THURSDAY, MARCH 7, 1907.

SIR CHARLES BUNBURY.

The Life of Sir Charles J. F. Bunbury, Bart. With an Introductory Note by Sir Joseph Hooker, C.B., G.C.S.I. Edited by his Sister-in-law, Mrs. Henry Lyell. With portraits and illustrations. 2 vols. Vol. i., pp. x+371; vol. ii., pp. v+411. (London: John Murray, 1906.) Price 30*s.* net.

SIR CHARLES BUNBURY was a naturalist of the old school; his chief interest, so far as science was concerned, was in botany and geology, his published papers being almost confined to palæobotany. He was an industrious diarist and letter writer, and having travelled extensively in Europe, South America, and Africa, he saw much worthy of record. He had an inexhaustible interest in all that is best worth seeing and knowing; interesting people, and all the aspects of nature and art, were industriously sought out and described. But it is on the lovable personality revealed in his letters and diaries that the attractiveness of the book in large measure depends. He seems to have been the most patient and even-tempered of travellers; his diaries hardly contain a querulous word. He may claim the sundial's motto, "Horas non numero nisi serenas." He was fond of summing up the characters of those whom he met, and these notes, without being unduly laudatory, are free from any trace of ill-nature. These acute and genial sketches are, to our thinking, the best part of the book. The picture which he unconsciously gives of himself is that of a man of breeding and unpretentious distinction, a man one would imagine of quiet dignity, with a simple and direct nature and an affectionate heart. He observed well and described things pleasantly; his only fault as a correspondent seems to have been his lack of humour, but of this we need not complain, for there are no flat remarks intended for witticisms, nor is there anything that rings false or "smart" in his quiet, easy style.

The present volumes are an abbreviation of a fuller version privately printed some years ago; unfortunately, the process of compression has not been sufficiently thorough. Much as we respect and like Sir Charles, we do not want a minute itinerary of his boyish travels, though we might have liked a paragraph showing at how early an age he was alive to the beauty and interest of the world. In the letters of his later life we find the same want of compression by the editor. Most of us are easily satiated with descriptive letters from abroad, and there is in these volumes a good deal of this class of writing which might well have been omitted. In other respects the editing of the book shows some conspicuous merits, especially in such details as biographers are apt to neglect. The volumes are well printed, they are pleasantly light in the hand, and the pages are cut. The date of Sir Charles's birth is given in the proper place, viz., the first line of the book, and lastly there is a full and carefully compiled index.

A large number of letters are addressed to his father and to his stepmother. His strong affection and respect for his father are expressed in a touching letter written in his forty-seventh year (ii., 87). After his marriage to Miss Horner, his father-in-law, Leonard Horner, his sisters-in-law, and his brother-in-law, Charles Lyell, all became regular correspondents.

Lyell seems to have consulted him on botanical matters and to have written fully to him on geological questions suggested by his own researches. We thus get some insight into Lyell's point of view when he was making up his mind about the "Origin of Species" and preparing for his magnanimous change of front with regard to evolution. On this point Bunbury quotes (ii., 227) Sir Joseph Hooker's weighty opinion that Lyell's

"complete conversion and open avowal of his conversion to the Darwinian theory, at his time of life, and with his established celebrity, and after he had elaborately argued against the same theory in many editions of his great work, is a phenomenon almost unexampled in science."

Sir Joseph was an old friend of Sir Charles Bunbury, and botanists will read with pleasure his tribute to Hooker's genius and character (ii., 156, 226). Kingsley was another friend, and Sir Charles often records his delight in Kingsley's versatile talk and vigorous personality. Kingsley must sometimes have been a little too bloodthirsty for Sir Charles. Still, he quotes (ii., 266) without disapproval Kingsley's rejoicings over the victory of the Germans in the Franco-Prussian war, in which he wishes that Bunsen had been alive to see "the battle of Armageddon. . . . fought, not as he feared, on German but on French soil."

In 1855 he paid a visit to Germany and made friends with many distinguished men. Here he saw Ehrenberg, Encke, Lepsius, Jacob Grimm, "with his fine poetical head," and Ranke with his "expression of shrewdness almost of cunning rather than power." He gives (ii., 68) some account of his meetings with Humboldt, of whom he writes:—

"He is a delightful old man with all the courtesy and polish of an old Frenchman, and with a vivacity and activity of mind that are perfectly wonderful in a man of eighty-five. He is a little bent, but still hale and fresh looking. . . . He has all the volubility of speech that I have so often heard of, but you may well suppose I was right willing to listen and did not wish to say much. . . . What is particularly striking is his eager interest in all that is going on in all the world of science, his acquaintance with all the newest researches, and his constant desire for fresh information."

Sir Charles Bunbury's letters, and especially his diaries, are of permanent interest as giving contemporary feeling about celebrated books and discoveries. Thus a number of letters tell of the impression produced by the "Origin of Species." There is a curious passage (ii., 217) where he quotes with approval Lyell's surprise in 1867 at Darwin's avoidance of "any reference to a Designer." It would seem that neither he nor Lyell quite understood the Darwinian point of view.

Among the numerous points interesting to botanists may be mentioned Lady Lyell's account (ii., 130) of

a visit to Robert Brown just before his death. "He talked quite calmly and cheerfully, recalling the days when he had sat in the same room in company with Banks, Solander and Dryander, and telling her *where* each of them used habitually to sit." There is, too, a striking letter (ii., 53), written apparently before Hofmeister's discoveries had reached him, in which Sir Charles argues for the connection of the Exogens with the Cryptogams by means of the Conifers, and (ii., 56) for the common nature of spores and pollen-grains.

In 1866 he noted down (ii., 214) the influences which he believed to have guided his development. Four books are mentioned:—(1) Plutarch's "Lives,"[1] which he valued as teaching magnanimity; (2) Hallam's "Constitutional History"; (3) Lyell's "Principles"; (4) Lindley's "Natural System of Botany." The two men of whose influence he speaks are Sir William Napier, "a great genius and a noble though singular character," and Sir George Napier, with whom he stayed at the Cape, "one of the most interesting and most profitable years of my life."

He died in 1886, aged seventy-seven; few men can have lived a long life more kindly and wisely.

F. D.

HAILEYBURY NATURAL HISTORY LECTURES.

Life and Evolution. By F. W. Headley. Pp. xvi+277; illustrated. (London: Duckworth and Co., 1906.) Price 8*s.* net.

THIS well-illustrated and attractive volume, according to the preface, is the final form assumed by a series of lectures delivered before the members of the Haileybury Natural Science Society, the great majority of whom are scholars at the famous Hertfordshire school. From the very nature of the case it aims, therefore, at being intelligible to readers unprovided with a large store of scientific knowledge of their own. It will be equally self-evident that it does not lay claim to be a new gospel. Rather is it an attempt, if we rightly understand its purport, to place before that section of the public which possesses a thirst for scientific knowledge a clear idea of the general structure and mutual relationships of the leading groups of animals and their adaptations to various modes of life, to show in what respects animals resemble and differ from plants, and how to distinguish between these two great primary groups of organisms, and, finally, to attempt a solution of the riddle of the evolution of organic life and of the human intellect.

The task is, of course, a heavy one, and one bristling with difficulties, but if we take into consideration the class to whom he is specially appealing and the amount of space available, we consider that Mr. Headley has come well out of the ordeal. It is not to be supposed that all his opinions will be accepted by each one of his readers, but in most cases, at any rate, he has expressed himself on debatable points with fairness and moderation, and he does not assume the character of an *ex parte* advocate. The great test of a work of this nature is whether it suits the taste of the class of readers for whom it is intended, and in the few instances in which we have been able to put this test to the proof the verdict is favourable. The style and mode of expression are almost everywhere good and interesting, and in all cases free from unnecessary technicalities, while the prevailing tone is that of a thoughtful lover of nature in all its forms. The illustrations speak for themselves.

Passing over the first chapter, which is devoted to the relationships and dissimilarities of plants and animals, attention may be directed to certain speculations in the second chapter—on the sea and its inhabitants—with respect to sedentary animals, which are regarded as having reverted to a semi-plant-like mode of existence. It is pointed out that such sedentary animals are much more numerous in the shore-waters than elsewhere. This the author believes is due to the movements of tides and currents, which bring ample food supplies without the need of any active exertion on the part of the recipients. How comes it, then, that almost all classes of sedentary animals are also well represented in the ocean-abysses, where no such free distribution of supplies takes place? The answer to the puzzle is, in the author's opinion, to be found in the fact that many of the abyssal organisms are stalked, and that they obtain nutriment by possessing the power of bending these stalks, and thus being endowed to a certain limited degree with motion. The proof that this power exists has, however, in many cases yet to be demonstrated. With regard to polyzoans and corals, the suggestion is that they may be fed by a rain of organic débris descending from the surface-waters.

Gills and lungs form the subject of the third chapter, in which reference is made to the occurrence in that hobgoblin-like fish, the Malay Periophthalmus, of an accessory breathing organ in the tail, by the aid of which the creature is enabled to spend much of its time out of water. The various phases of the respiratory function are shown to form an excellent instance of evolution, diffused breathing by the whole surface of the body giving place first of all to localised respiration by means of gills, and these again yielding to lung-breathing in the more active terrestrial forms, some of which have reverted, however, to the water, the ancestral home of all animal life.

Reptiles and their kin and the evolution of the reptile into the bird are discussed at length in the next two chapters. In seeking to find an explanation for the tendency to union between bones originally distinct, which forms such a marked feature of the avian skeleton, Mr. Headley suggests that the fusion of the tarsus with the long bones of the lower part of the legs has taken place in order to strengthen the automatic, pulley-like action of tendons which enables a bird to remain securely perched while asleep. The suggestion seems well founded. Later on we are told how the peculiar, saddle-like articulations of the cervical vertebræ enable birds to bend their necks in

[1] Fortunately for himself he read it in Langhorne's translation, so that he could peruse and re-peruse it so as almost to know it by heart. A boy of thirteen would never have got the essential good of the book if he had known it only in the original.

that supple manner which attains its maximum development in the darter, or "snake-bird." Having so carefully described this feature, it is a little surprising that the author has permitted his artist to reproduce in the plate facing p. 80 the old conventional restoration of a plesiosaur with its neck bent into a swan-like curve, when, from the form of the articular surfaces of the vertebræ, it is manifestly impossible that such a flexure could have been assumed. The power of neck-flexure is evidently a specialised feature due to a long process of osteological evolution.

A statement on p. 252 is another thing which the author on reflection would probably like to amend. It is there stated that the chamæleon keeps its tongue "rolled up (the only way of pushing its monstrous length in his mouth)." This is scarcely in accord with Dr. Gadow's explanation of the mechanism. "The elastic part of the tongue," writes that authority, "is, so to speak, telescoped over the style-shaped copula, and the whole apparatus is kept in a contracted state like a spring in a tube."

Exception may likewise be taken to certain statements in connection with the fossil vertebrates of Patagonia on p. 222. For instance, the author definitely states that the "strange hoofed animals have their nearest allies in the hyrax," whereas it is only a suggestion that one group of these ungulates might have affinity with the hyraxes, and this is discredited by Dr. Andrews. Again, although it may be permissible to allude to the megatherium as the megalothere, it is certainly wrong to style it the "megalothera"; while to write that the seriema (not siriema) had a skull as large as that of a horse displays great want of knowledge.

The author has much of interest to say with regard to the nature of feathers and the flight of birds, which is one of his favourite subjects, while in the final three chapters he takes into consideration the minds of men and animals, the struggle for existence, and natural selection, including under the later heading the evolutionary theories of Darwin, de Vries, Mendel, and others. To review these chapters, interesting as they are, is, however, unfortunately impossible within our allotted space. We must accordingly bring this notice to a somewhat abrupt close by reiterating our opinion that the author has succeeded in producing a very readable and thoughtful book, which deserves a large *clientèle* of readers.

R. L.

MEDICAL INSPECTION OF SCHOOL CHILDREN.

The Health of the School Child. By Dr. W. Leslie Mackenzie. Pp. vi+120. (London: Methuen and Co., n.d.) Price 2*s.* 6*d.*

"IN the Education Bill now [last October] before Parliament, a clause has been inserted to make medical inspection obligatory in all English State-aided schools" (p. vi.) "In their Scottish Education Bill of last year (1904) the Government included provision for the medical examination and supervision of school-children. . . . The examination of school-children is, therefore, no longer a question of doubtful politics. . . . It has now all but passed into the region of administration. . . ." (p. 53).

This stage having at length been reached in our own country, we can follow Dr. Mackenzie with all the more readiness and interest to Wiesbaden, and listen to his account of the medical inspection of schools as he found it carried on there. In this town, he tells us, there are some 10,000 elementary school-children who are under the supervision of seven specially appointed school doctors, each receiving an average stipend of about 40*l.* per annum. The school doctor has to examine every child when it enters and leaves the school, and during its third, fifth, and eighth school years. He rejects those who are unfit for school attendance, he notifies defects to the parents, and he may give them advice as to treatment. He visits the school for about an hour every fortnight in order to deal with current cases of ill-health.

Dr. Mackenzie describes how, on the occasion of one of his visits, he found the doctor examining thirty-five newly-entered children, observing the state of their nose, eyes, skin, bones, joints, spine, heart, lungs, and the presence or absence of hernia, measuring the chest, testing their speech, eyesight and hearing, and recording these various conditions on specially scheduled cards. The doctor "seemed to be readily welcomed by the teachers, and was sometimes waited for by the parents, who wished to get his personal opinion of the children" (p. 10)—an appreciation arguing diligent obedience to the two following regulations, which are issued in all Teutonic gravity to the school doctors. "In the filling in of the particular form (notifying ill-health to the parent) all harshness and rudeness of expression are to be avoided" (p. 94). "In reference to the teaching, the doctor is warned that he should tactfully avoid all exposure of a teacher before his class" (p. 93)!

But the current of our admiration slackens when Dr. Mackenzie tells us that the inspection of the thirty-five new children in the above manner occupied only an hour and a half. It is difficult to believe that an examination of so wide a scope thus rapidly conducted can be of great value. Practice, of course, brings speed, but not even the greatest expert could satisfactorily make such a detailed study of school-children, giving an average of less than three minutes to each individual. Eyesight and hearing alone could hardly be tested in that interval.

"When one reflects that from twenty to thirty per cent. of our school-children in Scotland suffer from eye defects needing correction or attention" (p. 81), we may reasonably doubt the policy of introducing into the United Kingdom this German system of school inspection without modification.

The German system should surely be modified in the direction of lightening the doctor's burden. Inasmuch as "Dr. Kerr, of the London County Council, found that with a little care the teachers were able to find out almost all the children that suffered from eye defects" (p. 82), there is no reason why teachers should not be trained and required to test periodically

the vision and hearing of every child under their care. It is manifest that "the more the teacher knows about the health of the children entrusted to him, the simpler and easier will the work of medical inspection become" (p. 61). We therefore suggest cooperation between the teacher and doctor in the manner indicated.

The above quotations and remarks will amply serve to show the general interest of Dr. Mackenzie's little volume. It is true that three of the four chapters, entitled "The Hygiene of School Life," "Normal Growth in the School Ages," "Medical Examination and Supervision of Schools and School Children," contain much that has been written of, if perhaps less attractively, before. But the remaining chapter, "The School Doctor in Germany," and the appendices on "Re-vaccination of School Children in Germany" and on "The Plan of a German Elementary School," traverse comparatively unfamiliar ground, and well deserve the attention of the serious student.

C. S. M.

ELEMENTARY PHYSICS.

(1) *Exercises in Physics for the Use of Schools.* By J. H. Leonard and W. H. Salmon. Pp. vii+116. (London: J. Murray, 1906.) Price 1*s*.

(2) *Introductory Practical Physics.* By W. F. Barrett and W. Brown. New edition. Part i. Pp. xii+284. (London: Simpkin, Marshall and Co., Ltd.; Dublin: Sealy, Bryers and Walker.)

(3) *Heat, Light, and Sound: an Introductory Course of Practical Exercises.* By J. R. Ashworth. Pp. xv+120. (London: Whittaker and Co., 1906.) Price 2*s*. net.

(4) *Light for Intermediate Students.* By F. E. Rees. Pp. viii+166. (London: J. M. Dent and Co., 1906.)

(5) *The Tutorial Physics.* Vol. iii. *A Text-book of Light.* By Dr. R. Wallace Stewart. Fourth edition. Revised by J. Satterley. Pp. viii+346. (Cambridge: University Tutorial Press, Ltd., 1906.) Price 4*s*. 6*d*.

(6) *The Elements of Physics.* By S. E. Coleman. Pp. vii+439. (Boston: D. C. Heath and Co., 1906.) Price 3*s*. 6*d*.

(7) *Physics—Theoretical and Descriptive.* By H. C. Cheston, J. S. Gibson, and C. E. Timmerman. Pp. xvi+373. (Boston: D. C. Heath and Co., 1906.) Price 3*s*. 6*d*.

(8) *A First-year Course of Practical Magnetism and Electricity.* By Dr. P. E. Shaw. Pp. vii+66. (London: *Electrician* Printing and Publishing Co., Ltd., n.d.) Price 2*s*. 6*d*. net.

(1) A GRADUATED collection of simple arithmetical exercises in physics, including mensuration, mechanics and hydrostatics, which will prove useful for school classes. No examples are given on heat conductivity. Answers are furnished.

