THURSDAY, FEBRUARY 10, 1910.

THE NUTRITION OF PLANTS.

Artificial Manures, their Chemical Selection and Scientific Application to Agriculture. By M. Georges Ville. Translated and edited by Sir William Crookes, F.R.S. New edition, revised by Sir William Crookes, F.R.S., and Prof. John Percival. Pp. xxxviii+347. (London: Longmans, Green and Co., 1909.) Price 10*s.* 6*d.* net.

SIR WILLIAM CROOKES and Prof. Percival have revised and re-issued the lectures given by Georges Ville at the experimental farm at Vincennes during 1867 and 1874–5, and originally translated by Sir William in 1879.

"It is only just," he says in introducing the volume, "that its claims to be regarded as a classic and its author's right to the title of pioneer should not be forgotten when many of Prof. Ville's views are so generally adopted that his prescience and acumen are likely to be underrated and his priority unrecognised."

Ville was an ardent supporter of Liebig's views on the nutrition of plants. He was one of the brilliant band of men who at that time were developing and spreading the new ideas; several of the lectures deal with his experiments showing that a full crop can be obtained by supplying the proper food-stuffs in inorganic combination. It is difficult for us now to realise the astonishment with which the older farmers saw crops raised solely by the aid of "chemical" manures without the dung which had always been supposed essential. Lawes and Gilbert showed that it was not; they also falsified the prediction of many of their critics that chemical manures would soon exhaust their land and leave it sterile. Ville went even further, and maintained that artificial manures were unquestionably more remunerative, and afforded, indeed, the only means of keeping up the fertility of the soil. A man who only used dung, he said, must exhaust his land. This is the characteristic note of a great part of the book.

The chemical manures were compounded on a definite plan. For each crop one of the three constituents nitrogen, potash, and phosphoric acid was found to be more necessary than the rest, and was therefore called the dominant constituent. Thus nitrogen was the dominant constituent for cereals and beetroot; potash for potatoes and vines; calcic phosphate for the sugar-cane; there was no dominant, however, for flax. An excess of the dominant constituent was always added to the crop manure.

Great stress was laid on the fundamental differences in nitrogen nutrition between leguminous plants and cereals; nitrogenous manures are not necessary for the leguminosæ, whilst they are for other plants. M. Ville had played a very prominent part in the great controversy that continued during many years as to the source of nitrogen in plants. It seems to have been begun by Priestley, who stated that a plant of *Epilobium hirsutum*, placed in a small vessel, absorbed during the course of a month seven-eighths of the air present. He therefore concluded that plants assimilated nitrogen, but this view was soon controverted by Ingenhousz, de Saussure, and others, and was for a time disposed of by the classical experiments of Boussingault. Ville, however, revived it, and his experiments, begun in 1849 and described in two very beautiful volumes, "Recherches expérimentales sur la Végétation" (1853 and 1857), appeared to show that all the plants examined, rape, wheat, barley and maize, actually did take some of their nitrogen from the air. Somewhat later, Lawes, Gilbert and Pugh repeated the experiments but failed to confirm the result. They even used his experimental vessels, which are still to be found among the treasures of the Rothamsted laboratory.

It is not our intention to discuss this discrepancy in the light of subsequent discoveries; we need only point out that Ville was perfectly correct so far as the leguminosæ are concerned, and that his error with regard to other plants did not lead him astray in making up his manures.

No value was placed upon soil analysis; "at the present time the most laborious analysis is not able to throw light upon the most vital and essential question of practical agriculture." The deficiencies of the soil are determined by trials with the plants themselves. Plots are directed to be laid out in the field as follows:—

(1) With the normal (*i.e.* complete) manure; (2) normal manure without nitrogen compounds; (3) normal manure without phosphates; (4) normal manure without potassium compounds; (5) normal manure without calcium compounds; (6) unmanured.

This is substantially the scheme now adopted in almost every county in England. Under his supervision large numbers of such experiments were carried out in France. Some of the results are astonishing. In one case a plot receiving 32 tons of farmyard manure per acre gave a crop of 14 bushels per acre whilst a neighbouring plot receiving half a ton of chemical manure per acre yielded 36 bushels. There was a loss of about 19*l.* in the former case and a gain of about 17*l.* in the latter.

Ville's main thesis that crops can be grown with chemical manures had already been demonstrated by Lawes and Gilbert, with whose names it will for ever be associated in England, and is now a commonplace in practical agriculture. His view that chemical manures are in all circumstances better than dung has not survived. He made no allowance for the wonderful effect of the organic matter present in the dung in improving the texture and water-holding capacity of the soil—an effect not shown at all, or even shown in an adverse sense, by artificial manures. When we remember how large a part of the farmer's labour is devoted to cultivation it is easy to understand his preference for dung. Indeed, on many soils addition of organic matter is absolutely indispensable. Further, it may be doubted whether we possess even yet the data necessary for working out the relative costs of farmyard and artificial manures in the complex conditions of modern farming, with its inter-

dependence of crops and of live stock and its fluctuating financial equilibrium. Nor have Ville's formulæ for compound manures survived. The amount of food a plant requires is known to be modified by the water supply, the temperature, and the general soil conditions. It is clear that no one formula could possibly suit all cases; indeed, we might sum up the difference between Ville's views and those current now by saying that Ville regarded the supply of plant food as the dominating factor in determining fertility, whereas we now know it is only one of several equally important factors.

The lectures are interesting to read and must have been delightful to hear; they will form valuable material for the historian of agricultural science when he arises, not only by reason of the views set forth, but also because of the numerous balance-sheets and statements of costs. For their historical interest also they will be read by the serious student of agricultural chemistry, who indeed is already attracted to them by the fact that they have interested Sir William Crookes.

Certain alterations have been made in the text, so that the lectures are not quite in their original form. The editors have preferred to do this rather than to make corrections in footnotes, a plan which, if more cumbersome, would have had the advantage of preserving the historical value of the book. A chapter has also been added on the fixation of atmospheric nitrogen. All fixation methods attract much popular attention, while the electrical method first indicated by Sir William Crookes is already a rich and promising addition to our agricultural resources.

E. J. RUSSELL.

MODERN CHEMISTRY.

Handbuch der anorganischen Chemie. Herausgegeben von Dr. R. Abegg und Dr. F. Auerbach. Dritter Band, Zweite Abteilung. Pp. xii+921. (Leipzig: S. Hirzel, 1909.)

THIS stately volume of more than 900 pages treats of the elements of the fourth group of the periodic system, namely, C, Si, Ti, Ge, Zr, Sn, Pb, and Th. It opens with an excellent comparative summary by Abegg and Brauner of the general chemical and electrochemical relationships of the members of the group. Then comes a truly magnificent monograph on carbon by Weigert, covering 276 pages, with a literature-index containing 1307 references. It would be quite impossible in a short notice such as the present to give any adequate idea of the masterly manner in which the author has dealt with his great subject, so that a few references must suffice. In dealing with the allotropic forms of carbon, the usual purely descriptive account is followed by an extraordinarily interesting discussion of the energy- and stability-relationships, in which the researches of Schenck and Heller, and of Smits, are dealt with. The author also applies Nernst's theorem to the problem of the transition-point between diamond and graphite, but an arithmetical error appears to have crept into his calculation here.

The highly important theoretical and experimental researches on the formation, dissociation, and stability-relationships of the hydrocarbons are treated very fully, Nernst's thermodynamical theorem serving here (as elsewhere) as a basis for calculation. A good account is also given of Bone's work on the oxidation of hydrocarbons.

Under the heading of "Flame" the author does not fail to give us a lucid account of the modern work of Haber and his collaborators, whilst the subject of explosions introduces the reader to the work of Mallard and Le Chatelier and Dixon.

The chemistry of carbon has afforded the author a splendid opportunity of familiarising the chemist with the thermodynamics of high-temperature gas equilibria, and he has taken good advantage of it. The treatment of such highly important subjects as the dissociation of CO_2, the $C—CO_2—CO$ equilibrium, the water-gas equilibrium, and various heterogeneous gas-equilibria, such as $C—N—C_2N_2$, $C—S—CS_2$, $C—NH_3—HCN—H$, is excellent. The treatment of these matters brings the author to the discussion of such fundamental questions as the free energy of carbon combustion and the quantitative measure of the reducing power of carbon and its simpler gaseous compounds. What a vista is opened here to those who have the eyes to see and the minds to understand! It is a painful reflection to realise how soon all this will be as familiar to the trained modern German chemist as the laws of Dalton and Avogadro, whilst the progress of scientific chemistry in this country is still retarded by the false prophets who are affrighted by the sight of an algebraical symbol, and grievously lament the advance of physical chemistry.

There is an excellent and suggestive account of photochemical plant synthesis, and of the free-energy changes involved in biological metabolisms.

The heterogeneous equilibria presented by solid CO_2 in its various forms, and the ionic dissociation of aqueous solutions of carbonic acid, are well treated. More technical questions, such as the manufacture of coal gas, the calorific power of fuels, and the light efficiency of burning oils, come in for their share of discussion.

Enough has been said to give some idea of the scope and method of this splendid monograph. It is to be sincerely hoped that English chemists will carefully study it.

The next article (by Grossmann) deals with silicon and its compounds, and is full of interesting things. As befits the theme, a very full account is given of SiO_2, the silicic acids, and the silicates. Here we find an excellent *résumé* of Tschermak's interesting researches on the constitution of the silicates, together with the criticisms of Jordis, van Bemmelen, and Mügge thereon.

Another very interesting section deals with the work of Vogt, Doelter, and Allen and Day on the silicate melts.

Silicon is followed by a compact and up-to-date article of twenty pages on glass, by Schaller.

Titanium is dealt with by Jacoby. Here we find a very full discussion of the important work of Diethelm and Foerster on the electrochemical reduction of acid titanic sulphate solutions.

Germanium and zirconium are well presented by

G. Rudorf and R. J. Meyer respectively, after which comes, if we may so express it, another *pièce de résistance* in the shape of a splendid article on tin from the pen of Ernst Cohen. In this is to be found a very scholarly and learned essay on the early history of this metal, and an exhaustive and beautifully illustrated account of that romantic and fascinating subject, the allotropic forms of metallic tin. As is well known, the chemistry of tin owes much to the researches of Cohen, and we are not disappointed in expecting to find his treatment of the subject exceptionally full and interesting.

Tin is followed by a long monograph on lead, by Ahrens and Pick. Here again the reviewer feels it his pleasant duty to bestow unstinted praise. The article opens with a very full account of the metallurgy of lead. The fundamental researches of Schenck and Rassbach on the heterogeneous equilibria between PbS, $PbSO_4$, PbO, and SO_2, are dealt with, however, under PbS. The electrochemical relations between lead and its ions are clearly and fully explained, including the work of Cumming on the oxidation-potentials of PbO_2. The chemistry of lead and its compounds offers many interesting points, all of which afford the author good opportunities for demonstrating the power and scope of physico-chemical methods of attack. Amongst these may be mentioned the work of Pleissner and Auerbach on the basic sulphates and carbonates of lead, the work of Pleissner and Auerbach and of Dolezalek on the solubility of $PbSO_4$ in water and sulphuric acid solutions, the work of Lewis on the solubility of $Pb(NO_3)_2$ in solutions of KNO_3 and $NaNO_3$, the stabilities and mutual relations of the oxides of lead, &c. In connection with the latter subject, the author has, however, missed the work of Brislee on Pb_2O.

In dealing with the demonstration by Allmand and Denham of the existence of *monovalent* lead ions, the author suggests by way of criticism that the experiments alluded to could be explained in another way, *i.e.* by the assumption of the existence of complex kations of the formula Pb_2^{+}. These might still be *monovalent* ions, and the assumption by Allmand and Denham of the simpler formula $Pb^{\cdot}$ remains the best explanation until the existence of such complex kations is experimentally demonstrated.

After lead comes an article on the lead accumulator, by Mugdan. Needless to say, the article is chiefly concerned with the thermodynamic theory as worked out so beautifully by Dolezalek, although due mention is made of the early work of Faure, Planté, Gladstone and Tribe, and Streintz. This excellent article may be earnestly commended to the attention of electrical engineers. The usual English treatises on the lead accumulator consist of constructive details plus a little perfectly useless juggling with chemical symbols.

Thorium, the last member of the series, is dealt with by R. J. Meyer. Here is to be found an excellent account of the manufacture and optical (selective radiation) theory of the incandescent gas mantle.

Throughout the book colloidal states of matter are treated by Lottermoser. Of especial interest are the articles dealing with those classical examples, silicic and stannic acids.

Atomic weights are dealt with by Brauner in masterly fashion.

On laying down this wonderful volume, one cannot help feeling, as in the case of its predecessors, that Abegg's great undertaking marks the beginning of an era, the era of scientific inorganic chemistry. One realises with a spirit of rejoicing that inorganic chemistry has become a rational science of which every chemist may justly feel proud. The day of the why and the wherefore has dawned. One may beg leave to reason in inorganic chemistry as in other exact sciences. What middle-aged chemist of the present day can forget the inorganic chemistry of his youth, with its alchemistic recipes, its dry lists of formulæ, and its grim determination to explain *actions* by means of symbols invented to describe the *static* facts of composition? It was in truth little more than a sort of glorified black magic. Even at the present day there are not wanting signs that this sort of thing is not entirely dead. How many of our young graduates could read and thoroughly understand the pages of Abegg's "Handbuch"? One would not like to hazard an answer to that question, and yet on that answer depends very largely the hope of future progress. The methods of physical chemistry have converted the empiricism of the older inorganic chemistry into the rational science of to-day. The same tremendous transformation is fast approaching in the sphere of organic chemistry. Other things being equal, the victory lies with those who can best command the keen-edged weapons of physics and mathematics. F. G. D.

TWO MAMMAL BOOKS.

(1) *The Grizzly Bear: the Narrative of a Hunter Naturalist, Historical, Scientific, and Adventurous.* By W. H. Wright. Pp. x+274; illustrated. (London: T. W. Laurie, 1909.) Price 7*s.* 6*d.* net.

(2) *The Animals and their Story.* By W. P. Westell. Pp. 322; illustrated. (London: R. Culley, n.d.) Price 5*s.* net.

(1) A VERY cordial welcome should be extended to Mr. Wright's intensely interesting volume, which has an exceptional value as embodying the experiences and opinions of a man who has hunted the great bear of the Rocky Mountains at a time when it was more numerous than is at present the case. The author tells us that he was born in New Hampshire in 1856, and that some time after 1883 he commenced bear-hunting during such intervals as could be spared from his business. Later on, in 1889, hunting became his profession, and he was seldom long away from the woods, his trips being sometimes made alone, but more frequently with companions who desired to be initiated into the mysteries of bear-stalking, and were able and willing to pay for the privilege.

"In the beginning," he writes, "I studied the grizzly in order to hunt him. I marked his haunts and his habits, I took notice of his likes and dislikes. . . . And then at last my interest in my opponent grew to overshadow my interest in the game. . . . I came to hunt him in order to study him. I laid aside my rifle. It is twelve years since I have killed a grizzly. Yet in all those years there is not

one but what I have spent some months in his company. And then (alas! that it had not been sooner) I undertook to photograph him."

The book commences with an account of the early history of the species, as given by Lewis and Clark and subsequent writers; and the author discusses whether the animal ought to be called the grisly (meaning fierce) or grizzly (grey) bear. He decides in favour of the latter, although admitting that Lewis and Clark used grisly (perhaps in the sense of grey), and that Ord gave the name *horribilis* as the Latin equivalent of grisly in its proper sense. In our own opinion this usage ought to be followed.

To follow the author through his bear-hunting and "bear-snapping" experiences is, in our limited space, impossible, and we must be content in directing attention to the beauty and interest of his photographs of grizzlies in their native wilds. Very interesting, too, are his pictures of the slots of the grizzly and the black bear, showing how widely they differ from one another. The front claws of a grizzly are generally described as being whitish and nearly straight; but the author shows that the latter definition is incorrect, and that they are better described as narrower and less sharply curved than those of other bears.

The book is teeming with interest, and may be cordially recommended to naturalists and sportsmen as a trustworthy account of a disappearing species.

(2) Commendation of a like nature can, we regret to say, scarcely be accorded to the second of the two works forming the subject of this notice. Mr. Percival Westell is a voluminous writer on the fauna of Britain and various groups of invertebrates, but has hitherto, we believe, not tried his hand on mammals as a whole. In the present volume he has attempted to give an account of a selection of the more interesting types of the class, especially those represented in the London Zoological Gardens, arranged according to the nature of their environment, and illustrated with a number of photographs and coloured plates. The photographs are for the most part worthy of all praise, while the execution of the coloured plates is also good, although it is a pity that in some instances—notably the one of the wapiti—the artist was furnished with such poor models.

The volume is confessedly a compilation, largely made up of extracts from the writings of Mr. Selous and two well-known works on natural history—one, by the way, somewhat out of date. When he confines himself to direct extracts from these Mr. Westell does not wander far from the right path, but when he draws material from his own mind the result is disastrous. We are calmly told, for instance, on p. 245, that, in consequence of the domestication of the species, there are probably no wild yak in Tibet; while from the text and figure on pp. 245 and 246 the author would appear to be labouring under the impression that the cows are hornless. On p. 139 we are informed that it is the brindled, instead of the white-tailed, gnu that is verging on extinction; while from the statement on p. 314 it would appear that the author is quite unaware of the existence of the white rhinoceros in Lado and the Bahr-el-Ghazal, where it is not in the least danger of extermination. Striped elands (p. 174) are said to occur in northern Africa, where there are no elands at all; Grévy's zebra (p. 114) is stated to have been discovered by Grant and Speke; and the roebuck is affirmed to be a near ally of the muntjac (p. 113). As instances of carelessness we may mention (p. 267) *Kabern* for *Kaberu*, and (p. 220) *arin* for *arui*. To quote Mr. Ingersoll (p. 242) as the authority for the absence of deer from Ethiopian Africa is about equivalent to referring to Sir Robert Ball as sponsor for the rising of the sun to-morrow morning; while the statement on p. 304 with regard to the distinctness or identity of the European and American beavers is absurd.

Many other blunders and instances of carelessness might be quoted, but the foregoing are sufficient to indicate the untrustworthy nature of Mr. Westell's book. R. L.

RELIGIO PHYSICI.

Man and the Universe: a Study of the Influence of the Advance in Scientific Knowledge upon our Understanding of Christianity. By Sir Oliver Lodge, F.R.S. Pp. viii+356. (London: Methuen and Co., n.d.) Price 7*s.* 6*d.* net.

IN this vigorous and attractive work Sir Oliver Lodge has gathered into a more or less systematic whole his well-known views upon the relation between science and religion. The result is a "Religio Physici" which recalls its famous prototype as much by contrast as by similarity. Sir Oliver Lodge, like Sir Thomas Browne, is at once a man of science and a sincere and candid friend to religion, but his apology for this position is far from a mere demonstration that a whimsical temperament can (by a *credo quia impossibile est*) hold incompatibles in conjunction. Nor does he follow the dangerous precedents of later apologists, who have strained analogies to prove that science and orthodox Christianity, so far from being at loggerheads, are really in perfectly amicable agreement. There is, admits Sir Oliver, "an outstanding controversy" between orthodox men of science and orthodox theologians, "although active fighting has been suspended." The reason for this controversy is "that the attitudes of mind appropriate to these two classes" are "at present fundamentally diverse." Such being the case, the only hope of reconciliation lies in the admission on the part both of man of science and of theologian that neither is in occupation of the sole point of view from which truth is visible. In particular, the man of science must learn

"that it is a sign of unbalanced judgment to conclude, on the strength of a few momentous discoveries, that the whole structure of religious belief, built up through the ages by the developing human race from fundamental emotions and instincts and experiences, is unsubstantial and insecure."

In place of such partisan exclusiveness we must cultivate the conviction that science and religion both contain systems of truth which must ultimately prove to be congruent: "the region of true religion and the region of completer science are one."

In pursuance of this plan of reconciliation, Sir

Oliver Lodge once more presses upon the physicist his favourite argument (formerly urged in these columns) that the universal operation of formal laws such as the conservation of energy, still leaves room for intelligent "guidance and control"—and may even be compatible with the efficacy of prayer. Further, he recommends more serious attention to the better established data of "psychical research," and the hypotheses as to the nature of human personality based upon them—since both data and hypotheses have an important relation to certain contents of orthodox Christian doctrine. To the theologian he commends a more frank acceptance of the established results of scientific inquiry, counselling him to base his system neither on facts of a negative kind (such as the biologist's present inability to trace the origin of life) nor on single historical events of an alleged miraculous order, but to found it upon the ever-present facts of human nature and experience. The synthesis of this "completer science" with this "true religion" would yield what the author regards and defends as an anthropomorphic pantheism.

Sir Oliver Lodge is evidently aware that professed theologians will regard his work in their department with little more than the politeness due to a distinguished amateur. It is to be feared that the professed philosopher will adopt a similar attitude towards his metaphysics, while, no doubt, there are physicists who remain unconvinced by the doctrine of "guidance." Nevertheless, the book will be read with approval and profit by a great many persons of moderate opinion, who, in matters that affect life as a whole, are disinclined to submit to the tyranny of the departmental expert. Moreover, it will be commended to most readers, not only by the writer's characteristic fairness and sincerity, but also by a tenderly reverent and sometimes eloquent treatment of certain topics unsuitable for specific discussion in this journal.

The reviewer has to express his regret for the late appearance of this notice, for which he alone is responsible. T. P. N.

MATHEMATICAL PRINCIPLES AND PRACTICE.

(1) *Descriptive Geometry.* A Treatise from a Mathematical Standpoint, together with a Collection of Exercises and Practical Applications. By Prof. V. T. Wilson. Pp. viii+237. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 6*s.* 6*d.* net.

(2) *Practical Arithmetic for Schools.* By W. G. Borchardt. Pp. viii+445+lxxvi. (London: Rivingtons, 1909.) Price 4*s.* 6*d.*

(3) *The Calculus and its Applications.* A Practical Treatise for Beginners, especially Engineering Students. By R. G. Blaine. Pp. ix+321. (London: Archibald Constable and Co., Ltd., 1909.) Price 4*s.* 6*d.* net.

