THURSDAY, JULY 16, 1914.

LOCOMOTIVES AND RAILWAYS.

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

BOYS of to-day are indeed fortunate in their literature; books are available on most subjects, written to interest them—not merely fairy tales, but dealing with many themes in a scientific way and in language free from technical terms likely to worry the young mind.

The volume under notice is certainly one of the best of its kind, "Every Boy's Book of Railways and Steamships" by the same author was most interesting, but "The Railways of the World" is alluring; and as most boys love a locomotive and study railway working, they will indeed be delighted with the contents of this book and hasten to possess a copy.

To commence with, the usual account of the early locomotive and railway is dealt with: and, of course, Stephenson is given the lion's share of the credit. It is a pity that the earlier pioneers are being overlooked and forgotten. For instance, the Liverpool and Manchester and many other railways were projected and surveyed by William James, called by many "The Father of Railways," before Stephenson appeared on the scene. Again, the famous locomotive "The Rocket" was fitted with a multitubular boiler, the very soul of a locomotive, by the Stephenson's—this boiler being of William H. James's design, and used by Messrs. Losh and Stephenson, as recorded in an agreement dated September 1, 1821.

In a volume of this nature it is possible to deal with much interesting matter. In chapter iii. we find the locomotive past and present well treated. Stroudley's "Gladstone" awakens many reminiscences and we are only too pleased to find on page 421 that the author considers that "William Stroudley proved himself one of the cyclopean knights of locomotive engineering who have left their mark on British railway practice." With this we can cordially agree. Stroudley was the first locomotive engineer to pay attention to the details of locomotive design and his master hand can even now be recognised on many British railways.

Reference is made to the famous Caledonian engine No. 123, which did such remarkable work in "the race to the North" in 1888. This engine was built by Neilson and Co. of Glasgow, and not by the railway company as stated.

Chapter iv. is most interesting. Locomotives of to-day are described in a capable way, but as the space at our disposal is limited, detailed comment is impossible. We cannot, however, agree that "a built-up crank axle is screwed together," see page 102. The parts are heated and shrunk together, and sometimes have the additional security of a screwed plug in the joints.

It is interesting to note that our author refers to certain notable cases of heredity in locomotive engineering; many are, of course, interesting, but if the subject were pursued to the bitter end perhaps the records would not be so conclusive.

On page 358 the old fairy tale of building a six-coupled goods engine and tender in ten working hours is served up, but nothing is said as regards its cost. The inconvenience of specially preparing and arranging the work at the expense of disorganising the whole works for the time being is not referred to. If there was any economy the practice would be common, but, as a matter of fact, this is not the case.

The chapters dealing with Scottish railways are far too short. The locomotive history of the Caledonian railway is one of intense interest. The late Mr. Dugald Drummond of the London and South Western Railway became famous there, and more recently the magnificent locomotives, designed by Mr. J. F. McIntosh, have been the delight of locomotive connoisseurs; "The Dunalastair" being the first of his creation, the first with "the big boiler," a practice carefully followed ever since. "The Highland Chief," a fine sample of North British practice, and an excellent example of the big boiler policy is illustrated—facing page 482.

The volume concludes with interesting descriptions of Continental practice and that of other parts of the world, and the work has been well done. Nominally written for boys, the language used is sufficiently non-technical to be clear; on the other hand, the book will be found very interesting to the railwayman. The information is sound, the illustrations good, and the general appearance excellent. N. J. L.

PARASITIC PROTOZOA.

Some Minute Animal Parasites, or Unseen Foes in the Animal World. By Drs. H. B. Fantham and Annie Porter. Pp. xi–319. (London: Methuen and Co., Ltd., 1914.) Price 5*s.* net.

THIS volume gives an account of the principal Protozoa which produce disease in man and in animals associated with man, *e.g.* domestic animals, game, bees, etc. As the book is intended to be of service to different classes of readers it has been written in a semi-popular

style, and technical terms have been used sparingly. There is, however, no reason why the term "flea larvæ" should not have been employed instead of "tiny fleas" (p. 48), which is rather misleading. The introductory chapter deals with the structure and characters of the chief classes of Protozoa, and the ways by which the parasitic forms gain access to their hosts. The next chapter is on trypanosomes and their relation to tsetse-flies, and is followed by an account of the life cycles of the flagellate parasites Crithidia and Herpetomonas, which occur normally in the gut of fleas, lice, etc., and are liable to be confused with certain phases of blood-parasites. In the section on Spirochætes considerable attention is devoted to the vexed question of the shedding of granules. The authors have studied the granules in the large Spirochætes from molluscs and regard them as "spores," and consider "that the balance of evidence is somewhat in favour of the inclusion of the Spirochætes among the Protozoa."

In the account of malaria the interesting statement is made that within the last few years the authors have seen malarial parasites in the blood of children suffering from ague in the Fens, and have been able to secure specimens of *Anopheles maculipennis* "in whose stomachs cysts occurred and whose salivary glands teemed with sporozoites [of malaria]."

Eimeria (Coccidium), the organism of coccidiosis in birds, is fully described, and measures are indicated for preserving domestic poultry and hand-reared game-birds from the attacks of this parasite. The following chapters deal with Entamœba in man, Babesia (Piroplasma) in relation to "red water" in cattle, Theileria—the organism of East Coast fever in cattle in Africa, Leishmania in relation to kala azar, infantile kala azar and Oriental sore, microsporidiosis of bees (Isle of Wight bee-disease), various Protozoa parasitic in fish, the nasal parasite (Rhinosporidium) of man, and the parasite (Sarcocystis) of striped muscle. The two concluding chapters contain interesting accounts of the relations of parasitic Protozoa with their environment, their effects on their several hosts, and the economic importance of the study of Protozoa.

Throughout the work the authors have considered preventive measures, and have pointed out their prime importance in the fight against parasitic Protozoa.

The volume is illustrated by clearly-drawn text-figures; the magnifications of these figures might have been stated, as in the absence of such statement the general reader is apt to acquire an exaggerated idea of the size of, say, a Spirochæte.

The authors, who have themselves taken a considerable share in the investigation of several of the organisms described, have succeeded in giving a clear, accurate, and interesting account of the principal Protozoa which have been proved to exert so malign an influence on man and to limit his activities in ways innumerable.

GENERAL AND SPECIAL PHYSICS.

(1) *Sound. An Elementary Text-book for Schools and Colleges.* By Dr. J. W. Capstick. Pp. vii + 296. (Cambridge University Press, 1913.) Price 4*s.* 6*d.*

(2) *Die Brownsche Bewegung und einige verwandte Erscheinungen.* By Dr. G. L. de Haas-Lorentz. Pp. 103. (Braunschweig: F. Vieweg und Sohn, 1913.) Price 3.50 marks.

(3) *Photo-Electricity. The Liberation of Electrons by Light.* By Dr. H. Stanley Allen. Pp. xi + 221. (London: Longmans, Green and Co., 1913. Price 7*s.* 6*d.* net.

(4) *Course de Physique Générale. Leçons professées à la Faculté des Sciences de l'Université de Lille.* By H. Ollivier. Tome Premier. *Unités. Gravitation. Electricité et Magnétisme. Ions et Electrons. Symétries.* Pp. 716. (Paris: A. Hermann et Fils, 1913.) Price 18 francs.

(1) THIS text-book is one that many teachers will find suitable for recommending to students in their degree courses preparing for examination in sound. It is always gratifying to find the writer of a text-book on sound with some considerable knowledge of the fundaments of music. Dr. Capstick certainly does pay attention to this aspect of the subject and from this point of view there is nothing but praise to be said of it. In his first chapter he introduces the idea of intervals, and later he gives some very interesting chapters on consonance, musical instruments, and scales and temperaments.

In the parts that relate more especially to the physics of the subject, readers will not be quite so much at ease. There is a tendency for the theoretical treatment to lack clearness, and students reading for the first time will often be driven to consult a teacher. The same cannot be said of the descriptive parts of the subject, for these are treated in a very interesting way. In a book of this scope though, it is questionable whether it is a wise plan to follow Barton in consigning all account of acoustical measurements to one chapter. These would be much more in place if treated separately in connection with the theoretical treatment to which each applies. The descriptions in this chapter are undoubtedly good, and it is inter-

esting to find there some account of intensity and audibility measurements and also of experiments to test the theories of vowel sounds.

The value of the book is increased greatly by an excellent collection of examples.

(2) This work on the Brownian movements is the outcome of a dissertation of the author, which was an account of a new method of attacking the theory of the subject. This method in itself seems to open a very promising field, for it can be applied to various branches of physics. Its application to Brownian movements consists in putting down the equation of motion of a particle in the form

$$m\,du/dt = -wu + F,$$

where w is given by Stokes's formula, $w = 6\pi\zeta a$, and F is a force which alters in direction in an irregular manner due to collisions with the molecules of the liquid. The mean velocity of a particle is calculated after n collisions, and it is shown how the influence of the initial motion diminishes in importance as n increases. Then the mean distance that a particle gets from its starting point in time t is calculated, and this comes to be exactly the same as that calculated by Einstein, whose formula has been experimentally verified.

An example of the application of this method is to calculate the energy of a magnetic needle at the centre of the coil of a tangent galvanometer due to a succession of small impulses of current in the coil. Some other applications are given, one of which has been worked out by Prof. H. A. Lorentz.

The work includes an account of the history of the development of our knowledge of the Brownian movements. The methods and results of the most important experimental researches on the subject are given and the theories of Einstein, Smoluchowski, and others discussed. The work of Millikan and others on the Brownian movements in gases is given a prominent place.

The new method of treating this interesting subject will be found instructive. Also from the point of view of a general treatment it can be recommended to all seeking a connected account of work on Brownian movements.

(3) Under the heading Photo-Electricity, is usually understood the emission of electricity from a metal surface when light falls on it, and the present volume is the first to be published which is devoted almost entirely to that subject. Dr. Allen, however, also includes in his book certain other subjects that are allied to the main one, such as fluorescence and phosphorescence, photo-chemical actions, and photography. Other relations between electricity and light such as the alteration of the resistance of selenium by light are not discussed. This is quite easy to understand, for the author had quite a large task without that.

Anyone who wishes to obtain a good account of the photo-electric effect ought to read this book. The subject is treated historically so far as possible, and a very clear account of the principal experimental work on the subject is given. The whole subject is so vast that the author is to be congratulated for having collected such a mass of results as he has done. There is a clear account of the methods for measuring the photo-electric current and the velocities of the electrons. The chief results for metals and solids and fluids generally are given. An exceedingly interesting chapter on the effect for gases comes about the middle of the book, and the importance of this in general physics is indicated, such as, for instance, the ionisation of the upper atmosphere.

Perhaps the most difficult task for the author was to give an account of the theories which have been advanced, and to decide on one as the most probable. In the present state of the subject Dr. Allen has taken the wisest course in deciding that the selective effect points to a resonance between the light and the electrons in the molecules, and indicating that the normal effect is most probably due to the same cause.

Readers will find the chapter on fluorescence and phosphorescence very interesting. A very clear account of Stark's and Lenard's views on these subjects are given. So also will practical photographers be interested in the chapter on photography. But the chief importance of the book is its value to the physicist who has not time to read through all the literature on photo-electricity and wishes to get a connected account of it.

(4) This is the first of three volumes which give in book-form the substance of a course of lectures on general physics at the University of Lille, 1911–13. The present volume is devoted chiefly to electricity and magnetism, which is treated under the headings Electrostatics, Magnetism, Current Electricity, and Electrons and Ions. In addition there are chapters on Gravitation and the Symmetry of Systems. Every part is treated so as to introduce the newest results. New work like the diffraction of X-rays by crystals, Barkla's work on X-rays, C. T. R. Wilson's photographs of the paths of single ions, and the magneton theory follow so logically each in its place, that one does not find it strange to see these newest developments in a general text-book. Many students will find the book of value because of the very clear account given of the most modern work in physics.

One new subject introduced is the symmetry of systems, which is really a summary of the work of P. Curie, and English readers will be thankful for having so easy a means of acquiring a knowledge of this important subject.

The book does not pretend to be an encyclopædia of physics, but it treats of the whole subject so as to bring students up to a standard when they can feel confident in taking up research on some definite subject. In other words, it meets the requirements of the standard of the Honours B.Sc. Examination. The whole book is clearly written, and teachers will have no hesitation in leaving students alone with it.

Another excellent feature is the treatment of a gravitational field first, and then later an electrostatic field where it is only necessary to give analogies with the former case. Here, generally, the Cartesian notation is used, but the Vector notation is explained without much use being made of it.

One of the most striking drawbacks of the book is the lack of an index. J. R.

LOGIC, TEACHING AND PRACTICE IN MATHEMATICS.

(1) *The Algebra of Logic.* By Louis Couturat. Authorised English Translation by Lydia G. Robinson. With a Preface by P. E. B. Jourdain. Pp. xiv+98. (London and Chicago: The Open Court Publishing Company, 1914.) Price 3*s.* 6*d.* net.

(2) *An Algebra for Preparatory Schools.* By Trevor Dennis. Pp. viii+155. (Cambridge University Press, 1913.) Price 2*s.*

(3) *Test Papers in Elementary Algebra.* By C. V. Durell. Pp. viii+233. (London: Macmillan and Co., Ltd., 1914.) Price 3*s.* 6*d.*

(4) *Practical Mathematics for Technical Students.* Part I. By T. S. Usherwood and C. J. A. Trimble. Pp. 370. (London: Macmillan and Co., Ltd., 1914.) Price 3*s.* 6*d.*

(5) *A Text-book on Spherical Trigonometry.* By Prof. R. E. Moritz. Pp. vi+67. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 4*s.* 6*d.* net.

(6) *Plane and Spherical Trigonometry* (with Five-Place Tables). By Prof. R. E. Moritz. Pp. xvi+357+67+96. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 10*s.* 6*d.* net.

(1) THIS is an excellent translation of M. Couturat's well-known "Algèbre de la Logique." The conciseness and modernity of M. Couturat's book is very apparent when we compare it with the first two volumes of Schröder's bulky, prolix, and somewhat antiquated work. The book under review is, as is remarked in the preface (p. viii.; *cf.* pp. 92–93), an exposition of the beautiful and simple calculus of symbolic logic, regarded as a branch of universal algebra. Leibnitz distinguished the two most important aspects of a symbolic language designed for purposes of reasoning, under the names *calculus ratiocinator* and *characteristica universalis*: the latter indicates broadly the route taken by Frege, Peano, Russell, and Whitehead; the former the route taken by Boole, Jevons, Venn, Schröder, and others, and is that described in the present work. Between these two routes, the "logic of relations" lies, and this is not dealt with here; but we are given a complete presentation of the important modern work of Whitehead (1898, 1901), Johnson (1901), Poretzsky (1899–1904), and Huntington (1904) on the logic of classes and propositions. Miss Robinson has added several valuable notes to her translation. The volume is neat and handy, and is an important addition to our English mathematical literature.

(2) "The development of the subject is based on psychological rather than logical principles." Here we have a sensible admission of the relation in which a text-book should stand to a scientific treatise, which the text-books of the past helped to obscure. The book consists of a series of graduated papers which exactly follow the lines of the syllabus issued by the curriculum committee of the Headmasters' Conference, and approved by the general committee of the Mathematical Association for all boys, except mathematical specialists, in public schools. There is no "book-work," and the subject is developed wholly by means of examples; but some attempt has been made to give the pupil an impression of the existence of foundations of the subject and some sense of their nature. The very first question of the book is rather characteristic: "A boy has 5*d.* and is given 3*d.* How much has he now? How much has he if he had 5*d.* and receives *x* pence? . . .", and so on. The last question of this paper is: "Make up more questions like these and give the answers." This is an excellent way of teaching, and there is a freshness about the book.

(3) This is a collection of papers designed primarily for out-of-school work, and consequently includes only few graphical questions. The papers follow the traditional course of elementary algebra, along the thorny path of quadratics, logarithms, the progressions, combinations, and easy probability, up to the giddy heights of

mathematical induction and the binomial theorem. The place assigned, as is usual in text-books, to mathematical induction shows how broad is the gulf between psychology and logic. The collection should prove useful.

(4) It is pleasant to read such a practical book as this one. The authors have dealt only with those parts of mathematics which seemed to them to be of real value in practical work, and the whole book is pervaded by the spirit of Prof. Perry. The very form of the questions is refreshingly non-academic: we are concerned with the important things of life—with kilowatts, gearing, and Whitworth standard nuts. It would seem to be a mistake to give (as on p. 257) areas and volumes of certain figures, and then remark:

"The formulæ are proved most conveniently by the aid of more advanced mathematics than need be given in this volume." It warms one's heart to see (p. 5): "*A formula* is practically the simple single statement in general terms of a whole series of particular facts." It seems to us that Prof. Perry and his school are doing much incidentally to help the development of mathematics by opening our eyes to the fact that what Boole called "a premature converse with abstractions" is ruinous for a boy's whole mental life.

