THURSDAY, DECEMBER 21, 1905.

THE JAR AND THE GENIE.

The Theory of Experimental Electricity. By W. C. D. Whetham. Pp. xi+334. (Cambridge: The University Press, 1905.) Price 8*s.* net.

Electric Railways: Theoretically and Practically Treated. By S. W. Ashe and J. D. Keiley. Pp. 285. (New York: D. Van Nostrand Co.; London: Archibald Constable and Co., Ltd., 1905.) Price 10*s.* 6*d.* net.

Modern Electric Practice. Vol. vi. Edited by M. Maclean. Pp. vi+318. (London: The Gresham Publishing Co., 1905.) Price 9*s.* net.

THERE is a tale in the "Arabian Nights" of a fisherman who, after a day's ill luck, cast his net for the fourth and last time with a prayer to Allah that he might have a good haul. He drew to shore a copper jar of curious construction and mysteriously sealed, which on being opened was found to have confined a genie possessed of remarkable powers. As the genie proposed to reward his liberator by taking his life, the fisherman induced him to return into the jar, in which he again confined him. About two centuries ago the body of fishermen who called themselves then natural philosophers drew to shore from the sea of natural phenomena a similarly remarkable jar capable also of confining a very powerful genie. The discovery of the Leyden jar, we are told, "caused the greatest excitement in Europe and America," two continents which three years ago exchanged congratulatory messages across 2000 miles of ocean by means of Leyden-jar sparks. This, the most recent sensational demonstration of the powers of the genie, is by no means the most important; he has truly produced as great a revolution in the doings of mankind as any of his imaginary predecessors.

Ever since the genie has been released the fishermen have been divided into two camps; those who were most interested in studying the jar with the view of discovering the wonderful properties by which it could confine so powerful an agent, and those who have preferred to take such things for granted and have devoted themselves to putting these powers to the service of mankind. As time has advanced the work of each camp has become more and more differentiated, the "theorists" pressing always deeper and deeper into the region of first causes, but ever and again bringing to the surface some fresh discovery on which the "practical men" are quick to seize and which they soon adapt to useful purposes. Thus each continues to supplement the work of the other until it is hard to tell to which is owed the greater debt of gratitude—to those but for whom the powers of the genie would have remained concealed, or to those but for whom they would have remained discovered but unused.

Mr. Whetham's book is an admirable exposition of all that the theorists have discovered so far. "To some extent," he writes in the preface, "even a scientific text-book must be a piece of literature and a work of art." "Experimental Electricity" can certainly claim to be both. The present writer does not profess to be very old, but the development of electrical theory has been so rapid since he first studied its elements that the text-books from which he learnt are more out of date than is Euclid as a text-book of modern geometry. An elementary text-book should give a comprehensive survey of the whole of its subject in such a way as to stimulate the curiosity and imagination of the student and this the book before us does. It is written in a clear and simple style, and the mathematics necessary are such as any student beginning his university career should have at hand. A very prominent and valuable feature of the book is the frequent reference to and quotation from the works of the founders of modern electrical theory, notably Faraday and Maxwell. The story which it tells of the development of this theory from the first suggestions of Faraday to the most recent conceptions of J. J. Thomson, Larmor, and others is one of extraordinary fascination and interest, and we cannot conceive any earnest student laying down the book without a desire to help to the best of his ability in solving the riddle with which it closes.

Books such as Mr. Whetham's should be read not only by the student who wishes to enrol himself in the scientific camp, but also by those who intend to become engineers. The engineer can never be the worse for a sound knowledge of what the men of science are doing. Incidentally he may be prevented from making some of the mistakes which Messrs. Ashe and Keiley make in the first chapter of their otherwise excellent book on electric railways. For example, these writers in the course of a few lines speak of the watt, first as power, then as work, and finally as energy. But after a few pages of this "miscallin' technicalities" they proceed to the more serious business of their book, and here there is little to which objection can be raised. The book is a good example of some of the feats that the genie has accomplished. It is a good example, too, of the extreme specialisation so characteristic now of all branches of electrical engineering. The title is somewhat broad, as the subject-matter is practically confined to rolling stock and rolling-stock equipment. The illustrations are plentiful and very clear.

If those who would learn what the jar is made of should study Mr. Whetham's book, those who would know in a general way the genie's powers should read "Modern Electric Practice," of which the present volume is the sixth and last. We have already reviewed the previous volumes and have pointed out what we consider to be somewhat serious defects in the plan and general arrangement of the work. Still, as a general summary of all the modern applications of electricity these volumes are not to be despised, especially when their very numerous illustrations are remembered. We would like to suggest that in future editions these are published without the text. The present volume contains very good articles on telegraphy and telephony; the article on electromedical appliances is disappointing in the extreme. There is in addition a good index to the whole six volumes.

