THURSDAY, MAY 23, 1912.

PICTURESQUE SAVOY.

Costumes, Traditions, and Songs of Savoy. By Estella Canziani. Illustrated with fifty reproductions of pictures by the author, and with many line drawings. Pp. xiii + 180. (London: Chatto and Windus, 1911.) Price 21*s.* net.

HERE is a book which should give pleasure to many. It appeals to the general reader who wishes to be told in an entertaining manner of journeyings in little-known places, or to look on charming colour reproductions of picturesque costumes, personal ornaments, and beautiful landscapes. It also appeals to many groups of specialists by its representations of wood carvings, seals, coins, and coats of arms, by its music remembered from olden times, and by its abundance of legends, customs, and folk-songs. We have vivid accounts of mountaineers, laborious, home-loving, honest, and frugal, who generously combine to make up a neighbour's loss by fire or by death in his herd, help him to tile his new house, and divide amongst themselves the outdoor work for his widow. The people fear crowds and towns, though not the loneliness of their mountain solitudes. Their houses are wooden stables with straw-coloured earthen floors, which they share with their animals. Their furniture consists of a few primitive chairs, beds of straw and rags in rough wooden boxes raised on tall legs, and a water tub and a hay box for the cattle. The food is as rude as the hovel. The midday meal at an inn may be boiled cabbage, black bread, and wine, and the staple fare is black bread, milk, and soup, with a little rice. Pigs killed, dried, and salted once a year furnish an occasional and unattractive dish, and mutton (of extraordinary toughness) is an exceptional treat.

In these widely different surroundings we find not a few beliefs and practices familiar in our own British Isles. The pigs must be killed under the waxing, and not under the waning, moon. The saint of Dieublanc village hangs his cloak on the sunbeams, as did St. Brigit of Kildare. The *Bacchu-ber* dance (pp. 74–5) closely resembles the complicated sword-dances which Mr. Cecil Sharp has found still lingering near Flamborough and elsewhere. The homeward way of the newly-married was once barred by a cart or plank until drink-money was paid, just as and why it was barred with a rope in rural England. The future of a bride (whether *elle portera la culotte*) is judged by her success in leaping a stream, as it was once in northern England by jumping the "petting stone." Still more curious is it to meet in Savoy (p. 128) the tale of the cat that, overhearing that "Doldrum is dead," dashes off to claim the succession as King of the Cats.

But most of the beliefs and practices are unlike our own. If the baying of dogs at midnight foretells death, as to ourselves, the hooting of owls is a sign, not of disaster, but of a birth. Mountains, glaciers, torrents, and especially caves, are the homes of evil spirits, but lakes and river sources of good spirits. The damned are confined in desolate places and beneath glaciers, whence they can cut their way up to Paradise by labouring for countless nights till cockcrow with the ineffective aid of a pin, and peasants still cut out steps to aid this labour of the lost. The Mer de Glace and the lake of Aigueblette each cover fertile lands destroyed on account of the inhospitality of their inhabitants. On stormy nights the witches and fays play ball with a baby, which they toss to one another and over the great fire in the midst of their circle, and their victim is ever after distorted and ailing, "and only cares for the company of snakes." The Devil is watchful, and picks off at once the red flowers which bloom on the mountain fern on St. John's Night, and confer invisibility. Sometimes, however, he comes by the worst, as when a saint seized him in the form of a bear, and forced him to draw the materials for a monastery in the place of the oxen previously destroyed by him. The art of making Chartreuse, by the way, is said to have been filched from the Devil by a monk who stole into the secret grotto where the Arch Enemy was making liqueurs. God's lightning warns of the coming of the Devil's thunder, so that one has time to avert evil by signing the cross.

But there is no end to the legends—of hidden treasures, lake serpents, ghosts, and animal-guardians of ruins and ancient castles—and the book contains much other interesting matter. We are present with the author at *festas*, where the "bidder," dressed up in colours, beats his drum and clashes his cymbals, and then turns somersaults, as he leads churchwards the peasants in their most gorgeous garments. We sympathise with her vain attempts to hurry the postcart, and we learn the social customs of the valleys. The lover knows without speech the failure of his courtship if oats are dropped into his pockets, or the burnt ends of the firebrands turned towards him, or if he is invited to sit near the logs piled beside the fire. As a funeral passes all doors and windows are shut to prevent entry of the freed soul of the dead, and the white gloves worn by the

bearers are cast upon the coffin in the grave to get rid of the impurity of death. Miss Canziani does not seem to have found, or noted here, charms or folk-medicine, or the evil-eye belief (which is prevalent at least in Rumilly).

We have left ourselves no space to dwell on the characteristic melodies or the songs, but these present less novelty, as MM. A. van Gennep, Tiersot, Ritz, and Servettaz have all published collections from Savoy.

Miss Canziani tells us that the distinctive village costumes which she depicts so brilliantly are gradually disappearing, that the fays are abandoning their mountain homes, and that the old legends are being forgotten. We must therefore congratulate ourselves that the brush and pen of an enthusiastic and painstaking recorder have preserved for us so much of antique beauty, poetry, and custom before they fade away for ever.

A. R. W.

THE GEOLOGY OF SELSEY BILL.

Selsey Bill: Historic and Prehistoric. By Edw. Heron-Allen. Pp. xvi+404+maps and plates. (London: Duckworth and Co., 1911.) Price £2 2s. net.

The Recent and Fossil Foraminifera of the Shore-sands at Selsey Bill, Sussex. By Edw. Heron-Allen and Arthur Earland. (Reprinted from the Journal of the Royal Microscopical Society.) (London: Printed by Wm. Clowes and Sons, Ltd., 1908–1911.)

SELSEY BILL, the south-western promontory of Sussex, is classic ground to the geologist on account of the fossiliferous Middle Eocene deposits (or Bracklesham beds) which are exposed along its shores. It is therefore appropriate that any work on this region should devote considerable space to its geology, and Mr. Heron-Allen's sumptuous volume now before us includes no fewer than six chapters dealing with various aspects of the subject. Realising the needs of the general reader, Mr. Heron-Allen does even more than refer to the geological formations which can be actually studied within the area; for he attempts a brief sketch of the successive changes in geography and conditions which have occurred in southern Britain since the beginning of geological time, and alludes to certain hypotheses and general principles which are likely to excite interest. Following this, he gives a most useful description, illustrated by a map, of the series of fossiliferous Bracklesham beds exposed on the beach, based partly on the work of the Geological Survey, partly on his own observations made in association with Mr. Thomas Woodland.

The successive beds dip very gently from the western shore under the peninsula in a north-easterly direction, reappearing on the east side of the Bill; and they are covered partly by patches of Pleistocene deposits, partly by variously moving modern banks of sand and shingle, which render the study of them difficult. Good figures of some of the typical fossils occupy three plates, and will be useful to a beginner; but the nomenclature adopted in these illustrations and in the long lists added to the geological description will not always satisfy the modern worker.

Mr. Heron-Allen's new observations relate to the Pleistocene and other more recent deposits, which he has evidently studied with great diligence. His description of a fresh-water clay from which he obtained the remains of a young mammoth in April, 1909, is especially interesting, and is illustrated by a plate of photographs of the lower molars and some bones. His records of discoveries of flint implements both of Palæolithic and Neolithic types are also important; and the photographs of a "Mesolithic chisel" found beneath the Coombe rock on top of the raised beach are especially noteworthy. It is curious that no relics of the Bronze Age have hitherto been met with, though those of the Iron Age are abundant.

Mr. Heron-Allen has also worked industriously at the collection and identification of the Foraminifera which occur in patches on the beach. Altogether he has discovered about four hundred species, of which a large proportion agree closely with forms now common in Torres Straits and on the Great Barrier Reef of Australia. Unfortunately, these Foraminifera are of very different ages—some Cretaceous, some Tertiary, and some recent—all mixed, and it is not easy to separate them into groups; but in association with Mr. Arthur Earland, Mr. Heron-Allen has contributed an interesting series of papers on the collection to the Journal of the Royal Microscopical Society. These papers have now been reprinted and issued as a separate volume, in which there is an appendix on the preparation and study of Foraminifera from the Chalk.

The greater part of Mr. Heron-Allen's work on Selsey Bill deals, of course, with history and statistics, with which we are not concerned, and his natural history notes are necessarily brief. He is, however, to be congratulated on his successful effort to give both an interesting and a trustworthy account of the geology, which should stimulate local observers to devote more attention to the Bracklesham fossils and the Coombe rock than these have received during recent years.

A. S. W.

EXPERIENCES OF A BUTTERFLY-HUNTER.

Butterfly-Hunting in Many Lands. Notes of a Field Naturalist. By Dr. G. B. Longstaff. To which are added translations of papers by Fritz Müller on the scent-organs of butterflies and moths: with a note by Dr. E. B. Poulton, F.R.S. Pp. xviii+728. With 16 plates, 7 coloured. (London: Longmans, Green and Co., 1912.) Price 21*s.* net.

IN the handsome volume before us, Dr. Longstaff has brought together an account of his collecting experiences. The first chapter, "Early Reminiscences," describes his work as a collector from 1858 to 1869, chiefly in Britain, and especially during a visit to Rannoch. About 1869 he relinquished collecting, owing to defective sight after the loss of an eye, but from 1903 onward he has been collecting specimens abroad for the benefit of the Oxford Museum, visiting India, Ceylon, China, Japan, Canada, Algeria, South Africa, West Indies, South America, Egypt and the Sudan, New Zealand, and Australia.

Although chiefly a collector of butterflies, insects of all orders attracted more or less of his attention, while Mrs. Longstaff, who frequently accompanied her husband, paid special attention to land and fresh-water Mollusca. He himself made a point of noting the habits of the insects, especially their position at rest, and the odours which many of them emit. The frontispiece shows us the well-known African butterfly, *Eronia cleodora,* on the wing and at rest, and the other coloured plates illustrate not butterflies alone, but numerous interesting insects of all orders, taken by Dr. Longstaff, many of them previously unfigured, and a large proportion actually new to science.

The last chapter is devoted to "Butterfly Bionomics," and deals with such subjects as coloured juices, tenacity of life, mimicry, flight, altitudes, seasonal forms, &c., and the appendix includes a series of twelve important papers by the late Fritz Müller, from various German and Portuguese periodicals, by no means easy of access, even to those acquainted with the original languages. These are translated by Mr. E. A. Elliott, and are illustrated with nine plates. We wish that Porchinsky's beautifully illustrated papers on the colours of larvæ, &c., could also be republished in English from the Russian Entomological Transactions.

Dr. Longstaff's book is addressed chiefly to entomologists, but there are many interesting notes on various subjects scattered through the book, especially his experiences during the earthquake in Jamaica on January 14, 1907. There are also some amusing travellers' tales, which may be found scattered here and there through the book. It is exceedingly well printed, and, notwithstanding the enormous amount of technical matter, and the scores of scientific names on almost every page, we have noticed scarcely any misprints; and, indeed, the only point which appears to be an error which we have noticed is the statement that the mongoose was introduced into Jamaica to kill *snakes.* We believe that it was really introduced to kill *rats,* for venomous snakes are unknown in Jamaica, and harmless ones are not remarkably abundant. W. F. K.

SOME TEXT-BOOKS OF CHEMISTRY.

(1) *A Text-book of Inorganic Chemistry.* By Dr. G. Senter. Pp. xi+583. (London: Methuen and Co., Ltd., 1911.) Price 6*s.* 6*d.* (Text-books of Science.)

(2) *Chemistry: an Elementary Text-book.* By Profs. W. C. Morgan and J. A. Lyman. Pp. xvi+429. (New York: the Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s.* 6*d.* net.

(3) *The Chemistry of the Radio-elements.* By F. Soddy, F.R.S. Pp. v+92+chart. (London: Longmans, Green, and Co., 1911.) Price 2*s.* 6*d.* net. (Monographs on Inorganic and Physical Chemistry.)

(4) *A Text-book of Practical Chemistry for Technical Institutes.* By Dr. A. E. Dunstan and F. B. Thole. Pp. x+335. (London: Methuen and Co., Ltd., 1911.) Price 3*s.* 6*d.* (Text-books of Science.)

(5) *Practical Chemistry for Medical Students.* By Dr. A. C. Cumming. With a preface by Prof. James Walker. Pp. 171. (Edinburgh: James Thin, 1911.)

(6) *Elementary Experimental Chemistry.* By F. E. Weston. Pp. vii+140. (London: Longmans, Green, and Co., 1911.) Price 2*s.*

(7) *Chemistry Note-book.* By E. J. Sumner. Pp. 92. (Burnley: the Cooper Printing Co., Ltd., n.d.) Price 2*s.*

(8) *An Experimental Course of Physical Chemistry.* By Dr. J. F. Spencer. Part i., Statical Experiments. Pp. xiv+228. (London: G. Bell and Sons, Ltd., 1911.) Price 3*s.* 6*d.*

(9) *Laboratory Exercises in Physical Chemistry.* By Dr. J. N. Pring. Pp. xiv+163. (Manchester: the University Press, 1911.) Price 4*s.* net.

(1) UNTIL recently the problems which are now discussed under the heading of "Physical Chemistry" were usually relegated to the preliminary chapters of a text-book of general

chemistry, and only very occasionally touched upon in the later chapters of the book. Such a text-book had undoubted advantages from the point of view of the teacher; the text-book supplied the dry bones of chemistry, and in a course of lectures the flesh and blood could be added without any undue risk of duplicating the teaching derived from the book. But for the solitary student it was an obvious disadvantage that such questions as mass-action and reversible changes should be dealt with in an isolated chapter, and their application to the "daily round" of chemical changes forgotten or neglected. It was to remedy this defect that the book now under review was written. The author has not merely professed the policy of stating facts before theories, but, in welcome contrast with some recent writers, has held to this policy, so that atomic weights are not introduced until chapter x., page 115. Criticism of the book is largely limited to points of detail. Thus the adoption of the old convention that one molecular proportion of a gas occupies "two volumes" appears to the writer to introduce unnecessary confusion, and seems to carry with it some lurking suspicion that the oxygen molecule O_2 occupies two volumes because it contains two atoms, although the volume occupied is precisely the same in the case of the monatomic molecule of mercury. More emphasis might have been placed upon the fact that molecular weights are now referred to $O_2=32$ instead of $H_2=2$, the statement on p. 109 that "the molecular weight of a gas is double its vapour density referred to hydrogen as unit" being therefore only an approximation and not an exact definition; we have also not noticed on a first reading any statement of the fact that Avogadro's hypothesis is itself only an approximation which becomes accurate only at zero pressure.

In reference to the illustrations, two points have been noticed. The crystal drawings on p. 302 are for the most part correct, but have been printed in curious positions, the upper part of the figure being on the right in Fig. 60, on the left in Fig. 65, and at the bottom of Fig. 63. In Fig. 24 the author has perpetuated the mistake (so often repeated as almost to have become a dogma of the chemical creed) of representing Dumas's experiments on the composition of water as having been made with a Bunsen burner with U-tubes of the modern pattern some six or eight inches long; a reference to the original paper shows that these tubes were a metre in height, and that the beak of the massive copper oxide bulb was also a metre long; on this scale the retort stands of the figure would be 8 ft. high, and the interpolated Bunsen burner about 2 ft. high!

The periodic classification of the elements given on p. 364 shows the elements praseodymium = 140·5 and neodymium = 143·6 as members of the nitrogen and oxygen groups respectively. In view of the extraordinary similarity of these two elements such a separation is very undesirable, and there is every reason for preferring Prof. Armstrong's arrangement, in which the rare earth elements, from lanthanum = 139 to ytterbium = 173, form a vertical column in the boron or aluminium group; precedents for such an arrangement already exist in the clusters Fe, Co, Ni; Ru, Rh, Pd; and Os, Ir, Pt.

These criticisms deal entirely with matters of detail. Turning to more general considerations, it may be noted that the information given is modern and accurate, and that reference is made to a considerable number of observations published during the year 1911, which appears upon the title-page. The style is clear, the book is attractively printed, and the author has undoubtedly succeeded in his endeavour to introduce something of the spirit of physical chemistry into the routine of descriptive chemistry.