(2) This text-book will be found useful for both elementary and advanced students. The volume deals with general physics, and the experiments described cover a wide range. They include measurements of length, area, volume, time, and mass; experiments on fluid pressure; measurement of force; mechanical properties of solids and liquids; molecular properties of fluids. The method of carrying out each experiment is briefly described, and an example is worked out in illustration. Theoretical considerations are generally avoided, but many references are given to text-books or original sources, so that a student may obtain further information if he desires. With such a wide range of subjects in so small a book, the treatment is often scant in places, *e.g.* the planimeter is dismissed without any mention of the datum circle. On p. 147 it is not at all clear how the mean value of Poisson's ratio is obtained from the recorded data. In the experimental proof of Boyle's law, one is told first to adjust the mercury to the same level in each limb of the tube; this very tedious operation is hardly necessary. There is little meaning in the statement on p. 123 that the value of g determined by simple pendulum experiments is 0·12 per cent. greater than the true value.

(3) Dr. Ashworth's book comprises a course of laboratory experiments in heat, light, and sound for first-year students. The plan adopted with each exercise is to give a list of the apparatus necessary, a short description of the method of carrying out the experiment, and a typical example to show how results are to be recorded in the note-book. It is to be regretted that these examples are not always well chosen. In the experiments on calorimetry, the temperature changes produced are often too small for measurement with any degree of accuracy by elementary students. There is little to be gained by comparing 78·9, the determined value of the latent heat of water, with an accepted value of 79·3 when the temperature change in the calorimeter is 5°·5 C. The example on the determination of the refractive index of glass, by tracing the ray through a slab, is bad. Measured lengths of perpendiculars from the incident and refracted rays on the normal vary from 0·5 cm. to 1·0 cm., and the mean value of the refractive index is stated as 1·52. A further illustration is afforded in an experiment to investigate the relation between the time of vibration of a spring of constant length with varying load. Recorded periods are 0·54 and 0·64 second; their ratio 1·185. The ratio of the square roots of the corresponding masses is given as 1·183, and the error is stated as 0·2 per cent.

(4) This little book is intended by the author for students with some previous knowledge of experimental optics. The subject-matter covered, however, is very elementary, and the treatment is rather formal and meagre. Two chapters, devoted to intrinsic brightness and photometry, are very clear, and will serve as a useful introduction to more advanced works on photometry. Two excellent photographs of models taken with a pin-hole camera are furnished by Mr. Andrew Stephenson, and a graphical proof of the minimum deviation position is due to him. Lens and mirror formulæ are derived in the ordinary way. The curvature method for obtaining these formulæ is not introduced, and no mention is made of the term "power of a lens." The book is attractive in appearance, and many students will probably find it useful for revision purposes.

(5) The revised and enlarged edition of Stewart's "Light" contains a very full treatment of the elements of geometrical optics. The inclusion of a large number of simple practical experiments enhances the value of the volume considerably. Dispersion and spectrum analysis receive a fuller treatment than in the previous edition. The book will prove distinctly useful.

(6) An introductory text-book of theoretical physics, the subject-matter having been selected with reference primarily to its value as part of a general education. Problems are interspersed at frequent intervals, and some of these are well designed to make a student think. A great deal of care has been exercised in the compilation of this book.

(7) This text-book of physics, which includes mechanics, heat, light and sound, electricity and magnetism, has been written for pupils in the American high schools. The statements are concise, and the diagrams clear. It is thoroughly up to date, and will prove a very suitable introductory course, especially if, as the author intends, laboratory work is carried out at the same time.

(8) The author in his preface intends this book for that class of technical students who are ignorant of the rudiments of algebra, geometry, trigonometry, and mechanics. The book includes three introductory exercises, six exercises on magnetism, and twenty-six on current electricity and its applications. There is very little in the method of treatment to distinguish it from other elementary text-books of practical electricity and magnetism. It is doubtful whether a student will draw a correct idea as to what determines a spark in air from the statement on p. 30:—

"Join 1 ft. of copper wire to one terminal (of a Leclanche cell) and brush the other terminal with the free end of the wire. No spark is seen because the E.M.F. of the cell is only about 1.3 volts and the resistance is high, so the maximum current is very small."

And on p. 32 (repetition with storage cell):—

"The E.M.F. is about 2 volts, and the resistance is very small, so the maximum current is large. Sparking is abundantly shown."

No thoughtful teacher would instruct a student to count the number of vibrations a magnet makes in a given time, as in the experiment described on p. 13. Elementary electrostatic experiments are omitted, as these are thought to be relatively unimportant and difficult. There is little to recommend this book when compared with some excellent introductions which have appeared in recent years.

OUR BOOK SHELF.

Animal Artizans and other Studies of Birds and Beasts. By C. J. Cornish. Pp. xxxiv+274; illustrated. (London: Longmans, Green and Co., 1907.) Price 6*s.* 6*d.* net.

THE late Mr. Cornish was a constant contributor of articles bearing upon natural history matters to the columns of the *Spectator* and *Country Life*, and the present volume, which is edited by his widow, consists mainly of a reprint of articles from those journals, with such modifications as the course of time has rendered necessary or advisable. In some cases the articles had been revised with a view to publication in book form by Mr. Cornish himself, but where this had not been done in the author's lifetime the task devolved upon the editor.

The volume opens with a brief account of the life of Mr. Cornish, which will no doubt be welcome to the numerous readers who find entertainment or instruction in his works. Following this are several articles, upon which the title of the volume is evidently based, some of these dealing with the works of such birds as the South American oven-bird and our own woodpeckers, while "road-making animals" and "landscape-gardeners" form the subjects of others. Several of these articles display a lamentable want of knowledge of scientific zoology on the part of the author. We are told, for instance, on p. 34, that "the musk-ox, the *ovibos*, is as much akin to the sheep as to *bovidae*, and in habits more like what we imagine the undescended great wild original of our sheep was than are the wild sheep of to-day." In regard to the first half of the sentence, it is now accepted that the musk-ox is not a near relative of either sheep or oxen, while the whole group is included in the Bovidæ. As to the meaning of the second half of the sentence, we are altogether in the dark. Again, on p. 48 we notice the astounding information that the pampas stag is the only large ruminant on the plains of South America, which, by the way, are stated to be formed of clay. Other similar cases might be cited, but in the case of a posthumous work criticism must not be too trenchant; and, after all, the volume is perhaps sufficiently accurate to suit the requirements of the readers to whom it is likely to appeal.

Rubber in the East. Being the Official Account of the Ceylon Rubber Exhibition held in the Royal Botanic Gardens, Peradeniya, in September, 1906. Edited by Dr. J. C. Willis, M. Kelway Bamber, and E. B. Denham. Pp. 269; illustrated. (Colombo: H. C. Cottle, Government Printer.)

THIS interesting and up-to-date work is the official account of the Ceylon Rubber Exhibition held in the Royal Botanic Gardens, Peradeniya, in September, 1906 (see NATURE, December 27, 1906, p. 209). The duration of the exhibition allowed of its being a Rubber Congress, lectures being given upon the various branches of the subject from cultivation to vulcanisation. These lectures, discussions, judges' reports, &c., have been brought together in the present volume and arranged in a logical order with the hope of making this account a standard treatise upon the rubber industry as it at present exists.

The chapters dealing with the cultivation of rubber in Ceylon and other countries, treatment of diseases, tapping knives, machinery for the treatment of latex, and the shipment and marketing of rubber, should prove valuable aids to the practical rubber grower.

Some idea of the rapid growth of the industry is gathered when we see that five years ago there were only 2500 acres under rubber in Ceylon, and to-day 104,000 acres, the *Hevea brasiliensis* being the species most extensively planted. This tree produces the well-known Para rubber, which, prepared in the ordinary way, possesses 90 to 95 per cent. of caoutchouc. The Hevea appears to stand tapping operations even when of a very drastic nature.

High tapping has been tried on some plantations up to 30ft. and 50ft., and this system gives in some cases 12lb. to 14lb. of rubber per tree; but there is

a curious phenomenon in connection with this high tapping, viz., the frequent difficulty of coagulating the latex.

One lecturer, Mr. J. B. Carruthers, deals with the possibility of rubber for pavements for roadways, and mentions the rubber pavement under the archway leading to Euston Station, which was laid down in 1881. In 1902 the pavement was found to have worn down to $\frac{1}{8}$ of an inch in the thinnest places. This rubber pavement cost less than three times as much as wood or asphalt, but the life of wood or asphalt was four years, and the life of a rubber pavement twenty years. The book is well illustrated throughout, and there are some interesting maps of Ceylon, Perak, &c., showing lands under rubber or alienated for rubber. L. C. B.

Some Modern Conditions and Recent Developments in Iron and Steel Production in America. By Frank Popplewell. Pp. x+119. (Manchester: University Press, 1906.)

THIS report contains an account of a visit to the iron and steel-producing centres in the United States from September, 1903, until April, 1904, made by the author as Gartside scholar of the University of Manchester. It comprises an introductory sketch of the metallurgy of iron and steel, some general considerations on the extent of the American industry, and descriptions of the raw materials used, of the production of pig iron, and of the manufacture of steel and of rolled steel products, and, lastly, some notes on American labour and education.

The author employed his time well, and has given a clear idea of modern conditions. The important subjects of the Steel Trust, organised labour, and railway transport are not touched upon, and the report suffers from the disadvantage that progress is so rapid in America that in the interval that has elapsed between the visit and the publication of the report many important changes have been effected which have rendered some of the information collected antiquated, and much of the interest has been impaired by the publication of reports by later visitors, notably in the German work by Dr. H. Levy, and in papers written by members of the Iron and Steel Institute who took part in the New York meeting of that society. Thus there is no mention of the most interesting novelty in blast-furnace practice, namely, Mr. Gayley's desiccation of the blast by a preliminary chilling of the air before its admission to the cylinder of the blowing engine, nor does the index refer to the Talbot continuous steel-making process which, first used at Pencoyd, has proved surprisingly economical in this country. Mr. Popplewell gives, however, a clear exposition of the results of specialisation in production, of the development of ore-handling machinery, and of the general use of the charging machine, features that characterise American practice. He shows, too, that the colossal blast furnace with huge yield due to high-blast pressure, regardless of consumption of steam and boiler coal, is giving place to a blast furnace of more modest dimensions, with a maximum height of 80 feet or 85 feet, for the treatment of fine ores.

The impression derived from reading Mr. Popplewell's report is that many of the most striking developments, admirable as they are, were designed to meet special wants, and are not necessarily applicable in Great Britain. Thus, to give one example, the enormous stock piles called for by the intermittent navigation of Lake Superior are not required in districts where supplies arrive continuously throughout the year.

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.]*

The Positive Charge Carried by the α Particle.

IN a letter in NATURE (August 2, 1906) I gave an account of some experiments which I considered proved that the α particle as initially expelled is not charged, and I also gave an account of the same work in a paper read before the British Association at York last August. Although I have no reason to doubt the accuracy of the experiments published in my letter, I do not now consider them sufficiently conclusive, as some recently published researches on the α particle have to be taken into account in their interpretation. I refer chiefly to a paper published by Rutherford shortly after my letter (*Phil. Mag.*, October, 1906, p. 348), in which the view is put forward that the α particle carries two atomic charges.

Now the reasoning in my letter was based on the assumption, then held universally, that the charge on the α particle was the indivisible single atomic charge, and it was not necessary at that time to contemplate the possibility of any intermediate condition existing between the α particle charged and uncharged. But it is clear that if, as Rutherford considers probable, the α particle carries a multiple charge, the results I published in my letter do not by themselves suffice to prove that the α particle as initially expelled is uncharged, for it might possess a fraction of its final charge initially, obtaining the remainder and becoming correspondingly easier to deviate magnetically in its passage through matter. This is, of course, a contingency not contemplated in my original conclusion.

I had hoped long ere this to submit this point to an experimental test, which is simple enough to do by varying the strength of the field. But I very much regret I have no longer the essential facilities necessary to carry on the investigation, particularly the means of obtaining a steady supply of liquid-air, and there does not appear to be any immediate prospect of my being in a position to repeat the experiments. The question at issue is a somewhat fundamental one in the relations of electricity and matter, and, of course, cannot be finally settled by any one series of experiments, but only after long-continued and frequently verified observations. But I can neither continue the investigation nor even repeat the experiments I have already made, so nothing remains but to withdraw what I have already published. FREDERICK SODDY.

The University, Glasgow, February 26.

The Rusting of Iron.

IN NATURE of February 21 (p. 390) appears a letter from Prof. Wyndham R. Dunstan in which he represents me as having concluded "that carbonic acid is essential to the rusting of iron, and that rusting does not occur in its absence." As such a general statement, without reference to the context of the paper to which Prof. Dunstan refers, may prove misleading, I shall be obliged if you will allow me to point out that the main and incontrovertible conclusion drawn from experiments extending over a prolonged period is that iron does not undergo oxidation in presence of oxygen and water. If, however, a minute quantity of acid (either carbonic acid or *any other acid capable of attacking iron*) be present, the metal is first converted into ferrous salt, which subsequently oxidises to rust. Samples of iron which contain such impurities as sulphur, phosphorus, and carbides may give rise to free acids when in contact with water and oxygen, and under these conditions rusting may be expected to occur, even if carbonic acid be rigorously excluded.

Prof. Dunstan does not inform us if he adheres to his definitely expressed views "that iron, oxygen, and liquid water are alone necessary for the rusting of iron to take place," and that "hydrogen peroxide is a necessary intermediate product of the chemical change involved in rusting," but he confines himself to stating again that acid potassium chromate, a substance which destroys hydrogen

peroxide, inhibits rusting. He ignores the fact that there are other substances, such as potassium iodide, which immediately destroy hydrogen peroxide and yet do not inhibit the rusting of iron. Moreover, if Prof. Dunstan's assumption that substances which destroy hydrogen peroxide (which he regards as an essential initial product of rusting) inhibit rusting be accepted, it will be necessary to admit, contrary to the general experience of chemists, that the presence of a substance capable of removing one of the products of an action does not accelerate the action, but actually prevents it.

Prof. Dunstan does not say in what respects his experiments on the oxidation of iron have afforded results differing from my own, but I may remind him that only after repeated failures was I successful in bringing together iron, oxygen, and water, and in avoiding the presence of acid.

GERALD T. MOODY.

Central Technical College, February 22.

The Valparaiso Earthquake, August 17, 1906.

PROF. MILNE'S note in NATURE of February 21 raises an interesting question which can readily be answered; the earthquake which preceded the Valparaiso shock originated under the North Pacific Ocean in about 30° N. lat., 170° E. long., at about oh. 11m. a.m. G.M.T., or 35½ minutes before the Chilian earthquake as recorded at Santiago. This position does not agree with the distance given in the note, but Prof. Milne, in correspondence, has informed me that this is in error, and the distance, as indicated by the Shide diagram, is 90°, which is in close accordance with my own determination of the distance.

It must be remembered that all attempts at deducing the distance of origin from a single seismogram are necessarily approximate, though the error will probably be within 5° of arc, or about 350 miles, in the case of a great earthquake giving a complete record. The determination of the place of origin becomes easy when a sufficient number of records from widely separated localities are available, and these are at my disposal, for, seeing that the Chilian earthquake was likely to be an important one in connection with an investigation on which I was engaged, I wrote to a number of seismological stations the addresses of which were known to me, and met with a most generous response to my requests. Unfortunately, when the copies of seismograms came in it was evident that they recorded two earthquakes, of which the earlier was of unknown origin, the record of which in every case overlapped that of the Chilian one, and rendered the latter practically useless.

R. D. OLDHAM.

Nomenclature of the Proteins.

IN the current number of the Proceedings of the Chemical Society, the council has issued some valuable proposals for change in the nomenclature of the proteids and allied substances. While not venturing to criticise the majority of the recommendations, I notice a definition in the proposed subclass 5 which appears to me slightly inaccurate. The subclass in question reads as follows:—

"5. Sclero-proteins. This new word takes the place of the word albuminoid in the limited sense in which the majority of physiologists have been accustomed to use it. It includes such substances as gelatin and keratin; the prefix indicates the skeletal origin and often insoluble nature of its members."

Now, it seems to be a generally accepted view that gelatin does not exist ready-formed in nature, but results from the hydrolysis or hydration of collagens (*v.* Allen's "Organic Analysis," vol. iv., and Cohnheim's "Chemie der Eiweisskörper"). Is not gelatin as much a product of protein hydrolysis as acid-albumin or alkali-albumin, for which the generic term meta-proteins is now proposed? Would it not, therefore, be preferable to reserve the term sclero-proteins, in its strictest sense, for the wholly insoluble products of animal-cell activity, such as chondrigen, ossein, sericin, and keratin, and class their hydration-products such as gelatin and silk-gelatin among the meta-proteins?

The committee apparently sees no objection to including gelatose among the proteoses.

W. S. GILLES.

Bocking, Braintree, Essex, March 4.

Maximum Gravitational Attraction on a Solid.

CAN you tell or refer me to the solution of the following question:—

What will be the shape of a definite quantity of mass of given specific gravity in order to obtain maximum gravitational attraction at a point on its surface? I have tried various shapes of equal volume, including square and rectangular figures, hemisphere, sphere, and cones. For these shapes I found that the maximum attraction obtained at the centre of the base of a cone the apex angle of which was about forty degrees; no doubt the frustrum of such a cone would attract with greater force.

This question is no doubt of academical interest only, but the solution should be instructive from certain points of view.

W. E. MILLER.

Publication Bureau, General Electric Co.,
Schenectady, New York, U.S.A.

THE solid is one of revolution (evidently), and the attraction being a maximum is unaltered by shifting a small elementary ring of matter from one point to another of its bounding surface. If dM is the mass of a ring formed by the revolution of the point r, θ, then the attraction is $dM \cos\theta/r^2$. Hence the equation of the generating curve of the boundary is $\cos\theta/r^2 = \text{const.}$, or $r^3 = k^2 \cos\theta$ say, or $(x^2+y^2)^3 = k^4x^2$. The curve may be traced by drawing the circle $r = k\cos\theta$, and taking on each radius vector a mean proportional between that radius and k.

