

EDINBURGH.—Since the beginning of the war the Officers Training Corps of the University has supplied 686 commissioned officers: artillery, 234; infantry, 288; engineers, 79; medical corps, 85. In addition many others have been under training as the University Reserve. Both in the 15th Royal Scots and in the 14th Argyll and Sutherland Highlanders, a nucleus of a company has been formed by University students. During the summer term a large part of the engineering building and the neighbouring class-room of applied mathematics have been used by the School of Instruction for Commissioned Officers. Systematic courses are being given and are being attended by seventy-five infantry officers and twenty-four artillery officers. The hours are from 9 a.m. to 6 p.m., and each officer under instruction is expected to read for two or three hours every night. Qualifying examinations are held at the end of each month's instruction. The adjutant who has charge of the School of Instruction is Major Mackenzie, one of the University lecturers in chemistry, and one of the instructors is Lieut. Todd, lecturer in engineering. These facts will give some idea of the way in which Edinburgh University men are answering to the call.

GLASGOW.—The Senate has appointed Dr. S. Alexander, professor of philosophy in the University of Manchester, to the post of Gifford lecturer for the period 1916-18.

LONDON.—Mr. G. F. Goodchild, principal of the Wandsworth Technical Institute, has been appointed to the post of registrar of the Council for External Students, in succession to Mr. Alfred Milnes.

It is announced in *Science* that by the will of Miss Helen Collamore, of Boston, 20,000*l.* is bequeathed to Simmons College, 4000*l.* to Radcliffe College, and 2000*l.* primarily to aid women students in post-graduate courses in the Massachusetts Institute of Technology.

To commemorate the services rendered to the Ocean Steamship Company, Ltd., by the two founders of the company, the late Mr. Alfred Holt and the late Mr. Philip Henry Holt, a sum of 20,000*l.* has been handed by the company to the Holt Education Trust, and the income is to be applied in perpetuity by the trustees for the purpose of higher education in Liverpool.

THE successful series of public lectures on the Empire, by Dr. H. B. Gray, the official lecturer, will be continued at the Imperial Institute throughout July. The lectures, which are now illustrated by lantern slides, are followed in each case by a visit to the exhibition galleries of the Imperial Institute, which afford a unique object-lesson in the Empire's commercial capacities. The lectures for July, which will be given on Wednesdays at 3 o'clock punctually, are as follows:—July 7, British West Africa; July 14, Fiji, Western Pacific, and Falkland Islands; July 21, Egypt and the Sudan. Admission is free by ticket, to be obtained at the central stand in the exhibition galleries, Imperial Institute, South Kensington, S.W.

THE recent report of the Board of Education (Cd. 7934) for the year 1913-14 remarks with regret that no improvement in the provision of higher technical instruction in day technical classes is shown in the figures relating to 1912-13. In that year twenty-six institutions provided technical institution courses, the total number of separate courses in these institutions being seventy-eight. Of these, nineteen were courses in preparation for matriculation or other examinations forming stages towards university degrees, fifty-four were technological courses in engineering, chemistry, and subjects connected with the building, mining, textile, and leather trades, many of which were also attended by some students preparing for

degrees, and five were scientific courses mainly in provision for professional qualifications. The total number of students enrolled in the courses was 1464. The number of students taking the full courses was 1236, of whom 539 were in their first year, 374 in their second year, 269 in their third year, and fifty-four in later years of their courses. The number of day technical classes, as distinct from courses, recognised in 1912-13 was 281, and these were held in 110 institutions. The students in attendance numbered 12,970. Of the courses held, 131 were only part-time or short full-time courses. The other 150 were in the nature of full-time day schools. While the latter was approximately the same in number as in the previous year, there has been a fall of thirty-nine in the case of the part-time courses.

