THURSDAY, APRIL 30, 1914.

NEW YORK WATER SUPPLY.

The Catskill Water Supply of New York City: History, Location, Sub-surface Investigations, and Construction. By Lazarus White. Pp. xxxii+755. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 25*s.* 6*d.* net.

TECHNICAL records of important engineering undertakings, so far as their accessibility to the public is concerned, are apt to be scattered and fragmentary. A paper will usually be read before one or other of the leading professional societies, giving in condensed form so much of the history of the work as is deemed suitable for publication. In addition, articles will have appeared from time to time in the technical and daily Press, authoritative in varying degree, giving descriptions in general terms of the progress made. But these, while admirable in themselves, scarcely exhaust the desire for information on the part of the general body of the profession, who would often wish to be furnished with certain specific details omitted from the condensed official accounts. A marked reticence, for instance, is observed, as a rule, on the subject of cost. There seems to be a fear lest the disclosure of more than a few figures of comprehensive significance should give rise to criticism of an adverse and inconvenient nature. And such details, accordingly, are almost invariably withheld, or, at best, are obtainable with difficulty.

These remarks are prompted by the consideration that the volume before us is quite exceptional in its scope and treatment to the experience described above. It is a commendably full, clear, and complete account of an undertaking of considerable magnitude, in which a great wealth of information germane to the subject is set out in much detail.

The author, a division engineer engaged on the work, has been fortunate in a chief who encouraged him in his task of compilation, and "gave him a helping hand throughout." He was also favoured with the cooperation of his colleagues. The long list of names mentioned in the preface demonstrates a very generous and loyal effort on the part of all concerned to produce a trustworthy and comprehensive account of the experience gained, the difficulties encountered and overcome, and the carrying through to a successful conclusion of a notable engineering feat.

The water supply of New York City has long been the subject of contention and conflicting opinion. It has been derived from many and varied sources. In the early days of Dutch colonisation it was mainly drawn from public and private wells. One well in particular, we are told, known as the Tea Water Pump, was so frequented that its neighbourhood became congested with water carts, and the spout of the pump had to be raised and lengthened to permit pedestrians to pass under it. Wells, however, are not a very trustworthy source of supply, and with the growth of the town they became tainted and inadequate. Spurred on by the ravages of epidemics which visited them, the inhabitants initiated a variety of schemes for obtaining a better and purer service; but it was not until 1830 that the first public waterworks were inaugurated. These consisted of a shaft, 16 ft. in diameter, sunk 112 ft. deep into the solid rock at a point situated at the junction of 13th Street and Broadway, with two horizontal galleries near the bottom of the shaft. The daily yield obtained by pumping was 21,000 gallons—an utterly inadequate provision for the needs of a rapidly-developing town.

The first really effective undertaking was the old Croton overflow weir or dam and aqueduct, constructed between 1837 and 1842, the former being located about six miles above the mouth of the Croton River. The capacity of the aqueduct was estimated at from 72 to 95 million gallons a day, and the population at this time was about 300,000. As time went on, it became necessary to increase the number and capacity of the storage reservoirs, and in spite of efforts made in that direction, the city experienced serious shortages of water in the years 1869, 1876, 1880, and 1881. By this last-named date, the population had increased to a million and a quarter, while the supply, augmented by a connection with the Bronx River, did not come to more than 102 million gallons a day. It was estimated that the demand was for 45 million gallons in excess of this. And here it may be remarked, in passing, that the daily consumption of water per head is curiously very much higher in the United States than it is in this country. For six of the largest cities in the United Kingdom, the quantity averages 35 gallons per head, as compared with more than 100 gallons in New York, 139 gallons in Chicago, and 187 gallons in Philadelphia.

The new Croton aqueduct from Croton Lake was built between 1885 and 1890, and the daily consumption of the population of 1,720,000 in 1890 immediately mounted to 170 million gallons—about one-half of the maximum capacity of the supply. The new Croton dam, commenced in 1892, was completed as recently as 1907.

As, owing to the growth of the city, the capacity of the Croton watershed showed signs of becom-

ing exhausted at an early date, a commission was appointed, in 1903, to report on the whole question of future policy, and after due inquiry they recommended the impounding of the Catskill watershed, including the Esopus, Rondout, Schoharie, and Catskill creeks. Following this report, in 1905, the Board of Water Supply was organised, and the necessary sanction having been obtained, the field was open for operations to be commenced.

The basins from which the new supply is taken lie due north of New York, within a range of about one hundred miles from the centre of the city. It is calculated that the available yield of the total area is about 660 million gallons daily, but from this, for the present, at any rate, must be deducted the Schoharie watershed (136 million gallons), for which powers of incorporation have not been granted.

At this point we must leave the reader who wishes to pursue his researches further to do so in the volume itself. It will be found replete with data and particulars relating to the various contracts entered into for the execution of the project which has just recently been completed, and the author must be complimented on the result of his painstaking efforts to produce an account worthy of the achievement, which, with its 120 miles of dams, aqueducts, and tunnels, he proudly describes as "hardly second to the Panama Canal." B. C.

ROMANCE IN ARCHÆOLOGY.

Egyptian Art. Studies by Sir Gaston Maspero. Translated by Elizabeth Lee. Pp. 223+plates. (London and Leipzig: T. Fisher Unwin, 1913.) Price 21*s.* net.

"AT two o'clock in the afternoon of February 12, 1906, while Naville was finishing his lunch, a workman came running up to tell him that the top of a vault was beginning to emerge from the earth." This is the opening sentence of the eleventh section or chapter in Sir Gaston Maspero's latest work, and it may serve as an indication of the book's quality. We here have no carefully reasoned presentation of the various aspects and problems presented by Egyptian Art. Such a work, by the same author, we already possess in "Art in Egypt," which has appeared within the year in the *Ars una: species mille* Series. "Egyptian Art" falls into quite a different category, and will prove an admirable foil or supplement to the more formal treatise.

It consists, in fact, as a sub-title warns us, of a collection of "Studies," written during a period of more than thirty years, which have been rescued from the pages of old periodicals, and are here presented together in an attractive English dress. Each is a separate essay, complete in itself; in some a single piece of Egyptian sculpture is described; others deal with an allied group of pieces, or of goldsmiths' work. But one characteristic is common to them all: the subject is used as a peg on which the author displays some idea or principle, generally of wider application than the particular example he selects. So any reader who already possesses "Art in Egypt" will here find Sir Gaston's views applied in a number of specific instances. The relation of the two books is very much that of a treatise on algebra to a series of worked-out problems.

The papers are here translated direct from the journals in which they made their first appearance, and have been subjected to no subsequent re-writing. Consequently, describing, as several of them do, masterpieces of Egyptian art within a day or two of their discovery, they still reflect the author's first enthusiasm, unblunted by later familiarity. The reader is transported from the atmosphere of a museum to the clear air of the Egyptian desert. He watches the diggers at their work, and shares something of their excitement. If he continues the chapter from which we quoted the opening words, he will soon see the head of the wonderful Hathor Cow standing out from the black recesses of the rock-hewn vault at Deir-el-Bahari as the *débris* of centuries is removed. Or turning to chapter xvii. he may, if he will, stand with Sir Gaston's *ghafirs* as they watch the workmen who are making a railway embankment on the site of ancient Bubastis. It has been reported that jewelry has been found; the police have searched the workmen's houses, and have recovered some of the pieces, but the fellahs have kept their secret. Suddenly a workman with his pick lays bare several fragments of silver. He tries to conceal them, but the *ghafirs* are too quick for him; and soon the Treasure of Zagazig, exquisite jewelry and vases of the XIXth Dynasty, is uncovered in the sunlight, a heap of gold between two layers of silver.

We have purposely laid stress on the vivid character of Sir Gaston's pages, for they serve to restore the element of romance which of late years archæology has run some risk of losing, at least for the general reader. But in doing so, we have left no space to touch on the general principles which the essays are intended to drive home, such as the utilitarian character of Egyptian art and the influence of a fixed purpose on its forms and conventions. Nor can we follow the

author in his discrimination of the local schools of sculpture, each with its own traditions and technique. It may suffice to say that in "Art in Egypt" the reader will find these subjects treated systematically. In the work before us he will see Sir Gaston Maspero evolving the principles he there explains. A special word of praise must be given to the illustrations, the great majority of which are admirable reproductions of photographs on a large scale. L. W. K.

ASTRONOMY.

Astronomy: a Popular Handbook. By Prof. Harold Jacoby. Pp. xiii+435+32 plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 10*s.* 6*d.* net.

IN the arrangement of the subject-matter in this book the author has attempted to serve a double purpose, namely, to provide material to satisfy the requirements of the ordinary reader who wishes to make himself acquainted with the present state of astronomy and also to produce a text-book for use in high schools and colleges. To attain this end the book consists of two parts, the former being a series of chatty discourses on astronomical matters devoid of all mathematics, the latter, called an appendix, which contains a series of notes involving the occasional use of elementary algebra, geometry and trigonometry so far as the solution of plane right angle triangles. The first part covers 361 pages and the second 58 pages.

As an introduction the author gives the reader a good general idea of the whole universe, at the same time pointing out the practical use of astronomy and its value as a culture study. In the subsequent twenty chapters he deals with the subject more in detail. The general reader will find that the author has been very clear and precise in all his statements and presents the matter in an easy, readable form. The thirty-two plates and numerous figures in the text enhance the value of the book considerably, the reproductions being principally from the fine negatives secured by Barnard and by the astronomers at the Lick Observatory.

In reading the book a few points have come to the reviewer's notice which rather invite criticism. In the chapter on solar parallax a good account is given of Gill's determinations, but while reference is made to the Eros value, the name of Mr. Hinks is omitted. In describing the solar features the reader is shown a fine photograph of the solar disc taken in calcium light by Fox; while the bright portions shown in the reproduction are referred to as faculæ, the usual term "flocculi" is not mentioned.

Of recent years fine photographs of the spectra of comets have been secured, but the reference to a comet's spectrum here given is decidedly brief, and occupies two lines as follows: ". . . existence of hydrocarbon gas in a luminous state as well as a dim continuous spectrum containing Frauenhofer lines. . ." Stellar spectra classification is also curtly dismissed, being restricted to that given by Secchi, the fact that other classifications have been suggested and are in use receiving no mention whatever.

It may be said, however, that in spite of the above minor deficiencies, the book is one that will serve a very useful purpose, and should appeal to a large circle of readers.

TEXTILE FIBRES.

(1) *Chemische Technologie der Gespinstfasern.* By Dr. Karl Stirm. Pp. xvi+410. (Berlin: Gebrüder Borntraeger, 1913.) Price 12 marks.

(2) *The Textile Fibres: their Physical, Microscopical, and Chemical Properties.* By Dr. J. Merritt Matthews. Third edition. Pp. xi+630. (New York: John Wiley and Sons; London: Chapman and Hall, 1913.) Price 17*s.* net.

(1) IT cannot be said that the contents of this work quite correspond to its title, for if the chemical parts of the subject were left out altogether, a very substantial volume would still remain. The actual chemical technology of the fibres is inadequately represented, though the author may be said to err rather on the side of omissions than on that of mis-statements. In this latter respect, however, attention should be directed to the statement (p. 6) that the temperature at which cotton begins to decompose is 160° C., no mention being made of the time factor used in arriving at this result. It is well known that by prolonged heating cellulose begins to decompose at much lower temperatures than that stated. A further statement that caustic potash is much less energetic in its action on cellulose than caustic soda might well have been qualified, for in equivalent strengths there is no difference in the mercerising action of the two alkalies. Again, the descriptions of the processes of bleaching cotton and linen are of the nature of generalisations, and are more likely to confuse than to enlighten the student. It might have been expected that the work of Haller, Lester, Knecht and Allan, Hoff-

meister, and others on the natural impurities contained in these fibres would at least have been mentioned, but such is not the case. On p. 37 reference is made to the presence in raw cotton of resins which withstand the action of alkalies, but no mention is made of the source of the information nor does the author appear to have published any original communication on this subject.

Wool and silk are more adequately dealt with from the chemical point of view, though here we miss a very important property of the former, viz., its behaviour on steaming which Breinl has shown to account for "ending" in the dyeing of piece goods (by which is meant that one end of the piece comes out deeper in shade than the other). A fairly good account is also given of the artificial fibres.

The rest of the work (pp. 261–378) contains what can scarcely be called more than a rudimentary account of dyeing and printing, in which the chemistry of the products employed and of the processes plays a very subordinate part.

The figures in the work are generally good, but it appears strange that in a special work of this kind the author has not recognised the importance of giving the appearance of cross-sections of the fibres described. A very large proportion of the text is taken up by matter which is quite irrelevant to the subject. Thus, in the case of wool no fewer than five pages are taken up by a description of the spinning process, while five more are devoted to trade statistics. Altogether the work is disappointing. It must, however, be said in its favour that the author generally acknowledges the source of his information, which has been largely taken from other German works. His copious references to current literature will act as a good guide to students and others who make use of the book.

(2) Since the textile fibres constitute the raw materials for some of our most important industries, a well-planned and conscientiously compiled monograph on the subject, in which all the facts concerning them are systematised and lucidly discussed, should form a welcome addition to our technical literature. It has been the endeavour of the author, in writing the present volume, to carry out this ideal, and though he does not claim to have attained it, we have no hesitation in saying that he has produced a most useful monograph. The subject-matter is well arranged, and is brought up to date, chiefly in the copious footnotes which give epitomes of the more recent researches and patent specifications. The figures representing the textile fibres are mostly micrographs by the author, and although they are somewhat rough, they bring out the essential features more prominently than many of the photographic reproductions that have been published. The figure on p. 230 seems to be out of place.

The last, and not the least, useful part of the work (pp. 461–592) gives an account of the various methods available for the analysis of textile materials. In his classification of the fibres (especially bast fibres) and the enumeration of the numerous species of the genus Gossypium (cotton), the author is rather too profuse. No mention appears to be made of the important effect of drying mercerised cotton in decreasing its affinity for dyestuffs. While admitting in the footnote on p. 283 that cotton begins to decompose above 120° C., the author seems to place the temperature at which decomposition begins at 160° C. (p. 282), but both are too high. No mention is made of that excellent reagent paranitroaniline for lignocellulose. The chlorination of wool, which is now a most important large-scale operation in connection with the production of unshrinkable fabrics, might with advantage have been more fully gone into. In spite of these shortcomings, the work must be regarded as one of considerable merit. That it has supplied a want is shown by the fact that within a comparatively short period it has gone through two editions.

OUR BOOKSHELF.

Pflanzenphysiologie. Versuche und Beobachtungen an höheren und niederen Pflanzen einschliesslich Bakteriologie und Hydrobiologie mit Planktonkunde. By R. Kolkwitz. Pp. v + 258 + xii plates. (Jena: Gustav Fischer, 1914.) Price 9 marks.

PROF. KOLKWITZ tells us that his book has grown out of courses of practical instruction in plant physiology for university and agricultural classes. It is a little difficult to see exactly for whom it is designed—students would probably find it a difficult book to use, still the teacher of ordinary plant physiology will discover many hints that he can utilise with advantage.

A number of experiments are described, illustrative of the physiology of the higher plants, but the greater part of the volume is devoted to the lower forms of life. This later portion is an odd mixture of systematic description of illustrative species, but the accounts given are often so meagre as to be practically worthless. Directions are given for the culture of some forms, and the distribution of certain plankton species is briefly discussed. Incidentally, the chief sources of information are usefully given, but the whole volume suggests that it is a reproduction of the private notes of a teacher who has explored a fairly wide field himself, and wants the notes to refresh his

recollection while conducting a course for students. But it is perhaps not often that short notes of this kind are of very much service to anyone except the man who put them together.

Lessons in Elementary Tropical Hygiene. By Henry Strachan. Pp. xi+116+vi plates. (London: Constable and Co., Ltd., 1913.) Price 1*s.* net.

WE heartily recommend this little book. It is, of course, quite simple and very elementary; that is what it was intended for. Still, London school-teachers will find many useful hints in it. But it is written chiefly for the help of school-teachers in the tropics, both in Africa and in the West Indies. The author has been Principal Medical Officer of Lagos and of Southern Nigeria, and for two years he was acting as Colonial Secretary in Lagos. If he does not know the feel of the white man's burden, who does? And he knows well that the way to put things right in this world is to get at the children. It is they who will hold the ground which our men of science have won in the tropics. The victories of protective medicine and of sanitary administration over tropical diseases in Africa are, to us older people, still new, still wonderful; to the children, before many years are past, they will be old stories retold, facts taken for granted.

Anaesthetics: their Uses and Administration. By Dr. D. W. Buxton. Fifth edition. Pp. xiv+477. (London: H. K. Lewis, 1914.) Price 10*s.* 6*d.* net.

THE advances in the knowledge of anæsthesia and analgesia made it necessary for Dr. Buxton to rewrite most of the sections in the previous edition of his useful work, to delete obsolete apparatus and theories, and to add much new matter. Among other new features are the procedures involved in giving nitrous oxide and oxygen in major surgery; of ether by the open method, by intra-vascular infusion, by intra-tracheal and pharyngeal insufflation, and by colonic absorption; the methods of local regional and spinal analgesia, and the employment of alkaloids in analgesia and anæsthesia.