The three books the titles of which head this review are typical of the three classes of men who have made the electrical industry. Mr. Whetham's of the seekers after truth who are always asking for more light and have discovered all the fundamental principles on which the industry is based, Messrs. Ashe and Keiley's of the pioneers who have developed the practical possibilities of these principles, and "Modern Electric Practice" of the great majority who are content to follow where others lead but whose united efforts have placed at the disposal of all mankind the forces latent in the philosopher's jar. MAURICE SOLOMON.

HYGIENE AT SCHOOL.

Text-book of Hygiene based on Physiology for the use of School Teachers. By A. Watt Smyth. Pp. xvi+256. (London: Simpkin, Marshall and Co., Ltd.) Price 6*s*.

MRS. WATT SMYTH rightly says in her preface that

"Physiology is the science of the action of the body in health, hygiene the practical application of this science; it is obviously impossible to understand the laws of hygiene without a knowledge of the fundamental principles of physiology."

She has set herself the task of providing a text-book of hygiene founded upon physiology, for the use of teachers, in order that they may comprehend the hygienic needs of the pupils committed to their charge. Hitherto the books written with this object (and there are several) have either been good as text-books of elementary physiology and bad as text-books of elementary hygiene, or *vice versâ*; and Mrs. Watt Smyth is to be congratulated upon having brought these two subjects, which are so intimately associated with each other, into a fairly satisfactory relationship, and upon having dealt with each in a very commendable manner. It must be said, however, that the physiological matter of the book is the better, and that in many instances the hygienic matter could have been presented in greater fulness of detail with advantage. The space given to physiology far exceeds that devoted to hygiene, and while the demands of the former subject upon space are necessarily somewhat greater, there can be no two opinions that the physiology in many respects is too elaborate for the purpose to which this book is dedicated. Some non-essential matter is included; for instance, a description is given of the ethmoid bone, the number of bones it articulates with, and the time when ossification is complete; the number of separate centres of ossification is also given of other cranial bones; the minute structure of the salivary glands is entered into with unnecessary fulness, for the teacher is informed that

"the secreting cells of the salivary glands are of two main types, according as the secretion of the gland is mainly serous or albuminous (Parotid), mainly mucous (sub-lingual) or both (sub-maxillary). In a gland that has not been recently secreting, the mucous secreting cells, which are round or oval, are distended with a clear substance, mucigen, from which mucus is formed when the gland becomes active. The cells of the glands which yield an albuminous secretion are cubical and almost fill up the acini. Their protoplasm is full of dark granules before secretion occurs; when it begins, the granules diminish in number and finally almost completely disappear."

These instances are referred to as illustrations of a certain lack of appreciation, which is evident here and there, of what is essential and what is not; for it is impossible to see what practical application can be claimed of the knowledge of the above facts. The illustrations and diagrams, moreover, are anatomical and histological. There is no single illustration of any form of sanitary apparatus or appliance, and these matters are referred to in the text often in such a cursory manner that the reader would find it impossible to form a satisfactory conception of their true nature.

Mrs. Watt Smyth deals with each subject on an excellent plan. First she gives a brief account of the physiology of the subject discussed (with special reference to any notable feature of these physiological processes in childhood), and then she proceeds to deal with the hygienic principles and practices which rest upon these foundations. Her scheme is well illustrated in the chapter on respiration and air; the nose, larynx, trachea, and lungs are first described, then the mechanism of respiration is explained, next the constitution of the air prior and subsequent to respiration is set out, and then there follows the consideration of the problems of ventilation and heating, and the evil consequences which result when these provisions are insufficient or faulty.

The other chapters of the book fairly cover the necessary ground, and the chapters upon the special senses and the muscular system (the latter including a syllabus of physical exercises based on the Swedish system) are very complete.

In conclusion, reference should be made to the great care which has been exercised in the preparation of this work. The facts set out are entirely accurate and the opinions expressed are sound, without exception. The author acknowledges her indebtedness for information and counsel from such authorities as Dr. Dawson Williams, Dr. James Kerr, and Miss Turner.

REGENERATION IN ROOTS.

Studien über die Regeneration. By Prof. B. Němec. Pp. 387; with 180 figures in the text. (Berlin: Gebr. Borntraeger, 1905.) Price 9.50 marks.

IN this somewhat bulky volume the author describes and discusses at some length the result of his numerous experiments on the regenerative processes that occur in wounded roots.

It is well known that if the tip be removed from a growing root a new apex is commonly differentiated, growth in length commencing once more when the new tip has become completely formed. The objects of Dr. Němec's investigation have been to endeavour to throw some light on the nature of the process of regeneration itself, the causes that initiate and determine its occurrence, and the meaning of the physiological events that are associated with it. The

methods adopted were extremely simple. The tips of growing roots, chiefly of seedlings, were injured in various ways by making incisions into the region about the apex, and the reactions that ensued were carefully followed and compared.