THE Professional Classes War Relief Council has issued a report of six months' work which shows not only the need that existed for such an organisation, but the variety of means that have been employed. The applications during the six months which ended on May 6 numbered 2000, and the number of cases dealt with is 1600. One hundred cases were referred to other societies. Among the most useful forms of assistance have been temporary employment, education and training, financial help and loans, medical help, and hospitality. The professions dealt with have included authors, analytical chemists, engineers, surveyors, and teachers. In the matter of education 1120*l.* has been expended. Through the generosity of headmasters and various governing bodies, 134 children who would otherwise have lost all education are becoming pupils at reduced fees, and in many cases the assistance given to pupils also enables schools to continue which would otherwise have been ruined. In addition to this thirty-three candidates are undergoing training in productive professions; four have already qualified and have obtained remunerative employment, and others are about to take up their work. The work of the council does not perhaps lend itself to picturesque description, but it is filling an important place in our present disturbed social conditions. The expenditure is now at the rate of 43*cl.* per week, and unless a sum of 25,000*l.* can be raised in the next few months the work cannot be continued. No other body is doing exactly the same kind of work, in trying by co-ordination of existing benevolent funds, as well as by its own specialised forms of assistance, to tide over the professional classes who are so heavily penalised by the war. The offices of the council are 13 and 14 Prince's Gate, S.W.

## SOCIETIES AND ACADEMIES.

LONDON.

**Royal Society, June 17.**—Sir William Crookes, president, in the chair.—Dr. E. J. Russell: Soil protozoa and soil bacteria. In view of the claim recently made by Goodey that soil protozoa cannot function as a factor limiting the numbers of bacteria in soils, the author has brought together the evidence on which this view is based. It has been shown in numerous experiments that the numbers of bacteria in normal soils are relatively low, but they can be raised by any treatment that kills trophic forms and not spores. Starting, in the first instance, to find the properties of the factor which keeps down the bacterial numbers, and without framing any hypothesis as to its nature, these were found to be: (a) active, and not a lack of some essential; (b) not bacterial; (c) extinguished by heat or poisons, and after extinction does not reappear; (d) can be reintroduced by adding a little untreated soil; (e) is favoured by conditions favourable to trophic life in the soil. These properties indicate that the

factor is biological. Search was therefore made for organisms fulfilling these conditions and numbers of protozoa were found. Definite evidence has been obtained that trophic forms occur as normal inhabitants of the soil, and the estimates of numbers so far available show that they are considerable. There is the closest possible relationship between the extinction of the protozoa and the extinction of the limiting factor, and also between the re-establishment of the protozoan fauna and the setting up of the limiting factor after re-infection with small quantities of soil.—Prof. W. M. **Hicks**: The enhanced series of lines in spectra of the alkaline earths. A discussion of the enhanced series of the alkaline earths is carried out in order to determine their relation to the sun. For this purpose the results given for Mg, Ca, Sr by Fowler in his recent Bakerian Lecture are used, and, in addition, the corresponding series in Ba and Ra are considered. It is found that the quantity  $\Delta'$ , giving the doublet separations, is given with great accuracy in terms of the sun, as follows:—Mg,  $56\frac{1}{2}\delta$ ; Ca,  $68\delta$ ; Sr,  $58\delta$ ; Ba,  $56\frac{1}{2}\delta$ ; Ra,  $60\frac{1}{2}\delta$ ; where  $\delta$  is four times the corresponding sun for the element. The satellite separations are also found as functions of the same quantity. Further it is shown that these series strongly support the general relations given in a former communication that the first  $p$ -sequence depends on a multiple of the atomic volume, and that the diffuse sequence is such that the denominators of the first lines, when the wave number is expressed in the form  $A-N/(\text{den})^2$ , are themselves multiples of  $\Delta'$  or of the sun.—Prof. H. F. **Baker**: Certain linear differential equations of astronomical interest. This paper is written to exemplify the application of a general method for the solution of linear differential equations given by the author some years ago. The method furnishes solutions in a form valid for an indefinitely extended region. It is here applied (1) to establish a result as to the convergence of the solution of a particular equation, apparently in disagreement with a conclusion reached by Poincaré in his "Méthodes Nouvelles de la Mécanique Céleste"; (2) to place the general method given by Laplace for the absorption of the time in astronomical series under trigonometrical signs in connection with the ordinary theory of characteristic exponents; (3) to discuss in general terms the oscillations of a dynamical system about any given possible state of motion; (4) to furnish a regular calculus for the solution of the equation used by G. W. Hill for the motion of the moon's perigee, and similar equations. The earlier part of the paper discusses particular equations from a less formal point of view, and has seemed necessary in order to place the matter in proper light. One particular problem discussed is that of the stability of three bodies of any masses moving in ellipses at the angular points of an equilateral triangle, a matter of which the discussion has recently been revived.—Prof. Karl **Pearson**: The partial correlation-ratio. The general theory of mutiple correlation has been long established, and is summed up in the discussion of two constants—the partial correlation coefficient and the multiple correlation coefficient. If there be  $m$  variates, 1, 2, 3...  $m$ , then the partial correlation coefficient of the  $(m-2)^{\text{nd}}$  order is related to the multiple correlation coefficients of the  $(m-1)^{\text{th}}$  and  $(m-2)^{\text{nd}}$  orders by the equation:—