(2) The American text-book is in striking contrast to the serious work of our first author. An endeavour has been made

"to bring out the *humanistic* side of the science, to use as far as possible that material which is laden with intense human interest because of its significance to the race."

In so far as this has led the authors to introduce excellent portraits of Dalton, Lavoisier, Faraday, and Kekulé it is to be commended, although Arrhenius, as shown facing p. 260, would scarcely be recognised by his friends. But they proceed to illustrate chemical energy by a picture of a forest being cleared by dynamite, and an obscure photograph of an automobile, enveloped in dust and steam, travelling at 80 miles an hour; rapid oxidation is illustrated by the burning of San Francisco, and slow oxidation by a picture of a bird nesting in a hollow tree; other illustrations show a primeval forest, a coal mine, hydraulic gold-mining in California, and the granite rocks of the Sierra Nevada mountains. The book has evidently been written for American readers, and is not likely to come into general use in England.

(3) Mr. Soddy's book on "The Chemistry of the Radio-elements" is the first of a series of "Monographs on Inorganic and Physical Chemistry," of which ten numbers are already announced. The idea of the series is excellent, and the monographs should appeal to a wider circle and have an even larger circulation than the biochemical monographs already issued by the publishers. Following a general description of radio-activity and radio-active constants, the three "disintegration

series," starting from uranium, thorium, and actinium, are considered, and a note is added in reference to the slight radio-activity of potassium and rubidium. A concise statement of the present position of radio-chemistry is very opportune, and will be welcomed by many readers who are not in a position to master the original literature of the subject.

(4) Messrs. Dunstan and Thole have included in one volume instructions for qualitative analysis, volumetric and gravimetric analysis, gasometry, organic analysis and identification, and physico-chemical determinations; tables of solubility, reagents, atomic weights, logarithms, melting-points and boiling-points are given as appendices. Qualitative analysis is dealt with largely from the ionic point of view, but exception must be taken to the suggestion on p. 12 that H. C. Jones is the originator of the view that the ion is "associated with a variable amount of solvent"; this author's first statement was that the molecules of a salt, and not the ions, are hydrated, and this erroneous view was not withdrawn until the idea of hydrated ions had become generally familiar from the work of Kohlrausch and others. The book does not contain any detailed series of organic preparations, though general instructions are given for acetylation, nitration, preparation of oximes, &c.; but the chapter on organic identification is unusually complete, and forms one of the most valuable features of the book.

(5) Dr. Cumming has compiled a very attractive practical chemistry for medical students, leading up from exercises on solubility, &c., to the examination of organic compounds. The earlier exercises appear to be almost too simple, and it may be doubted whether the separation of salt from sand and the recrystallation of potassium nitrate mixed with a little permanganate are actually carried out by the medical students in the Edinburgh laboratories. In a later edition it would be well to accord to "bunsen" the dignity of a capital letter.

(6) Mr. Weston's book is intended for the use of beginners, and deals with solution, air, water, acids, alkalis, salts, the common gases, and the laws of chemical combination. A feature of the work is the photographic reproduction of actual apparatus; the reproductions are usually good, but a badly-bored cork which makes its first appearance in Fig. 20 shows itself again in the later pictures with the frequency attributed to the "bad penny"; the face reproduced in Fig. 50 would give the impression that a pipette is a worrying instrument to use. The success of a practical course depends almost entirely upon the teacher in charge of the laboratory, and the incidental notes show that the author has that wider range of knowledge which contributes so much to the interest of the work. Black's work on "fixed air," referred to on p. 83, should be dated 1755 and not 1775.

(7) Historical notes are a feature of the "Chemistry Note-book," whereby Mr. Sumner seeks to supplement the imperfections of a school-boy's "notes." The book is published locally, and is issued in a form which does not lend itself to any modification of the course which the author has adopted in his own school; but the course is a good one, and it may be that other teachers will be content to follow it so closely as to render possible the use of the printed "note-book." Incidental faults are the occasional use of formulæ as abbreviations, a bad habit that needs no encouragement from the teacher of a class of boys, and the slovenly use of the adjective (?) "bunsen." The eleven pages of historical outline at the end of the book are of more general value, and go far to guarantee the qualifications of the author to devise a successful course of elementary chemistry. The list of elements "discovered" by Berzelius is a curious one: there seems to be some confusion between the discovery and the isolation of an element, and it would be easy to dispute the claims of Berzelius to one or other of the two stages in the "discovery" of barium or silicon.

(8) Dr. Spencer has provided a course of experimental work to run side by side with a lecture-course in physical chemistry; the first part, dealing with "statical experiments," is now issued as a separate volume, to be followed by a volume describing the more difficult dynamical experiments. The methods of measuring the mechanical, optical, and thermal properties of substances are illustrated in an ample series of experiments. The methods to be used in correcting a balance and calibrating the weights are described, together with the correction to vacuum standard. It is to be regretted that the correction for latitude is deliberately excluded, and that the vacuum correction is not used systematically in the later experiments. It is not generally realised by chemists that a boiling point under a given pressure of mercury has no accurate significance until a correction has been made for latitude, for height above sea-level, and for the temperature of the mercury of the barometer; the systematic neglect of such corrections is a source of much inaccuracy, and it should be one of the chief objects of a course of experimental work in physical chemistry to get rid of the slovenly habit of making and publishing uncorrected observations. In a later edition the author will perhaps use his opportunity to develop this important feature in a book that is likely to be widely read and used.

(9) Dr. Pring's "Laboratory Exercises" covers a rather narrow range of experiments in physical chemistry, but the book has the advantage that many of the experiments are well worth doing, and are not included in more conventional text-books. The use of Junker's gas calorimeter, the Mahler-Cook combustion bomb, and the Wanner pyrometer, together with experiments on the charge and discharge of an accumulator and on electrolytic oxidation and reduction, provide a course of real value both as an education in method and as a training in operations of great technical importance. Such a course affords a real inducement to a student to enter the Manchester laboratory, offering as it does exceptional opportunities for technical training on lines widely different from the ordinary course of work in physics or in physical chemistry. T. M. L.

OUR BOOKSHELF.

Prehistoric Thessaly: being some Account of Recent Excavations and Explorations in North-eastern Greece from Lake Kopais to the Borders of Macedonia. By A. J. B. Wace and M. S. Thompson. Pp. xvi+272+vi plates. (Cambridge: University Press, 1912.) Price 18*s.* net.

MESSRS. WACE AND THOMPSON have opened a new chapter in the history of early civilisation. They have shown that in northern Greece a Neolithic culture, with a peculiar geometric art of its own, held the field contemporaneously with the Bronze Age "Minoan" and "Ægean" culture of southern Greece until the latter had reached its final phase and was entering upon its decline. Bronze was not used by the prehistoric Thessalians until the "Third Late-Minoan Period" of the Ægean culture, when they finally accepted its use from the southerners, not earlier, probably, than *circa* 1300 B.C., and not very long before iron came into general use. This is a most revolutionary discovery, and its effect upon the supposed history of the development of the use of bronze in the rest of Europe cannot yet be gauged. M. Tsountas, the distinguished Greek archæologist, had already discovered important remains of the Neolithic Thessalian culture, with its remarkable polychrome geometric pottery, at Dimini and Sesklo, but he had failed to detect its remarkably late date. He placed it on the usual *a priori* grounds anterior to the Bronze Age Minoan civilisation merely because it was Neolithic. The discovery of Messrs. Wace and Thompson, for which they give chapter and verse in this book, is a much-needed rebuke to *a priori* arguments in dating prehistoric antiquities.

I regret that considerations of space forbid me to say more of the book, which is a fine one. In it the authors have given us not merely a description of their own work, but a comprehensive monograph upon all the recent excavations in northern Greece, including those of Tsountas and Sotiriadis, which have inaugurated this new knowledge of early European civilisation.

H. R. HALL.

Gem-stones and their Distinctive Characters. By Dr. G. F. Herbert Smith. Pp. xv+312. (London: Methuen and Co., Ltd., 1912.) Price 6*s.* net.

THIS compact and well-illustrated manual supplies a want which has long been felt. So many minerals have been found, in recent years, to furnish varieties characterised by brilliant colours, with exquisite transparency and lustre, that jewellers have now a much wider choice than formerly in making selections for their artistic productions. It is unfortunately true that the use of these new gem-stones is greatly hindered by popular prejudices in favour of the materials with an old-established reputation, but a work like the present is calculated to bring home, both to the artists in jewellery and the public served by them, the wealth of unexploited material at command for ornamental purposes.

The early chapters of the book, describing the characters of gem-stones and the methods of discriminating between different species, are characterised by simplicity, clearness, and accuracy. Among the chapters on technology, that which is perhaps of greatest interest deals with the *manufacture* of precious stones. The method by which true rubies are now regularly produced for the market is not only fully described, but is illustrated by a photograph of the apparatus actually employed. The author is, however, able to show what means are available for discriminating between the natural and the artificial gems, and he adds: "At the time the manufactured ruby was a novelty, it fetched as much as 6*l.* a carat, but as soon as it was discovered that it could easily be differentiated from the natural stone, a collapse took place, and the price fell abruptly to 30*s.*, and eventually to 5*s.* and even 1*s.* a carat. . . . The prices of the natural stones, which at first had fallen, have now risen to almost their former level." The wise caution is still insisted on, however, of *Caveat emptor.*

In the descriptive part of the book an attempt at classification of gem-stones is made, which will probably not meet with very general acceptance. The title of "precious-stones" is only allowed to the diamond, ruby, sapphire, and emerald. The large group of "semi-precious" stones includes (with the topaz, spinel, peridot, zircon, opal, &c.) many beautiful substances which up to the present have been little used. The remaining classes are the "ornamental stones" and the "organic products"—pearl, coral, and amber.

An important feature of the work is the number of illustrations given in it. Besides those in the text, there are thirty-three plates, three of which are in colour, giving a fair idea of the appearance of the gems in their natural and cut conditions.

J. W. J.

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.*]

A Method for the Detection of the Proximity of Ice at Sea.

THIS method has for its basis the varying alteration in the electro-conductivity of sea water in the neighbourhood of melting ice. The conductivity of such water is materially reduced, and is dependent on two separate factors: first, the fall in temperature, and, secondly, the dilution of sea water of high electro-conductivity with water derived from glacier ice of comparatively negligible conductivity.

With regard to the first factor, the fall in conductivity is approximately 2 per cent. per degree centigrade for every degree below 20° C., and with regard to the second factor, namely, admixture of ice-derived water with sea water, the fall in conductivity, as ascertained by direct reading with appropriate apparatus, is as follows:—

(Temperature of experiment throughout =17·8° C.)

Specific conductivity of sea water, as shown by the scale of the apparatus used, =42,000 reciprocal megohms.

With a dilution of 1 part of ice-derived water with 80 parts of sea water, decrease in conductivity is 1 per cent.; dilution of 1 in 50, decrease=3 per cent.; dilution of 1 in 25, decrease=7 per cent.; dilution of 1 in 10, decrease=12 per cent.

It is obvious that the presence of ice-derived water in increasing proportion in sea water will, with a continuous self-recording apparatus, show a continuous fall in the electro-conductivity readings, and will so furnish presumptive evidence of the approach of ice. It is possible, and even probable, that changes in the composition of the water would be more trustworthy than changes in the temperature. In any case, if the two effects were observed side by side, the results of each method would tend to eliminate any disturbing factor peculiar to the other, such as the presence of fresh estuarial water on the one hand, or, on the other, changes in the temperature due to other causes than the proximity of icebergs.

MYER COPLANS.

School of Medicine, The University, Leeds,
May 14.

Pinhole Images.

IN the last paragraph of his letter in NATURE of May 2, Mr. Edser alludes to several ways in which "pinhole" images of the sun's disc may be observed. It is not perhaps so generally known that such images are often produced in great numbers by the reflection of direct sunlight from a glass surface, or by its transmission through a glass plate.

My attention was directed to these images during the recent solar eclipse by observing that direct sunlight, reflected on to the ceiling of a room from a plate of ordinary unsilvered window glass, contained numerous overlapping, but well-defined, crescent-shaped images of the uneclipsed part of the sun's disc. Similar overlapping images could also be traced in the sunlight coming directly through a window pane and falling on the floor, but here the best results were obtained by first using a mirror to reflect the light, after having traversed the window pane, on to the ceiling. The mirror, it should be said, played no part in the production of the images.

These phenomena are not observable with perfectly flat glass, but only with the common kind of window glass, which has a noticeably irregular surface, and appreciably distorts the details of objects seen through it. For the most part a plate of this glass scatters the transmitted light, but here and there, distributed over its surface, are small isolated patches which can be regarded as truly plane-parallel. In the transmission of light these isolated patches act as "holes" relatively to the surrounding and light-scattering parts of the plate, and thus give rise to "pinhole" images. The images noted in the reflected light are obviously produced in a similar manner by regular reflection from any perfectly flat small patches scattered over a surface otherwise irregular. The uniformity in size of the images and their measured dimensions are in accordance with this explanation of their origin.

R. BEATTIE.

Manchester University, May 14.

Meteor-showers towards the End of May.

THE following meteor-showers become due during the last week in May:—

Epoch May 23, 16h. 30m. (G.M.T.), twenty-first order of magnitude. Principal maxima, May 24, 23h. 15m., and May 26, 20h. 5m.; secondary maximum, May 24, 7h. 20m.

Epoch May 27, 6h., third order of magnitude. Principal maximum, May 25, 10h. 30m.; secondary maximum, May 26, 4h. 5m.

Epoch May 29, 23h. 30m., twenty-fourth order of magnitude. Principal maxima, May 26, 4h. 5m., and May 28, 0h. 50m.; secondary maxima, May 27, 3h. 10m., and May 29, 13h. 50m.

Epoch May 29, 19h. 30m., thirteenth order of magnitude. Principal maximum, May 31, 10h. 35m.; secondary maxima, May 29, 21h. 35m., and May 31, 18h. 20m.

May 20. JOHN R. HENRY.

THE BRITISH SCIENCE GUILD.

THE sixth annual meeting of the British Science Guild was held at the Institution of Electrical Engineers on Friday last, May 17; and was followed in the evening by a banquet, which was attended by a large and distinguished company, in the Galleries of the Royal Institute of Painters in Water Colours, with the Right Hon. Sir William Mather in the chair. Sir Norman Lockyer, chairman of committees of the Guild, was unfortunately prevented by ill-health from being present at either function. His absence from the banquet was exceptionally disappointing, as the day was his seventy-sixth birthday, and arrangements had been made to mark the appreciation of the members of the Guild of his services to science in general and the Guild in particular by a presentation of plate to him, and a separate token to Lady Lockyer in recognition of her energetic work for the Guild as honorary assistant treasurer and in other ways.

The commemorative gift to Sir Norman co-

sisted of three silver bowls, on the largest of which was inscribed :—"Presented to Sir Norman Lockyer, K.C.B., LL.D., D.Sc., F.R.S., by members of the British Science Guild, on his seventy-sixth birthday, May 17, 1912, as a token of their esteem and as a recognition of his patriotic labours to promote the application of scientific principles to industrial and general purposes." This gift and that of a chatelaine satchel to her personally, was received by Lady Lockyer, who expressed, on behalf of Sir Norman and herself, their sincere appreciation of these marks of regard. In making the presentation, Sir William Mather referred particularly to the importance in national life of the objects of the Guild founded six years ago, and the influence the Guild has exerted, and can continue to exercise. He was followed by Sir David Gill, who paid a tribute to Sir Norman's work in astronomy and astrophysics, and compared the Royal Palace provided by the French Government for Janssen with the tumble-down huts in which like researches in astrophysics have had to be carried on at South Kensington.