Defensive Ferments of the Animal Organism. By Emil Abderhalden. Third enlarged edition. English translation by Dr. J. O. Gavronsky and W. F. Lanchester. Pp. xx+242. (London: John Bale, Sons and Danielsson, Ltd., 1914.) Price 7*s.* 6*d.* net.

THE first German edition of this work by the director of the Physiological Institute of the University at Halle a/S. was reviewed in the issue of NATURE for September 19, 1912 (vol. xc., p. 66). That two further editions were published in Germany in the following year is good evidence of the increasing interest being shown in Abderhalden's methods. The English edition will serve to bring these researches within the range of English students to whom the German text has been inaccessible.

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.*]

Cellular Structure of Emulsions.

ON Prof. Kerr Grant's letter (p. 162) see for previous observations of this striking phenomenon Prof. James Thomson, Proc. Glasgow Phil. Soc., February 15, 1882, reprinted in his collected Papers (p. 136); also by reference given in a footnote to the reprint, to more detailed and independent investigations by Prof. Bénard, of Bordeaux, in *Annales de Chimie,* 1901, and more recent papers, including a recent lecture to the Société de Physique, and to their discussion in connection with the solar phenomena referred to by Prof. Grant, by H. Deslandres, in the Annals of the Observatory of Meudon (vol. iv., 1910).

JOSEPH LARMOR.

THE cellular arrangement of convection currents in emulsions, described by Prof. Kerr Grant in NATURE of April 16, was first recorded by E. H. Weber in 1855, with gamboge suspended in a mixture of alcohol and water. It is discussed in O. Lehmann's "Molekularphysik." The structure is most conveniently seen in molten wax or spermaceti, and in this form was discovered by H. Bénard. Many papers by Bénard, Dauzère, and others have appeared on the subject in the *Comptes rendus* and *Journal de Physique* since 1901, and the possible bearing of the phenomenon on geological and astronomical problems has been discussed. A paper by James Thomson on cellular structure due to convection, originally published in 1882, is included in his collected works. In this case soapy water was the liquid used. An account of the phenomenon, with references, is given in the present writer's report to the Beilby Prize Committee, read at the March meeting of the Institute of Metals.

CECIL H. DESCH.

Metallurgical Laboratory,
University of Glasgow.

The Origin of the Moon and the Earth's Contraction.

IN my letter to NATURE of February 26, I said that, with the earth's radius and gravity at their present values, and with the speed of rotation assumed to be one revolution in five hours, gravitation would exceed the centrifugal force until a distance from the surface was reached of more than double the earth's radius. Dr. Ball upon this writes that I "concluded" that when the moon was detached from the earth, "the earth's radius must have been about three times its present one." I did not mean to imply this.

The whole subject of the moon's origin is highly speculative, as Sir G. H. Darwin himself admitted. There are two causes that might be invoked to account for the separation of her mass from the earth, viz., centrifugal force, and the sun's tidal action. These require different speeds of rotation. In Pratt's "Figure of the Earth," 4th ed., art. 102, he shows that with a homogeneous earth the time of rotation which would render the centrifugal force equal to gravity would be one revolution in two hours and twenty-four minutes. I think that if the central parts were the more dense the speed would be rather greater. It seems impossible that a solid crust could have formed at this early period, when the spheroid could only just hold together. The eccentricity would then have been about 0·22.

The other possible cause of separation would be that the times of the tide produced by the sun's attraction coincided with the period of gravitational oscillation of the mass of the spheroid; that is, that the period of free oscillation would be the same as that of the forced oscillation due to the solar tide. After this had gone on for some while, the tidal protuberances would become so large that, in the opinion of Sir G. H. Darwin, one (or both) might break away. He considered that the rate of rotation in this case would have been about one revolution in five hours. And it was this rate that I assumed in my letter to NATURE. By the time the earth's rotation had been reduced so far as this, it does not seem impossible that a crust might have been formed.

If the material which now constitutes the moon was in any way detached from the earth, the matter so detached cannot have coalesced into a single sphere until Roche's limit was passed, which would be 2·44 of the earth's radii from its centre. During this initial stage of the moon's existence the nearest analogy seems to be found in Saturn's rings. But the difficulty remains why the matter detached should not have fallen back again.

As regards the formation of mountains by the contraction of the earth, I have discussed the question to the best of my ability in my "Physics of the Earth's Crust," and have come to the conclusion that the theory is untenable. O. FISHER.

Graveley, Huntingdon, April 4.

Movements on Water Surfaces.

I HAVE often wondered what is the real explanation of the following observation. If on a bath of soapy water a skin is allowed to collect on the surface, and then lumps of soapy lather be allowed to drop from one's hands on to it, the skin will crack in all directions, radiating from the point where the skin was first pierced, and this will continue for some time after the initial cause of the disturbance has ceased. The phenomenon is very striking, and can be repeated several times, after which the effect cannot be produced. Also if a cake of wet soap be placed on a wet level surface, the moisture is repelled from the cake, until the latter becomes surrounded by a dry patch. These seem to suggest repulsion of similarly electrified bodies. EDWARD A. MARTIN.

MR. MARTIN'S second question is more easily answered than his first. The surface tension of clean water is about three times as great as that of water containing soap, so when the soap touches the wet surface the surrounding wet being no longer pulled towards the soap as strongly as it is pulled away, obeys the latter force as fast as it can.

I am inclined to think that his first observation may relate to a similar phenomenon, but of this I am not sure. With oleate of soda a very small quantity reduces the tension to the lower limit at once, and with this I do not think the experiment would succeed. I can only suppose, but I do not know it as a fact, that with the soap used first a scum is formed, and then when fresh lather breaks this at a point there is rather less surface tension at this point than there is in the surrounding surface. If so, the result observed would naturally follow. I should not, however, have expected to find this difference in the surface tensions. Or, possibly, the lather from the hand is warmer and for this reason has somewhat less surface tension. I have often shown in a striking way the diminution of surface tension with rise of temperature by holding the hand steadily against one side of the rainbow cup when the film upon it is already thin and highly coloured. Almost immediately a circulation is set up and a stream leaves the part warmed by the hand, and crossing the film diametrically, curls round on either side, producing a tree-like pattern in other colours. The film is very sensitive to temperature changes.

C. V. BOYS.

66 Victoria Street, London, S.W., April 24.

X-Ray Spectra.

J. HERWEG (*Berichte der Deutschen Physikalischen Gesellschaft*, Heft 1, 1914) using a crystal of gypsum, obtains by means of the photographic method the result that the α and β lines of the tungsten X-ray spectrum coincide with the α and β lines of the platinum X-ray spectrum, the values of the glancing angles being 4° 56′ and 4° 16′ for the α and β lines respectively. But there is reason to suppose that the wave-length of X-rays characteristic of an element varies inversely as the square of the atomic weight of that element. If this is so, we can calculate from the experimental results for a platinum antikathode obtained by Herweg the glancing angles for the tungsten X-ray spectrum and we obtain :—

Tungsten Antikathode (Calculated).

Spectrum line	α	β	γ	δ	ϵ
Glancing angle	5° 34′	4° 48′	4° 43′	4° 6′	3° 51′

We thus see that the calculated values of the β and δ lines are nearly the same as the experimental values found by Herweg for what he calls the α and β lines of the tungsten spectrum. G. E. M. JAUNCEY.

Physical Laboratory, University of Toronto, March 30.

An Optical Illusion.

I HAVE often noticed the phenomenon mentioned by Mr. J. W. Giltay in NATURE of April 23 (p. 189). In the position in which he was reading the sunlight passed through his eyelids and the coats of his eyes, and on account of having to pass through a layer of blood which acted as a red screen his retinas become flooded with red light. The red is not noticed where it is diluted with white, but the print appears red because red light is falling on the portions of the retina which receive the images of the printed letters.

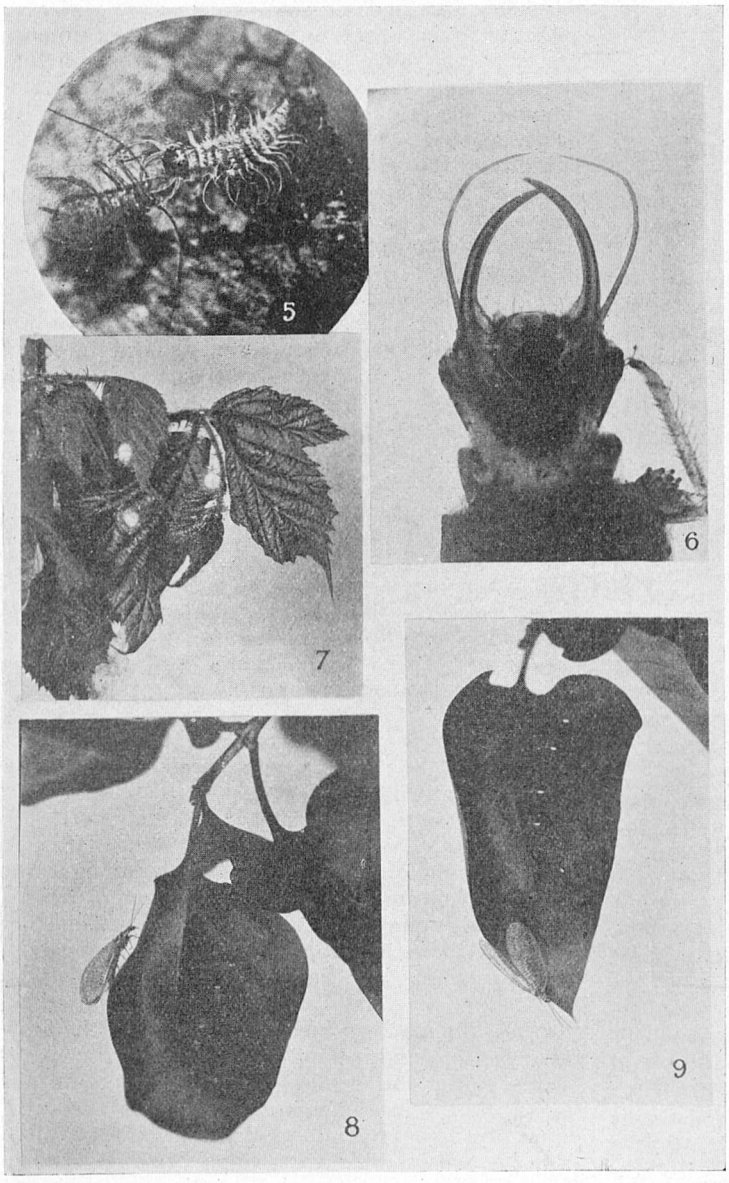
F. W. EDRIDGE-GREEN.

SOME LIFE-HISTORIES AND HABITS OF INSECTS.[1]

(1) IN his "Insect Biographies," Mr. J. J. Ward has written a pleasant and popular account of the life-history of several of our best-known insects. He has contrived to show how full of interest are the facts concerning the growth, development, and general mode of life of the subjects of his pen and camera, without overburdening his pages with technicalities, or, on the other hand, being guilty of inaccuracy or looseness of statement. The photographs with which the book is plentifully illustrated have been in almost every instance taken directly from living specimens in their natural attitudes and surroundings, and their execution must have involved the

[1] (1) "Insect Biographies with Pen and Camera." By John J. Ward. Pp. 206+plates. (London: Jarrold and Sons. 1913.) Price 6*s*. net.
(2) "Lebensgewohnheiten und Instinkte der Insekten bis zum Erwachen der sozialen Instinkte." Geschildert von O. M. Reuter. Vom Verfasser revidierte Uebersetzung nach dem schwedischen Manuskript besorgt von A. u. M. Buch. Pp. xvi+448. (Berlin: R. Friedlander und Sohn, 1913.) Price 16 marks.

expenditure of much time and patience. They form an important feature of the work, and are in most cases excellent examples of their kind; some of them, however, are too much reduced in size for perfect clearness. One of the best illustrations shows the extraordinarily indented outline of the "Comma" butterfly (*Vanessa C-album*) in its attitude of rest with closed wings. The



5. Larva of the lace-wing fly attacking an aphis. 6. Head of the larva. 7. Cocoons formed by the larvæ. 8. Lace-wing fly depositing eggs on a lilac leaf. 9. Another view of the lace-wing fly and eggs. 5 and 6 are enlarged, and 7, 8, 9, are actual size. From "Insect Biogaphies with Pen and Camera."

eggs and larvæ of the common lace-wing fly (Chrysopa), valuable for its destructive activity among the aphides, form the material of a series of figures some of which are here reproduced, while the life-history of another foe to the aphid pest, the wasp-like hover-fly or syrphid, is also well illustrated on Mr. Ward's photographic plates. One of the best chapters in the book is that devoted to the subject of the tree- and ground-wasps; the construction of the nests is clearly explained and well figured. Another interesting section is that which deals with the hornet-like clear-wing moth (*Aegeria crabroniformis*), remarkable in its larval stage for its powers of burrowing in the trunks and branches of various species of willow. Much stress is laid throughout the book on the protective value of the forms and colours adopted by many of the subjects of illustration, and the author has ingenious explanations to offer of the meaning of several curious instincts, such as the wholesale destruction of wasp larvæ by the workers towards the end of the season. Mr. Ward's bionomic conclusions are for the most part well grounded, but he seems in some passages somewhat too ready to admit without question the interpretation of instinct as inherited habit.

(2) The name and reputation of the late Dr. Odo Reuter were a sufficient ground for the anticipation that his work on the habits and instincts of insects would be a contribution to entomological science of high value. Such expectations are fully borne out by the work before us, which has been translated into German by A. and M. Buch from the original Swedish. The various heads of the subject are treated with great care and thoroughness, and the importance of the book as a work of reference is enhanced by the useful list of recent literature which concludes the volume. Among the topics dealt with are the various manifestations of activity and rest, including sleep and hibernation, the instincts concerned in feeding, in parasitism, commensalism, and mutualism. A chapter is devoted to the subject of migration; and the various methods of protection, active and passive, against unfavourable natural conditions, and the attacks of insectivorous foes, receive extended treatment. Instincts associated with metamorphosis, with pairing, with oviposition, and provision for the future needs of the offspring, are also fully discussed; and much space is given to the nesting and feeding habits of the solitary bees and wasps. The treatise concludes with a consideration of the transition from the solitary to the social habit in insects.

Dr. Reuter brought together for this work a great quantity of information gathered from the recorded observations of many naturalists in different countries. The treatment can scarcely

be called exhaustive, and it is almost inevitable that some parts of so wide a subject should be dealt with in greater detail than others of equal importance. But the book is a useful storehouse of facts, selected with discretion, arranged with judgment, and pleasantly recounted.

F. A. D.

THE MINERAL INDUSTRY OF CANADA.[1]

THE Department of Mines of Canada is doing excellent work in distributing information concerning the mineral wealth of the Dominion by means of publications that appeal both to the trained expert and to the seeker after general information. A good example of the latter form may be found in a pamphlet of some seventy-seven pages entitled "Economic Minerals and Mining Industries of Canada," written by the "Staff of the Mines Branch," which gives in clear and convenient form a brief review of the occurrences and distribution of all the economic mineral products of the Dominion of Canada, together with indications of the legislative enactments that control the tenure of mineral property, the latter being especially important, seeing that each province has its own mining laws. This popular description, which, though brief, is clear and easily intelligible to anyone interested in mining matters, should prove of the utmost value to prospectors or others who may be going to Canada and are anxious to acquire some general knowledge of the more important economic minerals that are found in Canada, of the districts in which they chiefly occur, and the conditions under which their occurrence may be looked for with the greatest probability of success.

No better example of the opposite extreme, that is to say, of publications written essentially for the trained mining or metallurgical engineer, can be quoted than the monograph on the nickel industry of Sudbury by Dr. A. P. Coleman, a work of some 200 pages, in which a full account is given of these important mineral deposits. The general geology of the region is first described in much detail, then descriptions of the various minerals met with and of typical forms of the ore deposits themselves, all of these being very careful and apparently very accurate. Dr. Coleman discusses the mode of formation of the deposits, and seems inclined to adopt the magmatic segregation theory in its simplest and most definite form; he certainly mentions the researches of Dr. Campbell and others which have shown that there is very much to be said in favour of the aqueous origin of the ores, but Dr. Coleman apparently lays but little stress on these. He does not appear to have considered the possibility that these conflicting views might be reconciled on the hypothesis that the ores might have been formed by some form of hydrothermal process, in which separation from a cooling magma in the presence of water in some form or other under conditions of intense pressure may have produced the phenomena that characterise these ore deposits. Detailed descriptions of the various mines are given, together with some account of the method of mining and an outline of the smelting processes in use. The value of the monograph is enhanced by a comparison of the nickel occurrences at Sudbury with the remaining most important sources of nickel in the world.