According to this result, the form of the bounding curve for a surface of revolution is the same as it would be for a plane lamina possessing the same property. The agreement can be justified by taking a thin slice through the axis of the solid. The matter contained in this slice must evidently be arranged in such a form as to give the maximum attraction independently of the remaining parts of the body.

G. H. BRYAN.

A New Chemical Test for Strength in Wheat Flour.

THE test described as new by Mr. Wood in NATURE of February 21 has been in use in my laboratory during the past year, where it forms part of the regular routine tests applied to flour. While I am fully in agreement with Mr. Wood's view that the volume of carbon dioxide evolved by a mixture of yeast and flour under standard conditions is a measure of the sugar content of the flour together with other fermentable matter produced during the fermentative change, it is important not to lose sight of the influence exercised by the character of the gluten on the volume of the loaf. A rotten gluten when distended by too much gas will break, and the gas will escape from the dough. From this point of view the character of the gluten is clearly of fundamental importance, but, after all, the problem is one in which no small number of variables must be dealt with.

E. FRANKLAND ARMSTRONG.

A Remarkable Lunar Halo, February 24.

IN NATURE of May 1, 1902 (vol. lxvi., p. 5), a remarkable lunar halo was described as having been witnessed from the Yerkes Observatory on January 19, 1902. It consisted of an ordinary lunar halo, of 45° or 50° in diameter, and of a second ring approximately the same in size intersecting the first, and cutting exactly through the moon.

The same phenomenon was very clearly seen by myself and others at Pembroke Dock during the evening of Sunday, February 24, between 9 p.m. and 10 p.m. The secondary ring appeared to be about a third as large again in diameter as the primary, and was situated approximately to the north-east of it. In both rings the brownish tinge of the edges and dark interiors were perceptible, though very much more strongly in the primary than in the secondary.

I should be glad to know whether any explanation has yet been advanced as to the optical formation of the secondary ring in the above rare phenomenon.

H. F. HUNT.

7 Officers Row, Pembroke Dock, Wales, February 26.

A PRACTICAL HANDBOOK OF BURMA.[1]

SIR GEORGE SCOTT has condensed into a volume of 485 pages, which any tourist can conveniently carry about, a mass of useful information about Burma. The book is described in the preface as of the nature of a skeleton or of a painter's study for a larger work. It is, however, much more than this, and contains all that any ordinary tourist needs to know about Burma, and, indeed, a good deal which is not known even to some who have resided for many years in Burma.

The work is divided into seven parts. Part i., "The Country and Climate," contains, besides an account of the fauna, flora, and geology and minerals of the country, a most interesting account of the races of Burma.

It is doubtful who were the original inhabitants of Burma. The only aboriginal tribe of which there is any trace are the Selungs, who live in the islands of the Mergui archipelago. Their language shows affinities with those of the Tsiam or Cham aborigines of Cambodia and of the Ætas or Negritos, aborigines of the Philippine Islands. In any case, the aboriginal inhabitants have been almost entirely replaced by swarm after swarm of Indo-Chinese invaders who have come down from north-western China, from Tibet, the Pamirs, and Mongolia, following the course of the great rivers. The Indo-Chinese were followed by the Tibeto-Burmans. After the Tibeto-Burmans came the peoples of the Siamese-Chinese subfamily—the Karens and the Tai, or Shans, and the last irruption, that of the Chingpaw, was only stopped by the British occupation of the country. The people of Burma, although they are divided into many tribes and races, are, with the exception of the Selungs, all of the same original stock. Out of the total population of Burma, which was found at the census of 1901 to be approximately ten and a half millions, about seven millions speak Burmese.

FIG. 1.—Stiff-necked Padaung Belles. The neckbands of these women are of solid brass rod. They vary from five coils to twenty-five. From "Burma: a Handbook of Practical Information."

Sir George Scott gives an account of all the various races found in Burma, and illustrates his text by photographs of many of them. We here reproduce the frontispiece photograph of the stiff-necked Padaung belles. These women wear neckbands of solid brass rods. The bands vary in number from five to twenty-five, and the idea with which the bands are worn is to keep the neck always on the stretch. Five coils are all that can be got on to begin with, but fresh coils are added as space is made for them as the girl grows, so that the neck is constantly kept at the stretch until the full limit of twenty-five bands is reached. Similar coils are worn on the legs and arms, so that the average woman carries fifty or sixty pounds of brass, and some manage as much as eighty pounds. Thus weighted, they carry water for domestic use, hoe the fields, and go long distances to market.

Part ii. contains an account of the Government of Burma. The first provinces of Burma to be annexed were Arakan and Tenasserim after the first Burmese war in 1826. The province of Pegu was added in 1852, after the second Burmese war, and Burma, as it now stands, was completed by the annexation of Upper Burma after the third Burmese war of 1885–1886.

The three provinces of Arakan, Tenasserim and Pegu were administered each by their own Commissioner under the Governor-General of India until 1862, when they were amalgamated under a Chief Commissioner, and it was not until May 1, 1897, that Burma became a Lieutenant-Governorship.

The account given of the duties of officers is generally correct, but since the handbook was written commissioners of divisions and deputy commissioners of districts in divisions and districts where work was heavy have been relieved of judicial duties by the appointment of divisional and district judges, whose time is devoted entirely to judicial work.

In this part Sir George Scott gives an excellent account of the Shan States, with which he is so intimately acquainted. The progress made in the Shan States, which were in a state of complete anarchy when Upper Burma was annexed, is surprising. All that they now require to secure their further development is the Southern Shan States railway, which will, it is anticipated, soon be commenced. Accounts are also given of Karenni, the Kachin Hills, and the Chin Hills. The Northern and Southern Shan

[1] "Burma: a Handbook of Practical Information." By Sir J. George Scott, K.C.I.E. Pp. x+520. (London: A. Moring, Ltd., 1906.) Price 10*s.* 6*d.* net.

States, Karenni, the Kachin Hills, and the Chin Hills are all administered by special officers under regulations which are suited to the primitive condition of the people.

The subject of education is also dealt with in this part. It is remarked that there is no province in India which can compare with Burma in the number of the population able to read and write. The fact that primary education is so widely diffused is due to the indigenous schools. Every monastery is a school, and there is a monastery in almost every village. Education is free, and there are no caste restrictions in Burma. There every Buddhist boy learns at least to read and write.

Part ii. concludes with a history of Burma from the earliest times. The history is as complete as it is possible to make it in 38 pages. An authentic photograph of the ex-King Thibaw and the ex-Queen Supava-Lat, who are now detained at Ratnagiri, an old Portuguese fort on the west coast of India, is given at p. 200 of the handbook.

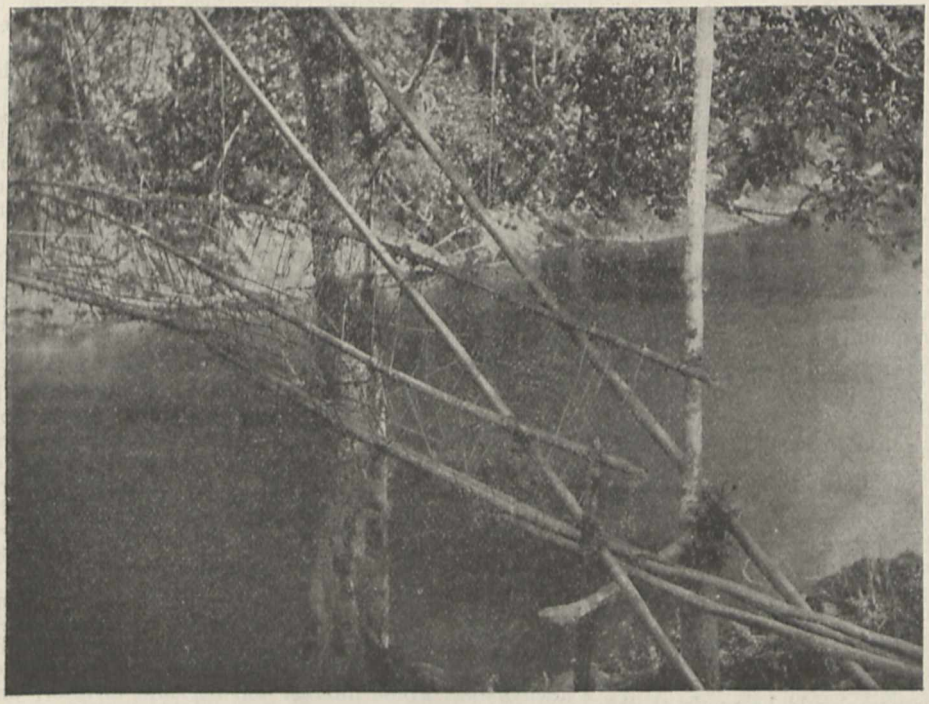


FIG. 2.—Wa Suspension Bridge. From "Burma: a Handbook of Practical Information."

Part iii. deals wth industries, the forests of Burma, mines, agriculture, trade, transports, currency, weights and measures. All these subjects are dealt with exhaustively, and this part will well repay perusal.

The subjects discussed in part iv. are archæology, architecture, art, and music. Burma is called the land of pagodas, and Sir George Scott points out that there are three distinct types of religious buildings—the solid pagoda enshrining relics, the carved and ornamented wooden monasteries, and the masonry temples. The most celebrated temples are in the ruined town of Pagan. Many pagodas are in ruins because, except where the founders have endowed them, and thus assured their preservation, it is to nobody's interest to preserve a pagoda. The merit of erecting a pagoda is great, but the merit attaches to the original builder, and not to the restorer or repairer.

The Government provides for the maintenance of some of the most notable pagodas, and for others there are trustees, who administer the endowments and collect the offerings of the faithful, and spend the proceeds on the repair of the buildings, but ruined and deserted temples are to be seen all over the country.

Part v. is taken up with an account of the Buddhist religion which is very complete. As Sir George Scott states, there is no doubt that the original religion of Burma was animism, and that this form of religion still survives amongst the vast body of the people. Buddhism, as many consider, is not a religion at all, but a system of philosophy. What most Burmans really reverence are the spirits of the air, the mountain and the fell. Many of the hill tribes are spirit worshippers pure and simple. Serpent worship, too, still survives.

Part vi. is devoted to language and literature. We are sorry that space does not permit us to give any extracts from this part.

Part vii. concludes the handbook with some useful hints to residents or new visitors, and the last paragraphs of this part tell the readers something about sport.

There are also three appendices. The illustrations are numerous and good. We reproduce as a sample the photograph of a Wa suspension bridge.

In conclusion, we strongly recommend every intending visitor to Burma to provide himself with a copy of this handbook, in the compilation of which Sir George Scott has shown that he has a thorough knowledge of the country, to which he has added much industry and research.

We think that the handbook, besides being indispensable to the tourist, is also well worth perusal by members of the non-travelling public who are anxious to know all that can be told about one of the most recent, and at the same time most interesting, possessions of the British Crown.

PROF. MARCEL BERTRAND.

IT was with deep regret that English geologists learned that Prof. Marcel Bertrand, professor of geology at the French National School of Mines, died on Wednesday, February 13. Born in Paris on July 2, 1847, a member of a family of great mathematicians, he inherited a natural gift for the exact sciences, and especially for geometry, which enabled him to enter into l'École Polytechnique in 1867. In 1869, owing to his brilliance as a student, he was selected by the French Government as mining engineer. For three years he attended the courses of Élie de Beaumont and others at the School of

Mines. This teaching decided the direction of his life's work along the traditional lines of the school of which he was in turn a student, an instructor, and one of the most distinguished professors from the year 1886.

It is a special feature of the French Geological Survey to avail itself of the help of outside professional geologists, such as university professors and teachers, by engaging them during the summer holidays as auxiliary collaborateurs. It is in that way that Marcel Bertrand was induced to carry out during the summer months of several years a series of field observations in the Jura mountains, with the view of publishing detailed geological maps of the region. It was quite natural that the growing interest of the young geologist was excited by the structure of this district—classical for the relative regularity of its foldings.

In 1881 Bertrand was led in the same way to investigate the geology of Provence, where a simple appearance hides extreme complexity of structure. It was there that, after several occasional visits to the Alps, he was able to bring new light to bear on the earth's anatomy. He was the first to perceive that the foldings of the pre-Alps have been altered in depth by the older horst of Maure Mountains, and have resulted in extensive overfoldings, which later on have been again obliquely plaited by more recent compression. These investigations culminated in 1887 in the publication of his "Memoire sur le Beausset (Var)," which, notwithstanding its shortness and local character, was received with keen interest by Continental geologists. It was for them the starting point for further inquiries upon new forms of disturbances, and especially upon those long recumbent folds the horizontal extension of which is so great that they are frequently spoken of as sheets.

Bertrand's great experience of the coal mines of the north of France afforded him the opportunity of detecting that overthrusts of the same amplitude had taken place at the close of the Carboniferous period. He expounded these similarities in his memoirs upon "Les Rapports de Structure des Alpes de Glaris et du Bassin Houiller du Nord," where it was suggested, for the first time, that the famous dopple fold of Glaris might be regarded as a single exaggerated overfold coming from the south. This explanation is now accepted by Prof. Heim himself.

In 1896 Bertrand wrote a preface to introduce to the French public a translation of Suess's "The Face of the Earth." If anyone should deny to scientific men the gift of expressing their ideas in a concise and adequate style, reference should be made to this brilliant and lucid account of the progressive development of structural geology from the first attempts of Leopold de Buch and Élie de Beaumont to the synthesis of Suess involving the whole surface of our planet, or the minute re-construction of the former orography of the Highlands by Prof. Lapworth.

In 1896 Bertrand was elected a member of the Académie des Sciences to fill the chair left vacant by the death of Pasteur. In 1900 he took a large part in the organisation of the Paris meeting of the International Geological Congress. He contributed two papers on the geology of the Western Alps, and personally directed one of the excursions in that district. It was the last gratification of his life, for shortly after he suffered great affliction by the death of his daughter, who was buried by a sand-slip when geologising with him.

It is deeply to be regretted that such a gifted man has passed away without having fulfilled his possibilities. He scattered some of his original ideas in short papers which appeared from 1884 until 1900, chiefly in the *Comptes rendus* of the French Academy of Sciences, in the *Annales des Mines*, and in the Bulletin of the Geological Society of Paris. But he did not concentrate his abilities upon a great scientific work which might have been compared to the volumes by Prof. Suess. Our only consolation is the power he possessed to impart his spirit to his students and to the number of his disciples, such as MM. de Launay, Lugeon, Termier, Cayeux, Ritter, &c., whom he left behind fitted to carry on his work.

M. M. ALLORGE.

H. C. RUSSELL, C.M.G., F.R.S.

THE announcement of the death of Mr. H. C. Russell, who for nearly forty years was among the foremost representatives of science in the colony of New South Wales, has been received with great regret by many men of science. Since 1870 he held the post of Government astronomer and director of the Sydney Observatory, in succession to Mr. G. R. Smalley, and in that capacity rendered most important services to the colony. His first duty on appointment was to organise the resources of the colony for the observation of the transit of Venus. With small funds, little skilled assistance, and short time for preparation, he nevertheless succeeded in equipping several stations in a highly efficient manner, reflecting great credit upon the readiness of the colonists and the exertions of the observatory staff.

Thenceforward the observatory pursued a course marked by continually increasing usefulness, culminating in the acceptance of a share in the international photographic chart of the heavens. The zone allotted to this observatory extends from $-52°$ to $-64°$ declination, and under Mr. Russell's direction the task advanced far towards completion. But in the course of the work it was found that considerable improvement might be effected if the telescope were removed to a station remote from the town of Sydney. The director had long advocated the removal of the observatory, and the mounting of the photographic equatorial at Red Hill probably presages the abandonment of the Sydney site. The measurement of the plates is being prosecuted on a common plan with those taken at Melbourne, and one of the latest papers from Mr. Russell has reference to an improved form of micrometer for the measurement of these plates. Mechanical devices always had great interest for the late director, and he paid great attention to special forms of driving clocks for equatorials.

But most of all the colony is indebted to him for his organisation of the meteorological service. He had charge of a district of the climate of which little was known, and as the colony extended and the population occupied areas of unexplored country, he had to widen the range of his inquiry in order to supply the necessary information to intending settlers. The long series of observations that he published on climate factors, especially those having reference to rain, evaporation, and state of the rivers, attest to his industry, his powers of organisation, and his recognition of the requirements of a young and rising colony. He put it on record that when he assumed office there were but five rain-gauges in the colony. On his retirement there were something like two thousand. His discussion of the results has scarcely been as happy as his collection. He seems to have relied upon statistical methods rather than on physical facts, and in this way was led to suggest a theory which would make the

amount of precipitation depend upon the moon's nodes. These cycles are shown very distinctly over the few years that he was able to bring under discussion, but his explanation has not been generally accepted. This is a small matter in comparison with the value of the information which he was able to furnish, and which has contributed in no small degree to the prosperity of the colony. This collection of observations will be of the greatest service in subsequent inquiries.

Mr. Russell has left a character for industry and closeness of application that cannot but prove stimulating to future astronomers in the southern hemisphere. He was much esteemed by many friends in this country, who regretted his retirement from the observatory; and besides being a Fellow of the Royal Society, to which he was elected in 1886, he was a member of many learned bodies, and was well known as a contributor of frequent and welcome papers.

W. E. P.

DR. ALLAN MACFADYEN.

BACTERIOLOGICAL science in England has sustained a great loss by the early death of Dr. Allan Macfadyen, who passed away on March 1, a martyr to that science he loved so well and to which he had devoted his best days, his last illness being caused by accidental infection in the laboratory.