(1) PROF. WILSON'S "Descriptive Geometry" is "a treatise from a mathematical standpoint." The author believes that the subject has "suffered mutilation in the interests of short cuts to immediate practical uses," and his aim has been to "refrain from any attempt to hold the student's interest by clothing a few principles with some immediate practical application." From this point of view he has succeeded in producing a sound and excellent work. In the chapters on the point, line and plane, the theorems and principles on which the constructions are based are formally and clearly set out. The scope of the book embraces a general classification of lines and surfaces, including developable surfaces such as the cylinder, cone and convolute; warped surfaces like the hyperbolic paraboloid, conoid, and helicoid; and double curved surfaces, for example, the sphere, ellipsoid, &c. The projections, tangencies, intersections and developments of these surfaces are dealt with. As each new problem is stated, its general solution is first given with reference to the principles involved, and this is followed by a drawing showing the full construction for a particular case; this seems to be an admirable method, conducive to clear thinking and a thorough grasp of the subject.

A collection of exercises and some suggestions for practical applications are provided in the last chapter, and the volume closes with a very complete index. Anyone who has mastered the contents of this book will have no difficulty in applying his knowledge to any practical cases that are ever likely to arise.

(2) The arithmetic by Mr. Borchardt will rank with the best of the recent text-books on the subject. It follows the latest developments, which are now so well known as to render superfluous any detailed description. The requirements of the counting-house, workshop, and laboratory are fully met. The exercises are abundant, carefully graded and of diversified interest, and test papers and copies of recent examination papers are provided. The book is divided into two parts, which may be obtained separately or under one cover, and with or without answers. This school arithmetic cannot fail to give full satisfaction wherever it is used.

(3) "The Calculus and its Applications," by Mr. Blaine, covers a considerable extent of ground, including the differentiation of hyperbolic functions; successive and partial differentiation; maxima and minima of functions of one and two variables; Taylor's theorem; integration by analytical, mechanical and approximate methods; double and treble integrals; differential equations, solutions by symbolic methods; and a chapter on periodic functions and harmonic analysis. The subject is not developed by the author in any very strict logical sequence, and the book is not suitable for beginners working without the aid of a teacher. The principal feature of the work is the large collection of examples illustrating the application of the calculus to practical problems in mensuration, physics, mechanics, and engineering. These are extensively used in the text to explain the significance of the symbols and the operations of the calculus, and are provided at short intervals as exercises for the student. Teachers will value the book mainly on account of the interest and variety of these practical problems.

OUR BOOK SHELF.

A Primer of Statistics. By W. Palin Elderton and Ethel M. Elderton. Pp. viii+86. (London: A. and C. Black, 1909.) Price 1*s.* 6*d.* net.

IN his Herbert Spencer lecture of 1907, Sir Francis Galton outlined a suggested course of "Object-lessons in the Methods of Biometry," adapted to persons with no mathematical knowledge. The course was to consist of five lessons, the first to introduce the learner to the idea of variability and the median, the second to deal with the scheme of distribution (the ogive curve), the third with deviations from the median, the fourth with frequency curves (including the arithmetic mean and the standard deviation), and the fifth with correlation.

The present little volume owes its genesis to this suggestion of Sir Francis Galton, who contributes a short preface, and it follows very much the lines he laid down, with the addition, however, of a chapter on probable errors. The style is for the most part very simple, and the volume should be of real service to biological students and others who desire to obtain a general idea as to the meaning of the terms used in modern statistical methods. A few statements seem, however, to be open to criticism. The student ought not to conclude that "shells possess a mid-length (or median) which is constant in different samples" (p. 6) when he has only examined *two* samples. It is hardly correct to state that "when the difference between two means exceeds three times the probable error, then it is considered to be certain that the difference is significant" (p. 79); it is merely moderately likely. Finally, while it is true that the theory of errors of sampling "depends on the assumption that the things dealt with have been taken at random" (a word which does not appear to be defined), we cannot agree with the unqualified statement that "the collection of statistics in any other way is sheer waste of time," nor that "it is far better . . . to take 5000 or 6000 cases at random . . . than to take 50,000 which are specially chosen" (pp. 82–3); the contrary, indeed, may often be the case.

In the first chapter, we also suggest, it would be better to use longer series as illustrations; Figs. 2, 3, and 5, especially, hardly suggest the true form of the "ogive" to anyone who is not prejudiced by a wider experience than the readers of this book are assumed to possess, and scarcely justify the statement made on p. 6 as to the form of the curve. A second edition of this little volume is sure to be called for, as it fills a distinct gap in statistical literature, and the points mentioned might receive consideration.

All About Ships and Shipping: a Handbook of Popular Nautical Information. By Commander R. Dowling, R.N.R. With a Preface by Commander W. F. Caborne, C.B., R.N.R. Third edition, revised. Pp. xvi+429. (London: Alexander Moring, Ltd., 1909.) Price 5*s.* net.

THIS is the third edition of a handbook of popular nautical information. It has been compiled by a seaman, and is intended largely, if not chiefly, for the use of general readers. At the same time, it contains much which will interest sea-going folks. It claims to be corrected up to date, but in some sections this can hardly be said to have been accomplished. This is particularly true of information given in regard to warships. For instance, the short chapter dealing with submarine boats does not go beyond the "A" class, whereas last year the "D" class had been reached. The latest developments in battleships are better dealt with, but the inevitable compression which has to be accepted in a book of very moderate size dealing with a great mass of miscellaneous information has resulted in meagre descriptions of types of ships both in war fleets and in mercantile marines. No pretence at originality is made by the author. His task has been one rather of collection and compression of information, and the attempt is, on the whole, fairly successful. The book would prove a pleasant companion to people taking long sea-voyages or short pleasure cruises who desired to identify vessels of different nationalities and different mercantile lines of steamships, or who wished to understand something of the *technique* and vocabulary of the seafaring profession.

In any future edition of the book Commander Dowling would confer a favour upon his readers if references were given which would enable anyone so desiring to turn to larger and authoritative works bearing on the very great number of subjects treated, many of which are necessarily described by him in barest outline. It must not be understood that Commander Caborne fails to acknowledge his indebtedness to others for facts and information; the only fault is that no systematic references are made to places from which information has been drawn. If he introduced another appendix dealing with the bibliography of ships and shipping, it would certainly be welcomed by those who take an interest in maritime affairs, and desire fuller information than can be expected to be found in a pocket book.

Van Nostrand's Chemical Annual, 1909. Second issue. Edited by Dr. J. C. Olsen. Pp. xii+580. (London: Constable and Co., Ltd.) Price 12*s.* 6*d.* net.

THE first edition of this "Annual" was published in 1907, and was reviewed in NATURE of January 23, 1908. The second issue, which has recently come to hand, has been increased in size by some eighty pages, and contains a considerable amount of new matter, including a table of the physical constants of the alkaloids, by Dr. A. Seidell, and a similar table for the essential oils, by A. E. Secker, who has also revised the tables on fats and oils. Prof. Parr's recently calculated table of the densities of carbon dioxide has been inserted, and also a table showing the melting points and the composition for a number of fusible alloys.

The table of gravimetric factors and their logarithms has been entirely re-calculated on the basis of the international atomic weights for 1909, which involved an unusually large number of alterations. The review of chemical literature and the list of new books give the titles of all important publications which have appeared since the first issue.

The publishers have, we think, been well advised in abandoning the attempt to present a fresh issue every year. Although important alterations in the recognised constants are made from time to time, the majority hold good for long periods, and there cannot be many chemists who would care to purchase a fresh volume of tables every year for the sake of the limited number of alterations that may be made. It appears, indeed, to the writer that the interval between successive issues might with advantage be extended to four or five years, so as to avoid burdening the bookshelves of the purchaser with a number of volumes in which the same tables are of necessity repeated again and again. The attempt to combine tables of reference with reviews of current literature can only be expected to achieve success through a compromise of this character. L.

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.]*

Surface Deformation and the Tides.

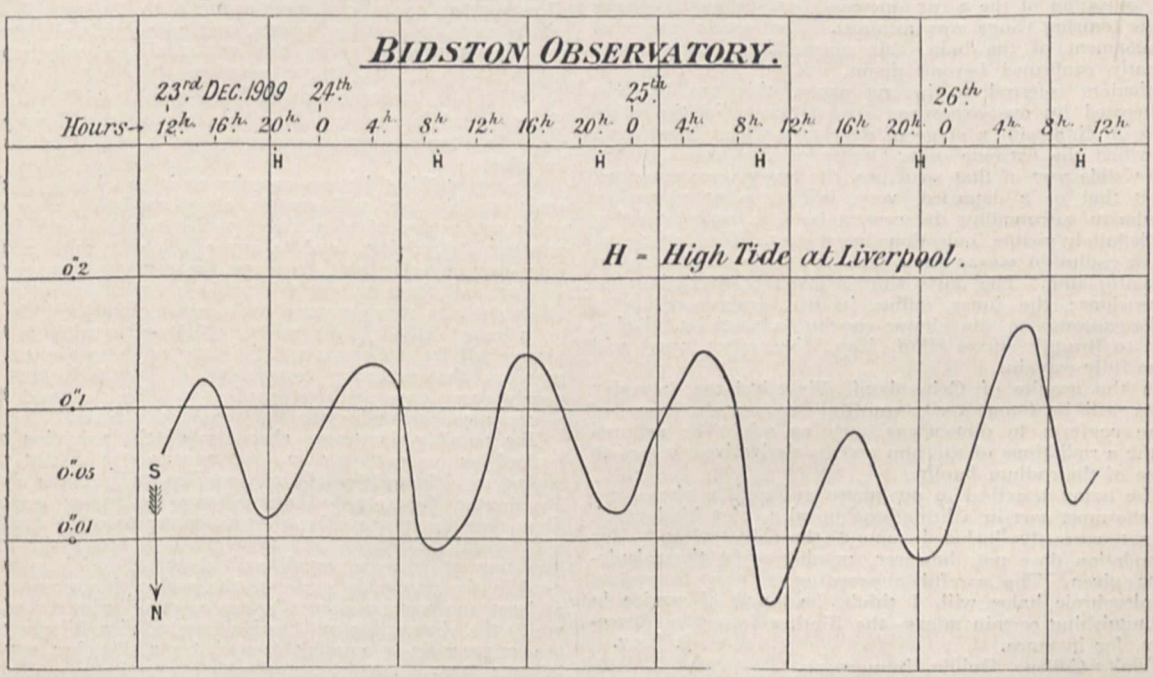
FOUR years ago I installed in a cellar beneath the Victoria Club, at Ryde, an astronomical level. It was oriented at right angles to the shore-line, only a few yards distant. At the time of high water I found, contrary to my expectation, that the strand, rather than sinking, rose upwards. This I attributed to the tide backing up underground drainage beneath the land, which in consequence bulged upwards. Sir George Darwin, however, makes the suggestion that my observations might be explained on the assumption that the load of water in the English Channel on the south of the Isle of Wight might reverse the effect of a smaller body of water in the Solent on the north side.

I was enabled to make a second attempt to measure the changing slope along a coast in consequence of tidal influences through the kind cooperation of Mr. W. E. Plummer, the director of the Bidston Observatory. This observatory is situated near Birkenhead, about one and a half miles from the sea. The instrument is a slightly modified form of a British Association type of seismograph. It consists of a horizontal boom, 2 feet in length, carrying a weight of 6 lb. At the outer end of the boom there is an extremely light lever, which multiplies the movement of the boom eight times. This, which is a peculiar feature of the apparatus, was designed by my assistant, Mr. Shinobu Hirota. The outer end of this pointer moves above a surface of bromide paper driven by clockwork. A displacement of the image shown on the paper through a distance of 1 mm. corresponds to the displacement which would be obtained were the stand of the pendulum tilted through an angle of 0·08″. The objects of this installation are two-fold, first, to record tidal effects, and, secondly, to pick up minute movements which other types of seismograph seldom record. The accompanying figure shows the tidal effect, which varies with the height of the water, the ebb, and the flow.

At high tide the bed of the Irish Sea is depressed, and the steepness of the bounding shores is increased. The buildings in towns along sea-boards twice a day are tilted seawards. When the tide flows out these movements are reversed. The deflection of the pendulum by tidal load and attraction, although greater than might be expected, is, however, very small. At Bidston it is about 0·2″, or 1 inch in sixteen miles.

JOHN MILNE.

Shide, Isle of Wight, January 24.



The movement of a Horizontal Pendulum at Bidston, December 23–6, 1909. The bob moves to the North with a rising tide. Scale $\frac{1}{16}$ in.=0·01 second of arc.

A Possible Identification of Comet 1909*e*.

HERR EBELL has recently determined approximate elliptic elements for this comet.

These elements bear some resemblance to those of comet 1890 VII. Spitaler, which has a period of 6·373±0·01 years, and has not been seen again.

Comet Spitaler had a perihelion distance of 1·8 and an aphelion distance of 5·1. It passes near no other planets than Mars and Jupiter. The small mass of Mars makes the perturbations by that planet of little account.

As comet Spitaler's period is half that of Jupiter, it only approaches Jupiter at alternate aphelion passages. It did not approach Jupiter at its aphelion after its appearance in 1890, but it did approach Jupiter on the following aphelion passage, 1899–1900.

The comet's motion is direct, and it therefore remains in proximity to Jupiter for a considerable time. Its closest approach took place about 1899 November 8, when its distance was about 0·6 and its eccentric anomaly 160°. For more than a year it remained within a distance 0·8 of Jupiter, and the perturbations must have been considerable. If we carry Ebell's orbit backwards, we see that comet 1909*e* was also near Jupiter in 1899–1900, and there is, therefore, a fair probability of the two comets being the same.

If Ebell's elements were definitive, this identification would have to be given up, for a rough calculation shows that the changes of elements are not in the right direction or of the right magnitude. Ebell's elements, however, merely represent the first attempt to get elliptic elements instead of parabolic elements. They depend on three places only, the first and last being six weeks apart. Herr Ebell himself tells us that the residuals for a fourth observation in the middle of the above-mentioned six weeks amount to a minute of arc, so that it is quite conceivable that the

errors of the elements are of the same order as the perturbations by Jupiter.

These perturbations by Jupiter depend upon the exact circumstances of the approach to Jupiter, and these circumstances in their turn may be largely modified by changes in the elements quite small enough to be consistent with the three months' observations in 1889–90. There is, therefore, great uncertainty as to where comet Spitaler should now be, and also some uncertainty as to what are the true elements of comet 1909e.

Identity is therefore very far from certain. The excuse for putting forward the present conjecture is the interest that naturally turns upon the question of what becomes of the short-period comets that are only once seen.

P. H. COWELL.

Pleochroic Halos.

IN a recent reference to the subject of pleochroic halos (*Phil. Mag.*, February, 1910) I stated that the outer edge of a corona might present an appearance suggesting an actual accentuation or deepening of the coloration, in accordance with the fact observed by Bragg and others that the ionisation of the α ray increased just before the limits of its ionising range was attained. For certain stages of development of the halo, this observation I have more recently confirmed beyond doubt. Like other structural particulars referred to in my paper, this too becomes obliterated by over-exposure. In one case (in the lithia mica of Zinnwald) a stage of development has been found in which the extreme outer border of the corona is the sole visible part of that structure, the appearance presented being that of a detached, very delicate, ring of perfect regularity surrounding the central halo, a space showing no definitely visible ionisation intervening. The outer ring has a radius of 0·0344 mm., and the inner halo a radius of 0·0191 mm. The outer ring is of about normal radial dimensions; the inner radius is that corresponding to under-exposure to the slower moving α particles. Reference to Bragg's curves (*Phil. Mag.*, September, 1905) will more fully explain.

In the granite of Ochsenkopf, Fichtelgebirge, complex halos will be found very beautifully developed. Some of these conform to dimensions such as might be referred to the α radiations of thorium and its derivatives, others to those of the radium family.

The halos described in my paper, referred to above, are for the most part in a lithia-bearing mica, of a kind which is not correctly included among the Muscovites. The emendation does not, however, notably affect the calculations given. The careful observation of the dimensions of pleochroic halos will, I think, be found of service in distinguishing certain micas—the Biotites from the Muscovites, for instance.

J. JOLY.

Trinity College, Dublin, January 31.

Dangerous Lecture Experiments.

THE explosion referred to by Mr. Power in NATURE of February 3 (p. 399) was probably due to the presence of a trace of moisture in the reacting substances. I had a similar alarming experience some years ago, using precipitated silica without specially drying it.

Moissan ("Traité de Chimie Minérale," ii., 389), referring to a paper by Ludwig Gattermann (*Ber.*, xxii., 186, 1889), states:—"La réaction ($SiO_2+2Mg=Si+2MgO$) est si violente, d'après cet auteur, que si l'on emploie la silice précipitée, le tube de verre est entièrement déformé, et une partie le la matière est projetée sous forme d'une gerbe de feu." Winkler (*Ber.*, xxiii., 2652, 1890) found that 0·2 gram of a mixture of magnesium and silica in the above proportions heated in a tube closed at one end caused explosion and shattering of the tube. Vigoroux (*Annales de Chimie et de Physique*, xii., 153, 1897) recognised that the explosion is due to incomplete desiccation of the reacting materials.

Few text-books point out the necessity for ensuring the absence of moisture, although most of them point out that the reaction is very rapid and violent. The only book besides Moissan's "Traité" that I have found to give the warning is by an American, Dr. Benedict ("Chemical Lecture Experiments," The Macmillan Company, New York, 1901). Dr. Benedict insists upon the absence of moisture, but does not mention any reason.

This is not the only case in which dangerous experiments have been described and copied from one text-book to another. The collection of hydrogen from the action of sodium upon water is a case in point. Many books describe, with a diagram, the "drowning" of a piece of sodium by means of a special instrument of wire gauze. This *may* be carried out safely in some instances, but, as Newth points out, it is liable to be dangerous. Upon one occasion in my own experience, using a small piece of sodium, an earthenware pneumatic trough was shattered as well as the gas jar used to collect the hydrogen.

It would seem desirable that writers of text-books should obtain some personal knowledge of the experiments they recommend, as young teachers, relying upon the instructions given, might easily cause very dangerous accidents. In neither of the cases cited above would a chemist, unless fairly experienced, be likely to apprehend any difficulty or danger.

E. R. MARLE.

Hartley University College, Southampton.

THE letter of Mr. Power in NATURE of February 3 directs attention to a danger common to the use of any of the metallic reducing agents, and, although well known to a few for many years, it is not at all generally recognised. Even the well-known reaction

$$Fe_2O_3+2Al=Al_2O_3+2Fe,$$

if performed in the way described, is positively dangerous unless all the precaution necessary for a violent explosion be taken.

A very striking lecture experiment is to charge a tiny steel crucible that will contain about one-half up to one cubic centimetre of a mixture of ferric oxide and finely powdered aluminium, and to cover it loosely with a thin sheet-iron cover so as to preserve the contents from water vapour, and then to heat this up in a little furnace made of strong iron gauze covered with asbestos and held rigidly in a retort stand. An ordinary blow-pipe with a foot blower will be sufficient, and the reaction is so violent, as soon as the necessary temperature is attained, that in nearly every case the steel crucible will be shattered into pieces, notwithstanding the lightness of the cover.

The possibly dangerous character of the reduction was noticed by me certainly so long ago as 1896 whilst preparing special qualities of iron experimentally in the South Kensington laboratories, and shown to many persons. Even then it may have been not unknown to other workers with metals, although new to us; and although the mixture was at once respected, and absorbents of heat were used in the charge to moderate the action, I am aware of at least one narrow escape by an operator who wished to verify the observation and used a quarter of a kilogram of the mixture in a crucible heated by a Fletcher oxygen injector furnace, the pieces of which were thrown all over a large room, fortunately without striking any person.

The explanation is simply that the preliminary heating to the temperature of reaction is sufficient to enable the mixture to reach the volatilisation point of the iron by the heat suddenly evolved throughout the mass, and thus there is practically detonation; but it also suggests that some danger of explosion exists should a store of the mixture be involved in a fire, and these mixtures are now in fairly common use industrially.

HENRY C. JENKINS.

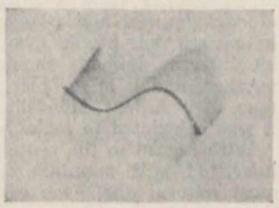
The School of Metalliferous Mining (Cornwall), Camborne, February 5.

The Maintenance of Forced Oscillations.

PLEASE permit me to add a few words to my note on "The Maintenance of Forced Oscillations of a New Type," which appeared in NATURE of December 9, 1909. I stated that when a vibrating fork maintains the vibration of a string by periodically varying its tension, the stationary oscillation maintained may have a frequency of half of, equal to, 3/2 times, twice, &c., of that of the fork, each term in the harmonic series appearing separately by itself, or with one or more of the others conjointly, according to circumstances.

When two or more of the harmonics thus appear con-

jointly, they generally are not all in one plane of vibration; in other words, one or more appear in a plane which is normal to that of the others, and this can always be secured by a manipulative device. The paths described by any point on the string would in such circumstances be curved figures identical with, or analogous to, the well-known figures of Lissajous.



I send two photographs (Figs. 1 and 2), each only 3 cm. by 2 cm., showing a short length of the string with a brilliant point in the middle of it, when executing such oscillations. The curves shown in them are only two out of a large number that I have observed and photographed, and can be recognised to be both compounds of the first three harmonics in the series mentioned above. It is difficult at first mentally to picture the process by which a tuning-fork executing normal oscillations maintains a string permanently in an oscillation of the type shown in the photographs. C. V. RAMAN.

Post-Box 59, Rangoon.

A Tertiary Leaf-cutting Bee.

ALTHOUGH fossil remains furnish us with abundant evidence of the antiquity of many structural characters in animals, and permit us to surmise a like antiquity of certain habits, it is not often that we find preserved the proofs of the latter. The leaf herewith figured, collected in the Miocene shales of Florissant, Colorado, by two of my students, Messrs. Duce and Rusk, shows the work of a leaf-cutting bee. Evidently the specialised and peculiar habit of cutting out pieces of leaf to use in forming the nest was as highly developed, perhaps, a million years

ago as it is to-day. The bee itself has also been obtained, and described as *Megachile praedicta*, Ckll., 1908.

T. D. A. COCKERELL.

University of Colorado, January.

