THURSDAY, JUNE 13, 1918.

ALUMINIUM AND RARE EARTH METALS.

A Text-book of Inorganic Chemistry. Edited by Dr. J. Newton Friend. Vol. iv., *Aluminium and its Congeners, including the Rare Earth Metals.* By H. F. V. Little. Pp. xx+485. (London: Charles Griffin and Co., Ltd., 1917.) Price 15*s.* net.

THIS book, the fourth of the series of nine volumes which constitute the "Text-book of Inorganic Chemistry," edited by Dr. J. Newton Friend, deals with the members of the third group of the Periodic Table. The arrangement of the subject-matter of the treatise in accordance with Mendeléeff's scheme has, no doubt, much to recommend it. The classification, of course, rests upon a rational basis, very different in character from the arbitrary and often inconsistent methods which prevailed prior to the enunciation of the epoch-making generalisation of the distinguished Russian chemist. At the same time, it must be admitted that the arrangement brings together elements which, at first sight, seem to have little or nothing in common. We jump, as it were, from boron to aluminium, from aluminium over scandium and gallium to indium, and thence by way of the "rare earth" metals to thallium. The older systems at least had the merit of attempting to group the elements so as to bring out their natural affinities as manifested by their chemical and physical attributes, and we seemed to pass from the consideration of one element to that of the next by easy and more or less obvious stages rather than by the brusque and *staccato* method of violent contrasts which appears to follow from the application of the periodic law.

Mr. Little, indeed, would appear to have been conscious of the somewhat bizarre effect which a too rigid adherence to the scheme of the table would produce in the arrangement of his material, and to some extent he meets the difficulty by starting with boron as the so-called "typical element," and following on with aluminium as a "short period" member. But it is really only in this sense and in its "formal valency resemblance" that boron can be styled a "congener" of aluminium. The other members of the group are "long period" elements, and are divided into the *odd* subgroup comprising gallium, indium, and thallium, and the *even* subgroup which comprises the "rare earth" metals but leads up to actinium, the relations of which to its "congeners" are as yet very ill-defined. Debierne regarded actinium as allied to thorium, which would place it in the next main group, but such congenital affinities as it possesses point to its being more akin to the cerium group, and thus afford some slight ground for placing it in the position assigned to it by the author.

In a short introductory chapter Mr. Little frankly faces the difficulties which his arrangement involves, and which grow upon him when he deals with the "rare earths," and in a few paragraphs refers to the analogies and discordances to which it leads. The student, therefore, is warned, at the outset, of its limitations—limitations necessarily imposed by the imperfect and provisional nature of the generalisation on which it is based, and of which the weakness is plainly revealed in the case of the "rare earth" elements.

With regard to the main body of the book we have little but praise. It has evidently been most carefully and conscientiously compiled, and practically every statement has been verified by reference to the original sources of information. The bibliography, indeed, is one of the most valuable features of the work, and will be appreciated, not only by the student, but also by the investigator, who may have to concern himself with the literature relating to the various elements and their compounds dealt with in the book.

The chemical history of boron has been brought up to the date of publication, but since the issue of the work much additional information has been gained respecting the many unstable hydrides of boron—a particularly difficult class of substances to deal with, but which have been investigated with great skill by Stock and his collaborators. The industrial extraction of boric acid and the manufacture of borax scarcely receive the treatment which they deserve as being by far the most important of the boron compounds. Incidentally, the writer terms the jets of steam from the volcanic vents in Tuscany *suffioni* instead of *soffioni*.

A good description of the methods of manufacture of metallic aluminium is given, together with a short account of its alloys, many of which are of growing importance. Compounds of aluminium, including some of the more important aluminous minerals, are dealt with in fewer than forty pages. The treatment is necessarily very slight in many cases, especially when compared with that of the chapter on clay and ceramics, which extends to more than thirty pages. This, and also the chapter on ultramarine, which seems to have been largely based on the article on that subject in Thorpe's "Dictionary of Applied Chemistry," are, judged by their length, the most important contributions to industrial chemistry in the book, which is otherwise not remarkable for its technology.

The most valuable feature of the work is, however, its treatment of the chemistry of the "rare earths." This section occupies more than half the volume, and is without doubt the fullest and most comprehensive account of their history, modes of extraction, properties, and relations which has yet appeared.

Although the first "rare earth" was discovered by the Finnish chemist, Gadolin, so far back as 1794, and was quickly followed by the isolation of other members of the group by Ekeberg, Berzelius, Gahn, Mosander, Cleve, Höglund, and others during the next fifty or sixty years, it is only within comparatively recent time that the chemistry of these substances has received its main develop-

ment. This is largely due to the great extension of the gas-mantle industry, which, in its exploitation of the sources of thorium and cerium, has placed at the disposal of investigators relatively large quantities of material more or less rich in "rare earths." Indeed, in the case of certain of these substances the term "rare earths" is a misnomer. Some of them have been found to be widely distributed and to occur in large amounts. Accordingly, the literature on these elements has been largely augmented during the last few decades, as its bibliography shows, and it has needed no inconsiderable skill on the part of Mr. Little to deal with it within the limitations of space necessarily imposed upon him. The bibliography reveals how very slight and comparatively unimportant have been the contributions of German chemists to this literature. Up to the present there are some fifteen "rare earth" elements (excluding actinium) the identity of which may be considered as established, and all of these have been discovered by Scandinavian, Swiss, or French chemists. An Austrian chemist, Auer von Welsbach, resolved Mosander's didymia into its components, and he shares with Urbain the credit of proving that Marignac's ytterbia was complex. Investigators of the type of Klaproth, Bunsen, and Wöhler are, apparently, no longer to be found in Germany. The work of enlarging our knowledge of a particularly interesting group of elements of great theoretical importance and rich in possibilities of technical application is rapidly passing into the hands of Anglo-Saxon chemists, and especially of American chemists, who have not only devised adequate methods of separation and isolation, but have also incidentally contributed a great amount towards the chemical history of the individual metals.

We can unreservedly congratulate Mr. Little on the production of a particularly useful work. If the remaining volumes of the series maintain the same high level, the entire treatise will constitute a most valuable contribution to our chemical literature.

THE CONSTRUCTION OF HARBOURS.

A Treatise on the Principles and Practice of Harbour Engineering. By Dr. Brysson Cunningham. Second edition. Pp. xvi+377. (London: Charles Griffin and Co., Ltd., 1918.) Price 25*s.* net.

THE second edition of this standard work has been revised and brought up to date; much new matter has been added—including numerous additional illustrations—nearly a further hundred pages. Many of the points briefly referred to in the first edition have been elaborated, so that its pages are now crowded with useful information.

Chap. v., dealing with "Piling," is one of the most instructive in the book. Timber *versus* reinforced-concrete piles is discussed, also the various methods of pile-driving. The sustaining power of piles, and the prevention of destruction of piles caused by decay or by marine organisms, are ably dealt with. The Hennebique and other forms of steel sheet-piling are described and compared with timber sheet-piling.

The introductory chapter deals, among other matters, with the national interest in harbours, which will doubtless be more marked after the war than it was previously, for undoubtedly the State will take over many of our principal harbours, and in many cases enlarge them. Chap. ii., dealing with "Harbour Design," has been dealt with in a most exhaustive manner, and the author has done well to include particulars and illustrations of that harbour which has probably caused more discussion than any other—the Madras Harbour, the projection of which has resulted in such a huge accumulation of sand on the windward side (due to the south-west monsoon), necessitating the spending of large sums annually in dredging inside the harbour; while the havoc wrought by erosion on the lee side, due to the trapping of the sand by the harbour, is most serious. The effect of rivers flowing through harbours has had due consideration in the book, but the cause of bars occurring at the mouths of harbours, and the suggested means for removing these, have not been dealt with so fully as one would have wished.

The chapters on "Breakwater Design" and "Breakwater Construction" deal very fully with these subjects, and many excellent details of construction are given which would only occur to a practical author; the additional plates which have been added to these chapters increase their value immensely. Figs. 154–59, showing the constructional staging at Gibraltar Harbour Works, are admirable.

One is disappointed to find no reference made to slipway construction at a time like the present, when so many slipways are being laid down; and the notes on the action of sea water on concrete might have been extended. A few more examples of failures in breakwaters, either through faulty foundations or storms, would have added to the value of the book, for, after all, the engineer learns more from failures than from successes.

The use of reinforced-concrete in harbour engineering has not been given the prominence in the book that one would have desired, especially its use in the construction of jetties. The effect upon reinforced-concrete piles of their being alternately submerged in sea water in tidal work and exposed to air does not appear to be referred to, and this is at the present time a very debatable subject. The mechanical handling of material might have occupied more space in the book, and the use of reinforced-concrete in the building of lightships and in the construction of lighthouses might have been discussed.

The chapter dealing with "Surveying, Marine and Submarine," will be most useful to civil engineering students, the course of procedure being clearly set out and well illustrated, and the notes on this subject are very practical.

The chapter on "Channel Demarcation" is interesting, as it deals with lighthouses, lightships, and buoys, while that on "Pier-heads, Quays, and

Landing-stages" contains some excellent notes and illustrations of the more modern methods of construction of these structures. River quays and wharves are well described, and the Liverpool floating landing-stage is discussed and well illustrated.

The various tables in the book will prove of great value to the maritime engineer, especially those indicating (on pp. 66 and 67) the tidal rises at certain harbours. The specification for cement and concrete (on pp. 149–59) is also most useful, and some of the larger plates give a great deal of detail as to the planning of harbours. Fig. 36*a*, which is a plan of the Aberdeen Harbour, is exceptionally good. The illustrations generally are excellent; it is seldom that one meets with a technical work so well illustrated.

The second edition of this standard work should certainly find a place on the shelves of the library of every maritime engineer; as a book of reference it is second to none. E. R. M.

RADIO-THERAPY.

Radiography and Radio-therapeutics. By Dr. R. Knox. Second edition. Part ii., *Radio-therapeutics.* Pp. x+387–606. (London: A. and C. Black, Ltd., 1918.) Price 15*s.* net.

THE second edition of Dr. Knox's work, "Radiography and Radio-therapeutics," is completed by the appearance of part ii., "Radio-therapeutics." Part ii. leaves on the mind of the reader very much the same general impression as that of part i., namely, that of an excellent production. A perusal of the book shows an ever-widening range of utility of X-rays and radium in the treatment and alleviation of disease. They are agents which, under expert guidance, are beneficial in the treatment, not only of superficial ailments such as intractable skin diseases, but also of deep-seated conditions; and of these the treatment of internal growths, benign and malignant, claims much of the author's attention.

Apart from the above-mentioned applications there is evidently a place for the radiations in the treatment of the several varieties of blood diseases and other somewhat obscure pathological conditions.

A special chapter is devoted to the use of X-rays and radium in injuries and diseases among the wounded, and a following chapter, which illustrates the value of radiations in plastic surgery of the face and jaws, is contributed by Mr. Percival P. Cole. The fearful nature of some of these wounds would lead many to despair of betterment, but the combination of surgery and the administration of some form of radiation have in many cases resulted in a veritable transformation of the patient.

The physical properties of the rays from radium and its emanation therefrom are very clearly dealt with in a chapter contributed by Mr. C. E. S. Phillips.

The thorough way in which the application of these agents to the appropriate pathological condition is set forth in this volume is in itself a reassurance as to their utility; but what pleases us most is the general outlook upon the subject of radio-therapeutics adopted by the author. A confidence in the utility of the agents he handles is tempered by a realisation of (1) the lack of precision in their administration, and (2) the little that is known as to the real nature of the changes set up in cell life under exposure to the rays. Moreover, he shows a keen appreciation of the service which the investigator may render to the future development of the subject of medical radiology, for on p. 395 we find: "By a combined attack from the physical and clinical aspects, we may hope in the near future to produce a marked improvement in our methods of treatment by radiations, which should result in material benefit to patients suffering from malignant disease."

The range of X-radiation which is at hand for clinical application covers several octaves, and the fact that one variety of cells may respond in a totally different manner from another, according to what type of radiation it is exposed to, is clearly in the author's mind when he writes, as on p. 540: "The reason why one case responds and another fails to do so is one of the profound problems which the radio-therapist is striving to fathom, and when the solution is arrived at it will go a long way to establish radiation treatment on a sound basis. In all probability the explanation is a biological one, a condition of cell, physical or other, which responds to a particular type of ray. . . ."

The book will undoubtedly do much towards a fuller recognition of the clinical utility of these radiations, and also towards placing radio-therapy on a surer scientific footing than it holds at the present day.

OUR BOOKSHELF.

Field Sanitation. By C. G. Moor and E. A. Cooper, in collaboration with other Officers and Men of the 1st London Sanitary Company. Pp. viii+220. (London: Baillière, Tindall, and Cox, 1918.) Price 2*s.* 6*d.* net.

WHEN the history of the war comes to be reviewed and all the marvellous achievements of our Army, none will be more noteworthy than the wonderful health record. This is, to a great extent, due to the work of the Sanitary Companies, and the volume under review, written by two of their officers, is intended to hand on the results of their experiences and those of their colleagues. It is written in simple and readable form, and will make a very useful text-book, not only for the highly trained but perhaps less experienced sanitary officers, but also for the men under their command.

The opening chapter deals with general hygiene, and includes notes on many, if not all, of the infectious diseases liable to attack the troops. Chapters follow on flies and other insect pests; disposal of refuse; latrine and urinal construction; baths and laundries; brickwork, wooden buildings, and metal work; disinfection; drainage and sewage disposal; water; ventilation; food; camping; economy; and the work of sanitary sections.