It was found, in confirmation and extension of the less complete observations of Prantl and of Simon, that the roots of ferns never truly regenerate themselves as do those of flowering plants. Possibly the difference is to be attributed to the more definite concentration of formative protoplasm in the apical cell of the former, as contrasted with its greater extension as layers in the roots of the latter. At any rate, no regeneration occurs in the roots of ferns, although some attempts at healing the actual wound may be made.

The case is different with the roots of phanerogams, although in them also the conditions of regeneration are more limited than might have been anticipated. In the first place, no union of the halves of longitudinally cut roots took place; the damaged apex was either replaced by a new one on either side of the slit or else the regeneration was confined to one half.

An annular incision made just behind the tip of the root into the cortex and extending as the endodermis fails to give the stimulus requisite to produce a fresh apex. Healing of the wound is more or less in evidence, but the original apex continues to function, and to supply cells for the further growth and elongation of the root. But if the knife has passed through the next layer, the pericycle, regenerative phenomena at once set in. A new apex, with all the complicated layers, is formed just behind (*i.e.* proximally to) the wound, and it is especially interesting to discover that the statolith starch now disappears from the original tip, to be transferred to, or at any rate to reappear in, the new one.

Lateral incisions are ineffective to bring about the differentiation of a new apex unless the slit has severed at least half the circumference of the pericycle. If this be done regeneration takes place, with the concomitant appearance of statolith starch in the new organ. All the experiments made on the roots go to emphasise the great importance of the pericycle in connection with regenerative processes, although it is not from this layer itself that the new tip is differentiated, but from the indifferent plerome cells within it. The damage done to the pericycle appears to act as an interruption of the coordinative relations between the various parts of the embryonic region as a whole. When this coordination is thus interrupted the capacity of giving rise to entire organs that is resident in the embryonic protoplasm asserts itself, and the new formation thus appears. We know as a matter of fact that the pericycle retains the embryonic condition until relatively late, since from it arise the normally produced lateral roots. Of course, the processes underlying the regenerative processes are by no means cleared up by the experiments indicated above, but at any rate certain definite facts have been ascertained, and further lines of profitable investigation readily suggest themselves.

Comparatively few anomalous cellular effects were observed. In the exceptional case of one fern root, however, the nuclei of the healing (not regenerative) cells exhibited irregularities both in their modes of division and in the number of their chromosomes which were commonly excessive. Multinucleate cells were also observed in the plerome of a wounded root of Ricinus, but they apparently took no part in the actual regenerative processes.

The book as a whole forms an important contribution to the literature of regeneration, its chief merit perhaps lying in the numerous problems it suggests for future investigation. It contains a bibliography that should be useful, but it would have been materially improved by the addition of a good index.

OUR BOOK SHELF.

Heredity. By C. W. Saleeby, M.D. Pp. 118. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1*s*. net.

THE appearance of a little shilling book on heredity is almost startling, when we consider the difficulty of the subject and the relative youth of its exact study. That a book like this should be possible indicates that considerable progress has been made in recent years. Was it not Leibnitz who said, "The more a science advances, the more it becomes concentrated in little books"? But it indicates also a noteworthy skill on the author's part. Without attempting to slur over difficult themes, *e.g.* Mendelism, as if they were easy, he has given us a clear and interesting exposition, which will be widely appreciated. It is a wonderful *multum in parvo*, dealing lucidly, for instance, with the contrast between hereditary resemblance and variation, between the germ-plasm and the body, between germinal variations and somatic modifications, between inherited nature and the results of nurture, between inborn and congenital characters, and so on. Even to have made these distinctions clear, so that they may be understanded of the people, is an achievement. As was natural in a book of this kind, the author takes up an eclectic position, and quotes freely from various writers—from one about ten times. He is inclined to allow that there is a limited transmission of "acquirements" or modifications, but the only instance we have found is an inept one—that bacteria may transmit an exaltation of their virulence. He agrees with Dr. Archdall Reid on many points, *e.g.* that amphimixis never produces more than regressive variations, but does not think that this author satisfactorily accounts for the origin of spontaneous variations. He has the same complaint to make of Weismann, but in regard to a view which that progressive biologist no longer holds, as, indeed, the author seems to know (p. 54). We may also note that even in "The Germ-Plasm" Weismann did not teach that "parthenogenetic species cannot vary"; in fact, he made experiments showing reversion in parthenogenetic generations of Cypris. There is a useful chapter on "physical degeneration," but we do not understand the author when he says that those who believe in progressive degeneration "have it incumbent upon them to demonstrate either the falsity or the suspension of the law of natural selection." Surely the many "degenerate" animals that we know have not become what they are without the help of selection. Another point that we do not understand is how the fact that "one-half of the nuclear chromatin of each gamete is thrown aside prior to the fusion of the two nuclei," "obviously

corresponds exactly with Galton's assertion that the two parents between them contribute one-half of the total heritage of the offspring." There is surely a screw loose here. Dr. Saleeby's vivacious style will fascinate some readers and help them over difficult themes, but we wish that he had been sometimes less conversational, as when he speaks of the Bathmic theory of organic evolution as "an amusing piece of nonsense." J. A. T.