Tests for Colour-blindness.

WITH reference to the article on colour-blindness in NATURE of January 27, I should like to point out that advocates of the Holmgren test assume that a person who fails with the wools will fail with coloured lights, and that a person who appears normal when examined with the wools is normal when examined with coloured lights. This was the first point which I proposed to settle when I took up the subject of colour-blindness. I found many varieties of colour-blindness, unimportant from a practical point of view, that failed, and many dangerous varieties of colour-blindness that passed this test. Many absolutely normal-sighted persons are also rejected by the Holmgren test; Germany has officially discarded it for this reason. Within the last fortnight I have examined two dangerous varieties of colour-blindness that passed the Holmgren test with the greatest ease; in fact, the most punctilious examiner would not have suspected that there was anything wrong with their colour sense, but both made the grossest errors with my lantern. The first case could not tell between the white, green, and red lights on trams at a distance of about one hundred yards.

The two factors which seem to be generally overlooked are the great effect of diminishing the intensity of a light in certain cases and the importance of taking into account the size of the image on the retina, that is to say, the number of cones stimulated. A few days ago I examined a normal-sighted man who had failed with the Holmgren test. He put definite browns with the green skein. When I found that he was normal I asked him to name the wools, and he did so correctly. I then asked him why he put browns with green. He replied, "I have been told I am green-blind, and I thought that there was green in those browns which I could not see." When I told him he was quite normal he had not the least difficulty with the test. F. W. EDRIDGE-GREEN.

Hendon, January 31.

Observations of Halley's Comet.

READERS of NATURE may perhaps be interested to know that Halley's comet can now be seen with a good pair of field-glasses. Careful estimates make it almost exactly equal to an eighth-magnitude star.

The best form of instrument is a high-power Galilean binocular, and though the comet does not present any interesting features with such small optical aid, it can be distinctly seen, and distinguished from a star by its nebulous appearance. It is, of course, necessary to know the comet's position fairly exactly before attempting to pick it up. The following are a few of my notes:—

1910, Jan. 8, 12 and 13, Comet faintly seen in 1-inch finder Mag. ± 9·0.
,, ,, 15d. 8h. 45m. Faintly seen in binocular.
,, ,, 30d. 8h. 0m. Steadily seen in binocular.
,, Feb. 3d. 8h. 0m. Found with binocular, eighth magnitude (estimate 8·1).

P. M. RYVES.

Zaragoza, Spain, February 5.

Records of the Earthquake of January 22.

DR. CHREE has noted in NATURE of February 3 the mechanical effect upon the Kew declination-magnetograph by the earthquake of January 22. Any confirmation of movements of this kind is of considerable value, and I therefore send you this notice of the corresponding effects upon the Stonyhurst magnetographs. All the three elements were markedly affected; the declination magnet was set in oscillation at 8h. 56m. a.m. for five minutes, the vertical force magnet also at 8.56 for about two minutes, and the horizontal force magnet was the most disturbed, commencing at 8.52 and lasting for quite ten minutes, with a maximum displacement of 3·5 mm. against the force of the torsion balance, but it is not clear that there was any swing on the opposite side of the normal position.

The origin of the earthquake remains apparently unknown, but, judging by our Milne seismograph, it was much nearer to us than any of the thirty earthquakes registered here since the instrument was fairly started on active service on July 1, and the proximity may account for the much greater swing of the boom. From the beginning I have claimed the eastern border of the Atlantic for the true region.

Prof. Milne's seismographs at Shide have shown an enduring displacement which has not been produced here.

WALTER SIDGREAVES.

Stonyhurst College Observatory, February 5.

The Mendel Journal.

IN NATURE for December 30, 1909 (p. 252), there appeared a review of the first number of the *Mendel Journal*, by "E. H. J. S." He also, in the same review, reviewed the current issue of *Biometrika*. I pass no comment upon the questionable fairness of having two

such diametrically opposed journals reviewed by the same person, who, if we may judge by certain statements in the review, is himself a biometrician, or very friendly disposed towards them. I am alone concerned in dealing with your reviewer's misinterpretation and imperfect reading of certain articles of mine written under the *nom de plume* of "Ardent Mendelian." He accuses me of "adopting a tone calculated to be offensive to biometricians," and as an instance he cites the following sentence:—"We may further infer, therefore, that the discipline of the army[1] is very severe, and perhaps this may throw some light upon the constant reappearance of the figure 0·5 in relation to the size of some of its artillery equipment."[2] Your reviewer interprets this as a "serious charge of faking" directed against biometricians. I do not know upon what plan he writes his reviews or whether he reads sufficient of the article he reviews to grasp properly its tone and meaning. Nothing was farther from my intention than to impute want of integrity to any biometrician, notwithstanding some bad examples which they themselves have set, when they deal with Mendelians. Had your reviewer but read a few lines lower down (p. 160) he would have found the following chivalrous sentence, describing them:—

"In some respects it is a very fine army, and it is certainly an imposing one upon parade. It is led, officered and manned by men of transcendent intellect, of whom any country may be proud." And again, on p. 185, in commenting upon Dr. Raymond Pearl's work, I wrote:—"Could we assent to his methods we might commend his results; we can admire his skill as a workman, while lamenting his tools." Then on p. 164, where I criticised the particular way in which Prof. Karl Pearson had set certain questions to a correspondent, I wrote:—"We do not, of course, for one moment suggest that Prof. Pearson desires to be unfair, or that the nature of the question has in the smallest degree influenced the answer. We accept the evidence quite unreservedly."

These quotations are sufficient to show that the articles written by "Ardent Mendelian" were couched in the most courteous tones, and contained even chivalrous acknowledgments of the high ability and integrity of those whose methods of investigation and conclusions he felt bound to criticise. None but the most tender conscience could have misconstrued the particular sentence complained of into a charge of "faking" when the context of the article was taken into account; for how could "any country be proud" of men who "faked"? Your reviewer either could not have read any more of the article than the sentence he quoted, or he must have approached his work in a peculiarly prejudiced frame of mind. I do protest against the unfairness of such treatment. When a writer has been deliberately careful to adopt a courteous tone, it is not fairness to disregard his context—to quote a particular sentence and then to misconstrue it.

This sentence was never intended to convey a charge of "faking," and it simply alluded to the biometrical method of definition in constituting a sort of guide when dealing with investigations in certain problems. Had I intended to impeach the probity of any biometrician my language would have been unmistakable. If your reviewer had but recalled to mind the earlier works of biometricians, he would have remembered a generalisation called "homotyposis," and he would have further recalled that the homotypic average of correlation turned round the figure 0·5. He would also have remembered that this figure was reached by a remarkable process of excluding the parts or organs which were either "too like" or "too different," and this process was based upon an attempted definition by Prof. Pearson—who in my article is alluded to as the Field Marshal—in which he hoped to define the differences between variation and differentiation. This correlation figure of 0·5 was therefore reached by the exclusion of all parts or organs which would otherwise naturally tend to raise or lower the figure, and it was to this process of working by definition and exclusion, as defined by the "Field Marshal" that I alluded when I wrote the sentence which has been, I cannot but help thinking, carelessly misconstrued.

1 Biometrical.

2 It should be mentioned that the article was advisedly written in terms of martial imagery.

In conclusion, I can only ask that your readers will read the articles and judge for themselves of their courteous tone and fair treatment.

"ARDENT MENDELIAN."

"ARDENT MENDELIAN" is correct in supposing that I am a biometrician; but I am, at the same time, a believer in Mendelism, and I hold that the main aims of the *Mendel Journal* and *Biometrika* are not opposed. To me it appears that people who are studying the same problem by different methods should work in sympathy with one another, and it is for just this reason that I criticised the tone of "Ardent Mendelian," as I was of opinion that it was calculated to make such sympathy difficult.

With regard to the sentence beginning "We may further infer," I still maintain that my interpretation was the most natural one, even after making every allowance for the context; but I accept with the greatest pleasure the author's correction.

E. H. J. S.

THE INTERPRETATION OF TOPOGRAPHIC MAPS.[1]

THE evolution of maps, and of our ideas regarding their use and function, might be made the subject of an interesting and profitable study. The main object of the early cartographers was to plot down with all attainable accuracy the relative size and position of countries, of towns or of smaller units, and to indicate such natural features as mountains and rivers; roads were added later, and, as the necessity became more evident and geodetic methods improved, the scale was enlarged, while the increasing accuracy permitted additional and minuter details to be introduced. The organisation of national cadastral surveys gave us at last the large-scale contoured maps that, with or without orographic colouring, constitute the highest expression of the map-maker's science.

Upon the basis of the topographic maps, special features of distribution and of activities, such as direction of winds and currents, may be shown, and lines of equivalent development of artificial and natural phenomena, such as isobars and all the other "isos," may find expression. Of these the topographic map takes no account; there has, however, with progress of geographical and geological methods, come a new way of looking at and interpreting a topographic map, so that it is made to disclose not only much that is hidden from the ordinary user, but even more than was recognised by the surveyor who made it. The old reading of a map was an appreciation of the morphology of a piece of country regarded as a statical phenomenon, without reference to either its internal anatomy, its physiology, or the mode and causes of its development; it asked for no reason. The new method seeks dynamical interpretations of all geographical phenomena, and asks how, and why, things are as they are.

A range of hills is no longer simply an elevated tract of country, delineated upon a map by certain contour lines, but it becomes the expression of facts of structure produced in a particular way, out of materials of a particular kind, by agencies the nature of which can often be inferred directly from the data supplied by the topographic map itself. In like manner, the history of a river-system, the development and interactions of its parts, and the climatic vicissitudes that have affected its drainage basin can be deduced from the map by the familiar exegetical device of reading the spirit of the commentator into the text. The department of geographical study, seeking among other objects the cultivation of this faculty,

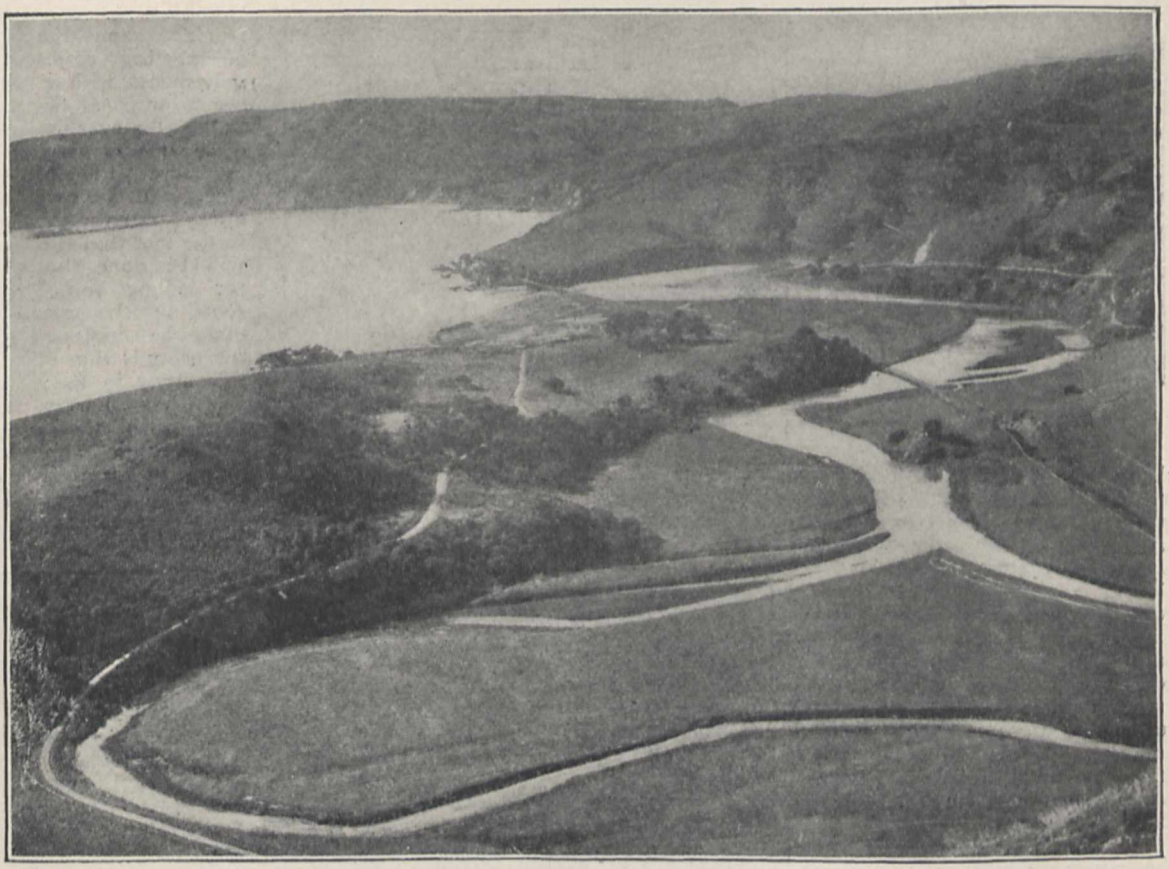
1 "The Interpretation of Topographic Maps." By R. D. Salisbury and W. W. Atwood. Pp. 84+c'xx plates. Department of the Interior, U.S. Geological Survey, Professional Paper, 60. (Washington: Government Printing Office, 1909.)

though deriving much of its initial impulse from the suggestion of British workers, from Hutton and Playfair to Ramsay, Jukes, Geikie, Jukes-Browne, and Marr, has been organised and placed upon a systematic basis, principally by the labours of workers like Penck and Bruckner on the Continent, and the host of American geomorphologists, foremost amongst whom must be placed Davis, Salisbury, and Shaler.

In the magnificently illustrated volume before us, Prof. Salisbury and Mr. Attwood have attempted to show how a topographic map may be made to yield up all its secrets. The first section of the preliminary letterpress is substantially that which appears in the explanation of each fasciculus or folio of the geologic map of the United States. It sets forth the nature of the features delineated in the three categories of (1) water (blue), (2) relief (brown), and (3) culture (black). The last term might easily be misunderstood by a British reader—it does not refer to cultivation only, but to all the signs of man's handiwork, such as roads, railways, buildings, boundaries, that appear upon the maps. The geological details are, of course, expressed by the conventional signs and colours adopted by the national service.

The succeeding sections deal with elementary concepts of relief, followed by a succinct discussion of the various agents of change and their effects, under the headings wind, stream-erosion, alluviation; topographic forms resulting from unequal hardness of rocks, erosion cycles, stream piracy and adjustment, topographic effects of ground-water, glaciation, coastlines, volcanism, faults, special types of lakes. Each of these subjects is illustrated by one or more maps, mostly on the scale of about one inch to the mile (1/62,500 instead of 1/63,360), of actual pieces of country, and in most cases by pictorial illustrations.

The maps are beyond all praise for the beauty of their execution and the admirable printing; indeed, the contrast between the splendid series of maps of which these are specimens selected merely because they portray typical features of topography, and our British maps, inferior in delicacy, heterogeneous in style, badly printed on poor paper, is very humiliating to our national pride. The contour lines are beautifully engraved, and are drawn at intervals of 20 feet, whereas the 1-inch maps of the British Isles, with the exception of a portion of a single sheet, that embracing Longridge Fell in Lancashire, have contour-intervals of 100 feet, and even our 6-inch maps are contoured only at the same intervals, saving those of the fortunate counties of Lancashire and Yorkshire, the surveys of which had been accomplished prior to 1858, when the depreciation of our maps was decreed.



A Tidal Lagoon formed by sand spit at the mouth of San Luis Obispo Creek, California.

If any adverse criticism were offered of this admirable manual it would be that the landscape illustrations do not in all cases represent the area or even the district shown upon the map, though illustrating similar phenomena, or, where the area is the same, the point of view cannot be identified. These are small defects in a work that cannot fail to be of the utmost value to students and teachers the world over, and particularly to those of America, for whom it is designed, and those of Britain, who may have a century or two to wait for the materials out of which a similar memoir could be prepared for our own country.

P. F. K.

THE OXFORD UNIVERSITY MUSEUM.[1]

FEW buildings devoted to the pursuit of science have a more interesting history or a more distinct individuality than the Oxford University Museum. It is the resultant of many of the most characteristic activities, and embodies some of the most earnest aspirations of the latter half of the nineteenth century. The two chief lines of scientific and artistic effort which converged upon Benjamin Woodward's Gothic pile found their most typical exponents in Acland and Ruskin; each of them a genuine enthusiast, each with not a few of the faults of his qualities, and each destined to witness the realisation of some of his ideals and the failure of others in the fabric which forms an appropriate monument of their life-long association.

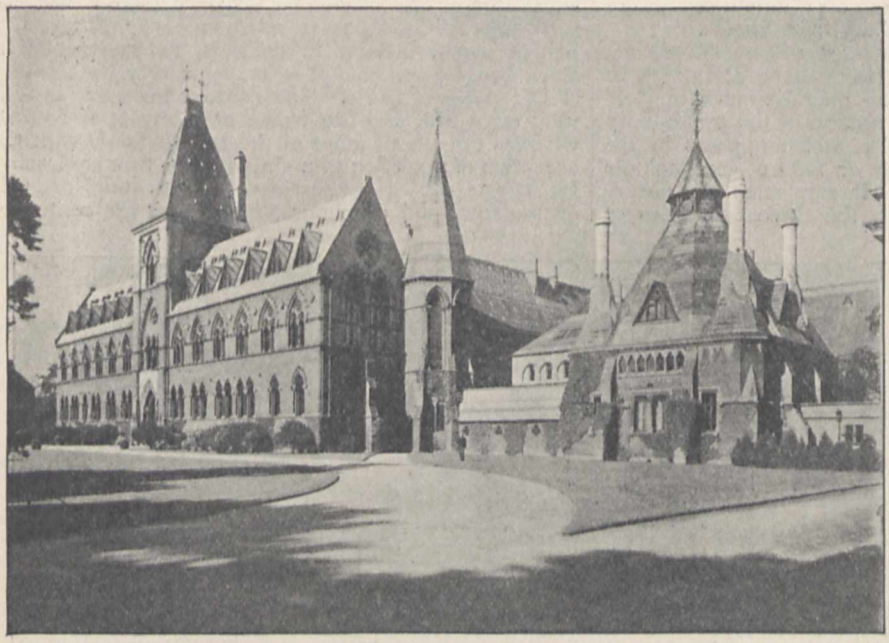


FIG 1.—The Oxford Museum from the south-west. From "A History of the Oxford Museum."

The newer buildings which at the present day are grouping themselves around the central structure of the museum constitute with it an apt symbol of the manner in which the university has responded to the needs of scientific research and education in modern times. Oxford can never forget that she inherits a great tradition—literary and artistic, as well as philosophical. When first aroused to a sense of her responsibility in view of modern scientific demands, her main endeavour was to graft the new upon the old. No visitor to the original part of the museum can fail to recognise the outcome of this spirit in the structure itself, which is Gothic both in conception and in detail, in the blend of the conventional and the realistic in its scheme of decoration, and in the array of statues which, forming an integral part of the design, carry the mind of the observer from Hunter and Harvey back through the ages to Hippocrates and Aristotle. But the outlook of the University is to the future as well as to the past, and in the various annexes which have sprung up around the original building we see evidence of a desire to "let the dead bury their dead," and to enter frankly upon the task of meeting modern requirements with a single eye to practical efficiency. Still, whatever scientific developments may yet be in store, the Museum Court will, we may hope, always remain to testify to the fact that the future will be none the worse for having some of its roots in the past. It must be confessed that the organisation of scientific study in the university has hardly kept pace with the growth of scientific appliances. There is still too much clinging to respectable but antiquated methods in the system of college tuition, and, above all, in that of examinations. A promising field of university reform lies open in this direction.

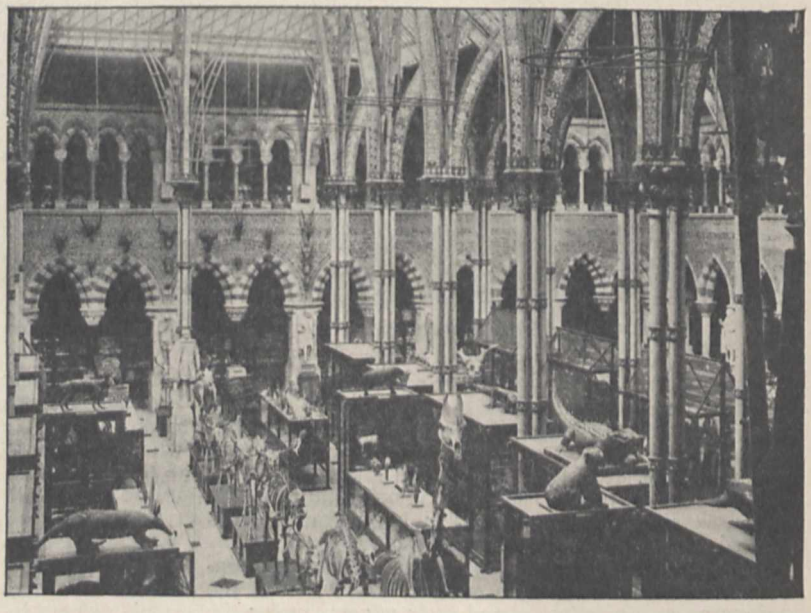


FIG. 2.—Court of the Oxford Museum, looking south-east. From "A History of the Oxford Museum."

The occasion which prompted the publication of the little book before us was the jubilee commemoration of the foundation of the museum, held in October,

[1] "A History of the Oxford Museum." By Dr. H. M. Vernon and K. Dorothea Vernon. Pp. 127. (Oxford: Clarendon Press, 1909.) Price 1s. 6d. net.

1908. Dr. and Mrs. Vernon have succeeded in presenting an admirable account of the progress of science in Oxford from the days when Willis, Bathurst, Seth Ward, and Robert Boyle held their meetings at the lodging of Wilkins, Warden of Wadham, in which college Sydenham and Wren were at that time undergraduates. The history of the struggles and ultimate success of the little band who, led by Acland, Daubeny, and Walker, with help from Pusey, resolved that, so far as in them lay, science should take its proper place among the activities of Oxford, is carefully and sympathetically recorded. The work of the museum during the fifty years of its existence—work associated with the names of Phillips, Brodie, Prestwich, Rolleston, Moseley, Lankester, and Burdon-Sanderson, to mention only a few—forms the subject of a specially interesting chapter; and the book ends with an account of the jubilee commemoration itself. We wish that the authors had found space to include in their record the address delivered on that occasion by Dr. Vernon Harcourt—an address justly characterised by them as "most instructive and entertaining." Extracts, however, are incorporated in the body of the work.