The aims and objects of the Guild were referred to incidentally or specifically by several speakers in the course of the evening. Prof. J. Perry, in proposing the toast of "The Peace Organisation of the Empire," expressed the view that organisation from above is unlikely to produce such a condition of permanent stability as organisation from below. Establish a satisfactory system of practical elementary instruction and you will obtain a broad and substantial base for the educational pyramid to be built upon it. In seconding the toast, Dr. W. N. Shaw referred to the fact that organisation is the essential factor of a satisfactory weather service. Mr. Dugald Clerk and Mr. W. Phipson Beale, to whom was entrusted the toast of "The British Science Guild," pointed out that men of science and men of business and affairs are complementary to one another, and it is always an advantage when their qualities can be combined to achieve a common purpose. The toast of "The Guests" was proposed by Sir Boverton Redwood in appropriate terms, and was responded to by Prof. Percival Lowell.

At the annual meeting Sir William Ramsay took the chair; and, in the course of his remarks upon the substance of the report, he referred to the desirability of impressing upon the Government the need for the establishment of works for the utilisation of atmospheric nitrogen in the preparation of nitric acid required in the manufacture of explosives. In the event of war, our supplies of nitrate would no doubt be intercepted, so that when those in the country had been exhausted, we should be at the mercy of the foreign enemy. For the sake of self-preservation, and to render us independent of such a contingency, plants for the production of nitric acid from the atmosphere should be laid down near the coalfields and in other districts, even though the nitrate obtained cost much more than its market value. Alluding to the appointment, by the Government, of committees to inquire into, and report upon, the subject of forestry and silviculture in England and Scotland, Sir William remarked that the subject is of great national importance; at present we spend almost nothing to secure our own supplies, whereas France and Germany spend two millions a year on their forests, and reap a revenue of six millions annually from them.

The adoption of the report was moved by Sir William Mather and seconded by a Canadian member, Dr. Henry Ami. Sir William Mather referred particularly to the sections relating to education, and suggested that one or two of the committees concerned with this subject should combine to prepare a report which would represent the views of the Guild as to the nature and contents of a course of primary education. Such a report, he considered, would be of great value in helping to determine the character of the Elementary Education Bill which may be introduced next year. Dr. Ami summarised the activities of the Canadian section of the Guild, described in an appendix to the annual report; the chief subjects with which the section has been concerned are elementary science teaching, technical education, municipal ice houses, ice conditions on the St. Lawrence, loss by fire—amounting in Canada last year to about £8 a minute—and university development in the West.

On the proposition of Sir Boverton Redwood, supported by Colonel Sir John Young, the meeting elected as vice-presidents the Lord Mayor, Dr. Ferranti, president of the Institution of Electrical Engineers, and Sir Gilbert Parker; and the following new members were added to the executive committee of the Guild: Sir Ernest Shackleton, Sir David Ferrier, Sir John Gorst, Major O'Meara, and Dr. R. M. Walmsley.

The wide scope of the Guild's interests is shown by the many subjects surveyed in the report. No other organisation exists to bring together authoritative opinion upon questions of national importance, and none has exerted greater influence in promoting progress in the right direction. In addition to the appendix mentioned already, there are several others dealing with the endowment and position of science and education, coordination of charitable effort, problems in technical education, synchronisation of clocks and the importance of correct time, disinfectants, coal, and tuberculosis. We must be content now with the mere mention of these subjects, but there may be an opportunity of dealing with some of them adequately in another issue. When the value of the work done by the Guild, as indicated in its annual report, is rightly and widely understood, the present membership of about nine hundred should be increased a hundredfold.

R. A. G.

NATURE AND MAN IN EASTERN AFRICA.[1]

(1) MR. KITCHING is already favourably known to students of Africa as the author of an outline grammar of the Gang language, the Gang, or Gañ, being one of the Nilotic tribes of central Uganda known previously by the Luganda name of Bakedi—"the naked ones." One might at first classify the work under review as a study of the Nilotic peoples of the northern and central parts of the Uganda Protectorate; but as it includes passages dealing with the Bantu races of the same region, especially in regard to the Banyoro, the more general descriptive title is the better. Still, the most valuable part of the book is the study of the Teso and Gañ peoples. (In regard to this last, I have fault to find with the author in that, instead of following well-established systems of orthography for dealing with African languages, such as were good enough for Barth and other African philologists of the first rank, he starts a variant of his own, in which *ñ* is used in the Spanish acceptation, and not, as it should be, to express the nasal consonant in words like "ringing" and "bang." This he expresses by another symbol, the *n'*—most confusing and misleading to the reader, the more so as apparently in some passages by an oversight *ñ* is to be taken as representing the nasal after all.)

For the rest, there is good material in this book for the ethnologist. The only other criticism one might raise is that the book is plastered with Mr. Rudyard Kipling's rhymes to an extent which is, to say the least, unusual. No doubt in dealing with backward races in Asia especially, and in Africa, an occasional line or couplet from Mr. Kipling is much to the point; but a more or less serious work dealing with ethnology has no need for such copious quotations, and quotations which do not always show the poet at his best.

FIG. 1.—Mwenge woman grinding millet. Tobacco is seen growing beside the house on the left. From "On the Backwaters of the Nile."

In one of the appendices there is an excellent selection of fifty proverbs in the Lunyoro language, in which the original version is given as well as the translation. These have every appearance of being authentic, and represent very fairly the wit and wisdom of a most interesting Bantu tribe. One becomes very weary of seeing in books and newspapers dealing with Africa a host of bogus proverbs expressed in English and attributed to the African merely because the writer of the book or newspaper thinks that is what the African ought to say. But this contribution to the stock of the negro's wit and wisdom on the part of Mr. Kitching is quite otherwise; it is genuine.

[1] (1) "On the Backwaters of the Nile." Studies of Some Child Races of Central Africa. By the Rev. A. L. Kitching With a preface by Dr. Peter Giles. Pp. xxiv+295. (London: T. Fisher Unwin, 1912.) Price 12*s.* 6*d.* net.

(2) "Animal Life in Africa." By Major J. Stevenson-Hamilton. With a Foreword by Theodore Roosevelt. Pp. xvii+539. (London: William Heinemann, 1912.) Price 18*s.* net.

(2) The work by Major J. Stevenson-Hamilton, warden of the Transvaal Government game reserves, deals with the big game, and to some extent the small mammals and birds, of the north-

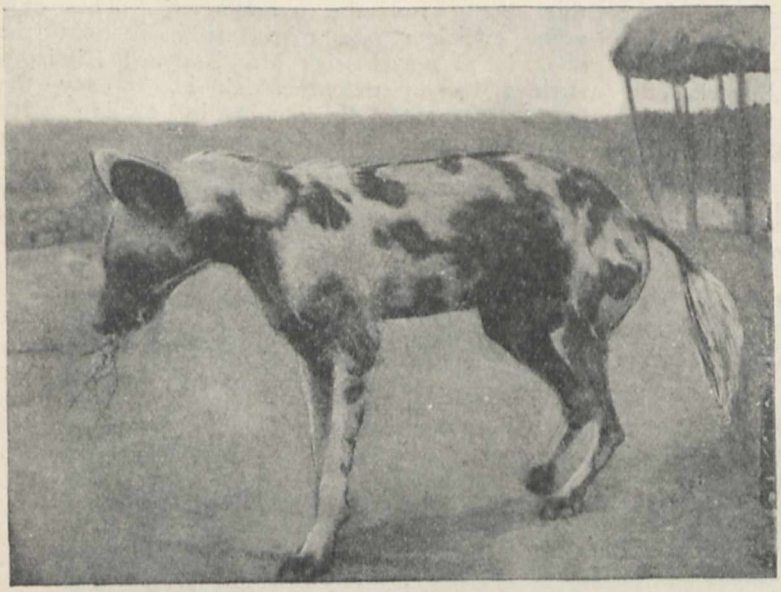

FIG. 2.—African hunting dog from the north-eastern Transvaal. From "Animal Life in Africa."

eastern Tranvaal, and to a lesser extent of East Africa, Uganda, and the Upper Nile. There is an interesting picture of the white rhinoceros of Zululand from a specimen just killed—for, alas! the care over this wonderful creature exercised by the authorities of Natal seems to take the form chiefly of killing it as specimens for museums. There are many striking photographs of gnus, impala, and lycaon hunting-dogs in the open, and of leopards, zebra, and eland in captivity—more or less; and there is much interesting and novel information regarding the life-history of lions, leopards, antelopes, and elephants.

There is one defect in the work which irritates the eye, and that is commencing the italicised Latin name of a genus or family with a small letter (examples, *bovidae, equus zebra*). Some authors annoy the reader by spelling the specific name with an initial capital in addition to that of the genus. This is confusing. But the practice adopted by Major Stevenson-Hamilton of giving generic and family names without a capital letter is more vexatious.

With regard to the first chapter on the great game of Africa, it is vitiated by a lack of sufficient acquaintance with the fauna of Western and West Central Africa. The author's survey of this question leaves out many important features, and states others incorrectly. His maps illustrating gaps in the distribution of species are not altogether correct. For example, the oryxes extend far into Senegambia and almost to the Atlantic coast of the Sahara. In common with the gazelles, they are also probably found immediately to the south of the Upper Niger. In the map of the Ethiopian region the West African faunal area is quite wrongly delineated. This area covers no very wide belt of territory along the west coast of Africa, and certainly does not extend so far north as the great bend of the Niger. On the other hand, it stretches across Central Africa to the kingdom of Buganda, to the west coast of Tanganyika, and down to the shores of Lake Mweru, besides covering much of northern Angola.

In his treatment of the distribution of mammals the author—like so many other writers on questions of zoography—omits any reference to the limited range of the zebra and the African wild ass. So far as extant information goes, no form of zebra has ever been met with *near the Nile* to the *north* of the 10th degree of N. latitude, or *west of the Mountain Nile*. Zebras are found to the south-west of Tanganyika, and thence right across southern Congoland into Angola, but have never been heard of elsewhere in West Africa. The ordinary black rhinoceros extends its range *west*

FIG. 3.—A waterbuck bull in the act of rising. From "Animal Life in Africa."

of the Nile not only to Lake Chad, but to the Upper Niger, and is found within the Niger bend. But in all that vast region of the western Sudan no form of wild horse is met with.

There are persistent stories from Arabs to the effect that there is a wild ass like that of Ethiopia in the western Sahara, and Mungo Park mentions seeing wild asses in northern Senegambia, but so far no proof has come to hand in the shape of skulls and skins. Amongst the fossils of Algeria are equine skulls very like that of the zebra. It is possible, therefore, that in late Pliocene or early Pleistocene times there was a zebra type existing in Northern Africa, but why the striped horses have since restricted their range to the easternmost and southern portion of Africa, and do not, like so many of the antelopes and the rhinoceros, extend their range westward of the Nile, is an unsolved problem.

H. H. JOHNSTON.

NEW AUTOMATIC TELEPHONE EXCHANGE.

A VERY interesting experiment has just been started in the new telephone exchange at Epsom. This exchange is the first in the United Kingdom to be installed on the automatic plan. In this system the subscriber, by means of an attachment to his telephone, himself selects and calls up the desired number, instead of communicating his wants to the exchange operator and being "put through" by her. The exchange operator is thus dispensed with.

The mechanism at the subscriber's telephone simply consists of a means by which a set of contacts are closed or separated a certain number of times—determined by the actual figures of the number required. These operations result in a series of impulses (or of breaks in an otherwise permanent current) over the telephone line and through the mechanism of the exchange. The movement of this mechanism puts the two lines into electrical connection. If the required subscriber be already engaged, the caller's apparatus returns to zero and gives him the well-known signal. Under the system the meter does not record a charge against the person telephoning until the required subscriber has answered. The whole system was described in detail in our issue of October 12 last year.

The system is complete as regards its own exchange, but when a subscriber on another exchange is required, a little more complication is introduced. At present such calls are dealt with by an operator. A slight extension of the principle is to allot a certain number of lines to the main exchanges and to number these with the subscribers. A caller then simply gets through to the required exchange automatically, and then asks for the number required in the usual way.

The working and development of the exchange will be watched with great interest by all telephone users.

MAJOR-GENERAL E. R. FESTING, C.B., F.R.S.

A LARGE circle of friends, both amongst his late colleagues and followers of science and and art, will be grieved to hear of the death of Major-General E. R. Festing (late R.E.) on Thursday last, May 16, from heart failure. Festing was born in 1839, and was educated at Carshalton during the headmastership of Prichett. He was transferred to the Royal Military Academy at Woolwich, and from there was gazetted as a lieutenant in the Royal Engineers when he was only fifteen years of age. His teachers often held up Festing as a worthy example to follow. He learnt thoroughly all he had to learn whilst under tuition, and he had the reputation of being "a calculating boy" from his early youth. The present writer has often had opportunities of knowing that in Festing's later years this power of mental arithmetic had not deserted him. In 1857 the young lieutenant of seventeen was sent to India as one of the officers of a company of sappers and miners, in which capacity he served under Sir Hugh Rose until 1859. On his return from India he was selected by Sir Henry Cole as deputy general superintendent at South Kensington. On the reorganisation of the museum he was appointed assistant director of the Science Museum, with charge of the Works Department under Sir Philip Owen. On this officer's retirement he was appointed director of the Science Museum, which office he held until his own retirement in 1904. For his services to the Department he was created a C.B. in 1900.

Festing was one who was universally beloved by his colleagues and by the subordinates who served under him. He was strict, but absolutely just, and was no self-seeker. He was always ready to further the welfare of his men, or to assist in aiding the science teaching or research with which he daily came in contact at the Royal College of Science. He himself was a man of science, and carried out many investigations, the gist of which is to be found in the pages of the Transactions and Proceedings of the Royal Society, of which he was elected a Fellow in 1886. Electrical science was perhaps what he loved best, though other departments of physics generally attracted him.

Brought into contact, by his position, with inventors, men of science, and artists, when they had gauged Festing's worth they soon became his friends instead of mere acquaintances, and many such will miss him. He was a general favourite of those brother officers with whom he had served in India or elsewhere, as he was with those younger ones of his corps who, when in London or its neighbourhood, found a warm welcome at his home.

Festing leaves a widow, two sons, and a daughter. The elder son is in the Ceylon Civil Service, and the other in the Artillery, whilst the daughter is well known as an author.

NOTES.

THE long-promised Government Bill to deal with the subject of the feeble-minded has appeared at last. A Royal Commission, which was appointed in 1904, reported in 1908, but the Government has taken four years before moving in what is admittedly an urgent matter. It would perhaps be ungrateful to inquire whether even this tardy appearance be due in part to the fact that a private Bill on the same subject was brought before the House of Commons on Friday last. The private Bill, which is due to the National Association for the Care of the Feeble-minded and the Eugenics Education Society jointly, gave rise to an interesting discussion, in which an all but general consensus of opinion was manifested in favour of the permanent care and control of those suffering from mental defect and unable to secure adequate protection in their own homes. The private Bill was read a second time without a division, but whether it will be carried further remains to be seen. It is to be hoped that the Government Bill, which is broader in scope, and grants some, though not adequate, financial provision, may be pressed forward in such a way as to make the more limited private Bill unnecessary. Fear of expense would appear to be groundless, for it is certain that each year's delay involves a prospective charge on the community for the support of hereditary defectives born therein far greater than the annual cost of the full scheme of the commissioners. From the wider points of view of the good of the race and the welfare of the existing sufferers the case is overwhelming.