(5) Is simply a reproduction of the second part of (6) with a new preface. Whereas the preface of (6) gives a list of the "distinctive features" of the book, (5) states somewhat ambiguously: "Whatever unusual merit the book possesses must be largely sought for in the following points. . . ."

In (6), then, we find that, both in plane and in spherical trigonometry, triangles are solved in detail by graphical methods before analytical methods are presented, and there are many other innovations—thus, Napier's rules are proved and the three fundamental formulæ for the spherical triangle are derived simultaneously. Having read (p. v.): "The references to algebra are limited to those with which every beginner may be reasonably assumed to be familiar," we are surprised to find (p. 278) the imaginary unit defined shortly as the solution of the equation $x^2+1=0$, no evidence having been given that this equation has a solution. After this, we cannot be surprised that there is not the slightest attempt either to point out to the student the very great and fundamental difficulties that there are in the theory of convergence (see especially p. 312) or even to treat the subject correctly. The historical references are sometimes faulty: Wessel was a Dane and not a German; the trigonometrical form of a complex number is due to Euler and not to Cauchy (p. 285). ϕ.

OUR BOOKSHELF.

The Schools and the Nation. By Dr. Georg Kerschensteiner. Authorised translation by C. K. Ogden. Pp. xxiv+351. (London: Macmillan and Co., Ltd., 1914.) Price 6*s*. net.

THIS is a book of exceptional interest for all who are engaged in the work of education and for those who are seriously concerned with the future social and economical well-being of the children of the nation.

It is a record of the aims and of the achievements of Dr. Kerschensteiner, of Munich, during the past twenty years in the sphere of continued education for the youth of that city. As a consequence of his assiduous enlightened effort, coupled with the ultimate goodwill of employers and employed, he has been able to establish a complete system of continued trade education for practically all the industries of Munich providing not only for the continued general education up to the close of their eighteenth year of the children leaving the elementary schools, but also for their technical training in industry and commerce combined with instruction bearing upon their daily life and duties and in relation to their future responsibilities as citizens.

The system has been gradually developed, but always in close cooperation with the City Trade Guilds, and its success has been assured by the adoption by the municipality of compulsory measures requiring the attendance of all apprentices and others engaged in employment at the courses provided within the usual working hours.

Special buildings have been erected providing for about fifty-six various industries, chiefly handicraft, many of them demanding much artistic knowledge and skill. This concrete illustration of the successful treatment of the problem of continued education deserves the most serious study.

How Man Conquered Nature. By Minnie J. Reynolds. Pp. v+249. (New York: The Macmillan Company, 1914.) Price 1*s*. 8*d*. net.

THE style of this little book will appeal to children. The language is simple without being babyish. Man's development is traced from the time when, realising the "opposition of the thumb," he threw his first stone, down to his use of a flying machine. Not unnaturally, perhaps, Miss Reynolds, in the first part of the book especially, gives great prominence to woman's part in the civilising process. We are told, for instance, "woman was the first harvester," "the first miller," "the first baker," "the first salt maker," "the first furrier," and so on.

Excelsior School Map of the United States. In four sheets. Size 62 in. by 48 in. (London: G. W. Bacon and Co., Ltd.) Mounted to hang, with rollers and varnished; or mounted, cut to fold, with eyelets. With political colouring, 15*s*.; the same with contour colouring, 16*s*.

THIS wall map is constructed on a conical projection on a scale of 1 : 3,200,000, or 50·5 miles to an inch. It is provided with an inset map of

the Philippines on a scale of 1 : 7,500,000. The coast-line, rivers and lakes are in blue; the railways and sea-routes, with distances, are in red; and town names are printed in black. The general effect is excellent, and the map should meet the needs of the class-room satisfactorily.

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.*]

Forests and Floods.

SOME time ago the question of the effect of forests in checking floods was discussed in the pages of NATURE. The subject was lately recalled to my recollection while watching gardening operations in the vegetable borders. I was then much struck by the different conditions, after rainfall, of newly dug ground and ground that had lain undisturbed for a year. The gardener was proceeding to put in plants in the newly dug part, but found it much too wet to be worked in. It was suggested he might continue the digging of the rest of the border and leave the planting until later. On breaking up the undisturbed ground, it was found to be fairly dry and in quite good condition for digging. These conditions seemed to indicate that newly disturbed ground holds a much greater proportion of the rainfall than does consolidated ground in which the soil particles are more closely packed together. In the latter the water seems to pass much more freely through it than in the former, possibly due to there being a continuous water film from the surface to the water table. It not only passes more quickly to the lower level, but much more of it passes, while the disturbed ground retains a much greater proportion of it to the benefit of the vegetation.

Experiments might be made to get further information on this point by means of proper water-tight tanks filled with earth, and comparative readings taken of the drainage water in tanks in which the soil had become consolidated by rainfall and those in which the soil had been recently disturbed. As this would take a long time to accomplish, it has not been done, but perhaps some others may be induced to make the tests, as the knowledge of the subject may be useful in agricultural operations. It does not directly bear on dry farming, as that is a question mostly of surface soil mulch produced by stirring the surface soil and so breaking the water film connecting it with the subsoil. But it would seem to indicate that before dry farming can be started, the surface soil, to a depth sufficient to hold the rainfall, should first be thoroughly pulverised to prevent the rainfall passing downwards and beyond the range of the roots.

Though satisfactory tests have not been made yet I had an opportunity of making some experiments on somewhat similar lines. There were three pots full of soil lying out in the garden. These had previously been in use in some experiments with plants. The soil in all of them was alike, having been taken from the kitchen garden. These pots and soil had been lying out for more than a year; and as the soil in them was thoroughly consolidated, the question was put to them. First, the pots were all weighed; as the weather had been fine for some time, the soil was pretty dry. The pot having the medium weight was then selected, the soil emptied out, broken up, and returned to the pot. Water was now poured slowly over the soil in all the pots in 4-oz. doses at a time. The first thing noticed was that the water entered the soil of the undisturbed pots more slowly than the other, and, secondly, that the water came more quickly through the soil in these pots than through the other. Water was added to the pots until they ceased to take up any more. After draining, they were weighed again, and the result is given in the table:—

Weights in Pounds and Ounces of the Three Pots.

	No. 1. Consolidated soil lb. oz.	No. 2. Pulverised soil lb. oz.	No. 3. Consolidated soil lb. oz.
Dry	7 9½	7 10	7 13
Wet	8 10	9 6½	9 1
Water held by soil	1 0½	1 12½	1 4

It may be further mentioned that it was thought that some of the soil in the consolidated pots might not have got thoroughly wetted, owing to the water running quickly through them; the three pots were therefore afterwards put in a vessel of water to soak; they were then drained and weighed, but the result showed but little change, showing that all the pots had got as much water as the soil would hold. An examination of the above table shows that the disturbed soil holds a much greater amount of water than the consolidated soil. No definite conclusion can be drawn from these figures as to the relative retaining powers of the soil in the two conditions, as no two soils are likely to be equally affected. The only thing to be noted is that the pulverised soil has a much greater power of holding water than the consolidated.

It may be asked: what has all this to do with forests and floods? If we are correct in supposing that soil by becoming consolidated and the particles close packed, by the action of the rainfall, causes it first to resist the entrance of heavy rainfalls, and secondly, after it has entered the soil, to facilitate its passage through it to depths beyond the range of being of use to vegetation. If this be so, then anything that breaks up the close packing of the grains and stirs the soil will tend to enable the water to enter the soil, and will also tend to enable it to retain it. Now the roots of trees in forests, by their constant growth and expansion, stir the soil and prevent it getting consolidated. The soil under trees will therefore always be in the best condition for absorbing and retaining the rainfall. And the surplus is only slowly parted with to feed the drainage, whereas on bare soil, or soil on which the vegetation is poor, tends to reject the rainfall, causing the water to run off the surface, and what enters is quickly passed downwards to swell the drainage water. From the above it would appear that bare and poorly cultivated land will tend to cause floods by speedily getting quit of its rainfall, while forest land will retain and only slowly part with it. The decaying vegetation on the surface under trees has also a beneficial effect, as it absorbs water and acts as a mulch, preventing drying.

It is well known that rains in early summer, unless when torrential, give rise to small amounts of flooding compared with winter rains of the same amount. There are a number of reasons for this which our space does not admit of treating, but it is probably in part due to the stirring action on the soil of the roots of grasses and other plants, as that is the season when root action is most active.

Ardenlea, Falkirk. JOHN AITKEN.
June 29.

Proposed International Magnetic and Allied Observations during the Total Solar Eclipse of August 21, 1914 (Civil Date).

IN response to an appeal for simultaneous magnetic and allied observations during the coming total solar eclipse, cooperative work will be conducted at stations along the belt of totality in various countries and also at some outside stations.

The general scheme of work proposed by the Carnegie Department of Terrestrial Magnetism embraces the following :—

(1) Simultaneous magnetic observations of any or all of the elements according to the instruments at the observer's disposal, every minute from August 21, 1914, 10h. a.m. to 3h. p.m. Greenwich civil mean time, or from August 20, 22h., to August 21, 3h. Greenwich astronomical mean time.

To ensure the highest degree of accuracy, the observer should begin work early enough to have everything in complete readiness in proper time. See precautions taken in previous eclipse work as described in *Terrestrial Magnetism*, vol. v., p. 146, and vol. vii., p. 16. Past experience has shown it to be essential that the same observer make the readings throughout the entire interval.

(2) At magnetic observatories all necessary precautions should be taken to ensure that the self-recording instruments will be in good operation, not only during the proposed interval, but also for some time before and after, and eye-readings should be taken in addition wherever it is possible and convenient. It is recommended that, in general, the magnetograph be run on the usual speed throughout the interval, and that, if a change in recording speed be made, every precaution possible be taken to guard against instrumental changes likely to affect the continuity of the base line.

(3) Atmospheric-electric observations should be made to the extent possible with the observer's equipment and *personnel* at his disposal.

(4) Meteorological observations in accordance with the observer's equipment should be made at convenient periods (as short as possible) throughout the interval. It is suggested that at least temperatures be read every fifth minute (directly after the magnetic reading for that minute).

(5) Observers in the belt of totality are requested to take the magnetic reading every thirty seconds during the interval, ten minutes before and ten minutes after the time of totality, and to read temperatures also every thirty seconds, between the magnetic readings.

It is hoped that full reports will be forwarded as soon as possible for publication in *Terrestrial Magnetism and Atmospheric Electricity*.

L. A. BAUER.

Washington, June 23.

Asymmetric Haloes with X-Radiation.

A RADIOGRAPH of a lead disc 2·5 mm. thick, raised above the plate, does not, as might be expected, appear of an even intensity, but gives well within its shadow a distinct white ring. The area inside this ring is grey, and the annular space outside it dark. Experiment has shown that its brightness, width, and diameter vary with the distances of the disc from the plate and antikathode. It also changes from a complete circle to almost a semi-circle, the position and dimensions of the absent arc depending upon the orientation of the bulb.

The ring is found to be complete when the X-rays are in the plane of the kathode rays and the normal of the antikathode, and from 10° to 15° within the angle of true reflection, *i.e.* that at which light substituted for kathode rays would be reflected. Diverging from this direction the circle becomes increasingly incomplete, the break in the curvature being always on the side furthest from it.

Apertures, cubes, cylinders, solid and hollow, spheres, etc., of various materials give analogous results, the form of the white area depending upon the shape of the object. Thus an ebonite cylinder gives this effect in addition to the peripheral bands and alternating semicircles described in former letters.

This phenomenon cannot be attributed to ordinary secondary radiation, since the ring is not dispersed by strong magnetic fields. Scattering, unless at some definite angle, is precluded by the sharpness of outline, and the asymmetry would seem to dispose of diffraction and polarisation, since the dark and light parts of the ring are opposite, and not at right angles.

It appears, therefore, that the X-radiation has been differentiated into two main types, one of which may consist of disparate doublets (magnetic); the polarity being distributed radially round a position which coincides with that of maximum intensity (Kaye). This phenomenon bears a close analogy to that of unilateral conductivity in crystals.

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The Composition of the Atmosphere.

MR. A. PARKER (*Jour. Chem. Soc.*, April, 1914) in a study of the inflammation of mixtures of methane with oxygen and nitrogen, has found that inflammation can be brought about more easily in mixtures containing nitrogen than in pure oxygen. In fact, the mixture which requires for ignition a minimum of methane contains only about 23 per cent. of oxygen. This unexpected result is traced to the difference in the specific heats of oxygen and nitrogen, and not to any property of methane. If one may assume that combustions at other temperatures behave in a similar manner, perhaps all slow combustions can be maintained with a minimum expenditure of energy in a mixture of oxygen and nitrogen containing about 23 per cent. of oxygen.

The close proximity of this proportion to that of atmospheric air is remarkable. Is it possible that living matter on the earth's surface has evolved its own atmosphere, as it were, so that the dissipation of the energy of metabolism may be a minimum? The temporary stimulation of animals by pure oxygen is not necessarily contrary to this hypothesis. I should be glad to know if the estimated total amount of carbon in organic matter, including coal, is equivalent to an amount of oxygen at all comparable with that in the atmosphere; or, in other words, if a large increase or decrease in the amount of organic matter on the earth could alter appreciably the proportion of free oxygen in the air. N. P. CAMPBELL.

Trinity College, Kandy, Ceylon, June 24.

Elevation of Mouth of Harton Colliery.

WILL some reader of NATURE kindly inform the writer, through this journal, what the elevation above sea-level and the location of Harton Colliery are, where Sir G. B. Airy made his pendulum observations on the force of gravity at the mouth and bottom of that mine in 1843, and also if the result of those observations is still generally accepted as correct.

EVAN MCLENNAN.

Corvallis, Ore., U.S.A., June 20.

THE FORTHCOMING TOTAL SOLAR ECLIPSE, AUGUST 21.

OWING to the great strides made in the study of the physics of the sun, the importance of the occurrence of a total eclipse of the sun is not so great as it was towards the latter end of last century. Nevertheless, there are still some problems to be solved, the data for which can only be obtained on these occasions, thus necessitating the organisation and dispatching of observers to several stations lying on the path traced out by the cone of the moon's shadow as it sweeps over the earth's surface.

The present year presents us with a total eclipse as near at home as that which occurred in the year 1896; in fact, these eclipses belong to the same family, and it is likely that the event in August next will be as well attended by both amateur and professional astronomers as was its forerunner. It is hoped, however, that weather conditions will be more favourable for successful observation, for it will be remembered that on the last occasion the only party that was fortunate enough to come home with results was that which took up a station in Novaya Zembla.

European observers will be especially favoured by the position of the path of the moon's shadow, because the greater portion of the accessible track cuts Europe diagonally through its central position. Thus, with comparatively little journeying, very favourable stations for observation can be reached.

The accompanying illustration (Fig. 1) shows the general position of the line of central eclipse. It will be seen that the eclipse begins at a point situated in north latitude about $71\frac{1}{2}°$ and ends in a latitude a little greater than $23\frac{1}{2}°$. The moon's shadow first strikes the earth in far north Canada, passing a little south of the Parry Islands, and pursuing its course just above Baffin's Bay. There it enters Greenland, and sweeps across this sparsely-inhabited region and emerges into the Arctic Ocean. Taking a south-easterly trend, it enters Norway near the island of Vega, and passes out of Sweden near Hernösand, and then crosses the Gulf of Bothnia and the Baltic Sea. The track then enters Russia at Riga, and passes near Minsk, Kiev, and the eastern part of the Crimea, crossing the Black Sea and reaching the opposite coast at Trebizond. It then traverses eastern Turkey and western Persia, and terminates its course on the north-west coast of India.