The book is attractively got up, and illustrated with some good photographic plates, in the legends of two of which, unfortunately, the points of the compass are incorrectly given. We reproduce views of the exterior and part of the interior of the original building. F. A. D.

THE DISTRIBUTION OF FRESH-WATER EELS.[1]

IT is certain that the hydrographers of the *Challenger* and other deep-sea expeditions made their physical observations in the Atlantic Ocean depths all unsuspecting of the fact that thereby they were essentially helping to make an important contribution to the natural history of the fresh-water eel. Yet this fact constitutes part of the interesting information derived from a perusal of Dr. Schmidt's latest publication, a continuation of his previous famous researches upon the eel which have previously been described in the pages of NATURE.

In spite of the abundance and wide distribution of the genus Anguilla, the first and final chapters of its life-history were, until quite recently, matters of profound obscurity. It is a fact of common observation and knowledge that the elvers or glass-eels which in the spring months ascend our rivers frequently in countless numbers develop into young eels, and also that adult eels in their silvery breeding dress descend to salt water in autumn; but there, until a few years ago, knowledge ended and conjecture began. It was a common belief in this country that estuaries and harbours probably afforded the spawning places. In 1893 the Italian zoologists Grassi and Calandruccio proved that *Leptocephalus brevirostris*, a deep-water fish of obscure systematic position taken in the Mediterranean, was really a larval stage of the common eel. Dr. Schmidt and his Danish colleagues, whose energies were first directed upon this particular research because of the economic importance of the eel-fishery in their country, traced the early "elver" stage down to the open sea, and at last, by their deep-water investigations in 1904–5, succeeded in locating an important breeding region off the west coasts of the British Isles at depths of more than 1000 metres. Subsequent trawlings have revealed the distribution of the early (Leptocephalus) larval stage in the Atlantic Ocean from the Færoë Islands to Gibraltar, but always in water of more than 1000 metres depth and not less than 7° temperature. From these investigations, Dr. Schmidt came to the conclusion that "in order to propagate, this species demands certain external conditions (chiefly great depths with high temperature and salinity of water)," and it was to test the validity of this conclusion for other parts of the world that the research upon the geographical distribution of the fresh-water eel was commenced.

The Anguilla genus is widely distributed, being found in the Atlantic as well as in the Indian and Pacific regions. However, the main point of this inquiry will be best indicated by limiting our consideration to the regions of America, Europe and Africa where most data are available, and where (if we except eastern Africa) the question is simplified by being confined to two species only, viz. *Anguilla vulgaris*, the European species, and *A. chrysypa*, the American form. Now fresh-water eels are entirely lacking on the Pacific shores of North and South America (and of course in the river systems which have their outlet on this coast). On the Atlantic side, however, they are abundantly represented in the easternmost parts of Canada and the United States, and are found from southernmost Greenland and Labrador to the West Indian Archipelago and Guiana. On the other hand, they are lacking in South America south of Guiana, no single record, for example, occurring of the presence of fresh-water eels in the large river systems of Brazil and Argentina. They are found on practically all the islands of the Atlantic north of the Equator (Bermudas, Azores, Madeira, Canaries, Iceland, &c.), and, what is especially worthy of attention, they occur on islands where other fresh-water fishes are completely lacking. On the eastern side of the Atlantic they are found from the region of North Cape and southwards along all the coast of Europe, on all coasts of the Mediterranean, and on the north-western part of the coast of Africa. In Senegal they disappear, and are absent from all the rest of the west coast of Africa as far as Cape Colony, where the Indian Ocean species begin to be met with.

Thus in tropical, temperate, and even Arctic regions, Atlantic fresh-water eels are found—truly a wide-spread habitat, and one affording extremely varied environments! But it is on account of "this astonishing power to submit to most varied outer conditions" that their absence from certain regions is apparently incomprehensible. Why, for example, have they not been able to penetrate further southwards along the coasts of the Atlantic? In order to understand this, it is necessary to recall some of the results of later years' marine biological investigations, especially "the ascertained fact that very often the sensitiveness of a species of fish to its surroundings differs a great deal in its growth-period and in its spawning-time, so that during the latter its requirements as regards the outer conditions (depth, temperature, salinity) are much more definite and very different from those during the first, the effect of which is that the distribution during spawning-time may often be very different from that during growth. . . . It is in the first instance the requirements as regards the outer conditions during spawning time which influence the distribution."

The earlier investigations upon the spawning places of the eel have shown that in order to be able to propagate, the European fresh-water eel requires great depth (at least 1000 metres), a high salinity (more than 35·2 per cent.) and temperature (more than 7° C.) at this depth; and this is where the importance of the hydrographical data obtained from the temperature curves of the *Challenger*, *Valdivia*, and other deep-sea expeditions comes in. It is shown that "the absence of eels in

[1] On the Distribution of the Fresh-water Eels (Anguilla) throughout the World. (1) Atlantic Ocean and Adjacent Regions. A Biogeographical Investigation. By Johs Schmidt. With one chart. Pp. 45. (Copenhagen, 1909.)

all the large fresh-water systems of South America, western North America, and West Africa is due to the fact that the temperature in the deeper layers of the adjacent seas is too low to admit of the propagation." Incidentally, an explanation is afforded of the hitherto puzzling lack of success which attended the transplantation of eels from the eastern to the Pacific States by the U.S.A. Fish Commission in 1874 and other years. The eels themselves flourished in their new surroundings, but the Pacific Ocean afforded no place for successful reproduction.

Oceanic hydrography has thus supplied the indispensable key to the elucidation of a point in the biology of a species which is universally regarded as a fresh-water form. More strictly, however, *Anguilla vulgaris* may be considered as an oceanic species which has acquired the habit of migrating to fresh water for food and protection.

After all, the most interesting feature of this work is that it deals with an extreme case of the problem of the relationship between physical environment and fish propagation, a most important question in connection with the economic aspect of the fish supply. Dr. Schmidt has contributed pioneer work of great value towards the understanding of these phenomena in regard to other species besides the eel. We may mention, for example, his research upon the plaice and cod in Icelandic waters, where he has shown by marking experiments that a regular spawning migration takes place into the warmer Atlantic water off the south and south-west of the island. Here again the phenomena are clear and comprehensible, because they are, as it were, "writ large"—the difference in temperature between the cold water off the north and east and the warmer Atlantic waters off the south and west of the island being very marked, which renders the migration practically an absolute necessity for the survival of the offspring. Essentially the same in principle are the problems of correlated physics and biology in British seas which still, to a great extent, await elucidation. But here the phenomena are not "writ large"; on the other hand, they can only be demonstrated by the study of observations made with fine precision and extended over a considerable period of time. A. E. H.

THE PARIS FLOODS.

IT is now an evident fact that Paris has recently suffered the ravages of an inundation greater and more severe than any which have visited the city within the last two and a half centuries. A gauge at the bridge of La Tournelle shows the surface of the water as having reached a height above the bed of the river of 27 feet 10½ inches. Normally, it is only about 8 or 9 feet, and it is necessary to go back so far as the year 1658 in order to find any record exceeding, or even approaching, this figure. At that date the height attained was 28 feet 10½ inches. A few years previously (1651) there was a flood of 25 feet 8 inches, and in 1649 another of 25 feet 2 inches. The flood of 1802, great as it was, did not exceed 24 feet 5 inches, and that of 1876 only reached 21 feet 11 inches.

The known records are as follows:—

		ft.	in.
February	1649	25	1½
January	1651	25	8
February	1658	28	10½
February	1690	24	9
March	1711	25	0
December	1740	25	11
February	1764	24	0½
January	1802	24	5
March	1807	22	0
January	1910	27	10½

The causes of the flood are not quite so obvious as the effects. At first sight it would appear that there is no very satisfactory explanation to be vouchsafed. In the watershed of the Seine and its tributaries there is an absence of lofty ranges with snow-capped summits, capable of producing copious liquidations such as prevail in mountainous regions. But on the other hand, there are numerous impermeable districts within the Seine Basin where the rainfall finds its way almost entirely into the river bed, and if to the effect of a prolonged precipitation in these areas there be added the far from negligible contribution of melted snow from the impermeable Morvan Plateaux, produced under the influence of a sudden and abnormal rise in temperature, we need not pursue inquiries very much further in order to arrive at an adequate solution of the problem.

The Seine at Paris is formed by the confluence of three important streams: the Yonne, the Upper Seine, and the Marne. Of these the Yonne is the only one presenting torrential characteristics; it rises rapidly, and subsides as quickly. The other two streams move more slowly, and change less abruptly. After a period of heavy rainfall the flood waters of the Yonne arrive first at the point of confluence, reaching it at the end of three or four days, and they produce the greater portion of the rise in level. Four or five days later the waters of the Upper Seine and Marne arrive, having been fed by filtrations through more permeable ground and by surfeited springs, and these simply serve to maintain the effect of the previous increment. If towards the end of this period the previous meteorological phenomena in the upper reaches repeat themselves, the effect produced is that of a single continuous flood of considerable intensity.

Fortunately, floods in the neighbourhood of Paris can be predicted sufficiently in advance to enable remedial, or at any rate palliative, measures to be undertaken. The Seine, as has been pointed out, rises but slowly, and the effects of floods in its affluents are visible several days beforehand, and can be announced accordingly. There is ample warning for the inhabitants to withdraw, if need be, from the threatened quarters. An empirical rule has even been established which enables the height attainable by the flood to be approximately stated. The rise of the Seine at Paris is just about double the mean of the partial rises in its affluents at certain fixed points. The hygrometric service of Paris, therefore, plays a very useful part in issuing these forecasts, and renders valuable service to the community at large.

PROF. F. PURSER.

THE news of the death of Prof. F. Purser, professor of natural philosophy in the University of Dublin, announced in last week's NATURE, has been received with deep regret. His life had just reached the regular period of seventy years, and intellectually he was as vigorous as ever.

Prof. Purser was one of the ablest and most brilliant members of a very clever family. His father managed Guinness's Brewery in the time of Sir Benjamin Guinness, and it was to a great extent owing to his skill, foresight, and enterprise that the brewery attained the colossal dimensions it possesses at present. His elder brother was a mathematician of a very high class, and was for several years professor in Queen's College, Belfast.

Two of his cousins were distinguished professors of the University of Dublin. One held the chair of institutes of medicine, or physiology; the other, Dr. Louis Purser, was professor of Latin, and is still public orator.

Prof. Purser's university career was very brilliant. He obtained a science scholarship in 1859, a large gold medal in mathematics, pure and applied, at the moderatorship examination in 1860; Bishop Law's mathematical prize, the MacCullagh prize, and in 1872 fellowship. At that time the fellows of Trinity College, Dublin, were supposed to be members of what had recently been the Established Church, and on their election were obliged to make a declaration which was partly of a religious character. Frederick Purser was a Moravian, and though no question would have been asked as to his special form of belief, he considered that he could not with truth make the required declaration, and consequently the fellowship he had won was declared vacant.

In 1873 Fawcett's Act abolished religious tests in the University of Dublin, and Purser began to read again for fellowship, which he gained for the second time in 1879. This has always been regarded as a wonderful feat by those who are best acquainted with the nature and difficulty of the fellowship examination in Trinity College. In 1902 Purser succeeded Tarleton as professor of natural philosophy, which professorship he held until his death. In 1905 and 1906 he was a vice-president of the Royal Irish Academy. He published in the Proceedings of the Academy some fine papers on the applications of Bessel's function to various difficult questions in physics. Some beautiful investigations of Prof. Purser are to be found in Tarleton's "Introduction to the Mathematical Theory of Attraction." Purser's publications, however, represent most inadequately the extent of his knowledge and his genius.

A more profound or accurate thinker than Prof. Purser it would be difficult to find. He was not merely a mathematician—he was also a metaphysician of the highest order. His paper, published many years ago in *Hermathena*, on "Hamilton's System of Natural Realism," was a work of rare ability. In that paper he showed that Hamilton's theory, when stripped of its absurdities and inconsistencies, was almost the same as the theory of Kant. As a metaphysician Prof. Purser was in the main a follower of Kant. Of geometrics of space of more than three dimensions he had a poor opinion, and looked upon them as little more than algebraical exercises.

Possessed of considerable wealth, he expended it with the greatest generosity. He was a munificent benefactor of Queen's College, Belfast, where his brother was a professor; of Trinity College, Dublin; and of the Royal Irish Academy.

Prof. Purser's chief fault—if it may be described as such—was one which appears to belong to the whole Purser family, that is, the fault of thinking far too little of his own powers and of the value of his own performances.

NOTES.

FOR the meeting of the British Association for the Advancement of Science, which is to take place this year at Sheffield on August 31 and following days, under the presidency of Prof. T. G. Bonney, F.R.S., the following presidents have been appointed to the various sections:—A (Mathematical and Physical Science), Dr. E. W. Hobson, F.R.S.; B (Chemistry), Mr. J. E. Stead, F.R.S.; C (Geology), Prof. A. P. Coleman; D (Zoology), Prof. G. C. Bourne; E (Geography), Dr. A. J. Herbertson; F (Economic Science and Statistics), Sir H. Llewellyn Smith, K.C.B.; G (Engineering), Prof. W. E. Dalby; H (Anthropology), Mr. W. Crooke; I (Physiology), Prof. A. B. Macallum, F.R.S.; K (Botany), Prof. J. W. H. Trail, F.R.S.; L (Educational Science), Principal H. A. Miers, F.R.S.

IN a speech delivered at Washington last week, Commander Robert E. Peary proposed, on behalf of the Peary Arctic Club, that the National Geographic Society should unite with the club in the organisation of a United States South Polar Expedition, to start in the autumn of this year. He promised that the Peary Club would lend the *Roosevelt* for the purposes of the expedition, but stated that he himself would be unable to assume the command in person. The proposal has since been accepted by the directors of the National Geographic Society. All proposals which aim at the extension of knowledge of the Antarctic area are to be welcomed, but now that so many projects for the exploration of the south polar regions are to the fore, it is necessary to consider how Commander Peary's scheme stands in relation to other Antarctic enterprises. The only expedition at present in the field is that under Dr. Jean Charcot on board the *Pourquoi Pas*, which a year ago penetrated the Antarctic regions to the south of South America. It intended to make its way westwards, and, if possible, undertake a "dash" to the South Pole from the ship's winter quarters. If the expedition makes its way northwards again this season, news of it should be received in the course of the next two months. The British expedition now in course of organisation by Captain Scott will make its headquarters in McMurdo Sound, and, if possible, land a small party on King Edward VII. Land. The expedition proposed by Commander Peary will not interfere with these plans in any way, since it is suggested that its base should be on the opposite side of the Antarctic continent, that is to say, on Coats Land, in the Weddell Sea, south of the Atlantic Ocean. This is the coast which Dr. W. S. Bruce, its discoverer, wishes to make the base of a Scottish Antarctic expedition, and Sir Ernest Shackleton has also stated that if he should go south again he would probably attempt to reach the Pole from the side of the Weddell Sea. An alternative base suggested by Sir Ernest Shackleton is Gaussberg, to the south of the Indian Ocean, off which the German expedition under Dr. Von Drygalski wintered in 1902. Gaussberg is situated on the Antarctic circle; the most southerly known point of Coats Land is just beyond the seventy-fourth parallel, or 960 geographical miles from the Pole, while Cape Royds, in McMurdo Sound, where Captain Scott proposes to winter, is in between 77° and 78° south latitude, nearly 750 geographical miles from the Pole.

MR. W. BATESON, F.R.S., and Dr. H. T. Bovey, F.R.S., have been elected members of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

THE Julius Thomsen memorial lecture of the Chemical Society will be delivered on February 17 by Sir Edward Thorpe, C.B., F.R.S.

FOUR lectures on "The Anatomy and Relationships of the Negro and Negroid Races" will be delivered in the theatre of the Royal College of Surgeons, Lincoln's Inn Fields, by Prof. Arthur Keith (conservator of the museum), on February 14, 16, 18, and 21. Ladies and gentlemen will be admitted to the lectures on presenting their private visiting cards.

THE annual conversazione of the Selborne Society will be held on Friday, February 18. An address will be given by Sir John Cockburn, K.C.M.G., and a lecture on "Selborne and its Associations with Gilbert White" by Mr. E. J. Bedford. There will be a large display of

exhibits under the microscope, as well as exhibits of natural-history specimens, nature photographs, and other objects of scientific interest.

SIR PATRICK MANSON has been elected a correspondant of the Paris Academy of Sciences in succession to the late Sir Burdon Sanderson.

ACCORDING to a Reuter telegram from Berlin, published in the *Times* of February 3, the expedition dispatched to German East Africa to collect dinosaurian remains is proving successful. A femur, measuring 6 feet 10 inches, is specially mentioned, on account of being nearly 2 feet longer than the corresponding bone of the Carnegie Diplodocus.

THE King has presented to the natural history branch of the British Museum the skeleton of his famous thoroughbred "Persimmon," which has been set up by Rowland Ward, Ltd., Piccadilly. This is the first complete skeleton of a thoroughbred to be exhibited in the museum, the skeleton of "Stockwell," which is also contained in the collection, being represented in the exhibited series merely by the skull and the limbs of one side. In common with most or all thoroughbreds with the blood of "King Tom" in their veins, "Persimmon" exhibits a trace of the sinuous skull-profile characteristic of Arabs. The museum previously possessed a statuette of "Persimmon," presented in 1905 by H.R.H. the Prince of Wales.

THE first ordinary meeting of a new society, formed by the amalgamation of the Society of Engineers and the Civil and Mechanical Engineers' Society, was held on Monday, February 7, at Caxton Hall, Westminster. Mr. Diogo A. Symons, the first president of the new Society of Engineers, delivered an inaugural address. Referring to the examination which is to be the qualification for fellowship of the society, he believes that its introduction will have the same beneficial effect as has been the case in the Institution of Civil Engineers. Proceeding to more general subjects, he directed attention to the value of workshop training to engineering students, whether they intend to take up the civil or the mechanical branch of the profession. Speaking of the education of young engineers, Mr. Symons emphasised the importance of a thorough grounding in fundamental principles before any attempt at specialisation is attempted, and laid stress on the advantage of gaining engineering experience with a contractor on public works. The tendency of engineering students to accept salaried appointments after too brief a training was deprecated, because such appointments usually involve loss of valuable instruction and experience.

ACCORDING to the *Pioneer Mail* of Allahabad, a preliminary astronomical conference was held recently at Papanasanum, and another will be held later at Kaladi (Travancore Native State). Astronomers from all parts of India, representing the three different schools of astronomy, viz. Siddhanatha, Vakya, and Drigganitha, are being invited. It is also proposed to give a prize of not less than Rs. 100 (one hundred) to each of these different schools of astronomy; but if Pundits from distant parts cannot come to the conference, they may send written papers in Sanskrit or English. The objects of the conferences are to check the irregularities in calculations now found in the Indian Almanac, and to arrive at some satisfactory solution with reference to the system of calculation to be adopted in the making of future almanacs.

THE second Congrès International du Froid will be held at Vienna on October 6–12, before the close of the International Sporting Exhibition, and the University has been lent for the meetings. Briefly, the subjects to be discussed are the science of cold; the industrial production of cold; the application of cold to alimentation and to other industries; transport; and legislation. The Archduke Leopold Salvator, at the request of the Emperor of Austria, is acting as patron of the congress, and receptions will be given to the delegates by the Court and by the towns of Vienna, Budapest, &c. Papers must be submitted to the Association International du Froid through the British committee. Full particulars of the congress may be obtained from Mr. R. M. Leonard, honorary secretary for the United Kingdom, 3 Oxford Court, Cannon Street, London, E.C.

THE scientific expedition dispatched to Dutch New Guinea by the members of the British Ornithologists' Union has sustained a great loss by the death of Mr. Wilfred Stalker, one of its most skilled naturalists. At the present time no details are known beyond the melancholy fact that he was drowned on January 9. The news was received by telegram from Batavia on February 1, and had probably been forwarded by steamer from the Aru Islands. With this telegram Mr. Ogilvie-Grant received a long letter from Mr. Stalker, written from "Amboina, December 24, 1909." In this he stated that he had been successful in engaging the services of 150 carriers, and was expecting the arrival of Mr. Wafter Goodfellow, the leader of the expedition, in a few days. He also mentioned the dispatch of various cases containing collections of mammals and birds, &c., which had been procured in Central Ceram, and are likely to prove of great interest. Mr. Stalker left England about a year ago, and proceeded to the Aru Islands to obtain living examples of birds of paradise for Sir William Ingram. It had been arranged that, after completing this engagement, he should join the other members of the British Ornithologists' Union expedition, filling up his time until their arrival by collecting natural-history specimens and in making the preliminary arrangements for transport in New Guinea. His letter, mentioned above, states how usefully he had employed his time in carrying out his instructions. Mr. Stalker had already had considerable experience of life in New Guinea, having spent several years (between 1904–6) at the gold mines on the Mambare River, in the northern part of the British territory. It was then that he first began to collect specimens for the Natural History Museum. Subsequently, at the suggestion of Mr. Oldfield Thomas, who had discovered his great ability in trapping and preparing mammals, he was sent by Sir William Ingram and the Hon. John Forest to Alexandra, in the northern territory of South Australia, and in 1907 to Inkerman, in East Queensland. In both these places he did admirable work, and formed fine collections of mammals, which were presented by his patrons to the Natural History Museum. In 1909, in company with Mr. C. R. Horsburgh, he again visited British New Guinea and the Aru Islands on behalf of Sir William Ingram, and was successful in bringing back a large number of living birds of paradise, including a male of the beautiful blue bird of paradise (*Paradisornis rudolphi*), which had not previously been brought to Europe alive. Early in 1909, after a short stay in England, he again started on the present undertaking, when he so unfortunately lost his life. Mr. Stalker was quite a young man—only thirty-one years of age—having been born on January 17, 1879, and it is sad to think that the successful career of this talented naturalist should have been terminated so early and in so tragic a manner.