In the chapter on water much attention is devoted to the important question of sterilisation, and although the authors give a brief historical sketch of the subject of chlorine sterilisation, they fail to mention the pioneer work of Houston, who, so far back as 1905, was the first to apply the treatment to the whole water supply of a town when he undertook the sterilisation of the water supply of Lincoln, and who now controls the chlorination of a large part of the London water supply. The question of dose in relation to period of contact of the water with the sterilising agent seems to require some modification.

The authors show great ingenuity in finding a use for all sorts of waste materials, such as empty oil-drums, biscuit-boxes, and petrol-cans; in fact, it appears that the complete sanitary officer must not only be highly skilled in medical and sanitary science, but also have some considerable knowledge of such trades as bricklaying, carpentry, metal work, and a host of others, besides knowing something of allotment gardening and poultry farming.

The book is well illustrated with clear and well-drawn diagrams, and concludes with what appears to be a most complete and useful index.

D. B. B.

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.*]

Propagation of Sound and Light in an Irregular Atmosphere.

I SUPPOSE that most of those who have listened to (single-engined) aeroplanes in flight must have noticed the highly uneven character of the sound, even at moderate distances. It would seem that the changes are to be attributed to atmospheric irregularities affecting the propagation rather than to variable emission. This may require confirmation; but, in any case, a comparison of what is to be expected in the analogous propagation of light and sound has a certain interest.

One point of difference should first be noticed. The velocity of propagation of sound through air varies indeed with temperature, but is independent of pressure (or density), while that of light depends upon pressure as well as upon temperature. In the atmosphere there is a variation of pressure with elevation, but this is scarcely material for our present purpose. And the kind of irregular local variations which can easily occur in temperature are excluded in respect of pressure by the mechanical conditions, at least in the absence of strong winds, not here regarded. The question is thus reduced to refractions consequent upon temperature variations.

The velocity of sound is as the square root of the absolute temperature. Accordingly for 1° C. difference of temperature the refractivity $(\mu-1)$ is 0·00183. In the case of light the corresponding value of $(\mu-1)$ is $0{\cdot}000294 \times 0{\cdot}00366$, the pressure being atmospheric. The effect of temperature upon sound is thus about 2000 times greater than upon light. If we suppose the system of temperature differences to be altered in this proportion, the course of *rays* of light and of sound will be the same.

When we consider mirage, and the twinkling of stars, and of terrestrial lights at no very great distances, we recognise how heterogeneous the atmosphere must often be for the propagation of sound, and we need no longer be surprised at the variations of intensity with which uniformly emitted sounds are received at moderate distances from their source.

It is true, of course, that the question is not exhausted by a consideration of rays, and that we must remember the immense disproportion of wave-lengths, greatly affecting all phenomena of diffraction. A twinkling star, as seen with the naked eye, may disappear momentarily, which means that then little or no light from it falls upon the eye. When a telescope is employed the twinkling is very much reduced, showing that the effects are entirely different at points so near together as the parts of an object-glass. In the case of sound, such sensitiveness to position is not to be expected, and the reproduction of similar phenomena would require the linear scale of the atmospheric irregularities to be very much enlarged.

June 7. RAYLEIGH.

The Drift of Meteor Trails.

IN the Astronomical Column of NATURE of May 23 there appears a note on the currents in the upper air as revealed by the direction of drift of the streaks left by meteors. Before we can say with certainty, however, that such drift represents movement of the air, we require to know the real nature of a meteor trail. The ordinary view seems to be that the trail is composed of air heated by the meteor in its flight through the atmosphere, the heating being produced not so much by friction as by the compression of the air in front of the meteor. But is it physically possible for a mass of air so heated to retain its heat so as to remain luminous for any length of time? Streaks have been seen which remained luminous for more than two hours, and though this is exceptional, yet any explanation which would account for long-enduring trails would apply also to the more transient kinds. Is it not possible that the trail is an electrical phenomenon akin to an auroral streamer, or to the patches of light seen during an aurora? The movement of both trails and streamers is usually towards the east, but both more rarely move in other directions. The movement in the case of the aurora is presumably due to the passage of electrified particles moving in the earth's magnetic field, and deflected by it. Is it possible that a meteor trail is due to the passage of electricity through rarefied air that may have been ionised by the passage of the meteor?

It is difficult to imagine that there are definite air currents in the upper part of the atmosphere. It is true that balloons have not explored the atmosphere much above twenty miles, and that meteor trails are far higher. But it is difficult to suppose that conditions are other than isothermal, in a vertical direction, above the base of the stratosphere, however high one may go. If this is so, there would be no vertical circulation; and if there is no vertical circulation, could there be any horizontal circulation? There is usually a marked falling-off of the wind as a balloon enters the stratosphere. Perhaps some of your readers more versed in dynamical meteorology, and in the question of the passage of electricity through rarefied air than I am, can throw light on the problem.

June 4. C. J. P. CAVE.

THE NEW STAR IN AQUILA.

THE unremitting character of the watch kept on the sky by the amateur astronomers in this country is well shown by the number of independent discoveries of the new star. Apparently, the first observation was made by Miss Grace Cook at Stowmarket when on the watch for meteors at 9.h. 30m. G.M.T. on June 8. Other independent discoveries were made by Mr. W. F. Denning, at Bristol, and Mr. David Packer, at Birmingham, at 10.0 G.M.T.; Mr. C. L. Brook, at Meltham, at 10.15 G.M.T.; Mr. W. H. Steavenson, at West Norwood, at 10.30 G.M.T.; Mr. H. Thomson, at Newcastle, at 10.44 G. M. T., and Mr. Felix de Roy, at Thornton Heath, at 10.45 G. M. T. It was also noticed at 9.40 G. M. T. by Mr. Witchell, of the Royal Observatory, Greenwich, but not identified as a Nova. On the following day it was also detected independently in Scotland by Dr. Anderson, the discoverer of Nova Persei and Nova Aurigæ. Mr. Denning says that the increase in the light of the star must have occurred during daytime in England on June 8, for he was observing meteors nearly the whole of the preceding night and saw nothing unusual in the sky. Presumably, therefore, the object must have been faint at the time and, in any case, of such small magnitude as to enable it to escape detection. As yet little information has been received with regard to observations in other countries; the star was seen at the Hector Observatory in New Zealand, but apparently 12h. after its discovery in England.

At discovery the star was very nearly of the same brightness as Altair (0·9m.). The testimony of all the discoverers agrees on this point. It was confirmed by photometric observations at Greenwich by Mr. Jonckheere, who determined the magnitude with a wedge photometer by comparison with Vega, Arcturus, and Altair. The change of brightness in the short night of June 8 was very slight, if indeed perceptible. In colour the star was like α Aquilæ. With the highest power the star showed a sharply-defined stellar nucleus in the 28-inch telescope at Greenwich. So far as could be seen with an eye-piece prism, the spectrum appeared to be perfectly continuous, no night lines being detected. At the Cape Observatory the important observation has been made that the Nova contains hydrogen and calcium absorption lines similar to Nova Persei, February 22, 1901. It is not stated in the cablegram whether the observation was made on June 8 or June 9.

A great increase of brightness occurred in the next twenty-four hours. On Sunday night the star certainly equalled Vega (0·1m.) in brightness, though Vega was at a much greater altitude. Observation at Greenwich was somewhat difficult owing to some faint, low-lying haze. To some observers the star appeared to be considerably brighter than Vega. As on the previous night no bright lines were seen in the star's spectrum.

The position of the star relative to B.D. +0·4023° (8·5m.) was determined by M. Jonckheere. Using the position of this star given in the Abbadia Catalogue (1900) the position of the Nova is found to be

R.A. 18h. 44m. 43·48s., Dec. 0° 29′ 28·2″ for 1918·0

Direct observation at the Transit-Circle by Mr. Witchell gave

R.A. 18h. 44m. 43·47s., Dec. 0° 29′ 31·5″ for 1918·0

It was noticed by M. Jonckheere that a star on the Algiers Chart Zone +1°, No. 141, having the co-ordinates −3′ and −32′ and of the ninth magnitude seemed to be in the position of the Nova. Reference to the measures of the Algiers Astrographic Catalogue shows that this star is No. 108 on plate 1003. Its magnitude is given as 8·8m. Its co-ordinates on this plate (centre: 18h. 40m. and 0°) are +57·0074′ and +27·8588′. With the data given in the catalogue the position of the star is found to be

R.A. 18h. 44m. 43·52s., Dec. 0° 29′ 31·0″ for 1918·0

It thus seems very probable that the Nova is identical with this star of the Algiers Astrographic Chart and Catalogue, photographed on the dates Aug. 20, 1909 and June 26, 1895. This star is also shown on a Franklin Adams plate taken at Johannesburg in 1910. It cannot be said with certainty that these three photographs show no evidence of variability, though on the photographs of 1909 and 1910 the star is perceptibly fainter than the neighbouring star (No. 105 in the Algiers Catalogue) while in the catalogue (date of photograph, 1895) it is given as of the same magnitude (8·8m.). If the identity of the Nova with this star is confirmed the point is one of great interest.

It is fortunate that the Nova will be well placed for observation for some months, so that ample records of its varying luminosity and spectrum will probably be secured. At the present time the star rises practically due East at about 7.20 p.m., and is on the meridian, 39° above the horizon at London, at about 1.20 a.m., G.M.T.

F. W. DYSON.

The spectrum of the Nova was observed by me on June 10 with a McClean star spectroscope on a 3-inch refractor, and on June 11 with a Zöllner spectroscope on the 6-inch refractor at the Imperial College. It was not notably different on the two evenings, except that the continuous background was possibly more intense on June 10. In each case the spectrum strongly recalled those of Nova Aurigæ and Nova Persei in their early stages, shortly after maximum brightness. The most striking feature of the spectrum was the red line of hydrogen, which was of extraordinary brilliancy. In the green there was a group of four bright lines, of which the most refrangible and brightest was doubtless H_β, while the others may well have been the enhanced lines of iron about wave-lengths 517, 502, and 492, which were observed in previous novæ. Another conspicuous line in the blue was probably H_γ. There was also a broad nebulous line about λ 532, and another of the same character which was roughly estimated to be about λ 560. On the red side of the latter was a dark shading, and there

was a strong absorption line or band which was estimated to be in the position of sodium D. There was possibly a bright fringe on the red side of this absorption line. Between D and C there were two fairly conspicuous bright lines, which were estimated to be in the neighbourhood of λ 615 and λ 630. The star was brighter than Altair, and was of a reddish-yellow colour.

A. FOWLER.

INSECT BEHAVIOUR.[1]

IT was on a *Harmas* (an untilled, pebbly bit of land) in Provence that Fabre, after heroic struggles, opened his "laboratory of living entomology," where, undisturbed, he might "pry into life." "Never, in my insect-hunting memories, have I seen so large a population at a single spot; all the occupations have made it their rallying-point. Here come hunters of every kind of game, builders in clay, weavers of cotton goods, collectors of pieces cut from a leaf or the petals of a flower, architects in pasteboard, plasterers mixing mortar, carpenters boring wood, miners digging underground galleries, artificers handling goldbeaters' skin, and many more." What a place for studying those inborn capacities for effective behaviour which we label instinctive! What disclosures this inimitable observer gives us—the sounds of the midsummer night from the tinkling of toads to the death-wail of the surprised cicada, the green grasshopper's strange banquet off her fertilising capsule, the quick and fatal bite which the "devilkin" or Empusa gives on the back of the butterfly's neck; the beautifully finished cupolas made by Eumenes wasps out of minute pebbles and mortar, and stored with half-paralysed caterpillars, the food for the grub which hatches out of the egg cleverly suspended from the roof; the way the glow-worm deals with snails, first chloroforming them and then drinking them, for the flesh has to be liquefied into a broth before it can be used. Fabre's words suggest that the liquid passes up the hollow mandibles to the mouth, but there seems some doubt on this point, as may be seen by comparing the recent observations of Miss Kathleen Haddon with those of Prof. Bugnion.