Dr. Macfadyen was a distinguished graduate of Edinburgh University, and subsequently studied at Bern, Göttingen, and Munich. One of his earliest investigations was on the behaviour of the bacteria in the digestive tract, in which he proved that the gastric juice and intestinal secretions protect but little against the invasion of pathogenic microbes. This was soon followed by a joint paper, with Prof. Nencki and Dr. Sieber, on the chemical processes occurring in the small intestine of man, in which the intestinal contents were examined and the exact chemical changes produced by several intestinal microorganisms in pure cultures were studied. With Sir Lauder Brunton, an investigation of the ferment action of bacteria was contributed to the Proceedings of the Royal Society, and his chemical bent was further shown by a paper on the action of bacteria on albumins and peptones, which appeared in the Reports of the Local Government Board. The thermophilic bacteria, organisms which thrive at high temperatures, attracted his attention, and with Dr. Blaxall he carried out an investigation on them in which, almost for the first time, a number of species were differentiated and their action studied. With Dr. Harden, Mr. Rowland, and the late Dr. Morris, researches were conducted on the nature of the yeast zymase of Buchner, and the phosphorescent bacteria and problems of disinfection were other subjects in which he made additions to our knowledge.

Dr. Macfadyen was early inspired with the idea of the paramount importance of the contents and extracts of the unit of life—the cell—and the happy culmination of Sir James Dewar's researches on low temperatures gave him an unlooked-for means of obtaining these in a comparatively unaltered state. He showed that the low temperatures of liquid air and of liquid hydrogen had little or no effect on either the vitality or the functions of microorganisms. With Mr. Rowland he attacked the problem of grinding up bacteria with liquid air, and by a number of ingenious devices he finally succeeded in obtaining the juices of bacteria in sufficient quantity for investigating their characters. The comparative failure of attempts to produce therapeutic sera for such diseases as tuberculosis, typhoid fever, cholera, pneumonia, &c., the organisms of which produce little or no extra-cellular toxins, suggested that the juices of these organisms, the "endotoxins," obtained by liquid-air grinding, might be used for immunising. He showed successively that the virulence of an organism varied directly with the amount of endotoxin that could be obtained from it, that an animal might be immunised by means of these endotoxins, and that the serum of such an animal possessed immunising and curative properties.

The application of these principles to the typhoid bacillus, cholera vibrio, pneumococcus, and hog-cholera bacillus was described in a series of papers. Latterly, the application of the results to the treatment of human disease occupied Dr. Macfadyen's attention with encouraging prospects, and it is a tragic circumstance that he should be cut off just as his life-work seemed to be nearing completion.

As secretary and head of the Bacteriological Department of the British, Jenner, and Lister Institute of Preventive Medicine, as it was successively named, Dr. Macfadyen had a large share in the organisation of the institute at Chelsea, and much of the bacteriological work that emanated from there was inspired by him. As Fullerian professor of physiology at the Royal Institution, 1901–4, his courses of lectures on the cell, antitoxins, physiology of digestion, and other subjects made him known to a wide circle.

R. T. H.

NOTES.

THE following candidates were selected on Thursday last by the council of the Royal Society to be recommended for election into the society:—Frank Dawson Adams, Hugh Kerr Anderson, William Blaxland Benham, Lord Blythswood, William Henry Bragg, Frederick Daniel Chattaway, Arthur William Crossley, Arthur Robertson Cushny, William Duddell, Frederick William Gamble, John Ernest Petavel, Henry Cabourn Pocklington, Henry Nicholas Ridley, Grafton Elliot Smith, and William Henry Young.

PROF. W. A. TILDEN, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule of the club which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public services."

A DEPUTATION representing the Anthropological Institute, the British Science Guild, and other scientific bodies, waited upon the Prime Minister on Tuesday to urge the establishment of a national anthropometric survey. Mr. R. C. Lehmann, M.P., who introduced the deputation, said that, in the first instance, the survey should have for its object the periodic measurement of children and young people in schools and factories. Besides this, a comprehensive survey of the general population of the whole country should be undertaken. The sum asked for is 4000*l.* or 5000*l.* The need for such a survey was described by Dr. D. J. Cunningham, Mr. J. Gray, Dr. Gow, Sir Lauder Brunton, and Dr. A. C. Haddon. In his reply to the deputation, Sir Henry Campbell-Bannerman confessed that he has been much impressed by the arguments adduced as to the great lack that there is in this country of knowledge of the quality of the population. It is obviously desirable to have a record of the kind proposed in order to be able to study the changes in the condition of the people at large as a guide to action in administration and in legislation regarding it. Any test applied to the condition of the inhabitants of any district is a test of their surroundings, of the mode in which they live.

and the circumstances which affect their health and utility, and therefore this cannot be an unimportant thing. It is very desirable to avoid any impression that a sort of experiment is to be practised upon the poor children in the common schools. Whatever is done to the poor ought to be done also to the rich, and the application of the system ought to be universal. In fact, it will cease to have its proper value if it is confined to the poor schools, which are a little more at the disposal of the Government and the authorities than the great schools, such as Westminster and others. Results are wanted referring to the whole population, so that comparison may be made between different districts and different occupations. The sum mentioned for the survey is a modest amount, but a great many modest sums make up a large sum. But the mere question of cost is not likely to stand in the way of a great scheme of this sort if the Government is satisfied on full consideration—which shall be given to it—that the time is ripe for this new enterprise.

THE Goldsmiths' Company has contributed the sum of 1000*l.* to the research fund of the Chemical Society.

THE 134th anniversary dinner of the Medical Society of London will be held on Wednesday, March 13, at the Whitehall Rooms, Hotel Metropole.

THE death is announced of Mr. C. A. Witchell, author of "The Evolution of Bird Song, with Observations on the Influence of Heredity and Influence," and of other works on natural history.

A MEETING of the Institution of Naval Architects will be held on March 20–22. At the opening meeting Lord Glasgow, president, will deliver the presidential address, and the gold medal of the institution will be presented to Prof. R. L. Weighton.

THE *British Medical Journal* states that the Portuguese Minister of Marine has decided to send a scientific mission to the Ilha do Principe, in the Gulf of Guinea, for the purpose of trying the effect of measures of general prophylaxis against sleeping sickness, the prevalence of which on the island continues to increase.

ON Thursday next, March 14, Dr. C. W. Saleeby will begin a course of two lectures at the Royal Institution on "Biology and Progress." The Friday evening discourse on March 15 will be delivered by Prof. Lunge, on "Problems of Applied Chemistry," and on March 22 by Prof. J. J. Thomson, on "Rays of Positive Electricity."

AT the meeting of the Anthropological Institute to be held on March 12 in the theatre of the Civil Service Commission, Burlington Gardens, W., Dr. C. G. Seligmann will exhibit a series of kinematograph pictures illustrating New Guinea native dances. Persons desirous of being present can obtain cards of admission on application to the secretary of the Anthropological Institute, 3 Hanover Square, W.

IN reply to a question asked in the House of Commons on Monday as to the cause of the recent explosion in the research laboratory at Woolwich, Mr. Haldane said:—"It is doubtful whether cordite can be detonated; but if it is possible the circumstances must be exceptional. Dynamite, if lighted, cannot be detonated unless it is confined. There was no iodide of nitrogen in the research laboratory in the chemical research magazine. It can be detonated under water, and cannot be kept in a dry state. An inquiry is being held as to the cause of the explosion at Woolwich."

IN January the American Museum of Natural History sent over a party, under Prof. H. F. Osborn, to the Fayûm desert of northern Egypt to explore and collect fossil vertebrates in the Upper Eocene formations made famous by the discoveries of Beadnell and Andrews. Captain H. G. Lyons, director-general of the Egyptian Survey Department, rendered material assistance in outfitting the expedition, and detailed Mr. H. I. Ferrar, of the survey, for a three weeks' tour of the formations with Prof. Osborn. As a result of this tour, it was decided to confine the search principally to the Upper Eocene. The party reached the Fayûm on February 5, and at once began the work of prospecting and excavating, which will be continued for two or three months under the direction of Messrs. Granger and Olsen, of the American Museum. The chief objects of the party are first to secure a representative collection of the extinct animals already known; second, to extend our knowledge of the small fauna of the period. The first step in the latter direction has been the discovery of Rodentia apparently of the myomorph group.

MR. W. BURDETT-COUTTS has decided to arrange for the publication in due course of a life of the late Baroness Burdett-Coutts. He informs us that he is anxious that those persons who possess letters of interest from the Baroness, addressed to them or their forbears, should send correspondence (after May 1 next) to him at 1 Stratton Street, London, W., or communicate with him on the subject. All documents will be treated with great care, and returned as soon as practicable, intact to their owners, after the necessary extracts have been made from them. At a general monthly meeting of the members of the Royal Institution on Monday, March 4, a letter from Mr. Burdett-Coutts was read expressing appreciation of the terms of a resolution, with reference to the death of the Baroness Burdett-Coutts, sent to him by the Royal Institution. In the course of his letter, Mr. Burdett-Coutts says:—The Baroness's social relationships to science, her friendships with many, her acquaintance with nearly all, of its eminent professors for the past seventy years, are well known; her efforts to encourage and aid those who were struggling in the same path, not so well: as was her custom. . . . If a scholarship was to be established at Oxford, not classics or history, or even theology, but science claimed her aid. Such things were not done at haphazard. She would spare no trouble to search out both the need and the means. With a touch of characteristic humour she inquired of Sir Wm. Hooker whether Kew Gardens, so far up the Thames, was not poor in seaweeds. She had already found out the fact, and had secured the Griffiths collection, so rare and extensive that, without impairing the central completeness, it provided duplicates for six other botanical establishments. She probably had not read Schimper's monograph on the genus Sphagnum, and did not know the details of the muscological collection of Bruch; but she found out that Kew also wanted mosses, and that Schimper's great herbarium could be acquired. Thus, not so much by wealth as by thoughtful insight, special departments of British science were enriched at her hands.

AT the annual general meeting of the Geological Society on February 22, Sir Archibald Geikie, the president, described the arrangements contemplated for the celebration of the society's centenary next September. Invitations to attend the meetings will be sent to all the foreign members and foreign correspondents of the society, and geological societies, geological surveys, and learned institutions which

have a geological side, will be asked to send delegates. Personal invitations will also be addressed to geologists of note in the old and the new world, who are not already enrolled in the foreign lists of the society. The official programme will probably extend over three days in London. The arrangements for each of these three days are under consideration, but Sir Archibald Geikie proposes to give his presidential address as the *pièce de résistance* of one of the forenoon or afternoon meetings. In that address he will offer a sketch of the state of geological science outside Britain at the time when the Geological Society of London was founded, and indicate the external influences that affected its start. By this choice of a subject he hopes to interest the foreign guests, while at the same time inviting the fellows of the society into a domain of the history of science which is perhaps less familiar than it deserves to be. The chronicle of the society itself during the first hundred years of its existence has been carefully and fully compiled from all available sources by Mr. Horace B. Woodward for publication in volume form. Excursions to places of geological note in this country will probably be arranged, some to precede and others to follow the meeting in London. The various museums and places of interest in the metropolis will, of course, be shown to the expected visitors, and there will doubtless be no lack of public and private hospitality. It is anticipated that the Universities of Oxford and Cambridge will both receive the foreign guests.

To *Naturen* for January Prof. A. W. Brögger contributes an illustrated account of the oldest stone implements of Norway. These are all Palæolithic, and include "celts," together with two distinct types of "axe-heads."

A PAPER by Mr. E. D. Congdon on the hydroid polyps of Bermuda is published in the January number of the Proceedings of the American Academy of Arts and Sciences, and two on plankton crustaceans from the San Diego region, by Mr. C. Juday, are issued in vol. iii. (parts ix. and x.) of the zoological series of the University of California Publications.

IN an earlier number of NATURE reference was made to an exhibition in the hall of the Natural History Museum of specimens sent by the Marine Biological Association at Plymouth. This exhibit has been augmented by a jar of specimens illustrating the transition from the marine leptocephalus larva into the fresh-water elver, or young eel, and by a second vessel containing specimens of the various animals which go to form the ordinary diet of the cod. Thirteen species are included in the latter, among which four are (for the most part immature) fishes.

THE January number of the *Victorian Naturalist* contains an account of a traverse of the Owen Stanley Range, British New Guinea, by Mr. C. C. Simpson. Some interesting observations on the habits of birds-of-paradise, of which several species were seen, are recorded. The "six-plumed" and "magnificent" species have dancing-grounds, carefully cleared, on which they disport themselves, while the "raggiana" has a special tree to which the males resort for their nuptial display, but the other species use for this purpose any tree that may be convenient. In the author's opinion, many of the rarer species lay only a single egg.

THE Paris illustrated magazine *Madame et Monsieur* for February 17 contains an appreciative account of Prince Roland Bonaparte and his scientific researches. The Prince is, indeed, before all things, a *savant*, and devotes the whole of his available time to scientific investigation. Although botany claims the first share of his attention, he likewise devotes much time and money to anthropology, having brought together a unique collection of anthropological photographs, while geology is by no means neglected. Prince Roland is likewise a great traveller, having visited a large part of the North American continent. The herbarium in his palace in the Avenue d'Iéna is stated to contain not less than 700,000 species of plants. The Prince has just been elected a member of the French Academy of Sciences.

WE have been favoured with a copy of the first part of a new work, "The Kennel Encyclopædia," edited by Mr. J. Sidney Turner, and published by the Encyclopædic Press, Sheffield. The work, it is estimated, will run to about sixteen parts, to be issued at intervals of from four to six weeks. Judging from the illustrations to the article on Airedale terriers, the work promises to be of an exceptionally attractive nature. Mr. R. I. Pocock contributes an excellent article on the ancestors and relatives of the dog, while Prof. Hobday illustrates canine anatomy by means of sketches. Mr. Croxton Smith, who writes on the antiquity of the dog, appears, however, to be unacquainted with all the literature of the subject, notably a recent article in *Globus*, by Prof. Kræmer, on the St. Bernard and the Tibet mastiff.

MAJOR POWELL-COTTON, who recently arrived in this country, during his journey home communicated to Reuter's Agency at Rome some of the results of his twenty-seven months' sojourn in the heart of Africa. According to this account, the explorer secured a specimen of the Central African race of the white rhinoceros near Lado. Like other British explorers of the Ituri Forest, he failed to see a living okapi, although he approached within twenty yards of one in dense jungle. The skeleton and skin of a male and the body-skin of a calf were, however, secured, and have now been transferred to the British Museum. Important information, derived from the Ituri pigmies, with regard to the habits of the okapi is promised in due course. Several mammals collected have been described as new by Mr. Lydekker. They are the black honey-badger, and local races or phases of the African tiger-cat, water-chevrotain, Stuhlmann's elephant-shrew, and a guereza monkey from the Ituri Forest, together with a large tawny buffalo from the open Semliki country near the Albert Edward Nyanza. Major Cotton has demonstrated that the range of the dwarf red buffalo, the water-chevrotain, and the potamogale extends right across the forest region. It may be added that Mr. Boyd Alexander has presented to the British Museum the skull and skin of an okapi obtained by his expedition in the southern Bahr-el-Ghazal country.

PUBLISHED as parts of the current volume of the Kew Bulletin, appendix ii. furnishes a catalogue, with alternate pages left blank, of additions to the library during the year 1906, and appendix iii. contains a list of new garden plants for the same year. Again a large number of the new plants have been obtained from China, being introduced by Messrs. J. Veitch and Sons, derived from the collections made for them by Mr. E. H. Wilson. Four species of Primula are added to a previously long list, among them being the vivid blue-flowered *Primula deflexa*. Of new species from Brazil a dozen are recorded, all except *Asplenium laceratum* being orchids.

A DISCUSSION, mainly theoretical, of the much-debated question of the water supply in plants, by Dr. A. Ursfruny, appears in the *Biologisches Centralblatt* (vol. xxvii., Nos.

1, 2, and 3). The author is a strong advocate of the important part taken by living parenchymatous cells in the ascent of sap, favouring the view that they act chiefly as intermediate pumping stations. It is noticeable that the explanation offered by Askenasy receives brief consideration, and no mention is made of the papers and investigations contributed to the subject by Dixon and Joly or other British workers.

UNDOUBTEDLY the greatest novelty at the rubber exhibition held in Ceylon last August was the sample of pressed or blocked rubber sent from a plantation in the Malay States. As blocked rubber possesses several advantages over "biscuit" rubber, an early opportunity was taken by Dr. J. C. Willis and Mr. M. K. Bamber to prepare an experimental block with creosote to ascertain whether it was suitable for shipment to Europe. The details of the experiment are given in vol. iv., No. 1, of the Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, from which it will be seen that, although the block contained a considerable amount of moisture, the price of the sample compared favourably with the best biscuit.

IT is improbable that students of natural history are sufficiently familiar with Crabbe's poetical works to express an opinion on his descriptions of birds and plants. An article on Crabbe as a poet is contributed by the Rev. J. Vaughan to the February number of the *Monthly Review*, claiming that his descriptions of scenery are characterised by their distinctness and accuracy. The botanical references in his writings are practically confined to the district of Aldeburgh, in Suffolk, as in the allusion to the salt-marshes where "Samphire-banks and salt-wort bound the flood," &c. But his interest in botany extended much beyond word painting; he was a keen collector, and knew the haunts of such rare plants as *Trifolium suffocatum*, *Pisum maritimum*, and *Urtica pilulifera*; also several note-books still extant indicate that he ardently followed the progress of knowledge with regard to grasses, sedges, and cryptogams.

THE current issue of the Quarterly Journal of the Geological Society (vol. lxiii., part i.) contains a valuable paper by Mr. W. R. Baldwin-Wiseman on the influence of pressure and porosity on the motion of subsurface water. It contains an able summary of the more important investigations of the behaviour of underground water, and shows that by the careful study of the hydrological map of a district which has been surveyed with some exactitude, it is possible to gain a considerable knowledge of the details of the geological structure of the district which might not otherwise be available, and to obtain at the same time valuable data for the scientific solution of the water-supply problems of that district.