DR. C. C. HOFFEUS, of Shöneberg, near Berlin, has favoured us with a copy of the *Leipziger Tageblatt* for

July 24, 1909, in which he recommends the alliaceous plant locally known as "knoblauch" (*Allium ursinum* and also *A. acutangulum*) as a table-vegetable. These plants grow abundantly at Rosenthal, where cabbages cannot easily be raised, and, when properly cooked, are stated to have a flavour superior to that of spinach, the garlicky odour entirely disappearing after a prolonged soaking in water and the application of salt.

THE Transactions and Proceedings of the Perthshire Society of Natural Science for 1908–9, vol. v., part i., contain the report of an address delivered in March last by the president, Mr. W. Barclay, on the proposal to re-afforest large areas in Scotland. The scheme is cordially approved in the address, and a resolution was carried at the meeting in support of the recommendation of the Royal Commission that a State forestry department should be established, with power to put the work in hand. The scheme, it was urged, would eventually prove a financial success, and would provide present employment.

No. 2 of section *b* of vol. xxviii. of the Proceedings of the Royal Irish Academy is devoted to a list of the Neuroptera of Ireland, by Messrs. J. J. F. X. King and J. N. Halbert. This catalogue, which is to replace one published more than twenty years ago by one of the present authors, it is hoped will form a standard of reference for future observations. Although our knowledge of the native dragon-flies, like that of the other Neuroptera, is far from complete, there is no doubt that Ireland possesses fewer of these insects than Great Britain. Twenty-five species were included in the Irish list of 1889, but the number must now be reduced to twenty-three. The study of the may-flies has been so neglected that there are few changes to record from the old list.

ANGLER-FISHES (Pediculati) and their habits form the subject of a richly illustrated paper by Dr. T. Gill, published in the Smithsonian Report for 1908. Nearly all the species inhabiting shallow or moderately deep water are provided with an angling apparatus—the "illicium"—which undoubtedly serves as a rod, line, and bait, although the action is probably automatic. Certain stoutly built members of the group are, however, denizens of deep water, and in these the fishing apparatus has been modified into a rod with a bulb furnished with a phosphorescent terminal portion, while the surrounding "bait" has likewise been specialised and augmented; and, in addition to all this, a lantern and worm-like lures are present. How efficient this apparatus must be will be apparent to all who have witnessed salmon-spearing by torchlight.

GREAT interest attaches to an article by Dr. R. S. Lull, in the January number of the *American Journal of Science*, on the distribution of dinosaurian reptiles. It should be premised that dinosaurian remains are unknown from Central and North-eastern Asia, which may be attributable either to our lack of knowledge of the palæontology of that area or to the circumstance that these reptiles never occurred there. The theropod group is believed to have originated in North America—"Laurentia"—whence they migrated in one direction, probably at a late epoch, into South America, and in another, by way of Greenland and Iceland, to Europe, and thence to India, Africa, Madagascar, and Australia. The Sauropoda, on the other hand, are regarded as an Old World group, migrating early in the Jurassic into the great southern continent of the Old World, "Gondwanaland," and also into the New World. In the southern hemisphere they had a distribution nearly as extensive as that of their carnivorous cousins, and survived long after they had disappeared from the north, occurring in India during some part of the Cretaceous, and in Patagonia—their last stronghold—during the Laramie, or topmost Cretaceous. On account of their semi-aquatic habits, they were independent of complete land-connections, and could thus extend their migrations across areas impassable to the strictly terrestrial Ornithopoda (Orthopoda), as typified by the iguanodon. This may be the reason why the latter group never succeeded, so far as our present information goes, in penetrating the southern hemisphere, although it is possible that the date of their radiation may have been later, when communication between Europe and Gondwanaland was interrupted; while it has also to be borne in mind that, judging from their dentition, they were dependent upon a particular kind of food. Originally the Ornithopoda were probably a North American group, and the horned, or ceratopsian, section appears to have been restricted to the western continent.

THE seventh volume of the *Journal of Experimental Zoology*, which was completed with the November (1909) number, contains no fewer than a dozen memoirs on regeneration in animals. Now that the study of this subject includes the effect of drugs upon the rate of regeneration, with the whole pharmacopœia on the one hand and the entire animal kingdom on the other from which to select material for experiment, there seems no reason why such researches should ever come to an end. Of course, the same may be said of almost any other branch of biological investigation, and, indeed, the rapid accumulation of literature at the present time threatens either to swamp biologists altogether or else to force them to take refuge in a very narrow specialisation.

THE problem of sex-determination continues to receive a very large share of attention from cytologists. One of the most notable recent contributions to the already extensive literature of the subject is a memoir, by Prof. T. H. Morgan, entitled "A Biological and Cytological Study of Sex Determination in Phylloxerans and Aphids," published in the *Journal of Experimental Zoology* for September, 1909 (vol. vii., No. 2). In addition to the author's own observations, this paper contains a critical review of the recent literature of the subject. The theory of accessory chromosomes and the Mendelian interpretation of sex are dealt with. It is admitted, however, that the problem has as yet by no means reached a satisfactory solution. Prof. Morgan regards the quantitative interpretation of sex-determination as only the first rough approximation to such a solution, and he thinks that the accessory chromosome may follow sex or be associated with other differences that determine sex rather than be its sole cause.

THE genus Œnothera has received world-wide attention from botanists since Prof. de Vries founded his mutation theory largely on the variations he obtained by cultivation of certain wild forms. In the hope that North American and European botanists may be induced to make a careful examination of other wild colonies, Mr. R. R. Gates, who has already investigated several of the variants, has compiled an analytical key to the principal segregates and mutants of the genus, which is published in the twentieth annual report of the Missouri Botanical Garden. Ten species and fourteen forms derived from *Œnothera Lamarckiana* are delimited.

THE consequences of cattle-grazing in Indian forests are discussed by Mr. J. W. Best in the *Indian Forester* (November, 1909), where he notes the results of his observa-

tions in a division of the Central Provinces. Grazing is restricted to definite areas where least harm can be done, and, as a rule, goats are prohibited entirely from reserved forests. The destruction of young trees is, of course, the chief danger, since it leads to uneven regeneration. A noticeable feature is the increased development of certain trees with protective devices, such as armed species of Gardenia and the thorny *Zizyphus Oenoplia*. The saplings of *Butea frondosa* also escape the ravages of the cattle; and since this tree is valuable for the cultivation of lac insects, it is recommended that it should be extensively grown on grazed areas.

SEVERAL facts of importance in connection with the development of monocotyledonous embryos are recorded by Mr. W. E. Evans in an account of the germination of Asparagus, Ruscus, and Polygonatum appearing in Notes from the Royal Botanic Garden, Edinburgh (August, 1909). In the case of Asparagus, the axis of the seedling soon breaks through the cotyledon sheath, although the first two internodes do not elongate, so that one or two small hypogeous scale leaves are found at the base. The buds in the axils of these leaves give rise to the first beginnings of the sympodial rhizome. The primary root thickens, and presents the appearance of a pull-root. The germination of Ruscus and Polygonatum seedlings is similar, but several basal scale leaves are formed, and in Polygonatum the hypocotyl takes part in the formation of the fleshy rhizome.

ON the island of St. Vincent cotton and arrowroot provide the most valuable agricultural export commodities, while cacao and sugar are of subsidiary but appreciable importance. The report for 1908–9 of the botanic station, published with the reports of other agricultural establishments, presents several interesting facts concerning these economic products. The Sea Island cotton, by reason of favourable soil and climate in the coastal districts where it is grown, has maintained its reputation as the best quality produced in the West Indies, and the quantity exported during the year has increased in amount; but lower prices and bad weather have caused a small decrease in the area planted and in the output. Arrowroot can be grown in all parts of the island, and the supply could be increased if fresh markets were obtainable. A feature of the cacao cultivation is the necessity for shade, for which purpose the leguminous tree *Gliricidia maculata* is utilised.

THE Department of Lands, New Zealand, has sent us a copy of the surveyor-general's report for the year 1908–9. The greater part of the report is occupied with an account of the progress of the different surveys, but some of the notes and appendices are of general interest. The Milne seismograph at Christchurch registered forty-six earthquakes, the average annual number during the preceding six years being eighty-two. The record of the Messina earthquake will prove of considerable interest, as Christchurch is not far from the antipodes of Calabria. A foundation has been laid for the measurement of secular movements of the New Zealand coasts in the determination of the mean sea-level at Auckland, Wellington, and four other ports, and its reference to permanent bench-marks on the adjoining shores. The Wellington Harbour gauge-charts exhibit many instances of very pronounced seiche-oscillations, much more so than at the other ports, and it is found that in most cases they are accompanied by a change of wind from north to south or *vice versâ*, the wind at the time being generally strong.

THE University of California has issued, as the fourth part of vol. vii. of its Proceedings, a report on the shell-mounds of the San Francisco Bay region, by Mr. N. C. Nelson. The environment of these shores favoured occupation by numerous fishing tribes, and no fewer than 425 mounds, some of considerable extent, have been mapped and described. The culture disclosed in these mounds is generally uniform and of the Neolithic type, rude stone implements being found only in inconsiderable numbers. These people buried their dead in the collections of shells and other débris in the neighbourhood of their dwellings, and a large collection of osteological remains has been made which still awaits examination. It seems probable that the builders of these mounds were of the same race as the present Indians of the neighbourhood, but it is at present impossible to fix the approximate date at which they may have been formed. They are certainly of considerable age, because some species of oysters and mussels the shells of which have been recognised in the mounds have disappeared from the locality. From calculations of the daily supply of fish required by the group of families occupying a single site, Mr. Nelson estimates that the accumulation of shells in one mound may have extended over 3500 years.

THE Bureau of Science of the Government of the Philippine Islands has published parts iv. and v. of vol. iv. of its Bulletin, dealing respectively with medical sciences and general science in respect to the Philippine Islands. The former of these two parts, compiled with the assistance of the staff of the Philippine Medical School, presents a very complete medical survey of the town of Taytay, showing the diseases prevalent in the community and the conditions under which it lives. "While the conditions of the town are generally unsanitary, the death-rate varying in different years from 27·91 per 1000 to 45·42 per 1000, they at times become most unsanitary. Under the present conditions epidemic diseases such as cholera, typhoid, and bacillary dysentery are likely to occur from time to time." Various recommendations in regard to vaccination and water supply are urged to remedy this state of unhealthiness. The part which deals with general science contains papers on geology, road-making materials, and anthropology. The anthropological contributions contain a vast number of measurements which must ultimately prove of great value to the ethnologist, despite the accompanying absurd classification of the inhabitants into Iberian, Cromagnon, Australoid, Alpine, Adriatic species, varieties, &c.

A MEMORANDUM on recent weather and on the probable character of that of January and February, 1910, in the Punjab and north-west frontier-province of India, published by the Director-General of Observatories, concludes that the total precipitation in that locality will probably reach or exceed the average in the latter months. This inference is chiefly based on the fact that during fifteen out of eighteen years since 1890–1 an excess or a defect in the rainfall in December has been maintained in the two following months. In December, 1909, the area in question had an excess of 1·4 inches over the normal amount. The Director-General states that another favourable sign is that the vertical gradients of barometric pressure were abnormally steep during December.

IN the *U.S. Monthly Weather Review* for June last, just received, Prof. A. G. McAdie refers to the interesting and somewhat important problem of the prevention of damage by frost in orchards, &c. He states that the great mass of experiments made in California orchards shows that direct heating of the air by open fires has not been sufficient to prevent injury at times of very low temperature, and quotes a recent experiment of a careful observer there during a night when the temperature ranged between

19° and 24°. Very large amounts of wood and wet hay were burned, but, the air being dry and calm, the smoke rose straight upwards, and although three large fires were maintained between 20 and 30 feet of a certain tree, the temperature in the vicinity of the tree remained for some hours about 20°. Prof. McAdie's conclusion is that a proper cover spread some feet above the surface is the most effective means of protection of plants. When necessary, this may be supplemented by the use of small stoves, &c., placed on the ground.

A NEW form of watch-glass clip has been submitted for inspection by Messrs. J. J. Griffin and Son, Ltd., of Kingsway, London. It consists of two small metal rods joined by steel spring wire to form a holder, of lenticular section, which can slide over a pair of watch-glasses having their edges in contact. When desired, it can also be used for a single glass. The hold is very firm, and the clip is easily affixed and detached; it is also lighter, neater, and less cumbersome than the older brass contrivances. Within limits, the same clip will serve for different sizes of glass; but two sizes of clip are recommended for ordinary use, namely, those taking glasses up to 1¾ inches and up to 2¾ inches in diameter respectively.

THE December (1909) number of the Journal of the Institution of Electrical Engineers contains a paper read before the institution in May last by the president, Mr. W. M. Mordey, on some tests of the Mansbridge paper condensers described in these columns a year ago, and of the Moscicki glass condenser, or engineering form of the Leyden jar. Mr. Mordey finds that the losses on alternating current circuits only amount to about 0·6 per cent. in the case of the Mansbridge and 1 per cent. in that of the Moscicki condenser, the former being tested up to 500 and the latter up to 10,000 volts. In these circumstances the author points out that the general introduction of condensers on alternating circuits to compensate for the lag of current due to inductive loads becomes a possibility of the near future.

THE agenda paper of the general meeting of the Société française de Physique on January 21 contains, in addition to the business items and *résumés* of the papers read at the last meeting, a balance sheet for the session 1908–9. From it we gather that the society now has about 1500 members, almost equally divided between Paris, the rest of France, and foreign countries. The subscriptions for the year amount to 600*l.*, and the society has 10,000*l.* invested in French railways. The cost of printing the quarterly *Bulletin des Séances*, a volume of 300–400 pages per annum, and the fortnightly agenda and *résumé* of papers read, is about 140*l.*, and the cost of distribution of these publications to the members amounts to 130*l.* We offer the society our congratulations on its strong position and on the excellent work it is doing.

THE reconstruction of the Tyne North Pier, which has just been completed, forms the subject of illustrated articles in *Engineering* and in the *Engineer* for January 28. The importance and difficulty of the work executed by the contractors, Messrs. Sir John Jackson, Ltd., under the direction of Sir John Wolfe Barry and Messrs. Coode, Son, and Matthews, may be understood from the fact that, in exceptional storms, waves 35 feet in height from trough to crest have been recorded at the mouth of the Tyne, and, owing to the deep water, are propagated almost so far as the pier itself. The old pier met its death-blow during the great gale of January, 1897, when 110 feet of the wall on the seaward side fell outwards. As reconstructed, the North Pier is 2900 feet long, and the entrance to the harbour is now 1180 feet wide. From the foundations on the shale, which was dressed level by divers, the pier has been built of concrete blocks, with granite facing on the outer courses. The depth of foundation below low water of spring tides varied from 28 feet to 44½ feet, being, on the average, about 20 feet more than in the old structure. The width at quay-level is 37 feet, and at low-water level 50 feet. Access is obtained during stormy weather to the lighthouse and machinery for blowing the fog signal at the pier-head through a tunnel, which is constructed under the promenade.

A DESCRIPTION is given in *Engineering* for January 28 of the system of photographic surveying from balloons devised by Captain Scheimpflug, of Vienna. The inventor's experiments have been going on for some years, and formed the subject of a lecture recently given by him before the Physical Society of Frankfort-on-Main. Briefly, the panorama camera consists of a central camera having a horizontal plate and seven inclined lateral cameras surrounding the former. The cameras are rigidly connected with one another, and the shutters are released simultaneously, so that a very large field is secured. Horizontal projections of the inclined negatives are produced by means of a special apparatus, when the resulting panorama views show a centre heptagon surrounded by seven other trapezoidal photographic sheets. The diameter of country represented will be about five times the height of the balloon and camera at the moment of exposure. Photographs are taken at rapid intervals while flying over the ground, and it is desirable that the resulting views overlap by more than half. The nadirs of successive photographs will then be discernible on the same plate. Heights can be obtained from the photographs by means of another apparatus—the zone transformer. The inventor estimates that a survey of German South-west Africa by his system could be accomplished in fifteen years at a cost of 2,000,000*l.*, as compared with a plane-table survey, which would occupy 150 years at an estimated cost of 10,000,000*l.* There certainly seems to be a field for photographic surveying from airships.

THREE new volumes, Nos. 6–8, have been added to the series of books on Egypt and Chaldæa published by Messrs. Kegan Paul, Trench, Trübner and Co., Ltd. They form a second edition, revised and enlarged, of part of Dr. Budge's work on the "Book of the Dead," published under the title of "The Chapters of Coming Forth by Day." The subtitle describes the volumes as an English translation of the chapters, hymns, &c., of the Theban rescension, with introduction, notes, &c. The first edition of Dr. Budge's work, of which the present translations formed the third volume, was reviewed at length in our issue for February 10, 1898 (vol. lvii., p. 337). The translation given in the present series is not merely a reprint from the original issue, for it has been carefully revised and compared with the original texts, and many brief explanatory notes have been added. More than four hundred vignettes, taken from the best papyri, have been reproduced in these volumes at the heads of the chapters, the general contents of which the ancient Egyptian scribes and artists intended them to illustrate. These translations form a representative collection of the various compositions which the Egyptians inscribed upon the walls of tombs and sarcophagi, coffins and funeral stelæ, papyri and amulets, in order to ensure the well-being of their dead in the world beyond the grave. The price of each of the present volumes is 5*s.* net.

THE twelfth edition, revised, of Mr. W. T. Lynn's small volume on "Celestial Motions" has been published by Messrs. S. Bagster and Sons, Ltd., price 2s. net. The book is an easy introduction to the main facts of astronomical science, and the frequent re-issues enable the author to keep it up-to-date.

MR. JOHN BROWNING has issued the fourth edition, rewritten and revised, of his concise little book "How to Work with the Spectroscope." The book provides beginners with a handy guide to the use of spectroscopes of various kinds, including McClean's star spectroscope, the microspectroscope, and others; and we welcome it as a simple means of extending the circle of observers of spectroscopic phenomena. The price of the book, with a coloured chart of spectra, is 1s. 6d., and without the chart, 9d.

OUR ASTRONOMICAL COLUMN.

NEW ELEMENTS FOR HALLEY'S COMET.—In a note appearing in No. 419 of the *Observatory* (February, p. 104), a set of elements for Halley's comet, deduced by Mr. C. J. Merfield from the observations made since the re-discovery of the comet in September last, is compared with the elements predicted for this return, as follows:—time of perihelion passage, April 19·6394 (G.M.T.), $\omega = 110° 43' 24''$ (=predicted+68″), $\Omega = 57° 15' 56''$ (=predicted−16″), $i = 162° 12' 34''$ (=predicted−8″), $e = 0{\cdot}967300$ (=predicted+0·000019″), and $\mu = 46{\cdot}6723''$ (=predicted+0·003″). From these elements Mr. Crommelin has calculated the conditions for the comet's transit over the sun, and finds that the first contact should take place on May 18d. 14h. 22m. (G.M.T.) in position angle 264°. Thirty minutes later the centres of the two bodies will be at their least separation, the comet being 62″ south. Last contact should occur at 15h. 22m., in position angle 92°, and the horizontal parallax of the comet will be 54·4″, or 45·7″ relative to the sun. The transit will be visible in Australia, the Pacific, and Asia, and it is sincerely to be hoped that careful and comprehensive observations will be made, for they may provide useful additions to our knowledge concerning the constitution of the denser portions of the comet.

In the same journal Father Cortie discusses the alleged Papal excommunication of Halley's comet ("The Devil, the Turk and the Comet") in 1456, and quotes conclusive evidence showing the story to be a myth.

STUDIES OF SOLAR AND STELLAR SPECTRA.—In two recent communications to the Academy of Sciences (*Comptes rendus*, Nos. 1 and 3), Count A. de Gramont publishes some interesting results as to the occurrence of what he designates *raies ultimes* in the spectra of the sun and various stellar types.

The *raies ultimes* of an element are those lines which persist in the spectrum throughout the range of flame, arc, and spark conditions. Treating different alloys in which the quantity of a component continuously decreases, M. de Gramont finds that the first lines to disappear from the spectrum are the "spark" lines, then those produced in the arc, and lastly the "flame" lines; the most persistent lines are the *raies ultimes*. On the hypothesis that the spectra of the various regions of the sun are dissociation spectra, and that their differences are due principally to variations of the proportions of elements present, M. de Gramont hopes to find indications which will show, more or less, the regions of the sun, and he gives a list of the most persistent and the most sensible lines of seventeen elements already traced in the solar spectrum.

M. de Gramont further points out that the absence of the lines of the metalloids, &c., from the solar spectrum should not be accepted as proof that these substances do not exist in the sun, for he has already shown that the "ultimate" lines of many of them exist in the more refrangible part of the spectrum which our atmosphere absorbs. The "ultimate" lines of gold occur at λλ 2676·0 and 2428·1, and it is suggested that this is the reason that gold has, so far, been considered as absent from the sun.

In the second paper M. de Gramont considers the distribution of *raies ultimes* in different stellar types, having studied for this purpose the Harvard classifications, the numerous publications of Sir Norman Lockyer, and the works of Sir William Huggins. Using the nomenclature of Miss Cannon, in the Draper Catalogue, he finds that these ultimate lines do not occur in the hottest stars, but make their appearance in B8A, the Algolian type, and generally increase in intensity as the lower types are reached. In the *c* division the "ultimate" lines appear at a stage later, and in less numbers, than in the *a* division. M. de Gramont points out that the *c* division corresponds with Sir Norman Lockyer's "ascending series," of which the most characteristic types are the Rigelian and the Cygnian, in which predominates the "test spectrum" or spectrum of enhanced lines. The presence of oxygen and nitrogen lines in the helium stars, lines dissimilar to the ultimate lines, is taken as an indication that in such stars powerful electrical discharges are in action.

M. de Gramont concludes by suggesting that the presence or absence of "ultimate lines" in the spectra of stars may furnish valuable indications of the relative temperatures, or the stage of evolution, of the different types, and is equally applicable to the Harvard classification and the conceptions of Sir Norman Lockyer.