There is little doubt that the first portion of the eclipse track—that is, the part that crosses the islands north of Canada and Greenland—will not be occupied by special observers. From Norway south-eastwards the case will be different, for there the sun will be at a useful altitude and the eclipse of long duration. On the west coast of Norway the sun will have an altitude of a little over 35°, and the duration about 126 seconds. On the east coast of Sweden the altitude will be more than 36·5°, and the duration 128 seconds. In the region about the Gulf of Riga the sun's altitude will be about 39·5°, and the duration 133 seconds. By the time the Crimea is reached the altitude will be somewhat reduced, namely, 36° 40′, and the duration diminished to 129 seconds. An excellent large-scale chart of the whole track of the eclipse across Europe accompanies Count de la Baume Pluvinel's article which appeared in the March number of the *Bulletin de la Société Astronomique de France*, and this should be consulted by all who wish to take up a suitable position on the track. Those who proceed to Norwegian stations will find some useful data published recently in the *Observatory* by Prof. H. Geelmuyden. There it is stated that among

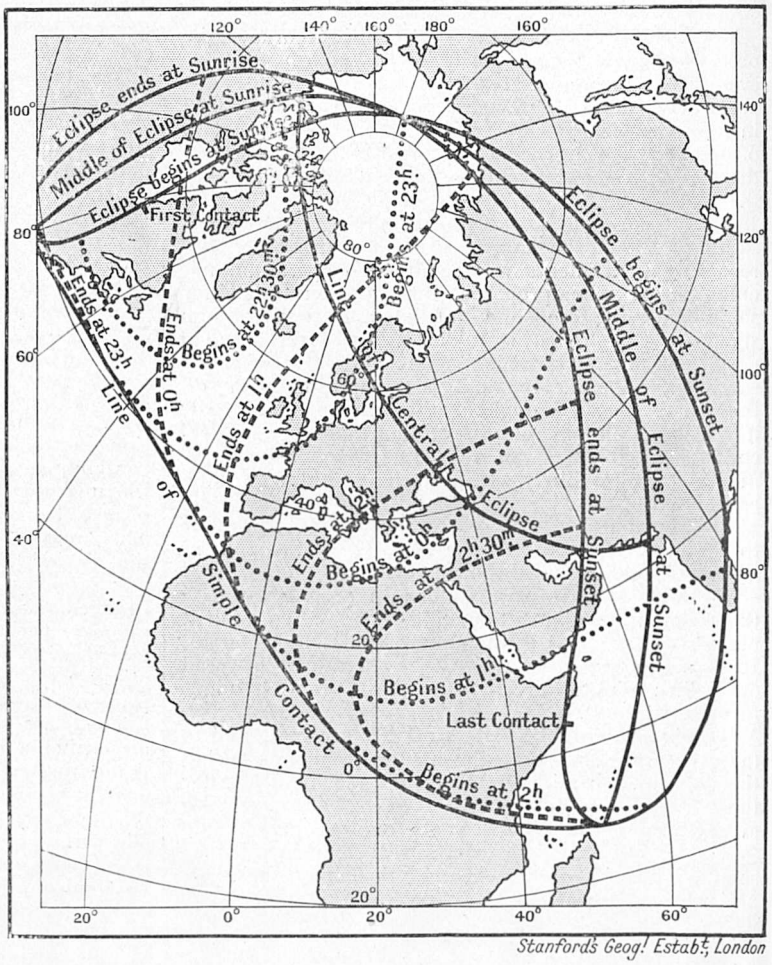

FIG. 1.

stopping places for the ordinary coast steamers, going out from Bergen or Trondhjem, may be named Sannessjöen, situated on the north end of the Alsten Island, from which stations near the central line will be easily accessible, either on the same island or (by motor boat or local steamers) on some other islands towards the north-west. From Mosjöen, situated at the end of the deep Vessen Fjord, stations near the central line in the Vessen valley may be reached by carriage. Brönnö is a stopping place not far from the southern limit, and Bodö is a little outside the northern limit. Details concerning the path of the shadow track across Turkey and Persia and the for the more scattered the observers are the more chance there is of some results being secured.

As to the actual expeditions that are in active preparation, the following statements may be made, and the accompanying map (Fig. 2) will help to indicate the positions of the stations which will be utilised. Dealing first with the British parties, the joint permanent eclipse committee of the Royal and Royal Astronomical Societies is sending out five observers. Three of these observers, namely, Prof. Fowler, Mr. W. E. Curtis, and Major Hills, will be stationed near Kief in Russia, and will undertake the photography of the spectrum of the chromosphere during the

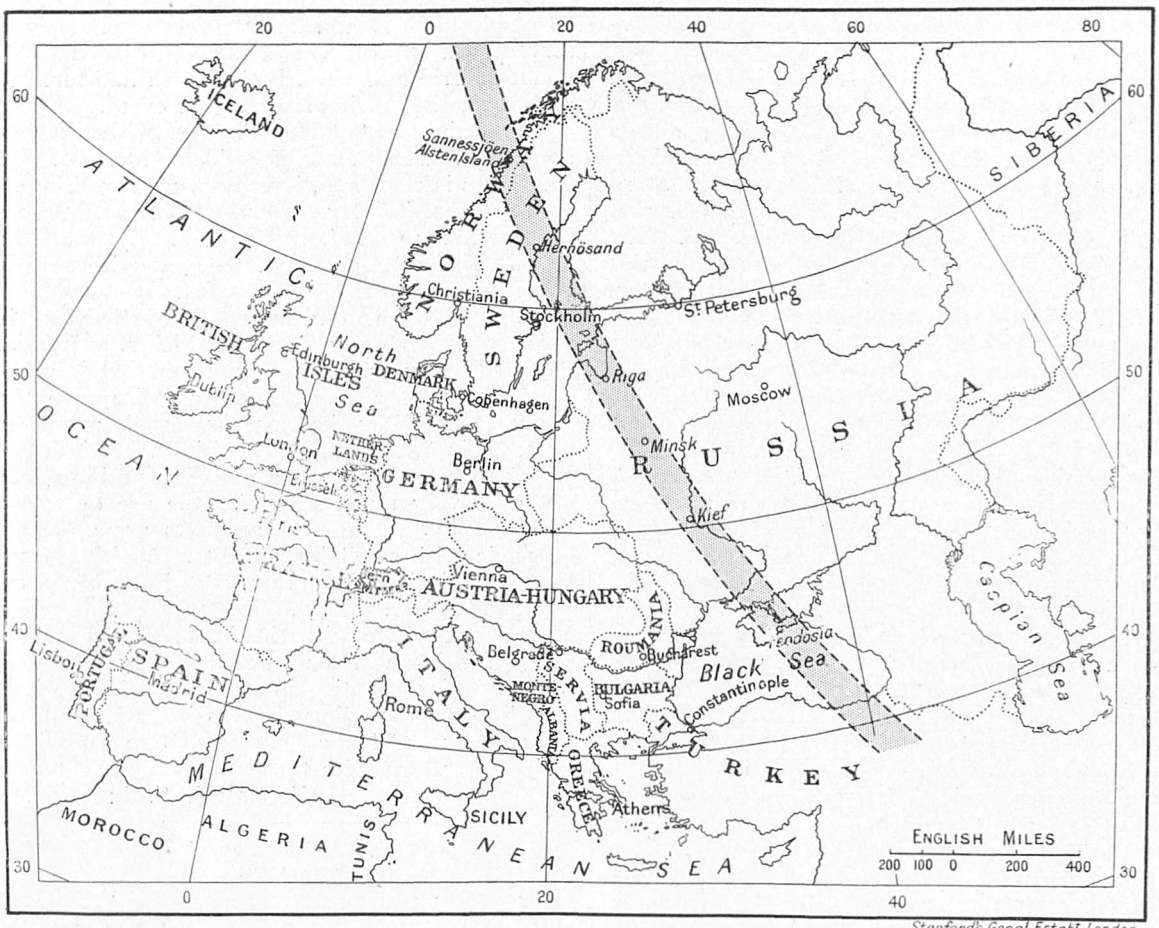

FIG. 2.

accessible places for forming camps in these countries have been described by Prof. David Todd in these columns (vol. xciii., p. 311, May 21), so that further reference to these regions becomes unnecessary.

With regard to the weather conditions that will be experienced, the probability of fine weather seems to increase the further east along the track the station is taken up. According to the information that is to hand, most of the main official expeditions will be located along the Russian portion of the line, where the good weather chances are more promising, but this should not deter others from occupying Norwegian or Swedish stations, partial phases, using the iron arc as a comparison spectrum. For this purpose a grating will be used giving much higher resolving power than any previously employed during an eclipse. Fathers Cortie and O'Connor are being sent to Hernösand in Sweden and will undertake direct photographs of the corona and photographs of the spectrum of the corona with special regard to the yellow and red regions. They will be accompanied by Messrs. J. J. Atkinson and G. J. Gibbs as volunteer helpers.

From the Royal Observatory, Greenwich, two observers, Messrs. Jones and Davidson, will take up their station at Minsk, in Russia. The pro-

gramme of this party will consist in securing large-scale photographs of the corona, the spectrum of the corona and chromosphere, more especially in the ultra-violet region, and photographs of the corona through "mercury-green" glass for investigation of the distribution of "coronium." Near Feodosia, in the Crimea, the party from the Solar Physics Observatory, at Cambridge, namely, Prof. Newall, Mr. Stratton, and Mr. C. P. Butler, will take up their stations. The work that will be undertaken includes small- and large-scale direct photographs of the corona for extensions and details respectively, objective grating photographs of the chromosphere for comparison with the slit spectra taken by Prof. Fowler's party, and lastly, polariscopic observations.

Feodosia will also be the observing station of two German expeditions, namely, one from the Astrophysical Observatory at Potsdam, and a second from the Royal Observatory in Neubabelsberg, near Berlin. Near Feodosia, at Starg Krym, an expedition from the Hamburg Observatory in Bergedorf will take up its position. The programme of the work to be undertaken by this expedition, kindly communicated by the director, Prof. R. Schorr, includes photographs of the corona with telescopes of focal lengths of 4, 10, 20, and 40 metres, with and without screens, a search for intermercurial planets, and photographs of the spectra of the chromosphere and corona.

In addition to the above, Prof. Miethe, of the photochemical laboratory of the Technical High-school in Berlin, is going to Sannessjöen, Alsten Island, in Norway, and it is quite possible that parties from other German observatories may swell the number of expeditions.

Feodosia will also be the selected spot for three French missions, details about which have been kindly communicated by Count de la Baume Pluvinel. Count de la Baume Pluvinel himself leads a private expedition, with Messrs. Senouque and Rougier as his assistants. Their instrumental equipment will consist of a two-mirror coelostat worked in conjunction with objectives of 12 and 3 metres for the photography of the corona. Two slit spectroscopes and two prismatic cameras with flint and quartz prisms will also be used, and measures will be made of the intrinsic brightness of different portions of the corona.

A second expedition is that which will set out from the Nice Observatory under the direction of M. H. Chrétien. M. Chrétien will be accompanied by M. Lagrula, and they will take up a position at Feodosia. Their main instrument will be a coelostat with two mirrors, one of which will feed an objective of 6 metres focal length, for securing photographs of the partial phases and of the corona, the other supplying light to a slit spectroscope for the study of the rotation of the corona. M. Chrétien proposes also to make photometric measures during the partial phases. M. Jekhowsky will also join this party, and will use a concave grating of 6 in. diameter and 7 metres radius of curvature for the study of the spectrum of the chromosphere in the ultra-violet.

M. Salet, of the Paris Observatory, is also going privately to Feodosia. He will use both an equatorial and a coelostat, and his chief endeavour will be the photographic study of the polarisation of the light of the corona.

Feodosia is also the station that Dr. Perrine will observe from, and of the expedition being organised by the Lick Observatory under Prof. W. W. Campbell one section will proceed to Kief while the other will occupy Feodosia. A Russian party under Dr. Donitch will also take up quarters at the latter place.

While most of the expeditions are concentrating at Feodosia, it is hoped that other intending observers will take up positions further north. No doubt several amateurs, both British and foreign, are completing their plans for the event.

The eclipse committee of the British Astronomical Association, of which Mr. G. F. Chambers is chairman, have been endeavouring to organise parties for different stations. From information received, it seems likely that the Royal Mail Company's *Arcadian* will convey numerous members to Norwegian coast stations, while Hernösand, on the coast of Sweden, is likely to claim about a dozen; and Riga, in Russia, perhaps a somewhat larger number. It is probable also that a small number will go to the Crimea, enticed by the more favourable prospects of possibly finer weather conditions. It is interesting to note that while a total solar eclipse does not offer very much scope for the use of colour photography, yet several attempts are going to be made with small instruments. Writing from the Nikolai chief observatory at Pulkovo, Prof. Backlund (*Astr. Nach.*, No. 4740) states that, after a conference with the Minister of Finance, every facility will be offered by the Government to further the interests of the various expeditions proceeding to Russia, and that all instruments will be customs free provided observers return with them.

WILLIAM J. S. LOCKYER.

INTERNATIONAL FISHERY INVESTIGATIONS.[1]

THE official reports on the work of the International Council for the study of the sea contained in the three volumes now under review mark a definite and important stage in the history of that undertaking, since for the first time recommendations on a considerable scale are put forward for international legislation dealing with the fisheries of the North Sea. From the commencement of the international undertaking particular attention has been directed to the plaice fisheries, and it is in connection with these that we now have not only a considerable part of Prof. Heincke's general report, but also a series of resolutions agreed to by the whole Council, which may be supposed to have resulted from

[1] Conseil permanent international pour l'exploration de la mer. Rapport et Procès-Verbaux des Réunions, vols. xvi., xviii., and xix.

a consideration of that report. It must, however, be admitted that both the report and the resolutions are in many ways disappointing. The former has already been referred to in the pages of NATURE (April 23, 1914, p. 201). The recommendations put forward are that, as an initial measure, a minimum international size-limit of 20 centimetres (8 in.), below which it would be illegal to land plaice, should be imposed, and that during the spring and summer months (April 1 to September 30 in each year) this limit should be increased to 22 centimetres. A perusal of the reports suggests that the council itself scarcely contends that such a small size-limit can produce any very marked result, since, as a matter of fact, a very small percentage of fish under these sizes is at present landed. The idea seems to be that by commencing with a small size-limit it will be possible to raise it gradually without producing any serious disturbance of the fishing industry. The recommendations are, however, really an admission that a size-limit which would be effective in preventing the great destruction of small plaice by steam trawlers on the eastern grounds of the North Sea is not practicable from the point of view of the fishing industry as a whole, which is very much the conclusion arrived at by the various Parliamentary committees which have inquired into the matter in this country in past years. So far as one can see, the only practical effect of the present proposals will be to harass the very poorest class of fishermen, generally old men who get a precarious living by working in a small way in estuaries and inshore waters, and do an infinitesimal amount of damage compared with what is done by the large trawlers. Whether the proposals will, or ought to meet with greater favour at the hands of our Parliamentary legislators than their predecessors have done, is open to very considerable doubt.

Apart from the question of plaice, the most important reports in the volumes we are considering are those by Dr. Johs. Schmidt on eel investigations for 1913, by Dr. Ehrenbaum on the mackerel, and by the late Dr. P. P. C. Hoek, whose recent death will be a cause of deep regret to all fishery investigators, on the pilchard or sardine. With regard to Dr. Ehrenbaum's report on the mackerel, it must be admitted that the the new facts and observations brought forward are not extensive, and the fact that the author is dealing throughout with the reports and writings of other observers rather than with a fishery of which he has himself any great personal knowledge somewhat detracts from its value. The same criticism applies to a large extent also to Dr. Hoek's report. Any weakness of the reports due to this cause would seem to be due to the policy of the International Council in spending considerable sums of money each year in having such reports produced, money which one would imagine could be better employed in carrying out original investigations in the areas where the fisheries take place.

In conclusion, we may direct attention to the summary of the work done by the International Council during the ten years 1902–12, edited by Commander Drechsel, the general secretary, which constitutes pp. 1–83 of vol. xvi. This should be of use to those who are interested in the work which the international coöperation has accomplished.

NOTES.

WE regret to learn of the death, on Sunday last, July 12, of the Rev. Osmond Fisher, the well-known geologist, in his ninety-seventh year.

THE honorary freedom of Newcastle-on-Tyne was conferred on the Hon. Sir C. A. Parsons on July 10 in recognition of his achievements in science, particularly as the inventor of the steam turbine. It had been decided to confer a similar honour on Sir Joseph W. Swan, but he has since died. The symbols of the freedom—a scroll and casket—have, however, been presented to a representative of his family.

A RUMOUR, based on a misunderstanding of a telegram from Captain Bartlett, who is at Nome, Alaska, reached London last week, announcing a disaster to the Stefansson Arctic Expedition, which left Canada last year with the object of exploring the vast uncharted regions between the north of Canada and Siberia and the north pole. A party, including three members of the scientific staff, was said to be missing. Later information received from Captain Bartlett shows that he is not aware that any disaster has occurred.

THE excavation of the Dewlish elephant-trench is still unfinished, but when the excursion of the Dorset Field Club took place on June 30 it was clear that the "trench" was not artificial. Instead of ending below in a definite floor it divides downwards into a chain of deep narrow pipes in the chalk. A few bones of *Elephas meridionalis* had been found, but no clear trace of man. We shall wait with interest the completion of this work, which is proving more arduous than had been expected.