$$r_{1 \cdot 2 \cdot 3 \dots m}^2 = \frac{1 - R_{1 \cdot 2 \cdot 3 \dots m}^2}{1 - R_{1 \cdot 3 \dots m}^2}$$

The object of the present paper is to give the corresponding equation for show-regression. It is known that the value of the above relation is exactly commensurate with the linearity of the regression, a condition not synonymous with but embracing as a special

case gaussian or normal distributions of frequency. When the regression is not linear, nor the partial variations homoscedastic in distribution, then the statistician has to use, in order to represent by a single coefficient the association of two variables, the correlation-ratio, usually symbolised by  $\eta$ . The use of the correlation-ratio has been hampered by the absence of any generalised theory in the case of multiple variates. If  $r_{1 \cdot 2 \cdot 3 \dots m}$  be the partial correlation-ratio of the first variate on the second for constant third, fourth...  $m^{\text{th}}$  variates and  $H_{1 \cdot 2 \cdot 3 \dots m}$  be the multiple correlation-ratio for 1 on 2, 3...  $m$ , then the fundamental formula is—

$$r_{1 \cdot 2 \cdot 3 \dots m}^2 = \frac{1 - H_{1 \cdot 2 \cdot 3 \dots m}^2}{1 - H_{1 \cdot 3 \dots m}^2}$$