The Annual Report on the Mineral Production of Canada is a volume that interests both the specialist and the seeker after general information, though it must be admitted that it appears to cater for the latter rather than for the former class of reader, there being throughout evidence of a desire to make the figures, especially the value of the mineral production of Canada, look as large as possible. No doubt the pernicious example of its neighbour, the United States, has much to do with this striving after inflated figures. The unfortunate result is that the figures given in the report are not the real value of the mineral production of the Dominion, as several items appear more than once. Thus in the report on the mineral production for 1911 the grand total of the value of the mineral production is given as 103,220,994 dollars; this is made up of metallic products, 46,105,423 dollars, non-metallic products (in which are included such items as arsenious oxide, chromite, manganese, ochres, pyrites!), 34,405,960 dollars, and structural materials and clay products, 22,709,611 dollars. Amongst the so-called non-metallic mineral products, by far the most important is coal, the value of which is given as 26,467,646 dollars, or about 77 per cent. of the whole; a very large proportion of this coal is, however, used in smelting the metals which are included in the first-named group and in burning the Portland cement, bricks, tiles, and other ceramic goods, and the lime included in the last-named group. As the value of all these products depends in part, often in quite considerable part, upon the fuel used in their production, the value of the coal appears twice over in the above grand total. Furthermore, very large quantities of coal and coke are imported into Canada, their value in 1911 exceeding 41,000,000 dollars, and it is certain that a very large proportion of this imported fuel is also used in manufacturing the metallic and other products above referred to, so that the value assigned to these includes in no small part the value of the imports of coal, etc. In spite of these facts, which show that the value of the mineral products of

[1] "The Nickel Industry: with Special Reference to the Sudbury Region, Ontario." By Dr. O. P. Coleman. (Ottawa: Government Printing Bureau, 1913.)
"Annual Report on the Mineral Production of Canada during the Calendar Year 1911." By John McLeish, Chief of the Division of Mineral Resources and Statistics. (Ottawa: Government Printing Bureau, 1913.)
"Economic Minerals and Mining Industries of Canada." By the Staff of the Mines Branch. (Ottawa: Government Printing Bureau, 1913.)
"A General Summary of the Mineral Production of Canada during the Calendar Year 1912." By John McLeish. (Ottawa: Government Printing Bureau, 1913.)
"The Production of Copper, Gold, Lead, Nickel, Silver, Zinc, and other Metals in Canada during the Calendar Year 1912." By Cosmo T. Cartwright. (Ottawa: Government Printing Bureau, 1913.)
"Summary Report of the Mines Branch of the Department of Mines for the Calendar Year ending December 31, 1912." (Ottawa, 1913.)

Canada cannot be compared with the mineral statistics of other countries unless these causes of inflation are taken into account, it is obvious that the Canadian mining industry is flourishing, and forms an important item in the wealth-producing power of the Dominion.

Important as was the mineral production in 1911, it appears to have been quite eclipsed by that of 1912, for it may be taken for granted that the figures contained in the General Summary, just issued, are not likely to be greatly modified in the final report. This gives the grand total of the entire mineral output, made up as it was in 1911, as 135,048,296 dollars, equal to an increase of 30·8 per cent. There is no new feature of any importance, except perhaps that the gold production shows an increase of about 40 per cent., due to the Porcupine district of Ontario. The silver output has fallen off slightly in Cobalt, but all other metals show an increased production. By far the most important mineral product is still coal, and as its output has increased by 28 per cent., this alone would cause the year to compare favourably with its predecessor. All that can fairly be said is that the 1912 report shows clearly that the mineral production of Canada is steadily growing in importance.

It is to be regretted that the scheme of Canadian mineral statistics takes no account of the labour conditions of the industry, and that no information is given concerning the number of men engaged in the industry, the wages earned by them, and of the accidents, fatal or non-fatal, that have befallen them during the year. Statistics on these points ought to be forthcoming in order to enable students of the subject to form a clearer picture of the course of development of the mineral industry of the Dominion.

The Report upon the production of the various metals in Canada may be taken as a final report, whilst it at the same time goes into somewhat greater detail than is possible in the General Summary, and also devotes more especial attention to the economic side of the subject. It can only be said fully to confirm the impression given by the General Summary as to the flourishing condition of the Canadian mineral industry.

The Summary Report of the work performed by the Mines Branch of the Department of Mines forms most interesting reading, and indicates that the Mines Branch is carrying out a vast amount of research work for the benefit of the mineral industry of the Dominion. A report upon the metallurgy of cobalt and its alloys, and another upon recent progress in the electrical manufacture of iron and steel may be named as indicating the nature of the work being carried on; it is most satisfactory to find evidence of the existence of a Government Department equipped for conducting such researches upon modern scientific lines, and to have such proof that the Canadian Government is far-seeing enough to give such excellent assistance to an important industry. It may fairly be said that if Canadian mineral industries are flourishing, the result is due not only to the great resources of the Dominion, but to the enlightened policy of a Government which devotes its energies to turning these resources to the best possible account.

IMPROVEMENTS IN THE BINOCULAR MICROSCOPE.

MICROSCOPISTS long ago appreciated the advantages that might accrue could *both* eyes be employed to view the object by means of a "binocular" microscope—the natural method of viewing objects with both eyes would be preserved and eye-strain lessened, and stereoscopic vision may be attained.

The viewing of an object with both eyes not only lessens eye-strain, but there is a summation of stimuli in binocular vision, and, even without a stereoscopic effect, a better appreciation of the object viewed is probably obtained—there is greater "vividity" about the image.

Three principles have now been applied in the construction of the binocular microscope. The first of these is the use of two complete microscopes pointed obliquely at the same object, as in the Greenough binocular. This form has but a limited application as it is adapted for low-power work only. In the second form, best represented by the "Wenham" binocular and its modifications, the light coming from a single objective

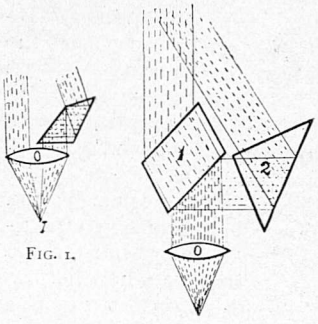


FIG. 2.

FIG. 1.

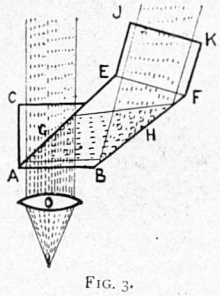


FIG. 3.

is "geometrically" divided, *i.e.*, the beam is bisected and half is directed into each eye. This is accomplished by interposing one or more prisms in the path of the beam as shown in Fig. 1.

This type of instrument involves the use of long tubes and is consequently bulky, resolution is diminished by reducing the size of the beam of light, and it cannot be used with high powers as the dividing prism cannot be placed sufficiently close to the back lens of the objective properly to bisect the beam before the rays have intermingled.

The third form alone embodies correct principles. In this, of which the Powell and Lealand and Abbé are the best examples, the beam of light is not bisected, but is physically sifted or filtered, so that a portion of every part of it goes to each eye. This "sifting" or "filtering" is accomplished in the forms mentioned by interposing in

the path of the beam a glass plate or prism which transmits part and reflects part, as shown in Fig. 2 (the Powell and Lealand type) where 1 represents the glass plate, and 2 is a reflecting prism.

In this form resolution is unimpaired, but the instrument is bulky, and there may be a good deal of difference in the amount of light which reaches the two eyes.

A great advance has recently been made in the last-named form by Messrs. Beck, in this country, and Messrs. Leitz, in Germany, by the use of a half-silvered film cemented between two prisms. The silvered film is semi-transparent and allows part of the light to pass through and part to be reflected by the surface of the prism into the second tube.

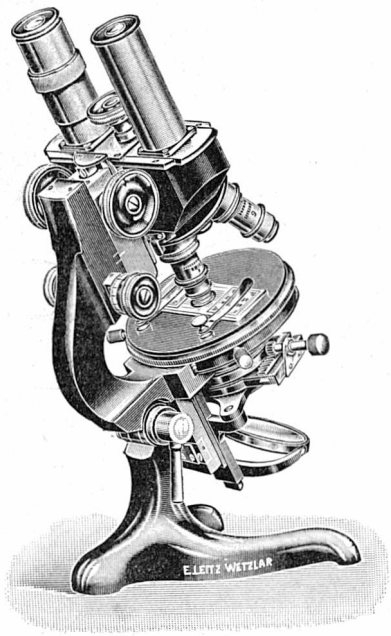


FIG. 4.—The Leitz binocular microscope.

Fig. 3 represents the construction in the Beck model, where EA represents the silvered film between the two prisms.

In both the Beck and the Leitz model, resolution is unimpaired, the illumination in both eye-pieces is the same, the instrument is much less bulky than the old forms, and short tube-lengths can be retained.

There can be no doubt of the superiority of this binocular form over the ordinary monocular microscope. Eye-strain is lessened, and there is an increased "vividity" about the image, even though a true stereoscopic effect is not attained. It is particularly valuable in the examination of objects with dark-ground illumination; more seems to be visible than with the ordinary monocular microscope.

There is an important difference between the Beck and Leitz models in the adjustment of the distance between the two eye-pieces to compensate for the varying distance between the two eyes in different individuals. In the Leitz model (Fig. 4) the tubes carrying the eye-pieces are parallel, in the Beck model they diverge (see Fig. 3). The inter-ocular distance in the former is adjusted by an arrangement which alters the distance between the two tubes; in the latter the inter-ocular distance is varied by lengthening or shortening the diverging tubes. Now the former method entails much less alteration of tube length than the latter, and inasmuch as the best lenses are corrected for a particular tube-length, for critical work we cannot help thinking that the Leitz adjustment is decidedly superior to that which obtains in the Beck model.[1]

R. T. HEWLETT.

THE SCOTTISH ANTARCTIC EXPEDITION.

BRITISH men of science will notice with keen regret the unpromising answer given by the Government to the application for 3,800*l.* to complete the publications of the Scientific Reports of the Scottish National Antarctic Expedition of 1902–1904. The application has been supported by a very influential body of Scottish scientific opinion. The expedition was entirely equipped by money privately raised in Scotland, and was mostly due to the generosity of Messrs. J. and A. Coats. The discovery by the *Scotia* of Coats Land is generally recognised as the most important addition to our knowledge of the boundaries of the Antarctic continent that has been made by the Antarctic expeditions of this century. It added half a million square miles to the previous estimates of the area of the continent and settled the position of the coast in the one part where there was no clue to its situation.

The *Scotia* made a series of voyages in the least known of the Antarctic seas and, as the whole of the energies of the expedition were devoted to scientific work, it made collections and oceanographic observations of the highest importance. Five volumes of its scientific results have been published and three others have been arranged owing to a grant previously made by the Government. Four further volumes are required to complete the series. The remaining volumes would be mainly devoted to description of the biological collections, and the memoirs have been already prepared by many distinguished British and foreign naturalists. The work of these men of science has been entirely gratuitous and it is peculiarly ungracious to the foreign contributors that it should be wasted owing to the lack of the comparatively small sum required to complete the publication. 17,500*l.* has been set apart to defray the cost of preparing the reports on the scientific work of the *Terra Nova* expedition, which excludes the reports on natural history which are being published at Government expense by the British Museum; hence the expenditure on the *Scotia* publications has not been excessive. Much confusion in biological nomenclature may be produced if the publication of these reports be delayed, so that they appear simultaneously with those prepared from the collections of later expeditions.

The application to the Treasury for a grant for the publication of the results has received very influential support; it is accompanied by letters from all the leading scientific societies and authorities in Scotland, and by the past and present

[1] In the preparation of this summary, free use has been made of the articles by Dr. Jentzsch and Mr. Conrad Beck in the Journal of the Royal Microscopical Society, 1914, part 1, pp. 1 and 17. For the loan of the blocks from which the illustrations are reproduced, we are indebted to Messrs. R. and J. Beck and Messrs. E. Leitz.

Presidents of the Royal Society. There certainly seems good grounds for the complaint that the Scottish expedition has not received its fair share of support from the Treasury. It will be lamentable if scientific results of such importance be still further delayed in publication, and it is to be hoped that the Government will give favourable consideration to this reasonable appeal.

NOTES.

WE record with deep regret the death in Vienna, on April 25, at eighty-three years of age, of Prof. E. Suess, foreign member of the Royal Society, and emeritus professor of geology in the University of Vienna.

MR. HERBERT SAMUEL stated in the House of Commons on Tuesday that he is about to appoint a Committee to consider the question of smoke abatement. The names of the members will be announced in a few days.

THE April number of *Science Progress* contains an editorial article of nine pages, entitled "Sweating the Scientist." During the past year an inquiry has been conducted by our contemporary as to the emoluments of scientific workers, and the article referred to is a provisional report on the results of this inquiry. As might, perhaps, have been anticipated, the replies received suffice to prove the "low scale of payment given throughout the British Empire for such work." This result is no doubt due to the law of supply and demand, and an interesting sketch is given of the conditions which give rise to such a state of affairs. Other grievances are also dealt with. "Besides the low rate of pay, there are, in this country at least, many small abuses attached to high intellectual work. Large portions of the income of many institutions are given to the maintenance of more or less useless pursuits. Originality and success in research do not receive their due place in selection for appointments. The best-paid posts are seldom given for the best work done, but rather for qualities which are of little account—popularity, eloquence, text-book knowledge, private influence, and skill in the arts of time service. We appear to judge men, not by the work which they have done, but by the work which we may imagine, from their appearance, that they may do." The lack of financial support afforded by the Government to the higher forms of intellectual effort and to higher education is also criticised. The article is a timely one, and deserves the careful attention of all scientific workers, as the question of remuneration is one of paramount importance to the future welfare of science in this country. Particular reference is made to the unpaid services of men of science upon Government Committees, and to the custom of Government departments going to learned societies for expert advice for which no payment is made. "In other words, the State exploits the man of science on account of his enthusiasm for his work and his patriotism." The whole subject is one which the British Science Guild could take up appropriately and refer to a committee.

DR. BASIL T. PARSONS-SMITH has been awarded the Hunterian Society's medal for his essay, "The Intermittent Pulse."

WE learn from the *British Medical Journal* that sufficient funds have now been collected for the erection at Verona of a memorial to Prof. Cesare Lombroso. It is hoped that the monument (which will be the work of Leonardo Bistolfi) will be unveiled in 1915 at the time of the International Congress on Pellagra, which is to be held at Verona.

ON Tuesday next, May 5, Prof. W. Bateson will deliver the first of two lectures at the Royal Institution on (1) double flowers, (2) the present state of evolutionary theory, and on Saturday, May 9, Prof. C. J. Patten, of Sheffield University, will begin a course of two lectures on bird migration. The Friday evening discourse on May 8 will be delivered by Prof. Karl Pearson on albinism in men and dogs, and on May 15 by Prof. F. Keeble on plant animals: a study in symbiosis.

THE council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1913–14:—A Telford gold medal to Mr. F. W. Cowie (Montreal); a George Stephenson gold medal to Mr. F. E. Wentworth-Sheilds (Southampton); Watt gold medals to Mr. Thos. Clarkson (Chelmsford), and Mr. Henry Fowler (Derby); and Telford premiums to Prof. E. G. Coker (London), Mr. W. A. Scoble (London), Mr. Wm. Willox (London), and Mr. S. P. W. D'Alte Sellon (London).

IN the House of Commons on April 22, Mr. Astor directed attention to the unsatisfactory state of legislation and administration with reference to the supply and sale of milk and cream in the United Kingdom; and moved "That fresh legislation is needed to control the supply and sale of milk and cream in the United Kingdom, and that the existing laws should be more thoroughly administered." Mr. Herbert Samuel, in reply, stated that the Board of Agriculture is about to issue a new Order granting more generous compensation to the farmers for the cows slaughtered for the purpose of checking the spread of tuberculosis, and that local authorities are to be assisted in the administration of the law. He further stated that he hopes shortly to introduce a Milk and Dairies Bill, more restricted than its predecessors, which will substitute for various codes now administered by local authorities the uniform provisions of a general statute. He is anxious not to disturb the dairying industry, or to raise the price of milk, and the Bill will be framed in that spirit.

FINAL arrangements are now being made for the International Congress of Tropical Agriculture, which is to be held in London at the Imperial Institute in June next, under the presidency of Dr. Wyndham Dunstan. Invitations to take part in the congress have been issued to foreign countries by H.M. Secretary of State for Foreign Affairs, and already many foreign Governments have nominated delegates to represent them at the congress. The cooperation of

many planters' associations, commercial museums, chambers of commerce, Colonial societies, and similar bodies in this country and abroad has also been secured, and it is already known that at least forty countries will be represented at the congress, ranging from our nearest neighbour France, to such remote places as Formosa, Hawaii, and Papua. A notable feature of the congress will be the organised discussions on certain questions of outstanding importance to tropical agriculture. Four of these have been arranged, viz., technical education in tropical agriculture; the organisation of tropical agricultural departments in relation to research work; the defects of plantation rubber and the means of avoiding them; and problems of cotton cultivation. The fact that the British Cotton Growing Association, the International Federation of Cotton Spinners, the Egyptian, Indian, Nyasaland, Uganda, and Nigerian Government Departments of Agriculture, and the German Colonial Economic Committee have each deputed officials to contribute papers in the discussion on problems of cotton cultivation, indicates the success attained by the organising committee for the congress in securing competent exponents of different points of view on these questions. Full particulars of these and other arrangements for the congress are given in the preliminary general circular and the members' circular, copies of which can be obtained on application to the congress secretaries (Dr. T. A. Henry and Mr. Harold Brown) at the Imperial Institute, London, S.W.