Apart from the sheer delight afforded by Fabre's intimate descriptions, the chief value of the essays before us lies in their evidence of the limitations of instinct, which gives a basis for the conviction, from which the author never departed, that instinctive behaviour is not in the same category as intelligent behaviour. On one hand we see extraordinarily perfect instinctive behaviour like that of the Capricorn grub boring in the depths of the oak-tree for three years on end, yet coming at the appropriate time to the surface and preparing down to minute details an exit for the future beetle. It behaves as if it had perfect prescience. On the other hand, the burying beetles, though persisting in trying all their bag of tricks when their undertaking is difficult, will allow themselves to be baffled by a hitch which the least spice of intelligence would remove, and will submit to incarceration in a prison which to expert tunnellers like Necrophori has practically an open door. Similarly, Fabre's procession caterpillars persisted for a week in a futile circumambulation of the margin of a vase in the garden. Instinctive

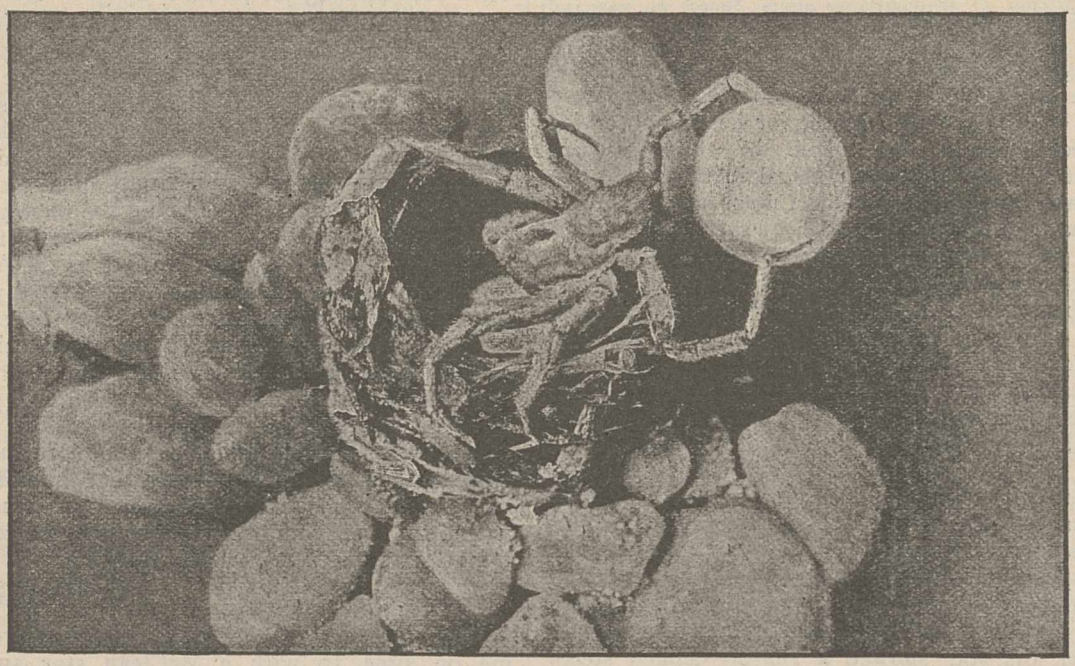

FIG. 1.—The Lycosa lying head downwards on the edge of her pit, holding in her hind legs her white bag of eggs, and lifting them toward the sun, to assist the hatching. From "The Wonders of Instinct."

[1] "The Wonders of Instinct. Chapters in the Psychology of Insects." By J. H. Fabre. Translated by A. T. de Mattos and Bernard Miall. Pp. 320. (London: T. Fisher Unwin, Ltd., 1918.) Price 10*s.* 6*d.* net.

behaviour depends on inborn, ready-made capacity; it is not reflective. But why did Fabre think that "transformism" was compelled to rank instinct in a line with reason?

Fabre was a very great naturalist, but not, of course, invariably wise. Thus, once in a way it may have been useful to deplore the fact, or supposed fact, that "natural history, youth's glorious study, has, by dint of cellular improvements [*sic*], become a hateful and repulsive thing," but it was unwise to reiterate contempt for the labours of the analytic zoologist who follows the nerve-fibres of a Cirripede, or counts the joints of a Crustacean's antenna, or puzzles over the architecture of an Annelid's egg. Fabre had no sympathy with this sort of study, and he did not understand it. The same must be said in regard to the great naturalist's attitude to "transformism" or evolution-theory.

The translation continues to be clear and spirited, but the right word has not always been found. More care should have been taken with the little notes; thus the word "species" is misused with tiresome reiteration; not every Annelid is a red-blooded worm; it is unhappy to say that "zoophytes are plant-like sea-animals, including star-fishes, jelly-fishes, sea-anemones, and sponges"; and surely the cicada is not "akin to the grasshopper." But these and their like do not affect the general success of the translators' work. We do not think that the British public could find reading much more wholesome than these essays by one of the greatest of observers, but we are in its name obliged to express to the publishers our surprise that this fascinating volume should contain several essays which we have read in book form before. We read "The Harmas" and "The Bluebottle" in "The Life of the Fly"; we read "The Processionary Caterpillar" and "The Cabbage Caterpillar" in "The Life of the Caterpillar." But can we have too much of a good thing?

PROF. P. BLASERNA.

OF the life and work of Prof. Pietro Blaserna, who died at Rome on February 26, an interesting account is now contributed by Prof. Cantone to the *Atti dei Lincei*, xxvii., (1) 7. Prof. Blaserna was born on February 29, 1836, at Aquileja, near Gorizia, and attended school at the latter place, afterwards proceeding to Vienna, where, after he had completed his degree course, he assisted in the physical department. Being thus a native of the scene of recent conflicts between Italy and Austria, he was entirely Italian in his sympathies, and, after studying in Paris under Regnault, he obtained a chair of physics, first at Palermo, and then at Rome. Here he devoted his main efforts to teaching and organisation, and succeeded in building up a school of physicists of which Italy has every reason to be proud. Instead of giving most of his time to researches, which might have necessitated his maintaining an attitude of exclusiveness towards elementary students, Prof. Blaserna endeavoured to make his classes popular, and thus to disseminate a scientific spirit in Italy. At Rome the laboratory of practical physics was originally in a church building, but was removed in 1881 to the Istituto di Panisperma. A weekly colloquium was instituted at an early stage, and the names of Alfonso Sella, Eugenio Beltrami, and Vito Volterra are among those who derived inspiration from him.

To physicists outside Italy Prof. Blaserna's name will be familiar in connection with the Accademia dei Lincei, of which he was president for twelve years, up to December, 1916. Although his duties left scanty time for research, Prof. Blaserna made important contributions to science connected with electromagnetic induction, determination of refractive indices, tangent galvanometers, and the polarisation of the light of the corona in the eclipse of 1870. Of practical problems, that of the design of the best form of amphitheatre was solved by him and applied to the construction of his classroom; this problem also led to a study of certain properties of Z and Gamma functions. Much work of national importance was also entrusted to Prof. Blaserna, who figured prominently in many proceedings of the Second Chamber. He was keenly interested in music, which he studied from the acoustical point of view, and he was instrumental in standardising the concert pitch for Italy, besides writing a popular treatise on sound and music.

G. H. B.

NOTES.

IN a long list of promotions in, and appointments to, the Order of the British Empire, made on the occasion of the King's birthday, we notice the following names of men who have been honoured for scientific services in connection with the war:—*Knights Commanders (K.B.E.)*: Col. H. E. F. Goold-Adams, late Controller, Munitions Inventions Department; Mr. Horace Darwin, F.R.S., chairman, Cambridge Scientific Instrument Co., Ltd., member of Munitions Inventions Department Panel; Lt.-Col. A. G. Hadcock, F.R.S., managing director, Sir W. G. Armstrong, Whitworth and Co., Ltd.; Dr. A. C. Houston, director of Water Examinations, Metropolitan Water Board; Mr. H. D. McGowan, managing director of Nobel's Explosive Co., Ltd.; Prof. T. H. Middleton, Deputy Director-General, Food Production Department, Board of Agriculture; Col. Sir Frederic L. Nathan, chairman, Standing Committee on the Causes of Explosions at Government and Controlled Factories, Ministry of Munitions, chairman Advisory Committee on Alcohol Supplies for War Purposes; Mr. A. Nimmo, president, Mining Association of Great Britain, chairman Board of Trade Committee on the Coal Trade after the War, member Central Coal and Coke Supplies Committee; Admiral Sir Richard H. Peirse, Naval Member of the Central Committee of the Board of Invention and Research; Mr. P. L. D. Perry, Director of Mechanical Warfare, Ministry of Munitions; Mr. J. W. Restler, chairman, Metropolitan Munitions Committee, chief engineer Metropolitan Water Board. *Commanders (C.B.E.)*: Prof. E. C. C. Baly, F.R.S., professor of chemistry, Liverpool University, Deputy Inspector of High Explosives, Liverpool Area; Dr. J. Barcroft, F.R.S., Superintendent of Physiological Investigations, Chemical Warfare Department, Ministry of Munitions; Mr. Conrad Beck, president, British Optical

Instrument Manufacturers' Association; Dr. H. N. Dickson, professor of geography, University College, Reading, Head of Geographical Section, Naval Intelligence Division, Admiralty; Prof. H. B. Dixon, F.R.S., professor of chemistry, Manchester University; Prof. A. S. Eve, F.R.S., Resident Director of Research, Admiralty Experimental Station, Parkeston; Prof. E. C. K. Gonner, professor of economic science, Liverpool University, Director of Statistics, Ministry of Food; Mr. C. H. Wordingham, president, Institution of Electrical Engineers, Director of Electrical Engineering, Admiralty. The list of several hundreds of Officers of the Order (O.B.E.), published on June 7, includes the names of a number of men of science.

THE creation of extensive hay dumps for Army requirements tends to bring into prominence the question, which is ever-recurrent in agricultural practice, as to the extent to which spontaneous ignition may take place and the conditions that are favourable to it. The commonest cases of spontaneous heat production are, of course, those in which living material, seeds, leaves, etc., undergo a "sweating" process when placed in heaps, and this change, which is associated with respiratory and enzymic changes, also proceeds to a certain extent in stacks of green or fresh hay. A much more potent effect is, however, exerted by the growth of micro-organisms, bacteria, and moulds, some of which have been shown to be capable of raising the temperature to upwards of 70° C. Beyond this temperature it is doubtful whether even these organisms can continue growth, and this view is supported by the fact that only carbon dioxide, and not inflammable gas, is produced, but the high temperature already attained, and possibly the products of microbial action, serve to initiate purely chemical oxidation changes, which eventually raise the temperature to the region of 90°–95°. During this phase the hay assumes a dark brown or black colour, small quantities of formic acid are produced, and there is a loss of pentosans and other nitrogen-free constituents. The latter temperature is, of course, unable to give rise to firing, but in view of the fact that substances such as bran become pyrophorus on exposure to temperatures of 145°–175°, and that energetic changes take place as low as 130°, it has been assumed that a prolonged action at the temperature occurring in the haystack may also result in the formation of similar pyrophorus substances. The presence of moisture and of easily decomposable compounds and a free air supply are predisposing conditions to excessive heating.

SOME interesting notes, which someone should collect, have been made from time to time by competent observers in regard to the behaviour of various animals under the terrific conditions of noise, vibration, explosion, and other disturbances at the front. Thus it seems clear that some kinds of birds, under the dominance of instincts of feeding, nesting, or brooding, behave as if they were indifferent to the most conspicuous anomalies of their environment. Living creatures of many kinds are not in the least impressed by sounds which have no interest for them. Just as human perceptions are affected by pre-established concepts, so the intensity of animal sensations is affected by previously established associations. To terrific disturbances, which have neither inherited nor acquired "meaning," an acutely sensitive organism may remain quite indifferent. The cuckoo's calls are not interrupted by the thunderstorm. But another point is raised by some observations which Capt. W. Neilson Jones has just sent us. These refer to the diverse ways in which sheep and cows react to dummy bombs released from an aeroplane. The cows seem entirely indifferent to the "swish" of the falling bomb, but the sheep "invariably scatter in panic." The first question is whether this can be taken as a well-established fact, and the answer must take the form of a considerable number of precisely and impartially observed cases. Supposing it to be a fact, we face the second question of interpretation. Have the cows a different—more placid—temperament? But how excited they get at times by the buzzing of flies that cannot hurt them. The excitement is probably due to fallacious association with the buzzing of blood-sucking flies which can hurt them; and Capt. Jones's suggestion is that sheep are panic-struck because the swish of a falling bomb is probably not unlike the sound of a bird of prey, say a golden eagle, swooping upon the lambs. Susceptibilities of ancient origin may prove very persistent, as Mr. Robinson has so well shown in his suggestive book "Wild Traits in Tame Animals."

COUNT A. DE LA BAUME PLUVINAL, Sir Frank Dyson, and Prof. F. Schlesinger have been elected foreign members of the Society of Italian Spectroscopists.

ON the recommendation of the council of the Royal Society of Arts, the Albert medal for 1918 has been awarded to Sir R. T. Glazebrook "for his services in the application of science to the industries of peace and war, by his work as director of the National Physical Laboratory since 1899, and as chairman of the Advisory Committee for Aeronautics."

ACCORDING to a correspondent of the *Times* (June 8), a severe earthquake was recorded at the Sydney Observatory on the preceding day. The epicentre is placed, probably on the evidence of the seismogram, in Keppel Bay, on the east coast of Australia, about 650 miles north of Sydney. The strength of the earthquake is evident from the fact that the north-eastern towns of New South Wales, not less than two hundred miles south of Keppel Bay, were severely shaken. The chief interest of this shock lies in its occurrence in a district which is rarely visited by earthquakes.

IN view of the public interest which is being taken at present in the Madsen machine-gun, we note that the *Engineer* has reprinted in its issue for June 7 a description of this gun, which first appeared in our contemporary on March 10, 1916. The article includes photographs of the weapon, and also a set of drawings showing the arrangement of the breech mechanism. It is impossible to attempt any description of this mechanism here on account of its complicated nature, and readers interested should refer to the original article.

WE regret to note that the *Engineer* for June 7 announces the death of Mr. Thomas Aitken on May 27. Mr. Aitken was road surveyor for the Cupar district of the County of Fife during the last thirty-six years. His invention of a road-tarring machine brought him into prominence during the introduction of the motor-car, and his machine gained the gold medal and the prize of one hundred guineas at the Road Surveyors' International Competition at Staines in 1907. His book, "Road-making and Maintenance," has now become a standard work. He was a member of the Institution of Civil Engineers.

WE learn from *Science* that Mr. W. Hague Harrington, one of the best known of the older Canadian entomologists, died on March 13 at Ottawa, Canada, at the age of sixty-six years. Mr. Harrington was one of the founders of the Ottawa Field Naturalists' Club, and at one time was president of the Entomo-

logical Society of Ontario. In 1894 he was elected a fellow of the Royal Society of Canada. For many years his main interest in life was entomology, and he brought together a large collection of Canadian Coleoptera and Hymenoptera. He was a systematist of recognised standing, and probably the highest authority on Hymenoptera in the Dominion of Canada.