THE recent remarkable development of the American iron industry is discussed in some detail by Mr. E. C. Eckel in the *Engineering Magazine* (vol. xxxii., No. 5). Dealing with the important subject of ore reserves, he shows that, on the assumption that the demand for iron ore during the present century may range from 50 to 100 million tons annually, the Lake Superior district would last for from twenty-five to fifty years more if it supplied the entire United States. But, counting on the known reserves elsewhere in the United States, the ore will last for a much longer period, though, of course, it must necessarily show a gradual but steady increase in value. Electric smelting will, he considers, have little influence on the general development of the iron and steel industries until fuel supplies become more scanty than they are at present. Considerably more practical results to the industry can be expected from the nodulising process of treating ore dust. This process accomplishes both the consolidation and desulphurising of the material, and its chief advantage, as compared with the older briquetting and roasting processes, arises from the fact that the rotary kiln employed is distinctly an effective labour-saving device.

THE remarkable paper which Mr. Dugald Clerk read before the Institution of Civil Engineers on February 26 brings us appreciably nearer a complete understanding of the thermodynamics of the internal-combustion engine. He examined the results of the tests made by the institution committee on the standards of efficiency of internal-combustion engines, and gives the results of further experiments on the large engine used in the test, with the view of finding the true heat distribution of the engine. Tables are given showing the ideal efficiencies for different compressions using the specific heat values given, and show that roughly the air standard is 20 per cent. too high, and that if γ, the ratio of specific heat at constant pressure to specific heat at constant volume, be taken as 1·285 for the explosion line and 1·37 for the compression line, the change of specific heat between 1700° C. and 1000° C. commonly used in practice is too small to produce much error. More investigation is, however, required before even the apparent specific heat values can be accurately known for the various mixtures used in internal-combustion motors. For a given expansion the best engines have approached very closely to the theoretical realisation of their cycle. The complete suppression of all heat losses due to conduction, &c., on the explosion expansion strokes could only increase the indicated power by about 13 per cent. It is satisfactory to find that the gas engine is so nearly perfect.

IN his recent notice of Dr. E. W. Scripture's work on experimental phonetics (February 21, p. 392), Prof. McKendrick pointed out that though mention is made in the work that Prof. Weber, with Prof. Schneebeli, applied the Fourierian analysis to a vowel curve, no date is given when this was done. Dr. C. E. Guillaume, of the Bureau international des Poids et Mesures, Sèvres, who was formerly Prof. Schneebeli's assistant, writes to say that the results of researches on the harmonic analysis of vowel sounds during the summer of 1878 were communicated to the Société des Sciences naturelles de Neuchâtel on November 21 of that year. The paper by Fleeming Jenkin and J. H. Ewing referred to by Prof. McKendrick was communicated to the Royal Society of Edinburgh on June 3 and July 1, 1878, and was published in part iii. of vol. xxviii. of the Transactions, which is dated 1879.

WE have received from Messrs. Shelley W. Denton and Co., 99 Regent Street, W., samples of their patent butterfly tablets, containing handsome tropical butterflies and moths, mounted on a special plaster background, and covered with glass in such a manner as to exhibit the wings, antennæ, &c., to perfection, while preserving the specimens from almost any injury short of the actual breakage of the glass cover or of the tablet itself. We believe the process is American, and have been familiar with Messrs. Denton's method for some years; and we are quite ready to concede that it possesses *most* of the merits claimed for it by the firm in the circular which they have sent us. But when they say that the specimens "preserve their rich colours intact," and "they make magnificent wall, table, or mantel ornaments," we can

only point out that light, especially direct sunlight, is always very destructive to the colours of butterflies (though some colours fade more quickly than others), and though they will preserve their colours fairly well for centuries *if kept from the light*, we should strongly recommend any person who values specimens of butterflies to keep them carefully covered, except when actually undergoing inspection.

WE have before us copies of the reports of the U.S. National Museum, Washington, for the years ending June 30, 1905, and June 30, 1906. These reports are for the future to be restricted to accounts of the administrative operations of the museum. The interesting and well-illustrated papers based on the collections of the museum, which in past years have appeared in the appendix to the reports, are for the future to be published in other series. The report for the year ending June 30, 1906, shows that the total number of accessions received by the museum during that year was 1516, comprising 257,605 specimens, of which 8232 were assigned to the department of anthropology, 227,633 to the department of biology, and 21,740 to the department of geology. In ethnology, large accessions were received from Arizona and New Mexico, the Philippine Islands, and Malaysia. The collections in physical anthropology were mainly enriched by material from Malaysia and from ancient Indian ruins and mounds in the western parts of the United States. The most important addition to the biological department was the collection of 75,000 American Lepidoptera given by Mr. William Schaus, and, besides these, 33,000 insect specimens were received through the U.S. Department of Agriculture. In view of annual additions such as these, it is not surprising to learn that "year by year the exhibition cases have been brought closer and closer together, and great spaces have been shut off from the public view to permit of the shelter of thousands of new accessions." Fortunately, the new building for the museum is making satisfactory progress, and its completion will make it possible to reveal to visitors the wealth of scientific material which has been amassed in recent years.

THE untrustworthiness of the underground conduit system for tramways when confronted with a heavy snowfall is once more brought to our notice in the reply of the manager of the Grand Berlin Tramways Company to the criticisms passed upon the recent breakdown of the few underground conduit lines in Berlin. Assertions were made that with the same system other towns on the Continent were free from interruption to their tramways during the recent fall of snow, but the manager in his reply clearly shows that, with the exception of Vienna, all the leading towns on the Continent in which the underground conduit system is employed were in a similar plight, and in Budapest the tramways were completely stopped for several days. The report of the Brussels Tramway Company also states that their troubles during the snowy period were due to the underground conductors, and that the working of the lines could not be carried out with a repetition of similar events, in spite of the fact that a large reserve plant was available. Vienna is almost an ideal city for conduit work, and has nothing like the traffic of Berlin, and is not, therefore, a fair comparison of everyday working conditions such as we have in London. We have before pointed out in NATURE the difficulties attendant on the working of the underground conduit system directly any unusual weather sets in, and the above reports fully bear out the contention that the underground conduit system is not so perfect as some of its disciples would have us believe.

UNDER the title "Erinnerungen an Johannes Wislicenus," Dr. W. Sonne has published (Leipzig: W. Engelmann, pp. 36, price 1.20 marks) a number of personal recollections of Wislicenus during the years 1876–1881, when, at the height of his activity, he was filling the chair of professor of chemistry at Würzburg. It was during this period that his work on ethyl acetoacetate was published, partly in collaboration with Conrad and others. In 1880 he was associated with Hantzsch, who succeeded him both at Würzburg and Leipzig. The "Erinnerungen" are of value as throwing light on the inspiring personality of Wislicenus, and may be regarded as supplementing the more complete accounts recently given of Wislicenus's work by Prof. Beckmann and Prof. W. H. Perkin, jun.

MUCH confusion arises at the present time from the lack of understanding, either here or abroad, as to the exact sense in which the various names applied to proteins and their derivatives shall be used. Difficulty is created by the use of a term in different senses, as well as ambiguity of meaning in some cases. The Chemical Society has for some time had this matter of nomenclature under consideration, and has just issued a series of recommendations in its Proceedings (vol. xxiii., No. 321). The first two recommendations are:—(1) The word proteid—which is used in different senses in this country and in Germany—should be abolished. (2) The word protein is recommended as the general name of the whole group of substances under consideration. It is at present so used both in America and Germany. It admits readily of the use of such derived words as protease and proteose. If used at all, the term albuminoid should be regarded as a synonym of protein.

MESSRS. CROSBY LOCKWOOD AND SON have published a second edition of Mr. George Clapperton's "Practical Paper-making." The work has been carefully revised and enlarged by twenty pages, so as to bring the information up to date.

MESSRS. MACMILLAN AND CO., LTD., have issued separately certain parts of "An Introduction to Practical Geography," by Mr. A. T. Simmons and Mr. Hugh Richardson, which was reviewed in our issue for May 10, 1906 (vol. lxxiv., p. 27). Section i., maps; section ii., the globe; and section iii., climate, may be obtained in small volumes bound in limp cloth, and the price of each is 1*s*.

THE Bulletins of Miscellaneous Information issued during 1906 from the Royal Botanic Gardens, Kew, have been bound together in a single volume, the price of which is 4*s*. The work can be obtained in London from Messrs. Wyman and Sons, Ltd., or through any bookseller. Reference has been made to separate bulletins from time to time in these columns, and botanical readers of NATURE are familiar with the general character of the publication.

OUR ASTRONOMICAL COLUMN.

PERTURBATIONS OF HALLEY'S COMET.—From an investigation of the Jupiter perturbations of Halley's comet, Messrs. Cowell and Crommelin find that the perihelion passage of that comet will probably occur about a fortnight earlier than the date given by Pontécoulant, that is, in the first half of May, 1910. What is more important, they also find that Pontécoulant's perturbations were about ten times too great, and consequently the perihelion distance will be appreciably the same (0·59) as at the last return, instead of being shifted some nine million miles nearer to the earth as found by the French investigator (Monthly Notices, vol. lxvii., No. 3, January).

STARS HAVING PECULIAR SPECTRA.—Circular No. 124 of the Harvard College Observatory contains the particulars of a number of variable stars and other objects which the Henry Draper memorial photographs, examined by Mrs. Fleming, show to have peculiar spectra.

The chief peculiarities are bright or multiple hydrogen lines, as, for example, in the spectrum of B.D.+47°·939, a 4·5 magnitude star in Perseus, in which Hβ is bright and the lines Hγ and Hδ appear to be double, probably because fine bright lines are superposed on them. A star in Scorpio, of magnitude 7·1, is found to have a spectrum similar to that of ζ Puppis. Several of the variable stars mentioned show a range of about five magnitudes.

SIMULTANEOUS DISPARITION OF JUPITER'S FOUR SATELLITES.—From a study of the phenomena of Jupiter's satellites, Signor Enzo Mora finds that on October 3, 1907, all four of the larger moons will be invisible, for several minutes, at the same time, and, as this is a rare occurrence, he directs attention to the matter in No. 4148 of the *Astronomische Nachrichten*. From 7h. 48m. to 7h. 54m. (Greenwich Civil Time) No. 1 will be eclipsed and occulted, No. 2 will be in transit, No. 3 will be eclipsed, and No. 4 occulted. The satellites will again be invisible at 9 p.m. on the same evening. The last time this phenomenon occurred was October 21, 1895, and, after October next, it will not occur again until October 22, 1913.

PHOTOGRAPHS OF FAINT STARS.—In Circular No. 123 of the Harvard College Observatory Prof. E. C. Pickering outlines a plan by which the information to be gathered from photographs of stellar regions, taken by numerous observers in various countries, may become readily available to anyone in search of such information. For stars of the thirteenth magnitude and brighter, the Harvard collection of photographs largely supplies the necessary data. For example, for each of the stars of magnitude 5·0 and brighter, some 2000 in number, the collection contains about one thousand photographic images taken during the last twenty years; similarly, for the thirteenth magnitude stars, about five million in number, there are about 200 images of each.

Prof. Pickering now suggests that anyone having in their possession photographs which might furnish useful information, such as the earlier appearance of Novæ, variable stars, &c., should publish particulars of the same, or should forward to him the necessary information in order that it may be included in a publication which the Harvard authorities are preparing, and so become available generally.

MODEL TO ILLUSTRATE EFFECTS OF THE EARTH'S ROTATION.—In No. 7 (February, 1907) of the *Comptes rendus* M. G. Blum describes a simple apparatus for reproducing the phenomena observed in the Foucault-pendulum experiment for showing the earth's rotation. Briefly, the apparatus consists of a sphere, representing the earth, and a small pendulum which may be made to oscillate on its surface in any latitude. The sphere rotates on an axis, and is slotted along a meridian so that the gallows carrying the pendulum may be clamped on to it at different points representing different latitudes. The oscillation of the pendulum—which consists of a thin wooden rod with a small wooden bob—is produced by a coiled spring, and always takes place in a plane normal to the sphere. With this apparatus the rotation of the plane of oscillation with regard to that of the sphere may be shown to be equal in period and opposite in sense at the poles, and to have a slower period as it approaches the equator, the change being so marked that it can be readily seen and its nature recognised.

PROMINENCE OBSERVATIONS (1906).—No. 1, vol. xxxvi. (1907), of the *Memorie della Società degli Spettroscopisti Italiani* contains a posthumous note of Prof. Mascari giving the results of the solar-prominence observations made at Catania during the first half of 1906. Three hundred and forty prominences were observed on eighty-seven days, giving a daily frequency of 3·91. In the northern hemisphere the daily frequency was 2·32 and the mean heliographic latitude 31°·6, the corresponding figures for the southern hemisphere being 1·59 and 29°·2 respectively.

METEOROLOGICAL OBSERVATIONS.

SUNSHINE and Snowfall in 1906.—In *Symons's Meteorological Magazine* for January, Mr. R. H. Curtis gives an interesting summary, with map, of the bright sunshine over the British Isles, registered by the Campbell-Stokes (burning) recorder. The year was one of the sunniest on record; the most favoured region was the English Channel, all stations from Torquay to Lowestoft recording approximately 2000 hours of sunshine. At inland stations the amount became less, yet, broadly speaking, all the region south of a line drawn from the Humber to the Bristol Channel received 200 hours more than the yearly average. In north-west Scotland the amount was below 1200 hours, which was not far from the average of that district. The most brilliant months (relatively to their possible amounts) were February, April, June, July, and September; the most sunless months were May and November, in both of which the amounts recorded were generally below the average.

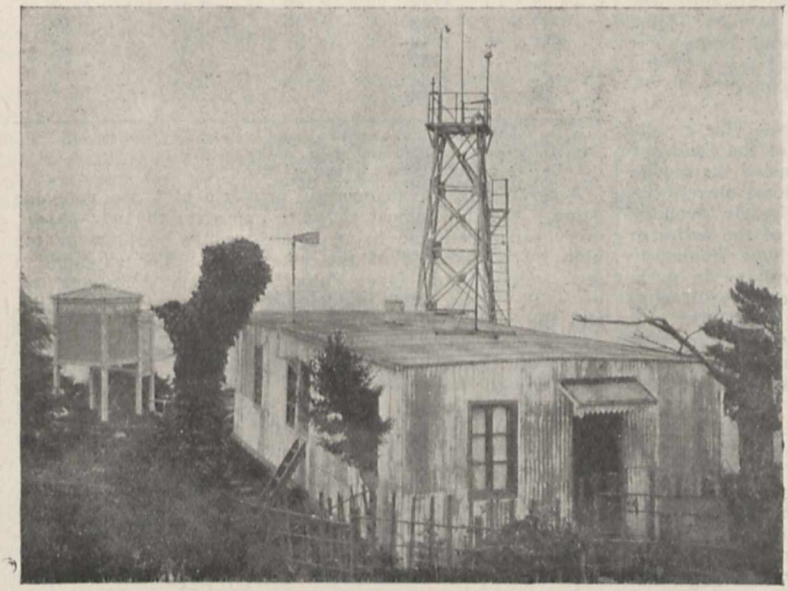
The snowfall is preliminarily dealt with by the editor, with especial reference to the storms between December 25–30, which occurred over nearly the whole of the British Isles. Considerably more than half the kingdom received above 5 inches, and some districts, especially north-east England and the southern uplands of Scotland, from 1 foot to 2 feet in depth. In the south of Scotland trains were blocked; Aberdeen was isolated for several days, and a most serious railway collision occurred near Arbroath. Although the greatest amounts recorded were in Scotland, Dr. Mill points out that the severity of the storm in Ireland, where more than a foot was recorded in the north and west, was noteworthy, owing to its usual immunity from heavy snowfalls, an amount of 5 inches over wide districts being very unusual there.

Rainfall of Scotland in May, 1906.—In discussing this subject in the Journal of the Scottish Meteorological Society, Mr. A. Watt shows that the rainfall of Scotland in that month was of a very exceptional character; in the eastern districts, generally, the fall was much the heaviest in May during the last fifty years. The rainfall on the east coast was heavier than that on the west; only a few scattered stations towards the north-west did not receive as much as 3 inches, about nine-tenths of the mainland received at least 4 inches, while a large area in the south and south-east and other isolated parts received 6 inches and upwards, or about thrice their normal amount. A note by Mr. R. C. Mossman on the conditions experienced by himself in the Greenland Sea during the month in question shows that the weather there was unusually inclement; the characteristic features were high barometric pressure, accompanied by strong north-west and north winds and gales, very low mean temperature, and densely overcast skies. Mr. Mossman states that there can be little doubt that the Arctic anticyclone was the dominating factor in the production of the abnormal rainfall in Scotland, and also of the unusually high temperatures observed in Russia at the same time, referred to in Mr. Watt's paper.

The Atmosphere in the Tropics.—In the Proceedings of the American Academy of Arts and Sciences for December, 1906, Mr. A. L. Rotch gives the results of the Franco-American expeditions undertaken at the expense of M. Teisserenc de Bort and himself to prove, by means of kites and unmanned balloons, the direction of the upper return currents above the trade-wind region of the North Atlantic. For this purpose M. Teisserenc de Bort purchased and equipped the steam yacht *Otaria*, of 350 tons, and expeditions were made in the summer of 1905 and in the winter (February) of 1906. With regard to the results of the first expedition, Mr. Rotch states:—(1) north of Madeira and near the Azores the upper winds are chiefly from west and north-west; (2) winds blowing towards the equator are from north-east to east in the lower region, and generally from north-west to north-east above 1000 metres; (3) the return currents from the equator, or anti-trades, are formed by winds having a southerly component, being generally south-west in the latitude of the Canaries, and south-east near the Cape Verdes. As most of the observations of direction of the upper currents found by Prof. Hergesell during the cruises of the *Princesse Alice*

in 1904–5 differ radically in showing no southerly component, the *Otaria* was sent again to the south and west of the region which had been explored in the preceding summer. Mr. Rotch states* that the upper anti-trade is shown both by the balloons and the drift of the clouds between 3000 metres and 4000 metres, and that the classic observations of the return trade on the Peak of Teneriffe indicate a general phenomenon, and agree with those obtained over the open ocean by the recent expedition. Prof. Hergesell's remarks upon this subject were referred to in NATURE of December 27, 1906 (p. 211).