IN a speech at the anniversary dinner of the Royal Geographical Society on Monday, May 20, Lord Curzon of Kedleston, president of the society, referred to the cosmopolitan character of geographical science. It is, he said, the handmaiden of history, the sister science to economics and to politics, and surrounded by the frontiers of geology, zoology, chemistry, physics, astronomy, and other sciences, while the literature of travel is appreciated by all. It will be remembered that Colonel Close, in his address as president of the Geographical Section of the British Association last year, contended that geography, apart from cartography, cannot be considered as a science in itself, but only as a common meeting-place and popularising medium for other sciences. The fact is that geography is a branch of science when it is studied and developed by scientific methods. Lord Curzon has no sympathy with the dull and pedantic school geography of former days, which meant, in the main, lists of the names and populations of great cities, the heights of mountains, the principal capes and promontories, number of square miles in a certain territory, and so on. More scientific methods of teaching geography are now followed, and the subject has justified the higher place it has gained as an educational factor, both in the school and outside. These are not the days to say that every branch of science must have its boundaries clearly defined. Astronomy long ago entered the domains of physics and chemistry, while these two sciences are scarcely distinguishable as separate departments of knowledge. So it is with biology, which becomes a branch of mathematics in biometric studies and of chemistry in other aspects. So long as geography is concerned with the advancement of knowledge of the earth and its relations to the needs of man it may claim to have a field of inquiry in which valuable work can be carried on for education and science.

THE programme for the educational section of the International Congress of Mathematicians at Cambridge (August 22–28) is now arranged. As already announced, the International Commission on Mathematical Teaching will meet at the same time and place, and in addition to the proceedings of the commission there will be further educational papers in the didactic subsection of the congress. At the first general meeting of the congress, Prof. Klein, president of the commission, will give an account of the work of the commission. The question of prolonging the mandate of the commission until the next congress (four years) will be raised. The commission will then hold three meetings in common with the didactic subsection of the congress, namely:—first meeting, presentation of the reports of the national subcommissions; second meeting, intuition and experiment in mathematical teaching at secondary schools; third meeting, mathematics as needed in the teaching of physics. In addition, the following papers will be read before the didactic subsection:—(1) Prof. J. Perry, the teaching of practical mathematics to evening classes; (2) Prof. M. J. M. Hill, the teaching of the theory of proportion; (3) Dr. T. P. Nunn, the proper scope and method of instruction in the calculus in schools; (4) Dr. A. N. Whitehead, the principles of mathematics in relation to elementary teaching (joint meeting of the didactic and philosophical subsections). Membership of the congress is secured by the payment of £1, which entitles the subscriber to attend the congress and to receive a copy of the Proceedings. The treasurer is Sir J. Larmor, F.R.S., St. John's College, Cambridge.

THE new building of the Royal Society of Medicine, in Wimpole Street, was visited by the King and Queen on Tuesday, May 21, and formally opened by his Majesty. In the course of a reply to an address presented by the society, the King said:—"It gives me great pleasure to open the fine building which will henceforth be the home of the society, and which will provide adequately for the increase in your membership and for the extension of your duties since a new and enlarged charter was granted to you by my father, King Edward. The importance of the society's work is now universally appreciated, and it is a matter of satisfaction that the needs of the society have been generously provided for, and that its varied functions can now be carried on unhampered by lack of space. The health and well-being of the community are safeguarded by the energies of the medical profession. We look to you to fight sickness and disease, and we claim from you an untiring vigilance in this contest and unceasing efforts to find, by the investigation of the

laws of nature, new means of combating these enemies. Medical science has revealed by experiment and trained observation new securities for life and health during recent years, and none can doubt that the improved public health is mainly due to the discoveries made by the medical profession in this and other countries, to the guidance given by that profession to civil authorities, and to the sanitary precautions against the spread of disease which they have enforced."

SIR DAVID BRUCE, C.B., F.R.S., has been approved by the King for special promotion to the rank of Surgeon-General, in consideration of his eminent services to science by his work on Malta fever, malaria, sleeping sickness, and other diseases.

DR. D. H. SCOTT, F.R.S., president of the Linnean Society, has been elected a foreign member of the Royal Danish Academy of Sciences and Letters (class of sciences), and foreign member of the Royal Society of Sciences, Upsala.

THE Berlin correspondent of *The Times* reports that on May 20 the Reichstag passed the first and second readings of the supplementary estimates for the promotion of aëronautics by means of the financial support of the recently founded "German Experimental Institute for Aëronautics." The estimates provide for a vote of 10,000*l.* as a contribution towards the founding of the institute and a vote of 2500*l.* towards the cost of maintenance for the financial year 1912.

THE President of the Board of Trade has appointed a technical committee to advise him, in the interests of safety of life at sea, with regard to the internal subdivision of vessels of all classes by watertight bulkheads and other means. The committee is constituted as follows:—Dr. Archibald Denny (chairman), Mr. James Bain, Mr. H. R. Champness, M.V.O., Dr. G. B. Hunter, Mr. Summers Hunter, Mr. J. Foster King, Mr. Andrew Laing, Mr. W. J. Luke, Dr. S. J. P. Thearle, and Prof. J. J. Welch. The secretary to the committee is Mr. Walter Carter, of the Board of Trade, 7 Whitehall Gardens, London, S.W., to whom communications relating to the work of the committee should be addressed.

ON Tuesday next, May 28, Prof. W. M. Flinders Petrie will give the first of two lectures at the Royal Institution on "The Formation of the Alphabet"; on Thursday, May 30, Prof. C. G. Barkla will begin a course of two lectures on "X-rays and Matter"; and on Saturday, June 1, Mr. Willis L. Moore, chief of the United States Weather Bureau, will deliver the first of two lectures on "The Development and Utilities of Meteorological Science." The Friday evening discourse on May 31 will be delivered by Prof. Howard T. Barnes on "Icebergs and their Location in Navigation," and on June 7 by Sir William Macowen on "Lord Lister." An extra Friday evening discourse will be given on June 14 by Mr. A. Henry Savage Landor on "Unknown Parts of South America."

WE learn from *The Times* of May 20 that under the will of the late Lord Wandsworth a sum of 10,000*l.* was bequeathed to Sir William Bennett, to be applied by him at his discretion for the promotion of medical research. Sir William Bennett has decided to entrust the administration of the legacy to the London School of Tropical Medicine, under conditions which include the establishment of a research scholarship, tenable for two or three years, and to be given preferably to a British subject. The committee of management of the Seamen's Hospital has been appointed by Sir William Bennett to be the trustee of the fund, and the research scholar will be appointed by that body on the recommendation of the committee of the London School of Tropical Medicine. It is probable that the first Wandsworth scholar will make human blood parasites the first objects of his study, and that he will proceed to the West Coast of Africa for this purpose.

AMONG the many interesting papers to be presented to the eighteenth International Congress of Americanists, which will be held in London next week, the account of the expedition of the Imperial Russian Geographical Society to Kamchatka and the Aleutian Islands, by Dr. Waldemar Jochelson, is specially worthy of note. The expedition, of which Dr. Jochelson was in charge of the ethnological section, was fitted out in 1908 at the expense of a Russian banker, M. F. P. Riobanschinsky. The expedition excavated thirteen ancient village sites and three burial caves, and explored shell-heaps and other kitchen-midden deposits of the Aleutian Islands. The collections brought back by the expedition included skeletons and skulls, and many prehistoric objects of stone and bone. In addition, much information as to the Aleutian language, folklore, and religion was secured. In 1910 the party crossed to Kamchatka, where old underground dwellings and fortifications were explored, and ancient pottery, the existence of which has been denied by former travellers, was found. The discoveries throw much light on the early relations of Kamchatka and Japan. Dr. Jochelson will also discuss the morphological relations of the language of Kamchatka and of the American Indians, and the identities which he has discovered in their mythology and that of the Indians of the north-west. The paper will be illustrated by a number of lantern-slides and kinematograph films.

WE regret to see the announcement of the death, on Tuesday, May 21, at sixty-two years of age, of Sir Julius Wernher, Bart., whose benefactions to education and science are gratefully remembered. He was greatly interested in education, and in many ways promoted the extension of knowledge, as will be seen in the following extract from an obituary notice in *The Times*:—He was a member of Lord Haldane's Committee on the Royal College of Science and Royal School of Mines, which reported in 1905, and the report of which led to the establishment by Royal Charter of the Imperial College of Science and Technology. In February of last year he was awarded the gold medal of the Institution of Mining and Metallurgy in recognition of his "great personal services to the advancement of technological education." A short time before he had given 10,000*l.* to the National Physical Laboratory for the extension of

its metallurgical department. But the greatest monument of his munificence will be the new South African University, if its benefactors' wishes are realised. Inspired by Rhodes's example, Beit had bequeathed property which has realised nearly a quarter of a million for the foundation of a university in the Transvaal; and when after the establishment of the South African Union it was decided to divert this money to the creation of a new teaching university for the whole of South Africa on the Groote Schuur estate at Cape Town, Wernher added a sum to his partner's bequest sufficient to bring up the endowment to 500,000*l*.

A PROVINCIAL meeting of the Royal Meteorological Society was held, on the invitation of the Mayor and Corporation, at Southport on Monday, May 13. After assembling at the Town Hall in the morning, the Fellows were driven to the anemograph station at Marshside, where they saw the pressure-tube anemometers and the anemoscope at work. After luncheon a visit was paid to the Fernley Observatory in Hesketh Park to see the large collection of self-recording and other instruments which are in use at this unique observatory. At the same time a demonstration was given of the method of filling and sending up a *ballon-sonde* with meteorograph attached for ascertaining the temperature in the upper atmosphere. Observations of the track of the balloon were made by means of a theodolite. Later, a meeting of the society was held in the Science and Art School, Dr. H. N. Dickson, president, in the chair. Mr. W. Marriott read a paper on the results of hourly wind and rainfall records at Southport, 1902–11, based upon data supplied by Mr. J. Baxendell, the borough meteorologist. When the hourly results are grouped according to summer and winter seasons, a great contrast in the figures is at once apparent. A most marked diurnal variation in the direction of the wind is shown in the summer, which is due to an extreme local development of land and sea breezes. Mr. J. S. Dines also read a paper on the south-east trade wind at St. Helena, in which he showed that observations tend to confirm the hypothesis of a long-period oscillation in the wind direction at St. Helena.

As it covers two years (1910, 1911), the recently issued report of the Felsted School Scientific Society is more bulky than usual; it is, at the same time, rendered much more attractive by containing reproductions of some of the prize competition photographs taken by members of the society last year. These represent ornithological subjects, including sedge-warblers' nests with eggs of cuckoos. Attention is directed to the interest attaching to a brickfield in the neighbourhood of the school, the clay of which is a plateau deposit containing Palæolithic implements.

THE *Aarsberetning* of the Bergen Museum for 1911 opens with a portrait and memoir of the late Prof. G. H. A. Hansen. Extensive additions are in progress or contemplation to the buildings, among which an illustration is given of one connected with the laboratory. Among the additions to the zoological department special interest attaches to a model of a cave with three newly born bears, of which an illustration is given in the report. Bear cubs, it may be mentioned, are remarkable for their extraordinarily small size at the time of birth.

IN its report for the past year the council of the Royal Zoological Society of Ireland announces the gift of 500*l*. by Lord Iveagh and the receipt of a legacy of 100*l*. from the late Mr. L. O. Hutton. The former sum has been devoted to building a hospital for the animals. Mr. Hutton's legacy, on the other hand, is allocated to the construction of a breeding establishment for salmon and trout, towards the cost of which contributions have also been promised from the Irish Fisheries Office and other bodies interested in the subjects. Experiments have been made in keeping apes and monkeys in the open air with satisfactory results. The collection of lions included twenty-two animals at the close of the year, two of these being presented by H.M. the King. One litter of five lion cubs was produced in the gardens during the year. By the courtesy of the society we are able to give an illustration of this litter from the report.

Photo.] [*J. A. Scott.*

Lion cubs four days old at the Dublin gardens.

SIR ARCHIBALD GEIKIE has sent to *The Times* a letter just received by him from Dr. E. A. Wilson, the chief of the scientific staff of the British Antarctic Expedition. The letter is dated October 31, 1911, at McMurdo Sound, and we extract a few points of

interest from it:—The self-registering meteorological instruments have given a continuous record of pressure, temperature, wind velocity, and direction, and these records have been checked every four hours by eye observations. A pressure-tube anemometer has given interesting records which will throw light on the character of Antarctic winds. The upper atmosphere has been investigated by means of small balloons, which have shown the direction of upper currents to a height of 6 miles and the temperature up to 1¾ miles. An almost unbroken record of the magnetic elements has been obtained, and absolute magnetic observations have been made every week. All through the winter the aurora was observed every hour, but very few brilliant displays occurred. Atmospheric electricity has also been studied. Ice work and physiography have afforded much field work. Land forms now appearing in fresh state with receding glaciation are being studied in relation to similar time- and weather-worn structures of other parts of the world. The discovery of evidences of interglacial period of vulcanicity gives additional interest to the study of this volcanic region. Pendulum observations for value of gravity have been carried out. A tide gauge has given a continuous record. Marine biological work has been carried on throughout the winter at a hole kept open in the sea ice for nets, water samples, and sea temperatures. Quantitative and qualitative observations of minute organisms at various seasons give interesting results. The parasitology of all the seals, penguins, other birds, and fish available has already given good results, and some new protozoa have been found.

THE period of Etnean activity which culminated in the eruption of last September began with the opening on May 27, 1911, of a new vent to the north-east of the central crater. This vent is at a height of 3160 metres, or about 80 metres below the north-east rim of the central crater. As seen on June 9 by Prof. A. Riccò, it is triangular in form, the sides being from 80 to 100 metres in length, and though the floor was obscured, its depth was evidently great. That it communicates in some way with the central crater is clear from its position and from the correspondence in the periods of their eruptive action.

WE have received from the Cardiff Naturalists' Society a report of the meteorological observations made in that district for 1911, prepared by Dr. E. Walford. The society is doing very useful work in collecting and discussing the rainfall at forty-seven stations, at heights above sea-level varying from 20 ft. at Barry to 2350 ft. at the summit of Tyle Brith (Brecon). The base of the coast-line extends from Neath to Chepstow. The mean annual rainfall for the whole district was 50·95 in.; July, 0·39 in.; December, 12·35 in. The greatest mean during the last ten years was 67·9 in. in 1903, and the least 39·98 in. in 1905. A complete meteorological station is established at Penylan, Cardiff. The rainfall for 1911, 37·63 in., was 1·38 in. below the average; the mean temperature, 50·5°, was 1·5° above the average. Readings above 80° were recorded on seventeen days, and above 90° on two days. At another station actually in Cardiff, Dr. Vachell recorded shade temperatures above 80° on thirty-eight days, and on three days above 90°; 1911 will be remembered as a record year in this respect.

IN December, 1910, we directed our readers' attention to the preliminary results obtained by Miss Jacob, of the University of Königsberg, in a research on the friction of solids on each other. The work is now completed, and the results are to be found in the May number of the *Annalen der Physik*. At ordinary temperatures perfectly clean, well-polished solids without lubrication will move over each other on the application of forces far below those generally regarded as the least necessary to start the motion. For these small forces the motion generated is uniform, but for larger forces it becomes an accelerated motion. This means that the friction of clean solids on each other is dependent on the velocity. It is independent of the area of contact and of the force pressing the surfaces together, but varies with the temperature. From ordinary temperatures up to 180° C. it decreases to about one-third its initial value, but resumes that value when the bodies are cooled. If they are heated above 180° C. the friction rises rapidly, and retains an abnormally high value after cooling.

IN the *Comptes rendus* for May 6 M. G. Darzens describes the preparation of a new compound of carbon and nitrogen. He names it carbon pernitride, and prepares it by the interaction of cyanogen bromide and sodium hydrazoate, NaN_3. The nitride, N_3—CN, can be separated from the aqueous solution in which it is prepared by ether, and forms colourless needles without smell melting at about 36° C. At a few degrees above its melting point the compound can be sublimed in a high vacuum, but it commences to decompose at 70° C., and detonates with extreme violence at 180° C. It is also very sensitive to shock, and, like all substances containing the N_3 group, must be handled in small quantities only and with suitable precautions against the results of explosion. In aqueous solution the nitride undergoes hydrolysis, giving azocarbonic acid, and ultimately hydrazoic acid and carbon dioxide. Measurements of its heat of decomposition were carried out in a calorimetric bomb; its heat of formation was found to be −92·6 calories. From these experiments, which were carried out with some difficulty on account of the destructive effect of each combustion on the calorimeter fittings, the author concludes that this pernitride of carbon is the most endothermic substance known.