MARKINGS ON MARS.—Too late for insertion at the end of his letter on Martian markings as seen with small and large telescopes, published in last week's NATURE (p. 397), Prof. Lowell writes:—"It will prove of interest to students of the subject that this optical shattering of lines, due to a large glass, is precisely what M. Antoniadi observed at Meudon in his observations of Mars. He saw in the canals, in place of lines, a tesselated series of dots. His observed mosaic effect is the exact theoretic effect that a large aperture should produce on continuous lines such as the canals, and always does produce in the case of the rings in the images of a star."

ELEMENTS AND EPHEMERIS FOR TEMPEL'S COMET (1873 II.).—In No. 4386 of the *Astronomische Nachrichten* M. Maubant gives the elements and a search-ephemeris for Tempel's second comet, which is expected to pass through perihelion in the near future. The conditions are not favourable for observation.

THE NEW COMET (1910a).

ALTHOUGH by its increasing distance from the sun and the earth, and by its apparent recession into the sun's rays, the great comet of 1910 is becoming less popular as a spectacle, the interest among astronomers as to the results accruing from the mass of observations will doubtless continue for a long period. From observers situated in many parts of Europe and Africa we are receiving further evidence of this comet's title to rank among the "great comets" of history.

In sending us the drawing here reproduced, Father Cortie encloses some valuable observations of the comet's appearance on January 26. The drawing was made by Mr. William McKeon, an assistant at the Stonyhurst College Observatory, at 6 p.m. January 26, and in making the observations a small pocket telescope of 1½ inches aperture and 17 inches focal length was employed. The following are Mr. McKeon's remarks concerning the comet's appearance at the time:—"Nucleus of the comet bright and sharp; no merging into the tail, magnitude 2. Nucleus of comet 2° S. and 7° W. of Venus (estimated). The tail terminated at a star of about the seventh magnitude some 8° N. by E. of the head. The star to the right of the comet (N. by W.) was of about the third or fourth magnitude."

Father Cortie identifies this latter star as α Equulei, magnitude 4·1, and thence deduces that the length of the tail, as seen in the small telescope employed, was about 7½°. Naked-eye observations by himself showed the tail extending almost to ε Pegasi, which would make its length 12°; its breadth at the end, he estimated, was about 3°. The sky was perfectly clear, and the tail of the comet

was quite a conspicuous object after the head had set, until it was lost in the moonlight. As the drawing shows, there was, in addition to the two main branches of the tail, separated by a dark segment, a fluffy extension on the eastern side; all these features are shown on the photographs taken the same evening, and mentioned in NATURE last week.

Further observations were made on January 29, and, although the sky was less clear, the length of the tail was estimated by Father Sidgreaves to be 17° or 18°; the general brilliancy of the comet was less.

Father Cortie also records some observations made by the Rev. J. Rowland at St. Asaph, N. Wales, who directs attention to "a faint general illumination of the sky to the east of the tail, of a width apparently of 10° to 15°, the length of the tail being over 20°. There was also an apparent deviation of the tail to the east between α and γ Pegasi." This confirms the independent observations, made at Stonyhurst and elsewhere, as to the apparent existence of a cloud of particles following the eastern branch of the comet's tail.

Mr. Theodore Kensington, West Malvern, also mentions a similar phenomenon. He says, in a letter dated February 5:—"The comet was a magnificent sight from the Malvern Hills a week ago, and of even more than ordinary interest owing to the glare which was visible, in apparent connection with it, on its southern side. This glare was best seen on the evenings of January 29 and 30, but it was also visible last Wednesday and Friday."

The comet as seen at Stonyhurst on January 26 by Mr. McKeon.

Mr. Kensington further states that the glow was like that from a distant city or an aurora, but that it was not terrestrial was shown by its setting with the stars. It was like an inverted U the right side, bounded by the comet and the square of Pegasus, reaching nearly to Saturn, while the left (south) side descended almost perpendicularly, but with a slight trend inwards, to the visible horizon. The distinction between the bright background on the one side of the comet and the dark sky on the other side was quite marked, but after January 29 there was a darker band of sky between the comet's tail and this glow.

Miss Eleonora Armitage, writing from Dadnor, Herefordshire, states that the glare seen in the neighbourhood of the comet was the zodiacal light, which showed particularly well on January 29. She adds:—"The tail of the comet was well defined on the west side, reaching a little beyond and above α Pegasi, as seen with the naked eye; on the east side it could be traced almost so far as γ Pegasi, but along most of this side the edge was very indefinite, owing to the light practically blending with that of the zodiacal light, both having apparently the same degree of luminosity. β Aquarii could be seen through the tail a little above the nucleus of the comet. The next evening, January 30, the comet was much fainter, but the tail could still be traced for nearly 30°, while the zodiacal light stretched up in a bright cone, the apex almost reaching to Saturn. When seen again on February 4 the northern movement of the comet had removed it from the track of the zodiacal light, so that the two lights appeared to be separated by a segment of dark sky, the eastern edge of the curved tail being now nearly as clearly defined as the western."

Reports from other observers indicate that the zodiacal light has been well seen on several occasions during the past fortnight. Dr. F. J. Allen saw it and the comet, under ideal conditions, from the Mendip Hills on January 30, and suggests that the "glare" near the comet as seen by other observers was doubtless the light. A correspondent ("E. W. P.") at Ross, Herefordshire, also states that "the zodiacal light was distinctly seen this evening at 6.45 (February 4), whilst the tail of the 'daylight' comet seemed to reach further than ever."

Dr. Allen's observations of the comet are of especial interest, for he remembers distinctly the comet of 1858 (Donati's), and has seen all the bright comets since, and states that, as he saw it on January 30, 1910*a* is the only one which can be compared in effect with Donati's. The intermediate ones, though brighter than the present one, were poor little things in apparent size. He suggests that the estimates of its apparent size have erred on the side of cautiousness. As he saw it at Cambridge, during the early days of its appearance, his estimates agreed with the usual ones; but as seen from the Mendips, smoke, gas-lamps, and clouds being absent, and the night exceptionally clear, the tail reached beyond and included α Pegasi, and then took a more pronounced curve to the left. He estimates its length as 40°, and suggests that, had the zodiacal light been absent, the tail might have been traced further, for the light rendered its S.E. limit indefinable; his observations extended for more than an hour, between 6 p.m. and 7.30 p.m. Prof. R. A. Gregory, observing at Chichester on January 29 and 30, found that the tail was certainly 30° long, whilst M. Giacobini reports (*Comptes rendus*, vol. cl., No. 5, p. 263) that, as seen by the naked eye at the Paris Observatory, on January 29, its length exceeded 45°. M. Chofardet, at Besançon, states that on January 27 the tail was 25° long, and, curving towards the south, mixed its light with that of the zodiacal light.

In a further communication, Mdlle. de Robeck, observing at Inistioge, Kilkenny, states that on January 29 the comet appeared very much in the same way as shown in Mr. Rolston's sketch in last week's NATURE, but the tail seemed to reach higher, and swept upward nearer to α Pegasi. After Venus had set, the tail of the comet was seen like a great search-light sweeping the sky, and the fainter stars below Pegasus were seen glittering brightly through it; the night was exceptionally clear at Inistioge. Mdlle. de Robeck also states that, before the comet became such a noticeable object, the country people around Inistioge took Venus to be the much-talked-of object, and saw in it a portent of dreadful calamities. That the Earl of Crawford's suggestion (NATURE, January 20, p. 349) was an urgent one is proved by the reports of "comet scares" in Russia, Turkey, and other countries, occasioned by the sudden and unexpected appearance of 1910*a*. It certainly would be well to prepare the native minds for the apparition of Halley's comet when, as Mr. Cowell thinks it will, it becomes sufficiently bright and large to attract general attention.

Mr. Keeling, of the Helwan Observatory, Egypt, reports that the comet (1910*a*) was observed on several evenings at Helwan, Egypt, and photographs of it were obtained on January 24, 25, 27, and 28; the camera employed has a Cooke lens of 4 inches aperture and 28 inches focal length. Naked-eye observations on January 27 and 28 showed the tail to be 24° to 25° in length.

A telegram from Dr. Aitken (*Astronomische Nachrichten*, No. 4386, p. 292) states that Dr. Albrecht finds the sodium lines in the spectrum of the comet to be so displaced as to indicate a recession of 66 km. per sec. in the line of sight. As the position of these lines has now, apparently, been measured with sufficient accuracy to justify a definite statement as to "shift," it seems very improbable that the yellow lines observed are due to helium, unless two sets of such lines have been observed, and there is no suggestion of this. In this regard Mr. Hinks writes to us dis-

claiming the statement attributed to him by a reporter, as mentioned on p. 410 last week, and states that "there is no truth in this reported unconventionality."

Spectroscopic observations of the comet, made at Meudon, are described by MM. Deslandres, Bernard, and d'Azambuja in No. 5 of the *Comptes rendus* (vol. cl., p. 253).

Using the prismatic cameras previously employed on the Morehouse and Halley comets, photographs were obtained on January 22, 24, 25, 27, 29, and 30. Orthochromatic, red-sensitive plates were used, and the best negative of January 22 was secured with an exposure of five minutes. This shows a brilliant nucleus giving a continuous spectrum from λ 700 to λ 420 and several condensations.

The brightest condensation is at λ 590, and is recognised as due to sodium; it shows a complete monochromatic image of the comet with a well-defined tail, brightest at its edges and extending to a distance of 20′ of arc from the head. The hydrocarbon bands at λ 560 and λ 470 are also recognisable. In addition to these, there are two condensations at λ 620 and λ 700 extending some 10 minutes of arc into the tail, and not previously recognised in cometary spectra.

The later photographs show the progressive differences which have been observed in other comets (*e.g.* that of 1882) having small perihelion distances; the sodium lines faded gradually, while the hydrocarbon bands became more intense, and those due to cyanogen made their appearance.

On January 29 and 30 the sodium bands were absent, the hydrocarbon bands (λλ 565, 517, 474) stronger than before, the continuous spectrum extended into the ultra-violet, and the cyanogen bands at λλ 388, 387, 386 were complete and intense.

The wave-lengths given now are, necessarily, only approximate, but other photographs, taken at the same time with a slit spectrograph, will give finer values, which are promised in a later publication.

Ordinary photographs were also secured, and those taken on January 22 show a fine, curved tail divided into two "antennæ" with a dark line down the centre. On January 29 a supplementary tail was shown, nearly as intense as the first, and making an angle with it of about 25° towards the south.

Observations made with a simple Nicol on January 29 indicated that the light from the tail was strongly polarised in the plane containing the sun, the comet, and the earth.

The *Astronomische Nachrichten* also contains the elements and ephemeris by Dr. Kobold, from which we gave an extract last week, and the records of a number of observations made at the Continental observatories. At the Bothkamp Observatory on January 23, 4h. 50m. (M.T. Bothkamp), Dr. Schiller found the comet to be of the first magnitude, and to have a sharply defined nucleus of 4″ diameter. He reports, also, that the head was very similar to that of Donati's comet shown in Fig. 153 of the third edition of Newcomb-Engelmann; the position-angle of the medial line of the two tails was 40°. On January 23 the comet was fainter, but, to the naked eye, the tail appeared to extend to a distance of 15°.

Later elements and ephemeris are published in Circular No. 119 from the Kiel Centralstelle, and are based on observations made on January 20, 23, 26, and 30; they are as follows:—

Elements.

$T = 1910$ January $17{\cdot}1235$ (M.T. Berlin)
$\omega = 320^\circ\ 58{\cdot}64'$
$\Omega = 88^\circ\ 47{\cdot}14'$ } 1910·0
$i = 138^\circ\ 47{\cdot}12'$
$\log q = 9{\cdot}11153$.

Ephemeris (Midnight, Berlin).

1910	R.A. h. m.	Decl. ° ′	Magnitude
Feb. 10 ...	21 54·4 ...	+ 7 40·8 ...	4·0
12 ...	21 57·2 ...	+ 8 24·8	
14 ...	21 59·8 ...	+ 9 5·5 ...	4·4
16 ...	22 2 3 ...	+ 9 43·5	
18 ...	22 4·6 ...	+10 19·1 ...	4·8
20 ...	22 6·8 ...	+10 52·8	
22 ...	22 8·9 ...	+11 24·9 ...	5·0

The magnitudes are based on the observation that the magnitude on January 27 was 2·0, and are independent of any physical changes in the comet itself.

We notice that the misnomer "Drake's comet" is still being employed. As this is likely to lead to subsequent confusion, it would seem as well to refer to this object as the "Worssell-Innes comet, 1910*a*," Messrs. Worssell and Innes, of the Johannesburg Observatory, having been the first to make and record any definite observations of it.

A FINNISH ETHNOLOGICAL EXPEDITION TO BRITISH PAPUA.

ABOUT the middle of this month Dr. Gunar Landtman, lecturer in sociology at the University of Helsingfors, will leave London for an ethnological expedition to British Papua. In 1904 Dr. Landtman attended the Martin White lectures on sociology that were given in the University of London by Prof. E. Westermarck and those on ethnology by Dr. A. C. Haddon. In 1905 he wrote his doctor's dissertation "On the Origin of Priesthood," and in 1909 published a thesis on "The Primary Causes of Social Inequality." Dr. Landtman will make the island of Badu, in Torres Straits, his headquarters; thence he expects to proceed to Saibai, and later to that portion of the mainland of British Papua which faces Torres Straits, and is known to the natives as Daudai, and, gradually working his way eastwards, he will eventually study the natives of various islands in the delta of the Fly River. Very little is known about this district, and it is important that it should be investigated before the natives are further modified by contact with the white man.

The ethnography of the islanders of Torres Straits has been carefully described by the members of the Cambridge Anthropological Expedition to Torres Straits, and it is fortunate that their results will now be linked on to the mainland of New Guinea, for there is no doubt that the western and eastern islands of the Straits were populated by various emigrations from the mainland. Friendly relations have always been maintained between the islanders and the mainlanders, and a good deal of simple trading has taken place between them; but most interesting of all is the culture influence that formerly extended from the mainland to the islands. In the island folk-tales we hear of the introduction of ceremonies (in most of which masks were employed) by men who seem to have been actuated by a missionary spirit, and the most important of the hero-cults of the central and eastern islands appears to have come from New Guinea. It is Dr. Landtman's intention to endeavour to trace these to their sources.

Totemism is known to occur in the district about to be investigated, where, for some unexplained reason, plant totems are more abundant than animal totems. We may also expect to learn something about the origin of the hero-cult of the islanders, but we do not in the least know whether these legendary persons are heroes in their own country. To the east, along the shores of the Papuan Gulf, the Rev. J. Holmes has discovered a belief in gods who appear to be apotheosised ancestors. It is remarkable that this is the only district of British Papua from which gods have been recorded, but we do not know the western limit of this belief.

A careful study of the social customs and religious beliefs and practices of the natives of Daudai and of the Fly River delta will reveal to us whether their totemism is in a typical condition or whether it is being modified by superior cults, and it is very desirable that a metamorphosis of this kind should be accurately recorded. There are many other problems connected with this interesting region that require elucidation, and we wish Dr. Landtman every success in his undertaking. Dr. Landtman would like to spend at least two years in the field, but is at present uncertain whether he will not have to content himself with one year. On his return he proposes to spend about nine months in Cambridge in order to work out his results, which will be published in English.

RECENT WORK OF GEOLOGICAL SURVEYS.[1]

II.

SOUTH AFRICA AND AUSTRALASIA.

THE Geological Commission of the Cape of Good Hope has issued Sheets 33 and 41 of the geological map of the colony on the scale of 1/238,000, covering the country to the north-east and south-east of Prieska, and just reaching to De Aar. A long stretch of the Orange River wanders through Sheet 41, and its excavating action has here and there revealed the rocks below the prevailing Dwyka series. To the north-west the ground rises, and the Transvaal system, with the dolomites, appears in force. Sheet 33 is a remarkable performance considering the small staff of the Survey, and shows the sinuous outcrops of the Karroo doleritic sheets invading the Ecca shales and the Dwyka series over 3000 square miles of country. Complicated inliers of the older rocks appear in the north-west. The country shown in these maps is described in the Annual Report of the Geological Commission for 1908 (1909). The ring-like outcrops of the igneous sills in Sheet 33 are explained by the presence of tectonic basins, whereby an escarpment of dolerite, facing outwards, encloses an area of overlying Ecca shales. On p. 111 of the report Mr. A. L. du Toit describes the kimberlite and allied pipes and fissures in the Prieska-Britstown region, giving interesting sections to show the typical dome-formation in the strata where the pipes have broken through. A careful study has been made of the inclusions of garnet-granulite and eclogite that are so characteristic of the pipes, and the author shows that they have been brought up from rocks, possibly of sedimentary origin, that were metamorphosed at considerable depths. Dr. A. W. Rogers (p. 135) has re-examined the Tygerberg near Prince Albert Village, and continues to maintain, in opposition to Dr. Sandberg, that the structure is that of an ordinary anticlinal (see NATURE, vol. lxxvi., p. 423).

The Geological Survey of the Transvaal Mines Department shows great vitality. The large areas mapped and reported on in a year may be seen in the maps recording progress, appended to the reports for 1907 and 1908. In the report for 1907 (received in July, 1909) attention is properly directed by the Secretary for Mines to the interrelation of the so-called scientific and economic duties of the Survey. From time to time a brief defence of this kind becomes necessary; but it requires some delicacy, since few geologists would like to set down in print the extraordinary ignorance of earth-structure prevailing among prospectors and "practical men." Support could always be given, however, to colonial surveyors by those in European countries, who know how small details of dip, unconformity, or rock-sequence shown upon their laborious large-scale maps, or perhaps revealed by palæontological studies, prove again and again of service to inquirers in directing their operations or in diverting them to more profitable fields. Geological surveys play, moreover, a high educational part in explaining the features and historical development of a country, and it should be the pride of a growing nation to allow natural sciences to take the place that has been accorded to dead languages in more conservative lands. In the report for 1907 Mr. A. L. Hall describes the geology of the Haenertsburg goldfields, and shows (p. 53) how the stratified rocks of the Pretoria series have been metamorphosed by the Bushveld granite, yielding every variety of type, from bedded shales with new minerals to strongly marked schists and gneisses. He urges that, while pressures have operated during this contact-alteration, dynamic metamorphism is insufficient to account for the phenomena. The rocks illustrate the spread of material along schistose surfaces perpendicular to the pressure (Rieke's principle), and the production of minerals of small molecular volume (Lepsius's law of volumes). We should like, however, to hear more of the relation of the foliation-planes of the most altered types of shale to the original bedding, since we believe that these features are frequently coincident in highly altered contact-rocks. Chromite occurs concentrated in bands in the hypersthenite of the Lydenburg district (p. 59), and similar bands are described by Mr. Humphrey (p. 89) in the norite of Kroonendal, near Rustenburg. Mr. Hall has been able to extend his conclusions as to the potency of contact-metamorphism to the country south-west of Rustenburg (p. 66). Mr. Kynaston reports on the cassiterite deposits in the Waterberg district, where the hilly ground falls northward to the Limpopo. The ore is found in granite in pipes of circular or oval section, which are formed of highly altered granite, with ore concentrated towards their margins (pp. 97 and 100). These are compared with smaller occurrences in New South Wales. Our knowledge of Waterberg is extended by Messrs. Kynaston and Mellor in the report for 1908. The Waterberg Sandstones, which are somewhat like our Old Red Sandstones, form characteristic tower-like kopjes (Fig. 1). The pipes of tin-ore occur on each side of the granite ridge that runs north-west near Zaaiplaats, and are already being well developed (p. 46). In a country where fossiliferous strata are so rare, petrography naturally plays a large part, and the metamorphic zones of both the older and younger granite receive careful description in various papers in this report. The younger granite of Waterberg, a handsomely red rock, yielded boulders to the Upper Waterberg series, but continued to send offshoots into this series in the Hoekbergen and the Middleburg district to the south-east. Deposits of manganese, zinc, and lead ore, and of gold are described by Mr. W. A. Humphrey from the Marico district away west; the Malmani goldfield, which has been worked sporadically, lies not far from Mafeking. These reports, which are priced at only 7s. 6d. each, are, as usual, well illustrated by landscapes and by coloured maps and sections. The Survey has also issued a special octavo memoir on the Waterberg tinfields (1909, price 7s. 6d.), in which the conclusions and illustrative sections are reproduced in a convenient form. The ore-bodies are discussed in detail, and a small example of the remarkable cylindrical pipes is well shown in a photograph in Plate viii.

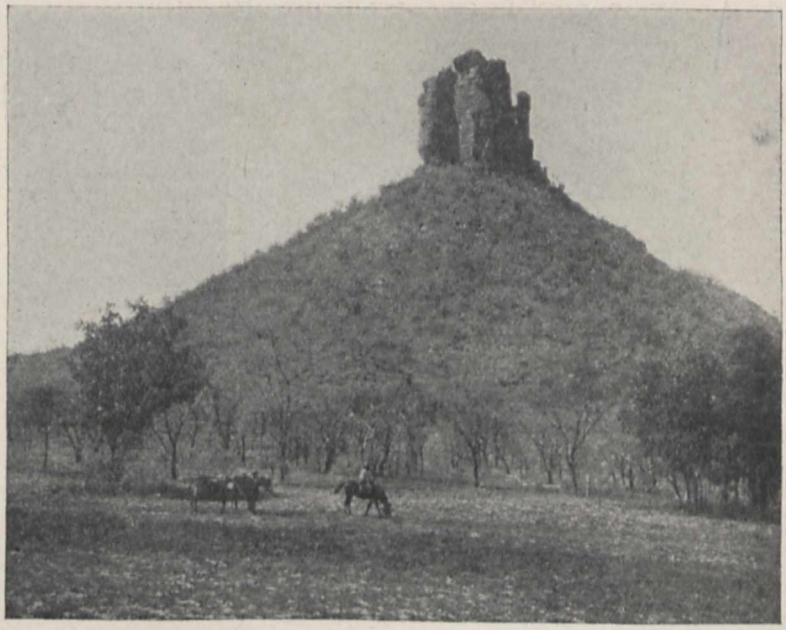


FIG. 1.—Kopje of Waterberg Sandstone, country west of Potgietersrust, Transvaal.

[1] Continued from p. 382.