IN order to provide opportunities for the more complete investigation of the nature and causes of human disease and methods of its prevention and treatment, Mr. John D. Rockefeller has just given 510,000*l.* to the Rockefeller Institute for Medical Research. This gift is in addition to a special fund of 200,000*l.* which Mr. Rockefeller has provided in order that the institute may establish a department of animal pathology. Mr. Rockefeller's previous gifts to the institute amounted to about 1,800,000*l.*, exclusive of real estate in New York City, so that the endowment of the institute amounts now to more than 2,500,000*l.*

ON Thursday last, Sir Clements Markham unveiled at Cheltenham a statue of Dr. Edward Adrian Wilson, who was born in that town, and perished with Captain Scott on the great ice barrier in March, 1912. The statue, which stands in a prominent position on the Promenade, was designed by Lady Scott, and executed under the superintendence of Messrs. Boulton, a local

firm of sculptors. It represents Dr. Wilson in polar dress, hands on hips, in a natural, careless attitude, and is an excellent likeness. A brass plate let into the stone base bears an inscription recording the heroism of the members of the expedition who perished with him.

MR. J. FOSTER STACKHOUSE has sent us a copy of a circular letter relating to the British Antarctic and Oceanographical Expedition being organised by him. The circular states that the expedition will leave England towards the end of the year for the following purposes :—(1) To investigate reports of mariners as to the existence of dangerous uncharted rocks, shoals, reefs, islands, etc., on the trade routes of the world; (2) to discover the extent and position of the coast line still left unmapped on the continent of Antarctica; (3) to make a scientific survey of the sea in general. This programme, we need scarcely point out, is ambitious enough for half a dozen expeditions, and we should be glad to know the names of men of science associated with it, either as members of Mr. Stackhouse's advisory committee or of the proposed undertaking.

DR. W. S. BRUCE left Edinburgh on Thursday, July 9, on an expedition to Spitsbergen. The object of the expedition is hydrographic and geological research in Wybe Jansz Water, or Stor Fiord, where the coast is little known, and where there are practically no soundings. Geological investigations will form an important item in the programme. Dr. Bruce is to be assisted by Mr. J. V. Burn Murdoch, who has previously twice accompanied him to Spitsbergen, by Mr. R. M. Craig, of the geological department of the University of St. Andrews, and by Mr. J. H. Koeppern, zoologist. He will be himself responsible for the conduct of the hydrographic work. The expedition is expected to be absent for about two months. It is supplied with instruments by the Admiralty and the Scottish Oceanographical Laboratory, and is also supported by the Royal Geographical Society and the Prince of Monaco.

AT the twelfth annual general meeting of the British Academy, held on July 10, Lord Bryce, who was in the chair, urged that the academy should have the means of encouraging and aiding inquiries of real value which cannot be materially profitable to those who undertake them, and of paying for the publication of works needed by students but which cannot be expected to command a remunerative sale. Ample justification, he said, for such grants would be found both in the practice of the chief nations of Continental Europe and in that followed as respects scientific inquiries, grants for which are made to the Royal Society to be administered by that body. Lord Haldane, Lord Fitzmaurice, and Mr. John W. Mackail were elected new fellows by ballot, and the following were elected corresponding fellows :—M. Charles Bémont, Mr. C. W. Eliot, M. Omont, and Signor Pasquale Villari. Lord Bryce was re-elected president, and Canon Charles, Prof. Percy Gardner, Sir Courtenay Ilbert, Prof. W. P. Ker, and Prof. W. R. Sorley were appointed members of the council.

THE annual meeting of the British Medical Association will be held this month at Aberdeen. The president's address will be delivered on July 28 by Sir Alexander Ogston, K.C.V.O. The address in medicine will be given by Dr. A. E. Garrod, and that in surgery by Sir John Bland-Sutton. Prof. J. Arthur Thomson will deliver the popular lecture. The scientific business of the meeting will be conducted in sixteen sections, which, with the names of the presidents, are as follows :—Anatomy and Physiology, Prof. R. W. Reid; Dermatology and Syphilology, Dr. A. Eddowes; Diseases of Children, including Orthopædics, Dr. J. Thomson; Electro-Therapeutics and Radiology, Dr. S. Sloan; Gynæcology and Obstetrics, Dr. F. W. Nicol Haultain; Laryngology, Rhinology, and Otology, Dr. H. Lambert Lack; Medical Sociology, Dr. J. Gordon; Medicine, Dr. F. J. Smith; Naval and Military Medicine and Surgery, Surgeon-General W. M. Craig; Neurology and Psychological Medicine, Dr. F. W. Mott; Ophthalmology, Mr. C. H. Usher; Pathology and Bacteriology, Dr. W. S. Lazarus-Barlow; Pharmacology, Therapeutics, and Dietetics, Prof. J. T. Cash; State Medicine and Medical Jurisprudence, Prof. Matthew Hay; Surgery, Mr. J. Scott Riddell, Tropical Medicine, Prof. W. J. R. Simpson.

THE *Eugenics Review* for July (vol. vi., No. 2) contains many articles of general interest. Mr. Nettleship reviews the results of consanguineous marriages, and concludes that those between cousins are as safe from the eugenic point of view as any other marriages, provided the parents and stock are sound. Mr. Macleod Yearsley deals with the problem of deafness and its prevention. The chief causes of acquired deafness are meningitis, fevers and other infective diseases, such as tuberculosis and syphilis, and adenoids and similar throat conditions. The prevention of acquired deafness therefore largely rests with efficient treatment in the fever hospitals and with medical inspection and treatment of school children.

IN the third part of that excellent periodical, *Ancient Egypt*, the editor, Prof. Flinders Petrie, gives an authoritative account of the discovery of the famous treasure of Lahun, in a tomb which had been already plundered, probably in the decadence of the kingdom before the Hyksos. The splendid diadem and two pectorals, one bearing the cartouche of Senusert II., the other that of Amenamhat III., are specially noteworthy. The same scholarly explorer contributes the first part of an article which, by reference to the work of recent travellers, provides material for the comparison of Egyptian funerary rites with those of the modern Bantu and other African races—a piece of work which throws important light on many anthropological problems.

IN the review of "Maya Art" in NATURE of July 2 (p. 456), in referring to Maya chronology, the statement was made that the number 13 "is based upon the fact that eight years of 365 days are exactly five years of the planet Venus." Mr. A. E. Larkman writes from Southampton to suggest that there is a discrepancy in this statement. The reviewer regrets having omitted to say that the five years of the planet

Venus refer to its synodic (not sidereal) revolutions of 583·9 days each, the only "Venus year" which the Mayas could appreciate, unless they had knowledge of the heliocentric system ($8 \times 365 = 5 \times 584 = 2920$). The justification of the number 13 as given on p. 456 is therefore good enough for a people who were great worshippers of the morning and evening star, of the representations, symbols, and attributes of which their almanacs are full. This and further detail is discussed fully in Foerstemann and Seler's collected and translated papers, published by the Smithsonian Institution, Washington, 1904.

A JOINT meeting of the British Psychological Society, the Aristotelian Society, and the Mind Association was held at Durham on July 3–6. A discussion of considerable interest to psychology took place on the rôle of repression in forgetting. In it was considered Freud's view that in forgetting, even among normal people, an important part is played by the factor which he terms "repression." There appeared to be distinct agreement among the speakers that forgetting, both of the ordinary and the pathological kind, while sometimes attributable to defects of retention, is frequently incapable of explanation without the assumption of positive factors which prevent recall of the retained matter. The nature of these positive forces, as they are treated by Freud, was discussed at length. Mr. Pear held that two kinds of forgetting should be distinguished, one due to failure to retain (the conditions for which may be purely physiological in character), the other to failure to recall. The latter condition may be due to psychological factors, some of which are possibly of the kind described by Freud. Dr. Wolf's paper criticised the use of the term "repression." Dr. Mitchell expounded in detail Freud's theory of hysterical amnesia, while Prof. Loveday criticised Freud's general conceptions, especially that of unconscious thought, pointing out the defects which were entailed by an adherence to the old doctrine of associationism. Dr. Ernest Jones and Dr. Crichton Miller supported Freud's theory by facts from clinical experience. Among other speakers were Mr. W. McDougall, Prof. T. P. Nunn, Prof. G. F. Stout, and Dr. H. Wildon Carr.

WE have received from Mr. H. Swithinbank and Mr. G. E. Bullen a copy of a paper entitled "The Scientific and Economic Aspects of the Cornish Pilchard Fishery: ii., The Plankton of the Inshore Waters in 1913 considered in Relation to the Fishery." Samples of plantkon were taken at twelve stations in Mevagissey and St. Austell Bay, at eleven stations in Mount's Bay, and at six stations in St. Ives Bay, on June 1–3, 1913, and similar collections were made at a number of these stations in August of the same year. The principal species found in the samples have been identified and recorded. The paper also contains some notes on the pilchard fishery during the season.

THE reports of the Albany Museum, Grahamstown, for the years 1910–13 are issued in a single cover. In that for 1910, the director reviews the condition of the building and collections at the time he assumed control, in the course of which he compliments the late director and his staff on their efforts to improve the museum, although hampered by insufficient funds. On a later page the preparation and publication of a series of works on the entire South African fauna is urged, those at present in existence being more or less obsolete. In the report for 1913 large additions to the collections are recorded, which render the need of extension of the building more pressing than ever.

TO prevent the deaths of migrating birds from exhaustion while fluttering around the lanterns of lighthouses, the Royal Society for the Protection of Birds a short time ago placed perches near the lanterns at St. Catherine's and the Caskets. The perches are made in the form of a small ladder of wood and iron within view of the light, but so placed as not to obstruct it. Observations have shown that these perches were crowded every night during the migrating season. Trinity House has now permitted the society to furnish other lighthouses with similar accommodation, and the next so to be treated are the South Bishop, off Pembrokeshire, and that at Spurn Head, where the work will be completed this summer.

A NOTICE of the English supplement, based on the second edition of "Jost's Lectures on Plant Physiology," appeared recently in these pages on May 7, and we now direct attention to the publication, by Mr. Gustav Fischer, of the third German edition of this work. The forty-two lectures which comprise the volume occupy 744 pages of text, and the various branches of the subject have been thoroughly revised up to the date of publication. Attention may be more particularly directed to the full treatment of hybridisation and plant-breeding in lectures 29 and 30 of this new edition. The work is on the whole so comprehensive and representative that it is a matter of regret that the subject of protoplasmic connections is somewhat inadequately treated, but it must be admitted that blemishes such as this are rare. Jost's lectures hold the position of pre-eminence as a standard presentation of the science of plant physiology, and the book is all the more valuable since the facts are presented in a particularly interesting manner.

WE have received the first part of the *Annals of Applied Biology*, the newly-founded official organ of the Association of Economic Biologists. Prof. Maxwell Lefroy, assisted by a strong committee, acts as editor, and the magazine is published by the Cambridge University Press. The number contains a varied selection of articles; perhaps the most important is Mr. A. E. Cameron's detailed account of the life-history of *Pegomyia hyoscyami*, known most widely by one of its several synonyms—*P. betae*—the mangel-fly. The leaf-mining maggot is here described in its successive stages. Mr. F. V. Theobald writes on the green spruce aphis (*A. abietina*), an insect very destructive in England and Ireland, but apparently rare on the Continent, and not certainly known in Scotland. All naturalists, whether specially interested in "economic" questions or not, should read Prof. F. W. Gamble's suggestive article on impending developments in agricultural zoology.

AT the conclusion of an article on the African element in the fresh-water fauna of India, published in the report of section 4 of the *Compte rendu* of the ninth International Zoological Congress, held at Monaco in 1913, Dr. Annandale remarks that the existence of this African element is more pronounced among lower invertebrates than in other groups. Admitting the existence in late Cretaceous and perhaps early Tertiary time of a land-bridge between the Malabar coast of India and East Africa, and of a second connecting Africa with South America, he argues that at this period India, Africa, and South America doubtless possessed a very similar fresh-water fauna, of which Africa formed the central area. Any land-passages from India to South America must almost certainly have included Africa; and the occurrence of similar generic types only in the two former areas must be explained by their dying-out in the third. Madagascar, if ever united with the tri-continental tract, must have been separated at an earlier date than the other constituents.

FOR some years past Mr. Roy Andrews has been engaged in investigating the whale and whale-fisheries of the North Pacific; and it has been decided to publish the results of these investigations in a series of monographs in the Memoirs of the American Museum of Natural History. In the first of these (ser. 2, vol. i., part 5) the author deals with the grey whale (*Rhachianectes glaucus*), of the Californian and Japanese seas, which is the sole representative of its genus, and is now shown to be the most archaic type of whalebone-whale in existence. Its most strikingly primitive features include the presence of scattered hairs over the whole head, the small number, shortness, thickness, and wide separation of the plates of whalebone, the persistence of a wide strip of the frontal bones on the vertex of the skull, and the length of the nasals, the retention of stout neural arches by the first two cervical vertebræ, which, like the other five, are completely free, the length and straightness of the humerus, and the large size of the remnants of the pelvis. In several of these respects the genus, which Mr. Andrews considers should represent a family by itself, approximates to Plesiocetus of the European Pliocene.

To the April number of the *American Museum Journal* Prof. H. F. Osborn communicates a note on the collection of Permian South African reptiles just acquired by the museum from Dr. R. Broom. The author remarks that these reptiles represent the climax of development of the amphibian stock, and the first attempts at progression on land. Reptiles of this early type are common to South Africa, Texas and New Mexico, and part of Russia, those from the first and last localities being much more nearly related than are those from America to either. "The Texan reptiles continued to crawl close to the ground, but in South Africa we find that in many of the groups, through a powerful development of the limbs, the body is raised well off the ground—a distinct advantage which gave the start that resulted in the development of mammals." In the course of a letter in the same issue on the work of field-collectors, Col. Theodore Roosevelt remarks that he particularly wishes "to avoid seeing growing up in the United States the type of scientist who merely supplies the nomenclature and technical descriptions for specimens furnished him by field-observers." No mention is made of the sportsmen, who, on the strength of the merest smattering of zoological knowledge, nowadays feel themselves qualified to discuss the affinities and nomenclature of game animals.

THE importance to science of accurately expressed terms and definitions could scarcely be enforced more clearly than in the case of seismology. Mallet, for instance, bequeathed to us the term *seismic focus*. Later writers have used the word *hypocentre* as an equivalent term, and *epicentre* for the projection of the hypocentre on the surface. All three terms imply that the region within which an earthquake originates is a point, or practically a point. Yet Mallet himself did not hold this view, for he regarded the focus of the Neapolitan earthquake of 1857 as a vertical fracture several miles long in both directions. The subject has lately been discussed by Dr. G. Martinelli in an interesting paper (*Mem. della Pont. Accad. Rom. dei Nuovi Lincei*, vol. xxxi., 1913). Dr. Martinelli also considers some recent inquiries as to the form of the hypocentre, and concludes that the "Herdlinien" of Harboe and the "seismotectonic lines" of Hobbs have little, if any, physical meaning. He is in favour, however, of retaining the term hypocentre as denoting the limited region within which the initial disturbance takes place.

THE Director-General of Observatories (India) has issued a memorandum (dated Simla, June 8) on the meteorological conditions prevailing before the advance of the south-west monsoon. Records of the past show that the monsoon rainfall of India is affected by previous conditions over various parts of the earth, *e.g.* high barometric pressure during March–May in Argentina and Chile, and low pressure in May in the Indian Ocean are favourable conditions, while high pressure in India in May is advantageous for Malabar, and possibly Mysore, but unfavourable for other parts. Among the inferences drawn from available data are: (1) that, on the whole, the total monsoon rainfall this year will probably be somewhat less abundant than usual, at any rate in the earlier part of the season; (2) as regards geographical distribution, during the first half of the monsoon period, while local conditions are favourable for the Malabar coast, they are somewhat unfavourable for several other parts.

WE have received from Prof. A. McAdie, director of the Blue Hill Observatory (Massachusetts), an appreciative review of the scientific work of the late Prof. A. L. Rotch, published (apparently) in the Annals of Harvard College. Many of the facts referred to are already known to our readers; Prof. Rotch was the founder, and for more than twenty-seven years director, of the observatory. The upper-air records obtained by him have been of great service in the study of various meteorological problems, and a list of 183 of his principal articles and memoirs are given in Prof. McAdie's notice.