The paper shows that there are only three independent first order partial correlation-ratios and gives the formulæ for these, and for higher order correlation-ratios in terms of the multiple ratios and lower order partial ratios.—S. **Skinner** and F. **Entwistle**: The effect of temperature on the hissing of water when flowing through a constricted tube. The experiments deal with the temperature coefficient of the effect described by Osborne Reynolds before the British Association at Oxford, 1894. It is shown that the velocity at which hissing just occurs between  $0^\circ$  and  $100^\circ$  C. suffers a diminution which may be expressed by a formula  $V_t = c(t - \theta)$ , where  $V_t$  is the velocity of the stream at a temperature  $t$ , and  $\theta$  the critical temperature of water, and  $c$  a constant. It is argued that this result forms a measure of the tensile strength of the liquid, and consequently it brings the phenomenon of hissing into relation with the other properties of a liquid.—J. C. **McLennan** and J. P. **Henderson**: Ionisation potentials of mercury, cadmium, and zinc, and the single and many-lined spectra of these elements. (1) It is shown that a spectrum consisting of a single line is obtainable for mercury, for zinc, and for cadmium. (2) The wave-lengths of these lines are, for mercury,  $\lambda = 2536.72 \text{ \AA.U.}$ ; for zinc,  $\lambda = 3075.99 \text{ \AA.U.}$ ; and for cadmium,  $\lambda = 3260.17 \text{ \AA.U.}$  (3) The minimum ionisation potentials for mercury, zinc, and cadmium are shown to be 4.9 volts, 3.74 volts, and 3.96 volts respectively. (4) Some considerations are presented which support Sir J. J. Thomson's theory of the two-type ionisation of atoms of mercury, and others which suggest that the theory is applicable as well to the ionisation of atoms of zinc and cadmium. (5) The minimum arcing potential differences which will bring out the many-lined spectra of mercury, zinc, and cadmium vapours are found to be 12.5 volts, 11.8 volts, and 15.3 volts respectively. These voltages are also probably the minimum ionisation potentials of the second type for the atoms of these three elements. (6) Considerations are presented which suggest the possibility of analysing the spectrum of an element in such a way as to enable one to correlate different portions of the spectrum with disturbances in definite portions of the atomic structure of that element.—Dr. A. E. H. **Tutton**: The monoclinic sulphates containing ammonium.—Completion of the double sulphate series. In this communication are described the five remaining double sulphates of the series  $R_2M(SO_4)_2 \cdot 6H_2O$ , in which R is ammonium and M is nickel, cobalt, manganese, copper, and cadmium. The present memoir completes the author's work on the double sulphates of this series. The main conclusions are the following:—(1) These ammonium salts are truly isomorphous with the similarly constituted potassium, rubidium, and caesium salts of the generic formula above given, but are not eutropic with them; the potassium, rubidium, and caesium salts alone form the exclusive eutropic series in which the crystallographical proper-

ties (both morphological and physical) obey the law of progression with the atomic weight of the alkali metal which has been established in previous communications. This law is particularly well illustrated by the fact, to which no exceptions have been observed, that average change of angle between crystal faces, and also maximum change of interfacial angle (which exceeds two whole degrees), are directly proportional to change in atomic weight when any one alkali metal is replaced by another. (2) The dimensions of the space-lattice of any ammonium salt of the series are nearly identical with those of the intermediate rubidium salt, so that the two atoms of rubidium are replaced by the ten atoms of the  $2\text{NH}_4$  radicle-groups without appreciably altering the crystallographic structural dimensions. (3) The salts of the series in which R is thallium (also studied in a previous memoir) resemble the ammonium salts closely, in truly belonging to the isomorphous series, but not to the more exclusive eutropic series formed by the salts of potassium, rubidium, and caesium. Like the ammonium salts, they also closely resemble the rubidium salts, but the thallium salts are distinguished optically, possessing transcendent refractive power, both their refractive indices and their molecular refraction being far higher than for any other salts of the whole isomorphous series.—E. B. R. **Prideaux**: General equations for the neutralisation of dibasic acids, and their use to calculate the acidity of dilute carbonate solutions.—Prof. H. A. **Wilson**: The electrical conductivity and luminosity of flames containing salt vapours.—T. R. **Merton**: A spectrum associated with carbon in relation to the Wolf-Rayet stars.—Sir Wm. **Abney** and Prof. W. **Watson**: The threshold of vision for different coloured lights.—Lord **Rayleigh**: Hydrodynamical problems suggested by Pitot's tubes.—Prof. M. C. **Potter**: Electrical effects accompanying the decomposition of organic compounds. II.—Ionisation of the gases produced during fermentation.—Prof. E. W. **MacBride** and A. **Jackson**: The inheritance of colour in the stick-insect (*Carausius morosus*).—Sir Francis **Darwin**: The relation between transpiration and stomatal aperture.—D. M. S. **Watson**: The monotreme skull—a contribution to mammalian morphogenesis.