PROF. P. GIACOSA gives elsewhere in this issue his impressions of the recent visit of university representatives from Italy to some of our educational institutions. The Italian delegation, which was invited by the British Government to visit the universities of the United Kingdom, consisted of Profs. Arcangeli, Bianchi, Borgese, Columba, Credaro, De Viti de Marco, Giacosa, Lori, Nasini, Romagnoli, Ruffini, and Volterra. For various reasons Profs. Borgese, De Viti de Marco, and Romagnoli were unable to accept the invitation. Prof. Ruffini, who was detained in Rome on political business, delegated Prof. Galante to represent him. The delegates visited Winchester, Portsmouth, London, Oxford, Cambridge, Leeds, Manchester, Sheffield, Edinburgh, and Glasgow.

THERE have been several rumours during the last few months to the effect that the Germans were building even larger raiding aeroplanes than the Gothas with which we are already acquainted, and it now appears that these rumours were well founded. A giant machine has been recently brought down in France, of which some particulars appeared in the *Times* for June 8. The information given shows that the machine had a span of about 140 ft. and a length of about 70 ft. The weight, fully loaded, was about 14½ tons, of which two tons consisted of bombs. The machine carries four engines of 300 h.p. each, and the speed is stated to be seventy-five to eighty miles per hour. If these figures are correct, the aeroplane in question appears to be the largest machine which has yet been flown. It is not by any means definitely established that the largest possible bombing machines will be the most effective; indeed, it is reasonable to suppose that a larger number of smaller machines with a higher speed would be the more effective and less easy to attack. The larger a machine becomes, the more difficult it is to land in the dark, and the more vulnerable it will be when there is a chance of definite aim from the ground or of attack by fighting machines. While this new development is highly interesting from the point of view of the possible development in the size of machines, it does not seem likely that these giant aeroplanes will appreciably increase the effectiveness of the enemy's night raids.

MR. FRANK HARWOOD LESCHER, who died on May 12, aged seventy-five, was for many years one of the best-known men in the wholesale drug trade, into which he made his entry more than sixty years ago. As a student he distinguished himself by carrying off the medal for botany and materia medica, a success which was soon followed by the Pereira medal, the blue ribbon of the Pharmaceutical Society. In after-life materia medica remained his favourite study, the results of which were, to a considerable extent, embodied in his "Recent Materia Medica," in which all the newer remedies were ably discussed. Averse to publicity, his contributions to the current journals were not numerous, but his work was, nevertheless, continuous and his store of knowledge profound. Those who were fortunate to hear it will not readily forget the fascinating and scholarly address delivered a short time ago to the students of the Pharmaceutical Society, in which he summed up the results of his researches on the drug-routes of the world. By his death a genial, active, and intellectual worker has been lost.

THE interim report of the Gas Traction Committee, noticed in NATURE of May 9, p. 188, referred to the need for experiments and tests in connection with the determination of factors affecting portable gas-generating plants, and the commercial use of gas for traction purposes in containers at high pressures, together with questions relative to liquefaction, absorption, and enrichment, as well as in regard to improvements in the existing arrangements for effecting the admixture of gas and air in the requisite proportions under varying conditions. A sub-committee of the Gas Traction Committee has now been appointed for the purpose of giving effect to this recommendation and of furnishing periodical statements on it. The sub-committee consists of Sir Boverton Redwood (chairman); Lieut.-Col. R. K. Bagnall-Wild, Mr. W. Worby Beaumont, Major A. McN. Cooper-Key, Prof. C. Vernon Boys, Major B. Hopkinson, Mr. E. S. Shrapnell-Smith, and Mr. S. Straker, with Mr. Cecil H. Lamb, of H.M. Petroleum Executive, as secretary.

THE death of M. Jules Lachelier, at the age of eighty-six, which occurred recently, deprives us of an eminent French philosopher who marked a distinct stage in the development of the philosophical movement of his country. He linked Poincaré and Boutroux and Bergson with Ravaisson and Maine de Biran. Lachelier was not widely known, and he contributed very little to philosophical literature—two volumes on "Le Fondement de l'Induction" and an edition of Leibniz—but his influence as a teacher was immense. His own philosophical theory was a refined form of idealism which goes for its origin direct to Leibniz. A science of Nature, he held, would be an impossibility if the laws of thought were not at the same time, as Kant maintained, the constitutive laws of Nature; but he went further than Kant, believing that there is a method, which he named reflection, by which thought possesses itself in its very essence, and has nothing to seek beyond. Sensible knowledge he conceived, in the manner of Leibniz, as an obscure form of intellection. His chief work and his influence dates back to the years 1864 and 1877, during which period he lectured regularly on philosophy as Maître de Conférences in the Ecole Normale Supérieure. In the latter year he was appointed Inspecteur Général de l'Instruction publique. Since 1901 he lived in practical retirement, but continued to take a keen interest in philosophy, especially as a member of the Société Française de Philosophie, assisting in discussions and in the work of producing the "Vocabulaire philosophique." He died on January 18 last at Fontainebleau.

IN 1896 Dr. Guiliano Vanghetti, an Italian physician, when seeking to ameliorate the condition of the hapless soldiers who had been mutilated by the Abyssinians after falling into their hands as prisoners of war, conceived the idea of utilising the muscles in the stumps of amputated limbs as the "driving-power" for artificial limbs. The technical difficulty of yoking such muscles to the levers of artificial limbs proved to be very great, and up to 1914 only twenty patients had been operated on. With the outbreak of the present war this new departure of surgery—the "kinematisation of stumps"— was taken up by a young Italian surgeon, Prof. V. Putti, professor of orthopædic surgery in the University of Bologna and director of the Rizzoli Institute. Prof. Putti has improved the technique needed to make such operations a success, and has now operated on fifty cases. His patients, by means of muscles retained in the stumps of their limbs, are able to execute movements in artificial hands, knees, and feet. During a recent visit to England Prof. Putti demonstrated his methods and

results to British surgeons, and convinced them that this new departure in surgery deserves their most favourable consideration. The muscles of the stumps are yoked to artificial levers by various devices, and it is surprising how the parts become tolerant of the abnormal burdens placed on them by the surgeon. The patient is even able to estimate the weight of the load which he attempts to lift. For success the surgeon depends on the intelligence and perseverance of his patients as much as on his own technical skill. It would be wrong to give rise to the hope that "kineplastic" surgery can ever give a limbless man conditions of movement comparable to those he has lost, but this new departure in surgery does promise an amelioration of our former helpless outlook. Prof. Putti has presented models and casts of "kinematised stumps" to the museum of the Royal College of Surgeons of England.

APPRECIATIVE notices of the work of Mr. C. D. Ahrens, who died on March 14, at eighty-one years of age, are contributed to the Journal of the Quekett Microscopical Club by Mr. E. M. Nelson and Prof. F. J. Cheshire. We extract the following particulars from Mr. Nelson's notice:—Mr. Ahrens was a prism and spar slitter. He made Nicol prisms and analysers, quartz and calcite prisms of all kinds, as well as the glass prisms for Wenham binoculars. In 1867 he designed a binocular upon quite a novel plan. The rays issuing from the back of the objective were separated to an angle of 15° by a double-image calcite prism; these rays were then crossed over by two flint prisms, to correct the chromatic dispersion. The rays used were the extraordinary, the ordinary being diverted out of the path. The tubes were equally inclined to each other. In 1881 he introduced another new binocular, in form like Stephenson's. It had parallel tubes, but they were bent as in the Stephenson. The ingenious part of the arrangement was that the beam from the back of the objective was divided by two Wollaston camera-lucida prisms placed back to back; these deflected the rays right and left, then another prism with two reflections bent them up the tubes. Probably a carefully made binocular on this plan would be a very successful instrument. In 1884 he designed a bent-tube erecting monocular microscope; obviously a most useful instrument, it is surprising that some energetic manufacturer has not taken up this idea. In the same year Mr. Ahrens designed a new polarising prism, which was further improved by Mr. H. G. Madan in 1885. In 1886 he brought out yet another improved form of polarising prism, the object of which was to lessen the ratio of its length to its breadth. That of the Nicol is about 3 : 1, while the Ahrens was $1\frac{1}{2}$: 1. In 1887 he made an erecting microscope the design of which has had far-reaching consequences. The erection was obtained by Porro prisms. It was Ahrens who first brought the long-forgotten Porroprism to remembrance.

WE have received the Report of the Bacteriologist, State Board of Agriculture, Michigan, for the year ended June 30, 1917. Much work has been done on contagious abortion of cows. Vaccines prepared with the *Bacillus abortus* did not prevent infection with succeeding abortion in guinea-pigs. The bacillus soon dies out on wool, silk, and in soil; on the two former materials within a fortnight, and in soil within a week. Cultivations of leguminous bacteria have been tested as fertilisers for leguminous crops. On alfalfa they seem to be of benefit in about one-third of the crops treated, but on other crops no definite conclusion has yet been reached.

THE Report of the Departmental Committee appointed to inquire as to precautions for preventing the danger of infection by anthrax in the manipulation of wool, goat-hair, and camel-hair has just been issued. (Cd. 9057). The Disinfection Sub-Committee concludes that anthrax can only be prevented either by preventing the disease among animals or by the destruction of the organisms in the wool or hair. The Sub-Committee has devised a process for the last-named purpose, the essential features of which are:—(1) Treatment of the material with a warm aqueous solution of soap containing a little alkali, followed by squeezing between rollers; this disintegrates the blood-clots. (2) Treatment with a warm solution of formaldehyde in water and again squeezing; this destroys most of the spores. (3) Drying and standing for a short time, by which any remaining spores are killed. The Committee is of opinion that the Government should undertake the work of disinfection at a central institute or station. For the treatment of 10,000,000 lb. of wool annually the cost of the central station is estimated to be 18,000*l*., and the working cost to be from 0·544*d*. to 0·824*d*. per lb. of untreated material. These figures were computed at pre-war prices, and about 75 per cent. would have to be added to meet present-day conditions.

CAPT. E. G. FENTON discusses in the May issue of *Man* the remarkable cart-ruts found in Malta. It has been formerly assumed that they date from prehistoric times, and that they probably belong to the Neolithic period. There is no sign of a groove cut by horses' feet between the ruts, and the suggestion has been made that they are the result of human power in the shape of a number of men drawing waggons, and that the Neolithic civilisation was brought to a close by a period of desiccation, such as that discussed by Ellsworth Huntingdon in "The Pulse of Asia," the dawn of our Mediterranean historical period being heralded by the increase of moisture. Capt. Fenton, on the whole, believes that they date from the early part of the Iron age, at a time when the Mediterranean was moister and the island was capable of supporting a larger population than under present conditions. The suggestion that these climatic changes can be equated with events in Egyptian history is interesting, but the evidence is scarcely sufficient to support any definite conclusion. Prof. Boyd Dawkins, in the June issue of *Man*, asserts that the ruts are "due to the weathering of the rock under vaporal conditions. They are merely the ordinary joints, widened and eroded by the rain-water containing carbon dioxide, familiar to geologists in all limestone plateaux, and to be seen over very wide regions in Southern France."

A RESEARCH of interest to veterinarians and zoologists on the efficiency of some Anthelmintics has been published by M. C. Hall and W. D. Foster (*Journ. Agric. Research*, vol. xii., No. 7, 1918). By comparing the number of worms evacuated after the administration of various drugs with those found in the digestive tracts of "patients" killed a few days later a sort of "percentage efficiency" can be calculated. The number of experiments of this kind is necessarily limited, but the result in nearly all cases is disappointingly low. Dr. H. E. Cross has been trying the effect of various emulsions intended to protect camels from the attacks of blood-sucking flies (Bull. 76, Agric. Research Inst., Pusa); he finds that the only serviceable agent is castor-oil, which is too expensive for practical use.

A SYSTEMATIC zoological paper of more than usual interest is Mr. J. Hewitt's "Survey of the Scorpion Fauna of South Africa," which constitutes part ii. of the Transactions of the Royal Society of South Africa (vol. vi., 1918). The region has a large number of

genera and species, which are described in detail with the help of structural drawings and admirably reproduced photographs. The author takes occasion to discuss the bearing of the variation of features of systematic importance on questions concerning the factors of evolution, and concludes:—"In view of the continuous variability of most of the characters employed in the distinction of species amongst our scorpions, it seems probable that discontinuity arises most frequently through the elimination of intermediate forms rather than by mutation processes."

IN his latest studies on American Permian vertebrates (Contributions from Walker Museum, Chicago, vol. ii., No. 4), Prof. S. W. Williston discusses the origin of the vertebræ in the amphibians and reptiles, and shows that all stages in the development are now known. Inheriting separate pleurocentra, hypocentra, and neural arches from the early fishes, the land-vertebrates soon consolidated their centra, until in later reptiles the only remnants of the primitive condition are certain wedge-bones and some separate parts in the atlas and axis. Among other notes Prof. Williston also describes and illustrates some fine specimens of the brain-case of Eryops, Edaphosaurus, and Dimetrodon.

PROF. ROLLIN D. SALISBURY, in his address to the Section of Geology and Geography at the Pittsburgh meeting of the American Association for the Advancement of Science (*Science*, April 5), urged the claims of geology as a factor in general education, and pointed to modern geography as having even greater promise. Like Mr. Bateson in the "Cambridge Essays," he feels that "the type of subject which works on strictly mathematical lines cannot, by itself, afford the best preparations for the solution of the average problems of the average man." We require a "training in the methods by which uncertainties are cleared up," and the sciences concerned with Nature in the field furnish this training to a marked degree.