Meteorological Observations on the Summit of the Tsukubasan, Japan.—The establishment of this first-order observatory, and the determination of the force of gravity and exact geographical position, are due to the interest taken in physical science by H.I.H. Prince Yamashina. The observatory is situated on the most westerly peak of the mountain, in lat. 36° 13′ 21″ N., long. 140° 5′ 47″ E., about forty miles north-east of Tokio, at an altitude of 2852 feet; it commands the view of the surrounding district for many miles to the north and west, while to the south and east it has an open view of the wide expanse of the Pacific Ocean. Its position is therefore extremely favourable for studying the conditions of the atmosphere at that height. As connecting links, intermediate stations have been established near the little village of Tsukuba, at an altitude of 787 feet, and at the base of the south-west of the mountain, 98 feet above sea-level. The illustration represents the peak observatory, which is constructed of wood and zinc, the main objects being durability and usefulness, without any attempt at ornamentation. On the roof are seen the rain-gauges, lightning conductor, and wind-vane; close to the main building, on the north-east, stands a steel tower carrying another lightning conductor, anemometers for recording both horizontal and vertical movements of the wind, and a sunshine recorder, while the thermometer screen is seen to the south-west of the building. It goes without saying that the instruments are of the best make, although the sunshine recorder is of the photographic (Jordan) type, not the burning (Campbell-Stokes) pattern. The latter instrument alone is now used at the stations of the British Meteorological Office, as giving strictly comparable results. The observing staff consists of a director and five assistants; at the time of the publication of the first report, for the year 1902, the observatory and subsidiary stations were under the supervision of Mr. Okada, adjunct of the Central Meteorological Office at Tokio, the control of the observers and other details being undertaken by Mr. J. Sato, chief observer at the peak station. The computation of the mean and extreme values for 1902 from hourly readings for all three stations, and tables showing the ranges and wind frequency and velocity, are carefully prepared, but no general textual summary of results is given. At the base station only the rainfall observations are complete for the year; the total fall was 63·72 inches, and at the peak station 62·82 inches. The absolute ranges of the barometer at the summit and intermediate stations were practically the same, being 1·87 inches and 1·78 inches respectively. The mean annual temperatures at these two stations were 48°·2 F. and 55°·2 F., and the absolute ranges 39°·2 and 37°·4 respectively. The resulting wind direction at the summit, computed from the records of a Robinson's anemometer, was N. 82° E., resultant velocity 0·39 metre per second (0·87 mile per hour); the mean hourly velocity, irrespective of direction, was approximately 17·2 miles.



The Meteorological Observatory on the Tsukuba-an.

Meteorology of India.—The Meteorological Department of India has issued a memorandum on the weather conditions during October and November, 1906, with a forecast of the rainfall in northern India and of the snowfall on the neighbouring mountain areas during the cold weather of 1906–7. Dr. Walker states that on the average of the whole country there was a defect of 22 per cent. in the rainfall of October and of 20 per cent. in November. The temperature conditions were determined by the distribution of rainfall; in the latter month the weather was unusually warm over practically the whole of the country, and especially in the North-Western Provinces. From information available, the snowfall also appears to have been less than usual. Among other factors affecting the cold-weather season, the director points out (1) that the active state of the sun during the past year is an element that should be taken into account; the number of sun-spots observed in 1906 is in moderate excess, which fact, if taken alone, suggests that a severe winter is rather more likely than a mild one. (2) That the mean of the departures of November rainfall at Zanzibar and Seychelles is −1·8 inches, which, taken by itself, suggests that the approaching cold-weather precipitation may be somewhat lighter than usual. All things considered, the final conclusion is that there is no reason for expecting any large departure from normal conditions.

Meteorological Observations in Cape Colony.—The report of the Meteorological Commission for the year 1905 shows that a large amount of useful work is being carried out in rather adverse circumstances. The sum received from the Parliamentary Grant for the year did not exceed 862*l.*; the supply of instruments and reduction of anemometrical and other observations have consequently been curtailed, while no general inspection of stations has been made since 1901. The results are published for a large number of ordinary meteorological and rainfall stations, some of which belong to adjacent territories outside the boundaries of Cape Colony; the report also contains a useful monthly chronicle of the weather by Mr. C. M. Stewart (secretary), and special tables of the maximum daily rainfall at various stations. The mean rainfall for the year, deduced from all the stations, was 23·77 inches, occurring on sixty-five days; the amount was only about 0·1 per cent. below the average for 1885–1894, and was an increase of 2·61 inches above the mean for 1904. The four largest records in one day were 11·33 inches at Evelyn Valley, on October 10; 10·70 inches at Durban, on June 1; 10·37 inches at Vogel Vlei, on April 9; and 10·18 inches at Forestbourne, on October 10. Thunderstorms were unusually frequent in December, and practically absent in July. The highest temperature recorded was 119°·5 at Main, on November 19, and the lowest

17°·0 at Moyeni, Basutoland, on August 23. The mean yearly value of the absolute maxima was 86°·9, and of the corresponding minima 41°·6. The mean temperature for the year was 0°·9 below the average. The stormiest month was October, and the calmest was April.

We have also received the official meteorological year-books for South Australia (1904) and Mysore (1905). Both of these works contain valuable means for previous years.

Forty Years of Southern New Mexico Climate.—Bulletin No. 59 of the New Mexico College of Agriculture contains the meteorological data recorded at the experimental station from 1892 to 1905 inclusive, together with results of temperature and rainfall observations at other stations in the Mesilla Valley for most of the years between 1851 and 1890, published some years ago by General Greely in a "Report on the Climate of New Mexico." The station is situated in lat. 32° 15′ N., long. 106° 45′ W., and is 3868 feet above sea-level. The data have a general application to those portions of southern New Mexico with an altitude less than 4000 feet. The mean annual temperature for the whole period was 61°·6, mean maximum (fourteen years) 76°·8, mean minimum 41°·4, absolute maximum 106° (which occurred several times), absolute minimum 1° (December, 1895). The mean annual rainfall was 8·8 inches; the smallest yearly amount was 3·5 inches, in 1873, the largest 17·1 inches, in 1905. Most of the rain falls during July, August, and September. The relative humidity is low, the mean annual amount being about 51 per cent. The bulletin was prepared by J. D. Tinsley, vice-director of the station.

Meteorological Observations in Germany.—The results of the observations made under the system of the Deutsche Seewarte, Hamburg, for 1905, at ten stations of the second order, and at fifty-six storm-warning stations, have been received. This is the twenty-eighth yearly volume published by the Seewarte, and forms part of the series of German meteorological year-books. We have frequently referred to this excellent series, and the volume in question is similar in all respects to its predecessors; it contains most valuable data relating to the North Sea and Baltic coasts. We note that the sunshine at Hamburg was only 29 per cent. of the possible annual amount, and that there were 103 sunless days; the rainfall was 25·9 inches, the rainy days being 172 in number.

VOX POPULI.

IN these democratic days, any investigation into the trustworthiness and peculiarities of popular judgments is of interest. The material about to be discussed refers to a small matter, but is much to the point.

A weight-judging competition was carried on at the annual show of the West of England Fat Stock and Poultry Exhibition recently held at Plymouth. A fat ox having been selected, competitors bought stamped and numbered cards, for 6*d.* each, on which to inscribe their respective names, addresses, and estimates of what the ox would weigh after it had been slaughtered and "dressed." Those who guessed most successfully received prizes. About 800 tickets were issued, which were kindly lent me for examination after they had fulfilled their immediate purpose. These afforded excellent material. The judgments were unbiassed by passion and uninfluenced by oratory and the like. The sixpenny fee deterred practical joking, and the hope of a prize and the joy of competition prompted each competitor to do his best. The competitors included butchers and farmers, some of whom were highly expert in judging the weight of cattle; others were probably guided by such information as they might pick up, and by their own fancies. The average competitor was probably as well fitted for making a just estimate of the dressed weight of the ox, as an average voter is of judging the merits of most political issues on which he votes, and the variety among the voters to judge justly was probably much the same in either case.

After weeding thirteen cards out of the collection, as being defective or illegible, there remained 787 for discussion. I arrayed them in order of the magnitudes of the estimates, and converted the *cwt.*, *quarters*, and *lbs.* in which they were made, into lbs., under which form they will be treated.

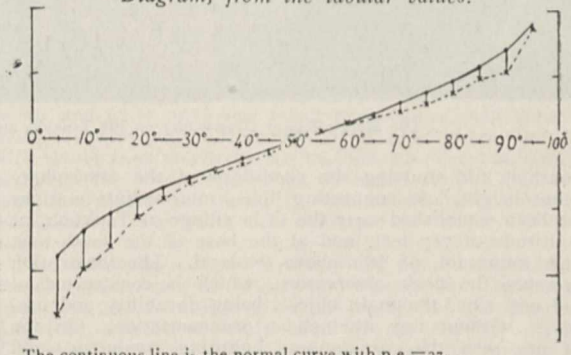
Distribution of the estimates of the dressed weight of a particular living ox, made by 787 different persons.

Degrees of the length of Array 0°—100°	Estimates in lbs.	Centiles: Observed deviates from 1207 lbs.	Centiles: Normal p.e =37	Excess of Observed over Normal
°				
5	1074	−133	−90	+43
10	1109	− 98	−70	+28
15	1126	− 81	−57	+24
20	1148	− 59	−46	+13
q_1 25	1162	− 45	−37	+ 8
30	1174	− 33	−29	+ 4
35	1181	− 26	−21	+ 5
40	1188	− 19	−14	+ 5
45	1197	− 10	− 7	+ 3
m 50	1207	0	0	0
55	1214	+ 7	+ 7	0
60	1219	+ 12	+14	− 2
65	1225	+ 18	+21	− 3
70	1230	+ 23	+29	− 6
q_3 75	1236	+ 29	+37	− 8
80	1243	+ 36	+46	−10
85	1254	+ 47	+57	−10
90	1267	+ 52	+70	−18
95	1293	+ 86	+90	− 4

q_1, q_3, the first and third quartiles, stand at 25° and 75° respectively.
m, the median or middlemost value, stands at 50°.
The dressed weight proved to be 1198 lbs.

According to the democratic principle of "one vote one value," the middlemost estimate expresses the *vox populi*, every other estimate being condemned as too low or too high by a majority of the voters (for fuller explanation see "One Vote, One Value," NATURE, February 28, p. 414). Now the middlemost estimate is 1207 lb., and the weight of the dressed ox proved to be 1198 lb.; so the *vox populi* was in this case 9 lb., or 0·8 per cent. of the whole weight too high. The distribution of the estimates about their middlemost value was of the usual type, so far that they clustered closely in its neighbourhood and became rapidly more sparse as the distance from it increased.

Diagram, from the tabular values.



The continuous line is the normal curve with p.e.=37.
The broken line is drawn from the observations.
The lines connecting them show the differences between the observed and the normal.

But they were not scattered symmetrically. One quarter of them deviated more than 45 lb. above the middlemost (3·7 per cent.), and another quarter deviated more than 29 lb. below it (2·4 per cent.), therefore the range of the two middle quarters, that is, of the middlemost half, lay within those limits. It would be an equal chance that the estimate written on any card picked at random out of the collection lay within or without those limits. In other words, the "probable error" of a single observation may be reckoned as ½(45+29), or 37 lb. (3·1 per cent.). Taking this for the p.e. of the normal curve that is best adapted for comparison with the observed values, the results are obtained which appear in above table, and graphically in the diagram.

The abnormality of the distribution of the estimates now becomes manifest, and is of this kind. The competitors may be imagined to have erred *normally* in the first instance, and then to have magnified all errors that were negative and to have minified all those that were positive. The lower half of the "observed" curve agrees for a large part of its range with a normal curve having the p.e.=45, and the upper half with one having its p.e.=29. I have not sufficient knowledge of the mental methods followed by those who judge weights to offer a useful opinion as to the cause of this curious anomaly. It is partly a psychological question, in answering which the various psychophysical investigations of Fechner and others would have to be taken into account. Also the anomaly may be partly due to the use of a *small* variety of different methods, or formulæ, so that the estimates are not homogeneous in that respect.

It appears then, in this particular instance, that the *vox populi* is correct to within 1 per cent. of the real value, and that the individual estimates are abnormally distributed in such a way that it is an equal chance whether one of them, selected at random, falls within or without the limits of −3·7 per cent. and +2·4 per cent. of their middlemost value.

This result is, I think, more creditable to the trustworthiness of a democratic judgment than might have been expected.

The authorities of the more important cattle shows might do service to statistics if they made a practice of preserving the sets of cards of this description, that they may obtain on future occasions, and loaned them under proper restrictions, as these have been, for statistical discussion. The fact of the cards being numbered makes it possible to ascertain whether any given set is complete.

FRANCIS GALTON.

THE WORK OF THE OPTICAL SOCIETY.[1]

THOUGH it is perhaps seldom that the Transactions of the Optical Society contain much record of original research, yet they often furnish matter of considerable value to the practical optician, and will usually be found to contain more than one paper of importance to the student of optics. The first paper in the present volume will have interest for many readers. It is a short and clear statement, by one well qualified to judge, Mr. W. A. Dixey, of the case for the use of periscopic lenses in spectacles. A periscopic lens, as defined by Mr. Dixey, is one through which its wearer can look obliquely as well as directly without his vision being impaired by radial astigmatism. The result is attained either by deepening the curves of the lens so as to produce an approximation to a sphere the centre of which coincides with the centre of rotation of the eye, or by the use of toric lenses. A careful reading of Mr. Dixey's paper would probably lead many wearers of spectacles to pay another visit to the optician.

The paper by Mr. Theodore Brown, on direct stereoscopic projection, is of special interest. It describes an ingenious device for obtaining stereoscopic effects in pictures projected on a screen, of which probably more will be heard. The argument is that in binocular vision the stereoscopic effect is due to the fact that the two images of the same object in the two eyes are not formed in similar positions on the retina, and that it should be possible to produce stereoscopic effects even when one eye only is used if by some means two simultaneous pictures can be formed on the retina in appropriate positions. Owing to the permanence of retinal impressions, this can be effected by throwing on the screen with rapid alternation the two stereoscopic pictures in somewhat displaced positions. The displacement is produced by giving a motion to the projection camera, and the stereoscopic can be combined with the "bioscopic" effect by the use of a kinematograph mechanism. It is clear from the paper and the discussion that further perfection of detail is necessary to produce completely satisfactory results, but there seems no reason why the difficulties should not be overcome. There is, however, some reason for suggesting that perhaps a one-eyed spectator would be the most appreciative.

In "A Method of Testing Prisms," Mr. S. D. Chalmers, the head of the optical department at the Northampton Institute, suggests some useful applications of the method of auto-collimation for the determination of the angles of prisms to the highest possible accuracy. We would direct attention especially to the procedure suggested for the measurement of one of the angles of a 60° prism ABC. Rays entering perpendicular to the face BC are totally reflected at 30° from CA or AB, and reflected normally at AB or CA, emerging again approximately perpendicular to BC. From the separation of the incident and emergent rays the error in the angle A can be determined. Only one reflection takes place normally at a glass-air surface, and there is, therefore, no difficulty in seeing the image. Simultaneous observation of the direct reflection from BC aids in setting the prism. A similar method can readily be applied in other instances, and the figures in the paper suggest at once the procedure in the cases which occur most frequently. The lack of parallelism in plane parallel glass can also be tested in this manner. Rigidity is, of course, essential in the apparatus to be employed for the observations, and Mr. Chalmers has obviously given some attention to details in the construction of a suitable auto-collimator; drawings or diagrams of this would have added to the value and interest of the paper.

Mr. L. W. Phillips, student member, in a paper on the measurement of absorption in tinted glasses, describes some observations on the absorption of light by coloured glasses, such as are used for spectacles, a "flicker" photometer being employed for the measurements. The method does not admit of great accuracy, but is no doubt useful within certain limits for rough work of the kind suggested. It raises, however, some vexed questions as to the photometry of coloured lights, and some points of interest in relation to the "flicker" instrument were brought up in the discussion by Dr. Garnett and others.

A presidential address by Prof. Silvanus P. Thompson, on the early literature of optics, demands no more than passing mention here, great though its interest must have been to those who had the pleasure of listening to it. The volume closes with a contribution by Mr. A. T. Bull, entitled "Some Notes on the Nature of Vision." The paper, being essentially of the nature of notes, passes rapidly over many points of interest in connection with the mechanism of vision and the molecular and other phenomena accompanying it. Various topics are thus touched on, from the accuracy of the photometric results obtained with rotating sectors to the difficulties yet requiring explanation on the Darwinian theory in regard to the process of evolution of vision. The notes are suggestive, but would make more interesting reading if less loosely put together.

We would venture to suggest, in conclusion, that the editing of the volume leaves something to be desired. It may be possible to interpret such phrases as "beep lenses on the Willaston principle," and to escape being deceived by the "dissimulation" of a photochemical body, but the fact that Lewis Carroll was a mathematician does not sufficiently justify such imitation of his playful extravagances in a scientific journal; and the volume is marred by many such misprints.

[1] Transactions of the Optical Society, London, Session 1904-5. Pp. 93. Price 10*s*.