The Practical Photographer. Library Series. Nos. 24, 25, and 26. 24 and 25, Pictorial Printing, parts i. and ii. Pp. xx+64 and xx+64. 26, Artificial Light and Night Photography. Pp. xx+64. Edited by Rev. F. C. Lambert. (London: Hodder and Stoughton, 1905.) Price 1*s.* net.

We have before us three more additions to this very practical and useful series of photographic handbooks, with which most of our photographic readers are now well acquainted. The first two are devoted to pictorial printing, in which are brought together many methods by which the negatives may be altered, the print controlled during printing, or generally or locally modified according to desire.

For the most part No. 24 treats chiefly of the employment of one negative only, while No. 25 is devoted chiefly to combination printing and enlarging, cloud negatives, and cloud printing. Both numbers are preceded by interesting and well illustrated *résumés* of the pictorial work of Bessie Stanford and Percy Lewis, which to the beginner should serve as admirable types of high order work.

The third number belongs to quite another branch of photography, namely, that in which the incident light on the object is for the most part artificial, such as flashlight, candle light, gas light, acetylene, &c. Here we have a collection of notes by numerous workers, all of whom have secured some interesting pictures by one or other of these methods. As before, the reader is not left to gather his ideas from the text alone, but is introduced to some interesting pictures with notes describing under what conditions they were taken. This number also contains an account by the editor of the pictorial work of J. C. Warburg, with a reproduction of many of his most typical photographs.

These three numbers thus form a welcome addition to those previously published, and will certainly be appreciated by those workers to whom they specially appeal.

Introduction to the Study of Organic Chemistry. By John Wade, D.Sc. (Lond.). New and enlarged edition. Pp. xx+646. (London: Swan Sonnenschein and Co., Ltd., 1905.) Price 8*s.* 6*d.* net.

The fact that the present volume has reached its second edition points to the public appreciation of Dr. Wade's book. This is not surprising.

The arrangement of the subjects bears evidence of the author's thought, and the immense number of facts compiled speaks eloquently of his industry.

There are several novel features to which the author directs attention in the preface, and which possess certain merits. There is no doubt that charts or surveys, which serve to show, in a condensed form, the relation of a variety of compounds, are an aid to the memory, and the author has introduced them freely.

The principle of making a thorough study of a single common substance like ethyl alcohol and then dealing with its more important derivatives before thrusting the student into the tangle of homologous series has very much to recommend it.

Perhaps the title of the book is a little misleading. One would be inclined to suppose that a student who was familiar with these 624 pages of closely printed matter might be regarded as a well informed organic chemist; but he has only an introductory knowledge. We must express our respect for those who have passed beyond this "introduction," whilst others who may be examined in the information required by Dr. Wade's introductory standard demand our sympathy. The illustrations exhibit rather too plainly the defects of photography applied to glass apparatus, though they possess a realistic character which may appeal to the student. We are glad to notice the author's respect for the traditional spelling of the word *radical.* J. B. C.

The Romance of Insect Life. Interesting Descriptions of the Strange and Curious in the Insect World. By Edmund Selous. With twenty-one illustrations by Lancelot Speed and Carton Moore Park. Pp. 352. (London: Seeley and Co., Ltd., 1906.)

The letterpress consists of a series of extracts, derived from a variety of sources, relating to ants, termites, locusts, butterflies, water-insects, fireflies, scorpions, &c., connected together by general observations on all kinds of subjects. Occasionally the compiler's remarks on the senses of insects or on mimicry are worthy of notice, but they are frequently in bad taste and often inaccurate, which is not surprising, as we are constantly told that he is only quoting his data second-hand, and has not seen the original records.

This is a pretty book, but otherwise we regret that we have little to say in its praise. The author suggests that the genus of grasshoppers called "Scudderia" were so named because they "scud," though Scudder's name is actually referred to on the opposite page. As an illustration of style and inaccuracy we may quote the following:—"From 1778 to 1780 a dreadful curse of locusts, alluded to by Southey in his 'Curse of Kehama,'—or perhaps forming the subject of that poem—I really don't know—fell upon the Empire of Morocco." There are *two lines* relating to locusts in the "Kehama," and it is "Thalaba" in which they are noticed at greater length.

There are really only sixteen page illustrations, some of them being double—*i.e.* divided in the middle, and thus making up the twenty-one of the title-page.

Most of our scientific men must be very far behind other people, for Mr. Selous tells us, "Everybody knows nowadays how all the different species of animals and plants, living and extinct, have come into existence," &c., &c.