A CONVENIENT method of determining the melting or solidifying range of temperature of a lava or similar substance, which on account of its want of homogeneity must be tested in bulk, is described by Messrs. K. Fuji and T. Mizoguchi in the March number of the Proceedings of the Tokyo Physical Society. The material to be tested is placed in the form of powder in an earthenware crucible of about 50 c.c., and is heated in an electric resistance furnace. The temperature is measured by a standardised platinum platinum-rhodium couple, and the electrical conductivity by the current sent by an alternating electromotive force applied to two spherical platinum electrodes immersed in the molten material. The apparatus is standardised by the use of fused sodium chloride. According to the measurements made by the authors, the conductivity of molten lava may exceed 0·5 reciprocal ohms per centimetre cube, and may therefore influence the propagation of electric waves over that part of the earth's surface beneath which it is present.

IN the July number of *Science Progress* the editorial article entitled "Irrationalism" is a strong condemnation of the position taken up by the anti-vivisectionist. "Irrationalism," it is truly urged, "is generally the enemy of humanity. In the form of crankism it clings shrieking to the hands of science just when she is engaged upon her most difficult but beneficent labours, and, in the form of political party, it paralyses the efforts of the wisest legislators." The age of the earth is discussed by Prof. J. Joly, whilst Mr. H. S. Shelton, dealing with the same subject, brings forward arguments, with which probably most chemists will agree, to show that sea-salt data are unsatisfactory as a basis of calculation of geologic time. Mr. Arthur Holmes considers the terrestrial distribution of radium, which bears upon the same problem. Articles of general interest are contributed by Dr. J. J. Jenkins on scientific research and the sea-fisheries, by Mr. W. R. G. Atkins on some recent work on plant oxidases, and by Mr. R. Steele on photographic and mechanical processes used in the reproduction of illustrations.

THE fourth article on the Ford motor-car works in the *Engineering Magazine* for July describes the methods adopted for assembling motors and their components. It is common practice in these works to place the most suitable component on elevated ways or rails, and to carry it past successive stationary sources of component supply, and past successive groups of workmen who fix the various components to the principal component, until the assembly is completed and ready to leave the assembling line. A slow-moving chain is used in certain cases to drive the assembly in progress along the rails. The following figures will illustrate the saving in time effected: Motor assembling on separate benches gave, in October, 1913, 1100 men working 9 hours to assemble 1000 motors. On full-length motor-assembling lines, in May, 1914, 472 men working 8 hours assembled 1000 motors. It will be understood that elaborate systems of making all parts to gauge and of rigid inspection of the finished components contribute largely to these results.

AMONG the papers read at the Paris meeting of the Institution of Mechanical Engineers last week is one on signalling on railway trains in motion, contributed by the engineers of six of the French railways. On the Nord, a fixed ramp is set in the centre of the track parallel to the rails, and at a distance from the signal varying from the foot of the signal to 200 metres. The oak beam forming the ramp carries a cover-plate of brass; a stout square piece of copper is riveted to the plate and is connected to the wire from the battery. Cushions of tarred felt are placed between the ramp and the sleepers so as to reduce vibrations due to trains passing. The locomotives carry an electro-automatic whistle, the steam or compressed-air valve of which is operated by a strong spring and a Hughes electromagnet. A brush on the locomotive formed of a series of small brooms of hard elastic copper wire connects the electromagnet through the ramp to the battery; the other wire goes to earth through the wheels and rails. The signal vane is provided with a switch which controls the position of the signal vane as well as releases the whistle. All the installations described in the paper must be regarded as being in the experimental stage.

WE have received a copy of "The Leather Trades Year Book," the official publication of the United Tanners' Federations of Great Britain and Ireland. The year-book is published at 3*s*., and can be obtained from the hon. editors, 176 Tower Bridge Road, London, S.E. It contains a large number of statistical data for the last five years of hides, tanning materials, and leather-made goods, and a series of illustrated articles dealing with the science and practice of the leather industry.

AMONG recent additions to the "Cambridge Manuals of Science and Literature," published by the Cambridge University Press at 1*s*. net each, the following deserve mention. One by Dr. R. A. Sampson, Astronomer Royal for Scotland, has the title, "The Sun," and provides in its 141 pages a brief statement of the present position of fact and theory relating to the sun. The second is by Mr. T. C. Cantrill, and deals with coal mining. He outlines the evolution of the industry from its primitive beginnings, and indicates some of the far-reaching effects it has had on domestic and mechanical affairs. The third book, "The Making of Leather," is by Mr. H. R. Procter, who gives a sketch of the methods and some discussion of what is a very ancient industry, involving in its explanation some difficult branches of human knowledge.

OUR ASTRONOMICAL COLUMN.

COMET 1914*c* (NEUJMIN).—Prof. H. Kobold contributes to a supplement to *Astronomische Nachrichten* (No. 4748) the elements and ephemeris of the comet most recently discovered, namely, comet 1914*c* (Neujmin). The observations of July 1, 2, and 3 were utilised and a parabolic system of elements was computed. The elements are as follows: —

Elements.

$T = 1914$ Feb. 11·518 Berlin M.T.
$\omega = 289° 2'0''$
$\Omega = 265° 45'3''$ 1914·0
$i = 36° 19'3''$
$\log q = 0{\cdot}13179$

The comet is getting very faint, but for those with larger telescopes the following ephemeris may be useful :—

		R.A. (true) h. m. s.		Decl. (true) ° ′		Mag.
July 16	...	17 50 2	...	−9 30·6	...	12·9
17	...	49 24	...	21·6		
18	...	48 48	...	12·9		
19	...	48 13	...	9 4·5	...	13·0
20	...	47 41	...	8 56·3		
21	...	47 10	...	48·5		
22	...	46 41	...	41·0		
23	...	17 46 14	...	−8 33·8	...	13·1

COMET 1913*f* (DELAVAN).—For the last few months comet 1913*f* (Delavan) has been lost in the sun's rays, but it will soon now become visible again, and it is expected that it may appear as a naked-eye object. Numerous elements, both parabolic, elliptic, and hyperbolic, have been computed by different workers. Thus Dr. G. van Biesbroeck advocates parabolic elements (*Astronomische Nachrichten*, No. 4739) as follows :—

$T = 1914$ Oct. 26·3000 Berlin M.T.
$\omega = 97° 28' 17{\cdot}4''$
$\Omega = 59° 8' 46{\cdot}4''$ 1910·0 (Osc. 1914 Sept. 28·0)
$i = 68° 1' 46{\cdot}4''$
$\log q = 0{\cdot}0430113$

Herr E. E. Kühne calculates his ephemeris (*Astronomische Nachrichten*, No. 4739) on the basis of elliptic elements, which he gives as follows :—

$T = 1914$ Oct. 26·5626 Berlin M.T.
$\omega = 97° 27' 8{\cdot}7''$
$\Omega = 59° 10' 16{\cdot}3''$ 1914·0
$i = 68° 6' 23{\cdot}6''$
$\log q = 0{\cdot}043697$
$e = 0{\cdot}999655$

Messrs. S. B. Nicholson and C. D. Shane (*Lick Observatory Bulletin*, No. 255) do not consider a parabolic orbit to be included within the range of possible solutions, and so advocate a set of hyperbolic elements on which their ephemeris is based. The following are the elements they give :—

$T = 1914$ Oct. 25·8690 Greenwich M.T.
$\omega = 97° 25' 06{\cdot}7''$
$\Omega = 59° 12' 41{\cdot}2''$ 1914.0
$i = 68° 00' 36{\cdot}9''$
$q = 1{\cdot}10333$
$e = 1{\cdot}00163$

The following ephemeris for the current week is based on the computations of Dr. G. van Biesbroeck :

		R.A. (true) h. m. s.		Decl. (true) ° ′ ″		Mag.
July 16	...	5 22 31	...	+33 52 3	...	6·8
17	...	24 51	...	34 10 16		
18	...	27 14	...	34 28 36	...	6·7
19	...	29 38	...	34 47 4		
20	...	32 6	...	35 5 40		
21	...	34 35	...	35 24 24		
22	...	37 7	...	35 43 16	...	6·6
23	...	5 39 42	...	+36 2 16		

Attention may be directed to a communication to the Royal Academy of Belgium (*Bulletin de la Classe des Sciences*, 1914, No. 2, p. 101) by Dr. G. van Biesbroeck. In this the author discusses in detail the elements and positions of the comet, and gives an interesting chart of the positions of the comet in the sky (with the sun's positions) extending from September 1, 1913, to July 1, 1915.

CLASSIFICATION OF NEBULÆ AND STAR CLUSTERS.—Those who have observed or photographed a large number of nebulæ and star clusters have no doubt experienced the difficulty of classifying them briefly without having to describe each in detail. Nearly every astronomer who has had to deal with a large number of these objects has either adopted a previous system of nomenclature or has formed one of his own based partially on one previously selected. The time seems to have arrived when a universal method of nomenclature should be adopted, and M. G. Bigourdan, in the *Comptes rendus* (No. 26, June 29, 1914, p. 251), discusses the whole question from this point of view. He reviews the systems of W. Herschel, J. Herschel, Schultz, Kobold, Wirtz, Max Wolf, Bailey, etc., and finally submits a scheme which while embodying the chief points and notations of previous classifications appears to be simple, brief, and comprehensive. This scheme should serve as a good basis for discussion, and, even if modified, M. Bigourdan will have done a good service by bringing this subject of classification to a head.

WATTS'S "INDEX OF SPECTRA."—The "Index of Spectra" by Dr. W. Marshall Watts is a publication familiar to all spectroscopists, and completes and brings up to date in the forms of appendices the wave-length determinations of the elements. Appendix W, the second of a new series, has just made its appearance, and contains the spectra of chromium, cobalt, copper, dysprosium, erbium, europium, and fluorine, concluding with additions and corrections to Appendix V.

THE NAPIER TERCENTENARY.

THE Napier tercentenary celebration, to be held in Edinburgh under the auspices of the Royal Society of Edinburgh, will open formally on the afternoon of Friday, July 24, when the Right Hon. Lord Moulton will deliver the inaugural address. The same evening the Lord Provost and magistrates will give a reception in honour of the event. On the afternoon of Saturday, the governors of Merchiston Castle School will entertain the members of the congress, who will thus have an opportunity of seeing the very room which John Napier occupied as his study. The divine service in St. Giles' Cathedral on the afternoon of July 26, and the farewell reception given by the president and council of the Royal Society of Edinburgh, form the remaining gatherings of a general nature.

The other meetings will be essentially mathematical in character, and will be held on Saturday forenoon and on the greater part of Monday, in the University, the rooms of the mathematical department, and a number of other rooms and halls in the immediate vicinity being utilised for the purpose.

The general arrangement of the programme is to devote Saturday forenoon to papers and discussions of an historical character. Dr. Glaisher, F.R.S., Prof. Cajori, Prof. Eugene Smith, and others are expected to take part.

On the Monday the communications will refer mainly to the construction of mathematical tables and the methods of calculation. Prof. Andoyer, of Paris, Prof. Bauschinger, of Strassburg, Prof. d'Ocagne, of Paris, and M. Albert Quiquet, the secretary of the Actuarial Society of France, have all agreed to read papers on the subjects with which their names are identified, and well-known representatives from America and the United Kingdom will also be among the speakers.

Some points of practical interest have been suggested for discussion, *e.g.* a facsimile reprint of the original edition of the "Descriptio," the construction of a table of co-logs to seven figures, the publication of part of Dr. Sang's great volumes of manuscript tables of logarithms and sines.

A particularly interesting feature of the congress will be the exhibits of books, instruments, calculating machines, Napier relics, etc. These are to be arranged in the large examination hall of the University, close to the mathematical department. From Lord Napier and Ettrick and other representatives of the Napier family some interesting portraits and other relics have been received; and Mr. Lewis Evans's remarkable collection of "Napier's Bones," or "Numbering Rods," will form a valuable exhibit in itself. Mr. J. R. Findlay has set out a large selection of portable sundials dating from the sixteenth century. John Napier's own works and the other early editions of logarithmic tables published both in Great Britain and the Continent will be of great interest to all mathematical students. Mr. Roberts has undertaken to set up his tide-predicting machine, and have it in action during the time of the Napier Congress and the succeeding mathematical colloquium. Slide-rules, arithmometers, integraphs, and many other forms of calculating machine, will be of special interest to the practical calculator.

These and many other exhibits are being described in an illustrated handbook which every member of the congress will receive with his membership card.

It is expected that the exhibition will be open to members on Thursday, July 23, or on Friday morning at the latest, so that there will be ample time to view it before the meetings begin.

All members of the congress will have the privilege of using the rooms of the Royal Society of Edinburgh. They will also be elected honorary members, for the time being, of the Edinburgh University Students' Union, where luncheon and other club privileges may be enjoyed.

It should be mentioned in conclusion that the Napier tercentenary celebration has received a remarkable degree of support from individuals and from educational institutions over the whole civilised world. In virtue of this support, the committee has felt justified in preparing beforehand for distribution a handbook full of mathematical lore. In the memorial volume valuable communications will be published, and the salient features of the congress will be recorded.

To all who have thus aided in making the tercentenary celebration of the publication of the first book of logarithms a real success, I wish now to convey the cordial thanks of the general committee of the Napier celebration, and of the council of the Royal Society of Edinburgh, among whom the project first took shape. C. G. KNOTT.

THE ROYAL SANITARY INSTITUTE CONGRESS AT BLACKPOOL.

THE twenty-ninth Congress of the Royal Sanitary Institute, held at Blackpool on July 6–11, was well attended, and the addresses, papers, and discussions were well above the average in interest and importance.

Lord Derby, who opened the congress on the Monday, pleaded for greater attention being given to physical and military drill as an aid to hygiene, basing his argument upon the improved physique of the Army, as compared with that of the classes from which they were drawn.

A paper upon the action of some metals upon certain water and other bacteria, presented by Prof. Delepine and Dr. A. Greenwood, gave an account of the recent results of the investigation of the above subject, carried on in the pathology and public health laboratory of the University of Manchester. The detailed results are contained in a series of tables printed in the original paper, and are summarised in the conclusions at which the authors arrive, as follows:—

Pure platinum, gold, and tin, which do not seem to be appreciably acted upon by water, or by the organic media used in the experiments, did not appear to have any action on the four kinds of bacteria experimented upon.

Lead, aluminium, and iron, which were distinctly acted upon, were either without appreciable effect (lead), or had only a slight inhibitory action (aluminium and iron).

Copper, silver, zinc, and mercury had a powerful inhibitory action, and also showed evidence of being acted upon by the media, and of forming certain compounds the nature of which will be discussed elsewhere. In all cases where a marked inhibitory action was produced it was noticed that in reduced doses the metals were also capable of an excitatory action which resulted in increased growth of bacteria.

It will be noticed that all bacteria were not affected in the same way and to the same extent. The action of soft water upon copper and upon lead is very rapid; but while the passage of lead into the water does not appear to affect the bacterial contents, that of copper is attended with complete, or almost complete, sterilisation in about half an hour.

Dr. J. W. Brittlebank, veterinary officer to the Sanitary Committee of the Manchester City Corporation, delivered an address to the Veterinary Section of the congress, in which he dealt chiefly with the milk supply and the provisions of the new Milk Bill, now before the House of Commons. His own views are summed up in the following paragraphs:—

"Public attention has been directed for many years past to the question of the milk supply, and there is little doubt that considerable progress and improvement has been made in the general conditions; but there is, I am afraid, a constant danger of allowing ourselves, when considering the question, to drift into one of its side-issues, namely, the elimination of tuberculous milk. Doubtless this is a most important question, perhaps the most important aspect, but in considering this we are apt to forget the other branches of the problem.

"Our aim should be to put within the reach of everybody a supply of good, clean, disease-free raw milk, which may be consumed in any quantity with safety. It is perfectly true that many are so unfortunately situated, as to be able to purchase only the most meagre amounts, but they have just as much right to protection as their more fortunate brethren.

"The whole question teems with difficulties, and requires great qualities of statesmanship in its handling. The business aspects of the question are important, inasmuch as the price of the article to the consumer is of paramount importance. Certain it is that improvement in conditions cannot be obtained without enhancing the value of the article produced, and it behoves all concerned to restrict the requirements asked for, within such limits as may be regarded to be the minimum of safety."

In the Preventive Medicine Section, Dr. Arthur Sellers, lecturer on comparative pathology in the University of Manchester, read a paper on the blood changes in lead workers, giving the results of investigations carried on in the public health laboratory of that University. The chief object of this investiga-

tion was to obtain some first-hand information concerning the blood changes in workers in lead, especially as regards the significance of the presence of basophile granules in the red corpuscles (the "erythrocytes ponctués" of French writers), and the conditions under which they occur.

The men examined were all adult males. Most of them were employed at the works of the Chloride Electrical Storage Co. at Clifton Junction, in various ways involving contact with lead. Three men were undoubted cases of lead-poisoning, not employed by the Chloride Company, but sent to the works to obtain bath treatment.