THE COMPRESSIBILITY OF CRYSTALLINE ROCKS.[1]

THE latter-day revival of interest in geological physics has led to a keen demand for experimental data, the absence of which has hitherto rendered futile most speculation in this domain. Our almost complete ignorance of the simplest physical constants of rocks and the rock-forming minerals is easy to account for. The kind of investigation required is both difficult and laborious, calling for skill and practice as well as the appliances of a well-equipped physical laboratory; and the geologist may lack either the capacity or the opportunity for such re-

[1] "An Investigation into the Elastic Constants of Rocks, more Especially with Reference to Cubic Compressibility." By Prof. Frank D. Adams and Prof. Ernest G. Coker. Pp. 69. (Washington, D.C.: Carnegie Institution, 1906.)

searches. On the other hand, the professed physicist, interested in the properties of matter from a more general point of view, prefers to work on materials of a more tractable nature than those with which the geologist is concerned.

The memoir before us, the joint work of a geologist and an engineer, deals with the constants of elasticity of a number of crystalline rocks, and gives the results of a series of experiments made in the laboratories of McGill University at Montreal. The quantities investigated are among the prime desiderata of geological mechanics, being involved in the calculation of the velocity of propagation of earthquake shocks and in other important questions. The only data of this kind previously published seem to be open to serious criticism, and the contribution by Profs. Adams and Coker is specially opportune and welcome.

The authors describe the method employed and the precautions taken to ensure such accuracy as is possible. The rock is cut to the shape of a column 3 inches high and 1 inch in diameter, either square or circular in cross-section. The column is subjected to pressure applied perpendicularly upon its ends, and the resulting longitudinal compression and lateral extension are observed. In this way are obtained Young's modulus, E (the longitudinal stress divided by the longitudinal compression), and the ratio (m) of longitudinal compression to lateral extension (*i.e.* the reciprocal of Poisson's ratio). The modulus of cubical compression (D) is then calculated from the relation

$$D=\tfrac{1}{3}\left(\frac{m}{m-2}\right)E,$$

and the modulus of shear (C) from

$$C=\tfrac{1}{2}\left(\frac{m}{m+1}\right)E.$$

From the theoretical point of view these equations do not seem to be fairly applicable to the case in hand. A crystalline rock is an aggregate of many crystals, each of which is anisotropic; and in the case of such a rock as granite the crystals belong to a number of distinct minerals, differing as regards their elastic constants. The argument that an average isotropic effect will result from the random orientation of a large number of anisotropic crystals is not quite convincing. Nevertheless, the results found are reasonable and consistent, and go far towards justifying the method adopted.

When the relation of strain to stress is plotted on a diagram, it is seen in every case that the progressive loading gives a curve not very different from a straight line, while the corresponding line for unloading is a curve lying very near the other, and returning to the initial point. It follows that the rocks examined approximate nearly to perfect elasticity, and obey Hooke's law somewhat closely, and with small hysteresis, for pressures ranging up to 10,000 lb. or even 15,000 lb. to the square inch. Many of them compare favourably in these respects with cast iron. We quote some of the results obtained for the seventeen rocks examined. The figures are to be multiplied by 10^{11} to give the measure in C.G.S. units:—

	D	C
Cast iron	6·897 ...	4·132
Carrara marble	4·090 ...	2·171
Peterhead granite	3·300 ...	2·340
Quincy granite	2·750 ...	1·916
Nepheline-syenite, Montreal	4·290 ...	2·505
New Glasgow Anorthosite	5·760 ...	3·275
Sudbury diabase	7·329 ...	3·700

It appears that the granites offer less resistance, both to compression and to shearing, than the basic igneous rocks. The authors connect the greater compressibility of the granites with the presence of quartz, but the granites appear to be actually more compressible than that mineral. We should suppose rather that the alkali-felspars, which constitute the greater part of an ordinary granite, are notably more compressible than the ferro-magnesian silicates and lime-felspars; and this seems to be confirmed by the intermediate value found for the nepheline-syenite.[1] The general character of the rocks which compose the bulk of the earth's crust is doubtless fairly represented by the crystalline igneous rocks selected for investigation, and the average compressibility must lie between the highest and lowest values tabulated above. A simple average of all the igneous rocks examined gives a modulus of compressibility $4{\cdot}374\times10^{11}$, which is slightly less than that for plate glass. In such an average the acid rocks are probably over-represented, and the value consequently too low.

A. H.

[1] The authors cite Voigt's value for the compressibility of quartz. The more accurate determination by Amagat gives 4·212 in terms of the unit adopted above. For the felspars there are no known data.

CYANOGENESIS IN PLANTS AND THE CONSTITUTION OF PHASEOLUNATIN.

SINCE 1900 a considerable number of plants yielding prussic acid have been investigated in the Scientific and Technical Department of the Imperial Institute. Among these are *Lotus arabicus*, a plant which grows commonly along the valley of the Nile; *Sorghum vulgare*, widely cultivated as a cereal in tropical countries; the Lima bean (*Phaseolus lunatus*); common flax; and cassava (*Manihot utilissima*). The source of prussic acid in each of these cases has been proved to be a glucoside, which in the presence of water is decomposed by an enzyme, also occurring in the plant, yielding prussic acid, glucose, and a third neutral substance. Three of these glucosides have been fully studied by Prof. Dunstan and Dr. Henry. Lotusin, $C_{28}H_{31}O_{16}N$, from *Lotus arabicus*, is comparatively complex in structure, and is the lotoflavin ether of maltose cyanohydrin, lotoflavin being a yellow colouring matter isomeric with fisetin and luteolin, and belonging, like these, to the quercetin group of dyes. Dhurrin, $C_{14}H_{17}O_7N$, from *Sorghum vulgare*, is a dextrose ether of parahydroxybenzaldehyde cyanohydrin. Phaseolunatin, $C_{10}H_{17}O_6N$, which occurs in the Lima bean, flax, and cassava, has been shown to be a dextrose ether of acetone cyanohydrin (Phil. Trans., 1901, B, 515; 1902, A, 399; Proc. Roy. Soc., 1903, lxxii., 285; 1906, lxxviii., 145 and 152; British Association Reports, 1906, and *Ann. Chim. Phys.*, 1907, [viii.], x., 118).

In a paper communicated to the meeting of the Royal Society held on February 28, the same authors, in conjunction with Dr. Auld, gave the results of some further investigations carried out with the object of determining the nature of the dextrose residue present in phaseolunatin.

Fischer and others have shown that glucosides are divisible into two classes, derived respectively from the α and β forms of the hexoses, and that the glucosidolytic enzymes which occur in plants also belong to two groups, the one, typically represented by maltase, being capable of decomposing α-glucosides, and the other, of which emulsin is the best known, having the power of hydrolysing β-glucosides. From the results of the examination of the sugar initially produced when phaseolunatin is hydrolysed by the enzyme, which occurs in association with it in the Lima bean, it is clear that this is α-dextrose, and, therefore, that phaseolunatin is the α-dextrose ether of acetone cyanohydrin. It is the first naturally occurring glucoside of this type so far known.

This conclusion has rendered necessary a further investigation of the enzymes, which occur with phaseolunatin in the Lima bean, the flax plant, and cassava. The mixture of enzymes, prepared in the usual manner from the Lima bean, decomposes amygdalin and salicin, and may therefore be assumed to contain emulsin. The latter, prepared from sweet almonds, has, however, no action on phaseolunatin, and this is in harmony with the constitution now assigned to the latter glucoside, since the emulsin of almonds has been shown to hydrolyse only glucosides containing β-sugar residues.

It has now been found that the Lima bean contains, in addition to emulsin, a second enzyme, which is of the maltase type, and that the decomposition of phaseolunatin, which takes place when the beans are ground up in water, is due to the action of the maltase-like enzyme. The maltase of yeast is also capable of decomposing phaseolunatin, so that the enzyme which occurs in the Lima bean appears to be of the same type as the maltase present in yeast.

The mixtures of enzymes occurring in association with phaseolunatin in the flax plant and in cassava have also been investigated and found to behave in the same manner as the mixture of enzymes prepared from the Lima bean.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. C. Punnett has been re-elected for three years to a fellowship at Gonville and Caius College, in recognition of his researches in zoology, and Mr. C. M. Doughty, the distinguished Arabian traveller, author of "Arabia Deserta" and other works, has been elected an honorary fellow of the same college.

The general board of studies will proceed shortly to the appointment of a university lecturer in pathology in connection with the special board for medicine, to hold office until December 31, 1911. The annual stipend is 100*l*. Candidates are requested to send their applications, with testimonials, on or before Tuesday, March 12.

Prof. A. C. Seward, professor of botany, has been nominated to represent the University at the celebration of the three-hundredth anniversary of the death of Ulisse Aldrovandi, to be held in Bologna in June.

The council of the Senate has appointed Prof. G. Sims Woodhead as the representative of the University of Cambridge on the council of the Lister Institute of Preventive Medicine, in the place of the late Sir Michael Foster.

The general board of studies has appointed Dr. G. S. Graham-Smith to be university lecturer in hygiene for the five years from January 1, 1907, to December 31, 1911, and the appointment has been confirmed by the special board for medicine.

The governing body of Gonville and Caius College proposes in June next to make an election to the Sir Thomas Gresham research studentship in economics. The value of the studentship will be 120*l*. a year. Candidates for the studentship must be more than twenty-one and under twenty-five years of age on the first day of October, 1907. The election will not be made on the result of a competitive examination. Applications should be made before June 1 to the master (the Rev. E. S. Roberts), who will be glad to supply further information.

The general board of studies has received a memorandum from the board of agricultural studies embodying a statement presented to that board by the forestry committee of the board to the effect that the committee has during the past year made efforts to obtain such contributions from public bodies and individuals interested in the subject, and is able to report that the efforts have met with a gratifying response. The board is now assured of grants for various terms of years amounting to upwards of 500*l*. These there is reason to expect will in most cases be renewed. Donations or promises of donations have also been received from other contributors amounting to a considerable sum, and a beginning has been made in the collection of specimens for a forestry museum. The general board is of opinion that, for the proper organisation of this instruction, in addition to the teaching already provided in connection with the Department of Agriculture, the services of two special teachers are required. One of these should be a forestry expert, capable of assuming the general direction of the students' work, of advising the committee and other bodies, such as colleges and local education authorities, on technical subjects, and of promoting study and research in forestry. The board thinks that he should have the status of a reader, and should have a stipend of 400*l*. The other teacher should have a particular branch or branches assigned to him, and should be a university lecturer. The board of agricultural studies accordingly desires to submit a series of proposals to the Senate embodying these recommendations.

The appointments board has presented to the Senate the report for the year 1906. In the year ending December 31, 1906, 136 appointments were obtained on the introduction of the appointments board by graduates on the register. These appointments include appointments of a public character at home and abroad, as well as industrial and technical appointments, engineering appointments, administrative appointments on railways, appointments for scientific work of various kinds, and lectureships in university colleges. The board has decided in future to make recommendations for scholastic appointments, and some progress has already been made in this direction.

DR. J. M. BEATTIE, senior assistant to the professor of pathology, University of Edinburgh, has been elected by the council of the University of Sheffield to the chair of pathology in succession to Dr. Cobbett, who has resigned the chair on his appointment as lecturer on bacteriology at Cambridge.

AN official fellow in natural science will shortly be appointed by the principal and fellows of Jesus College, Oxford. The fellow will be expected to teach one of the larger subjects recognised in the honour school of natural science, to undertake the entire direction of the science tuition of the college, and generally to superintend the college laboratory, now in course of erection; this, when completed, will be adapted for the teaching of chemistry and physics. The stipend will be not less than 450*l*. per annum, together with the free use of rooms in college, and the usual allowances. Further particulars may be obtained by application to the principal, Jesus College, Oxford.

THE Copenhagen correspondent of the *Times* reports that at a meeting in that city on February 26 the proposal to establish a second university for Denmark at Aarhuus, equal to that existing in Copenhagen, was supported by well-known men of science and politicians alike. Though the sympathy with the new university idea is very great, the correspondent says a Bill can hardly be laid before the present Parliament, which closes its session within four or five weeks. In view of the satisfactory state of the national finances, however, it is said to be probable that ultimately a new university will be erected at Aarhuus.

THE Prince of Wales presided at a special meeting of the Royal Commission for the Exhibition of 1851 at Marlborough House on February 28, when a resolution was passed granting a site on their estate at South Kensington for the erection of the proposed Royal Institute of Technology. The commissioners have also granted a site on their estate for the Institute of Medical Sciences (University of London). It is understood that the site will be reserved for a period of one year, during which it is hoped that the additional sum of about 30,000*l*. required to build and equip the institute may be obtained.

A LETTER has been addressed to the President of the Board of Education, by the Vice-Chancellor of the University of London, expressing satisfaction that, although it has not been found practicable to accept proposals for the immediate incorporation in the University of the new technological institution at South Kensington, the course of action proposed will tend to facilitate the accomplishment at an early date of the objects the Senate of the University has in view. The Senate fully appreciates the disadvantages which would attend any further delay in the establishment of the new college. The Vice-Chancellor concludes his letter by expressing the hope that during the time before the appointment of the Royal Commission proposed by the President of the Board of Education, the new governing body and the Senate may find themselves, as a result of friendly discussion, in a position to submit to the Board joint proposals for complete incorporation, and so avoid the need for a commission.

THE late Mr. C. J. Oldham, a well-known ophthalmic surgeon, left large bequests for educational purposes. These gifts include:—10,000*l*. to the principal and three other members of the governing body of Corpus Christi College, Oxford, as trustees, to be applied as to one-third in the award of scholarships for proficiency in or furthering the study of classics, and as to the remaining two-thirds to be applied to the advancement of general learning in that college; 5000*l*. to the University of Oxford, 5000*l*. to the University of Cambridge, each of these bequests to be applied to the encouragement of the study of Latin and Greek and to the works of Shakespeare; and 3000*l*. to the Manchester Grammar School. The residue of the testator's property, which will apparently amount to between 15,000*l*. and 20,000*l*., is left as one-half to Corpus Christi College, Oxford, and one-half to Manchester Grammar School.

THE annual meeting of the Institute of Chemistry was held on March 1. Prof. P. F. Frankland, F.R.S., president, was in the chair. The report, which was adopted,

shows that the institute now has 1016 fellows and 177 associates. The president, in his address, said the most important feature of the year's work has been the inauguration of examinations in chemical technology. The council believes that the institution of these examinations will materially help fellows and associates to obtain employment in chemical industries. Another piece of work accomplished has been the publication of a list of official chemical appointments. Commenting on the value of the qualifications of the associateship and fellowship of the institute, the president showed how the examinations of the institute differ from those of the universities. The latter, he said, are contrived to test the amount of knowledge which a candidate has succeeded in bringing to a focus at a particular moment, while the main object of the institute's examinations is to test what the candidate can actually perform when he is placed as nearly as possible under the same conditions as he would be if working in his own laboratory and within reach of a good chemical library. The candidate who shines in the one will not necessarily shine in the other examination. The university graduate is more qualified to talk and to teach, but the overcrowding of his curriculum leaves him little time in which to practise and acquire technical skill, without which the institute's qualification cannot be attained. It is, Prof. Frankland said in conclusion, this practical character which must be preserved in the institute's examinations, so that fellows and associates may be known for the soundness of their judgment and for their capacity to perform chemical work upon which the public can place implicit reliance.

SOCIETIES AND ACADEMIES.

LONDON.

Faraday Society, February 19.—Dr. T. Martin Lowry in the chair.—The present position and future prospects of the electrolytic alkali and bleach industry: J. B. C. **Kershaw.** The paper opens with a brief historical review. The second part of the paper contains a list of the works now operating in Europe and America, summarising, so far as information is available, power used, type of cell and process employed, and products made. The totals show that about 55,000 h.p. are now being devoted to the production of alkalies and bleach by the electrolytic method, and that plant representing about 13,000 h.p. is lying in reserve. Assuming that all the plants are being worked to the best advantage, the production of 70 per cent. caustic soda at present would be about 110,000 tons per annum, with an equivalent of 231,000 tons of 35 per cent. bleaching powder (2 tons of caustic and 4·2 tons of bleach per E.H.P. year). In conclusion, the future of the industry is discussed.

Royal Meteorological Society, February 20.—Dr. H. R. Mill, president, in the chair.—Report on the phenological observations made during 1906 by observers in various parts of the British Isles: E. **Mawley.** The most noteworthy features of the weather of the phenological year ending November, 1906, as affecting vegetation, were the dry period lasting from the beginning of June until the end of September, and the great heat and dryness of the air during the last few days in August and the first few days in September. Wild plants came into flower in advance of their usual dates until about the middle of April, after which time they were, as a rule, to about the same extent late. Such early spring immigrants as the swallow, cuckoo, and nightingale reached these islands somewhat behind their average dates. The only deficient farm crop, taking the country as a whole, was that of hay, all the others being more or less above average. The yield of apples was about average in all but the north of England and in Scotland, where there was a very scanty crop. Pears and plums were everywhere very deficient, whereas all the small fruits yielded moderately well. As regards the farm crops, the past year proved even a more bountiful one than that of 1905.—The metric system in meteorology: R. **Inwards.** Attention was directed to the advisability of adopting some uniform system by all the meteorological observers upon the globe.

CAMBRIDGE.