IN the second part of *Ancient Egypt* Prof. Flinders Petrie, the editor, discusses the question of so-called "mummy wheat." At Hawara in the Fayum he discovered a large store of corn of the Roman period, some of which was sown, but failed to germinate. The "mummy wheat" legend is based on various accidents: some dealers in Thebes sell little pots of ordinary corn to tourists; Sir Joseph Hooker noticed accidental admixture of fresh raspberry seeds with some found in the Laurion Mine; there is, lastly, the desire of the gardener to make the experiment successful. Doubtless from time to time the story of the germination of "mummy wheat" will be told, and only credulous people will continue to believe it.

IN the Museum Journal of the University of Pennsylvania for December last Dr. Edith H. Hall describes a fine collection of ancient glass, recently increased by numerous specimens from graves in Palestine and Italy. It includes fine examples of the primitive type, in which the decoration was achieved by laying threads of variously coloured glass over the surface of the vase while it was still hot, and then rolling the whole upon a smooth stone until the threads were pressed in. Besides these there is a good series of Roman mosaic glass, of which the best are the *millifiori* bowls, so called by the Venetians who valued them highly. The rapid increase of the art collections in this museum, due to the wise expenditure of its income and the munificence of American citizens, is noteworthy.

A LARGE portion of the April number of the *Irish Naturalist* is devoted to a memoir, with portrait, of the late Major G. E. H. Barrett-Hamilton, by Mr. C. B. Moffat.

To the first part of vol. xxxvi. of Notes from the Leyden Museum, Dr. J. H. Vernhout contributes an article on the land and fresh-water molluscs of Surinam, or Dutch Guiana, a subject which has hitherto received but scant attention at the hands of naturalists, the only complete list being one published by van Martens in 1873. Many new species are described in the part now issued.

AT the conclusion of an article in the April number of the *American Naturalist*, by Dr. A. F. Shull, on the biology of the Thysanoptera (thrips, etc.), it is stated that *Anaphothrips striatus*, hitherto known almost exclusively by females, recently produced about 25 per cent. of males at Douglas Lake. This suggests that the theory of an alternating life-cycle in this and certain other members of the group, which was at one time formulated but subsequently rejected, may have some measure of justification.

IN the February number of the *American Museum Journal* Dr. F. A. Lucas concludes his account of groups of animals in museums, with reproductions from photographs of a large number of the most striking examples selected from various American museums. Among these, the great albatross colony on Laysan Island in the State University of Iowa and the scene illustrating North American mammalian life in the museum of Kansas University are perhaps the most wonderful. Nothing approaching them is to be seen in any English museum.

THE thorough and exhaustive manner in which the German Government explores its colonial possessions in Africa is well exemplified by *Ergänzungsheft*, No. 9*a*, of *Mitteilungen aus den Deutschen Schutzgebieten*, which is devoted to the topographical results of several exploring expeditions in the southern and eastern Cameruns, as well as of one in Togo. Members of the various exploring parties have contributed their own notes, well illustrated with photographs of scenery, these notes including remarks on the anthropology, zoology, and botany of the districts traversed.

WITH the view of improving the Zoological Gardens under his care at Giza, Egypt, Captain Stanley Flower made a tour of inspection of the establishments of a similar or kindred nature in India during 1913, the results of which are published, with a number of interesting illustrations, in a Report on a Zoological Mission to India, issued by the Ministry of Public Works, Egypt, as No. 26 of the Zoological Service Publications. The author observes that in every zoological garden visited in India there were features of interest, and in each there were new facts of menagerie-technique to be learnt. The gardens at Calcutta were notable for the extent of the collection, those at Trivandrum for the scientific method on which they are arranged, and those at Peshawar for the splendid condition of the animals.

OPTIMISM pervades the report of the council of the Zoological Society for 1913, the total number of fellows and the income from their subscriptions continu-

ing to show a steady increase, while the receipts for admission at the gates of the gardens were the highest on record. The year will be notable for the commencement of the "Mappin Terraces" in the gardens, now nearing completion, and also for the preparation and acceptance of a general plan, made under expert advice, for improvements in the arrangement of the gardens as a whole. These alterations, which have become imperative owing to the increasing popularity of the gardens, will involve the abolition of the old bear-terrace, which, although one of the landmarks of the gardens, is now hopelessly antiquated and out of date. It is satisfactory to learn that plans for new and up-to-date salt- and fresh-water aquaria are under consideration. Neither has the scientific side of the society's work been neglected, special attention being directed in the report to the society's share in the new mammal survey of British India, which has already resulted in the discovery of one new genus and several new species of rodents.

IN the twenty-seventh annual report of the Marine Biological Station at Port Erin, Prof. B. Moore and his co-workers have summarised important observations on the hydrogen-ion concentration of sea-water, determining its degree of alkalinity or acidity, which does not remain constant throughout the year but varies with the relative activities of vegetable and animal organisms, and acts as an index to these activities. There are two maxima of alkalinity corresponding to the two seasonal outbursts of diatoms. The change observed indicates a synthesis, at these seasons, of some tons per acre of sea-water of organic vegetable matter for the nutrition of the animals. The green plants or diatoms break up the bicarbonates present in sea-water and form organic compounds, the amount of the removal of the carbon dioxide being shown by the increase in alkalinity in the water. It is noteworthy that the spring increase in alkalinity is just of the grade formerly found to be most favourable to the rapidity of cleavage in the initial stages of development of the eggs of the sea-urchin (Echinus).

A RECENT issue of the *Naturwissenschaftliche Wochenschrift* (March 15, 1914) contains an article by Dr. F. Stellwaag, of Erlangen, in which he directs attention to the apparently contradictory results obtained by various observers who have experimented on the colour-sense of bees. Following the methods of Lord Avebury and of Forel, von Dobkiewicz came to the conclusion that bees are able to distinguish between colours, but are only attracted by them when they have learnt by experience to associate a given colour with the presence of honey. This he considers to accord with the fact remarked by Plateau that many colourless and inconspicuous flowers are eagerly sought after by bees, while many brightly-coloured flowers are unvisited by them. These results were to some extent confirmed by von Frisch, who concluded further that the colour-vision of bees must resemble that of "red-blind" men. Hess, however, disputes the conclusions of both preceding experimenters, and considers that bees show no indication of being otherwise than totally colour-blind. Stellwaag himself is of opinion that in all these experiments an important factor has been overlooked, viz. the condition of the bees with regard to the general supply of provender. When this is deficient, bees will seek it anywhere.

AN interesting paper has been issued by W. E. Castle and J. C. Phillips in Publication No. 195 of the Carnegie Institution of Washington (1914), on the effects of selection in modifying the pattern of piebald rats. The piebald or "hooded" pattern behaves as a Mendelian recessive to the self-coloured condition, but within the hooded class there is considerable variation in the extent of the coloured areas. The authors have made continuous selection experiments, both in the direction of greater and of less pigmentation, extending over thirteen generations and involving the breeding of some 25,000 rats. Although the hooded pattern behaves as a Mendelian unit, selection of either plus or minus variation brought about permanent changes extending far beyond the original variation of the race. In each generation the offspring of selected parents tended to regress towards the mean of the preceding generation, with the result that when, after several generations of selection, the selection was reversed, the regression was *away* from the original mean. But by continued reversed selection from a race which had become very divergent, the mean was brought back nearly to the original starting point. Results are described of crosses between extreme plus and minus strains, and between such strains and self-coloured types. An account is also given of an extreme variant which appeared as a mutation. The paper should be compared with the recent work of Hagedoorn (*Zeitsch. indukt. Abstam.*, xi., 1914, p. 145).

A DETAILED account of the twelve months' poultry laying competition at the Harper Adams Agricultural College is given in the report of the college for 1913. Upwards of six hundred birds were tested, the average egg production being 152 for the twelve months period. A comparison of the returns obtainable from one acre of grass land when stocked entirely with poultry and the same area used for milk production, shows that a much greater return per acre can be produced in the former case, these being respectively 41*l.* 13*s.* 4*d.* and 4*l.* 3*s.* 2½*d.* It must be borne in mind that, although the gross return per acre in the case of the poultry is so much greater than for cattle, the expenses, capital and depreciation of stock, would be correspondingly high. Unfortunately, there seem to be no available figures which might be utilised for purposes of comparison. That the possibilities of egg production on commercial lines are great cannot be denied, and the actual determination of these, and the factors which govern such production, should prove an interesting and profitable field for further investigation.

A REPORT on sugar cane experiments in the Leeward Islands which has just been published, contains a summary of the varietal trials and work on manuring conducted during the last few years. Of the varieties which have been under cultivation for some considerable time, and of which the relative merits and suita

bility to various conditions are well appreciated and recognised, Sealy seedling and B 147 have attained considerable popularity, while the more recently introduced varieties, B 4,596 and B 1,528, are more prominent. The importance of incorporating with the soil a sufficiency of organic matter, either as pen-manure or green crops, is becoming more and more recognised, and the various bacterial changes concerned in the breakdown of these manures are discussed in this report in the light of recent investigations. The extreme rapidity with which such changes proceed in tropical climates is indicated by the fact that under favourable conditions the humus content of the soil may be decreased by as much as 25 per cent. in the space of six months.

SOME interesting observations on the action of thunderstorms in giving rise to seiches have recently been made by Messrs. Okada, Fujiwhara, and Maeda (Proc. Tokyo Math. Phys. Soc., vol. vii., 1914, pp. 210–221). The measurements of the seiches were made with a Honda limnimeter on the shores of Lake Biwa in central Japan. The authors indicate as important causes of seiches during thunderstorms the accumulation of rain-water over a portion of the lake, the impulsive action of winds on the surface, and sudden changes of barometric pressure; and as subsidiary causes the impact of falling raindrops on the surface of the lake and the attraction of the electrified mass of thunderclouds. They examine in detail the effects of a heavy thunderstorm that swept over Lake Biwa on April 19, 1912, and estimate that the change of barometric pressure (2·7 mm.) would account for an amplitude of 6·6 cm. in the seiches, the rainfall (32 mm. in twenty minutes) for an amplitude of 6·1 cm., while the impulsive action of the wind may have contributed an amplitude of 4·5 cm. The sum of these amplitudes is 17·2 cm., which is very close to the total amplitude observed.

THE two last contributions to the geology of the Antarctic Expedition of the *Belgica* ("Expédition Antarctique Belge: Résultats du Voyage du s.y. *Belgica* en 1897, 1898, 1899; Zoologie, Tuniciers, Caducichordata," by Ed. van Beneden and Marc de Selys-Longchamps, 1913; and "Géologie, Petrographische untersuchungen der Gesteinsproben," part ii., by Dragomir Sistek, 1912) include the account of the tunicates and a further contribution to the description of the rocks collected. The memoir on the tunicates was begun by E. van Beneden, and after his death was continued and completed by M. Marc de Selys-Longchamps. The expedition obtained eight species, of which five are new and another is represented by a new variety. All the species collected have been described in elaborate detail; the memoir comprises 120 pages, and is illustrated by seventeen plates and some figures in the text. The classification adopted is that by Hartmeyer. The new contribution on the petrography of the expedition is a description by D. Sistek of the rocks collected in the Straits of Magellan and the Beagle Channel, which is on the southern side of Tierra del Fuego. The rocks are all igneous or metamorphic. The most varied collection, including granite, diorites, quartz-porphyries, andesite, diabase, basalt, gneiss, schists, and clay slate, was made at Cape Gregory in the Straits of Magellan. The crystalline schists include a varied series. The chief rocks are illustrated by a plate of microphotographs of unusual clearness.

AN important by-product of the adjustment of the primary triangulation of the United States was the discussion of the deflections of the vertical and anomalies of gravity, by Mr. J. E. Hayford, on the hypothesis of isostatic compensation of inequalities of the earth's surface. In this way the discrepancies between the observed and the anticipated values of each was very largely reduced, but, whatever the precise form of hypothesis used, there still remained an average anomaly of gravity of not less than 0·020 dyne, which was attributed by Mr. Hayford to an imperfection of isostatic adjustment. Prof. G. K. Gilbert has taken up the subject in Professional Paper 85–C of the U.S. Geological Survey, and shows that the distribution of the anomalies of gravity does not indicate any relation to the leading features of geological structure, as would be expected if they were due to variation in the distribution of density, or imperfect isostatic adjustment, within the earth's crust. From this he concludes that they are due, at least in part, to variations in the nuclear portions of the earth, below the limits within which isostatic adjustment, and compensation of elevated tracts of the earth's surface, take place.

PROF. G. A. GIBSON, of Glasgow, has issued in separate pamphlet form the address he recently gave before the Royal Philosophical Society of Glasgow on Napier and the invention of logarithms. The pamphlet contains a clear picture of the career and personality of the great Scottish mathematician, bringing together within the compass of twenty-four pages the salient facts of his life. The interest for the mathematical student is the account given of the way in which Napier originally defined the logarithm. This does not correspond exactly with what is known as the Napierian logarithm, although it is closely related to it. There is a passing reference to Bürgi, whose "Progress Tabulen" has probably been seen by very few mathematicians in this country. The evidence that Napier was in possession of his method at least twenty years before he published his tables is also referred to; and Napier's other mathematical and arithmetical discoveries have as adequate a notice as is possible in such a brief statement. Prof. Gibson's sketch comes at an opportune time when mathematicians are preparing to celebrate the tercentenary of the publication of the "Canon mirificus logarithmorum."

A PAPER by Messrs. K. M. Faye-Hansen and J. S. Peck, published in the last issue of the Journal of the Institution of Electrical Engineers, deals with some interesting uses of inductance coils or "reactances" in heavy electrical engineering. These are being used to an increasing extent on large power supply systems of the order of 100,000 kilowatts for the purpose of limiting the current that may flow in various parts

of the circuits in cases of accidental short circuits with the view of localising the damage that can be done. For example, it is possible by placing reactances in the conductors between the generators and the switchboard, to limit the current under conditions of short circuit on the switchboard or feeders to, say eight times, the normal working current, and thus to protect the machines from enormously greater rushes of current that would be destructive. The paper discusses the relative utility of such reactances in the generator leads, in the feeders, and between different sections of the main "bus-bars," and suggests various combined arrangements. These reactances generally take the form of large coils without iron in their magnetic circuit, but a partial iron circuit is sometimes employed. An appendix discusses the effect of bus-bar reactance on the parallel operation of alternators.

IN twelve pages of the March number of the Journal of the Franklin Institute Mr. W. P. Davey, of the X-ray laboratory, Cornell University, succeeds in giving a most valuable summary of the present state of our knowledge of Röntgen, or X-rays. After explaining the production of Röntgen rays by the impact of kathode rays on the target of a vacuum tube, he shows that they produce fluorescence in certain bodies on which they impinge, they affect photographic plates and ionise the air through which they pass. In each case the laws which have been found to hold are stated. When the rays fall on metals or on metallic salts they produce in certain cases secondary radiations which differ in properties from the original rays, and by analogy have been called fluorescent Röntgen or X-radiations. The methods adopted for the measurement of the quality or penetrating power of the radiations, and the quantity of radiation which falls on a given surface in a given time, are also described. The article will prove of great value to those who wish to make themselves acquainted with the principal facts of the subject without entering into details.

THE Société de Chimie-Physique has issued two more numbers of its series of monographs. These are vii., "Paramagnetism Applied to the Study of Metallic Salts," by Mlle. E. Feytis; viii., "Relations between Chemical Constitution and the Coloration of Organic Substances," by M. André Meyer. The latter contains, in addition to a review of the chief types of coloured compounds, a bibliography of the subject extending over ten pages, and containing more than two hundred references to original papers.

AN interesting illustrated article on charcoal burning in the Weald, by Mr. W. R. Butterfield, is contained in the April number of the *Selborne Magazine*. This primitive industry is still carried on in the Weald, although it has declined considerably during the last thirty years, owing to the decreased quantity of home-grown hops, for the drying of which the charcoal is mainly used. All the charcoal that is required is made during the few weeks before hop-picking, and the "collier," as the burner is called, and his mate move from farm to farm as required, and cover a wide area each season. The burners depend wholly upon empirical knowledge, either acquired by their own experience or handed on to them by their predecessors, and the operation is one requiring considerable skill and unremitting vigilance day and night.