Errors in Latin names abound, the worst being Orthoptera for Ornithoptera wherever it occurs. It is a pity that a book intended to popularise natural history should not have been more carefully written and edited. It almost looks as if the compiler thought anything would be good enough for his prospective readers.

The Art and Practice of Laundry Work for Students and Teachers. By Margaret Cuthbert Rankin. Pp. 191. (London: Blackie and Son, Ltd., 1905.) Price 2*s.* 6*d.*

There is little that is scientific in this book; it gives the impression, indeed, that even the teachers of laundry work are guided by empirical rules. It should be possible to inculcate the broad scientific principles upon which the art and practice are based while teaching girls how to do their laundry-work successfully. The washing of clothes, and the other processes through which they pass in the laundry, would then not be matters of rule of thumb, but intelligent applications of scientific principles to particular purposes.

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.*]

Radio-activity of Ordinary Matter in connection with the Earth's Internal Heat.

MR. CAMPBELL'S letter in your last issue (p. 152) reminds me of a point to which I have intended for some time to direct attention. Prof. Rutherford ("Radio-activity," second edition, p. 494) has calculated that the radio-activity required to compensate for the earth's internal heat is much exceeded by the (apparent) activity of ordinary materials, as determined by me (*Phil. Mag.*, June, 1903).

Thus the smallest activity I observed was about 10^{-4} times that of uranium nitrate, or 7×10^{-11} times that of radium: whereas the amount of activity, per unit mass of the earth, required to compensate for the loss of internal heat is only $4{\cdot}6\times10^{-14}$, or less than one-thousandth part of the activity computed to be actually there.

We cannot well assume a much smaller apparent radio-activity for the unknown material of the earth's interior, for all materials hitherto examined have given effects of the same order of magnitude, the radio-active elements, of course, excepted.

The simplest way out of the difficulty is to suppose that the apparent radio-activity of ordinary materials is not a volume effect of the same nature as that of radium, but that it is merely a superficial effect of quite a different kind, and only occurring at an exposed surface. It is difficult to understand why Prof. Rutherford did not draw some such conclusion. I do not know if he doubted the correctness of my results. It is easy, however, to confirm them from other sources. Thus C. T. R. Wilson (*Proc. Roy. Soc.*, vol. lxviii. p. 158) found the current through the air in a vessel of 163 c.c. capacity equal to $2{\cdot}0\times10^{-6}$ electrostatic units per second; this is equivalent to 7×10^{-17} electromagnetic units. Madame Curie ("Thesis," p. 14) found the current through a flat vessel of about the same size, the bottom being covered with uranium nitrate, equal to 7×10^{-13} (electromagnetic). If this vessel had been wholly lined with uranium, the current would have been more than doubled, say 2×10^{-12}. Thus the ratio of activities may be put at 3×10^{4}, as against 10^{4} in my own experiments. Considering the various activity of ordinary materials, and the rough nature of the comparison in both cases, this measure of agreement is fully confirmatory.

As the question of the earth's internal heat has been raised above, I may mention that I am engaged on an extensive investigation of the amount of radium contained in various rocks. The majority of those rocks which I have as yet tried (chiefly sedimentary) contain a good deal more radium than the percentage which would keep up the heat supply. Much more, however, must be done before any confident statement can be made as to the average amount of radium in the earth's crust.

Experiments are also in progress with native iron, both terrestrial and meteoric, with the idea that this may be representative of the composition of the earth's interior.

Sunnyside, Cambridge. R. J. STRUTT.

Magnetic Storms and Aurora.

IN his letter in your issue of December 14 (p. 152) Mr. F. C. Dennett assigns a positiveness and a generality that were not intended to the statement in my previous letter that on November 12 "no special auroral display seems to have been noted in this country." In years of sun-spot maximum, in the belt of greatest auroral frequency, nights wholly free from aurora are probably the exception. In the Shetlands, or even in the north of Ireland, aurora is a much more common phenomenon than in the south of England.

On November 15 I learn from several sources that the aurora was particularly brilliant, and the apparent movements especially lively during the time 8.53 to 9.25 p.m., when the large declination movement occurred. Various Arctic explorers have stated that it is only when the aurora displays this variable character that there is any clear connection between it and magnetic disturbances in those regions where both phenomena have their maxima. The aurorâ on November 12 is said by the Lisburn observer to have been of "the usual type" exhibiting "a steady glow." It would be interesting to know whether this aurora was observed at Lisburn or elsewhere *during the time of the large declination movement* (6.30 to 7.10 p.m. G.M.T.), and, if so, whether it then showed none of the brilliant and variable phenomena seen during the time of the large declination movement three days later.

For aurora to be observed on thirteen days in less than three weeks must, I think, be rather an unusual event for any place in England or Ireland; the Lisburn observer must keep a sharp look-out. CHARLES CHREE.