**Mineralogical Society**, June 15.—Dr. A. E. H. **Tutton**, president, in the chair.—G. M. **Davies**: Detrital andalusite in Cretaceous and Eocene sands. Detrital andalusite is not confined to Pliocene and later deposits as was formerly supposed, but is a frequent constituent throughout the Cretaceous and Eocene beds of the south-east of England. In the lower Cretaceous beds it is still perfectly fresh, and shows no signs of instability under the influence of meteoric water.—J. F. N. **Green**: The garnets and streaky rocks of the English Lake District. Certain peculiar rocks occurring in the Lake District are characterised by almandine garnets and parallel streaks of secondary minerals. The capricious distribution of the garnets in diverse rock-types was considered to exclude originality, and thermal or dynamic alterations were shown to be inadequate. Circulating solutions under pressure during the solfataric stage of the Borrowdale episode were suggested as the agent, and illustrations were given of the replacement of felspar by garnet in Lake District rocks. The same origin was assigned to the streaky infiltrations which frequently contain pyrites or garnet.—Dr. S. **Kôzu**: The errors in the angle of the optic axes resulting from those of the principal refraction indices determined by total reflection. The indices so found are correct within 0.0002 for sodium light. Assuming the error to be only half this, the extreme values of the angle are for anorthite,  $76^\circ 8'6''$ , and  $79^\circ 21'8''$ ; for albite,  $76^\circ$

$14'1''$  and  $80^\circ 46'9''$ ; and adularia  $56^\circ 16'9''$  and  $65^\circ 56'9''$ .—Dr. S. **Kôzu**: The influence of temperature on the optic axial angle of sanidine from the Eifel. Pockels has shown that in those rhombic crystals in which the axial angle varies considerably in the neighbourhood of zero the relations between the angle and the temperature is represented by a parabola. Sanidine from the Eifel very nearly approaches the conditions of a rhombic crystal. The values of  $2E$  were determined for seven different wave-lengths. The plotted curves were found to accord with Pockels's statement; further, the complex curves for the various wave-lengths were identical.—Dr. G. T. **Prior**: The meteoric stones of Warbreccan, Queensland. Three stones, weighing respectively about 69, 64, and 1 lb., were known to the natives of central Queensland before 1904, and their fall was probably seen. They were acquired by the British Museum in 1905. They are white-veined chondrites, and in chemical and mineral composition are similar to other members of the group.—A. F. **Hallimond**: Autunite. It is concluded that the Cornish material is essentially different from the Autun mineral, and the name bassetite is proposed for the former, the fundamental characters of which are:—Oblique,  $\beta = 89^\circ 17'$ ,  $a:b:c = 0.3473:1:0.3456$ ; forms, 010, 110, 120, 011, 111, 121, 121, 141, 101; twinning by parallel growth of  $a$  and  $c$  axes, perfect cleavage parallel to 010, also 100, 001; yellow, transparent; biaxial,  $2E = 110^\circ$ ; pleochroic, pale to deep yellow; soluble in acids.

**Linnean Society**, June 17.—Prof. E. B. **Poulton**, president, in the chair.—The four following papers were reports on materials brought home by Prof. J. Stanley Gardiner from the expedition to the Indian Ocean in H.M.S. *Sealark* in 1905:—E. T. **Browne**: Medusae from the Indian Ocean.—Prof. A. **Dendy**: (1) Report on the Hexactinellid sponges (Triaxonida); (2) Continuation (Tetraxonida).—J. C. **Robson**: The Cephalopoda obtained.