THERE is an interesting illustrated article in the *Engineering Magazine* for April, giving an account of the workshops and methods of the Ford Motor Company. This company turns out 1000 automobiles a day at its Highland Park Works in Detroit. The other two factories belonging to the company, one at Ford, Ontario, Canada, and one at Manchester, England, bring the total Ford car-producing capacity to at least 1200 cars a day. The company produces one article only, viz., the Ford motor-car, and employs rather more than 15,000 hands.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR MAY:—

May 1. 11h. 24m. Neptune in conjunction with the Moon (Neptune 4° 17′ S.).
" 20h. 43m. Mars in conjunction with the Moon (Mars 1° 37′ S.).
15. 7h. 4m. Uranus in conjunction with the Moon (Uranus 2° 3′ N.).
16. 1h. 50m. Jupiter in conjunction with the Moon (Jupiter 1° 13′ N.).
" 2h. 7m. Venus in conjunction with Saturn (Venus 2° 10′ N.).
" 20h. 0m. Uranus stationary.
" 23h. 0m. Mercury in superior conjunction with the Sun.
25. 23h. 5m. Saturn in conjunction with the Moon (Saturn 6° 9′ S.).
26. 21h. 2m. Venus in conjunction with the Moon (Venus 3° 21′ S.).
28. 17h. 57m. Neptune in conjunction with the Moon (Neptune 4° 1′ S.).
30. 5h. 16m. Mars in conjunction with the Moon (Mars 0° 42′ S.).
" 10h. 0m. Mercury at greatest heliocentric latitude N.

COMET 1914a (KRITZINGER).—Recent observed positions of comet 1914*a* (Kritzinger) have enabled Prof. Kobold (*Astronomische Nachrichten*, No. 4729) to improve the elements of this comet, and consequently the ephemeris. The new positions for the current week are now as follows:—

12*h*. *Berlin M.T.*

	R.A. h. m. s.	Decl. ° ′	Mag.
April 30 ...	18 13 21 ...	+16 30·7 ...	8·6
May 1 ...	17 56 ...	17 31·9	
2 ...	22 34 ...	18 32·8	
3 ...	27 14 ...	19 33·3	
4 ...	31 55 ...	20 33·3	
5 ...	36 39 ...	21 32·6	
6 ...	41 23 ...	22 31·2	
7 ...	18 46 9 ...	+23 29·0 ...	8·5

The comet is situated in that portion of the constellation of Hercules lying to the south of Vega, and it will be noticed that the present calculation makes the object brighter by more than half a magnitude than that previously given.

THE APRIL METEORIC SHOWER.—Mr. W. F. Denning writes:—More favourable weather for meteoric observations could scarcely have occurred at the period of the Lyrid meteors. At Bristol the fourteen successive nights from April 10 to 23 were clear or generally

clear throughout. The expected shower of meteors, however, failed to display itself in a prominent manner. There were a few bright Lyrids seen between April 19 and April 22, but the return of this year must certainly be classed among the failures. A number of other streams showed themselves in the absence of the major shower, but meteors were rather scarce generally, with a great exception on one night, April 22, when they were quite abundant, though the Lyrid display was scarcely visible. On April 14 there was a remarkable dearth of meteors before midnight, though the firmament was splendidly clear.

Mr. Denning has computed the real paths of several interesting meteors recently observed at two stations :—

1914 April	G.M.T. h. m.	Mag.	Height at first. Miles.	Height at end. Miles.	Path. Miles.	Velocity per sec. Miles.	Radiant Point. ° °
12	10 5	2–1	64	44	21	18	167+31
15	9 46	4–2	88	64	49	35	309+61
,,	10 22	2–1	71	55	18	36	180+77
,,	10 44	1	73	57	29	29	312+61
20	11 7	>1	62	48	57	29	319+40
22	10 51	2	76	44	76	24	238–2

The chief radiant points have been :—

° °			° °
142+27	...	...	220+13
199+ 7	...	...	239± 0
204+55	...	...	272+33
209–10	...	...	312+61

The Aquarid meteoric shower, supposed to be connected with Halley's comet, is due to reappear on the mornings of May 1–6. The radiant point is at about 337°–2°.

THE PRESSURE IN THE REVERSING LAYER OF THE SUN.—In an early number of a Bulletin of the Kodaikanal Observatory (No. 18) Mr. Evershed attempted to make a rough estimate of the pressure in the reversing layer of the sun based on the assumption that those lines which were most and least affected by pressure in the laboratory were similarly affected in the sun. In a more recent Bulletin (No. 36) he suggests a new interpretation of the general displacement of the lines in the solar spectrum towards the red. He shows that taking into consideration probable differences of level, the absolute and relative shifts can be quite easily explained as due to motion in the line of sight, and have very little relation to pressure shifts. While the quantities measured are exceedingly small, and, as he says, subject to considerable errors, yet he is so convinced that pressure is not the main factor involved that he publishes his results, even although all the work of measurement is not yet completed, and exact values cannot be submitted. Many interesting points are mentioned in the paper, one being that a small pressure effect is traceable in the relative positions of the solar and arc lines, but that it is a minus effect, thus indicating a decidedly smaller pressure in the sun than in the arc in air. With such a small pressure effect he finds the shifts closely related to the intensities of the lines, the strong lines showing larger shifts than the weak. He arrives also at the conclusion that in the higher levels of the sun there is a movement of descent which is retarded in the lower levels.

THE NEW UNIVERSITY OF ZÜRICH.

ON the four days from Friday, April 17, to Monday, April 20, Zürich celebrated in a very interesting fashion the inauguration of the new University which for six years she has been engaged in building at a total cost of 5,600,000 francs (224,000*l*.). As is usual on such occasions, the guests were welcomed at a reception in their honour on the Friday evening. The *Weiheakt* of Saturday morning was held in the central court of the new University, which is covered with a roof of tinted glass carried on light iron girders. Thither the University authorities and their guests marched two and two from the Kunsthalle, the procession rendered picturesque by the robes of the foreign delegates, for the republican simplicity of Switzerland does not admit of academic dress. Many speeches were delivered, those of the local officials naturally dwelling upon the efforts required to complete the task. Amongst those of foreign delegates that of Dr. Macan, master of University College, Oxford, was distinguished by its wit and humour, and by the obvious pleasure which it gave to the people of Zürich where he had been a student thirty-nine years before.

The speeches were followed by a cantata written by Prof. Alfred Frey, and set to music by the director of the Conservatorium, Dr. Hegar. Both words and music were well adapted to the occasion, most parts of the libretto attaining a high poetic level. A banquet lasting nearly four hours followed, and for those who wished for more festivity still there was a students' *kommers* in the evening. Sunday was no less full, with a special service in the Fraumünsterkirche, a luncheon given by the Guild of Smiths, a trip on the lake, and an admirable performance of Gluck's "Orpheus," in the Stadt-Theater in the evening. Monday was the annual festival of the *Sechseläuten*, where, as of old, the departure of winter was betokened by the burning of a huge puppet filled with fireworks at the end of a procession through the town which lasted the whole afternoon. This year the procession was developed into a gorgeous pageant of the history of learning from its beginnings in Egypt and Babylon, through Greece and Rome, troubadours and goliards, monks and reformers, to the present day. In the evening the trade guilds had their separate banquets, to which visitors were invited. The entertainment was followed by visits from the younger members of one guild to each of the others in turn. As they came in with their band and banner, with lanterns hanging from long poles, and the emblems of their craft, while their leader exchanged loving-cups with the master of the guild visited, and the two made, and in turn listened to, speeches at one another's expense, one felt that one had here a custom which had known no change since at least the fifteenth century.

Nothing could exceed the hospitality and kindness with which the foreign visitors were welcomed. As a means of identification the guests were asked to wear in the buttonhole a stud with the colours of Zürich (light blue and white), which proved a most useful "open sesame" everywhere.

This is the third time that the University of Zürich has been furnished with buildings since its revival in 1833. The intermediate edifice was built in 1864. For some time back the University has shared in the building occupied by the Polytechnic, but by 1907 it was felt that the difficulties of accommodation must be otherwise provided for. In 1908 architects were invited to compete, and ultimately the plan of the firm of Curjel and Moser, of St. Gallen and Karlsruhe, was adopted. The site on the Zürichberg was not easy, because the slope is very considerable, and from parts of it various other institutions had to be removed. The buildings, which, of gray stone and many windowed, resembles many Germany university buildings, consists of two wings with a great tower between. The northern and lower wing is the biological institute, the southern is the University proper, in the sense that it contains the lecture-rooms, reading-rooms, *seminars*, libraries for

the theological and arts faculties, and accommodation for the administration. To it also have been moved the archæological and ethnological collections. Natural science and medicine are provided for in the biological institute and in other buildings adjacent.

Apart from the tower, the building is in three storeys at present, though in the University proper it will be possible, as the numbers increase, to provide more accommodation for classes in the attics. With an imposing façade on two sides, the rooms are admirably lighted. Round the central court runs a wide passage on each storey, thus giving easy access from room to room, and also providing in these passages, which can be seated, excellent galleries for such occasions as that of April 18. The parapet towards the court is broken by openings, the superincumbent mass being on the first storey supported in each case by two Moorish pillars. In the storeys above are romanesque arches, so that the appearance towards the inner court is more like that of some southern palazzo than could be guessed from its external aspect. The effect is heightened by the insertion in the walls of small artistic figures. The rooms for the administration are well furnished; the desks and seats in the lecture-rooms are substantial but simple.

On the walls of the galleries are frescoes which the spectator was asked by notices to believe were not yet finished, and which seemed, truth to tell, to represent an early stage of art. But the general effect of lightness and airiness was excellent, and the people of Zürich and their architect, Mr. Moser, are to be congratulated on the way in which they have secured an admirable result at what, for the accommodation provided, seems a minimum of cost. It is to be remembered that the whole of this is paid for out of the rates of the Canton of Zürich, which not unnaturally are very high. But as the inscription above the entrance tells us, all has been done "by the will of the people," which, when the first credit was insufficient, voted a second. The people of Zürich are convinced of the value of good and cheap education, and nothing in the whole celebration perhaps was more interesting than to mix with the crowd on Monday morning, when the building was thrown open to the public, and to hear the approving remarks of tradesmen and labourers as they examined the new building which they were proud to call their own. G.

RADIUM AND QUACK MEDICINES.

IN view of the fact that a large number of drugs, earths, and waters, said to be radio-active, are being offered for sale to the general public for the treatment of certain diseases, the medical committee of the British Science Guild recently instituted an inquiry into the question of radium and its therapeutic uses.

The result of the inquiry indicates the urgent necessity for legislation in order to safeguard the interests of the community in the sale of these substances, by compelling a written guarantee to be given as to the quantity of radium present in the substances offered for sale.

The use of radium in cases of cancer is now widely known, but it is necessary to warn the public that no definite evidence that cancer is permanently curable by radium is yet forthcoming. The immediate effect of the treatment of cancer by radium is often highly satisfactory, but it must not be forgotten that agents other than radium are known to give equally good results. It is only by keeping under observation for at least five years patients who have been so treated that a definite decision can be come to as to the place radium-therapy shall take in the treatment of malignant diseases.

The great strides that have been made in recent years in the use of radium for the treatment of disease, and the results obtained, encourage the medical profession to persevere with this therapeutic agent. However, radium in its application to disease is still but little understood, and until more experimental, pathological and clinical data have been collected to show the effect of this agent upon, not only the diseased but also the healthy tissues of the body, dogmatic statements as to its therapeutic value cannot be made.

In these circumstances of uncertainty the public is warned that there is danger that the claims which have been advanced for radium as a curative agent may lead to frauds on the credulous section of the public, which may be imposed upon by the sale of substances or waters in which radium does not exist, or may be harmfully treated by persons with no medical qualifications.

The inclusion of radium in the Pharmacopœia would be of material benefit to the public, and it is proposed to take the steps necessary to secure this end. It has also been suggested that radium should be scheduled as a poison under the Foods and Drugs Act, which would be an additional safeguard against the victimisation of the public.

The report of the medical committee of the British Science Guild contains further valuable and important information concerning the sources, etc., of radio-active substances, the price of radium, and diseases which are treated with radium, and this will be published in full in the annual report of the guild, to be issued in May next.

JAPANESE FISHES AND NOMENCLATURE.

THE latest part of the Journal of the College of Science in the Imperial University of Japan (vol. xxxiii., article 1, March, 1913) is a catalogue of the fishes of Japan, by David Starr Jordan, Shigeho Tanaka, and John Otterbein Snyder. It consists of 497 pages, and has 396 figures in the text. There is a very excellent index, and the volume is one which is likely to be of considerable assistance to ichthyologists. The list is based on the work of Temminck and Schlegel (1848 to 1850), on the collections made by David Starr Jordan in 1900, the collections of Snyder (1906), and the collections in the Imperial University of Japan, and the Imperial Museum at Tokyo. It includes all records of Japanese fishes made up to February 1, 1913.

The fish fauna of Japan appears to be an extraordinarily rich one, for the present list deals with 1230 species, while it is pointed out that many additional species from the tropics may yet be found in the Kuroshiwo (that is, the Japan current corresponding to the Atlantic Gulf Stream); the deep-sea species are yet imperfectly known; and large accessions to the lists may be expected when Hokkaido is explored. Japanese names are given for all the species, but full synonymies are not given, and this is occasionally rather troublesome to the worker unaccustomed to the light-hearted manner in which the American systematists play fast and loose with generic names, and their uncompromising insistence on the rules of priority with regard to specific names.

One example from this catalogue may be given—it is not the only one that might be quoted in illustration of our complaint; the Japanese sardine called "Iwashi," was described by Schlegel in 1846 as *Clupea melanosticta*, and this name was adopted by Günther. Richardson also described the same fish in

1846, calling it *Clupea caeruleovittata,* but Schlegel's description appeared on p. 237 of his book, while Richardson's appeared on p. 305 of *his* book. Therefore Schlegel's name has "page priority." But in 1901 Jordan and Snyder changed the generic name from Clupea to Clupanodon; and then in 1906 Jordan (the same worker) and Herre changed it from Clupanodon to Sardinella. In the present paper Jordan, Tanaka, and Snyder discard Sardinella and go back to an old generic name Amblygaster, used by Bleeker in 1849. So it remains for the immediate present.

Of course, irritating as all this is, one cannot but feel that a rigid adherence to the rules of priority (provided that systematists can agree about these) is the only way by which we can approach finality in matters of nomenclature. The case is different, however, with regard to generic and family names, and one may reasonably urge that so long as large tracts of the earth are imperfectly explored, and so long as accessions to specific lists may be expected, the older generic names should be retained. Even should the genus attain "unwieldy" dimensions, it may be broken up into divisions of a provisional nature, but the temptation to make new genera might be resisted, for as a rule these generic changes only burden the synonymies. When the same author places a species in three genera, almost within the same decade, one does not feel confident that the state of our knowledge justifies the adoption of the rather fine distinctions on which these groupings depend. J. J.

THE CANADIAN ENTOMOLOGICAL SERVICE.

THIRTY years ago, in 1884, the Canadian Government appointed a Dominion Entomologist to advise agriculturists and others regarding the control of insect pests. Two years later, on the establishment of the experimental farms system, Dr. James Fletcher, who occupied the position, was attached to the new branch of the Department of Agriculture in the joint capacity of entomologist and botanist, which position he occupied with conspicuous success until his death in 1908. The growth in importance of the subjects necessitated their separation, and accordingly divisions of entomology and botany were created. Dr. C. Gordon Hewitt was appointed Dominion entomologist in 1909, and entrusted with the work of organising the new division of entomology of the Experimental Farms Branch of the Department of Agriculture, with offices and laboratory at the Central Experimental Farm, Ottawa.

The urgent need of legislation in order to permit action to be taken to prevent the introduction into Canada and spread within the country of serious insect pests and plant diseases was responsible for the passage of the Destructive Insect and Pest Act in 1910. The still greater need of investigations on the insect pests affecting agriculture, forestry, and other branches of human activity has led to the establishment of field or regional laboratories in different parts of Canada, with trained entomologists in charge to study local problems.

Owing to the consequent expansion of the entomological work along investigatory and administrative lines, and the fact that such work did not constitute a necessary part of the work of the experimental farms system, and executively was virtually distinct, the Entomological Service has now been separated from the Experimental Farms Branch, and has been constituted an independent branch of the Department of Agriculture under the direction of the Dominion Entomologist. It is proposed to erect a building to provide offices and laboratories for the new entomological branch. Correspondents are requested to note that all official communications and publications should be addressed to "The Dominion Entomologist, Department of Agriculture, Ottawa"

This reorganisation, which will also include the establishment of a national collection of the insects of Canada in the Canadian National Museum (the Victoria Memorial Museum) at Ottawa, under the care of the Dominion Entomologist, marks an important step in Canadian entomology. It will result in a still greater development of the study of Canadian insects along scientific and practical lines.

DISEASES OF PLANTS.