The conclusions arrived at were as follows:—

(1) The presence of basophile granules in the blood of lead workers affords very strong evidence of lead absorption, but in itself is no absolute proof of lead poisoning. It would appear wrong to exclude such cases from following their ordinary work, but they should be regarded as a special class, and kept under close observation. The knowledge of the existence of such cases in a factory would certainly facilitate the work of inspection.

(2) Blood examinations are of great value in cases where the clinical symptoms are doubtful, and in cases of suspected malingering or imaginary illness. In such cases a positive finding would at all events go to show that lead absorption had occurred. A negative result is of less significance, though it has a certain value.

Dr. S. Rideal, of London, in a paper read before the Domestic Hygiene Section of the congress, discussed the use of paper utensils in the home as a substitute for glass and china or earthenware. The argument for the use of paper plates, cups and saucers, which can be destroyed after use, was based chiefly on the fact that recent scientific investigation has proved that cups taken from schools, stores, and hotels have been found infected with several pathogenic forms of bacteria (including those of diphtheria, pneumonia, and influenza), even when supposed to be clean and ready for use. At one of the largest hospitals there is a regulation that all crockery, cutlery, glass, etc., should be rinsed in a disinfectant before being used again. In these days of typhoid and diphtheria "carriers," the public are entitled to expect the adoption of similar precautions in places of refreshment; but this, of course, involves expense and labour.

Samples of the following articles, made in paper, were exhibited at the close of the address, which aroused much interest and a keen discussion:—*Cups:* automatic dispenser; collapsing. Plates, table-covers; handkerchiefs; towels (various); blind; spitting-cup; formaldehyde generator (home-made). *Bags:* coke bag; moth bag; bags for cookery.

PALISSY AS A PIONEER OF SCIENTIFIC METHOD.

EVERYONE is familiar with the dramatic story of Bernard Palissy, the potter, and how he fired a kiln with his household furniture in order to produce sufficient heat to melt his glazes, but his scientific work is rarely mentioned. A paper on "Palissy, Bacon, and the Revival of Natural Science," by Sir T. Clifford Allbutt, published in the Proceedings of the British Academy (vol. vi.) is therefore a welcome contribution to the history of science.

Palissy shares with Galileo and Gilbert the credit of being a pioneer of modern scientific method. Born in 1519, in Périgord, he was apprenticed to the art of glass painting, and in 1539 saw the cup of glazed faïence which inspired him to produce a similar glaze upon ware. After he had succeeded, he found his way to Paris, where he wrote books on many scientific subjects; and during the years 1575–84 he exercised great influence upon society in the city. He lectured on agriculture, chemistry, mineralogy, and geology, and illustrated his lectures with demonstrations of natural objects from his museum. "Into the faces of the learned of his time he thrust his facts; he urged the might of the verified fact, the tests of practical experience, the demonstration of the senses; and these in a keen and original way." Among the physicians who attended his lectures was no less a person than Ambrose Paré.

By observation and experiment Palissy combated the prevailing notion that springs originated in the percolation of sea-water into the earth; and he showed that they were formed at the junction of permeable and impermeable strata. He collected fossils widely and understood their nature; and both Buffon and Réaumur bore testimony to the correctness of his judgments upon this and other geological subjects. At the age of eighty Palissy was thrown into the Bastille as a dangerous heretic, and he died there after enduring about a year's imprisonment.

Sir Clifford Allbutt suggests that Francis Bacon, who went to Paris in 1576, and resided there for three years, must have been influenced by Palissy's Museum or lectures, though no mention of them is found in any existing work. "What is certain is that Palissy was then teaching practically the methods which a few years afterwards Bacon propounded at length; and not only so, but was teaching them, if with a far inferior literary capacity, yet with a sounder grasp of their methods."

Bacon constructed an imposing philosophical system of rules by which natural facts and phenomena were to be studied, but it was Palissy, Gilbert, and Galileo who were the real founders of the experimental method of inquiry upon which the superstructure of modern science has been built.

EXPLOSIVES.[1]

AN explosive is a body which, under the influence of heat or shock, or both, is, speaking popularly, instantaneously resolved entirely, or almost so, into gases.

Practical explosives consist either of bodies such as nitroglycerine and nitrocellulose, which are explosive in themselves, or mixtures of ingredients which separately are, or may be, non-explosive, but when intimately mixed are capable of being exploded.

Explosives are exploded either by simple ignition, as in the case of black gunpowder, or by means of a detonator containing mercury fulminate.

The molecules of an explosive may be regarded as in a state of unstable chemical equilibrium. A stable state of equilibrium is brought about by the sudden decomposition of the original compounds with the evolution of heat. An explosion is thus an extremely rapid decomposition, accompanied by the production of a large volume of gas and the development of much heat.

There are two well-defined modes of explosion which can be described as combustion and detonation. In the former case, the explosive is simply ignited and combustion takes place by transference of heat from layer to layer of the explosive. The rapidity with which the combustion proceeds depends not only on the physical form of the explosive, but also on the pressure under which the decomposition takes place. When in the form of fine grains, combustion pro-

[1] From a course of lectures delivered before the Institute of Chemistry, at King's College, London, by Mr. William Macnab, and published by the Institute

ceeds much more quickly than when the grains are large, and the powder maker takes advantage of this fact in preparing powder for rifles and the various sized large guns.

Detonation, on the other hand, has to be started by a sufficiently strong impulse, such as the explosion of a charge of mercury fulminate; it proceeds much more rapidly and is due to the formation of an explosion wave that has a velocity of thousands of metres a second.

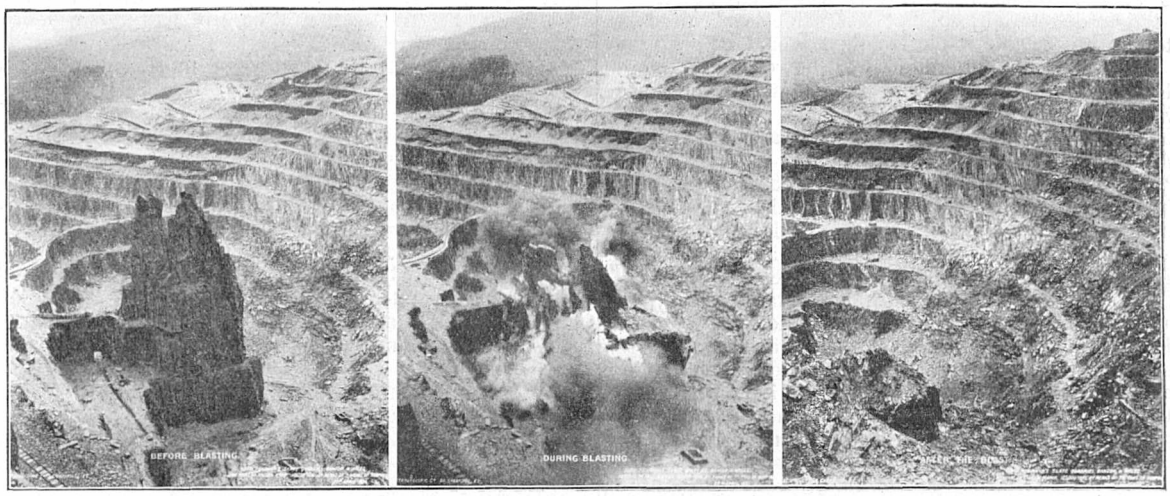

FIG. 1.—Blast at Lord Penrhyn's slate quarries.

Black gunpowder and allied explosives, as well as the smokeless powders, belong to the first or combustion class, and they are commonly designated "low" explosives.

"High" explosives indicate those, such as dynamites and nitrate of ammonia explosives, which detonate and have a greater shattering action than the former.

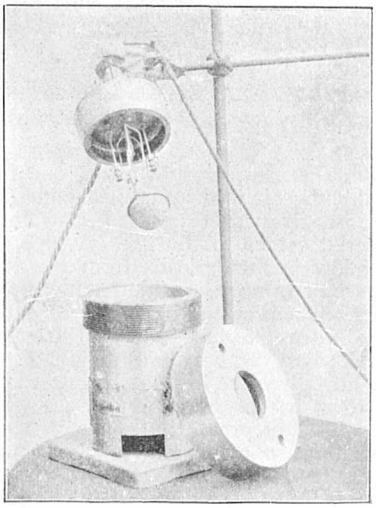

FIG. 2.—Berthelot calori-metric bomb.

The volume and composition of the gas produced, both in regard to the power of the explosive, and, in the case of mining explosives, the health of the miner, are of great importance. These gases are largely determined by the original composition of the explosive.

When there is insufficient oxygen for complete oxidation, the products are carbon dioxide, carbon monoxide, hydrogen, water, and nitrogen, but the relative proportions vary with the pressure developed. When such an explosive is fired in a closed vessel under different densities of charge, that is, different quantities of explosive in the same volume, the volume and composition of the gas varies with the pressure developed by the explosion. The carbon dioxide and hydrogen increase and the carbon monoxide and water diminish as the pressure increases; also, at high pressures, considerable amounts of methane are formed. In the foregoing, it has been assumed that complete explosive decomposition has taken place.

When a high explosive burns, instead of explodes, the chemical changes are not only very much slower and the disruptive effect practically *nil*, but the character of the gases is entirely changed, large volumes of poisonous nitrous fumes along with other gases being produced.

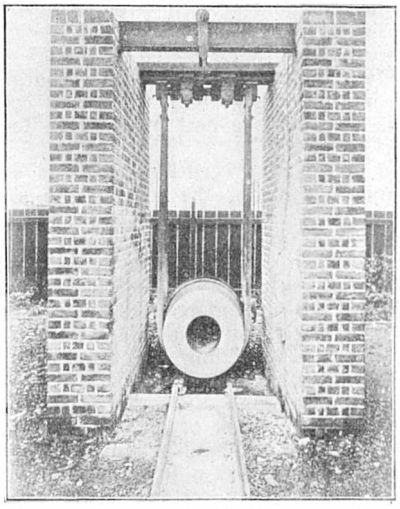

FIG. 3.—Ballistic pendulum, Home Office testing station.

The temperature developed by an explosive is of importance, because the higher the temperature the greater the erosion of the guns.

Nearly all blasting explosives, except black powder, are fired by means of a detonator. Fulminate of

mercury is the most widely employed constituent of the detonator charge; sometimes it is used alone, but more usually with an admixture of 20 per cent. of potassium chlorate.

Trinitrotoluene, picric acid, and tetranitromethylaniline, each with a small quantity of fulminate as primer, have also been used for charging detonators.

More recently lead azide prepared from the sodium salt of hydrazoic acid N_3H, by means of a lead salt, has also been used, as it has a greater power of initiating detonation, so that less azide is required to detonate an organic explosive than would be required of fulminate. Its manufacture, however, is more delicate than fulminate, and the formation of large crystals must be avoided, as they have the unpleasant property of sometimes exploding spontaneously.

Another new explosive body which appears likely to play an important part as a charge for detonators is tetranitroaniline, manufactured by nitrating meta-nitroaniline. It combines an exceptional explosive power with aromatic stability and has a high density. It can be easily detonated, even when highly compressed, and has such a high percentage of oxygen that it can be detonated without residue or smoke.

In blasting operations, gunpowder and detonators are either fired by a time fuse or electrically. The time fuse consists of a thin but continuous core of black powder covered by a case of twine and tape and varnish. It is made to burn at a known uniform rate, generally 2 ft. a minute, in order that a sufficient length can be used to allow the shot-firer, after lighting the fuse, to reach shelter before the explosion takes place.

The instantaneous fuse, which burns at the rate of 100–300 ft. a second, affords a mean of firing many charges simultaneously.

Occasionally it happens that a coil is defective, generally through discontinuity in the powder core. C. Napier Hake, late Chief Inspector of Explosives for Victoria, ingeniously employed X-ray photography to examine suspected coils, and, in this way, was able to recognise those which were defective.

One of the most interesting recent productions is the "detonating fuse," a soft metal tube filled with trinitrotoluene which detonates with greater velocity than most explosives. When placed alongside the cartridges in a deep borehole, it is considered to give an enhanced blasting effect by causing the whole charge to go off more simultaneously than when the column of explosive is fired at one end by a detonator in the usual way.

With the object of preventing accidents so far as possible, and minimising the loss of life should an explosion occur, a number of rules and regulations have been drawn up by the Explosives Department of the Home Office which have to be followed in the construction and working of explosive factories.

The object of the restrictions is to allow only limited quantities of explosive material and a limited number of workpeople in one building at a time, and, further, to place the different buildings at such distances from each other, or surround them by protecting earth mounds, that in the event of an explosion the effect is localised as much as possible and the explosives in the adjacent buildings are not "set-off."

The manufacture of guncotton and the other forms of nitrocellulose is carried out in the first stages in the non-danger part of the factory.

The most interesting development of the nitration process is the method devised by J. and W. Thomson, of the Royal Gunpowder Factory, Waltham Abbey.

The composition of the acid mixture is of the greatest importance and largely determines the character of the product. The ratio between the nitric and sulphuric acids and the water must be accurately adjusted.

It must also be remembered that the cotton is by no means a definite chemical body, and its physical state plays an important part. Samples of different cottons, under the same conditions in a bath of the same composition, while yielding nitrocelluloses containing practically the same percentage of nitrogen, may vary in solubility in ether-alcohol from 25 per cent. to 70 per cent.

Turning now to the production of nitroglycerine, this manufacture is much simpler than that of nitrocellulose; at the same time, it is much more dangerous.

The plant which is at present most employed is known as the nitrator-separator. It was developed at Waltham Abbey by Sir Frederic Nathan and W. Rintoul, and is a great advance on the former methods.

The nitrator-separator is a cylindrical leaden vessel with a coned top; inside are placed leaden coils, through which cooling water circulates, and pipes, through which compressed air is blown to mix the contents. The glycerine is introduced in the form of a fine spray under the acid by means of a special injector, worked also by compressed air.

When everything goes right, the nitration of the

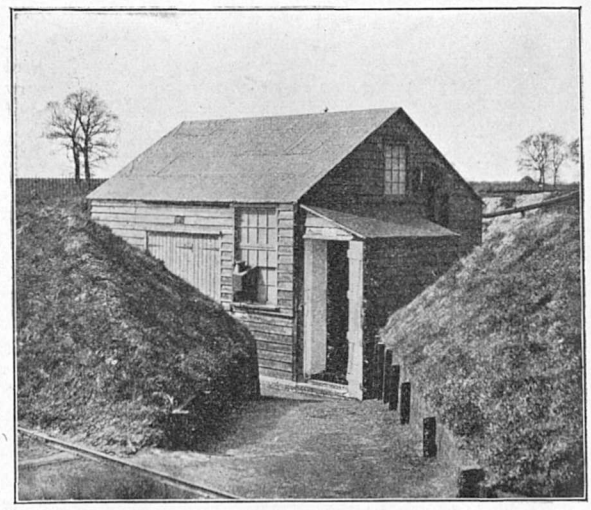

FIG. 4.—"Mounded" house, Cotton Powder works.

charge is usually completed in about one hour; the agitation with the air is discontinued and the separation of the nitroglycerine from the acids takes place—being lighter it comes to the top. A pipe, in which a glass window is fitted, leads from the top of the nitrator-separator to a pre-washing tank; by allowing waste acid from a previous operation to enter at the bottom, the nitroglycerine is forced over into the washing tank; and the flow of acid is stopped whenever all the nitroglycerine has passed into the washing tank, which can be observed through the window.

With the object of preventing explosions of gas or coal-dust in mines, our Government, in common with many others, has instituted a test which explosives have to pass before they are put on the "permitted" list, and are available for use in fiery or dusty mines. This test has varied in the different countries, and a change has been introduced recently, since the transference of the testing station from Woolwich to Rotherham. Much difference of opinion still exists as to the best means of carrying out such a test.

One of the chief factors in determining the ignition is the temperature developed by the gases of explosion. Owing to lack of data, the temperature cannot be calculated with sufficient accuracy, and other condi-

tions obtain which make a practical test more helpful. Nevertheless, the temperature is of great importance and many means are employed of lowering it, such as adding salts which absorb heat on volatilisation.

The rapidity of detonation, the length of the flame, and the heat evolved, all influence the readiness with which explosives ignite gas or coal-dust; but in this connection knowledge and progress have been chiefly promoted by direct experiment at the various testing stations here and abroad.

The filling material for shells has been the subject of much experiment and trial by the different countries. Picric acid, under the various names of melinite, lyddite, shimose powder, etc., has been extensively tried and found wanting. Ammonal, containing ammonium nitrate, with a large percentage of trinitrotoluol and finely divided aluminium, is a very safe and powerful explosive, and has been adopted as the charge for shells by the Austrian Government. It has the disadvantage of containing the hygroscopic ammonium nitrate as an ingredient, and must consequently be specially protected against moisture. At present, trinitrotoluol is the body which has commended itself to most of the Governments as the best bursting charge for shells, torpedoes, and general military blasting work, and has just been adopted by our own Government.