IN the Quarterly Journal of the Geological Society of London, vol. lxxiii., p. 1, Dr. A. Smith Woodward describes two additional cranial fragments and a molar tooth of Eoanthropus, which were discovered by Mr. Charles Dawson at Piltdown in 1915. Since one fragment is occipital, and the same region is represented in the imperfect skull originally described, there is no doubt that we now possess traces of a second individual. The paper is rendered still more valuable by an appendix by Prof. G. Elliot Smith, and by the printing of the discussion, in which Mr. Pycraft, Prof. A. Keith, and Sir Ray Lankester took an important part. Attention may be directed to Mr. Pycraft's comments on a ramus of the mandible of a chimpanzee with worn molars, sent him by Mr. G. T. Miller, who, as is well known, opposes the attribution of the Piltdown jaw to the skull fragments associated with it in the gravels.

A WRITER in the *Zeitschrift für angewandte Chemie* for March 22 estimates the available water-power in Germany at 11·4 million h.p., only about four millions being yet utilised. In 1910 the proportion utilised was only 5 per cent. of the steam-power produced, while in France the percentage has reached 40 per cent.

THE restoration of Alsace to France would put the latter country in possession of the valuable potash deposits discovered in 1904. These rich deposits cover an area of seven square miles, to the north-west of Mulhouse. The workable yield is estimated at 300 million tons, and they could be made to yield an annual output of 800,000 tons at a low cost of production. According to the *Zeitschrift für angewandte Chemie*, March 22, fifteen shafts have already been sunk, but production has been hampered by legal restrictions arising out of the German potash laws.

ACCORDING to a writer in the *Berg- und Hüttenmannischer Jahrbuch*, part i., 1917, there are extensive, unworked deposits of manganese ore in the Bukovina which reach into Rumanian territory. The article describes the deposits and the methods of working them. Analyses made show the yield of metallic manganese to be 40·65 per cent. The ore occurs in some parts in the form of outcrops, thus making it cheap and easy to win. Another authority, writing in *Stahl und Eisen* for April 4, estimates the quantity of manganese ore in the Kutais Government of Russia as thirty million tons, and in the Yekaterinoslav Government about eleven million tons. The possession of Batoum by the Turks should enable them to control the entire output of the deposit first mentioned, while the peace made with the Ukraine brings the second source of supply within the range of German influence.

FOR the making of chemical manufacturing plant chemists and metallurgists have long sought some form of metal which will resist the corrosive action of acids. Such a metal would have obvious advantages over the stoneware or similar breakable material ordinarily employed. In the laboratory it has long been known that iron could be made resistant to either sulphuric or nitric acids by alloying it with a certain proportion of silicon or chromium, but it is only recently that successful use has been made of this acid-resisting property on a large scale for chemical installations. In the Journal of the Society of Chemical Industry for March 30 Mr. S J. Tungay gives an account of what has been done in this country and abroad towards the industrial production of acid-resisting iron. Considerable manufacturing difficulties have had to be overcome, but British metallurgists are now able to produce a large variety of vessels and plant suitable for the making of sulphuric and nitric acids; the material employed is understood to be an iron-silicon alloy containing a small proportion of one of the rare elements. Since the outbreak of war the metal has been found a great boon in condensing the nitric acid required for high explosives, as by making use of it large nitric acid plants were installed very rapidly; moreover, the condensing efficiency obtained was high, since the alloy possesses a heat conductivity about ten times that of stoneware.

WE have received from the Controller of Munitions Mineral Oil Production a report on "The Production of Fuel Oil from Ordinary Gas-works Plant." In view of the peculiar and difficult conditions now obtaining, the technical advisers of this Department realised that existing apparatus and trained staffs must be employed, and they appear to have gone a long way to solve a problem of the greatest urgency. Without betraying any official secrets, it may be said that the enormous deposits of cannel and bastard cannel which occur in this country are being explored and tested with a view to the production of an indigenous oil supply. It is obvious that our almost complete dependence on foreign sources for fuel oil, gas oil, benzine, and kerosene is a weakness that the enemy has not been slow to realise, and it is a matter for congratulation that on the eve of the fifth year of war the authorities have decided to prosecute their search for substitutes. It appears that the researches of the Department indicate that excellent yields of tar can be obtained from cannel coal—a fact which is by no means novel, seeing that, in the distant past, there actually was existent in Staffordshire a home oil industry. Where the

present report, however, achieves novelty is in the production, at suitable temperatures, of not only a good yield of tar, but also an excellent production of gas and of sulphate of ammonia. It has commonly been considered that a good gas make indicates a low oil production, and *vice versa*. The Department, however, by means of a compromise on temperature and by various modifications of standard gas-works technique, has, without doubt, made a distinct step in the direction of producing ample supplies of fuel oil compatible with the maintenance of the gas output.

IN a communication to the Journal of the Röntgen Society, vol. xiv., No. 54, January, 1918, Mr. C. A. Schunck describes a series of tests made to ascertain the region of the ultra-violet spectrum that produces the greatest therapeutic effect. The several parts of the spectrum were isolated by the absorption of weak solutions of quinine sulphate, salicylic acid, and phenol, or by glass plates. The therapeutic effect was observed by exposure of the operator's forearm to the screened rays for definite periods of time, and note was taken of the reaction produced. The greatest effect appears in the region 2500 to 2350 Å.U.; the boundaries, however, of this region are not sharply marked.

Engineering of May 31 contains an account of the new Tröllhattan Canal, connecting Lake Vänern with the Kattegat. Sanctioned by a Parliamentary vote in May, 1909, the waterway in October, 1916, had reached a stage which enabled it to be opened to traffic, and the ceremony was performed by the King of Sweden. The project is really one of old standing, dating back to the days of Gustavus Vasa, who initiated steps for linking up Lake Vänern with Tröllhattan by means of a navigable waterway. The first lock was opened in 1607. It was not, however, until 1800 that through connection was established to Gothenburg. Various extensions have since been carried out, culminating in the development called the new canal, the cost of which has somewhat exceeded a million and a quarter sterling. The enlarged waterway, which is fifty-two miles in length, is adapted for vessels generally up to 13 ft. draught, but the locks, which are six in number, enabling a change in level of 140 ft. to be negotiated, are constructed to pass vessels of 16½ ft. draught, this being a provision to meet likely developments in the near future. Each of the lock-chambers has a length of 320 ft. and a width of 45 ft., with a depth of 18 ft. of water over sill. The canal has a mean bottom width of 79 ft. The traffic during last year amounted in the aggregate to 9759 vessels, totalling 870,668 tons. Of this number 7827 were steamers, 664 sailing vessels, and 1268 barges. The undertaking was designed and carried out under the direction of the Royal Waterfalls Board.

OUR ASTRONOMICAL COLUMN.

KODAIKÁNAL OBSERVATORY REPORT.—The report of the Director of the Kodaikanal Observatory for the year 1917 has been received. The weather during the year was generally unfavourable, according to Indian standards, but substantial progress in many departments of solar research is recorded. Direct photographs of the sun were obtained on 294 days, monochromatic images of the disc in K light on 328 days, prominence plates on 262 days, and H_α disc plates on 255 days. Judging by the mean latitude of spots, it would appear that the maximum of the sunspot cycle was not reached, though the northern hemisphere may possibly have attained its greatest activity. The prominences, with a mean daily number of 19·8, were in excess of those recorded in 1916; the northern hemisphere continued to be more active than the southern, as regards both prominences and spots, and also as shown by prominences projected as absorption markings on the disc. Work with the large grating-spectrograph included the spectrum of Venus (see NATURE, vol. ci., p. 192), sun and arc comparison spectra, and the spectrographic determination of the solar rotation, in addition to experimental work on the "pole effect" in the iron arc. It has been found that most of the iron arc lines in the region between 4337 and 4494 show a tendency to shift towards the red with increasing exposure time, indicating that they are unsymmetrically widened towards the red to a very slight degree. The vertical motion-shift of 3 km./sec. reported by Perot for the B group of oxygen (telluric lines) was not confirmed by observations made at Kodaikanal. An attempt to photograph the conjunction of Regulus and the sun on August 22, in infra-red light, was unsuccessful, but the sky was not sufficiently clear to give a satisfactory test of the method. Time determinations and meteorological and seismological observations were also carried on.

ANNUARIO OF THE RIO DE JANEIRO OBSERVATORY.—The thirty-fourth issue of this useful almanac of 524 pages fully maintains the high standard of previous years. It is divided into four sections, dealing respectively with astronomical data for 1918, a collection of tables for the reduction of astronomical observations, geophysics and climatology, and a summary of meteorological observations made at thirty-three stations in Brazil. It is interesting to note that the tables include details of the corrections to be applied to the tabulated times of rising and setting of the sun and moon in order to obtain the corresponding data for other parts of the country; the inclusion of such data in our own official almanac would doubtless be generally welcomed. Since 1660 the magnetic declination at Rio de Janeiro has varied from 12° E. to its present value of about 11° W., and may be approximately represented by a formula given by the director of the observatory, Dr. H. Morize, namely, $d = 5{\cdot}6° + 0{\cdot}08°t + 8{\cdot}0° \sin(0{\cdot}73°t - 44{\cdot}1°)$, where t is the interval in years from 1850 taken as zero.

ALEXANDER THE GREAT AND HIS CELESTIAL JOURNEY.

PHOTOGRAPHS were given in NATURE of August 23, 1917, and March 14, 1918, of traditional representations of Alexander, seated in a car drawn by flying griffins, from St. Mark's, Venice, and Bâle Cathedral, and it was conjectured that a diligent hunt would reveal many similar examples in Europe and England. Since then an article by Prof. R. S. Loomis has appeared in the *Burlington Magazine* of April and May, which shows that the author had been engaged already in a research on the subject of Alexander's celestial journey. Prof. Loomis gives copious references to earlier authorities, with the addition of more than a score of photographs of other examples of the representation, in which we are pleased to find some ten are taken from English churches and cathedrals, as Wells, Chester, Lincoln, Gloucester (surely Canterbury), and Beverley Minster, Cartmel Priory, Whalley Church, St. Mary's Darlington, and Charney Bassett, Berks.

The figure of Alexander can be recognised by the two spears he carries in his hands, baited at the end with a tasty lure to guide the griffins alongside to bear him aloft. They are not sceptres, or distaffs even, in the mistake of the local designation (Borgo-

Aeronautics - History

San-Donino) of the subject as "Berta che filava"; and chains are shown as traces to harness the griffins. The detail of the mosaic pavement, A.D. 1165, in Otranto Cathedral bears the name Alexander, to prove there is no doubt of the subject.

FIG. 1.—Detail of mosaic pavement, A.D. 1165, Otranto Cathedral. From the *Burlington Magazine*.

In "Dynamics of Mechanical Flight" (1912) I have given, on p. 7, a vignette representation from an English MS. in the British Museum, bearing a strong resemblance to the Tournay tapestry in Fig. O of Prof. Loomis's article. The subject was thus evidently a favourite as familiar to readers of medieval romance.

Photo] [*G. C. Druce.*

FIG. 2.—Detail, about A.D. 1345, from Gloucester Cathedral. From the *Burlington Magazine*.

Prof. Loomis tells us (p. 136) that the story of Alexander the Great is not to be found in the earliest body of romantic Alexander tradition of the Greek Pseudo-Callisthenes, but must be considered a late medieval or Renaissance interpolation. But no mention of this can be found in the edition by Carolus Müller, 1846, in the Reading Room of the British Museum, where the Greek version of the Pseudo-Callisthenes is given in chap. xli., book ii., p. 91.

The legend was familiar to Chaucer, from the reference to it in his "House of Fame":—

> for never halfe so hye as this
> N'as Alexander of Macedon
> King—ne of Rome dan Scipion,
> That saw in dreame at point devise,
> Heaven and Earth, Hell and Paradise,
> Ne eke the wretch Dedalus,
> Ne his childe nice Icharus
> That flew so hie that the hete
> His wyngs molte, and he fel wete
> In midde the sea, and there he dreint,
> For whom was made a great complaint.

Chaucer returns to it in "The Squieres Tale," alluded to by Milton as the one—

> that left half told
> The story of Cambuscan bold
> And of the wondrous steed of brass
> On which the Tartar king did ride—

the subject of the Scribe-Auber opera of "The Bronze Horse" ("Le Cheval de Bronze") in the Tartar-Chinese legend. In the Chinese euphemism the Emperor is said to mount the dragon when he ascends to heaven.

Prof. Loomis traces Greek inspiration in the bas-relief on St. Mark's, and conjectures it was brought from elsewhere as a trophy of war. Later ages, he tells us, identified Alexander with Antichrist and Lucifer, for his impious experiment and scientific research.

Here is an opportunity to rectify the omission of the interpretation of the line in the ode to Archytas (NATURE, March 14),

> animoque rotundum percurrisse polum,

as a reference to another of the mathematical text-books of Horace's schooldays, the treatise of Archytas on Spherics, what we call the Use of the Globes, a study highly commended by Lord Kelvin for its stimulus.

G. GREENHILL.

THE VISIT OF DELEGATES FROM ITALIAN UNIVERSITIES.

IF the British Government in courteously inviting a delegation from the Italian universities to make a tour of England and Scotland in order to inspect the higher educational institutions of the United Kingdom had as its purpose to show to the Italians to what an extent the war had exercised an influence on national studies, and how far the students had participated in the work of military preparation and in the risks of the war, certainly that purpose was fully achieved. The Italian professors, welcomed in the historic university towns and in the other centres of knowledge with the utmost kindness, found the halls and colleges empty and transformed into barracks for troops. It is precisely the same in Italy, where, except for the medical students, who have been sent back from the front in order to complete their studies, the schools have been practically closed. Among the Italian professors and students the killed and wounded are numerous. It has always been a tradition of the educated youth of Italy to lend its aid to national movements, and in the present war the first sign of the decision of Italy to intervene with those who are now our Allies was given by the university classes, either as active participators in the work of government or as members of the body of students.