DR. G. H. PETHYBRIDGE, economic botanist to the Department of Agriculture and Technical Instruction for Ireland, has recently published two papers, of considerable scientific as well as economic interest, on species of the genus Phytophthora, and the diseases which these fungi cause in the potato. In the first paper (Sci. Proc. Royal Dublin Soc., vol. xiii., No. 35) he describes the rotting of potato tubers by a species of Phytophthora having a method of sexual reproduction hitherto undescribed, and gives in the introductory portion of the paper a useful summary of the literature dealing with the chief forms of rot previously known to occur in the potato tuber. The new form of rot ("pink rot") is caused by the new fungus *Phytophthora erythroseptica,* the most peculiar feature of which is the fact that the oogonium rudiment enters the antheridium at or near its base, the female organ then growing up through the male and out at the top, expanding there to form the oogonium proper in which the oosphere develops. The "pink rot" disease is prevalent in the west of Ireland, and the losses caused by it, which are considerable, and in some cases being greater than those due to *P. infestans,* are greatest in crops grown continuously on the same land (infection taking place from the soil), and can be avoided by a proper rotation; it is probably transmitted to some extent by oospores which adhere to the seed tubers.

In the second paper (*ibid.,* No. 36) Dr. Pethybridge, in conjunction with Mr. P. A. Murphy, describes the results of investigations on the common potato blight fungus, *Phytophthora infestans,* and points out that much remains to be discovered regarding the life-history and modes of transmission of this well-known parasite. Thick-walled spores were found in the tissues of various parts of the potato plant that had been destroyed by *P. infestans,* and these are probably the oospores of this fungus. The two papers are illustrated by beautiful figures, including two plates of very fine photomicrographs.

In connection with the foregoing paragraphs, mention may be made of a paper received simultaneously, dealing with the same group of fungi, entitled "Studies in Peronosporaceæ," by Mr. E. J. Butler, Imperial Mycologist, and Mr. G. S. Kulkarni, Mycological Assistant, Bombay Department of Agriculture (Memoirs of the Department of Agriculture in India, Botanical Series, vol. v., No. 5, 1913). The forms described in detail by the authors are *P. colocasiae* (parasitic on *Colocasia esculenta*), the ubiquitous *Pythium debaryanum, Sclerospora graminicola* (parasitic on three Indian cereals and a fodder grass), and *S. maydis* (a very destructive parasite on maize, which has apparently reached India recently from Java). The four papers included in these careful studies are illustrated by fine plates, in some cases coloured, and directions are given for treatment of the disease in question. F. C.

EASTER VACATION WORK AT PORT ERIN.

THE Easter vacation party at the Port Erin Biological Station has this year been larger than ever before, and has carried out a longer programme of work—both in the laboratory and on the seashore. During the last few weeks (March and April) the number of researchers and senior students enrolled in the books of the station has reached the record total of eighty-five, including half a dozen professors and a dozen university lecturers and demonstrators, while nearly half of the total number were post-graduate researchers. Altogether twelve universities or university colleges have been represented. Practically all the senior students and post-graduate workers of the botanical and zoological departments of the University of Liverpool, under Profs. Harvey Gibson and Herdman, migrated to the Port Erin laboratory for the vacation. Prof. Cole brought a considerable contingent from the University College of Reading, and Dr. Stuart Thomson a number from Manchester; Mr. Holden came with some students from University College, Nottingham, and smaller groups came from Birmingham, Cambridge, Oxford, Bristol, Bangor, Cardiff, London, and Melbourne. In addition to the laboratory work of the students and their collecting expeditions on the seashore, the activities of the biological station at this time of year are threefold: first, the flat-fish hatching (seen at its best during March and April); secondly, the plankton investigation going on at sea from the s.y. *Runa*; and thirdly, the special investigations of the post-graduate researchers.

The spawning of the mature plaice in the open-air fish-ponds started at the beginning of February this year, at least a fortnight earlier than usual, and it is by no means finished yet. Already more than eight millions of eggs have been skimmed from the ponds, and about seven millions of young fish have been set free in the sea round the south end of the Isle of Man.

Work at sea was much hampered by bad weather during the earlier part of the time, and it was sometimes difficult to get the periodic plankton hauls taken. This is now the eighth year of Prof. Herdman's scheme of intensive study of the nature and distribution of the plankton, of which it is hoped to complete ten years' statistics before winding up the investigation. Up to the present the phytoplankton this spring has been characterised by the prevalence of Coscinodiscus.

In addition to the collecting and recording of rare species, both of animals and sea-weeds, which has gone on very much as in former years, there has been a large amount of special investigation both at sea and in the laboratory on the part of those who are engaged in the preparation of L.M.B.C. Memoirs, and also of others who are at various researches. For example, Mr. R. D. Laurie has been making observations on the movements of Amphidinium in the sand, Mr. S. T. Burfield has been working at Sagitta, Miss Gleave at Archidoris, Mr. H. G. Jackson on Decapod larvæ in the plankton, and Prof. B. Moore and Mr. E. Whitley on the nutrition of marine animals and the variations in the alkalinity of the sea-water. The memoir on Echinoderm larvæ which Mr. Chadwick has been engaged on for some years is now in the printer's hands, and will be published at an early date. The pressure on the laboratory accommodation has been very great during this vacation, and the need of further extension of the building is urgent.

W. A. H.

RELATIONS BETWEEN THE SPECTRA AND OTHER CHARACTERISTICS OF THE STARS. *

I.

Historical.

INVESTIGATIONS into the nature of the stars must necessarily be very largely based upon the average characteristics of groups of stars selected in various ways—as by brightness, proper motion, and the like. The publication within the last few years of a great wealth of accumulated observational material makes the compilation of such data an easy process; but some methods of grouping appear to bring out much more definite and interesting relations than others, and, of all the principles of division, that which separates the stars according to their spectral types has revealed the most remarkable differences, and those which most stimulate attempts at a theoretical explanation.

In the present discussion, I shall attempt to review very rapidly the principal results reached by other investigators, and shall then ask your indulgence for an account of certain researches in which I have been engaged during the past few years.

Thanks to the possibility of obtaining with the objective prism photographs of the spectra of hundreds of stars on a single plate, the number of stars the spectra of which have been observed and classified now exceeds one hundred thousand, and probably as many more are within the reach of existing instruments. The vast majority of these spectra show only dark lines, indicating that absorption in the outer and least dense layers of the stellar atmospheres is the main cause of their production. Even if we could not identify a single line as arising from some known constituent of these atmospheres, we could nevertheless draw from a study of the spectra, considered merely as line-patterns, a conclusion of fundamental importance.

The spectra of the stars show remarkably few radical differences in type. More than 99 per cent. of them fall into one or other of the six great groups which, during the classic work of the Harvard College Observatory, were recognised as of fundamental importance, and received as designations, by the process of "survival of the fittest," the rather arbitrary series of letters B, A, F, G, K, and M. That there should be so few types is noteworthy; but much more remarkable is the fact that they form a continuous series. Every degree of gradation, for example, between the typical spectra denoted by B and A may be found in different stars, and the same is true to the end of the series, a fact recognised in the familiar decimal classification, in which B5, for example, denotes a spectrum half-way between the typical examples of B and A. This series is not merely continuous; it is *linear*. There exist indeed slight differences between the spectra of different stars of the same spectral class, such as A0; but these relate to minor details, which usually require a trained eye for their detection, while the difference between successive classes, such as A and F, are conspicuous to the novice. Almost all the stars of the small outstanding minority fall into three other classes, denoted by the letters O, N, and R. Of these O undoubtedly precedes B at the head of the series, while R and N, which grade into one another, come probably at its other end, though in this case the transition stages, if they exist, are not yet clearly worked out.

From these facts it may be concluded that the prin-

* An address delivered before a joint meeting of the Astronomical and Astrophysical Society of America and Section A of the American Association for the Advancement of Science, at Atlanta, Georgia, December 30, 1913, with a few additions, by Prof. H. N. Russell.

cipal differences in stellar spectra, however they may originate, arise in the main from variations in a single physical condition in the stellar atmospheres. This follows at once from the linearity of the series. If the spectra depended, to a comparable degree, on two independently variable conditions, we should expect that we would be obliged to represent their relations, not by points on a line, but by points scattered over an area. The minor differences which are usually described as "peculiarities" may well represent the effects of other physical conditions than the controlling one.

The first great problem of stellar spectroscopy is the identification of this predominant cause of the spectral differences. The hypothesis which suggested itself immediately upon the first studies of stellar spectra was that the differences arose from variations in the chemical composition of the stars. Our knowledge of this composition is now very extensive. Almost every line in the spectra of all the principal classes can be produced in the laboratory, and the evidence so secured regarding the uniformity of nature is probably the most impressive in existence. The lines of certain elements are indeed characteristic of particular spectral classes; those of helium, for instance, appear only in Class B, and form its most distinctive characteristic. But negative conclusions are proverbially unsafe. The integrated spectrum of the sun shows no evidence whatever of helium, but in that of the chromosphere it is exceedingly conspicuous. Were it not for the fact that we are near this one star of Class G, and can study it in detail, we might have erroneously concluded that helium was confined to the "helium stars." There are other cogent arguments against this hypothesis. For example, the members of a star-cluster, which are all moving together, and presumably have a common origin, and even the physically connected components of many double stars, may have spectra of very different types, and it is very hard to see how, in such a case, all the helium and most of the hydrogen could have collected in one star, and practically all the metals in the other. A further argument—and to the speaker a very convincing one—is that it is almost unbelievable that differences of chemical composition should reduce to a function of a single variable, and give rise to the observed linear series of spectral types.

I need not detain you with the recital of the steps by which astrophysicists have become generally convinced that the main cause of the differences of the spectral classes is difference of temperature of the stellar atmospheres. There is time only to review some of the most important evidence which, converging from several quarters, affords apparently a secure basis for this belief.

The first argument is based upon the behaviour of the spectral lines themselves. To appreciate its full force, one must familiarise himself with a multitude of details. A typical instance is that of the heavy bands in the region of longer wave-length, which are the most characteristic feature of spectra of Class M, appear faintly in Class K5, and are absent in Class K and all those higher in the series. Fowler has shown [1] that these bands are perfectly reproduced in the spectrum of the outer flame of an electric arc charged with some compound of titanium, while the spectrum of the core of the arc, though showing conspicuously the bright lines of titanium, does not contain the bands. Here we are evidently dealing with some compound—perhaps titanium oxide—the vapour of which is present in the relatively cool flame of the arc, and emits a spectrum of the banded type, characteristic of compounds, while in the hotter core it is dissociated, and only the lines of the metal are seen. There seems then to be no escape from the conclusion that the atmospheres of stars of Class M are cool enough to permit the existence of this compound, and hence cooler than the core of the arc, and that the temperature of its dissociation is approached in Class K5, and surpassed in Class K. In general, those metallic lines which are relatively strong in the spectra produced in the oxyhydrogen flame or the electric furnace are also strong in spectra of Classes M and K; the lines most prominent in Class G are the typical arc lines; and the relatively few metallic lines which persist into Classes A and B are those which appear exclusively, or with greatly enhanced intensity, in the spark spectra of the laboratory.

[1] Proc. Roy. Soc., vol. lxxii., pp. 219–225, 1904.

The second line of evidence is afforded by the distribution of intensity in the continuous background of the spectra, the differences of which from type to type are obvious to the eye as differences in the colour of the stars. This characteristic is fortunately capable of accurate measurement. For the brighter stars, spectro-photometric comparisons may be made with a terrestrial light-source the energy curve of which is known, as has been done visually by Wilsing and Scheiner,[2] and photographically by Rosenberg.[3] Much fainter stars may be reached by the comparison of their brightness as measured visually (or on isochromatic plates with a suitable colour-screen), and photographically on ordinary plates. The "colour-index" so obtained, which expresses, in stellar magnitudes, the relative photographic brightness of stars of equal visual brightness, is found to be very intimately related to the spectral type, the differences within each spectral class being scarcely greater than the errors of observation. The results of King,[4] Parkhurst,[5] and Schwarzschild,[6] working with different instruments and on stars of very different brightness, are in excellent agreement, as is shown in Table I. The near approach to equality among the differences in colour-index from class to class is very remarkable, when it is considered that these types were picked out somewhat arbitrarily according to the general appearance of the photographic spectra. The judgment of the Harvard observers in selecting the really important points of difference was evidently very good.

TABLE I.

Spectrum	Colour-index			Temperature
	King	Parkhurst	Schwarzschild	
B0	−0·32			20,000
B5	−0·17	−0·21	−0·20	14,000
A0	0·00	0·00	0·00	11,000
A5	0·19	0·23	0·20	9,000
F0	0·30	0·43	0·40	7,500
F5	0·42	0·65	0·60	6,000
G0	0·72	0·86	0·84	5,000
G5	0·98	1·07	1·10	4,500
K0	1·10	1·30	1·35	4,200
K5	1·62	1·51	1·80	3,200
M	1·62	1·68		3,100
N		2·5		2,300

If the spectral sensitiveness of the plates used in such investigations has been determined (as Parkhurst has done) it is possible to calculate the temperature at which a black-body would emit light of the same colour as that observed; and similar calculations can be made, with greater accuracy, from the spectro-photometric data. The last column of Table I. gives the effective temperatures thus derived (based mainly on the work of Wilsing and Scheiner). The absolute

[2] Potsdam Publications, vol. xix., part 1.
[3] *A.N.*, 4628, 1913.
[4] Harvard Annals, vol. lix., p. 179.
[5] *Astrophys. Jour.*, vol. xxxvi., p. 218, 1912.
[6] Göttingen Aktinometrie, Teil B, p. 19.

values of the temperatures here given may be considerably in error, especially at the top of the scale (in fact, Rosenberg's work indicates a much greater range), but there can be no doubt about the relative order.

Of a third independent confirmation of the temperature hypothesis, based on the determination of the surface brightness of the stars, I shall have occasion to speak later.

It should be expressly stated that the "temperatures" here spoken of are the effective "black-body" temperatures corresponding to the spectral distribution of the radiation. Unless the surfaces of the stars possess decided selective emissivity for certain wave-lengths, these effective temperatures should also indicate with tolerable accuracy the energy-density of the flux of radiation which escapes from them. This tells us little about the temperature of the deeper regions; but it must be the main, if not the only, factor in determining the temperature of those outer and nearly transparent layers of the atmospheres in which the characteristic line absorption takes place. If we further assume, in accordance with Abbot's studies of the solar atmosphere,[7] that the absorption is nearly complete in so small a thickness of the atmosphere that wide variations in its depth and density would modify its total absorption but little, it becomes easy to see how the influence of its temperature (which presumably determines the relative strength of absorption in different lines) may predominate so greatly over all that of all other factors in determining the spectral type.

We may now review rapidly some of the relations which have been brought to light between other characteristics of the stars and their spectral types. First, as regards the relative numbers of stars of the different classes, we have in Table II some results of counts made at Harvard.[8]

TABLE II.

Spectrum	O	B	A	F	G	K	M	N
No. above 3.25m.	3	52	32	16	20	35	21	0
„ 6.25m.	20	696	1885	720	609	1719	457	8
Percentage in Galactic region	100	82	66	57	58	56	54	87

Classes A and K make up more than half of all the stars brighter than 6·25 m—that is, of the stars visible to the naked eye. The remaining stars are divided fairly evenly among the other four principal classes, while only one star in 300 is of Class O, and only one in 800 of Class N. The relative proportions of the different classes are, however, different in different parts of the heavens, as is indicated by the last line of the table, which give the percentage of stars of each class which lie in a belt covering one-half of the celestial sphere, and extending for 30° each side of the Milky Way. All the stars of Class O are close to the central line of the Galaxy (except for a few in the Magellanic Clouds). The stars of Class B are very strongly concentrated in the galactic region; those of Class A are considerably so; those of the following classes very little, except in the case of Class N (for which the tabular percentage is derived, not from the eight brightest stars of this class alone, but from a much larger number of fainter ones).[9]

The relative proportions of the different classes vary also with the apparent brightness of the stars. Among the stars brighter than 3·25m., as the table shows, Class B has more representatives than any other; but the percentage of this type steadily diminishes as we pass to fainter stars. The percentage of stars of Class A at first increases with diminishing visual brightness; but there is good reason to believe that, at least in regions remote from the Galaxy, the relative proportion of these too falls off rapidly in the neighbourhood of the ninth magnitude[10]; and Fath's work on the integrated spectrum of the Milky Way[11] shows that, even there, the bulk of the very faint stars which form the galactic clouds must be of Secchi's second type (F, G, or K).

Counts of the stars down to any given magnitude may, however, be very misleading unless we bear in mind the enormous preference which this method of observation gives to the stars of great actual luminosity, which can be seen afar off, and hence are being sought in a much greater volume of space than those of small luminosity. A difference of but five magnitudes in the real brightness of two groups of stars gives the brighter kind (if both are uniformly distributed in space) a thousand-fold better chance of getting into our catalogues; and this example understates the actual conditions in some cases. Mere counts of stars need therefore to be supplemented by such knowledge as we can obtain concerning their distances.

Much information can be obtained from the average proper-motions of the stars of the various classes, and still more by deriving their average parallaxes from the mean parallactic drift due to the motion of the solar system in space. Studies of this character have been made by several investigators of the first rank. Their results, which are summarised in Table III., show certain apparent discrepancies, which, however, arise principally from differences in the methods according to which the various workers have selected the groups of stars for investigation.