Experience in America, South Africa, and Australia has shown that the fruit-grower has a real friend in explosives, and it seems to me that, in this country also, we must wake up to this beneficent aspect of explosives and the means they offer of attaining results otherwise impossible.

In the case of tree planting, it is not the mere comparison of the cost of the excavation of the hole in which to place the tree which has to be considered. When an explosive is employed, the soil is shaken up and fissured for a comparatively wide area beyond the hole actually required for the tree. When, as often happens, there is a hard and impervious subsoil beyond reach of the spade, this is also opened and fissured, and experience has shown that trees planted in ground prepared by explosives make a much more vigorous and rapid growth than when planted in the ordinary way. Some trees have begun bearing after four years, while others similarly situated but spade planted did not yield fruit until six years.

In the case of existing orchards little can be done in the ordinary way to aerate or render the soil more pervious to the roots and moisture, but a small cartridge inserted at some depth below the tree, or a larger one exploded at a depth of 3 ft. or so below the surface and midway between trees planted about 15 ft. apart, has a most beneficial effect in loosening the soil without injuring the trees. The roots have less resistance to overcome, the soil is aerated, the moisture retaining properties improved, and a new lease of life is thus given to an old orchard; the trees become more vigorous and productive, and indeed are rejuvenated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The following appointments have been made:—Mr. Howard Priestman to be lecturer in textile industries; Dr. A. M. Pryce to be demonstrator in bacteriology; Dr. H. E. Woodman to be research assistant in animal nutrition; Mr. H. A. Wyllie to be additional assistant lecturer and demonstrator in agriculture.

The second annual Yorkshire Summer School of Geography will be held at Whitby on August 3–22. The work of organisation has again been undertaken by the University of Leeds, and the director of the school will be Prof. Kendall. The special subject this year will be the British Isles, treated in a general course, dealing with land forms and structure, meteorology and economic geography. There will be alternative courses at the choice of each student on (1) agriculture, rocks and soils, and (2) oceanography, rivers and river development, and the evolution of transport. As in last year's course, special attention will be paid to practical and field work.

LONDON.—The council of Bedford College has made the following appointments:—Assistant-lecturer in mathematics, Mr. C. Clemmow; demonstrators in physiology, Miss G. Hartwell and Miss N. Tweedy; demonstrators in chemistry, Miss E. Field and Miss B. M. Paterson; demonstrator in geology, Miss I. Lowe.

DR. F. R. MILLER, of the department of physiology, McGill University, Montreal, has been appointed professor of physiology in the Western University, London, Canada.

THE distribution of prizes at the Horticultural College, Swanley, Kent, will be held on July 23. The prizes will be presented by Lady Reid, and Sir George Reid, G.C.M.G., High Commissioner for Australia, will give an address. The chair will be taken at 4 p.m. by Sir John Cockburn, K.C.M.G.

THE governors of the Imperial College of Science and Technology have appointed Dr. A. N. Whitehead, F.R.S., to the newly constituted chair of applied mathematics, and Dr. C. G. Cullis to the professorship of economic mineralogy. These changes form part of the general scheme of development of the Imperial College "for the provision of the fullest equipment for the most advanced training and research in various branches of science, especially in its application to industry."

THREE issues of the *Undergraduate*, the University of London magazine, published by the Students' Representative Council, have been received. The first issue announced in December last that four numbers of the magazine would be published during the current session, and gave the last day for receiving contributions for the next issue as "19th January, 1914." Yet the second number bears the date May, 1914, and it says nothing of the number of issues during the session. The third issue is dated July, 1914. Sir Henry Miers writes in the December issue:—"A magazine which will represent the University as a whole, and will give to all its members a medium of free expression upon the numerous and increasing matters of University interest will . . . satisfy a very real need." We trust that the magazine will meet with the success to which the variety and interest of its contents entitle it.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 25.—Sir William Crookes, president, in the chair.—Sir W. **Crookes**: The spectrum of elementary silicon. The author has tried in vain for years to get pieces of fused silicon in an approximate degree of purity. Lately the Carborundum Co. at Niagara Falls sent him three samples giving an analysis of 99·56, 99·86, and 99·98 per cent.

of silicon, the impurities being titanium, iron, and aluminium. This material has been used in the present research. The paper gives a complete list of silicon lines from λ 2124·163 in the ultra-violet to λ 6371·032 in the extreme red, with some remarks referring to missing or doubtful lines.—Prof. S. P. **Thompson**: Note on Mr. Mallock's observations on intermittent vision. In his paper of December, 1913, on intermittent vision, Mr. Mallock discussed the phenomena observed when a rotating disc of twelve black sectors painted on a white ground is viewed while a slight mechanical shock is given to the body or head. He concluded that a mechanical acceleration imparted thus to the nerve structures on which vision depends produces a momentary periodic paralysis. The author, repeating Mr. Mallock's experiments, finds that effects of precisely the same kind appear when, on viewing the rotating sector disc in a mirror mounted elastically on a support, slight mechanical shocks are given to the mirror instead of to the observer. He therefore attributes the effects, both in Mr. Mallock's original experiments and in his own, to momentary minute displacements of the image on the retina, stimulating rods and cones which are relatively unfatigued and which therefore are momentarily of greater sensitiveness.—T. R. **Merton**: Attempts to produce rare gases by electric discharge. An investigation has been made of the apparent production of neon and helium by electric discharges in vacuum tubes. An apparatus has been designed in which protection from atmospheric contamination can be secured by a mercury seal throughout the experiment. It has been found that the presence of argon in the residual gases furnishes an exceedingly sensitive test for atmospheric contamination, and that a mercury seal can only be relied on if precautions are taken to ensure that the mercury and glass are scrupulously clean. The author has not been successful in reproducing the conditions necessary for the production of neon and helium.—A. C. G. **Egerton**: The analysis of gases after passage of electric discharges.—C. T. **Heycock** and F. H. **Neville**: Dilute solutions of aluminium in gold.—Prof. F. G. **Donnan** and G. M. **Green**: The variation of electrical potential across a semipermeable membrane.—J. H. **Jeans**: The potential of ellipsoidal bodies and the figures of equilibrium of rotating liquid masses. Sir G. Darwin was convinced that the pear-shaped series of figures of equilibrium discovered by Poincaré was initially stable, while M. Liapounoff had with equal conviction announced that it was unstable. The present investigation was undertaken primarily in the hope of deciding between these two views. The main conclusion arrived at is somewhat disappointing. It is that, in spite of the labours of Poincaré, Darwin, and Liapounoff, we have still no definite knowledge as to the stability or instability of the pear-shaped figure. All these investigators have worked at the question of the stability of the pear-shaped figure carried so far as the second order of small quantities. The present paper indicates that, so far as second-order terms, there is a doubly-infinite series of such figures which can, of course, be broken up into linear series in as many ways as we please. So far as can be seen, Sir G. Darwin has concerned himself with only one of these series, while M. Liapounoff has presumably dealt with a different series. It appears that the true linear series demanded by the general theory of Poincaré (*Act. Math.*, vii., p. 259) only reveals itself when the computations are carried so far as the *third* order of small quantities, a conclusion which is confirmed by the result of a previous investigation on the figures of equilibrium of rotating cylinders (Phil. Trans., A. 200 (1902), p. 67).—Dr. C. **Chree**: The 27-day period in magnetic phenomena. The author has dealt in two previous papers in the Philosophical Transactions with data which seemed to confirm the reality of a period of about 27 days in magnetic phenomena, in the sense that if any particular day is more than ordinarily disturbed, or more than ordinarily quiet, the day which is 27 days later shows a decided bent in the same direction. In these investigations use was made almost entirely of magnetic "character" figures. As international "character" figures do not exist for years prior to 1906, and as "character" figures assigned at one station are open to certain objections, it appeared desirable to ascertain whether or not the 27-day period is clearly shown in the average year by the amplitude of the daily ranges of the magnetic elements. This is investigated in the present paper, use being made of the Kew declination horizontal force and vertical force ranges from 1890 to 1900, treated independently. The period is found to be clearly shown by the range of each element.—J. J. **Nolan**: Electrification of water by splashing and spraying. Water is broken into fine drops—(1) by allowing it to fall into a horizontal air stream of high velocity; (2) by spraying. The size of the drops and the charge per c.c. of water are measured. The conditions of the experiments enabled measurements to be made for drops of different sizes. It is found that the charge is positive and inversely proportional to the radius of the drops. This result follows if we assume that there is a constant charge produced per unit area of new water surface formed. The value of this constant is approximately $2{\cdot}7 \times 10^{-3}$ electrostatic units for distilled water, the splashing and spraying methods giving identical results.—W. G. **Duffield**: Effect of pressure upon arc spectra. No. 5.—A. **Campbell** and D. W. **Dye**: The measurement of alternating electric currents of high frequency. As the accurate measurement of currents larger than 1 ampere at high frequencies presents considerable difficulty, the authors have investigated the accuracy obtainable in the use of air-core current transformers (suggested by Mr. T. L. Eckersley). It is found that, with proper design, such transformers allow of the measurement of currents up to 50 amperes or higher, at frequencies from 50,000 up to 2,000,000 per second, with an accuracy of 1 or 2 parts in 1,000. Over the same range of frequency it is also found that iron-cored transformers can easily be designed so as to give very accurate results.—Sir D. **Bruce**, Maj. A. E. **Hamerton**, Capt. D. P. **Watson**, and Lady **Bruce**: (1) The trypanosome causing disease in man in Nyasaland. The Liwonde strain. Part i.—Morphology. Part ii.—Susceptibility of animals. (2) The naturally infected dog strain. Part i.—Morphology. (3) Susceptibility of animals to the naturally infected dog strain. (4) Morphology of various strains of the trypanosome causing disease in man in Nyasaland. The human strain. vi.–x. (5) The trypanosome causing disease in man in Nyasaland. ii.—The wild game strain. iii.—The wild *Glossina morsitans* strain. Part ii.—Susceptibility of animals. (6) The naturally infected dog strain. Part iii.—Development in *Glossina morsitans*. (7) The naturally infected dog strain. Part iv.—Experiments on immunity.—Dr. F. **Horton**: The origin of the electron emission from glowing solids.—W. A. D. **Rudge**: Some sources of disturbance of the normal atmospheric potential gradient.—Prof. J. **Joly**: A theory of the nature of cancers and of their treatment by radio-therapy.—C. S. **Mummery**: Morphological studies of benzene derivatives. VI.—Parasulphonic derivatives of chloro-,

bromo-, iodo-, and cyano-benzene.—F. H. **Newman**: Absorption of gases in the discharge tube.—Miss M. P. **FitzGerald**: Further observations on the changes in the breathing and the blood at various high altitudes.—W. E. **Agar**: Experiments on inheritance in parthenogenesis.—C. S. **Myers**: The influence of timbre and loudness on the localisation of sounds.—S. J. **Kalandyk**: (1) The conductivity of salt vapours. (2) The ionisation produced by gas reactions. The experiments described in (1) show:—1. The conductivity of the salt vapours is due to the processes occurring in the vapours themselves. 2. The vapours of carefully dried salts conduct the electric current. Therefore the conductivity cannot be ascribed to the chemical action of water vapour in the salt vapours. However, the presence of water vapour increases the current passing in salt vapours. 3. When cadmium iodide was very carefully dried it was possible to observe a current which was practically independent of time. 4. The connection between the current i and the temperature θ may be expressed with considerable accuracy by the formula $i=ae-b/\theta$ where a and b are constants. 5. The ionising potential calculated from the energy of dissociation is considerably less than for the ordinary gases. 7. The dissociation of vapours is not always accompanied by ionisation.—H. **Richardson**: The excitation of γ-rays by β-rays.—F. E. E. **Lamplough** and J. T. **Scott**: The growth of metallic eutectics.—W. E. **Curtis**: Wave-lengths of hydrogen lines and determination of the series constant. (1) The wave-lengths in I.A. of the first six lines of the hydrogen series have been determined with an accuracy of about 0·001 A.U. (2) Balmer's formula has been found to be inexact. The results may be represented by a modified Rydberg formula containing only two constants, thus:—

$$n=\frac{N}{4}-\frac{N}{(m+\mu)^2}$$

where

$$N=109,679{\cdot}22$$

and

$$\mu=+0{\cdot}0_569.$$

(3) An accuracy of 0·001 A.U. is attainable in the third order of a 10-foot concave grating if the exposures are short (say less than half-an-hour). With longer exposures accurate determinations become very difficult if the temperature of the instrument cannot be controlled. (4) The tertiary iron arc standards determined by Burns were tested in the special regions under investigation, and found very satisfactory.—A. **Compton**: Constancy of the optimum temperature of an enzyme under varying concentrations of substrate and of enzyme.—Dr. E. H. **Griffiths** and Ezer **Griffiths**: The capacity for heat of metals at low temperatures. An account is given of an investigation into the capacity for heat of some metals at various points in the range 0° to −160° C. A new method of obtaining constant temperatures is described in which the Joule-Thomson cooling effect on expansion of air is utilised. The formulæ of Einstein, Nernst and Lindemann, and Debye are compared with the experimental results over a very extended range of temperature. None of the formulæ, however, can be regarded as completely representing the experimental results.—T. **Lewis**, J. **Meakins**, and P. D. **White**: The excitatory process in the dog's auricle.—Dr. P. J. **Cammidge** and H. A. H. **Howard**: (1) Observations on the composition and derivatives of urinary dextrin. (2) The so-called lævulose met with in urine. Communicated by Dr. A. E. Garrod.—T. M. **Lowry**: The silver voltameter. Part iii.—The solvent properties of silver nitrate solutions.—A. **Mallock**: Fog signals.—Areas of silence and greatest range of sound.—W. R. **Bousfield**: The osmotic data in relation to progressive hydration.—Dr. S. **Chapman**: The lunar diurnal variation of the earth's magnetism at Pavlovsk and Pola (1897–1903).—W. **Barlow**: The interpretation of the indications of atomic structure presented by crystals when interposed in the path of X-rays.—Prof. J. C. **McClennan**: The fluorescence of iodine vapour excited by ultra-violet light.—A. E. **Oxley**: The influence of molecular constitution and temperature on magnetic susceptibility. Part iii.—On the molecular field in dia-magnetic substances.—A. **Holt**: Diffusion of hydrogen through palladium.

Physical Society, June 20.—Sir J. J. Thomson, president, in the chair.—Sir J. J. **Thomson**: Production of very soft Röntgen radiation by the impact of positive and slow kathode rays. Röntgen and his pupils held that light waves are identical in nature with electrical waves produced by mechanical means, but there is a gap between the longest infra-red radiation and the shortest electrical wave that can be produced mechanically. The work already done on X-rays has demonstrated the existence of two separate rings of electrons in the atom, one within the other. These rings are responsible for the K and L types of radiation respectively. The L radiation is so much softer than the K that if a third ring of electrons exists, the radiation from which is proportionately softer than that of the L type, this radiation will fall well within the gap. In an experiment described a special form of discharge tube was employed. The positive rays passed through a tubular perforation in the kathode and impinged obliquely on a metal target. A photographic plate of the Schumann type was situated at the further end of a branch tube so that no solid obstacle interposed between the target and the plate. When the discharge passed the photographic plate was affected. An intense transverse electrostatic field between two metal plates situated between the kathode and the target completely stopped the effect, showing that this was not due to stray radiation *reflected* from the target. Hence the passage of positive particles from the kathode to the target was essential. A strong transverse electrostatic field in the branch tube had no effect, showing that a radiation was passing between the target and the plate, which was not, therefore, merely affected by positive particles rebounding down the side tube after impact on the target. The properties of this radiation were intermediate between ordinary X-rays and Schumann waves. They were susceptible to reflection by metal surfaces, and their penetrating power was small. They were stopped by the finest collodion film obtainable. The quality of the radiation did not depend on the energy of the moving particles which gave rise to it, but on the velocity. Hence equally soft rays should be produced by kathode particles if these were travelling as slowly as the positive rays. The velocity of impact was varied over a large range, and radiations were obtained varying in quality from hard X-rays to the so-called Schumann waves. It is hoped by the study of these radiations to determine not only the number of rings of electrons within the atom, but the number of electrons in each ring.—F. W. **Aston**: The homogeneity of atmospheric neon.