IN spite of their commercial importance and their wide distribution in plants, the chemical structure of the tannins has so far eluded research. Since the discovery by Strecker, in 1852, that they contained glucose in their molecule, they have been frequently regarded as glucosides of gallic acid. Others, however, have disputed the presence of glucose in the molecule, and tannin is frequently described as digallic acid, a view which is not in agreement with the

optical activity. Nierenstein has supposed tannin to be a mixture of digallic acid and optically active leucotannin; this does not agree with the slight acidity of tannin. The recently published researches of Emil Fischer in conjunction with Freudenberg throw a new light on the question. The authors show that carefully purified tannin contains about 8 per cent. of glucose in its molecule. They do not regard tannin as a glucoside of gallic acid, but consider that it is an acyl compound of glucose analogous to the penta-acetyl and penta-benzoyl derivatives of this sugar, in which the alcohol groups form esters with the acid. This novel conception of tannin as a penta-digalloyl glucose is in agreement with its chemical behaviour, but, as is his custom, Fischer has had recourse to synthesis to confirm his views. Digallic acid was not available, but a synthetic penta-galloyl glucose could be obtained without great difficulty, it sufficing to combine glucose with tricarbomethoxygalloyl chloride in presence of quinoline and remove the tricarbomethoxy-groups by cautious hydrolysis with alkali. The new compound has all the properties of the tannins, and there can be little doubt that the new conception is the correct one, and that synthetic tannin will shortly be added to the achievements of the organic chemist.

SUCCESSFUL trials have just been concluded of the first Clyde-built motor ship, *Jutlandia*. An illustrated article in *The Engineer* for May 17 gives some particulars of this ship, which is a sister ship to the *Selandia*. The builders, Messrs. Barclay, Curle and Co., Ltd., Whiteinch, have fitted Diesel engines of the four-cycle type. On the measured mile at Skelmorlie the vessel attained a mean speed of 12 knots, the engines developing 2700 indicated horse-power at 135 revolutions per minute. The fuel used on the trials was oil of specific gravity 0·855, but the engines are capable of using heavier oil, such as is obtainable from the Roumanian or American oil fields. The builders estimate that in regular service the quantity of fuel necessary will be about 10 tons per day of twenty-four hours' continuous running.

Engineering for May 17 gives an account of the system of ozone production and distributing plant installed for air purification and ventilation on the Central London Railway by the firm of Ozonair, Ltd. The system is a plenum one, and consists of Sirocco fans placed at each of the underground stations, excepting that at Shepherd's Bush. The total air supplied to the tubes is about 80,000,000 cubic feet per day. Each fan draws its air through a filter screen, and works in conjunction with an ozone-generating plant. The latter consists of mica sheets with metallic gauze on each side, stacked side by side, and energised by alternating current at about 5000 volts, in such connection that a silent discharge passes between the various plates, so that air flowing between them is ozonised. The ozone generator is supplied from a small transformer, which in turn is supplied with 380 volts alternating current from a small rotary converter. The converter is connected on its direct-current side to the 550-volt lighting circuit of the railway.

OUR ASTRONOMICAL COLUMN.

THE RECENT SOLAR ECLIPSE.—Many preliminary accounts of the solar eclipse of April 17 are given in the May number of *L'Astronomie*; the June number is to be devoted to a fuller discussion.

M. Flammarion—who is to receive the Cross of the Legion of Honour—gives, *inter alia*, a map on which he has drawn the central line derived from numerous observations. Going from south-west to north-east, it passes very slightly to the north of St. Nom-la-Bretèche, rather further north of St. Germain-en-Laye, south of Maisons-Laffite, north of Sartrouville, over Franconville and Moisselles, north of Villiers-la-Sec and south of Luzarches.

Analysing the observations made from a dirigible near the last-named place, Comte de la Baume Pluvinel finds that the line is 1·8 km. north of that given by the *Connaissance des Temps*, and that the central phase occurred at the time given by the "American Ephemeris"; this was from fifteen to twenty-five seconds earlier than the times given by other ephemerides. The shadow of the moon, as seen from the dirigible, appeared as a greyish circle 3·5 km. in diameter travelling over the ground at about 800 metres per second. This shadow passed over the villages Belloy and Villiers-la-Sec at the same moment, the former lying near its northern limit.

At Sartrouville, M. Tramblay determined the interval between the appearance and disappearance of the cusps as four seconds. M. G. Renaudot, at Paris, made some very definite and interesting observations ot the effects on birds and certain plants, which in every case behaved as they usually do at nightfall. As the eclipse was neither total nor annular, M. Flammarion suggests the designation *d'éclipse perlée*, which would describe the appearance of a collar of irregular pearls seen at maximum phase.

M. Simonin asks that observers will forward to him, at the Paris Observatory, the results of their observations of this eclipse.

SOLAR PROMINENCES IN 1910.—We have received amended tables of Prof. Riccò's summary of the prominences observed during 1910 at Catania, in which some of the values are essentially different from those previously given, which we briefly noted in these columns on May 9. The mean frequencies for the four trimestres should read:—N. hemisphere, 1·9, 1·5, 1·1, and 0·3; S. hemisphere, 1·7, 1·3, 1·2, and 1·4, the mean frequencies for the year being N. 1·2 and S. 1·4. Compared with 1909, the year showed a decrease in the frequency and the size of the prominences. Considering their distribution, there were two principal maxima at 25°–29° and 55°–59°, respectively, in the northern, and two at 15°–19° and 50°–54°, respectively, in the southern, hemisphere.

THE UNITED STATES NAVAL OBSERVATORY.—The superintendent's report of the work performed at the U.S. Naval Observatory for the year ending June 30, 1911, contains, among many other items, several interesting results of investigations of instrumental errors. A wide difference of opinion among the staff concerning the performance of the 6-in. transit circle has been settled, as the result of an investigation lasting over three years, by a declaration that the instrument is fit for the fundamental observations for which it is now to be employed. Another investigation was carried out to determine the cause of a periodic error of exactly four minutes, having a range of more than 5 seconds of arc, in the driving-clock of the 26-in. equatorial. No single cause could be found, so it was decided to correct the error by introducing one of opposite sign and having the same amplitude. This was done by scraping the driving

side of the bevel gears at those parts which were in mesh at the moment the error occurred, and the error was thereby reduced to about eight-tenths of a second.

The sun was photographed on 148 days, and showed spots on 88 days. In future, the "Nautical Almanac" publications are to be stored and distributed by the Naval Observatory librarian.

EPHEMERIS FOR BORRELLY'S COMET, 1911*e*.—To No. 4572 of the *Astronomische Nachrichten*, M. Schaumasse contributes an ephemeris for comet 1911*e*, which is at present about a degree north of 36 Lyncis, and is travelling in the direction of β Leonis Minoris. This comet is extremely faint, but an observation by M. Schaumasse, with the Nice equatorial *coudé* on April 19, showed that the error of the ephemeris was only $-3s.$, $0'$.

THE TEACHING OF MATHEMATICS.[1]

The Content of the School Course in Mathematics.

A SYSTEM of education designed on broad lines to prepare pupils for some particular occupation is not only the best training for that particular occupation, but it is better as a "general education" than a system which has been designed simply as a general education, and not as a preparation for any particular calling. For a boy willingly undertakes work which clearly leads up to the solution of a real and interesting problem, even if that problem is one that belongs to his neighbour's after-life and not to his own. But the course designed for "general education" tends to become a "mental discipline" lacking in interest, and such discipline deadens the mind and makes the boy a machine.

In Papers Nos. 15 and 16 of this series, Mr. Carson and Mr. Durell advocate the inclusion in a school course of certain methods of great beauty, which to a few boys will be a source of delight. But the authors of those papers have no criterion of the suitability of these subjects beyond their own love of them. To a certain point that is a true criterion; what has given pleasure to one person has a good chance of giving pleasure to another; and all the subjects which they advocate deserve a place in a system of recreations for the mathematician's leisure hour. But to determine which of these methods and subjects are to be thrust upon every boy of an ordinary degree of mathematical ability, some better criterion is necessary. I do not say that I would exclude any of these methods, but only that they have not yet been judged on a suitable criterion.

That suitable criterion must be a consideration of the needs in after-life of certain groups of boys. In many cases mathematics is a form of technical knowledge required for the after-career, *e.g.*, for the careers of engineer, mathematical schoolmaster, professor of mathematics. In such cases the content of the subject will be determined by a wide interpretation of the requirements of the career, the treatment of the subject being of the broadest and every problem viewed from many points of view. The boy to whom mathematics is merely a part of his general education will, so far as he goes, study along with the technical group with which he has most in common. It is not necessary that each boy's future career should be planned in advance; all boys, technical, semi-technical, and non-technical, will study together for a time; then gradually the non-technical boys will drop out, and the remainder will bifurcate according to their varying intellectual powers and their varying technical needs.

These are the views to which observation, experiment and reflection are leading students of education. Many a doubter will be converted by a study of Mr. Mercer's admirable account of the teaching at the naval colleges (Paper 17). It is a document which every mathematical master should have by him. Some small portions of the course are special to the requirements of the Navy, but the course as a whole makes an excellent starting point from which to lay out a scheme for any school.

In Paper No. 12 Mr. Usherwood provides further evidence in favour of our principles. The close correlation of mathematics with engineering has given his boys a breadth of mathematical knowledge and a real grasp such as would have been incredible a generation ago. Mr. Usherwood justifies his procedure by quoting Mr. Branford's classification of the impulses which urge towards mathematical study, a classification also held by Dr. Nunn. Of these impulses, the utilitarian is the chief one at the school stage, and every central truth should be made to arise in response to some demand arising from a practical problem. Mr. Usherwood holds that manual as well as mental dexterity should be involved in the practical problem from which an investigation sets out, and he petitions for a greater place in the curriculum for suitable manual training.

Further support to the principles enunciated above is given by Mr. Palmer's historical account of the teaching of arithmetic. It is an excellent account of the changes which have been made in the last quarter-century. A generation ago "general education" was the cry, and if any method had a "bread-and-butter" value that was sufficient reason for its exclusion. The course consequently contained such monstrosities as "true discount." The true criterion has now been adopted; in part, half unconsciously. More conscious application of the criterion will in time recognise that most fractions should be dealt with in decimal form, and will greatly reduce the time spent on vulgar fractions, greatest common factor, and least common multiple. We learn from Mr. Palmer how far removed the school treatment of stocks and shares is from business practice. The whole subject seems to us unsuited to the school. The difficulty lies in the realisation of the circumstances of the problem; the circumstances are far removed from a boy's experience, and the explanation of them profits him nothing. The circumstances once realised, the arithmetic is child's play.

The Methods of Mathematical Study.

The various methods of mathematical investigation have been added one by one at various times to our available stock of tools. On the historical principle that the development of the individual should copy the history of the race, it is appropriate that these various tools should be put in the pupil's hand in the order of their discovery. It is, however, the practice to follow the development of the race too closely, and to discuss by the more primitive method all the problems for which our ancestors used it, regardless of the fact that a later method is a more suitable weapon with which to attack many of these problems. Such exactness of recapitulation cannot be justified; it is the haphazard result of the successive

[1] Papers on the Teaching of Mathematics in the United Kingdom, published by the Board of Education:—
(12) "Mathematics with relation to Engineering Work in Schools." By T. S. Usherwood. (1912.) Price 2*d*.
(13) "The Teaching of Arithmetic in Secondary Schools." By G. W. Palmer. (1912). Price 2½*d*.
(14) "Examinations for Mathematical Scholarships." By Dr. F. S. Macaulay and W. J. Greenstreet. (1912). Price 3*d*.
(15) "The Educational Value of Geometry." By G. St. L. Carson. (1912.) Price 1½*d*.
(16) "A School Course in Advanced Geometry." By C. V. Durell. (1912.) Price 1½*d*.
(17) "Mathematics at Osborne and Dartmouth." By J. W. Mercer and C. E. Ashford. (1912.) Price 2½*d*.
Earlier papers were noticed in NATURE of March 14.

origins of the various methods; the physiologist from whom education has borrowed the historical principle says that "the history of the individual is a *blurred* recapitulation of the history of the race."

Too exact a recapitulation is wasteful of time and deadens the intellect. The recapitulation must be a blurred one; the barriers between the various branches of mathematics must be broken down, and the pupil given freedom to select for any problem whatever tool he finds most appropriate.

In Paper 16 Mr. Durell drives home this principle. The freedom to treat a problem by Euclid's method, by Descartes', or by Monge's, by the principle of duality or by that of continuity, gives to the pupil a breadth of view and to the subject a unity otherwise unattainable. It reduces the multitude of properties of geometrical figures to a small number of greater generalisations which the mind can carry without effort. And it effects a saving of time, which makes possible a much further advance in mathematics than is now customary.

Mr. Durell rightly reduces to small compass the Euclidean treatment of conics, but he retains conics as the chief material to which the various methods are to be applied. His course might be further improved by the substitution in some cases of other material, such as an occasional higher algebraic curve, a transcendental curve, or a surface.

The Postulates of Geometry.

Mr. Carson (Paper 15) pleads for more system in the treatment of elementary geometry, in order that the pupil may gain a better grasp of the subject and have time to pursue his studies further. Mr. Carson would assume as postulates all the geometrical properties which can be looked upon as "intuitive," and build a system of reasoned geometry upon these; a suggestion which deserves serious consideration. The elaboration of this idea must involve some preliminary discussion of the nature of intuition. Intuition varies greatly from individual to individual; that "things equal to the same thing are equal to one another" is not an intuition to every child (see Branford's "Principles of Mathematical Education"); and, on the other hand, to an occasional genius results are intuitive which involve prolonged investigation for the average mathematician. Intuitions depend upon experience, and differ according to the experience of the individual.

It will clearly be necessary to give precision to each particular property which is to be assumed as an intuition. One valuable method of giving such precision is strangely repugnant to Mr. Carson, I mean that of numerical illustration. This method has real value, not only for these intuitions, but also for ensuring the comprehension of a property of which the proof is to follow. Nevertheless, when worked out Mr. Carson's scheme would probably differ little from some courses now in use.

Mr. Carson's main thesis is that if the inclusion of mathematics in the school curriculum is to be upheld, its study must be justified as an end in itself, and not by any consideration of utility. This view is best judged by the conclusions to which it leads him. One such conclusion is that the study is essential for girls as well as for boys; perhaps if Miss Burstall's excellent discussion of that topic in a recent number of *The Mathematical Gazette* had been available at the time when Mr. Carson wrote this paper, he might have modified his views.

We have already referred to Mr. Carson's criterion of the content of the mathematical course—"mathematics for its own sake." To most of us beauty is closely connected with utility; there are on the high road of progress just as many and as lovely views to be seen as in Mr. Carson's bypaths. For many of us, also, the high road provides bread and butter along with beauty; at the present day the view is all too prevalent that real work and beauty are incompatible.

But really Mr. Carson is barely half in earnest. He is constantly falling into some utilitarian justification for his teaching, and then pulling himself up short. And the programme he sketches is excellent, chiefly because he keeps so close to the concrete and to utility.

Examinations.

In recent years there has been much discussion of the value of literary examinations, some holding them to be the only true criterion of a pupil's ability, others holding them entirely harmful. The truth would appear to lie between these extremes. On the one hand, no literary examination can tell us much of the character of a boy, and there are subjects in which training is the great element, and knowledge so small an element that any attempt to examine would spoil the value of the subject. There are, on the other hand, many subjects in which examination has real value—provided it is properly conducted.

An examining body cannot escape the responsibility of influencing schools, whether for good or ill. If the examiner is ignorant of the schools his influence will be bad; he must in some way be put in close touch with the school. He must also not be a mere hack, but have a fresh interest in the subject and some knowledge of educational principles. With that granted, there is ground for hope that his influence on the schools will be good. Another thing of much value is difficult to get, namely, the criticism of the business man who has no expert knowledge of the subject but a real knowledge of the kind of boy he wants in his business. I remember Prof. Henrici's modest account of his early mathematical development as teacher in a technical college. The business committee wanted certain things done which seemed impossible to the young professor with his academic views. But he agreed to try, and speedily he concluded that the business men had been perfectly right.