But the Italian professors had yet another mandate, that, namely, of making themselves acquainted with the course of education in Great Britain and of comparing it with that of their own country. However the external forms of the various English universities may differ among themselves, and differ from ours, we have found that, after all, the founda-

tion and the intrinsic value are the same. With regard to the English didactic method, we have been struck by a greater tendency towards a systematic arrangement and simplification of methods; one receives the impression that the whole system of English education is based much more on visual representations than is the case with Italian methods, which are more verbal and abstract. This is particularly apparent and important in connection with primary and secondary instruction, which makes an excellent impression, both on account of the intuitive basis of the education and the distribution of subjects and time, as well as on account of the large part which is devoted to moral and physical training. In her conception of what elementary and secondary schools should be, both intrinsically and extrinsically (methods of teaching and scholastic buildings), England offers a notable example, which is worthy of study, especially by us Italians, for whom these problems are of the greatest importance, as the Government and the people are fully aware.

With regard to the universities, on the other hand, we were able to pursue our journey in company with English men of science, trusting to those spiritual affinities which have hitherto been of such great value in strengthening the friendship between our two peoples. Our visit to certain universities which were more particularly technical gave us great satisfaction for a different reason, since they showed us that they were well on the way towards that co-operation between the man of science and the industrialist which, with ourselves, has recently proved to be very effective. It is in virtue of a similar co-operation that the Italian universities have now, in some branches of education, an abundance of means which ensures their proper working; and it is hoped that not only the physico-chemical sciences, but also the biological sciences, to their full extent and application, will soon be enjoying the benefit of the assistance of the industrialists.

To the Italian delegation it seemed that the reciprocal knowledge of the languages of the two countries was the problem that had, in the first place, to be solved; the meetings at the Royal Society of Literature, the lectures delivered at various places that were visited, did much towards assisting the efforts in this direction, and it was certainly a great encouragement to us, coming from Italy at this grave moment to carry on a work of reconstruction, to find so much willingness expressed in the English manner, not in words alone, but in deeds as well, to spread the knowledge of our language, which is the chief and the most effective instrument of our union.

PIERO GIACOSA.

APPLIED SCIENCE IN THE COTTON INDUSTRY.

OPINIONS may differ as to which is the most valuable or most important of the many aspects of this question which were set forth by Dr. Lawrence Balls in a paper entitled "Some Applications of Research to the Cotton Industry," read before the Royal Society of Arts on April 10, and published in the Journal of the society for May 3 (vol. lxvi., p. 389). His contributions to the scientific and practical sides of the problem may appeal in varying degrees to different people, but no one could fail to be impressed by their compelling interest.

The necessity for scientific research is in danger of becoming a catchword which everyone repeats, though few have sufficient knowledge of what it means to have any real faith in it. Dr. Balls has shown that the scientific study of the cotton plant and its environment is essential before the spinner can even describe what he wants in his raw material, in terms which can be translated by the plant-grower into efforts to produce the desired results. Even the question of length of staple has always been dependent on a rule-of-thumb method of determination which left the grower very much in the dark. On this point one might be tempted to award the major importance to Dr. Balls's invention of an ingenious machine which will not merely give the maximum and minimum length of individual hairs in a cotton sample, or even the average length, but will sort them out in graduated lengths and make it easy to measure the total quantity of each length, thus ascertaining accurately the degree of uniformity or otherwise of the staple, which is of prime importance to the spinner. The use of this machine should go a long way towards determining in a really definite way the value of any cotton sample, and may prove the main step towards a method which would enable the grower himself to estimate the suitability of a new cotton for a particular trade.

Equally valuable from the practical point of view was the hint which Dr. Balls's studies of flowering and bolling curves give of a scientific method of forecasting such crops as cotton. If it is not too good to be true, we may live to see the "arrivals" of the crop plotted out weeks in advance, and the probable total yield of the crop foreseen with an accuracy which would certainly be an improvement on the present rather haphazard and sometimes very deceptive methods.

The important results of the work out of which much of Dr. Balls's material arose, in its effects on the water control policy of the Egyptian Irrigation Department, is now a matter of history, but it is one which cannot be told too often either in scientific or official circles as an encouragement and stimulus to the one and a warning to the other.

THE CO-ORDINATION OF ELECTRIC POWER SUPPLY.

THE report of the Committee appointed by the Board of Trade to consider the question of electric power has now been issued (Cd. 9062, price 3*d*.). Several of the questions the Committee had to consider have already been dealt with by the Coal Conservation Sub-Committee, the report of which was described in NATURE of January 3 and February 14 last. The report begins by the statement of several general conclusions on which it bases its recommendations. The first of these is that after the war the success of British industry will depend to a large extent on the adoption of the most efficient methods and machinery, so that manufacturing costs may be reduced to a minimum. In this connection the extension in the use of electric power supplied at the lowest possible price will be a most important factor. The present system of supply by separate authorities to small areas is economically unsound, and prevents the cheapening of the supply. Hence a comprehensive system for the generation of electricity and, where necessary, for reorganising its supply should be established as soon as possible. With these statements every engineer is in agreement. If it had been possible to work on a clean slate, the devising of a suitable scheme under a central authority would have been comparatively easy. Owing, however, to the existence of the present patchwork system and the many conflicting interests which will have to be adjusted, the problem is one of considerable complexity. The Committee advises that a new body to be called the Electricity Commissioners be set up, to whom the existing powers of the Board of Trade

relating to the supply of electricity be transferred. It recommends that the existing system of generating electricity for small areas be abolished. One of the first duties of the Electricity Commissioners would be to divide the country into districts technically suitable for the generation and distribution of electricity. In each district an Electricity Board is to be set up, which will purchase all the generating stations in it. These Electricity Boards are to be financed in whole or in part with Government assistance, and are to make no divisible profits. The Committee laudably strives to conciliate those authorities and engineers who are adversely affected by its proposals. It claims, however, extended powers for the use of overhead wires, wayleaves, and the acquisition of water rights. From the practical point of view the proposals are good, and their adoption, provided that they could be smoothly carried out, would be greatly in the national interests. We hope that Parliament will give to these proposals its most serious consideration.

THE EDUCATION BILL.

THE debate on clause 10, the most important feature of the Education Bill, was resumed in Committee of the whole House on Wednesday, June 5, and continued on June 10 and 11. Sir H. Hibbert submitted, at the instance of many Lancashire Members, an alternative scheme to that of the Bill, whereby, at the option of the local authority, half-time between fourteen and sixteen years of age and thenceforward no compulsory scheme of continued education might be substituted for the proposal in the Bill to require between the ages of fourteen and eighteen a maximum of 320 hours in each year to be included within the ordinary working hours. Mr. Fisher opposed the amendment on the ground that it could not be made mandatory over the whole country, that it would seriously reduce wages, introduce confusion into administration, and would practically double the demand for teachers and for school accommodation. To the great disappointment of many friends of the measure, and especially of this important and vital feature of it, Mr. Fisher, in response to representations not only on behalf of the textile industry, but also in respect of agriculture and of coal-mining, submitted amendments to section i. of clause 10 reducing the compulsory hours in each of the four years from 320 to 280, if the local authority so resolve, and providing that the obligation to attend continuation schools shall not, within the period of seven years from the appointed day on which the provisions of clause 10 (i.) come into force, apply to young persons between the ages of sixteen and eighteen. The Lancashire Members thereupon withdrew their opposition, and Mr. Fisher's amendments were adopted, together with an amendment leaving the local authority free to deal with the times and seasons best suited to the circumstances of each locality. Difficulties of buildings, equipment, and the supply of teachers had doubtless something to do with this decision, but the great advantage gained by the concession is permanently to secure the educational oversight of the adolescent until he reaches the age of eighteen. On Monday Mr. Fisher accepted an amendment by which it was agreed to establish a national scheme for training boys who desire to enter the mercantile marine. Sir Philip Magnus moved to amend subsection 2 in such a way that the recognition of a school as efficient by a British university, equally with such recognition by the Board of Education, should make full-time attendance in that school up to the age of sixteen years a ground of exemption from the obligation to attend continuation schools. After discussion the amendment was withdrawn, and Mr. Fisher agreed to substitute for the words "under arrangements approved by the Board of Education" the words "under regulations made by the inspecting body after consultation with the Board of Education."

It was suggested in the discussion on Tuesday that pressure might be brought to bear upon young persons to attend continuation schools at or in connection with their place of employment. An amendment was afterwards accepted against any such compulsion by a local authority without the consent of the young person or his parents. Clause 10 was finally agreed to as amended.

LIGHT AND VISION.[1]

THE phenomena which take place between the incidence of light on the cornea and the mental appreciation of the fact may conveniently be divided into three stages:—

(1) The production of an image on the retina by means of the dioptric system of the eye. This is purely a physical question, and has been very completely worked out. The only component of a physiological nature is the mechanism of accommodation, by which the curvature of the lens is changed in order to vary the focal length of the system. It would appear that the muscular mechanism here involved is liable to fatigue, and doubtless plays its part in the choice of appropriate methods of illumination, as in the tests used by Ferree.[2] It will also be plain that insufficient illumination requires more exact and tiring accurate adjustment of focus.

(2) When light arrives at the particular layer of the retina known as that of the rods and cones, it excites a photo-chemical change of some kind, which in its turn acts upon the terminations of the optic nerve-fibres and sends along these fibres a series of disturbances which we call nerve impulses.

(3) Arriving at the brain, these impulses are distributed to a complex system of centres composed of nerve-cells, where processes occur associated, in some mysterious way, with the conscious perception of light and illuminated objects.

We naturally ask the question:—What kind of sensation do we experience if the optic nerve is stimulated in other ways, as can be done by means of sufficiently powerful agents? The answer is that whatever be the way in which the optic nerve is stimulated, the sensation is one of light. This statement applies, altering light for sound, taste, etc., to all the nerves of special sense, and is commonly known as Müller's law. In point of fact, it had been formulated by Sir Chas. Bell at an earlier date, though perhaps in not so complete a form. The sensation, then, is an affair of the brain, the "cerebral analysers," as Pavlov calls them, and provided that this part of the brain is set into activity, it matters not by what means, the sensation is the same. This again applies to all the special senses. What, then, is the function of the elaborate structure at the peripheral end of the nerve? Such organs are known in general as "receptors," and their function may be grasped if we try to stimulate the optic nerve by throwing a beam of light upon it. Nothing happens at all, because the nerve-fibres are not responsive to light energy. Some sort of mechanism that is affected by this form of energy must be provided, and is to be found in the rod and cone layer of the retina.

But what is passing along the optic nerve when a light sensation is experienced is identical with that

[1] Abridged from a paper read at the meeting of the Society of Illuminating Engineers on April 16 by Prof. W. M. Bayliss, F.R.S.

[2] Trans. Illumin. Engineer. Soc. (U.S.A.), vol. viii., p. 40, and Ferree and Rand, *ibid.*

passing along the auditory nerve when a sound is heard.

In addition to the rod and cone layer, the retina of the vertebrate contains several layers of nerve-cells. These do not really belong to the receptor organ itself, but are probably of the nature of relays. In the cuttle-fish they form a separate mass, outside the eye itself.

We know that the cones are sensitive to light, because they are the only elements present in the most sensitive spot of the retina, the fovea centralis. That of the rods is more disputed, but their nervous connections are similar to those of the cones, so that it is difficult to believe that they are not also receptors for light.

The only satisfactory explanation of the mode of stimulation of the retina by light is that it is through the intermediation of a chemical reaction brought about by radiant energy of a limited series of wave-lengths. As yet only one substance sensitive to light has been discovered in this situation. This is usually known as "visual purple," but its actual colour would be described by most people as deep rose red.

Remembering, in the first place, Grotthus's law, that light can produce an effect only in proportion as it is absorbed, it is of importance to investigate the absorbent properties of visual purple as regards that part of the spectrum which is visible to us. This has been done by Victor Henri and Larguier des Bancels.[3] They determined the absorption of light by solutions of visual purple, compared it with the degree of chemical action, and also with the minimal amount of light energy required to excite a just perceptible sensation from the peripheral parts of the retina. The determinations were made throughout the visible spectrum, and the three curves show a remarkable agreement. These facts show that visual purple is at least the most important photo-chemically sensitive component of the retina, if not the only one. We note also that there are no absorption bands in its spectrum, so that there is no difficulty with respect to colour vision. An interesting fact comes out from the curve of sensibility of the retina compared with the energy of the light acting. At that particular frequency of vibration corresponding with the yellow-green, the threshold of stimulus coincides with the energy quantum of Planck for that rate of vibration. In other words, the retina is sensitive to as small an incidence of energy as it is possible for it to receive.

Very little is known as to the chemical nature of visual purple. It exists in colloidal solution in a liquid in which the rods and cones are immersed. Although it is not produced in the fovea itself, Dr. Edridge-Green has found evidence that it flows in from surrounding parts.

The best information to be obtained of the course of the photo-chemical reaction is obtained from records of the electrical changes which occur on the incidence of light. The simpler curve given by the eye of the cuttle-fish is to be regarded as indicating the essential part of the phenomenon; the more complex form of the vertebrate curve is probably due to the presence of the extraneous nerve-cells. The chief points to be noticed are the following:—

First, the curve gradually falls, the stimulus merely disappears, on the advent of darkness. There is no indication of a stimulus of any kind produced by darkness. This is contrary to the well-known theory of Hering, according to which the reaction of restoration, occurring when the light ceases, is associated with a positive sensation of darkness. This point of view had been applied to physiological phenomena in general, but is now practically given up.