Philosophical Society, January 28.—Dr. Hobson, president, in the chair.—Kanalstrahlen in helium: Prof. **Thomson.**—An experiment with a pair of Robison ball-ended magnets: G. F. C. **Searle.** A Robison ball-ended magnet AB is supported on a pivot O close to a drawing board, and a second Robison magnet CD, resting on the board, deflects AB. If p_{AC} denote the perpendicular from O upon AC, the turning moment experienced by AB is the resultant of the four moments $mm'p_{AC}/AC^2$, $mm'p_{AD}/AD^2$, $mm'p_{BC}/BC^2$, and $mm'p_{BD}/BD^2$, where m is the pole-strength of CD and m' that of AB. If h_A, h_B be the perpendiculars from A, B upon the line A_0B_0, where A_0, B_0 are the undeflected positions of A and B, the moment due to the earth's magnetic force, H, is $m'H(h_A+h_B)$. Equating these results, the value of m is found in terms of H and of the four distances AC... and the six perpendiculars h_A, h_B, p_{AC}.... These ten lengths are measured on the drawing board.—A method of determining the thermal conductivity of india-rubber: G. F. C. **Searle.** Steam from a boiler passes through an india-rubber tube, part of the tube being immersed in water contained in a calorimeter. Since the conductivity of india-rubber (0·00042) is small compared with that of water (0·0013), the temperatures of the inner and outer walls of the tube may be taken as equal to θ_1 and θ_2, the temperatures of the steam and of the well-stirred water in the calorimeter. The conductivity K is found from the rate of rise of temperature of the calorimeter by the equation

$$K=\frac{M}{2\pi l(\theta_1-\theta_2)}\cdot\frac{d\theta_2}{dt}\cdot\log_e\left(\frac{a}{b}\right),$$

where M is the water equivalent of the calorimeter and its contents, a and b are the external and internal radii of the tube, and l is the length immersed.—A curvature method for measuring surface tension: C. T. R. **Wilson.** To measure the surface tension of mercury, a circular hole of about 1 mm. in diameter is made through a glass plate closing the upper end of a vertical tube. The tube is filled with mercury, and sufficient pressure is applied to give a suitable curvature to the meniscus projecting into the aperture. The curvature is measured by making the meniscus serve as a convex mirror. A microscope is focussed (1) on the centre of curvature (when a reflected image of the eye-piece cross-wires will be seen in focus); (2) on a fibre stretched just above the meniscus; (3) on the virtual image of the fibre formed by the meniscus. From the vertical displacements of the microscope between these three positions the radius of curvature is obtained. If the pressure be changed by a known amount between two such measurements of curvature the surface tension can be deduced.—The application of integral equations to the determination of expansions in series of oscillating functions: H. **Bateman.**

February 11.—Mr. D. Sharp, vice-president, in the chair.—The mode of formation of the initial cell-wall, the genesis and neogenesis of the connecting threads, and the method of connection of living tissue cells: Dr. W. **Gardiner.** Having summarised the existing theories as to the structure of the "initial-wall" of plant cells, and the current view expressed by Strasburger as to the development of connecting threads, the author stated that his own observations appear to prove that the above views are inadmissible.—The ethnology of modern Egypt: Dr. C. S. **Myers.** The measurements, notes, and photographs taken in this investigation lead to the conclusion (1) that, compared with the "prehistoric" people of 5000 B.C., the modern inhabitants show no sensible difference in head measurements or in the degree of scatter of individual measurements about their average; (2) that the modern Copts throughout Egypt are less negroid than the modern Moslem population; (3) that both the Copts and the Moslems in Upper Egypt are more negroid than those in Lower Egypt; (4) that from the anthropometric standpoint there is no evidence of plurality of race in modern Egypt.—Notes on the structure and behaviour of the larva of *Anopheles maculipennis*: A. D. **Imms.** The paper dealt briefly with the occurrence of the larva of *Anopheles maculipennis* in the neighbourhood of Cambridge, together with notes on its bionomics.

EDINBURGH.

Royal Society, February 4.—Dr. R. H. Traquair in the chair.—The fossil Osmundaceæ: R. **Kidston** and D. T. **Gwynne-Vaughan.** The paper contained a description of two new species of Osmundites, collected from the Jurassic of Otago, N.Z., by Messrs. Dunlop and Gibb, after whom they have been named. *Osmundites Dunlopi* differs from the hitherto described species in possessing a continuous ring of xylem which is not interrupted by the departure of the leaf-traces. In *O. Gibbiana* the xylem ring resembles that of the recent Osmundaceæ, and is broken up into a large number of separate strands. The structure of two other species, *O. Dowkeri* and *O. skidegatrusis*, was also described and compared with that of the new species. Their discussion of the bearing of the structure of the fossils upon the anatomy of the order led the authors to regard the osmundaceous stele as derived from an ancestral protostelic type with a solid central axis. It was consequently suggested that the Osmundaceæ were derived from the same ancestral stock as the Botryopteridæ.—The development of the anterior mesoderm and paired fin, with their nerves, in Lepidosiren and Protopterus: W. E. **Agar.** The pro-otic mesoderm is quite unsegmented. The material from which the eye-muscles are derived is, however, drawn from an extended source, probably representing the three anterior somites of van Wighe. A study of the conditions in these fishes lends support to the view of Gegenbaur as to the segmentation of the head in opposition to those of van Wighe. It seems probable that the latter's fourth pro-otic somite represents a fused mass of segments to which the whole of the branchial region morphologically belongs. An extension of splanchic head structures backwards in relation to trunk myotomes actually takes place in the ontology of these forms. The constrictor muscle of the pharynx is derived from two distinct sources, one splanchic, from the walls of the pericardio-peritoneal duct, the other somatic, from the occipital myotome y. A separation of the hypoglossal and brachial plexures is brought about by the greatly distended pronephros separating the ventral processes of those myotomes which supply the hypoglossal and pectoral fin musculature respectively. The pectoral fin is situated in front of the myotomes which supply its mesoderm, and posterior myotomes are gradually ceasing to contribute to its development. The pelvic fin develops at the hind end of its innervation region. Its position is subject to considerable individual variation, but this is always accompanied by a corresponding variation in the position of the cloaca.—Scottish Tardigrada, collected by the Lake Survey: James **Murray.** Though found in Scotland nearly 150 years ago, the Tardigrada were totally neglected until recently the Lake Survey offered an opportunity for their study. In the paper a summary is given of all that is known about Scottish Tardigrada. The list contains forty-one species. In the Scottish lochs thirty-one species have been found. Most of these are of casual occurrence in lochs, only two or three species being normal inhabitants of water. About twenty species were noted in the Shetland Islands, a fact of great interest being the occurrence of a number of species hitherto known only from Arctic regions. A number of new species discovered had the same limited distribution, being known as yet only from Scotland and Spitsbergen or Franz Josef Land. Seven new species and four new varieties were described.—Arctic Tardigrada, collected by W. S. Bruce: James **Murray.** Richters had already noted twenty-four species of Arctic Tardigrada. Bruce's collections on various expeditions yielded twenty-eight species, bringing the total number of known Arctic species up to forty. Three new species were described, and there were eight which had been recently discovered in Scotland. There were fourteen species common to Scotland and some part of the Arctic regions. Of the twenty-two species collected in Spitsbergen, twelve were new for that region. Franz Josef Land was virgin soil, and of the nineteen species found there, fifteen occur in Spitsbergen.—*Prymnothonus Hookeri,* Poisson pelagique de *l'Erebus* et de la *Terror* retrouve par l'Expedition Antarctic Nationale Écossaise: Louis **Dollo.** The fishes collected on the voyage of the *Erebus* and *Terror* were not all brought home in safety. The most interesting of these lost fishes were the Prymnothonus and the Pagetodes. The latter, which is probably the same as the Cryodraco of the Belgian expedition, was eaten by the cat of the *Terror.* A figure of *Prymnothonus Hookeri* was copied from a sketch by Hooker and published in 1841 by Richardson, who considered it to be a Murænoid allied to the congers. The figure is reproduced by Günther in the eighth volume of his catalogue of the fishes in the British Museum, and he follows Richardson in his description. Later, in his "Pelagic Fishes of the *Challenger*" (1889), Günther places Richardson's specimen third in a series of four small fishes A, B, C, D, and says:—"I have no doubt that all these specimens represent larval conditions of fishes belonging to Paralepis or Sudis or of genera allied to them. That they all are stages of development of the same generic type of fishes is very improbable, but the second and third specimens may well be considered to be the same type, which provisionally may be designated by the name proposed for it by Richardson." M. Dollo, on the other hand, does not consider the *Challenger* specimens A and B to have anything to do with Prymnothonus, and regards specimen D to be a mature specimen of Richardson's fish. He gives a rectified diagnosis of *Prymnothonus Hookeri,* Richardson, from three specimens collected by the Scottish Antarctic Expedition, and places the fish in the family Paralepidæ, in accordance with Günther's indications.

PARIS.

Academy of Sciences, February 25.—M. Henri Becquerel in the chair.—The president announced the death of M. Moissan, member of the section of chemistry, and gave a short account of his life-work.—Certain algebraical surfaces related to Abelian functions of the third kind: L. **Remy.**—Remark on waves of shock. Application to the explosive wave: M. **Jouguet.** For a wave of shock to be propagated, it is necessary that it should have a velocity higher than, or at least equal to, that of ordinary waves in the medium which precede it, and lower than, or at least equal to, that of the ordinary waves which follow it. Admitting this proposition, the author applies it to the interpretation of the phenomena of the explosive wave.—Some properties of the explosive wave: M. **Crussard.**—The influence of temperature on absorption in crystals. Magneto-optical phenomena at the temperature of liquid air: Jean **Becquerel.** At the temperature of liquid air the optical properties of crystals approach the properties of transparent vapours, the absorption bands contracting, forming a line spectrum. The author's interpretation of these results is that the period of the proper movement of the electrons is not influenced by temperature in solid bodies, but that the damping, or the resistance to the particles in vibration, increases and decreases with the temperature. The magneto-optic phenomena exhibited by xenotime and tysonite at the temperature of liquid air have also been studied.—The theory of the formation of aventurine copper glass: V. **Auger.** Experiments tending to show that the colour is due to the presence of copper silicate.—Ethyl lactyl-lactate: E. **Jungfleisch** and M. **Godchot.** A study of the products formed by the action of heat on ethyl (*d*+*l*) lactate. These are analogous to those obtained by heating lactic acid, but the mechanism appears to be different in the two cases.—The atomic weights, a function of the position which they occupy in the series of their increasing value: Adolphe **Minet.**—The melting points and boiling points of aliphatic and aromatic hydrocarbons: Gustave **Hinrichs.** A discussion of a recent paper of M. Tsakalotos.—The coagulation of the latex of caoutchouc and the elastic properties of pure caoutchouc: Victor **Henri.** The latex of india-rubber is a negative emulsion, and its coagulation can be compared with the precipitation of negative colloids. A study of the conditions of coagulation leads to the conclusions that the coagulation of the latex by electrolytes is determined by the positive ions of the electrolytes, the structure of the coagulum varies with the nature and concentration of the bodies employed for the coagulation, a feeble coagulant producing a pulverulent or flocculent precipitate, an energetic coagulant an elastic clot with a reticular structure. The elastic properties of the india-rubber obtained depend

greatly on the nature of the coagulant employed, there being a distinct relation between the fineness of the reticular structure of the clot and the elastic properties.—The presence of phenylethyl alcohol in the essence from the needles of the Aleppo pine of Algeria: Émilien **Grimal.** Details are given of the method of extraction and identification of the phenylethyl alcohol.—The successive distributions of terpenic compounds in various organs of the living plant: Eug. **Charabot** and G. **Laloue.**—Fluorine in the shells of molluscs: P. **Carles.** The presence of fluorine in the mollusc shells is proved: if the shell is treated with hydrochloric acid, the presence of fluorine may be easily overlooked, since hydrofluoric acid is carried away with the carbon dioxide.—A new genus of Pennatulideæ: Ch. **Gravier.**—*Giardia alata*, a new species: J. **Kunstler** and Ch. **Gineste.**—Some physico-biological conditions of Lake Mélah, Algeria: J. **Bounhiol.**—The toxic effects of oysters: J. **Baylac.** Apart from the possibility of bacterial infection, the fluid of the oyster itself possesses toxic effects, and these are greatly increased by keeping at a temperature of about 16° C. for two or three days. The author is of opinion that many accidents attributed to the bacterial contamination of oysters are really due to the increase in the toxic power of the natural fluids of the oyster under the influence of temperature.—Do elephants possess a pleural cavity? Mme. Marie **Phisalix.** A reply to a recent note of M. Giard.—New researches on the transplantation of nerve ganglia; transplantation in the frog.: G. **Marinesco** and J. **Minea.** In cold-blooded animals, the transplanted ganglion cells live for a much longer time after transplantation, and react and repair their lesions more readily than the ganglion cells of animals at constant temperature.—The distribution of microbial secretions, in a culture, between the liquid of this culture and the micro-organisms. Free toxins and adherent toxins. Extracellular bodies and intra-cellular bodies: MM. **Charrin** and **Goupil.**—A remarkable case of an aneurism of the ophthalmic artery cured by gelatin: MM. **Lancereaux** and **Paulesco.** In the treatment of aneurisms of the aorta by gelatin injection the improvement, although marked, proves to be only temporary, and the effect of each injection is less than that of the one preceding, no permanent effect being produced. In the case described the cure was complete and permanent after thirty-nine injections.

DIARY OF SOCIETIES.

THURSDAY, MARCH 7.

ROYAL SOCIETY, at 4.30.—Experiments with Vacuum Gold-Leaf Electroscopes on the Mechanical Temperature Effects in Rarefied Gases: Dr. J. T. Bottomley, F.R.S., and F. A. King.—On the Resistance of Air: A. Mallock, F.R.S.—Electric Furnace Reactions under High Gaseous Pressures: R. S. Hutton and J. E. Petavel.—On the Absorption of Water by Cotton and Wool: Dr. M. W. Travers, F.R.S.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Chaulmoogric and Hydnocarpic Acids: M. Barrowcliff and F. B. Power.—Volume Changes which accompany Transformations in the System $Na_2S_2O_3$, $5H_2O$: H. M. Dawson and C. G. Jackson.

AERONAUTICAL SOCIETY, at 8.—Wings *v.* Screws: Colonel J. D. Fullerton, R.E.—The Free Lever in the Flying Machine: Herr Karl Milla.—Theory of Sailing Flight: José Weiss.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Transmission of Electrical Energy by Direct Current on the Series System: J. S. Highfield.

LINNEAN SOCIETY, at 8.—On the Development of the Frog: Miss N. F. Layard.—Biscayan Plankton, Decapoda: S. B. Kemp.—A Special Point in the Colour Adjustment of Chamæleon: Prof. E. B Poulton, F.R.S.—New Channel Island Plants: G Claridge Druce.—*Exhibitions*: Specimens of *Nitella ornithopoda*, A.Br.: H. and J. Groves.—(1) Probate of the Will of Richard Anthony Salisbury; (2) Manuscripts of Dr. W. J. Burchell; Prof. E. B. Poulton, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Types of Enclosed Steam Water Heaters: C. R. Allensby.

FRIDAY, MARCH 8.

ROYAL INSTITUTION, at 9.—Certain Seasonal Diseases of the Sheep, and the Means of Preventing Them: Prof. D. J. Hamilton.

PHYSICAL SOCIETY, at 8.—The Rate of Recovery of Residual Charge in Electric Condensers: Prof. Trouton and Mr. Russ.—Experimental Mathematics: Mr. Pichon.—An Instrument to describe Families of Equiangular Spirals: Mr. Blakesley.—A Micromanometer: Mr. Roberts.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Corrugations on Tram-Rails: A. T. Arnall.

MALACOLOGICAL SOCIETY, at 8.—On the Non-Marine Mollusca of the Mylne Collection: A. S. Kennard and B. B. Woodward.—Notes on Holocene Mollusca from Ightham: A. S. Kennard and B. B. Woodward.—Descriptions of Four New Species of Melania from New Ireland and Ke-lan-tan: H. B. Preston.—On the Arms of the Belemnite: G. C. Crick.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Computation of Secular Pertubations: R. T. A. Imnes.—Observations of Occultations: Rev. A. L. Williams.—Baxendell's Observations of U Geminorum: Edited by H. H. Turner.—On the Classification of Long-period Variable Stars, and a Possible Physical Interpretation: H. H. Turner.—Perturbations of Halley's Comet: P. H. Cowell and A. C. D. Crommelin.

SATURDAY, MARCH 9.

ROYAL INSTITUTION, at 3.—Röntgen, Kathode, and Positive Rays: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Journeys in Turkey-in-Asia: Mark Sykes.

TUESDAY, MARCH 12.

ROYAL INSTITUTION, at 3.—The Visual Apparatus of Man and Animals: Prof. William Stirling.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction of Overhead Electric Transmission-lines: A. P. Trotter.

WEDNESDAY, MARCH 13.

SOCIETY OF ARTS, at 8.—Mediæval Stained Glass, its Production and Decay: Noel Heaton.

GEOLOGICAL SOCIETY, at 8.—A Silurian Inlier in the Eastern Mendips: Prof. Sidney H. Reynolds.—On Changes of Physical Constants which take place in certain Minerals and Igneous Rocks, on the Passage from the Crystalline to the Glassy State; with a short Note on Eutectic Mixtures: J. A. Douglas.

THURSDAY, MARCH 14.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—On the Gravitational Stability of the Earth: Prof. A. E. H. Love, F.R.S.—The Total Ionisation of Various Gases by the α Rays of Uranium: T. H. Laby.—On the Ionisation of Various Gases by the α, β and γ Rays: R. D. Kleeman.

ROYAL INSTITUTION, at 3.—Biology and Progress: Dr. C. W. Saleeby.

SOCIETY OF ARTS, at 4.30.—The City of Madras: Sir James Thomson.

MATHEMATICAL SOCIETY, at 5.30.—Exhibition of a New Calculating Machine: G. W. Evans-Cross.—On the Reduction of the Factorisation of Binary Septans and Octans to the Solution of Indeterminate Equations of the Second Degree: Dr. T. Stuart.—Invariants of the General Quadratic Form *Modulo* 2: Prof. L. E. Dickson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned discussion*: The Transmission of Electrical Energy by Direct Current on the Series System: J. S. Highfield.

CONTENTS.