December 16.

The Total Solar Eclipse of August 30.

IN visiting Spain at the end of August of this year I was actuated by the desire once again, after an interval of twenty-three years, to witness the marvellous and unique phenomenon of a total solar eclipse. It is a sight which cannot be imagined—it must be seen. Happening at a time of maximum sun-spot frequency, it was reasonable to expect a considerable display of protuberances, and I wished to form my own idea of their size by checking their persistence or non-persistence through the phase of mid-totality on a day which otherwise may be taken to have been chosen at random. For this purpose a station on, or very close to, the line of central eclipse was essential. Torreblanca was chosen because it was the station of the Barcelona and Valencia railway which was nearest to the line of central eclipse, lying, in fact, about a mile to the south-west of it.

I observed the eclipse from the railway station, the position of which is lat. 40° 12′ N. and long. 0° 12′ E. (Greenwich). The railway and official time in Spain is that of Greenwich. By the clock at the railway station, mid-totality occurred between 1h. 18m. and 1h. 19m. p.m. Before the beginning of the eclipse I entered in my note-book half the expected duration of totality, 1m. 50s.; when I had observed the second contact, I wrote the time underneath, and, by addition, ascertained the time of mid-totality by my watch. The display of protuberances which appeared just before the moment of second contact, and on the part of the sun's limb which was about to be eclipsed, was, according to all witnesses, exceptionally brilliant. When the time of mid-totality came round I looked for these protuberances. They were absent. Not a trace of them or of any others was visible to the naked eye, and I searched the whole edge of the moon's disc with the greatest attention. Their absence was confirmed by Stephan (*Comptes rendus*, October 9), observing with the best instrumental aid at Guelma.

The sun's true altitude at Torreblanca on August 30, at 1h. 18·5m., may be taken as 54°·5. For this altitude the augmentation of the moon's semi-diameter is 14″·3. Adding this to the geocentric semi-diameter, 16′ 21″·4, as taken from the Nautical Almanac, 16′ 35″·7 is obtained for the apparent semi-diameter of the moon as seen from Torreblanca at mid-totality. Deducting from this the semi-diameter of the sun, namely 15′ 50″·7, we obtain 45″ as a sufficient approximation to the width of the annular band by which the disc of the moon overlapped that of the sun. Therefore, to an observer stationed on the central line in this neighbourhood, no protuberance could be visible at mid-totality which had a height less than 45″, and, neglecting the small displacement of Torreblanca from the central line, the protuberances of second contact, magnificent though they were, could not have exceeded this height.

Eight seconds before second contact I detected the streamers of the outer corona on the western limb of the moon. At this moment there was no trace of the inner corona, which presents to the spectator during the whole of totality the appearance of a bright, luminous ring surrounding the moon.

If we assume that the argument from parallax is applicable to the inner corona, as it is to the protuberances, we have to conclude that, eight seconds before second contact, the light-giving portion of it did not extend further than

between 93″ and 94″ from the western limb of the sun. To an observer on the central line, at mid-totality, it is eclipsed to a distance of 45″ from the sun's limb, and this would leave only between 48″ and 49″ as the width of the outer portion, which furnished the unexpected amount of light which persisted through totality. It is clear that if the inner portion, having a width of 45″, had been uncovered, the daylight during totality would have been still more remarkable.

In this respect there was a great contrast between the eclipse of this year and that of May 17, 1882, which I witnessed at Sohag, on the Nile, where a large camp of astronomers of many nations was established. In it, one of the most striking features was the rapid darkening during the last moments before second contact. I have always compared it to what is witnessed when a lecture-room is darkened during the day by quickly closing the shutters of the windows in succession. In 1882 the darkening took place rapidly and completely; and immediately quite a number of stars came out, besides the great comet which revealed itself, all unsuspected, close to the sun's limb, and formed the feature of that eclipse which was most noticed and is best remembered by the spectators. In 1905 the darkening effect was much less striking; but the illustration of the lecture-room holds if we imagine that the shutter of the last window is out of order, and has to remain open during the demonstration.

The contrast between the two eclipses is accentuated when we remember that the apparent semi-diameter of the moon, as seen from Torreblanca, was 45″ greater than that of the sun, while on the Nile this excess was only 15″·4. Therefore a width of 45″ of the brightest part of the corona was eclipsed in 1905, as against only 15″·4 in 1882. If, therefore, the uneclipsed coronas had possessed equal efficiency as furnishers of daylight, the darkness during totality ought to have been much greater in 1905 than it was in 1882; but the opposite was the case. Therefore, whatever may be the process by which the inner corona or luminous ring is produced, it was much more active on August 30, 1905, than it was on May 17, 1882.

December 9. J. Y. BUCHANAN.

The Engineer's Unit of Force.