## PARIS.

**Academy of Sciences**, June 21.—M. Ed. **Perrier** in the chair.—J. **Boussinesq**: The extreme slowness of cooling in the deep parts of the earth's crust, and an attempt to estimate, starting from a certain period, the progress of the solidification.—Paul **Brück**: Observations of the Mellish comet (1915a) made at the Observatory of Besançon with the 33 cm. equatorial. Eleven positions of the comet are given for March 16, April 13, 15, 16, 17, May 14 and 15.—René **Garnier**: The representations of the integrals of the equations of M. Painlevé by means of the theory of linear equations.—M. de **Brogliè**: The spectra of the homogeneous secondary X-rays. A claim for priority as regards a recent paper on the same subject by M. Glagolev.—E. **Raverot**: A temperature interval regarded in relation to mechanical measurements. Starting with the numerical coincidence that the erg is  $0.2381 \times 10^{-7}$  calories, and the specific heat of air at constant pressure is 0.2382 calories, the joule (0.238 cal.) is defined as the quantity of calorific energy corresponding to a variation of volume of the mass of 1 gram of air of  $1/273$  of its volume at  $0^\circ \text{C}$ ., at the constant pressure of the atmosphere.—Léon **Bouthillon**: The charge of condensers by means of a constant electromotive force and their discharge in a spark circuit. Whatever may be the kind of spark-gap employed, the conditions under which a musical note is produced are the stable conditions under which the system is self-regulating.—G. A. **Le Roy**: The measurement of the waterproof qualities of cloths and military fabrics. The percolating water falls on a dry filter paper impregnated with a salt, and establishes an electrical circuit. The apparatus can be made recording, and does not re-

quire watching.—J. **Deprat**: The modifications in the structure of the Fusulinidæ from the Dinantian to the end of the Permian.—Pereira de **Sousa**: The earthquakes at Algarve (southern Portugal) from 1911 to 1914. These appear to be of epigenetic origin.—B. **Galitzine**: The earthquake of February 18, 1911. This earthquake coincided with a great rock slide at Sarez, in the Pamir, which filled up the valley of Mourgab and transformed it into a lake. The author concludes that this rock fall was not the consequence, but the cause of, the seismic disturbance registered at so many stations.—J. **Clarens**: The estimation of urinary acidity.—H. **Busquet**: The mode of action of colloidal gold: the production of cardiac effects by particles of metal not in solution. From a study of the effects of the injection of colloidal gold into the dog and rabbit, it is concluded that the immediate effects on the heart cannot be attributed to gold in solution, but must be produced by the suspended colloidal particles.—H. **Stassano**: The sterilisation of microbial cultures or emulsions by heat in thin layers.—Em. **Bourquelot**, M. **Bridel**, and A. **Aubry**: Researches on the glucosidification of glycerol by  $\beta$ -glucosidase (emulsin). The product obtained by the biochemical synthesis contained two glucosides, differing in their rotatory power and resistance to the action of emulsine.

### BOOKS RECEIVED.

Lessons and Experiments on Scientific Hygiene and Temperance for Elementary School Children. By H. Coomber. Pp. xx+163. (London: Macmillan and Co., Ltd.) 1s. net.

Indian Mathematics. By G. R. Kaye. Pp. 73 (Calcutta and Simla: Thacker, Spink and Co.)

Numerical Examples in Physics. By H. S. Jones. Pp. xii+332. (London: G. Bell and Sons, Ltd.) 3s. 6d.

Citrus Fruits. By Dr. J. E. Coit. Pp. xx+520. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 8s. 6d. net.

The Principles of Rural Credits as Applied in Europe and as Suggested for America. By J. B. Morman. Pp. xviii+296. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 5s. 6d. net.

The Mutation Factor in Evolution, with Particular Reference to *Cenothera*. By Dr. R. R. Gates. Pp. xiv+353. (London: Macmillan and Co., Ltd.) 10s. net.

Plant-Life. By C. A. Hall. Pp. xi+380. (London: A. and C. Black, Ltd.) 20s. net.

The Analysis of Dyestuffs and their Identification in Dyed and Coloured Materials, Lake-Pigments, Foodstuffs, etc. By Prof. A. G. Green. Pp. ix+144. (London: C. Griffin and Co., Ltd.) 8s. 6d. net.

The Aeroplane. By A. Fage. Pp. viii+136. (London: C. Griffin and Co., Ltd.) 6s. net.