June 26.—Dr. A. Russell, vice-president, in the chair.—Prof. J. A. **Fleming**: Atmospheric refraction and its bearing on the transmission of electromagnetic waves round the earth's surface. The conditions under which true atmospheric refraction would be sufficient to carry a ray of light or electromagnetic radiation

sent out horizontally from any point on the earth's surface round the earth parallel to its surface are considered. Pure diffraction is insufficient to account for all the phenomena of long-distance wireless telegraphy, but some action of the atmosphere which tends to curve the radiation round the earth has to be postulated. The theory of ionic refraction, based on the theoretical conclusion that in ionised air the velocity of long electric waves is increased, has been put forward. The atmosphere decreases in density as we rise, and this alone produces a decrease of refractive index and an increase in velocity. Formulæ are deduced expressing the variation of density with heights taking into account the known temperature variation with increase of height. At a height of 100 km. the terrestrial atmosphere must consist substantially of hydrogen and helium. An expression is obtained for the radius of curvature at any point of a ray of light sent out horizontally from the earth's surface. This radius at the starting point is given by $\rho=\mu_0(98Aq_0^2)$, where μ_0 and q_0 are the refractive index and density at the surface, and A is the Gladstone and Dale constant for the gas which forms the atmosphere. For air ρ is four times the earth's radius, for hydrogen 136 times, and for krypton equal to the earth's radius. If the terrestrial atmosphere consisted wholly of krypton a ray sent out horizontally would be refracted round the earth, and wireless telegraphy to the Antipodes would be possible. For the same atmospheric density and constant A this circular refraction would result if the earth were twice its present diameter. The suggestion is made that perhaps neon and krypton are manufactured at great atmospheric heights by electric discharges occurring in the rarefied hydrogen atmosphere. Also that by their ease of ionisation they contribute to produce the ionised layer demanded by the theories of Heaviside and Eccles to account for the actual achievements of long-distance wireless telegraphy. Our earth is perhaps unique in being the only planet on which long-distance radio-telegraphy is possible. —G. **Dobson**: Atmospheric electricity observations made at Kew Observatory. Observations were made (1) using the standard Wilson instrument on a stand according to the usual practice, and (2) using an experimental apparatus level with the ground, which was assumed to give correct results. A comparison was made of the electric conductivity of the air as measured by Mr. Wilson's apparatus and that designed by Prof. Ebert.—T. **Barratt**: Thermal and electrical conductivities of some of the rarer metals and alloys. A new method of the "stationary temperature" type is employed for measuring the thermal conductivities of some of the rarer metals, including tantalum, molybdenum, rhodium, iridium, and tungsten, at air temperatures and at 100° C.—F. **Mercer**: Some investigations on the arc as a generator of hgh-frequency oscillations. Experiments on the copper-carbon arc when used as a generator of high-frequency oscillations. The first experiments deal with the effect of varying the arc length, and also the arc current, on the magnitude and frequency of the shunt current. The effect on frequency arises from a change in the resistance of the arc. The second refers to the effect on the shunt current of altering the ratio of inductance to capacity.

PARIS.

Academy of Sciences, July 6.—M. P. Appell in the chair.—Arnaud de **Gramont**: General observations on the ultimate lines of elements from various sources of light. It is pointed out that the strongest lines in the spectrum of a simple body, the "Hauptlinien" of the German physicists, are not identical, the ultimate lines persisting in the condensed spark, and the work of Hartley and Moss is criticised from this point of view. Arranged in decreasing order of temperature the sources of light used were the condensed spark with self-induction, condensed spark without self-induction, non-condensed spark, electric arc, oxy-acetylene blowpipe, oxygen-coal gas flame. Experiments were carried out on forty elements, and a general summary of the results is given.—M. de **Forcrand**: The thermochemical study of some hydrates of manganese sulphate. The values obtained for the hydrates with 2, 3, and 4 H_2O are not in accord with Thomsen's data for the same salts. There would appear to be two isomers of the anhydrous sulphate.—P. **Chofardet**: Observations of the new comet 1914c (Neujmin) made at the Observatory of Besançon. Position given for July 4. The comet appeared as a round nebulosity, about 15″ diameter, with a slight central condensation. About 12·5 magnitude.—G. **Beauvais**: The definition of time given by a clock. A study of the clock installed in the cellars of the Paris Observatory, by means of Abraham's photographic chronograph. It was found that a double second might easily be 0·008 sec. too long or too short, with occasional rare deviations amounting to 0·02 sec. The effect of this on the comparison of two pendulums by the method of coincidences and upon the definition of time is discussed. Georges J. **Remoundos**: Series of functions and the singularities of differential equations.—Th. **De Donder** and O. **De Ketelaere**: The electromagnetic field of Maxwell-Lorentz and the gravitation field of Einstein.—Gustave le **Bon**: The principle of relativity and intra-atomic energy.—Léon **Brillouin**: The calorific conductivity and viscosity of monatomic liquids.—C. de **Watteville**: A new method of studying spark spectra. It is known from the work of Hemsalech that when a spark passes between two conductors the initial spark is followed by the production of metallic vapour, and the latter remains luminous for an appreciable time. A new form of apparatus is described which permits of the separation of the luminous effects of the spark and the metallic vapour.—G. **Brañas**: The microradiograph. A description (with diagram) of a new self-recording Morse apparatus for radio-telegraphic signals. With this apparatus installed at Madrid records of messages sent from Paris, Poldhu, and Norddeich have been registered.—H. Kamerlingh **Onnes**: The persistence of electric currents without electromotive force in superconductors. From a study of the resistance of metals at low temperatures attainable with liquid helium it was concluded that the resistance of mercury would be measurable at 4·25°, but would become negligible at 2°. This conclusion has been verified experimentally, but with the unexpected result that the resistance disappears suddenly, for mercury at 4·19°. In a mercury thread at 1·7°, current can be passed with a density of 1000 amperes per sq. mm. without a measurable difference of potential (limit of accuracy $0{\cdot}03\times10^{6}$ volt) at the extremities, and without developing heat. (See article in NATURE, July 9, p. 481).—H. **Abraham**, A. **Dufour**, and G. **Ferrié**: A method of direct measurement of the time of propagation of the waves of wireless telegraphy on the surface of the globe. The chronographic method ultilised permits of the absolute measurement of a time interval with a precision of 0·00001 sec. The velocity of propagation found for the Hertzian waves between Paris and Washington was 296,000 km. per sec., slightly less than the velocity of light.—M. **Abonnenc**: The influence of tellurium on the sensibility of selenium to light. Carefully purified selenium was

mixed with 1, 3, 4, 5, and 7 per cent. of tellurium, and the changes of resistance caused by exposure to light measured. Pure selenium was most sensitive to white light; with red rays the cell with 1 per cent. of tellurium gave the largest change of resistance.—M. **Boulouch**: Systems of dioptres of revolution round the same axis.—L. G. **Stokvis**: The creation of third harmonics in alternators as a result of a want of equilibrium of the phases.—Ruby **Wallach**: The magnetic study of iron oxide. Three forms of precipitated ferric oxide were studied, and the magnetic susceptibility of each determined as a function of the temperature. The results are given graphically.—R. **Portevin**: The velocity of transformation of steels on heating and on the specific electrical resistance of iron.—P. **Chevenard**: The specific volumes of nickel steels.—H. **Guilleminot**: The coefficient of diffusion of the X-rays by substances of low atomic weights, especially organic substances. Some new facts in support of the conclusions given in an earlier paper.—André **Kling**, D. **Florentin**, and P. **Huchet**: Properties of Recoura's green chromium sulphate. For twenty-four hours after their preparation solutions of the green chromium sulphate contain no sulphate ions precipitable by benzidene chlorhydrate; on standing sulphate ions are gradually formed, an equilibrium, depending on the temperature and concentration, being ultimately reached.—L. **Tschugaeff** and W. **Ichlopine**: Some compounds of monovalent nickel. Nickel salts treated with a mixture of sodium hydrosulphite and nitrite give a violet compound, in which the nickel appears to be monovalent, since caustic soda gives a hydroxide NiOH, convertible by sodium sulphide into Ni_2S.—Jacques **Joannis**: The catalytic influence of copper oxide on the combination of oxygen with hydrogen. Iron wire at 300° does not act catalytically on the combination of hydrogen and oxygen, but the two gases react in presence of CuO at the same temperature. The water vapour formed exerts a considerable influence on the catalysis.—A. **Villiers**: Sulphide of manganese and the estimation of this metal. A study of the conditions necessary for the precipitation of the green form of manganese sulphide.—P. **Lebeau** and M. **Picon**: Some hydrogenations by sodammonium: hydrocarbons. With this reducing agent acenaphthene takes up four atoms of hydrogen—anthracene two, phenanthrene four, diphenyl four, and stilbene two. Amylene, benzene, toluene, and cymene, on the other hand, are unaffected.—H. **Gault**: The conversion of oxalacetic ester into α-pyrone derivatives.—R. **Cornubert**: The allyl*cyclo*hexanols, methylallyl*cyclo*hexanols, propyl- and methylpropyl-*cyclo*hexanones, and *cyclo*hexanols.—Henri **Wohlgemuth**: Syntheses by means of the mixed organometallic derivatives of zinc. The γ-chloro-ketones and corresponding products of hydrolysis.—J. **Bougault**: The dioxytriazines.—Léon **Lutaud**: The Senonian of Mazougues (Var).—E. A. **Martel**: The torrential origin of peduncular rocks.—Emile **Belot**: An attempt at the verification of the new physical theory of the formation of oceans and primitive continents.—M. **Cluzet** and Th. **Nogier**: The physical analysis of some springs of Evaux-les-Bains. The water from three springs and the gas from one were examined. Measurements are given of the temperature, density, electrical resistance and radio-activity. The César spring gives a high figure for the radium emanation, 80 millimicrocuries per litre of gas at the spring.—Henri **Lecomte**: The constitution of the seeds of Musa.—H. **Guillemard** and G. **Regnier**: Observations on the physiological action of the climate at high altitudes.—Paul **Godin**: A series of laws of growth based on 2000 observations of children, 300,000 measurements, 1891–1893–1914.—André **Mayer** and Georges **Schaeffer**: Constancy of the concentration in lipoids containing phosphorus of the whole organism; concentration in lipoids in course of growth. Application to biometrics.—Emile F. **Terroine**: Constancy of concentration of whole organisms in fatty acids and cholesterol. Evaluation of the reserves of fats.—Georges **Tanret**: Some physiological properties of the sulphate of galegine. The alkaloid leads to paralysis of the spinal column and nerve centres.—Mme. Marie **Phisalix**: Vaccination against experimental hydrophobia by the cutaneous mucous secretion of Batrachians, followed by snake poison.—E. **Bataillon**: The electrical conductivity of the eggs of virgin Batrachians.—M. **Lécaillon**: The reproduction of *Galerucella luteola*.—Ed. **Sergent** and H. **Foley**: The period of latency of the spirillum in the bug infected with recurrent fever. The virus of recurrent fever, besides the spirillum form, can assume another form, very minute, but equally virulent.—L. **Lindet**: The influence of the mineral content of caseins upon their solubility.—Pierre **Thomas** and Robert C. **Moran**: The proteid substances of *Aspergillus niger*.

NEW SOUTH WALES.

Linnean Society, May 27.—Mr. C. Hedley, vice-president, in the chair.—R. J. **Tillyard**: Some problems concerning the development of the wing-venation of Odonata. As a result of a study of the tracheation of the developing wings of a very large number of dragonfly nymphs, several problems have been elucidated. It is claimed that the Zygoptera are undoubtedly reduced descendants of broader-winged dragonflies. The primary cause of all the peculiarities in Odonate wing-venation is traced back to the change made by an originally land-dwelling larva to fresh water, and the consequent development of a flow of oxygen in the tracheal system from the anal end of the body.—E. W. **Ferguson**: Revision of the Amycterides. Part iii.—Notophes, Amycterus, and genera allied to Talaurinus. A number of the smaller genera are dealt with, partly for convenience, partly because they are mostly related to Talaurinus.

BOOKS RECEIVED.

A First Book of Chemistry. By W. A. Whitton. Pp. vii+150. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

The Pupil's Class-Book of Geography. The British Isles. By E. J. S. Lay. Pp. 118. (London: Macmillan and Co., Ltd.) 6*d*.

Physics of the Household. By Prof. C. J. Lynde. Pp. xi+313. (London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

The Farm Woodlot. By E. G. Cheyney and Prof. J. P. Wentling. Pp. xii+343. (London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

The Man of Genius. By Dr. H. Türck. Pp. vi+483. (London: A. and C. Black.) 12*s*. 6*d*. net.

Boletin do Museu Goeldi (Museu Paranese) de Historia Natural e Ethnographia. Tome viii., 1911–12. Catalago das Aves Amazonicas. By Dr. E. Snethlage. Pp. iv+531. (Para, Brazil.)

Index of Spectra. Appendix W. By Dr. W. M. Watts. (London: Wesley and Son; Manchester: A. Heywood and Son.)

Summary Report of the Geological Survey. Department of Mines. For the Calendar Year 1912. Pp. 544. (Ottawa.) 20 cents.

Proceedings of the South London Entomological and Natural History Society, 1913–14. Pp. xvii+158+plates. (London.) 4s.

Engineering Geology. By Prof. H. Ries and Prof. T. L. Watson. Pp. xxvi+672. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17s. net.

Rapid Methods for the Chemical Analysis of Special Steels, Steel-making Alloys, and Graphite. By C. M. Johnson. Second edition. Pp. xi+437. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12s. 6d. net.

Geological Map of the Caucasus. With Explanatory Notes. By Dr. F. Oswald. (London: Dulau and Co.) 15s. net.

Marine Biological Association of the West of Scotland. Annual Report, 1913. Pp. 125. (Glasgow.)

Nature and Development of Plants. By Prof. C. C. Curtis. Third edition. Pp. vii+506. (New York: H. Holt and Co.) 2.50 dollars.

Introductory Geology: a Text-Book for Colleges. By T. C. Chamberlin and R. D. Salisbury. Pp. xi+708. (New York: H. Holt and Co.) 2 dollars.

Die Raumorientierung der Ameisen und das Orientierungsproblem im Allgemeinen. By Dr. R. Brun. Pp. viii+234. (Jena: G. Fischer.) 6 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Lief. 44. Band iii. Erste Hälfte. Pp. 1761–1922. (Jena: G. Fischer.) 5 marks.

U.S. Department of Agriculture. Weather Bureau. Report of the Chief of the Weather Bureau, 1912–13. Pp. 252. (Washington: Government Printing Office.)

Union of South Africa. Mines Department. Geological Survey. The Geology of the Pilandsberg and the Surrounding Country. An Explanation of Sheet 12. With Sheet 12. By Dr. W. A. Humphrey. The Geology of the Haenertsburg Goldfields and Surrounding Country. An Explanation of Sheet 13. With Sheet 13. By A. L. Hall. (Pretoria: Government Printing Office.) 2s. 6d. net.

Bibliotheca Geographica. Jahresbibliographie der geographischen Literatur. Band xviii. Jahrgang 1909 und 1910. Pp. xvii+483. (Berlin: W. H. Kuhl.)

Wild Life. Vol. iv. No. 3. July. (Kingsway: Wild Life Publishing Co.) 2s. 6d. net.

Elektrische Spektralanalyse chemischen Atome. By Dr. J. Stark. Pp. viii+138. (Leipzig: S. Hirzel.) 5 marks.

Monistische Bausteine. Edited by W. Breitenbach. Zweites Heft. Pp. viii+252. (Brackwede-i-W.: Dr. W. Breitenbach.) 3 marks.

Die Umwelt des Lebens eine Physikalisch-Chemische Untersuchung. By Prof. L. J. Henderson. Pp. xviii+170. (Weisbaden: J. F. Bergmann.) 5 marks.

Quarterly Journal of Experimental Physiology. Vol. viii. Nos. 2 and 3. Pp. 103–302. (London: C. Griffin and Co., Ltd.) 15s. net.

Mind. New series. No. 91. July. (London: Macmillan and Co., Ltd.) 4s.

Smithsonian Institution. United States National Museum. Contributions from the United States National Herbarium. Vol. xviii. Part I. Classification of the Genus Annona. By W. E. Safford. Pp. ix+68+plates. (Washington: Government Printing Office.)

Norwegian Self-Taught, with Phonetic Pronunciation. By C. A. Thimm. Pp. 128. (London: E. Marlborough and Co.) 2s.

Machine Construction and Drawing. By A. E. Ingham. Book ii. Pp. xii+180. (London: G. Routledge and Sons, Ltd.) 3s. net.

The Physical Society of London. Report on Radiation and the Quantum-Theory. By J. H. Jeans. Pp. iv+90. (London: The *Electrician* Publishing Co., Ltd.) 6s. net.

The Journal of Egyptian Archæology. Vol. i., part iii. July. Pp. 159–232. (London: Egypt Exploration Fund.) 6s. net.

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