[3] V. Henri et J. Larguier des Bancels, *Journ. de Physiol. et Pathol.* ol. xiii., pp. 841–56 (1911).

Secondly, the curve, after it has attained its maximum, remains constant while the illumination lasts.

Thirdly, the reaction does not attain its full intensity suddenly, nor do the products disappear suddenly. In other words, the sensation does not appear at once, nor does it immediately disappear when the stimulus ceases. This is the obvious explanation of the absence of flicker when the alternations of light and darkness are sufficiently rapid. Further, as would be expected from a chemical reaction, the greater its magnitude, the longer it requires for the products to recombine or otherwise disappear. Incidentally, the form of the curve differs somewhat for different colours.

Fourthly, there is a short latent period between the time of incidence of light and the electrical effect. If this is not counterbalanced by a similar period after the illumination ceases, it would result in some deviation from Talbot's law in its physiological aspect, such as has been described by Parker and Patten. The latent period reminds us of the "photo-chemical induction" of Bunsen and Roscoe.

There is reason to believe that the maximum sensibility of the fovea is not when it is the only part of the retina illuminated, but when there is simultaneously a weak illumination of the surrounding parts. This seems to be connected with the production and movement of the visual purple. If it be the fact, its importance in observations with the microscope, the polarimeter, and other optical instruments is obvious.

The explanation of positive and negative after-images is fairly plain—the former by the products of photo-chemical change not disappearing at once, the latter by temporary exhaustion of the visual purple. Edridge-Green[4] has shown that the situation and shape of the positive after-image can be altered by jerking the head, showing that the chemical change is located in the liquid surrounding the rods and cones. Hence these structures must be affected secondarily. The negative after-image is fixed, indicating a situation in the more solid parts of the receptive mechanism.

The adaptation of the retina to various degrees of illumination—an important fact in daily life—is probably due to a change in the position of the pseudo-equilibrium which results from the fact that the products of a reversible photo-chemical reaction are continually recombining during the illumination itself. The circumstance that this adaptation is not a very rapid process is of importance in relation to the practical aspect of artificial illumination, and shows that sudden changes in the lighting of neighbouring objects are not desirable. The suggestion that the ratio of brightness of objects to which the eye turns should not exceed 1 : 100 seems a reasonable one.

The problem of "glare" is also connected, although the fact of the unpleasant and injurious effect of powerful local stimulation of the retina has also to be taken into account. But, like so many of the practical problems we meet with, it requires much more investigation, and the co-operation of the physiologist, the illuminating engineer, the oculist, and the factory inspector is much to be desired.

The effect of lateral illumination brings up the question of the function of the rods as distinct from that of the cones, as do also vision under weak illumination and that known as "night-blindness." The first problem has been very able treated by Dr. Herbert Parsons in a Home Office report, while the enormous range of intensity of the light perceived has been emphasised by Mr. Trotter. This degree of "adaptation" is much greater than could be accounted for by varying apertures of the pupil.

The question of the colour of the light in relation

[4] *Journ. of Physiol.*, vol. xlv., p. 70.

to fatigue has been brought to my notice. According to Ferree's observations, either a yellow or a blue tint is more fatiguing than a white light. The difficulty of a satisfactory test for fatigue of the visual mechanism arises here, and we have to deal with a very complicated set of factors. Many of the tests used seem to indicate muscular fatigue either of the extrinsic eye muscles or of the mechanism of accommodation. Moreover, the large question of general fatigue is involved. Tests such as those used by Dr. Stanley Kent would give valuable information as to the effects of various systems of illumination, and especially as to what are to be regarded as defective. It may be pointed out that the present conditions are unusually favourable to investigations of this kind in factories under Government control. An equally important series of questions has been raised by Mr. Gaster, namely, the effect on school children with normal and with imperfect vision of working in adequate light. Data on all these points would be of great value.

Whatever may be the precise results obtained from such investigations, there can be no doubt that children should not be compelled to do their home-work in bad lighting conditions, however necessary it may be to effect a saving in the consumption of gas and electric current. A more widely spread diffusion of information as to ways in which saving may be effected without injurious results is much to be desired.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A memorandum emphasising the urgency of making formal provision for the encouragement of the study of geodesy and geodynamics in the University, and recommending the early establishment of a readership in these subjects if a suitable endowment can be obtained, has been submitted by the Special Board for Mathematics to the General Board of Studies. The latter has reported that it fully concurs in the importance of the early establishment of such a readership. In its memorandum the Special Board gives reasons why special provision and formal recognition for geodesy and geodynamics is particularly called for at the present time in the University. The progress on the theoretical side of the science of the figure of the earth has been promoted in the past very largely by investigators belonging to Cambridge in connection with the scientific problems presented both by the British and by the Indian Surveys, trigonometrical and gravitational. More recently the interconnection of the Surveys of different nations has made the subject an international one, and for the last twenty years the headquarters of the International Geodetic Association, supported by subventions from the various Governments, has been at Potsdam. Reconstruction is called for in the near future, and this country ought to be in a position to resume a large share in the direction. The establishment of a British Imperial Geodetic Institute, with State endowment, is now being urged by responsible scientific bodies, and some institution of the kind will be necessary. Whatever arrangements may be made on the technical and administrative side, the theoretical side, which is the foundation of all progress, is a subject of pure mathematical and dynamical science, and can best be advanced by the universities. In order for Cambridge to retain her historical position in the advance of this important science, and to take part in the training of the men who will be required for its prosecution, some special provision and formal recognition for the subject are called for under modern conditions.

OXFORD.—On June 8 a numerous company assembled in the Sheldonian Theatre to hear Mr. Asquith deliver his Romanes lecture on the Victorian age. The chair was occupied by Lord Curzon of Kedleston, Chancellor of the University, who took occasion to denounce "the gross and gratuitous defamation of the character of our public men." Mr. Asquith, after speaking of the financial and commercial activity which formed one of the chief characteristics of the Victorian age, and the prominence of the novel among the literary productions of the time, went on to offer a brief appreciation of the most famous names in the period under review. Towards the end of his discourse he touched upon the great scientific movements initiated by Victorian chemists, physicists, and biologists, selecting for special mention Faraday, Kelvin, and Darwin. Disclaiming all qualification to speak as an expert, or to hold the balance between antagonistic views as to the method of evolution, he nevertheless paid tribute to the spirit of single-minded investigation manifested by Darwin and to the unselfish and generous manner in which Wallace had minimised his own merits as a co-discoverer with Darwin of the principle of natural selection. The celebrated retort by Huxley upon the ill-judged attack of Bishop Wilberforce was once more related before an Oxford audience, and Mr. Asquith ended by declaring his own conviction that, whatever man's physical pedigree, he had reached a stage in development which raised him into an essentially different category from that of other living beings, and endowed him with qualities which could only be appreciated and expressed by "the poet who had the gift of vision."

On June 11, the anniversary of the burial of Roger Bacon within the precincts of the Grey Friars at Oxford, the first visitation took place of the memorial tablet which was affixed to the city wall in October, 1917.

MR. P. L. BERNSTEIN, of the Municipal College of Technology, Manchester, has been appointed lecturer in electrical engineering at the Hull Technical College.

A HOLIDAY course in psychology, arranged for teachers and others, is to be held at Bedford College for Women, Regent's Park, from August 1 to 10 inclusive. It will include lectures on psychological topics, and afford opportunities for individual laboratory work. Particulars are obtainable from the Principal of the College.

TWO Chadwick public lectures on "Our Fisheries and the Food Supply" will be delivered in London by Prof. D'Arcy Wentworth Thompson on June 21 and 28, at 5 p.m. The first lecture, on "The Catch by Line and Trawl," will be given at the Mansion House, and the second, on "The Catch by Net, or the Great Herring Fishery," at the Surveyors' Institution, Westminster. Admission will be free. Further particulars of these and other Chadwick public lectures may be obtained of the Secretary at the offices of the Trust, 40 (6th) Queen Anne's Chambers, Westminster.

THE serious shortage in the supply of teachers for elementary schools is again dealt with in the Report of the Board of Education for the year 1916–17 (Cd. 9045), which is now available. The total number of boys and girls beginning in 1917 to train for the career of teaching was 6158, as compared with 6544 in 1916, and 9614 in 1908. From 1908 there was a steady decline down to 1912 in the number of entrants, when it had fallen to 5232. This was followed by a period of recovery, the number reaching 7047 in 1915, since which date it has steadily fallen again. The imme-

diate cause of the decline which has again set in is to be looked for in the war, though, as the report points out, the end of the war cannot of itself be expected to remedy the evil. A specially serious feature of the present situation is that the progressive decline now going on comes at the end of a series of years, during which the number of entrants has been altogether insufficient for the needs of the country. The report states emphatically that there is no hope of meeting this shortage except by a substantial increase in the salaries of adult teachers and by a general improvement in the prospects of the teaching profession. There is little hope at present of securing an increase in the length of the school-life of elementary-school pupils or of reducing the size of classes—two measures of crying importance—because both improvements depend upon an increased supply of teachers.

AN interesting and suggestive address on "A Londoner's Opportunity in Commerce," under the auspices of the Education Committee of the London County Council, was recently delivered in the Kingsway Hall to the students of the educational institutions in London by the Minister of Labour, the Rt. Hon. G. H. Roberts. The address dealt with the much-increased facilities now offered in London for the due education and training of those engaged in commerce, and it appeared that there were now in attendance as many as 100,000 students in fifty-nine senior and ninety-eight junior institutes. The Minister pleaded that full opportunity of a generous education based upon liberal lines should be available for all the children of the nation. Talent was widely diffused, and was centred in no particular stratum of society. The future abides with those peoples whose standard of education, both technical and moral, is of the highest order. The State must devise some means of ensuring that no child is wasted. Scientific training, not only vocational, but to fit the child for his full duties as a citizen, was indispensable if the nation is to be in a position to meet successfully the crucial problems and the severe competition which will inevitably arise at the close of the war. There must be a closer union and identification of interests between employer and employed and of Government departments concerned with the problems of labour and education, since the one reacts upon the other. If this be ensured, along with the diffusion of education amongst all classes of the community, the future of the country will give no cause for anxiety, since the British people, with their great traditions, and keen to exercise their great qualities, need not fear the rivalry of any existing race in the world. Out of the horrible evil which the war has brought in its train some good has at least arisen, since it has awakened our people to the value of education and to the necessity for measures to give it full and fruitful effect.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 30.—Sir J. J. Thomson, president, in the chair.—Prof. J. **Joly**: Method of avoiding collision at sea. The method of avoiding collision at sea now proposed involves the determination of distance between ship and ship at regulated intervals by means of synchronised signals (preferably wireless and submarine). The principle involved is that ships which are advancing so as to collide approach one another with constant velocity, *i.e.* the relative velocity is constant. If they are going to pass clear the relative velocity is not constant, diminishing to nothing when the vessels are at the passing distance, and then changing sign. The paper embodies tables and curves showing the variations of relative velocity for different passing distances. Assuming that a quarter of a sea-mile is distinguishable by the use of synchronised signals, the method appears to be certainly available for a passing distance of half a mile. Mechanical aids towards increasing the trustworthiness of observations and facilitating them are described. The advantages of the method are chiefly that it involves no special inter-communication between ship and ship (other than the regulated synchronised signal supposed to be emitted by all vessels navigating in fog or thick weather), and that the distance separating the vessels is necessarily kept under observation throughout.—Dr. R. A. **Houston**: A statistical survey of colour vision. The colour vision of seventy-nine students was tested by the method of Dr. Edridge-Green's colour-perception spectrometer. Three of the seventy-nine were found to be colour-blind. The number of observers containing a given number of patches was plotted against the latter, and a frequency curve obtained. If the Young-Helmholtz theory is true, this curve should have two maxima, one for normal colour vision and one for dichromatism. The results show, however, that normal colour vision has quite enough "scatter" to explain colour blindness as an outlying portion of itself, and that it is not necessary to assume the existence of a separate maximum. Various points of interest in connection with the observations are discussed, and it is suggested that a more extensive survey made on similar lines at different places might settle definitely once for all the vexed question of colour-vision theory.—Dr. A. E. **Everest**: The production of anthocyanins and anthocyanidins. Part iii. The paper is a continuation of the author's previous work, and deals with the mode of formation, in Nature, of the anthocyanin pigments. Available data concerning the co-existence of anthocyans and flavonol derivatives are discussed, and preliminary experiments with a view to the elucidation of the manner in which the anthocyanin pigments are formed in plants are described. For the first time direct chemical evidence is recorded which supports the prevailing view that the anthocyanin pigments are produced in Nature *via* flavonol derivatives, it being shown, with a very considerable degree of certainty, that in the flowers examined (purple-black viola) the anthocyanin pigment exists side by side with a glucoside of the flavonol derivative, from which the anthocyan would be produced by reduction. The isolation, from the purple-black viola (Sutton's "Black Knight") of a pigment identical with Willstätter's violanin, and experiments to show the presence of a myricetin glucoside in the same flower, are described.