TABLE III.

Spectrum	Mean centennial proper-motion: Kapteyn	Boss	% rejected	Mean parallax: Kapteyn	Boss	Campbell	% rej.
	"	"		"	"	"	
O		1·6	0		0·004		
B	2·6	2·4	0	0·007	0·007	0·006	0
A	5·8	4·6	3	0·010	0·010	0·016	3
F	14·5	7·7	28		0·012	0·035	3
G	27·0	5·2	20	0·022	0·008	0·022	8
K	13·0	5·7	6		0·010	0·015	9
M	5·9	5·0	6	0·011	0·008	0·011	3
N		3·2		0·0007			

Kapteyn's data[12] represent the mean proper motions and parallaxes of all the stars of the fifth magnitude of each class, except for Class N, in which, to get enough stars, it was necessary to include faint objects, so that the average magnitude is here 8·3. His results show a conspicuous maximum of average proper-motion and parallax for Class G, with a rapid fall on both sides of it. The stars of Class N would have to be brought about five times nearer to appear as bright as the others, but even then they would have the smallest mean parallax of all.

Boss,[13] in his investigation of the solar motion, had at his disposal very accurate proper-motions of all the stars down to 5·7m., and about half as many more between this and the seventh magnitude. The average magnitude of his stars is therefore nearly the same as that of Kapteyn's. But, for very good reasons, he excluded from his main solution all stars with proper-motions exceeding 20″ per century. The percentage of stars thus excluded (which differs greatly from class to class) is given in the fourth column of Table III. It is natural that this often drastic rejection of the large proper-motions, and hence in general

7 Abbot, "The Sun," p. 252, 1911.
8 Harvard Annals, vol. lxiv., p. 134.
9 Harvard Annals, vol. lxvi., p. 213.
10 *Astronomical Journal*, vol. xxvi., p. 153, 1910.
11 *Astrophys. Journal*, vol. xxxvi., pp. 362–367, 1912.
12 *Astrophys. Journal*, vol. xxx., p. 295; vol. xxxii., p. 91, 1909–10.
13 *Astronomical Journal*, vol. xxvi., pp. 187–201, 1911. The mean proper-motions of the few stars of Classes O and N which appear in Boss's Catalogue have been added by the writer.

of the nearer stars, should greatly diminish his mean values. Among the classes in which the mean proper-motion is small, the percentage of exclusion is also small, and the results are but little modified. But it is noteworthy that the exclusion of 6 per cent. of the stars of Class K has reduced the mean proper-motion in a greater ratio than that of 28 per cent. of those of Class F, and also that the removal of one-fifth of the stars of Class G decreases the mean for the remainder to less than one-fifth of its initial value. It appears from these results that a large majority of the stars of Classes F, G, and K have nearly, if not quite, as small parallaxes and proper-motions as those of Classes A and M, though they are not quite so remote as the stars of Class B. The large mean values obtained for all the stars of these classes are due to the presence of a relatively small proportion of near and apparently rapidly moving stars, of which the percentage decreases, but the mean proper-motion and parallax increase, from F to K.

Campbell's results [14] are derived from a comparison of the radial velocities and proper-motions of nearly 1200 stars, mostly brighter than the fifth magnitude, and averaging about a magnitude brighter than Boss's stars, which would lead us to expect that their mean parallaxes should be 40 or 50 per cent. greater. In his work, "a few stars having proper-motions abnormally large for their classes were omitted in accordance with definitely set limits" (which unfortunately are not described more specifically). The approximate percentage of exclusion is given in the last column of the table. It appears on inspection that the differences between Campbell's and Boss's results for stars of Classes A, K, and M arise mainly from the greater brightness of Campbell's stars; those for Classes F and G are due mainly to the different percentages of exclusion, and that the only significant difference is that Campbell's B stars, though averaging much brighter to the eye than Boss's, have a slightly smaller mean parallax, and therefore must be, on the average, of greater real brightness.

Closely allied with these investigations is the determination of the mean peculiar velocity of the stars of each spectral class. The results of Boss and Campbell, reached almost simultaneously, and from quite independent data—proper-motions in one case and radial velocities in the other—are in extraordinary agreement. The values found for the average component of motion in any arbitrary direction are (in kilometres per second):—

Spectrum	B	A	F	G	K	M
Campbell	6·5	10·5	14·4	15·9	16·8	17·1
Boss	6·3	10·2	16·2	18·6	15·1	17·1

The rapid increase of the mean velocity from B to F is very remarkable. The slow further gain from F to M would attract little attention if it were not in the same direction.

It should here be added that the phenomenon known as preferential motion, or "star-streaming"—the excess of the average peculiar velocity of the stars in a certain direction above those in the perpendicular directions—is almost absent in Class B, very conspicuous in Class A, and somewhat less so in the following classes, being partially concealed by the greater average magnitude of the velocities.

Another notable difference between the various spectral classes may be found in the number of binary stars, both visual and spectroscopic, among them. We may distinguish two classes of visual double stars; binary stars for which orbits have been computed (with periods rarely exceeding two centuries), and physical pairs, the real connection of which is proved by common proper-motion, but the relative motions of which are slow, and periods long—probably often thousands of years. The counts of the two classes here given are from a list prepared in the course of my work, and include all stars for which the necessary data could be obtained, including many stars for which unpublished observations of spectra have been generously furnished me from Harvard. For the spectroscopic binaries, Campbell's counts have been taken from his catalogue of 1910.[15] They include all the systems the periods of which were then known, and are divided into two groups, one including all the periods of which are less than ten days, and also all those the periods of which, though not exactly known, are described as short; the other all the known periods exceeding ten days, and those which, though not precisely determined, are known to be long.

TABLE IV.

Spectrum	Visual binaries	Physical pairs	Spectroscopic binaries: Short period	Spectroscopic binaries: Long period
B	0	52	33	15
A	14	152	15	14
F	33	115	11	9
G	24	74	8	14
K	12	62	0	13
M	0	11	0	2

It appears that, in Campbell's picturesque phrase, visual double stars of relatively short period "abhor" Classes B and M, the greatest number being of Class F, with G a good second. Among the physical pairs, of long period, the most favoured class is A. Class B is abundantly represented, and Class M very sparingly.

The percentage of stars which are found to be spectroscopic binaries is very probably greater among Classes B and A than lower down the list. As time goes on, indeed, more and more of the stars of these "later" types are found to be spectroscopically double, but of long period; but among these classes the detection of such systems, where the range of velocity is small, is much easier than among the stars of the first type, the lines of which are diffuse. In any case it is certain that short periods are almost confined to Classes B, A, and F, and are especially abundant in the first of these. The few short-period stars of Class G which appear in the table are all Cepheid variables, most of which were selected for observation on this account, and would not otherwise have got into the list.

Finally, we may note that, among variable stars, those of the eclipsing type, such as Algol or Beta Lyræ, are for the most part of Classes A and B, though there are a number of Classes F and G, and one at least of Class K; that the Cepheid variables are almost all of classes F and G, with a few A's and K's; and that almost all the irregular variables, and all the variables of long period, are of Classes M or N. Stars of Class M the spectra of which show bright hydrogen lines are without exception variable, and almost all the stars of Class N are also subject to changes in brightness.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. James Ward, professor of mental philosophy and logic, has been nominated to represent the University on the occasion of the celebration at Oxford on June 10 of the seventh centenary of the birth of Roger Bacon, and Dr. Sorley, Knightbridge professor of moral philosophy, to represent the Univer-

[14] Lick Observatory Bulletin, vol. vi., p. 134, 1911.

[15] Lick Observatory Bulletin, vol. vi., p. 38, 1910.

sity at the fifth International Congress of Philosophy to be held in London next year.

EDINBURGH.—It is announced that the honorary degree of LL.D. is to be conferred on Dr. F. W. Mott, F.R.S., and Dr. Byrom Bramwell on July 3.

OXFORD.—The Romanes Lecture for this year will be delivered in the Sheldonian Theatre on Wednesday, June 10, by Sir J. J. Thomson, upon the subject of "The Atomic Theory."

MR. J. D. ROCKEFELLER has given the sum of 200,000*l.* to the Rockefeller Institute for Medical Research, New York, as an endowment for a new department which is to deal with the diseases of animals.

THE following Chadwick lectures have been arranged for London:—Thursday, April 30, "Water Supply: Sources, Reservoirs, and Distribution," E. P. Hill; Wednesdays, May 6, 13, and 20, a course of three lectures, "Altitude and Health," Prof. F. F. Roget, of the University of Geneva; Wednesday, May 27, "Milk Supply: a Public Health Criticism," Prof. H. R. Kenwood. Admission to all or any of the lectures is free. Information concerning future Chadwick Lectures may be obtained of the secretary, Mrs. Aubrey Richardson, at the offices of the trust, 8 Dartmouth Street, Westminster.

A UNIVERSITY College of Science is shortly to be started in Calcutta as the result of generous gifts by Sir T. Palit and Dr. Rashbehary Ghose. The services of Dr. P. C. Rây, professor of chemistry in the Presidency College, Calcutta, will be lent by Government to the college, and as such he will be made the Palit professor of chemistry in the University of Calcutta. In a note on this appointment in NATURE of March 19 (p. 75) it was incorrectly stated that Dr. Rây had been appointed to the Palit professorship in the Presidency College, whereas, as is well known, he has been professor of chemistry in that college for many years. We learn from the *Pioneer Mail* of April 3 that the foundation stone of the new college in connection with the Calcutta University was laid on March 27 last by Sir Asutosh Mookerjee, Vice-Chancellor of the University. In performing the ceremony, Sir Asutosh said that the scheme was first rendered practicable by the execution of a trust deed by Sir Taraknath Palit, by which he transferred money and land for the promotion of pure and applied science among his countrymen. A few weeks later Sir Taraknath executed a second deed for the purpose of supplementing the trusts mentioned in the first deed. The University Syndicate had received Government's permission to apply 800*l.* annually for the maintenance of the laboratory, and Dr. Rashbehary Ghose has offered 67,000*l.* for the foundation of four professorships and eight research studentships.

THE Department of Agriculture and Technical Instruction for Ireland will, in July, 1914, award a limited number of commercial scholarships (not more than six) to young men who have had a sound general education and some commercial experience. The object of the scholarships is to afford facilities for the holders to obtain training in some higher institution, approved by the Department, with a view to their employment as teachers of commercial subjects in Ireland. The scholarships are of the value of 100*l.* per annum each, and are tenable for two years. Candidates must be at least twenty-one years of age on July 1, 1914, and must have been born in Ireland, or have been resident in Ireland for three years immediately preceding July 1, 1914. Successful candidates will be required to enter into an undertaking that they will engage in the teaching of commercial subjects after the termination of their scholarships. Candidates must fill in Form S. 195 and return it to the secretary of the Department not later than May 30, 1914. Copies of this form may be had on application.

THE Standing Committee of the House of Commons has now concluded its consideration of Mr. Denman's Children (Employment and School Attendance) Bill, and the Bill will be reported to the House for third reading. Several important changes have been made, and new clauses added. As amended, the Bill proposes the following changes in the existing law:—Limitation of powers of local education authorities: (1) No exemption from school attendance allowed for children under thirteen years of age; (2) restrictions in exemption above thirteen. Extension of powers of local education authorities: (1) Optional powers granted to extend school leaving age to fifteen; (2) optional powers granted to make employment by-laws for children up to age of sixteen (instead of fourteen as at present). Abolition of existing half-time system and a restriction on street trading. The Bill renews proposals passed by Standing Committees of the House of Commons in 1912 in the Education (School Attendance) and the Employment of Children Bills. The chief objects of the Bill not contained in those Bills are the transference of the duty of approving by-laws relating to the employment of children from the Home Office to the Board of Education, and the raising to fifteen of the school leaving age and the minimum age for boys engaged in street trading.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, March 27.—Sir J. J. Thomson, president, in the chair.—F. W. **Jordan**: A new type of thermogalvanometer. The puff of air from an orifice in an air chamber when the air within is heated suddenly is utilised to deflect a small suspended vane. The current to be measured is made or broken through a heater of small thermal capacity in the air chamber and the outrush or inrush of air through the orifice delivers an impulse to the vane. In one instrument the sensibility was 4 mm. per microwatt, and the extremity of the throw of the vane was attained in two seconds.—J. D. **Morgan**: An instrument for recording pressure variations due to explosions in tubes. A mechanical oscillograph for recording the pressure variations which accompany a gas explosion in an open tube. A steel vane of rectangular form is employed and is mounted parallel to the explosion tube in a cell presenting a lateral opening to the interior. Along three edges the vane is free, and along the fourth is attached to a torsion wire. The vane fits the cell as closely as possible without touching the sides of the cell. The diagram is produced by a style on smoked paper wrapped round a clock-driven drum, and on the strip is described a time curve. To make the instrument dead-beat a dash-pot is mounted on the front of the vane cell and attached to the style.—R. **Appleyard**: The direct measurement of the Napierian base. A simple apparatus was described intended to convey an idea of the way in which the base *e* of the Napierian logarithms enters into physical problems. A length of chain hung from a loop of thread, and the remaining part of the chain pulled aside until the thread is at 45° to the vertical. The curved portion becomes a true catenary when the angle between the vertical and curved portions of chain at the attachment of the loop is 90°. To ensure this, the circle of curvature of the catenary at that point is drawn, and

found to have a radius equal to the vertical portion. If the vertical length is taken as unity, and its lower end as origin, it is shown that e is the sum of the y-ordinate at $x=1$, and the length of the curved chain between the point where that y-ordinate cuts the curve and the top of the vertical portion. The application of this result to the relationship and meaning of hyperbolic functions was also shown.

Zoological Society, April 7.—Prof. E. W. MacBride, vice-president, in the chair.—Dr. F. E. **Beddard**: The anatomy and systematic arrangement of the Cestoidea. Two new species of tapeworms belonging to the genera Linstowia and Oochoristica were described.—E. W. **Shann**: The lateral muscle of Teleostei. The author has undertaken the present work in view of the conflicting statements extant as to the nature of the lateral muscle in Teleostean fishes; the primary object of the paper is to uphold the single-layer theory of its composition.—Dr. W. T. **Calman**: Report on the river-crabs (Potamonidæ) collected by the British Ornithologists' Union and Wollaston Expeditions in Dutch New Guinea. Two new species were described.—Oldfield **Thomas**: Report on the mammals collected by the British Ornithologists' Union and Wollaston Expeditions in Dutch New Guinea. The species obtained numbered thirty-one, of which the types of twelve had been brought home by the expeditions. The two expeditions had obtained a very valuable series of ground-animals, notably of the genus Uromys, but there seemed to be, in the part of New Guinea explored, a remarkable absence of arboreal species, these forming in other parts of New Guinea a large proportion of the mammal fauna.—Guy **Dollman**: Mammals obtained by Mr. Willoughby P. Lowe during the recent East African Expedition organised by Mr. G. P. Cosens. The entire collection, some two hundred specimens in all, was presented by Mr. Cosens to the national collection. Besides examples of many rare and important species, specimens of several new forms were included.

Geological Society, April 8.—Dr. A. Smith Woodward, president, in the chair.—Prof. J. W. **Gregory**: The evolution of the Essex river-system, and its relation to that of the Midlands. The post-Eocene geology of Essex must be learnt from its gravels and their non-local constituents. In the absence of any rock which affords a certain proof of its route, the effort was made to determine the direction of transport by tracing the variations in the proportions and size of the non-local constituents; this test shows that the quartzites and felsites came from the north-west, and the Lower Greensand cherts from the south and south-east. The gravels are classified as follows:—(1) The oldest series. The Brentwood group, which consists of redeposited Bagshot Beds and of local materials only. (2) The Danbury Gravel, which was deposited before the arrival of the felsites, and at the beginning of the arrival of the Lower Greensand cherts. (3) The Braintree Gravel, which is largely composed of quartzitic drift, with abundant Lower Greensand cherts and some felsites that were probably derived from the Lower Greensand conglomerates north-west of Essex. (4) and (5) Glacial and post-Glacial gravels. Judged from the distribution and dates of appearance of the non-local constituents in these gravels, the evolution of the Essex river-systems is traced. The Lower Thames and Essex river-systems appear to be due to the Eocene earth-movements which formed the London Basin; and the coeval uplift of the English Midlands started thence a radial drainage. The streams to the south-east cut the wind-gaps on the Chiltern Hills, and the drainage to the south-west flowed along a subsidence on the north-western side of the Jurassic escarpment as the Warwickshire Avon and the Lower Severn.—J. B. **Scrivenor**: The topaz-bearing rocks of Gunong Bakau (Federated Malay States). Gunong Bakau is a peak, 4426 ft. high, in the main range of the Malay Peninsula. It is composed of porphyritic granite, into which have been intruded veins of quartz-topaz rock, and, at a later date, masses and veins of topaz-aplite.