Messrs. Macaulay and Greenstreet (Paper 14) discuss the scholarship examinations on which the universities select entrance scholars. The discussion concerns Cambridge chiefly, and the authors make a strong case for their view that the universities are not sufficiently acquainted with the conditions of the schools, and that more weight should be attached to the opinions of the schoolmasters who prepare the boys for the examinations. The authors deserve all sympathy in their desire that pupils should not waste time in exploring bypaths and in the acquisition of excessive skill in manipulation, but should push on along the main road. Some of their suggestions, however, scarcely carry conviction. Consider, for instance, their disapproval of the graphical method in statics, a method of such value for giving a grasp of principle. Take, again, their view that a boy should sit still and watch his master draw algebraic graphs without drawing them himself.

DAVID BEVERIDGE MAIR.

BIOLOGICAL PAPERS FROM PRAGUE.

PROF. HLAVA (Bull. Internat. Acad. Sci., Prague, xv. Ann.) has found, in the blood of children infected with measles, oval or rod-like bodies, which he regards as probably of protozoan nature. In a blood-smear from another infected child (who also exhibited severe anæmia due to the presence of numerous whip-worms in the intestine),

sickle-shaped bodies were present in the red corpuscles. These bodies could not be found in the blood of this child on the following day, but there occurred, in the plasma, ovoid bodies, which, according to Prof. Hlava, were similar to Leishmania. In the accompanying figure, however, only a single nucleus is shown in each cell, whereas two nuclei are present in Leishmania.

J. Hořejší (Bull. Internat. Acad. Sci., Prague, xv. Ann.) records observations on the symbiotic union of a cyanophycean alga (Anabæna) with the roots of *Cycas revoluta*. The alga, which enters a root through the lenticel-system, passes into the meristematic apical tissue, retarding the activity of the latter, inducing dichotomy and the eventual production upon the root of a coral-like outgrowth. The advantages to the two organisms concerned are probably mutual; the root derives from the alga its nitrogenous products, whereas the alga takes up from the root a certain part of its host's products of assimilation. In the same bulletin Dr. B. Němec traces the stages of degeneration of the nuclei in the cells which form the sieve-tubes in Euphorbia, Ricinus, &c.

The biology and physiology of a species of dodder (*Cuscuta gronowii*), parasitic on willows, have been investigated by Dr. K. Spisar (Bull. Internat. Acad. Sci., Prague, xv. Ann.). He found that seedlings would wind round organic or inorganic supports of varying thickness, the contact-stimulus being very strong, contact with a suspended thread being sufficient to bring about the reaction. The zone in which the response reaches its maximum is in or near the growing zone. During the formation of haustoria, which is not dependent either on light or on the want of food, growth ceases, and the circumnutation movements are lost, but reappear in two or three days. This dodder is not very fastidious in regard to its host, and may even be "parasitic" on itself. The tissues remaining in the haustorial zone, when the rest of the dodder has been torn off its host, give rise to adventitious buds, and thus regenerate the parasite. The purple-red colour depends on the influence of light; at any rate, it was soon lost in the dark. In the absence of a suitable food-plant the axis of the dodder (which is green in the seedling) does not assume the usual purple colour.

PALÆOLITHIC MAN IN NEW JERSEY.[1]

SINCE Dr. C. C. Abbott's discovery of Palæolithic implements in the river-deposits of Trenton, New Jersey, nearly forty years ago, the valley of the Delaware has continually attracted the attention of students of early man in North America. This region lies immediately south of the southern limit of the ice-sheet which extended over the greater part of the continent during the Glacial epoch, and it is covered by a thick stratum of boulder clay, with associated gravels, through which the existing rivers have cut their channels. The Trenton gravels occupy the valley excavated by the Delaware, and therefore represent a period later than that of the maximum glaciation, though their constitution suggests that they date back to a time before glacial conditions had completely passed away. Over the Trenton gravels are spread yellow sands and loam, which Dr. J. B. Woodworth regards as Post-glacial; and there is also a thin superficial covering of black soil. All these three deposits yield evidence of man, and for more than twenty years they have been systematically searched and studied by Mr. Ernest Volk. His work has been done under the general direction of Prof. F. W. Putnam, for the Peabody Museum of Harvard University, and an exhaustive, well-illustrated report of his results has now been published by the Museum.

From Mr. Volk's researches, it appears that all the remains found in the surface soil and the pits and graves dug through it are those of the Indians who were displaced by the first European settlers. Numerous human skeletons were obtained, most of them buried in a crouching posture, with the knees drawn up towards the body, as well shown in several photographs.

Traces of man in the underlying yellow sand and loam are rarer than in the black soil. Charcoal and pebbles broken by fire are found, but there is no pottery, and all the stone implements are of argillite. Some of the latter are obviously spear-heads, others are borers, and some are rudely made with a jagged cutting edge. Mr. Volk was fortunate enough to discover a few human skeletons undoubtedly of the same age, but the bones were too much decomposed for preservation, and merely showed that the people were strongly built.

Discoveries in the Trenton gravel, with its intercalated clays and sands, are still rarer. Mr. Volk notes chipped pieces of quartz and certain quartzite pebbles, which he regards as having been artificially broken. He also records fragments of a human cranium, and part of a human femur, which both he and Dr. A. Hrdlička consider to have been cut and worked by man. In the same deposits were found identifiable bones of the musk-ox and the elk.

Both Mr. Volk and the Peabody Museum are to be congratulated on the painstaking thoroughness of this interesting investigation, which it is to be hoped may be continued. In these days of overcrowded libraries, however, we must add a word of protest as to the undigested state in which the report is issued. It may be of moment to the Peabody Museum to know that Mr. Volk did not work on Sundays or Washington's birthday, and was continually interrupted by rain, snow, ill-health, and "errands in town"; but these and innumerable other trivialities lengthen the text to an inordinate extent, while a large proportion of the 125 plates might well have been omitted without detracting from the value of the volume.

A. S. W.

[1] "The Archæology of the Delaware Valley." By Ernest Volk. Papers of the Peabody Museum of American Archæology and Ethnology, Harvard University, vol. v. (Cambridge, Mass., 1911.)

RHEINBERG'S MICRO-SPECTRA METHOD OF COLOUR PHOTOGRAPHY.

THE special features of the micro-spectra method of colour photography are, first, that by its means pictures absolutely faithful in colour, tone, and texture are obtainable by means purely optical without the intervention of any artificial colouring matter whatsoever, and, secondly, that it is a one-plate process involving nothing more than everyday black and white photography. A single negative is taken on a panchromatic plate, a lantern slide is made from it and placed in the position of the negative, white light is projected through the apparatus, and the picture, after slight adjustment, flashes out in its true colours.

The theory of the process is a simple one. It consists in producing by optical means a surface composed of hundreds of complete but very narrow spectra, lying next to one another, the spectra being so close together as to render the individual colours indistinguishable to the unaided eye, so that the surface appears to be white. The photographic positive is used as a mask to block out or weaken those colours which are not wanted, the remainder combining to form the picture.

The surface, composed of these contiguous narrow spectra, is produced by allowing white light to fall

upon a fine line screen, of which the opaque lines are three times as wide as the clear interspaces, and forming an image on this screen by means of a lens with a prism just in front of it. The prism spreads each white line into a complete spectrum, and is so calculated that the spectra lie next each other on the focussing screen without interspace. If instead of white light falling upon the line screen we allow coloured light to fall upon it, only those spectrum colours of which the line in question is composed appear on the focussing screen, the colours which are wholly or partially missing from the spectrum of

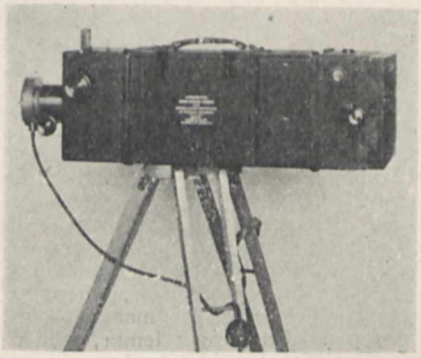

FIG. 1.—Micro-spectra camera on stand.
(Made to instructions by Alfred B. Allen, 20, Endell Street, London, W.C.)

white light being represented by spaces wholly or partially dark.

In taking the photograph, the image of the coloured object is projected by means of any ordinary objective lens on to the line screen, the image of which is in turn projected by the second lens with the prism in front of it on to the photographic plate placed in the position of the focussing screen (Fig. 2 shows diagrammatically the general optical arrangement). The plate must be approximately equally sensitive to all colours, so that the resulting negative is completely darkened when acted upon by any colour in its full intensity, and partially darkened where the incident colour is weakened. A lantern slide positive from this negative

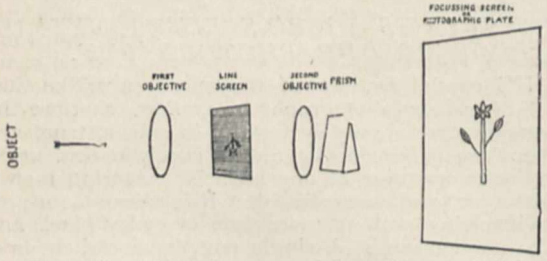

FIG. 2.—General optical arrangement shown diagrammatically.

will, of course, show the reverse effect, being completely transparent where the colour has acted with full intensity, of partial transparency where the colour has acted less strongly, and opaque where the colours were missing, *i.e.* in those parts coincident in position with the spectrum colours of white light that were not present in the object photographed. When therefore this positive is placed in the exact position of the negative, and white light is projected through the apparatus, it acts as the desired mask to block out those colours that are not wanted, and the picture is reproduced in the original colours.

Like so many other scientific problems, however, whilst the theory was simple, in practice difficulties in the way of the construction of the necessary apparatus (Figs. 3 and 4) arose at every turn, and matters were further complicated by the necessity of keeping the camera within portable limits. To indicate one of the main sources of difficulty, an ordinary glass prism produces a spectrum widely extended in the violet and blue region and crowded up at the yellow and red end, an effect very detrimental to the proper rendering of the latter colours. This was overcome by the use of a compound prism specially computed to give a spectrum in which the colours are evenly distributed, as in a grating spectrum. The introduction, however, of a thick prism of this kind introduced aberrations of all kinds, both in the images of the object and of the spectra, which had to be

Sectional plan of micro-spectra camera viewed from above (optical system).

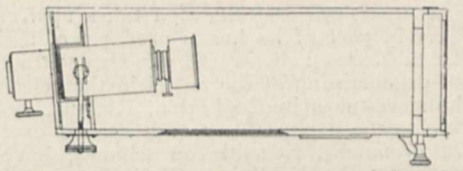

FIG. 3.—Section of micro-spectra camera.

successively overcome. It was, for example, found necessary to place the line screen (which has 372 lines per inch) at a slant to bring the spectra all over the field sharply into focus, a cylindrical lens is used in front of the prism to correct for astigmatism, the front of the camera is placed at the proper angle to prevent wedge distortion, a narrow prism behind the first objective brings the object sharply into focus, and so on. The objectives used in the camera are two 75 mm. Zeiss micro-planars. A field lens is interposed between the first objective and the line screen to direct the light towards the second objective. The whole optical system can be slightly rotated by means of a milled head on the left-hand side of the camera in front; at the back is another milled head securing slight lateral movement, and a lever above the viewing screen (not shown in Fig. 1), permits of

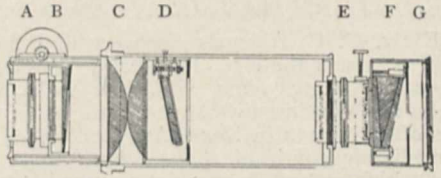

FIG. 4.—Section of optical system.

A, Zeiss 75 mm., micro-planar objective on focussing mount; B, spectacle prism; C, field lens; D, line screen or grating in adjustable frame; E, 75 mm. micro-planar objective; F, compound prism; G, cylinder spectacle lens, 120″ focus.

a slight backward or forward movement of $\frac{1}{2}$ mm. These three movements are necessary to enable the lantern plate to be brought to the exact position of the negative, but correct registration is easily secured in a few seconds—the readings can, moreover, be noted on the positive.

Besides the method of viewing the picture on the focussing screen of the camera, which requires a strong artificial light source, the pictures may also be viewed direct on the line screen by means of a magnifying eyepiece, for which purpose ordinary daylight or a weak illuminant suffices. This method in practice does not, however, yield *quite* such good

results. The pictures may also be projected in a size of 3–4 ft. diameter on a lantern screen.

Until the advent of a really rapid and satisfactory bleach-out paper, there is no possibility of recording the photograph on paper in colours, and since they can only be viewed in or by means of the camera itself, and the latter (which costs somewhere about 60*l.* at present) will always be a somewhat expensive apparatus, even if the optical and mechanical parts can be further simplified, the process is scarcely one that is likely to become general. That indeed was recognised from the start of the experiments. Nevertheless, given the camera, the process is undoubtedly a simple method of colour photography to work, and this, together with its true colour rendering and the many interesting and quite novel effects to which it lends itself, will, it may be hoped, encourage plenty of other workers to take it up, besides those who may be disposed to experiment with it from the point of view of its scientific interest.

THE FORTHCOMING OPTICAL CONVENTION.

THE issue of a programme of business by the committee of the Optical Convention, which is to meet in London on June 19–26 next, marks the entrance of this undertaking upon a new stage in its development. The idea of an optical convention is not new—in fact a meeting, the first of the kind, was held in London in 1905, and it is out of that gathering that the present proposal has grown. The committee has secured support of a substantial kind in the form of a guarantee fund, which puts the undertaking on a sécure financial basis and will enable the catalogue and volume of Proceedings to be produced.

Underlying the whole scheme of the Optical Convention is the fact that optical appliances in one form or another are familiar, at least as tools, to everybody. This circumstance, and the interest of the scientific problems which present themselves for solution in the manufacture of optical instruments, give to optical manufacture its special place in the view of scientific men at large and of those leaders of thought who occupy themselves with the realities of the public weal. It is therefore by no means so surprising as it is pleasant to find that the Board of Education on one side and the scientific societies on the other are furthering the scheme and assisting to bring the plan of an optical convention to a successful issue.

Another aspect of optical work is its national importance. It is probably not realised, even by men who are fairly familiar with the developments of applied physics, how the progress of manufacture is dependent on the provision of the special optical and scientific instruments required at each stage of its development. Field-glasses, gun-sights, range-finders, and numerous other purely optical instruments are absolutely essential in the equipment of any fighting force at the present day, and it is vital to our national interests that we should have, within our own borders, the means of producing such instruments in sufficient quantity for the use of our sailors and soldiers.

The experiment of holding the exhibition in connection with this Convention in the buildings of the Science Museum at South Kensington will be observed with considerable interest, no doubt, by the officers of the Education Board, and certainly by the scientific public. Some years ago, when the Science Museum was much less completely organised than at present, a departmental committee was appointed to consider its organisation and to report upon the improvements that might be made. Among the proposals which commended themselves to that committee was a suggestion that an empty hall should be built, as part of a reconstructed museum, which might be available for purposes of this kind. That proposal is, no doubt, receiving the attention of the authorities at the present time in connection with their rebuilding plans, and it will be of value to them to be able by this experiment to make themselves practically acquainted with the working of such an arrangement. The Art Department at South Kensington already possesses accommodation of this kind in the unoccupied North Court of the Victoria and Albert Museum. If such a building is provided in connection with the Science Museum, with suitable equipment and under proper regulation, it may, we think, prove to be of very great value in establishing and developing a fruitful connection between scientific work and the practical aims of the industrial and manufacturing community.

Attention may also be directed to the very interesting loan collection of optical instruments which is to be exhibited. This loan collection cannot but be full of interest, not only to the student who desires to see how any particular instrument has grown by successive developments to its present stage of efficiency or otherwise, but also, as is often the case, it may contain the germs of still further discoveries which may yet have to be worked out by the efficiently trained minds of our men of science and manufacturers.