Physical Society, May 10.—Prof. C. H. Lees, president, in the chair.—Dr. S. **Chapman**: The times of sudden commencement of magnetic storms. The paper is a discussion from a new view-point of the data, collected by Dr. Bauer, for fifteen magnetic storms. Maunder's work on the recurrence of magnetic storms at intervals equal to the rotation period of the sun suggests that storms are due to some solar agent transmitted along narrow, well-defined streams issuing from and rotating with the sun. This suggests the view that the relative time of commencement of a storm at different stations depends mainly on the orientation of the latter at the time relative to the sun, *i.e.* on the local time at the station. This forms the basis of the classification in the paper.—Dr. H. S. **Allen**: The entropy of a metal. An expression for the entropy of one gram atom of a substance in the solid state has been given by Ratnowsky. In a communication to the Physical Society in 1916 the author gave the correct form of the approximation required for high

values of the absolute temperature in terms of Bernoulli's numbers. The data required for testing the formula have been supplied in a recent paper by Lewis and Gibson, who have given values for the entropy of the elements under the condition of constant volume, and also under constant pressure. These values were deduced from observations on the specific heat assuming the truth of the heat theorem of Nernst, that the entropy of every actual substance in the pure state is zero at the absolute zero of temperature. It is found that the formula of Ratnowsky gives values for the entropy of a solid in very close agreement with those obtained by Lewis and Gibson. The hypotheses assumed in the theory of Ratnowsky are discussed, and the conclusion is drawn that these are probably justified as being at least approximately true.—T. **Smith**: Tracing rays through an optical system.

CAMBRIDGE.

Philosophical Society, May 20.—Prof. Marr, president, in the chair.—B. **Sahni**: The branching of the zygopteridean leaf, and its relation to the probable pinna-nature of *Gyropteris sinuosa*, Goeppert. (1) The supposed quadriseriate "pinnæ" of forms like Stauropteris and Metaclepsydropsis are Tertiary raches, the vascular strands of the secondary raches (pinna-trace-bar, Gordon) being completely embedded in the cortex of the primary rachis. All Zygopterideæ, therefore, have a single row of pinnæ on each side of the leaf. (2) This revives the suggestion that *Gyropteris sinuosa*, Goepp., is a free secondary rachis of a form like Metaclepsydropsis. (3) The genus Clepsydropsis should include Ankyropteris, because (*a*) a fossil described in 1915 (Mrs. Osborn, Brit. Assoc. Rep., p. 727) combines the leaf-trace of Clepsydropsis with the stem of Ankyropteris, the leaf-trace in both arising as a closed ring; (*b*) in *C. antiqua*, Ung., also the leaf-trace arose similarly, as shown by a section figured by Bertrand (Progressus, 1912, Fig. 21, p. 228), in which a row of small tracheides connecting the inner ends of the peripheral loops represents those lining the ring before it became clepsydroid by median constriction.—The structure of *Tmesipteris Vieillardi*, Dang. The most primitive (least reduced) of the Psilotales. Specifically distinct from *T. tannensis* in (1) erect terrestrial habit, (2) distinct vascular supply to scale-leaves, (3) medullary xylem in lower part of aerial stem.—Acmopyle, a monotypic New Caledonian Podocarp. Indistinguishable from Podocarpus in habit, vegetative anatomy, drupaceous seed, megaspore membrane, young embryo, male cone, stamen, two-winged pollen, and probably male gametophyte. Chief differences:—(1) Seed nearly erect; (2) epimatium nowhere free from integument, even partaking in formation of micropyle; (3) outer flesh with a continuous tracheal mantle covering the basal two-thirds of the stone.

DUBLIN.

Royal Irish Academy, May 13.—The Most Rev. J. H. Bernard, president, in the chair.—J. A. **McClelland** and J. **Enright**: Some properties of large ions. The paper deals mainly with the determination of certain constants in connection with large ions. One constant, for example, is measured, showing the rate at which small ions are attached to uncharged nuclei so as to form the large ions. The rates of recombination of large ions and of large and small ions are measured, and also the average charge on the large ions.

May 27.—The Most Rev. J. H. Bernard, president, in the chair.—H. C. **Plummer**: The symmetrical optical instrument. Schwarzschild has discussed the third-order errors of a symmetrical optical instrument on the basis of Hamilton's characteristic function. This treatment leads to the desired end by assuming the results of the Gaussian first approximation. In the present paper the order of development is reversed and a self-contained theory is obtained. This has the advantage of greater simplicity and directness, and it also makes clearer the actual degree of approximation, which would concern the development to a still higher order if required. The conditions for this further development are indicated. The aberrations for a mirror system are deduced directly from those for a refracting system.

Royal Dublin Society, May 28.—Prof. J. A. McClelland in the chair.—Dr. W. E. **Adeney** and H. G. **Becker**: The rate of solution of atmospheric nitrogen and oxygen by water. Part i.: The rate of solution by thin films of water. In this communication the authors deal with the question of the rate at which atmospheric nitrogen and oxygen are dissolved by the surface layer of a quiescent body of water, apart from that of the rate at which the same gases after solution pass downwards through the lower layers of the water. A new method of studying the rate of solution of these gases by water, when the latter is exposed to them in thin films, is described and discussed. The method is shown to give accurate and important results.—Dr. G. H. **Pethybridge** and H. A. **Lafferty**: A disease of flax seedlings caused by a species of Colletotrichum and transmitted by infected seed. The disease described was submitted as a form of "yellowing," but has proved to be one of the "damping-off" type. The parasitic fungus is described as a new species under the name of *Colletotrichum linicolom*. Dormant mycelium is present within the epidermis of the seed-coat of affected seeds, and seedling infection occurs from this during or subsequent to germination. Disinfection of the seed with formalin and with hydrogen peroxide gave good results, but did not entirely suppress the disease. Infected seed has been found in samples coming from Japan, Russia, Holland, Ireland, Canada, and the United States of America.

PARIS.

Academy of Sciences, May 27.—M. P. Painlevé in the chair.—G. **Bigourdan**: The astronomical station of the College of Clermont (first period) and the astronomical expedition to Siam. History of work done at this station between 1652 and 1685, and an account of the astronomical expedition to Siam in 1687.—H. **Le Chatelier** and B. **Bogitch**: The use of the Brinell ball for testing construction materials. For cements and silica bricks the method is modified by introducing a thin sheet of foil between the ball and the material under test, the impressions being then measured on the foil. Preliminary experiments with blocks of lead and copper proved that the use of the foil did not modify the diameter of the imprints. Tests with cement, plaster, silica brick, and clay brick showed that the variations from the mean were much less than in the usual crushing test. The fact was brought out that the opposite faces of the same brick often show marked differences in hardness.—C. de la Vallée **Poussin**: The maximum of the modulus of the differential of a trigonometrical expression of limited order and modulus.—M. **Balland**: Wheat substitutes in munition bread. Details of results with seventeen substitutes for wheat in bread are given.—M. Brachet was elected a correspondant for the section of anatomy and zoology in succession to the late M. Francotte.—J. **Martinet**: Syntheses in the α-naphthindol series.—Mme. Karen **Bramson**: The manufacture of paper pulp from dead leaves. The paper pulp required by France in an average year amounts to about one-tenth that obtainable from the dead leaves produced. As by-products 1000 kilograms

of leaves would give 200 kilograms of pure charcoal, 30 kilograms of tar, 1 kilogram of crude acetic acid, and 600 grams of acetone.—C. **Galaine** and C. **Houlbert**: The carbonisation and distillation of peat, sawdust, house refuse, and other light organic products. A continuous process of distillation is described with rotary retorts, securing uniformity of carbonisation, with recovery of gas and by-products.—H. **Colin** and Mlle. Y. Trouard **Riolle**: The graft of the sunflower on the Jerusalem artichoke.—F. **Morvillez**: The leaf-trace of the Chrysobalanæ.—A. **Guilliermond**: Mitochondria and vacuolar system.

MELBOURNE.

Royal Society of Victoria, April 11.—Mr. J. A. Kershaw, president, in the chair.—Miss A. **Osborne**: An abnormality of the frog, *Hyla aurea*. Although abnormalities in the arrangement of the anterior veins are fairly common in this genus, a departure from type is more rare in the case of the posterior vessels. In the specimen described there were two right renal portal veins, one connecting with the iliac in the ordinary way, the other—apparently due to longitudinal splitting of the original single vessel—draining the posterior pelvic region, from which there was a rather more developed venous system than is usual.

BOOKS RECEIVED.

Stoichiometry. By Prof. S. Young. Second edition. Pp. xiv+363. (London: Longmans and Co.) 12*s*. 6*d*. net.

Cookery under Rations. By M. M. Mitchell. Pp. 65. (London: Longmans and Co.) 2*s*. net.

A Medical Dictionary. By W. B. Drummond. Pp. ix+625. (London: J. M. Dent and Sons, Ltd.) 10*s*. 6*d*. net.

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. v., No. 1. Cœlenterata. Part i., Actiniaria. By T. A. Stephenson. Pp. 1–68. (London: British Museum (Natural History).) 10*s*.

Essentials of Practical Geography. By B. C. Wallis. Pp. xv+213. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*.

Field Book of Insects. By Prof. F. E. Lutz. Pp. ix+509. (New York and London: G. P. Putnam's Sons.) 12*s*. 6*d*.

The Dispensatory of the United States of America. by Prof. J. P. Remington and others. 20th edition. Pp. cxxii+2010. (Philadelphia and London: J. B. Lippincott Co.) 2*l*. 1*s*. net.

Studies in Electro-Physiology (Animal and Vegetable). By A. E. Baines. Pp. xxix+291. (London: G. Routledge and Sons, Ltd.) 12*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 13.

ROYAL SOCIETY, at 4.30.—Experiments on the Effect of the Vibration of a Stretched Wire forming part of a Closed Electric Circuit: Admiral Sir Henry Jackson.—The Effect of Wind Pressure on the Pitch of Organ Pipes: A. Mallock.—The Diamagnetism of Hydrogen and the Value of the Magneton: Dr. A. E. Oxley.

OPTICAL SOCIETY, at 7.—The Prevention of Filming in Enclosed Optical Instruments: H. S. Ryland.—A Chart for Finding the Number of Lenses in, and Size of, a Block: Horace Lee.—Charts for Assisting in the Selection of Suitable Glasses for Cemented Doublets: T. Smith.

MATHEMATICAL SOCIETY at 5.—Hellinger's Integrals: Prof. E. W. Hobson.—An Assumption in the Theory of Singular Solutions of Ordinary Differential Equations of the First Order: Prof. M. J. M. Hill.—Quartic and Cubic Residuacity Tables: Col. A. J. Cunningham and Th. Gosset.—Lucas's Process applied to Composite Mersenne Numbers: Col. A. J. Cunningham.—The Gaussian Period Numbers and the Conditions that 2 should be a Residue of a 16th or a 32nd Power: Dr. A. E. Western.—The Aberrations of a Symmetrical Optical System: T. W. Chaundy.—The Rotation-groups of the Regular Figures in Four or more Dimensions: T. Lindsay Ince.

FRIDAY, JUNE 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Literal Development of the Motion of the Lunar Perigee: R. Moritz.—William Herschel's Observations of Variable Stars and Stars suspected of Variability.—The Measurement of Time to the Thousandth of a Second: R. A. Sampson.—The Motion in Longitude of the Red Spot on Jupiter: Rev. T. E. R. Phillips.—The Stellar Magnitude Scales of the Astrographic Catalogue. 12th Note; Hyderabad, Perth, Edinburgh, and Cape Magnitudes: H. H. Turner.—An Example of the Determination of a Minute Periodic Variation as Illustrative of the Law of Errors: S. Chapman.—The Pulsation Theory of Cepheid Variables: F. A. Lindemann.—*Probable Papers:* The Proper Motions of the B Stars: Sir F. W. Dyson.—Observations of a New Star in Aquila.—W. H. Steavenson.—The Origin and Energy of Magnetic Storms: Dr. S. Chapman.

PHYSICAL SOCIETY, at 5.—*Discussion:* The Teaching of Physics in Schools: Opener, Sir Oliver J. Lodge.

MALACOLOGICAL SOCIETY, at 7.—Notes on Magilus and Allied Genera: G. B. Sowerby.—Note on an Unpublished Reprint of a Paper by J. W. Brazier, published in the *Sydney Mail* of December 2, 1871: H. O. N. Shaw.—On a Supposed New Genus of Pelecypoda from the Older Tertiaries of Southern Nigeria: R. Bullen Newton.

MONDAY, JUNE 17.

VICTORIA INSTITUTE, at 4.30.—Annual Address. 'The Future of Education: Prof. D. S. Margoliouth.

TUESDAY, JUNE 18.

ROYAL STATISTICAL SOCIETY, at 5.15.—Annual General Meeting.—Recent Economic Developments in Japan in their Relation to her Trade with the United Kingdom: K. Yamasaki.

MINERALOGICAL SOCIETY, at 5.30.—The Origin of Septaria: W. A. Richardson.—The Composition of the Nickeliferous Iron of the Meteorites of Lodran, Powder Mill Creek, and Holbrook: Dr. G. T. Prior.

WEDNESDAY, JUNE 19.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Lunar Atmospheric Tide at Greenwich, 1854–1917: S. Chapman.—The Audibility of the Gunfire on the Continent at Chignal St. James, near Chelmsford, during 1917: Miller Christy.—Seasonal Variation in the Audibility of Distant Gunfire: F. J. W. Whipple.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Photo-synthetic Processes: Prof. Benjamin Moore.—A New Type of Infusorian, *Arachnidiopsis paradoxa*: E. Penard.—Diatom Ooze from Deep Antarctic Waters: E. Heron-Allen and A. Earland.—Gnats and Gnat Larvæ: J. M. Offord.

THURSDAY, JUNE 20.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Physiological Basis of Thirst: Major W. B. Cannon.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN AND CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.