The Annual Report of the Geological Survey of Western Australia for 1908 (Perth, 1909) contains an account of the phosphatic deposits of Christmas Island, by Mr. H. P. Woodward. The travertine that has become phosphatised from above is about 2 feet thick, and is ascribed to the evaporation of capillary waters, which bring calcium carbonate in solution from underlying shelly sands. This kind of rock may be matched in South Africa and in other countries where rains are only seasonal. The fundamental rocks appear along the coast and in bold hills at the north and south ends of the island. They are granite, gneiss, and schist, with basic dykes rich in magnetite. A large number of analyses of the phosphatic beds and a map of the island are supplied. The Survey has reprinted three earlier bulletins on the Pilbara goldfield in a compact little volume (1908), with a large number of folding maps and plans. This goldfield is in a tropical region east of the Yule River. The gold occurs in quartz-reefs, mainly in a green schist series, which is probably of igneous origin. Alluvial tin-ore is also worked, and has been traced to local granite masses. Bulletin No. 32 (1908, price 2s.) is also a guide to miners in special districts. The tests given for the ready discrimination of ores are an excellent feature, and that on p. 12, for cassiterite in a concentrate of similar heavy minerals, is new and fascinating. Native tin has been found (p. 22) in the Greenbushes tinfield in the south-west of the State, and is attributed to the action of bush-fires on surface ores. Tantalite is of growing importance in Australian fields. Mr. Gibb Maitland pointed out some years ago that the laterite of the Greenbushes area is being denuded away. Mr. H. P. Woodward now states (p. 31) that the deposit appears in places as a zone between two alluviums. It has resulted from the alteration of rocks as diverse as diabasic schist and alluvium, under conditions of climate that may have been recurrent, but which do not now prevail. Bulletin No. 35 (1909) deals with the gold and copper deposits of the Phillips River Goldfield, about 150 miles east of Albany. The basic schists of the region are capped by laterite and the serpentines by magnesite (p. 10); bands of laterite, moreover, traverse the country like lodes, but are believed to be only the weathered tops of basic igneous dykes (p. 12). Certain andalusite-sericite schists are attributed to the alteration of granites rich in soda and alumina (pp. 21 and 23). The coloured map of Ravensthorpe is impressive, with its grand series of basic dykes running across the granite from a greenstone region in the north-west. These dykes can usually be recognised across country by the rich red soil upon them. Bulletin No. 37 (1909), by Mr. C. G. Gibson, is of imperial importance, being a description of the geology along the proposed transcontinental line of railway through Australia from west to east, so far as the route lies in the State of Western Australia. The illustrations of camels procuring water at small holes in bush and desert are not encouraging to the townsman, but will probably serve only as a stimulus in these lands of healthy enterprise. These remarkably cheap reports, in which maps and memoirs are combined, must be of immense service in a country intent on understanding its resources.

FIG. 2.—Mount Lambert, New Zealand Alps, with glacier broken by a precipice in its descent.

The Secretary for Mines for South Australia issues a review of mining operations in the State for 1908 (Adelaide, 1909). Mr. H. Brown describes certain phosphate deposits (p. 21), which have a general interest because of their interstratification with Cambrian clays, sandstones, and limestones. It is suggested, as in the case of the Welsh beds, that the calcium phosphate results from the abundance of organisms which utilised it in their shells in Palæozoic times. At present these deposits are overshadowed commercially by Christmas and Ocean Islands.

The Geological Survey of New South Wales issues a report and map, by Mr. E. C. Andrews, on the Drake Gold and Copper Field, where folding at the close of Carboniferous times was accompanied by successive intrusions of granitic magmas of decreasing basicity. Dioritic dykes then broke through, with which the gold, copper, lead, and silver ores are associated. The mineral features are thus of early Mesozoic age (p. 6). The porphyritic hornblende-granite of Malarra (p. 9), a member of the earlier intrusions, seems of unusual attraction

as an ornamental stone. There is a somewhat exceptional mingling of sound geology and mining applications in this compact report. The Survey shows a keen interest in palæontology in its Records, vol. viii., part iv. (1909, price 7*s*. 6*d*.). Mr. R. Etheridge, among other contributions by him, describes a large tubular organism from Gotlandian strata, allied to the Carboniferous Mitcheldeania. Dr. A. S. Woodward adds to our knowledge of the labyrinthodont Bothriceps. Mr. G. W. Card continues his painstaking determinations of the minerals of the State, and the analyst, Mr. J. Mingaye, supplies details of importance to all chemists as to the modes of separation of thoria from monazite (p. 276).

Mr. W. E. Cameron has written for the Queensland Geological Survey a second report on the Etheridge Goldfield (Brisbane, 1909), where the ores occur in reefs in granite, or associated, like those of the Drake Field in New South Wales, with basic dykes, which here penetrate schists. The Survey has also issued a third edition of a very useful geological and mining map of Queensland, on the scale of 1 inch to forty miles.

In Bulletin No. 6 of the New Zealand Geological Survey (1908, price 2*s*. 6*d*.) Mr. P. G. Morgan describes the southern part of North Westland, on the western coast of the South Island. The author feels strongly that high ground existed in the oceanic area to the west down to the commencement of Pliocene times (pp. 34 and 37), and

FIG. 3.—Ice-carved terraces on slope of Ben More, Western Otago.

that this land disappeared only when the present Alps of New Zealand rose towards their maximum height. A relic is believed to remain in the Carboniferous Greenland series (p. 96), which is folded almost at right angles to the trend of the Southern Alps. The conglomerates of the Oligocene or Miocene Koiterangi series (p. 102) are at first glacial and then fluviatile, and their pebbles may have descended from the old western highlands. The modern glacial features of the interior furnish material for several striking photographs (Fig. 2).

Prof. James Park, in Bulletin No. 7 (1909, price 2*s*. 6*d*.), has an equally grand field in the Queenstown subdivision of western Otago. Queenstown lies on the winding Lake Wakatipu, which is fifty miles in length, and close against serrated Alpine ranges. The main theme of this splendidly illustrated monograph is the evidence for widespread Pleistocene glaciation in the South Island. All the signs of confluent glaciers, developing into an ice-sheet, are here brought together in an argument that appears complete. The decline of the ice seems to have been as rapid as in Europe, giving rise to "unparalleled fluviatile activity" (p. 41). The late Pliocene elevation of the country is held to have had considerable influence on the refrigeration, and the Pleistocene subsidence was accompanied by recession of the ice. Striated surfaces, boulder-clays, drumlins, eskers, and all the features familiar in our hemisphere, are here illustrated from 45° south latitude. Especially remarkable, however, are the terraces carved out on Ben More above Lake Luna, in a quartzose mica-schist (p. 31), which Prof. Park believes to be unique features of ice-erosion (Fig. 3). The author contributes a short essay on ice-flow and the excavating powers of glaciers. References to the structure of glacier-ice and to experiments on its plasticity would have rendered this more complete, but enough is said to excite interest. The bulletin concludes with an account of local gold-mines, and the maps cover the important areas in which alluvium has been worked, or in which the quartz-reefs seem of promise. As usual, for beauty of illustration and the excellent production of the accompanying maps, these New Zealand bulletins remain unsurpassed.

G. A. J. C.

THE LINNEAN SOCIETY'S DISCUSSION ON THE ORIGIN OF VERTEBRATES.

DURING the past fifty years one of the chief tasks to which zoologists have applied themselves has been the reconstruction of the phylogeny of the animal kingdom in accordance with the principles of evolution laid down by Charles Darwin. This task is still far from being completed, although no one can doubt that very substantial progress has been made. The evidence is still very imperfect, and every increase of knowledge makes more clear the need for extreme caution in drawing conclusions. When we think of the familiar comparison of the animal kingdom to a luxuriantly branching tree of which only a few of the topmost twigs are known to us in the living condition, while at the same time we are only able to recover from the past the most fragmentary records of the millions of extinct forms, we are able to realise why it is that most zoologists at present refuse to commit themselves to any particular theory of the origin of vertebrates. Of course, numerous theories have been put forward from time to time, but none has met with anything like general acceptance, and there appears to be a widespread feeling that in the present state of our knowledge any such theory is somewhat premature. The discussion of the subject, however, cannot fail to be of use in stimulating thought, and the debate which has occupied the last two meetings of the Linnean Society has naturally aroused considerable interest.

Dr. Gaskell, as opener, expounded, in his usual brilliant style, his own particular theory of the origin of vertebrates from an arthropod ancestor. This theory has already been before the scientific public for many years, but has met with little favour amongst professional zoologists, most of whom find it impossible to believe that a highly specialised Limulus-like arthropod could have given rise to such a very different type of organisation as the vertebrate. Dr. Gaskell, as is well known, bases his argument mainly upon his study of the Ammocœtes larva of the lamprey, between which and the king-crab he endeavours to draw a very close comparison.

The keynote of this comparison lies in the central nervous system. The ventricles of the brain, with their lining epithelium, are supposed to represent the arthropod stomach, and the central canal of the spinal cord the intestine. The infundibulum is the ancestral œsophagus, and the neurenteric canal the ancient vent. Around this tubular foundation the various ganglia of the arthropod nervous system have become arranged to form the nervous tissue of the vertebrate brain and spinal cord. The original functions of the ancestral alimentary canal have disappeared, and it has been finally replaced by an entirely new structure developed from a respiratory chamber in some palæostracan ancestor. This theory, of course, lands us in a serious difficulty from the embryological point of

view, for if we accept it we must admit that the germ-layers in arthropods and vertebrates are not homologous—that the epiblast of the one becomes the hypoblast of the other, and *vice versa*. Dr. Gaskell does not find this difficulty by any means insuperable, and, as part of his argument, runs a tilt against the germ-layer theory as at present accepted. In this he was largely supported by the subsequent observations of Dr. Gadow and Prof. Stanley Gardiner.

The debate naturally centred around Dr. Gaskell's theory, which was discussed from the standpoints of embryology, comparative anatomy, palæontology, physiology, and even psychology, the subsequent speakers being Prof. MacBride, Prof. Starling, Mr. Goodrich, Dr. Gadow, Dr. Smith Woodward, Prof. Dendy, Sir Ray Lankester, Dr. Chalmers Mitchell, Prof. Stanley Gardiner, the Rev. T. R. R. Stebbing, and the president (Dr. D. H. Scott). Dr. Gaskell replied at length at the end of the second evening.

It is impossible in this article to give more than a very general account of the course of the discussion, and this is the less necessary as the Linnean Society has announced its intention of publishing it in full, while Dr. Gaskell's views have recently been given to the world in book form.

For reasons which have already been indicated, no definite theory was put forward as a rival to that of Dr. Gaskell, though probably no competent zoologist would have much difficulty in formulating such a theory. Amphioxus, however, loomed large, especially in the remarks of Mr. Goodrich. Dr. Gadow, whose remarks, on the whole, tended strongly to support Dr. Gaskell, expressed the opinion that the attempts which have been made to bring Amphioxus into line have not been successful, but it was pointed out that this animal, though in some respects undoubtedly modified—according to Sir Ray Lankester, even degenerate—nevertheless more nearly resembles a primitive vertebrate than any other animal living at the present day. Probably no zoologist now claims it as being in the direct line of descent of the higher vertebrates from their invertebrate ancestors, but it has gone off on its own little side-track for only a short distance from the starting point. In many respects it retains primitive vertebrate characters, such as the notochord, the numerous gill slits, and the comparatively undifferentiated central nervous system (which may, however, be partly explained as due to degeneration). It shows hardly any sign of cephalisation, and no trace of the paired sense organs which form so dominant a feature of the organisation in higher vertebrates. It represents an altogether lower grade of organisation than the lamprey or even the Ammocœtes larva, yet, as Dr. Goodrich clearly showed, there is no difficulty in deriving the lamprey from an Amphioxus-like ancestor by a normal process of evolution in which cephalisation has played the leading part. If, however, we accept an Amphioxus-like ancestor as the starting point of the vertebrate phylum, we must put the arthropod theory out of court at once, for many of the structures upon which Dr. Gaskell lays much stress as evidence in support of his theory, such as the lateral and pineal eyes, have not yet appeared at the commencement of the vertebrate series, and must have been evolved within the limits of the phylum.

As to what preceded the Amphioxus-like ancestor of vertebrates, zoologists, as already observed, refuse to commit themselves to an opinion. They await more evidence. In the meantime, it is pointed out that the possession of nephridia with solenocytes, identical with those of certain chætopod worms, suggests annelidan affinities, and that the worm-like Balanoglossus, with its Amphioxus-like gill slits but very dubious notochord, must also be taken into account, while the evidence of embryology points to some far remote relationship between Amphioxus, Balanoglossus, and the echinoderms.

The chief difficulty in the way of comparing the vertebrate with the annelid lies, of course, in the reversal of the surfaces which such comparison implies. In the annelid the principal part of the central nervous system lies ventrally beneath the gut, in the vertebrate it lies dorsally above the gut. Dr. Gaskell maintains that the old way of getting over this difficulty by turning the animal upside down and making the dorsal surface of the vertebrate represent the ventral surface of the invertebrate ancestor is now universally discredited. Yet we find Prof. Sedgwick saying in his "Text-book of Zoology," so recently as 1905, that it is quite clear that the dorsal surface of the vertebrate corresponds to the ventral surface of other cœlomates, a view which is strongly supported by the history of the ascidian tadpole, in which the mouth is dorsally situated, instead of ventrally, as in higher chordates.

A considerable amount of detailed criticism of Dr. Gaskell's theory was, of course, brought forward during the discussion. Prof. MacBride pointed out that the skin of the primitive vertebrate must have been ciliated, while in the arthropod the entire organisation is dominated by the production of a thick, chitinous cuticle. He also spoke in defence of the germ-layer theory, and criticised Dr. Gaskell's explanation of the hollow gastrula stage of the arthropod Lucifer, the existence of which seems clearly to indicate that the two primary layers of arthropods are identical with those of vertebrates.

An attempt was also made by the present writer to show that Dr. Gaskell's interpretation of the lateral and pineal eyes of vertebrates as the homologues of the lateral and median eyes of arthropods would not bear the test of critical examination. The same speaker endeavoured to explain the hollow tubular character of the vertebrate central nervous system as a comparatively recent adaptation to the requirements of the vertebrate organisation, in which the necessary increase of surface is brought about by the familiar process of folding. Dr. Chalmers Mitchell directed attention to the mode of origin of the nervous system in various invertebrate groups, and scored a point against Dr. Gaskell by his reference to the recent conclusions of Prof. C. Judson Herrick with regard to the arthropodan nervous system.

Prof. Starling maintained that, as regards the principles which must guide any research into the phylogeny of our race, a physiologist has as good a right to be heard as a comparative anatomist, and he thinks that "it is as difficult to conceive that the vertebrate was evolved from a primitive worm-like organism which shot up past the more highly developed Arthropoda as it is to believe that mankind is destined to be replaced by some beast that is now being evolved from lower groups in the depths of the sea." The observations of Dr. Smith Woodward, on the other hand, which dealt with the subject from the palæontological point of view, seemed to indicate that the process of evolution takes place very much in the way which Prof. Starling finds it so difficult to imagine. Moreover, the claims of the ancient ostracoderms to arthropodan affinities, upon which Dr. Gaskell lays so much stress, seem to be extremely dubious; they were probably highly specialised forms, perhaps related in some respects to the lampreys.

Though unable to accept his views on the subject before the meeting, Sir Ray Lankester voiced what must have been a very general feeling amongst those present in expressing his appreciation of Dr. Gaskell's observations.

ARTHUR DENDY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor gives notice that the Sadlerian professorship of pure mathematics is vacant. The election to the professorship will take place on Monday, February 28. Candidates are requested to send their names to the Vice-Chancellor on or before Saturday, February 19.

The office of superintendent of the museum of zoology is vacant by the resignation of Prof. Punnett. The stipend at present attached to the office is 200*l*. per annum. Applications should be sent to the chairman of the special board for biology and geology (Prof. Langley, The Museums, Cambridge) on or before March 7.

Mr. J. C. F. Fryer has been elected to the Balfour studentship from March 25.

A grant of 200*l*. has been made from the Balfour fund to Mr. C. F. Cooper, for an investigation into the Tertiary vertebrate fauna of India, and a grant of 40*l*. to Mr. K. R. Lewin, in furtherance of his work in protozoology to be carried on abroad.

The following grants were made in the year 1909 from

the income of the Gordon Wigan fund at the disposal of the special board for biology and geology:—(*a*) 12*l*. 10*s*. to Dr. D. Sharp; (*b*) 50*l*. to Prof. Langley, for the purchase of a Sändstrom kymograph and accessory apparatus; (*c*) 50*l*. to Mr. A. G. Tansley, that the botanic garden syndicate may continue to offer facilities for plant-breeding experiments; (*d*) 50*l*. to Mr. H. Scott, for the care and development of the collection of insects; (*e*) 25*l*. to Mr. H. H. Thomas, for collecting fossil plants in east Yorkshire with the view of a thorough investigation of its Jurassic flora.

OXFORD.—Dr. Henry Wilde, F.R.S., has offered the University the sum of 600*l*. for the foundation of an annual lecture on astronomy and terrestrial magnetism, in honour and memory of Edmund Halley.

A DEPARTMENT of experimental biology has, says *Science*, been organised in the Rockefeller Institute. Prof. Jacques Loeb, of the University of California, has been elected head of the department.

THE total amount received and promised up to the present for the building and endowment fund of Bedford College (University of London) is 47,700*l*.; a further 12,300*l*. is required before the buildings can be begun.

THE twelfth annual dinner of the Central Technical College Old Students' Association will be held at the Trocadero Restaurant, Piccadilly, W., on Saturday, February 12. Among the guests will be Sir Philip Magnus, M.P.

IT is announced in *Science* that the late Mr. D. Ogden Mills, of New York City, bequeathed 20,000*l*. to the American Museum of Natural History, 10,000*l*. to the New York Botanical Garden, and 5000*l*. to the American Geographical Society of New York City. From the same source we learn that Mr. J. S. Huyler, of New York, has given 4000*l*. to Syracuse University.

IN the Journal of the Royal Statistical Society for January Dr. W. Garnett discusses briefly the statistics of certain scholarship examinations of the London County Council. Returns of marks were available for about 10,000 boys and 10,000 girls, in round numbers, in the subjects of arithmetic and English, and Dr. Garnett has drawn up diagrams and formed models illustrating the correlation between the marks in the two subjects for each sex. Some interesting points are brought out very clearly in quite an elementary way, the distributions of frequency in the two cases presenting some conspicuous differences as well as some general similarities. In both sexes, for example, the weaker candidates on the whole did better in English than in arithmetic, and the stronger candidates better in arithmetic than in English; but while boys gaining more than half-marks on the entire examination began to do better as a whole in arithmetic than in English, the same could only be said of the girls attaining 67 per cent. of the total marks or more, *i.e.* it was only the comparatively exceptional girls who did the better in arithmetic.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 3.—Sir Archibald Geikie, K.C.B., president, in the chair.—F. D. **Thompson**: The thyroid and parathyroid glands throughout vertebrates.—Prof. E. A. **Minchin** and J. D. **Thomson**: The transmission of *Trypanosoma lewisi* by the rat-flea (*Ceratophyllus fasciatus*). The experiments that form the subject of this communication are concerned essentially with the *method* of transmission and with questions connected therewith. Incidentally, the *fact* of transmission is confirmed. All experiments were arranged so as to eliminate the possibility of infection other than by fleas, and to separate "direct" from "cyclical" infection. When preliminary experiments showed that infection, not "direct," had taken place, further experiments were arranged to determine if fleas once infective retain infection so as to be capable of infecting a series of healthy clean rats without themselves being again exposed to infection, and at the same time to determine by direct observation and within narrow limits (1) the length of the incubation period in the flea, and (2) the length of the multiplication period in the rat. In all the experiments tame rats and fleas bred in captivity were used. The general arrangements and a detailed account of each experiment are given, but cannot be summarised briefly. A few observations on fleas dissected are recorded, and reference is made to Nuttall's experiments and conclusions. The following conclusions are drawn from the results of the experiments:—(1) The rat-flea (*Ceratophyllus fasciatus*) transmits *T. lewisi* from infected to non-infected rats. (2) Transmission takes place by the "cyclical" method. (3) Transmission by the "direct" method did not take place. (4) The incubation period in the flea has a minimum length of about six days, but may be longer. (5) The length of the multiplication period in the rat is about twelve days. (6) In the developmental cycle the establishment of the trypanosome in the flea begins with multiplication of Crithidia-like forms in the rectum. No flagellates have been found by the authors in any fleas which had not fed on infected rats.—Dr. F. **Medigreceanu** (Bucharest): The relative sizes of the organs of rats and mice bearing malignant new growths. The effects have been determined for rats and mice of the growth of transplanted carcinomata and sarcomata upon the weights of the principal organs of the body. The weights of the different organs of normal animals bear a relatively constant ratio to the total weight of the body. Weighing experiments on 200 mice and rats bearing transplanted tumours, and on four mice with spontaneous tumours, have shown (1) no disturbance of the normal ratio for the alimentary canal; (2) hypertrophy of the liver in all cases, and up to a certain point proportional to the weight of tumour; (3) hypertrophy of the heart, also in proportion to size of tumour; (4) no disturbance of normal ratio for the kidneys except in the case of a spindle-celled sarcoma, which induced hypertrophy; (5) varying ratios for the lungs. The most important result has been the discovery of an enlargement of the liver in animals bearing carcinomata and sarcomata, whether transplanted or naturally arising.—Dr. E. F. **Bashford** and Dr. B. R. G. **Russell**: Further evidence on the homogeneity of the resistance to the implantation of malignant new growths. The principal object of the paper is to adduce further evidence that the resistance which animals already bearing transplanted tumours may offer to a second transplantation is identical in nature with the resistance offered by animals without tumours, after immunisation with normal or tumour tissue of the same species. A study of the processes at the site of the second implantation shows that, concomitantly with the establishment of the tumour developing from the first inoculation, an active resistance may be induced by the absorption of tumour tissue. Then the cancer cells implanted at the second inoculation fail to elicit the supporting connective tissue and vascular scaffolding necessary to their development into a tumour, and the process of resistance is exactly analogous to that previously described, when tumour tissue is implanted into mice after a preliminary immunisation with tumour or normal tissue of the same species. The assumption of a distinct form of resistance, "atreptic immunity," is thereby rendered superfluous when tumour-bearing animals are resistant to a second inoculation. Prevailing conceptions of what constitutes immunity to cancer *sensu strictiori* are simplified further by experiments demonstrating that the active immunity to cancer which follows in rats after a preliminary inoculation of mouse cancer is not an immunity against cancer, but against the protein of a foreign species. Therefore hypotheses of cancer immunity, based upon a study of the behaviour of tumours in strange species, have at most only an indirect bearing upon the immunity to cancer of the same species. By actual observation of the processes occurring in animals immunised against the inoculation of cancer of their own species, only one form of induced resistance has been demonstrated to exist, consisting, so far as elucidated, in an inhibition of the chemiotactic powers the cancer cells normally exercise upon the connective tissue and vascular scaffolding of the host. This single explanation harmonises all the observed facts and rids the experimental study of cancer both of confusing hypotheses and of errors.—Dr. M. **Haaland**: The contrast in the reactions to the implantation of cancer after the inoculation of living and mechanically disintegrated cells. Inoculation of living tumour of normal tissue of the same species has been shown to induce resistance to subsequent

transplantation of cancer. The present paper records experiments in which cancerous or normal tissues, after mechanical disintegration at −180° or 0° C., have been inoculated into mice. The experiments show that a complete disintegration of the cells entirely robs them of their immunising properties against a subsequent transplantation of cancer. There is no difference between tumour cells and normal cells in this respect. The absence of immunising power does not seem to be a question of dose of introduced material, because relatively enormous doses of dead material do not induce any resistance. In the same way the press-fluid, obtained from tumours and normal tissues by Buchner's press, is devoid of immunising properties. The immunising property is not bound up with the protein of the cell, but depends on a different principle. Living cells are necessary to induce resistance to transplantation of cancer. It seems necessary that these cells must not only remain alive, but also even grow for a certain time; without the fulfilment of these conditions the reaction inducing active resistance is not set up. The same consequences follow autolysis, the action of heat, radium, &c., upon tumour tissue and normal tissue. The reaction which the introduction of disintegrated cells calls forth is not only quantitatively different from that induced by living tissues, but also qualitatively different. Far from inducing any increased resistance, inoculation of disintegrated cells only seems to manure the soil for a subsequent growth of tumours. The failure to elicit the reactions of immunity to the transplantation of cancer by devitalised tissues reveals an important difference from the immunity reactions obtained against bacteria and their products and foreign proteids in general, in which cases the immunising properties are independent of the vitality of the organisms or cells.