The committee of the Optical Convention has, as we are glad to see, realised that the establishment of such relations in their particular departments ought to be a principal object of their undertaking. From the provisional programme, it appears that the scientific societies in their corporate capacity will take a prominent part in this Convention. We observe that the Physical Society, the Royal Astronomical Society, the Royal Photographic Society, and the Optical Society have all arranged for joint meetings with the members of the Convention, and that their several presidents will be presiding at these meetings in the character of vice-presidents of the Convention.

This close connection of the leading scientific societies, having special interests in optical science, with the Convention is not the only way in which the interest of the scientific public is to be manifested and utilised. The scheme of operations comprises a somewhat elaborate plan for making the work of the Convention subservient to the practical aim of improving the design and construction of optical instruments. With this object, a highly qualified committee, announced under the name of the cooperation committee, has been organised. Its members are all very distinguished men, but it is not to their initiative that the Convention trusts for suggestions of the lines along which improvement ought to move. A schedule of inquiries, which has been very extensively circulated during the last few weeks, will, through one or other of the learned societies of London and the Provinces, have come into the hands of most of our readers. It is intended to elicit the expression of private and personal opinion by all users of optical instruments. That is substantially equivalent to saying of all who are engaged in exact scientific work.

These inquiries are intended to produce not so much suggestions for improvement as suggestions of existing defects and desiderata. The committee is to be informed what it is that the users of optical instruments desire. From the material so supplied it will draw up a report in which it may be presumed that the matter of value communicated in answer to this

widespread inquiry will appear in a refined and systematic form. How far the demands of the public in this direction can be satisfied remains to be seen, but probably the committee will not consider itself responsible for supplying the requirements of its public. It will be a great matter if these requirements are expressed articulately and stated in such a scientific form that the attention of inventors and manufacturers may be concentrated upon the lines of useful and necessary advance.

The undertaking is one the development of which will be watched with considerable interest. If it should prove that the requirements of the professional man, with whom some optical instrument is part of his equipment, can in this way find useful exposition, the idea is one for which there may prove to be a great future, since it opens up a new line of cooperation between the scientific world and the world of industry, and one which, if it brings them together successfully, will bring them together on a very satisfactory footing.

Among the attractions of the exhibition is one, we observe, which caters for the taste, so much developed in recent years, for the realistic representation of bygone days. An "Isaac Newton" room is to be fitted up in which the leading experiments described by Newton in his "Opticks" will be reproduced by means of apparatus constructed in accordance with Newton's description of the appliances which he himself employed. An arc lamp will make Newton's successor independent of the sunshine, but in all other respects he will follow closely in Newton's footsteps. Another room will, in like manner, be devoted to the demonstration of Fresnel's crucial experiments. That these demonstrations will be among the most popular features of the exhibition cannot be doubted, but the popular appeal should be the smallest part of their merit. There is nothing more stimulating to the modern student than to realise with what slender resources and imperfect appliances some of the great scientific discoverers have accomplished their greatest work.

THE USE OF PEDIGREES.[1]

INFORMATION about family history can be presented most clearly by the use of tabulated pedigrees. Until recently, genealogy has shown a tendency to lay principal stress on the single line of paternal descent, as is shown by early heraldic rolls and other records. Nevertheless, the heralds' visitations were founded on the sound idea of a complete genealogical survey of one section of the nation.

The hereditary descent of physical and mental qualities may often be traced in pedigrees prepared for general purposes, but is better shown in diagrams where the character to be traced is indicated in symbolic form. Instances may be given of the transmission of scientific, administrative, and legal ability, of good and bad character, of mental defect, or of special liability to tuberculosis. Almost any physical or mental character may be traced, and shown to be definitely hereditary. It is impossible to explain the facts by the influence of environment alone.

In some cases, such as in eye colour and certain diseases and physical defects, the laws of inheritance have been shown to be definitely Mendelian in character, and it then becomes possible to predict the average result of any given marriage.

Regarding the nation from the point of view of its innate qualities, the question of selection becomes of supreme importance. In present conditions, what qualities tend to be preserved and what tend to be bred out of the race? There is evidence to show that, on the average, in England the people of the towns are shorter and darker than country dwellers. This fact seems to suggest a gradual increase of the Mediterranean elements in our urban population at the expense of those of northern or Teutonic origin. Again, the modern phenomenon of the limitation of families is most marked among the careful and thrifty in all ranks of life; the careless and casual tend relatively to increase. It seems probable that the nation may tend to become shorter, darker, more emotional, and less rational and self-controlled. Until lately, no attention has been paid to racial considerations; but a genealogical survey of the people is at least as important as a geological survey of the land, for the character of the race is the greatest of national possessions.

[1] Abstract of a discourse delivered at the Royal Institution on Friday, May 3, by W. C. Dampier Whetham, F.R.S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Shipley (Master of Christ's College), Prof. Punnett, Mr. C. Warburton, and Mr. H. Scott have been nominated to represent the University at an International Congress of Entomology to be held at Oxford in August next.

DR. JOHN SATTERLY has been appointed lecturer in physics at the University of Toronto.

MR. J. HENDRICK, lecturer in chemistry at Aberdeen College of Agriculture, has been appointed professor of agriculture in the University of Aberdeen.

THE annual dinner of the Royal School of Mines Old Students will be held on Wednesday, June 12, at the Imperial College Union, South Kensington. Several distinguished guests have already accepted invitations to be present, including the Right Hon. A. H. D. Acland (chairman of the Education Committee of the Imperial College), Sir Alfred Keogh (Rector of the Imperial College), Mr. F. G. Ogilvie (Board of Education), and Mr. Edward Hooper (president of the Institution of Mining and Metallurgy). Mr. W. Frecheville, who has just been elected to the chair of mining in succession to Prof. Herbert Cox, will preside at the dinner.

A CORRESPONDENT in *The Electrical Review* for May 3 directs attention to the serious inconvenience to students caused by the City and Guilds of London Institute examinations being held at the end of the Easter holidays, three or four weeks after the teaching has come to an end. The question whether there should be an interval between the teaching and the examination is an important one, and it would be well to have the opinions of the best students on the matter. Those who advocate an interval claim that it is in the interest of the student, who by its means has an opportunity of digesting the information he has received. The University of London, for example, ceases its courses for the degree examination at the end of June, although the examinations do not take place until October or November.

THE London County Council proposes to award in July next a certain number of free places at the Imperial College of Science and Technology, South Kensington, for the session beginning in the following October. The instruction will be of an advanced nature, suitable for students qualified to enter on the fourth year of the college course. There is no restriction as to income, but intending candidates must be ordinarily resident within the area of the administrative County of London, and must be

students who have attended appropriate courses of instruction for at least two sessions. The studentships cover all ordinary tuition fees, and will be awarded solely on consideration of the past records of the candidates, the recommendations of their teachers, the course of study they intend to follow, and generally upon their fitness for advanced study in science applied to industry. In special cases the free places may be extended to two or more years. Application forms may be obtained from the Education Officer, L.C.C. Education Offices, Victoria Embankment, London, W.C., and must be returned not later than Saturday, May 25.

THE latest number of the Journal of the Royal Agricultural Society of England contains an article on rural education in our village schools, by Mr. K. J. J. Mackenzie, of the School of Agriculture, Cambridge. It discusses an important question in an interesting manner. Some of our practical agriculturists, the article points out, hold that the "atmosphere" of the schoolrooms rather stimulates a desire on the part of our country lads to become messenger-boys, shop assistants, or junior clerks, and that the training they there receive is much more likely to make them successful in such avocations than to help them on to become good cowmen, waggoners, shepherds, or skilled labourers. To arrive at some conclusion as to what improvements the agricultural employers of labour desire, Mr. Mackenzie circulated a series of questions, to which he invited replies. His paper summarises the expressions of opinion received, but on the whole it cannot be said that the answers are very helpful or unanimous. The bulk of the suggestions seem to be in the direction of introducing definite instruction in rural subjects, with the view of interesting and instructing the children in the work they will do if they remain in the country. Mr. Mackenzie is right when he urges that what is wanted, and what is becoming more imperative every day, is true education which trains the pupil's intelligence to the best advantage.

THE new Harrison-Hughes Engineering Laboraties at Liverpool University were opened on May 18 by Lord Haldane. The laboratories are the outcome of a gift of some 40,000*l.* by Mr. T. F. Harrison, Mr. J. W. Hughes, and Mr. Heath Harrison, of the Harrison line of steamships. During the course of an address, Lord Haldane said it is difficult to underrate the importance of a movement such as that for the development of the engineering side of Liverpool University or the value of such gifts as those which have made the new laboratories possible. It is not merely the bigness of the equipment with which the new laboratories are furnished. The chance is given to the student of getting that expansion of mind which only a university training can give in another branch of applied learning and on a scale which raises its level to the best that can be attained. The functions of a university are quite different from the functions of an elementary or even a secondary school. The teacher in an elementary school delivers certain facts and certain principles to a pupil too young to question them and not expected to inquire into their scope and truth. The mind of the pupil is receptive; he has started learning. But when we come to the university, professor and student are alike in the unknown. They are on a voyage of discovery, in which the professor is more equipped and more thoroughly experienced in the difficult road along which both are advancing in quest of new learning. It is a voyage of discovery which the student and the professor are taking in common, and unless the professor is a man of capacity who can stimulate and develop the imagination of the student and infuse in him the spirit of research and develop a new atmosphere, the work will fail. Later Lord Haldane went on to say Liverpool University has been developing year by year in a fashion which shows that the great and wealthy citizens appreciate what the public life of their city requires, what part the University may play, and how it is their privilege, as well as their pleasure, to make additions which mark a further stage in the life of the city as a whole. It is a very great pleasure to see the University growing and making itself more and more worthy of the great city of Liverpool.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 16.—Sir Archibald Geikie, K.C.B., president, in the chair.—W. B. **Hardy:** The general theory of colloidal solutions. The physical properties of colloidal solutions prove them to be heterogeneous fluids. If the colloid particles are regarded as a stage in the appearance of a second fluid phase the variations of the energy of the particles with the radius are of predominant importance. If we could assume, for instance, that the tension of the interface varied with the radius as the tension of a free film of fluid was found to vary with the thickness of the film by Renold and Rücker, globules of certain dimensions would alone be stable. It is pointed out, however, that at present there is no adequate basis in experiment or theory for regarding the peculiarities of soap films, themselves a colloidal form of matter, as the property of films or minute spheres of matter in general.—W. B. **Hardy:** The tension of composite fluid surfaces and the mechanical stability of films of fluid. In order to gain further information as to the variations of surface energy with variations in the thickness of a film, the tension and mechanical stability of the surface of water on which a known impurity was allowed to spread has been investigated. It was found that the effect of the impurity depended upon its chemical nature. Substances of great chemical stability, such as the higher paraffins, refuse to spread at all, and only slightly lower the tension of water. Esters—such as glycerides—produce a great fall of tension, and an exceedingly thin film of the order of 2 $\mu\mu$ thick suffices. It is suggested that the great activity of esters is due to their being partly decomposed at the interface with the production of a contact difference of potential between the film and the water.—W. B. **Hardy:** The Formation of a heat-reversible gel. In the course of his study of the cyclo-pentanes, Dr. Ruhemann has synthesised a substance which forms gels with apparently any solvent (alcohol, ether, carbon tetrachloride, carbon bisulphide, aldehyde, glacial acetic acid, &c.). A remarkable feature is that gelation occurs as readily in associating as in non-associating solvents. The gels have a peculiar structure owing to the fact that gelation starts from nuclei and only gradually involves the whole mass.—H. E. **Armstrong,** E. F. **Armstrong,** and E. **Horton:** Studies on enzyme action. XVI.—The enzymes of emulsin (II): Prunase, the correlate of prunasin. Evidence has been adduced in previous studies of the series that the diglucoside amygdalin is resolved into glucose, benzaldehyde and hydrogen cyanide by two distinct enzymes present in the emulsin prepared from the almond fruit, one (amygdalase) serving to resolve it into glucose and δ-mandelonitrile glucoside or prunasin, the other to convert this latter compound into glucose, benzaldehyde, &c. Amygdalase is known to occur in certain yeasts unaccompanied by the second enzyme. It is now shown that the second enzyme occurs in the leaf of the almond and of other species of Prunus from which prunasin, but not amyg-

dalin, may be separated; it is proposed to term this enzyme *prunase*. Apparently, the two enzymes are always present in the fruit in association with amygdalin, but amygdalin is not known to occur in the leaf, and the leaf enzyme, as a rule, has little action on amygdalin.—H. E. **Armstrong**, E. F. **Armstrong**, and E. **Horton**: Studies on enzyme action. XVII.—Enzymes of the emulsin type (II): The distribution of β-enzymes in plants. A method of general application is described by which the enzymic activity of plant materials may be determined. It has been applied to the study of the distribution in plants of enzymes capable of acting on the glucosides linamarin, prunasin, salicin, arbutin and amygdalin.—H. E. **Armstrong** and J. Vargas **Eyre**: Studies on enzyme action. XVIII.—Enzymes of the emulsin type (III): Linase and other enzymes in Linaceæ. The method developed in the previous communication has been applied to various species of Linaceæ. The family is found to be divisible into two groups—one of these, which apparently includes all species similar in habit to *L. usitatissimum*, having blue, white, or red flowers, contains the cyanophoric glucoside linamarin and the corresponding enzyme linase. The second group, which comprises the yellow-flowered species of arboreal habit (*L. arboreum*, *L. flavum*, &c.), apparently contains neither glucoside nor enzyme. One important outcome of the inquiry is the proof that whereas the enzyme extracted from *Phaseolus lunatus* is about equally active towards linamarin and prunasin, that present in Linum is much less active towards the latter. It is therefore not improbable that linase is usually accompanied by prunase, and itself without action on prunasin.—A. **Forbes**: Reflex rhythm induced by concurrent excitation and inhibition.—T. Graham **Brown**: The factors in rhythmic functions of the nervous system. In a previous communication it was shown that the act of rhythmic progression is intrinsically conditioned centrally and not peripherally. At the same time, it was suggested that the phenomenon of rhythmic movement in the act is conditioned during a balance of equal and opposite activities.

Zoological Society, May 7.—Prof. E. A. Minchin, F.R.S., vice-president, in the chair.—G. A. **Boulenger**: A collection of fishes made by Mr. A. Blayney Percival in British East Africa to the east of Lake Baringo. This collection was of special importance as coming from a district the fishes of which had not been collected before, and contained examples of five new species.—Dr. F. E. **Beddard**: A new genus of the Cestoidea, founded on some specimens of tapeworms which the author had discovered in the small intestine of an example of the Tasmanian devil (*Dasyurus ursinus*). In briefly describing the most salient points of anatomical interest in this form, which formed the type of a new family, the author remarked that in view of the very considerable peculiarities of structure observed, it was remarkable that the generative organs did not show any marked features of interest as compared with those of other tapeworms.—R. E. **Turner**: Studies in the fossorial wasps of the family Scoliidæ, subfamilies Elidinæ and Anthoboscinæ. Several new species of Elidinæ from South Africa were described, including a new genus in which the female was wingless, and the genus Anthobosca was monographed. The geographical distribution of Anthobosca, which was almost entirely confined to the southern hemisphere, was discussed, and the conclusion was reached that the distribution was due to survival from a wider range in the past, and not to a southern origin.—A. **Chapman**: Notes on the Spanish ibex, with reference to Prof. Angel Cabrera's recent paper on this species.