Royal Meteorological Society, April 22.—J. E. **Clark** and R. H. **Hooker**: Report on the phenological observations from December, 1912, to November, 1913. This dealt with the dates of the flowering of plants, the song and migration of birds, the appearance of insects, and also the character of farm crops. Considering England as a whole, the main feature of the weather, so far as it affected crops, was the cold wet summer of 1912, the abundant precipitation during the spring, which resulted in a bountiful hay crop, and the dry summer.—A. J. **Bamford**: A small anemometer for tropical use.

Mathematical Society, April 23.—Prof. A. E. H. Love, president, in the chair.—Major P. A. **MacMahon**: (1) A modified form of pure reciprocants possessing the property that the algebraical sum of the coefficients is zero. (2) Lattice and prime-lattice permutations.

DUBLIN.

Royal Dublin Society, April 21.—Dr. J. H. Pollok in the chair.—Prof. W. **Brown**: Note on the change of length in nickel wire due to small longitudinal loads and low alternating magnetic fields. It is shown in this note that the contraction of the nickel wire is from 63 to 44 per cent. greater than for equivalent direct continuous magnetic fields. The loads employed were from $0{\cdot}1184\times10^5$ to 10^5 grams per sq. cm., and magnetic fields up to 200 c.g.s. units.

PARIS.

Academy of Sciences, April 20.—M. P. Appell in the chair.—Maurice **Hamy** and M. **Millochau**: The effects of variations of voltage on the intensity of the radiations of the arc obtained with an arrangement utilising an alternating current. The time of exposure of a photographic plate for a constant impression was found to be proportional to V^{-9}, where V is the voltage.—A. **Haller** and Edouard **Bauer**: The action of sodium amide on the allyldialkylacetophenones. General method of synthesis of the trialkylpyrrolidones. This ketone does not follow the normal reaction, production of benzene and trialkylacetic acid, but forms a condensation product, $C_7H_{13}ON$. The reactions of this substance were in agreement with those of a 3 : 3 : 5-trimethylpyrrolidone, and this constitution was confirmed synthetically.—Charles **Moureu** and Jacques Ch. **Bongrand**: Carbon subnitride. The action of ammonia and amines. The nitride, $CN-C\equiv C-CN$, enters violently into combination with ammonia and amines. Ammonia gives aminobutenedinitrile, $CN.C(NH_2)=CH.CN$, and homologues of this are produced when amines are substituted for ammonia.—M. **Considère**: The contraction of armoured concrete: its influence on the forces developed in armoured concrete constructions. A comparison of experimental results obtained by Otto Graf at Stuttgart with some made at the laboratory of the Ecole des Ponts et Chaussées at Paris, and a discussion of a recent note by M. Rabut on the same subject.—O. **Lehmann**: The suction effects observed in liquid crystals in the course of growth (myelinic forms).—J. A. F. **Balland**: The lowering of the proportion of gluten in flour. The bread-making properties of Parisian flour have deteriorated during recent years, and this is in part due to the decline in the proportion

of gluten in the flour. The causes of this decline are discussed.—P. **Chofardet**: Elements and ephemerides of the Kritzinger comet, 1914*a*.—M. **Gunther**: The general theory of systems of partial differential equations.—Marcel **Moulin**: Influence of the rachet on the concentric development of the spiral springs of chronometers.—Jean **Bielecki** and Victor **Henri**: The calculation of the absorption spectrum of a body from its chemical composition. A general formula is given for the absorption spectrum of a substance containing two chromophores.—F. **Dienert**: A new nephelometer for use in analytical chemistry.—E. **Cornec** and G. **Urbain**: The application of cryoscopy to the determination of double salts in aqueous solution. A study of the double salts of cadmium chloride, bromide, and iodide with the alkaline haloid salts.—F. **Pisani**: Some calcites showing marked phosphorescence under the action of heat.—N. **Bezssonoff**: Some facts relating to the formation of the perithecium and the delimitation of the ascospores in the Erysiphaceæ.—J. **Wolff**: The mechanism of oxidation and reduction phenomena in plant tissues. A study of the oxidation and reduction phenomena produced by the oxydase present in the apple and pear.—F. Le **Cerf**: A grub of the family Lycænidæ raised in Acacia galls by ants of the genus Cremastogaster. The grub is fed inside the gall with acacia leaves provided by the ants.—L. **Joleaud**: The eastern termination of the Numidian chain (Algeria).—Robert **César-Franck**: The relations between the form of the southern coast line of England and its geological constitution.

CALCUTTA.

Asiatic Society of Bengal, April 1.—A. **d'Orchymont**: Hydrophilidæ from the Lake of Tiberias. The hydrophilid beetles are represented in Dr. Annandale's collection by sixteen specimens, including examples of six species.—M. S. **Ramaswami**: Note on leaf-variation in *Heptapleurum venulosum*, Seem. This paper illustrates the remarkably wide range of leaf-variability in the above species. The author shows that the method used in "The Flora of British India" for differentiating between the two sections of the subgenus Euheptapleurum, namely, the simply digitate or twice digitate character of the leaves, is incorrect so far as this species is concerned.—Dr. W. M. **Tattersall**: Amphipoda and Isopoda from the Lake of Tiberias. Three species of Amphipoda and three of Isopoda are included in Dr. Annandale's collection. It seems probable, on comparing these with the collections made by Barrois and by Festa, that the complete fauna of the Lake of Tiberias is now known, so far as the aquatic and semi-aquatic representatives of the two groups are concerned. Of the species in the collection, one Amphipod, *G. syriacus*, and one Isopod, *A. soxalis*, are endemic and have not so far been found outside Syria. The remaining species are distinctly "Mediterranean" in character, though one (*Orchestea platensis*) is known also from the Atlantic coasts of America.

BOOKS RECEIVED.

Reports upon the Present Condition and Future Needs of the Science of Anthropology. Presented by W. H. R. Rivers, A. E. Jenks, and S. G. Morley. Pp. 91+14 plates. (Washington: Carnegie Institution.)

Department of Marine Biology of the Carnegie Institution of Washington. Papers from the Tortugas Laboratory of the Carnegie Institution of Washington. Vol. v. Pp. 222. (Washington: Carnegie Institution.)

King Edward VII. Sanatorium, Midhurst. Preliminary Report on the Treatment of Pulmonary Tuberculosis with Tuberculin. By Dr. N. D. Bardswell. Pp. xxi+141. (London: H. K. Lewis.) 6*s*. net.

Instituto Central Meteorológico y Geofisico de Chile. No. 4, Observaciones Meteor. en la Isla de Pascua. Mayo 1911–Abril 1912. Pp. viii+180+charts. (Santiago de Chile.)

A Text-Book of Geology. By Prof. J. Park. Pp. xv+598+70 plates. (London: C. Griffin and Co., Ltd.) 15*s*. net.

The Railways of the World. By E. Protheroe. Pp. xx+752+plates xvi. (London: G. Routledge and Sons, Ltd.) 7*s*. 6*d*. net.

Handbook and Guide to the British Birds on Exhibition in the Lord Derby Natural History Museum, Liverpool. Pp. ix+69+plates 12. (Liverpool: C. Tinling and Co., Ltd.) 6*d*.

Ministère de l'Agriculture. Direction Générale des Eaux et Forêts. 2e. Partie. Eaux et Améliorations Agricoles. Service des Grandes Forces Hydrauliques (Régions des Alpes et du Sud-Ouest). Etudes Glaciologiques Savoie-Pyrénées. Tome iii. Pp. viii+166+plates xix. (Région des Alpes) Annexe du Tome v. Cartes. (No publisher's name given.)

Geschichte der Chemie von den Altesten Zeiten bis zur Gegenwart. By Prof. E. von Meyer. Vierte Auflage. Pp. xiv+616. (Leipzig: Veit and Co.) 13 marks.

Government of India. Department of Revenue and Agriculture. Agricultural Statistics of India for the Years 1907–08 to 1911–12. Vol. ii. Pp. ii+123. (Calcutta: Superintendent Government Printing, India.) 1*s*. 6*d*.

The Antiquity of Man in Europe, being the Munro Lectures, 1913. By Prof. J. Geikie. Pp. xx+328+xxi plates and maps. (Edinburgh: Oliver and Boyd.) 10*s*. 6*d*. net.

Biology, General and Medical. By Prof. J. McFarland. Second edition. Pp. 457+3 plates. (Philadelphia and London: W. B. Saunders Co.) 7*s*. 6*d*. net.

The Bacteriological Examination of Food and Water. By Dr. W. G. Savage. Pp. x+173. (Cambridge University Press.) 7*s*. 6*d*. net.

Isolation Hospitals. By Dr. H. F. Parsons. Pp. xiv+275. (Cambridge University Press.) 12*s*. 6*d*. net.

Country House Electric Lighting. Pp. 50 (South Kensington: Rawlings Bros., Ltd.)

Report of the Advisory Committee for the Tropical Diseases Research Fund for the Year 1913. Pp. iv+239. (London: H.M.S.O.; Wyman and Sons, Ltd.) 2*s*. 4*d*.

Some Desert Flowers Collected near Cairo. By G. M. Crowfoot. Pp. 50. (Cairo: F. Diemer.)

Behavior Monographs. Vol. ii., No. 4. Habit Formation in a Strain of Albino Rats of less than Normal Brain Weight. By G. C. Basset. Pp. iv+46. (Cambridge, Mass.: H. Holt and Co.)

Ueber den Mechanismus der Oxydationsvorgänge im Tierorganismus. By Dr. L. Stern. Pp. vi+61. (Jena: G. Fischer.) 2.20 marks.

Grundlehren der Chemie und Wege zur künstlichen Herstellung von Naturstoffen. By Dr. E. Rüst. Pp. iv+138. (Leipzig and Berlin: B. T. Teubner.) 1.60 marks.

Ueber den dermaligen Stand des Krallismus. By Prof. H. Dexler. Pp. 49. (Prag: D. Kuh.)

Conférences de Radium-biologie. Faites à l'Université de Gand en 1913. Pp. 214. (Bruxelles: L. Severyns.) 6 francs.

Answers to the Exercises in a School Course in Geometry. By W. J. Dobbs. Pp. 16. (London: Longmans and Co.) 6*d*. net.

The Riddle of Mars the Planet. By C. E. Housden. Pp. xi+69+plates. (London: Longmans and Co.) 3s. 6d. net.

The Religion of a Naturalist. By H. A. Longman. Pp. viii+123. (London: Watts and Co.) 1s. net.

Annuaire de l'Académie Royale des Sciences, etc., de Belgique. Quatre-Vingtième Année. Pp. 594+plates. (Bruxelles: Hayez.)

Bell's Outdoor and Indoor Experimental Arithmetics. By H. H. Goodacre, E. F. Holmes, C. F. Noble, and P. Steer. Teacher's Book. Pp. xii+377. (London: G. Bell and Sons, Ltd.) 3s. 6d. net.

The Progress of Eugenics. By Dr. C. W. Saleeby. Pp. x+259. (London: Cassell and Co., Ltd.) 5s. net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College for the Years 1905–13. By R. M. Milne. (London: Macmillan and Co., Ltd.) 6s.

Iowa Geological Survey. Bulletin No. 4. The Weed Flora of Iowa. By L. H. Pammel and others. Pp. xiii+912. (Des Moines: Iowa Geological Survey.)

Baumé and Specific Gravity Tables for Liquids Lighter than Water. By N. H. Freeman. Pp. 27. (London: E. and F. N. Son, Ltd.) 2s. 6d. net.

An Elementary Treatise on the Calculus for Engineering Students. By J. Graham. Fourth edition. Pp. 355. (London: E. and F. N. Spon, Ltd.) 5s. net.

Flower Favourites: their Legends, Symbolism, and Significance. By L. Deas. Second edition. Pp. viii+229. (London: Jarrold and Sons.) 3s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 30.

ROYAL SOCIETY, at 4.30.—The Presence of Inorganic Iron Compounds in the Chloroplasts of the Green Cells of Plants, considered in Relationship to Natural Photo-synthesis and the Origin of Life: Prof. B. Moore.—The lack of Adaptation in the Tristichaceæ and Podostemaceæ: Dr J. C. Willis.—The Genetics of Tetraploid Plants in *Primula sinensis*: R. P. Gregory.—The Action of certain Drugs on the isolated Human Uterus: J. A. Gunn.—The Influence of Osmotic Pressure upon the Regeneration of *Gunda ulvae*: D. J. Lloyd.—(1) *Glossina brevipalpis* as a Carrier of Trypanosome Disease in Nyasaland. (2) Trypanosome Diseases of Domestic Animals in Nyasaland. *Trypanosoma pecorum*. III. Development in *Glossina morsitans*: Surg.-Gen. Sir D. Bruce, Major A. E. Hamerton, Capt. D. P. Watson and Lady Bruce.

ROYAL INSTITUTION, at 3.—The Last Chapter of Greek Philosophy: Plotinus as Philosopher, Religious Teacher and Mystic: The Very Rev. W. R. Inge.

FRIDAY, MAY 1.

ROYAL INSTITUTION, at 9.—A Criticism on Critics: E. F. Benson.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—The Control and Organisation of the Engineering Profession: S. T. Robson.

GEOLOGISTS' ASSOCIATION, at 8.—A Geological Excursion in Matabeleland: F. P. Mennell.

SATURDAY, MAY 2.

ROYAL INSTITUTION, at 3.—Similarity of Motion in Fluids. (2) The General Law of Surface Friction in Fluid Motion: Dr. T. E. Stanton.

BRITISH PSYCHOLOGICAL SOCIETY.—The Psychology of Play with Special Reference to the Value of Group Games in Education: Miss M. J. Reaney.—Corresponding points: Prof. C. Spearman.—An Attempt at an Exact Estimation of Character: E. Webb.

MONDAY, MAY 4.

VICTORIA INSTITUTE, at 4.30.—Frederic Godet, Tutor of Frederick the Noble: Prof. F. F. Roget.

SOCIETY OF ENGINEERS, at 7.30.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Apparatus for the Automatic Measuring and Injection of Chemicals: Hon. R. C. Parsons.—Jets for Mixing: Dr. Oscar Nagel.—A Reaction of Tetranitromethane: W. R. Hodgkinson.

ARISTOTELIAN SOCIETY, at 8.—The Psychology of Dissociated Personality: Dr. W. Leslie Mackenzie.

ROYAL SOCIETY OF ARTS, at 8.—Some Recent Developments in the Ceramic Industry: W. Burton.

TUESDAY, MAY 5.

ROYAL INSTITUTION, at 3.—Double Flowers: Prof. W. Bateson.

ZOOLOGICAL SOCIETY, at 8.30.

RÖNTGEN SOCIETY, at 8.15.—X-rays and Crystals: L. W. Bragg.

INSTITUTION OF CIVIL ENGINEERS at 9.—Twenty-second "James Forrest" Lecture: The Flying Machine from an Engineering Standpoint: F. W. Lanchester.

WEDNESDAY, MAY 6.

ROYAL SOCIETY OF ARTS, at 8.—Inexpensive Motoring: A. L. Clayden.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Detection of Castor Oil Seeds: Dr. G. D. Lander and J. J. Geake.—The Composition of Milk: H. D. Richmond.—Note on "Sharps": J. F. Liverseege and G. D. Elsdon.

AERONAUTICAL SOCIETY, at 8.30.—The Calculation of Aeroplane Wing-Spar Stresses: H. Booth.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, MAY 7.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—*Probable Papers*: (1) Some Calculations in Illustration of Fourier's Theorem; (2) The Theory of Long Waves and Bores: Lord Rayleigh.—Protection from Lightning and the Range of Protection afforded by Lightning Rods: Sir J. Larmor and J. S. B. Larmor.—The Flow in Metals subjected to Large Constant Stresses: E. N. da C. Andrade.—The Properties of Magnetically-shielded Iron as Affected by Temperature: Prof. E. Wilson.—Eddy Motion in the Atmosphere: G. I. Taylor.

ROYAL INSTITUTION, at 3.—The Last Chapter of Greek Philosophy: Plotinus as Philosopher, Religious Teacher and Mystic: The Very Rev. W. R. Inge.

ROYAL SOCIETY OF ARTS, at 4.30.—The Punjab Canal Colonies: Sir J. M. Douie.

CHILD STUDY SOCIETY, at 7.30.—Education in Early Childhood before School-Age: Miss E. A. Parish and Dr. W. P. Sheppard.

LINNEAN SOCIETY, at 8.—The Botany of the Utakwa Expedition in Dutch New Guinea: H. N. Ridley and Others.—The Genus Lernæodiscus, F. Müller: G. Smith.—The Botanic Gardens at Sibpur (Calcutta), and the Government Cinchona Plantations: Major Gage.—A New Natural Order of Flowering Plants: Tristichaceæ: Dr. J. C. Willis.—The Forced or Cultural Production of Free, Spherical Pearls; a Preliminary Note on a New Method: J. Hornell.—Some Terrestrial Isopoda from New Zealand and Tasmania; with the Description of a New Genus, Notoniscus: Prof. C. Chilton.

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