Royal Microscopical Society, January 19.—Sir E. Ray Lankester, F.R.S., president, in the chair.—The **President** gave the annual address, in the course of which he referred to such work as he thought could be carried out by the fellows with reference to the action of light upon protoplasm, the differentiation and specific effects of α, β, and γ rays emanating from radium, and the part actually played by bacteria in the processes of digestion. Medical science wanted their assistance in these investigations, which he thought could be, in some directions, better followed up by naturalists than by physiologists. Attention was also directed to an organism (*Clathrocystis aeruginosa*) found by Henfrey in 1852, in a pond in Kew Gardens, and so named by him, as worthy of their attention.

Institution of Mining and Metallurgy, January 20.—Mr. Edgar Taylor, president, in the chair.—A. L. **Simon**: Copper leaching plant in the Ural Mountains. A resumed discussion on this paper, which deals with the plant at the Gumeshevsky Copper Mine. The paper contained figures dealing with the installation and the cost of production, and a detailed description of the plant installed and the methods employed in operating it.—A. T. **French**: Some analyses of copper blast-furnace slags and determination of their melting points. The author gives tabulated results of a series of experiments, from which he deduces that slags may vary in composition to a considerable extent with very little change in the melting point.—Bede **Collingridge**: Errors due to the presence of potassium iodide in testing cyanide solutions for protective alkalinity.—A. R. **Andrews**: The detection of minute traces of gold in country rock.

Challenger Society, January 26.—Sir John Murray in the chair.—L. W. **Byrne**: A remarkable fish, apparently a new generic type, belonging to the family Stomiatidæ, taken from a trawl lowered to 700 fathoms off south-west Ireland.—James **Murray**: Life under Antarctic conditions. Sketching the difficulties of zoological research at high latitudes, the author described some unsuccessful experiments as a guide to fellow-workers. Between tide-marks no marine animals were found, the lower limit of this barren zone being the average depth of one year's ice; below that were always animals, protected by the ice, and living under singularly unvarying conditions. The land was extremely barren; the vegetation consisted of dwarfed mosses and lichens; the microscopic animals were rotifers, tardigrades, &c., which are permanently frozen through the ten months of winter, and in the summer thaw by day and freeze by night. The smaller ponds, which sometimes reached 60° F. in the summer owing to melted snow flowing over warm rocks, contained very little plankton, blue-green algæ, bacteria, and infusoria; the rotifers, &c., were found at the bottom on a plant of which nothing is known, perhaps lichenous in nature. The larger lakes were not melted through in three summers; a few animals were, however, obtained by boring. The rotifers lived under normal conditions at anything between 60° and −4° F.; they survived under experiment the temperatures of boiling water on the one hand, and on the other of a mixture of solid CO_2 and alcohol of about −172° F. While these fresh-water forms can bear such enormous temperature differences, the marine animals died if heated or cooled to a few degrees from their normal.

DUBLIN.

Royal Dublin Society, January 25.—Prof. J. A. McClelland, F.R.S., in the chair.—Prof. S. **Young**: The vapour pressures, specific volumes, heats of vaporisation, and critical constants of thirty pure substances. The determination of the vapour pressures, specific volumes, and critical constants of a number of pure liquids was commenced in 1888 in order to test the validity of the generalisations of Van der Waals regarding "corresponding" temperatures, pressures, and volumes. The data have been published at various times in several scientific journals. New or improved methods of experiment or calculation have been devised or adopted in the course of the work, and some of the data have required correction from time to time; it happens, consequently, that complete data for any one substance are not to be found in a single paper. The whole of the data, including the values obtained before 1888 by Ramsay and Young for ethyl ether, three alcohols, and acetic acid (up to 280°), have now been revised and collected, and are tabulated in this paper, which also contains a brief account of the methods of preparation and purification of the thirty liquids, and a description of the apparatus and methods employed for the determination of the physical constants. The heats of vaporisation have been calculated by Dr. J. E. Mills by means of the Clapeyron-Clausius formula, and he has very kindly supplied the data. The author is also indebted to Dr. Mills for some of the other calculated data.—Prof. J. **Wilson**: The inheritance of coat colour in horses. Having stated that Mr. C. C. Hurst had already shown (Proc. Royal Society, vol. lxxvii., 1906) chestnut to be recessive to bay and brown—the two taken as one—the author proceeded to show where some other colours fit in. Much uncertainty exists among breeders in distinguishing bay from brown, and dark brown from black. Allowing for this, the five main colours form a series in which those towards one end are recessive to all towards the other. Chestnut is recessive to black, bay, brown, and grey; black to bay, brown, and grey; bay to brown (probably) and grey; and brown to grey. The position of two other colours can be fixed only approximately, for want of sufficient data. Dun is dominant to all to the left of brown, that is, to chestnut, black, bay, and brown. Roan is also dominant to chestnut, black, bay, and brown, and perhaps also to dun and grey; but it has this peculiarity, that the roan does not blot out the other colours, but the white hairs of the roan mingle with coats of the other colours. This implies that there are chestnut roans, bay roans, and so on.

PARIS.

Academy of Sciences, January 24.—M. Émile Picard in the chair.—Ch. **André**: The Johannesburg comet. This was seen by M. Guillaume on January 21. It was very brilliant, its nucleus having a brightness a little greater than that of Arcturus.—Alfred **Grandidier**: The international map of the earth on the scale of 1/1,000,000. At the Geographical Congress held at Vienna in 1891 Prof. Penck suggested the production of a uniform map of the earth on the scale of 1 in 1,000,000, and an account is given in the present paper of the progress that has been made with this map, and the difficulties owing to lack of uniformity in the conventional signs employed. The total cost of this work is estimated at 5,000,000

francs.—E. **Esclangon**: Observation of Drake's comet. A description of the appearance of the Johannesburg comet on January 22 at Bordeaux.—H. **Bourget**: Observations of Drake's comet (1910*a*) made at the Observatory of Marseilles. Positions of the comet are given for January 19, 20, and 21.—Remarks by M. **Baillaud** on this paper, giving an account of other dates and places in France where observations of the comet had been made.—E. **Maubant**: The elements of Tempel's comet.—J. **Le Roux**: The conditions of maximum or minimum of an analytical function with an infinity of variables.—D. **Mirimanoff**: The last theorem of Fermat.—M. **Galbrun**: The representation of the solutions of a linear equation of finite differences for large values of the variable.—Paul **Helbronner**: The connections of the meridian chain of Savoy with the fundamental Italian and Swiss triangulation.—Edm. **van Aubel**: Pulfrich's relation between the volume contraction and the refractive power of mixed liquids. A discussion of the experimental data of R. Wintgen on the density and refractive indices of solutions of salts and acids from the point of view of the formula of Pulfrich.—P. **Vaillant**: The laws of evaporation. In the apparatus devised by the author the quantity of liquid evaporated per second is independent of the nature of the liquid, depending only on the area of the opening through which the vapour of the liquid escapes. An examination of numerous liquids led to the relation $q=aMF^{\frac{1}{4}}$, in which q is the rate of evaporation per second, F the maximum vapour pressures of the liquids at the temperature of the experiments (20° C.), and a an approximate constant. To fall into line with the other liquids, it is necessary to attribute the molecular weight $(H_2O)_3$ to water.—C. **Féry**: Prisms with curved faces applicable to spectroscopy. The object of the arrangement described and figured is to reduce the spectroscope to the slit, prism and ocular, or photographic plate. The arrangement possesses advantages in stellar spectroscopy.—Gaston **Gaillard**: Observation of a dissymmetry in the velocity of solution of crystals of sugar along the different faces.—J. **Chaudier** and Ed. **Chauvenet**: The radio-activity of the halogen and oxyhalogen compounds of thorium. The radio-activity of these compounds of thorium for quantities of substance containing more than 10 milligrams of thorium varies with the nature of the associated elements. The intensity of the radiation diminishes as the atomic weight of these elements increases. The curves of radio-activity of the various compounds of thorium tend towards that of thorium as the quantities of material are reduced.—Pierre **Camboulives**: The action of carbon tetrachloride vapours upon some minerals. Many natural oxides are attacked by the vapours of carbon tetrachloride as easily as the oxides prepared in the laboratory. Corundum offers an exception, being attacked only to the extent of 11 or 12 per cent., whilst alumina arising from the calcination of ammonia alum is completely transformed. Wolfram is so readily acted upon that the process forms the basis of a good analytical method. Silicates are the more readily acted upon the poorer they are in silica. Numerous examples are given.—F. **Kerforne**: An auriferous lode situated at Beslé (Loire-Inférieure). An account of some ancient gold workings.—Ch. **Moureu** and J. Ch. **Bongrand**: Carbon subnitride, C_4N_2. This substance, which is the second definite compound known of carbon and nitrogen, is formed by the removal of water from butine diamide, $NH_2—CO—C\equiv C—CO—NH_2$, and hence has the constitution $N\equiv C—C\equiv C—C\equiv N$, or dicyan-acetylene. It forms fine white needles, melting at 21° C. and boiling at 76° C. under a pressure of 753 mm. Its vapour is violently irritating, and catches fire in the air at a temperature of about 130° C. Particulars are given of the analysis, determination of the vapour density and molecular refraction, and further work is being carried out on its physical and chemical properties.—Maurice **Lombard**: The chemical and biological effects of the ultra-violet rays. The formation of nitrites in these experiments is definitely proved.—Gabriel **Bertrand** and M. **Holderer**: New observations on the individuality of cellase. Details of experiments proving that cellase is a specific diastase. It is found, more or less mixed with other species of diastases, in barley, almonds, the mycelium of *Aspergillus niger*, &c.—M. **Marage**: The photography of the voice in practical medicine. The photography of the vibrations of the larynx shows very clearly the state of the voice at the beginning and end of a course of treatment. Its use as an aid to diagnosis is being further examined.—A. **Rosenstiehl**: The consequences of Young's hypothesis. The sensation of binary white.—P. **Hachet-Souplet**: The association of sensations in animals. The law of recurrence.—A. **Lécaillon**: The structure and signification of the membrane which envelops the vitelline sphere in the egg of birds.—Léon W. **Collet**: The presence of fossil-bearing Cenomanian in the limestone Alps of Haute Savoie.—E. **de Martonne**: The genesis of Alpine glacial forms.—Kr. **Birkeland**: The magnetic deviability of the corpuscular radiations proceeding from the sun.—Alfred **Angot**: The earthquake of January 22, 1910. The seismograph of the Parc Saint-Maur Observatory recorded a distant earthquake of great violence on January 22. The examination of the seismograms showed that the epicentre was about 3000 kilometres to the south-east. Observations from other stations are required to fix the direction with certainty.—Bernard **Brunhes**: The record of an earthquake on January 22, 1910, at the Puy de Dôme Observatory. The seismograms indicated 3000 to 3500 kilometres as the distance of the epicentre.

January 31.—M. Émile Picard in the chair.—H. **Deslandres**, A. **Bernard**, and L. **d'Azambuja**: First observations of Drake's comet at the Observatory of Meudon. Spectroscopic observations were possible on January 22, 24, 25, 27, 29, and 30. Changes in the comet's spectrum were observed during these days. At first the sodium line was the most marked, together with a faint hydrocarbon band. The strength of the sodium line diminished from day to day, the hydrocarbon bands increasing in clearness and the bands of cyanogen appearing. On the last two days the sodium line became invisible, but the spectra of the hydrocarbons and cyanogen became complete and intense. The spectrum of the hydrocarbons even appeared to extend a considerable distance into the tail. These changes are exactly those undergone by the large comet of 1882.—B. **Baillaud**: The photographic map of the sky. Presentation of the proceedings of the last congress.—A. **Muntz**: The mud carried away by the waters of the Seine. Determination of the amount of mud in suspension in the Seine shows that the total amount carried away by the river between January 25 and 29 varied from 18,800 to 11,000 tons per day. This is not regarded as causing a serious loss of fertility in the soil from which this mud has been removed.—Edmond **Perrin** gave an account of the state of the museum after the floods.—Henri **Douvillé**: The discovery of the marine Trias at Madagascar.—M. **Giacobini**: Observations of the comet 1910*a* made at the Observatory of Paris with the 38-cm. equatorial. Positions are given for January 22, 24, 25, 27, 29, and 30.—P. **Chofardet**: Observations of the Johannesburg comet, 1910*a*, made at the Observatory of Besançon with the bent equatorial. Positions given for January 27 and 29.—Ch. **Lallemand**: A systematic error in the determination of the mean level of the sea by the medimaremeter. In this instrument, consisting of a tube closed at the lower end by a porous pot, the water-level oscillates round the mean sea-level. The systematic error now discovered is due to the removal of a few drops of water each time a tube is introduced to take the level. On this account the readings of the instrument are 1·5 mm. too low.—M. **Biquard**: A method of measuring the coefficient of thermal conductivity of badly conducting bodies. In the instrument described the heat is transmitted regularly through isothermal surfaces, the amount being measured by the rate of production of water from ice.—G. **Thovert**: Diffusion and the kinetic theory of solutions. An extension of the method previously described to solutions in methyl alcohol.—Ch. **Fabry**: The intrinsic brightness of the starry sky.—J. H. **Russenberger**: The absorption of liquids by porous substances.—F. **Laporte** and P. **de la Gorce**: Researches on the electrochemical equivalent of silver carried out at the Central Electrical Laboratory. Successive improvements introduced into the purification of the silver nitrate used in these experiments have resulted in the removal of the difference of 0·0004 originally found between the determinations of the National Physical Laboratory and those made

at the Central Laboratory in Paris. The general mean of the results is 1·11829 mgr. silver per coulomb.—G. **Fouquet**: The spontaneous crystallisation of sugar.—M. **Oberreit**: The synthesis of 5 : 7 : 5′ : 7′-tetrachlorindigo.—P. **Yvon**: Aniline emetic. This is prepared by the interaction of oxide of antimony and the acid tartrate of aniline. Figures are given for its density, rotatory power, solubility, and crystalline form.—Maurice **Holderer**: The influence of the reaction of the medium on the filtration of some malt diastases.—H. **Agulhon**: The use of boron as a catalytic manure. From the experiments described it is concluded that boron is an element of use to the higher plants. The addition of a small quantity of boron (in the form of boric acid) to a culture medium or to a natural soil leads to a sensible increase in the weight of dry material formed.—André **Brochet**: The radio-activity of some springs in the Vosges.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 10.

ROYAL SOCIETY, at 4.30.—Some Phenomena of Magnetic Disturbances at Kew: Dr. C. Chree, F.R.S.—On a Novel Phenomenon in the Diurnal Inequality of Terrestrial Magnetism at Certain Stations: R. B. Sangster.—The Absorption Spectra of Vapours of the Alkali Metals: Prof. P. V. Bevan.—On the Shapes of the Isogeotherms under Mountain Ranges in Radio-active Districts: Prof. C. H. Lees, F.R.S.—On the Propagation of a Disturbance in a Fluid under Gravity: F. B. Pidduck.—On the Flow of Water through Pipes and Passages having Converging or Diverging Boundaries: Dr. A. H. Gibson.—The Effect of Pressure upon Arc Spectra: Titanium: R. Rossi.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Losses off Transmission Lines due to Brush Discharge, with Special Reference to the Case of Direct Currents: E. A. Watson.

MATHEMATICAL SOCIETY, at 5.30.—A Note on Double-sixers of Lines: H. W. Richmond.—On the Diffraction of a Solitary Wave: Prof. H. Lamb.—Notes on Various Points in the Theory of Functions: Dr. H. F. Baker.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

FRIDAY, FEBRUARY 11.

ROYAL INSTITUTION, at 9.—Electrical and other Properties of Sand: C. E. S. Phillips.

PHYSICAL SOCIETY, at 8.—Annual General Meeting. President's Address.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

MALACOLOGICAL SOCIETY, at 8.—Unio, Margaritana, Pseudanodonta, and their Occurrence in the Thames Valley: Fritz Haas.—(1) Pleistocene, Holocene, and recent Non-marine Mollusca from Mallorca; (2) Marine Mollusca from Alcudia, Mallorca: Rev. R. Ashington Bullen.—Description of a New Species of Vivipara from New Guinea: H. B. Preston.—Description of a New Species of Unio from the English Wealden Formation: R. Bullen Newton.

SATURDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

MONDAY, FEBRUARY 14.

ROYAL SOCIETY OF ARTS, at 8.—The Petrol Motor: Prof. W. Watson, F.R.S.

TUESDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 3.—The Emotions and their Expression: Prof. F. W. Mott, F.R.S.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Glare, its Causes and Effects: Dr. J. H. Parsons.

ZOOLOGICAL SOCIETY, at 8.30.—Kinematograph Demonstration (Studies in the Society's Gardens): Charles Urban.—Additions to our Knowledge of the Fossorial Wasps of Australia: R. E. Turner.—Descriptions of New Lycænidæ and Hesperiidæ from Tropical West Africa: H. H. Druce.—On certain Subcutaneous Fat-bodies in Toads of the Genus Bufo: C. L. Boulenger.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Notes on the Sheffield Water-supply and Statistics relating thereto: L. S. M. Marsh.—Statistical and Experimental Data on Filtration: W. R. Baldwin-Wiseman.

ROYAL STATISTICAL SOCIETY, at 5.

WEDNESDAY, FEBRUARY 16.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Notes on *Dendrobrachia fallax*, Brook, a Rare and Divergent Antipatharian: Prof. J. Arthur Thomson.—(1) On the Measurement of the First Nine Groups of Grayson's Finest Twelve-band Plate; (2) On the Measurement of the Diameter of the Flagella of the Cholera Bacillus prepared by Löffler's Method: A. A. C. Eliot Merlin.

ROYAL SOCIETY OF ARTS, at 8.—The Lifeboat and its Work: Sir John C. Lamb, C.B., C.M.G.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1909: E. Mawley.—The North Atlantic Anticyclone. Tracks of the Centres of High Areas 1882–3: Colonel H. E. Rawson, C.B.

THURSDAY, FEBRUARY 17.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Phosphorescenc produced by α and β Rays: E. Marsden.—Theory of the Luminosity produced in Certain Substances by α Rays: Prof. E. Rutherford, F.R.S.—(1 The Scattering of the α Particles by Matter; (2) The Ionisation produced by an α Particle. Part II.: Connection between Ionisation and Absorption: Dr. H. Geiger.—The Influence of Pressure on the Boiling Points of Metals: H. C. Greenwood.—On the Viscosities of the Gases of the Argon Group: A. O. Rankine.

ROYAL INSTITUTION, at 3.—Illumination, Natural and Artificial (Experimentally Illustrated): Prof. S. P. Thompson, F.R.S.

LINNEAN SOCIETY, at 8.—The Plum-moths of the Seychelles Expedition: T. B. Fletcher, R.N.—Die von Herrn Hugh Scott, auf den Seychellen gesammelten Embiidinen, Coniopterygiden und Hemerobiideen: Dr. G. Enderlein.—Die Termiten der Seychellen-Region: Dr. Nils Hohngreen.—On the Land and Amphibious Decapoda of Aldabra: L. A. Borradaile.

ROYAL SOCIETY OF ARTS, at 4.30.—The Bombay Housing Question: G. O. W. Dunn.

INSTITUTION OF MINING AND METALLURGY, at 8.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Head Hunters in Assam: T. C. Hodson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Clocks: F. Hope-Jones.

FRIDAY, FEBRUARY 18.

ROYAL INSTITUTION, at 9.—Halley's Comet: Prof. H. H. Turner, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—*Further discussion*: Ninth Report to the Alloys Research Committee: On the Properties of some Alloys of Copper, Aluminium, and Manganese (with an Appendix on the Corrosion of Alloys of Copper and Aluminium when Exposed to the Sea): Dr. W. Rosenhain and F. C. A. H. Lantsberry.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Irrigation Works: Sir R. Hanbury Brown, K.C.M.G.

SATURDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

CONTENTS.