Royal Astronomical Society, May 10.—Dr. Dyson, F.R.S., president, in the chair.—F. W. **Dyson** and E. W. **Maunder**: The position of the sun's axis as determined from photographs from 1874 to 1911, measured at the Royal Observatory, Greenwich. It was concluded that the final mean value for the position of the sun's axis agrees very closely with Carrington's, and that there is no sufficient evidence of any change during the period covered by the photographs measured.—S. **Chapman** and T. **Lewis**: The effect of magnetism on the rate of chronometers and watches. The chronometers are placed in magnetic fields of different strengths; the balance arm becomes magnetised, and the magnetic field pulls it towards its own position, causing the watch to gain or lose according to its position with regard to the magnetic field. Owing to the smaller size of its balance a watch is more affected than a chronometer.—Prof. **Lowell** spoke on the spectroscopic discovery of the rotation of Uranus, made at the Lowell Observatory, Arizona. The photographs showed the inclination of the lines in the spectra of the limbs of the planet, from which a rotation period of between 10 and 11 hours was deduced.—Dr. J. W. **Nicholson**: The constitution of the solar corona, second paper. The subject was dealt with from the point of view of the movements of the electrons within the atoms.—H. C. **Plummer**: The motions and distances of certain stars of the types B8 and B9. The paper was a continuation of one read in January, certain other classes of stars being examined, the motions of which appeared to be in the plane of the Milky Way.—J. H. **Reynolds**: Preliminary observations of spiral nebulæ in polarised light. The assumption was made that some of the luminosity of a nebula might be due to light reflected from the stars involved in it. From the photographs shown there appeared some evidence of polarisation, and the author proposed to continue the investigation.—Prof. H. F. **Newall**: The spectrum of the sun's limb during the partial eclipse of 1912, April 16–17.

CAMBRIDGE.

Philosophical Society, May 6.—Sir George Darwin, K.C.B., president, in the chair.—Sir J. J. **Thomson**: The unit theory of radiation.—Dr. G. F. C. **Searle**: A simple viscometer for very viscous liquids. If the space between two coaxal cylinders of radii a, b, and of length h, be filled with viscous liquid, the viscosity μ is given in terms of the couple G, which maintains the inner cylinder in motion about its axis with angular velocity ω relative to the outer fixed cylinder, by the equation

$$\mu = \frac{G(a^2 - b^2)}{4\pi\omega h a^2 b^2} \quad \ldots\ldots\ (1)$$

The apparatus exhibited is adapted for finding the viscosity of treacle. At 12° C. the viscosity of treacle is about 400 in C.G.S. units, that of water at the same temperature being 0·0146.—W. A. D. **Rudge**: The action of sunlight and of radium salts on glass. The author has studied the action of sunlight and of radium salts on glass tubing, and exhibited specimens showing the results of the action on the two cases. Glass tubing is affected by sunlight differently, some specimens acquiring a deep amethyst tint, others being merely darkened or bleached, and others, again, being after six months' exposure to a tropical sun practically unaffected. Radium salts produce the same effect, but the coloration with identical glass is much deeper than is the case with sunlight. The change in colour in both instances is probably due to some oxidation of the manganese oxide usually present in small quantity in glass, either as an accidental impurity or deliberately added to

destroy the greenish colour due to iron salts.—R. D. **Kleeman**: The different internal energies of a substance. II. In this paper it is further tested to what extent an agreement of a number of formulæ with the facts is obtained on the assumption that (ϕ) in the law of molecular attraction is a function of the temperature only. The coefficients of viscosity and diffusion of gases can be approximately calculated on this assumption. It is found that the more complex the molecule the greater the variation of (ϕ) with the temperature. The value of (ϕ) always decreases with increase of temperature. Evidence is brought forward that the change in the value of (ϕ) and of the internal energy of a molecule with temperature is due to a change in the configuration of the atoms. —A. E. **Oxley**: The detection of small amounts of polarisation in light from a dull sky. The paper describes an arrangement of a bitrapezoid polariser and a Babinet's compensator by the aid of which the existence of polarisation in light from a dull sky can be detected when that light is insufficient in quantity and of an azimuth too indefinite to produce visible complementary tints in crystalline plates.—J. C. **Chapman**: An attempt to refract Röntgen radiation. In this experiment an attempt was made to refract X-rays, under exceptional conditions, by a prism of ethyl bromide vapour. That is when the radiation which it was attempted to refract (1) stimulated the bromine characteristic radiation, (2) was selectively absorbed by the vapour. In neither case could appreciable refraction be detected.—Major P. A. **MacMahon**: (1) The problem of derangement in the theory of permutations; (2) Compound denumeration.

DUBLIN.

Royal Irish Academy, May 13.—Dr. F. A. Tarleton, and subsequently Sir John Ross of Bladensburg, in the chair.—H. **Ryan** and T. **Nolan**: Higher ketones and secondary alcohols derived from amides of palmitic and stearic acids. The higher amides, such as those of palmitic and stearic acids, give good yields of ketones by interaction with alkyl magnesium halides. In this way the authors obtained methyl-, phenyl-, *p*-tolyl-, and α-naphthyl-pentadecyl ketones from palmitamide and ethyl-, phenyl-, and α-naphthyl-heptadecyl ketones from stearamide. The ketones formed crystalline oximes, semicarbazones, and phenylhydrazones. By reduction of the ketones secondary alcohols were obtained, which formed acetyl derivatives and phenyl urethanes.—R. J. **Ussher**: Birds (Clare Island Survey). This report deals with the west coast of Connaught. On the islands land-birds that breed are few, and comprise the chough, raven, peregrine, and rock-dove, while the golden eagle nested within the last twenty years, though now but one survives in Mayo and one in Donegal. The district contains great colonies of cliff-birds; on the Bills many great black-backed gulls nest. Petrels and shearwaters also breed on the islands. The influence of the Atlantic with its west winds produces a moderate temperature in winter, when there is a regular movement to the islands of song thrushes, finches, starlings, rooks, and larks, that do not breed there.—A. R. **Nichols**: (1) Polyzoa, and (2) Echinodermata (Clare Island Survey). (1) Seventy-five species of marine Polyzoa, chiefly encrusting forms belonging to the suborder Cheilostomata, were collected in the Clare Island district. A single species (*Plumatella repens*) of fresh-water Polyzoa was found in a small lake at Clare Island and also at Inishbofin; four other species were found in lakes in the western part of the mainland of Co. Mayo. (2) Thirty-two species of echinoderms are enumerated from the Clare Island district, nine of which belong to the group Holothurioidea.

PARIS.

Academy of Sciences, May 6.—M. Lippmann in the chair.—MM. **de Vanssay**, **Cot**, and **Courtier**: Observation of the solar eclipse of April 17, 1912. These observations were carried out at three stations near Luzarches, on a line perpendicular to the central line of the eclipse. Details are given of the times of contact and the duration of the annular phase.—P. **Salet**: The character of the solar eclipse of April 17, 1912, in Portugal. The eclipse was not total on the line of centrality in Portugal.—L. **Picart**: Observations of the solar eclipse made at the Observatory of Bordeaux. Times for the first and second contacts are given. The presence of clouds interfered with the observations.—E. **Rabioulle**: The latitude of the Observatory of Toulouse. A comparison of measurements made since 1844. The result for 1911 was 43° 36′ 43·5″.—René **Garnier**: The limits of the substitutions of the group of a linear equation of the second order.—Zoárd **de Geöcze**: The quadrature of curved surfaces.—Louis **Roy**: The dynamical adiabatic law in the motion of flexible membranes.—L. **Riéty**: The electromotive force produced by the flow of saline solutions in capillary tubes.—G. **Berlemont**: A method of joining platinum and quartz. A sound joint can be made directly between quartz and an alloy of platinum and iridium.—Samuel **Lifchitz**: The range of the particles in the Brownian motion. An ultramicroscopic study of smoke particles under the influence of sound waves.—L. **Houllevigue**: The kathode rays with low velocity produced by incandescent lamps.—Ch. **Fabry** and H. **Buisson**: The size of the lines of the spectrum and the production of interference with large differences of path. The theory of Lord Rayleigh, completed by Schönrock, gives a relation between the width of a line in the spectrum, the wave-length, the absolute temperature, and the mass of the vibrating particle. From this follows that in interference there is an order N above which the fringes cannot be observed. N has been determined for helium, neon, and krypton, and the values are in close agreement with the figures predicted by the theory. The increase in the value of N which should result if the temperature is lowered has also been confirmed experimentally. The experiments as a whole confirm the principles of the kinetic theory of gases.—G. D. **Hinrichs**: The systematic errors in the chemical operations used in the determination of the atomic weights.—F. **Bourion**: The separation of iron and titanium. A mixture of the two oxides is heated in hydrochloric acid gas containing a small proportion of chloride of sulphur (S_2Cl_2). The iron is volatilised as chloride, the titanium dioxide remaining unattacked.—G. **Darzens**: A carbon pernitride (see p. 303).—Ed. **Chauvenet**: The oxychlorides of zirconium.—A. **Wahl** and M. **Doll**: The preparation of the αβ-diketonic esters. The authors have extended the method of preparing the diketonic esters by the action of nitrous fumes on the acylacetic esters to the propionyl-, butyryl-, and heptylacetic esters. The properties and chief chemical reactions of the new diketones are given.—Alph. **Mailhe**: Some new colouring matters derived from phenyloxyaniline.—Jean **Escard**: A new densivolumometer applicable to the rapid determination of the density of solids.—Paul **Desroche**: The influence of temperature on the zoospores of Chlamydomonas.—L. **Lutz**: A comparison of the total nitrogen and the nitric nitrogen in parasitic and saprophytic plants.—H. **Hérissey**: The presence of amygdonitrileglucoside in *Photinia serrulata*.—L. **Bull**: An optical illusion perceived at the moment of shutting the eyes.—W. Broughton **Alcock**: Attempts at antityphoid vaccination in man by means of a sensitised living vaccine.—J. **Bridré** and A. **Boquet**:

Anticlavelous vaccination with sensitised virus.—M. **Fabre-Domergue**: Some new experiments on the bacteriological purification of oysters in filtered water. After four days' circulation of the filtered water the oysters were free from *B. coli*.—Em. **Bourquelot**: The action of emulsin on gentiopicrin in solution in various neutral organic liquids.—Victor **Henri** and Albert **Ranc**: The decomposition of glycerol by the ultra-violet rays. Formaldehyde and other aldehydes and acids are formed when glycerol is exposed to the light from a powerful quartz mercury lamp.—D. **Eginitis**: The recent earthquakes in Cephalonia and Zante.

BOOKS RECEIVED.

Rationalist English Educators. By Dr. G. E. Hodgson. Pp. 254. (London: S.P.C.K.) 3*s*. 6*d*.

Einführung in die Agrikulturmykologie. By Prof. A. Kossowicz. i. Teil: Bodenbakteriologie. Pp. vii+143. (Berlin: Gebrüder Borntraeger.) 4 marks.

Contribution a l'Étude des Relations existant entre les Circulations Atmosphériques, l'Électricité Atmosphérique, et le Magnétisme Terrestre. By A. Vialay. Pp. x+203. (Paris: H. Dunod & E. Pinat.)

Aristotle's Researches in Natural Science. By Dr. T. E. Lones. Pp. viii+274. (London: West, Newman and Co.) 6*s*. net.

Farm Dairying. By L. Rose. Pp. 303. (London: T. Werner Laurie.) 6*s*. net.

A Revision of the Ichneumonidæ. Based on the Collection in the British Museum (Natural History). With Descriptions of New Genera and Species. Part i.: Tribes Ophionides and Metopiides. By C. Morley. Pp. xi+88+plate. (London: Printed by order of the Trustees of the British Museum; Longmans and Co., and others.) 4*s*.

The Analyst's Laboratory Companion. By A. E. Johnson. Fourth edition. Pp. ix+164. (London: J. and A. Churchill.) 6*s*. 6*d*. net.

The Social Guide, 1912. Edited by Mrs. H. Adams and E. A. Browne. Pp. lxvii+270. (London: A. and C. Black.) 2*s*. 6*d*.

Principien der Metaphysik. By B. Petronievics. Erster Band. Zweite Abtheilung. Pp. xxxviii+570+ii. (Heidelberg: Carl Winter.) 16 marks.

The Puering, Bating, and Drenching of Skins. By J. T. Wood. Pp. xv+300. (London: E. and F. N. Spon, Ltd.) 12*s*. 6*d*. net.

The Mineral Kingdom. By Prof. R. Brauns. Translated, with additions, by L. J. Spencer. Parts xxi. and xxii. (Esslingen a. N.: J. F. Schreiber; London: Williams and Norgate.) Each 2*s*. net.

The Cambridge Manuals of Science and Literature:—The Origin of Earthquakes. By Dr. C. Davison. Pp. viii+144. Spiders. By C. Warburton. Pp. x+136. Rocks and their Origins. By Prof. G. A. J. Cole. Pp. viii+175. (Cambridge: University Press.) Each 1*s*. net.

The Electrical Properties of Flames and of Incandescent Solids. By Prof. H. A. Wilson. Pp. vii+119. (London: Hodder and Stoughton.) 6*s*. net.

Photochemische Versuchstechnik. By Dr. J. Plotnikow. Pp. xv+371. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 11 marks.

The Works of John Caius, M.D., Second Founder of Gonville and Caius College and Master of the College, 1559–1573, with a Memoir of his Life. By Dr. J. Venn. Edited by E. S. Roberts. Pp. xii+78+115+36+227+116+21+111+19+71+47. (Cambridge: University Press.) 18*s*. net.

The Gateways of Knowledge. By J. A. Dell. Pp. xii+171. (Cambridge: University Press.) 2*s*. 6*d*.

A Dictionary of Applied Chemistry. By Sir E. Thorpe, assisted by eminent contributors. New and enlarged edition. In five volumes. Vol. ii. Pp. viii+786. (London: Longmans and Co.) 45*s*. net.

The People's Books:—The Foundations of Science. By W. C. D. Whetham. Pp. 94. Inorganic Chemistry. By Prof. E. C. C. Baly. Pp. 96. Radiation. By Dr. P. Phillips. Pp. 94. Lord Kelvin: his Life and Work. By Dr. A. Russell. Pp. 93. Huxley: his Life and Work. By Dr. G. Leighton. Pp. 94. Francis Bacon. By Dr. A. R. Skemp. Pp. 94. A Dictionary of Synonyms. By A. K. Gray. Pp. 91. (London and Edinburgh: T. C. and E. C. Jack.) Each 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 23.

ROYAL SOCIETY, at 4.30.—Theory of a New Form of the Chamber Crank Chain: H. S. Hele-Shaw.—A New Treatment of Optical Aberrations: Prof. R. A. Sampson.—On the Extinction of Light by an Illuminated Retina: Sir W. de W. Abney, K.C.B.—Determination of Physical Properties at High Pressures by Optical Measurements: Walter Wahl.—The Changes in Certain Absorption Spectra in Different Solvents: T. R. Merton.—On Changes in Absorption Spectra of "Didymium" Salts: W. C. Ball.—The Viscosity of Carbon Dioxide: Dr. P. Phillips.

ROYAL INSTITUTION, at 3.—Ice Formation in Canada: The Economic Aspect: Prof. H. T. Barnes.

FRIDAY, MAY 24.

ROYAL INSTITUTION, at 9.—Recent Advances in Agricultural Science: The Fertility of the Soil: A. D. Hall.

TUESDAY, MAY 28.

ROYAL INSTITUTION, at 3.—The Formation of the Alphabet: Prof. W. M. Flinders Petrie.

THURSDAY, MAY 30.

ROYAL INSTITUTION, at 3.—X-Rays and Matter: Prof. C. G. Barkla.

FRIDAY, MAY 31.

ROYAL INSTITUTION, at 9.—Icebergs and their Location in Navigation: Prof. H. T. Barnes.

PHYSICAL SOCIETY, at 5.—The Calibration of Wave-meters for Radiotelegraphy: Prof. G. W. O. Howe.—On the Use of Heaviside's Resistance Operators in Air-core Transformer Theory: Dr. W. H. Eccles.—The Movements of Semi-oily Liquids on a Water-surface: C. R. Darling.—Experiments on Surface Leakage in Alternating Electric Fields: G. L. Addenbrooke.

SATURDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—The Development of Meteorological Science: Willis L. Moore.

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