Aero Engines. By G. A. Burls. Pp. x+106. (London: C. Griffin and Co., Ltd.) 8s. 6d. net.

Laboratory Work for Coal-Mining Students. By J. Sim and A. M. Wylie. Pp. viii+136. (London: E. Arnold.) 2s. 6d. net.

Meteorology of Australia. Commonwealth Bureau of Meteorology. Results of Rainfall Observations made in Queensland, including all Available Annual Rainfall Totals from 1040 Stations for all Years of Record up to 1913, together with Maps and Diagrams. Pp. 285. (Melbourne: A. J. Mullett.) 10s. 6d.

Staffordshire. By W. B. Smith. Pp. xi+155. (Cambridge: At the University Press.) 1s. 6d. net.

The Strength of Materials. By E. S. Andrews. Pp. x+604. (London: Chapman and Hall, Ltd.) 10s. 6d. net.

Climbing Plants. By W. Watson. Pp. x+132+ plates. (London and Edinburgh: T. C. and E. C. Jack.) 2s. 6d. net.

The Analysis of Non-Ferrous Alloys. By F. Ibbotson and L. Aitchison. Pp. vii+230. (London: Longmans and Co.) 7s. 6d. net.

Bartholomew's New War Map of Italy and the Balkan States. (Edinburgh: J. Bartholomew and Co.) 1s. net.

The Poison War. By A. A. Roberts. Pp. 144. (London: W. Heinemann.) 5s. net.

### DIARY OF SOCIETIES.

FRIDAY, JULY 2.

GEOLOGISTS' ASSOCIATION, at 8.—A Provisional Hypothesis to Explain the Occurrence of the Various Types of Fossil Man: Prof. A. Keith.

SATURDAY, JULY 3.

ARISTOTELIAN SOCIETY, BRITISH PSYCHOLOGICAL SOCIETY, and the MIND ASSOCIATION, at 6.—Joint meeting. Mr. Bertrand Russell's Theory of Judgment: Prof. G. F. Stout.

MONDAY, JULY 5.

ARISTOTELIAN SOCIETY, BRITISH PSYCHOLOGICAL SOCIETY, and the MIND ASSOCIATION, at 4.—Joint meeting. The Import of Propositions: Miss Constance Jones, Dr. Bernard Bosanquet, and Dr. F. C. S. Schiller.

### CONTENTS.

PAGE

Physical, Chemical, and Engineering Constants.	
By Dr. J. A. Harker, F.R.S.	475
Elementary Zoology. By G. H. C.	476
Economic Geography. By J. D. F.	476
Sewage Problems. By Percy Gaunt	477
The Production of New Varieties of Plants	478
Our Bookshelf	478
Letters to the Editor:—	
A Canadian Memorial to Hugh Miller.—Sir Arch. Geikie, O.M., K.C.B., F.R.S.	479
The "Green Fluorescence" of X-Ray Tubes.—Prof. Herbert Jackson	479
The Magnetic Storm and Solar Disturbance of June 17, 1915.—Dr. C. Chree, F.R.S.	480
The Names of Physical Units.—Dr. Norman R. Campbell	480
The Use of Cotton for the Production of Explosives	481
Problems of Airship Design and Construction	482
A Regional Survey ( <i>Illustrat. d.</i> )	483
Prof. Barnard's Astronomical Photographs. By Dr. William J. S. Lockyer	485
Cerebro-Spinal Fever. By R. T. H.	487
Notes	488
Our Astronomical Column:—	
The Origin of Comets	493
Companions to Mellish's Comet	493
The Aberration Constant and Latitude Variation	493
The Henry Draper Memorial	493
The Report of the Cambridge Observatory, 1914-15	493
The Destruction of Flies	493
Air Pollution. By J. B. C.	494
Radiations from Exploding Atoms. By Sir Ernest Rutherford, F.R.S.	494
University and Educational Intelligence	498
Societies and Academies	499
Books Received	502
Diary of Societies	502

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