IN his letter of November 16, your reviewer refers to the "apparent inability of academic writers to understand the engineer's position in this matter." May I, as an "academic writer," state that I have no difficulty whatever in understanding the engineer's position in regard to the gravitational unit of *force*. It is his treatment of *mass* that I do not understand. I am not quite sure whether it is worth while trying to understand it, as it always seems, somehow or other, not to be altogether satisfactory, and I have great doubts at present as to whether it is necessary.

I have always supposed that the great advantage of a gravitation unit of force was that it enables problems in motion under force to be treated *without* introducing the notion of *mass* at all, by means of the relation

$$\frac{\text{force on body}}{\text{weight of body}} = \frac{\text{acceleration produced by force}}{\text{acceleration of gravity}}.$$

Moreover, when we come to deal with mass, if we take a pound as the unit of mass and a pound weight as the unit of force, the numerical measures of the mass and weight of any body will be identical. This is surely simple, intelligible, and convenient.

But instead of this I find that engineers put $W/g = M$ and call M the mass of the body, and that they have adopted a unit of mass, called a slugg, based on this relation, which to my "academic mind" appears both meaningless and useless. If "people do not, and never will, think in poundals," still less will they think in sluggs, and a terminology involving this unit can scarcely be described as "not divorced from common thought and speech." I cannot think any reasonable engineer would expect to see tea and sugar sold by the slugg, and one thing I do not understand is whether, if this custom *were* adopted, I should get the same quantity of tea or sugar at London as at Johannesburg, or whether the grocer would be expected to make allowance for the variations in g.

If, on the other hand, the grocer retained the time-honoured custom of weighing out the sugar by the pound, it would appear that the engineer's estimate of the mass of the sugar depended, not only on the sugar itself, but also on his choice of units of length and time. In these circumstances it seems reasonable to ask whether the engineer still accepts or discards the conventional, but somewhat meaningless, definition of our text-books, "Quantity of matter is called mass."

Is not the writing of W/g equal to M a mere attempt to copy blindly the academic method of treatment, and to adapt it to a system of units to which it is ill-suited? Writing on a similar issue elsewhere, I pointed out on one occasion that I prefer to solve the problem of the three cats killing three mice by some method equivalent to the "rule of three," and not to adopt an artificial unit of cats in order to write the equation mice = cats × minutes.

G. H. BRYAN.

IT will be seen that Prof. Bryan, instead of defining force as the rate of change of momentum, or using the corresponding dynamical equation $F = Ma$, works problems in motion by means of a proportion, his equation being equivalent to $F = W/g\,a$; he thus avoids both the poundal and the slugg. This differs from the two absolute systems previously discussed in that W/g is not here a measure of mass, on account of the variable nature of the gravitational unit of force, as his weight and mass are numerically the same, while g varies with locality. A concrete example well illustrates this system. Suppose a body weighing 32·182 pounds at London to leave the earth under the action of an upward resultant force of one pound, and to travel through space with an acceleration of one foot per second per second. The value of g would continually decrease, but the weight (*i.e.* the gravitational force between the earth and the body) would in this system always be called 32·182 pounds, so that at the instant when g was reduced, say, 50 per cent., the acceleration force, though unchanged in amount, would be called two pounds, in order that Prof. Bryan's proportion should still be true. In fact, the pound force at this juncture would have only half its original absolute value, and would go on diminishing indefinitely; and this system is described as "simple, intelligible, and convenient." The beginner, introduced to dynamics in this fashion, as simply rule of three, with the conception of inertia designedly veiled, endeavouring to think in a variable unit, and with only one name for both force and mass, cannot be considered to have made a very auspicious start, and he may well be forgiven if he is never able to free himself from the tangle. The gravitational system, at any rate, must be ruled out of court.

In the everyday work of the engineer, mere inertia has seldom to be spoken or thought about, and I must still maintain that the engineer's system, with its new inertia unit, is "not divorced from common thought and speech." As a matter of fact, it is much easier to think of inertia in a distinct unit like the slugg than one the name for which is also used for force.

Prof. Bryan is evidently sincere when he says that he does not understand the engineer's treatment of mass. The operation of weighing is not a dynamical one. Inertia does not enter into the matter at all. It is a statical problem in the equilibrium of forces. If the inertia unit were here dragged in as suggested, Prof. Bryan fails to see that the specification in sluggs would be at least as definite as a specification in pounds; and it might be even more definite, for if the grocer in Johannesburg had studied dynamics in the variable gravitational unit, the weigher of the sugar might plausibly argue that, as "the numerical measures of mass and weight," in pounds, are "identical," he was quite justified in using an imported spring balance.

The present confusion is no doubt partly due to the substitution of the word mass for the good old word inertia. If mass means quantity of matter as determined by weighing, then inertia is probably, but not necessarily, proportional to mass. Readers who are interested in the subject may be referred to a correspondence which took place in NATURE about nine years ago (vol. lv.), and especially to letters by Prof. (now Sir) Oliver J. Lodge, Prof. John Perry, and Prof. G. F. Fitzgerald.

THE REVIEWER.

"Mathematics" applied to Chemistry.

IN his notice of my book "Researches on the Affinities of the Elements" in NATURE, November 16, the reviewer impugns the legality of applying mathematical formulæ to my surfaces. I trust I may be allowed to answer briefly my critic's objections. His difficulty as to the non-continuous nature is imaginary, and arises from a mistaking of the object to be achieved—which is simply to obtain either a surface or a mathematical expression from which *can* be deduced the affinities any one element exhibits for any other. This can be done from the formulæ, and they do, therefore, characterise the chemical properties of an element which depend upon these affinities. Although there exist an infinite number of points on the surface which are occupied by no element, yet there exist only a *finite* number of points the x and y coordinates of which are *whole* numbers, and to *every* integer value given to x and y in my formulæ there corresponds a definite element; so that, so long as we keep within the domain of integer numbers (as we are forced to do by the nature of the construction) continuity is attained.

The complexity of the formulæ is more apparent than real, because the only values which x and y can have are integer numbers, and the constant and many terms disappear in practice. GEOFFREY MARTIN.

Kiel, December 6.

IT is true that the plan proposed by Mr. Martin is occasionally used on the convention that only the values of the equations to the curve which occur at the integer points are to be used; but the reviewer still maintains that the principle is a false one. A curve is intended to exhibit *continuous* change, according to some law, and he is unaware that any result of value has ever been obtained by the use of the plan, except, perhaps, that of appealing to the visual sense. THE REVIEWER.

Heat a Mode of Motion in the Seventeenth Century.

THE following statement occurs in the "Medulla Medicinæ," by J. A. Van der Linden, Med. Prof., Franekeræ, 1642, p. 182:—

"Calor est minutissimarum materiæ partium motus in se reverberatus."

Van der Linden was a famous teacher, but the theory may not have originated with him. Are there other co-temporary anticipations of "Heat a mode of motion"?

W. R. GOWERS.

THE PULSE OF THE ATMOSPHERIC CIRCULATION.

SOME fifteen years ago an American eclipse expedition which included Prof. Cleveland Abbe visited St. Helena, and, on leaving represented to the Governor, Mr. R. L. Antrobus, now of the Colonial Office, the importance of establishing a meteorological observatory there. The representation was sent to the Colonial Office, and, the colonial finances being then in a depressed condition, the Colonial Office applied to the Meteorological Council for assistance.

It is needless to spend many words over the meteorological importance of such an enterprise. St. Helena emerges from the sea in the heart of the trade wind of the southern Atlantic. In no part of the globe, perhaps, is the trade wind current so persistent. The trade winds have long been recognised as primary factors of the atmospheric circulation. Speculation on their origin, which still forms the staple of the physical geography of the schools, carries us back to the writings of Halley and Hadley. The south-easterly current over St. Helena is the flow along the main artery of the never-failing atmospheric circulation, and at St. Helena if anywhere we may put our finger on the pulse of that endless and complex process of transformation of solar energy of which the weather of our islands and elsewhere is an expression.

The council, itself not wealthy, had a Robinson anemograph, then lately returned from duty in Heligoland. This was lent to the colony, and with it was found a small annual sum by way of payment for its curator, Mr. Hands, of St. Matthew's Vicarage, who undertook as well the duties of observer for a normal station of the second order, with instruments furnished by the council.

The anemometer continued its run with some unavoidable interruptions, and the observations were taken until the middle of 1904. There are besides observations of rainfall at other stations in the island.

By 1904 that part of the spiral of the direction pencil which had to record south-easterly winds became so worn by constant use that a hollow was formed there and the record had become an unsatisfactory one. With the assistance of the engineer officers stationed at St. Helena the matter was inquired into, and, as a result, the instrument was ordered home for repairs. At the same time an attempt was made in the observatory branch of the Meteorological Office to put together the results of the long run and to collate them with the other observations. I will not anticipate the publication of the results which, I hope, will follow in due course, but to one interesting side of them, too speculative for an official report and too suggestive to be altogether ignored, I would like to direct attention, because it shows a possibility (perhaps more) that with more searching we may find a working connection between the pulsations of the trade wind in the southern hemisphere and the general type of weather in so distant a part of the globe as our own islands.

While the trade winds may be regarded as the most obvious representative of the dynamical effect of solar energy, rainfall must be allowed to be also very closely connected with the process of distribution of that energy. The convection of heat by evaporation from warm water surfaces and condensation in cooler regions represents a process tending towards equalisation of thermal distribution on a gigantic scale. The main directions of transference are from south to north on the one hand, and generally eastward from sea to land on the other. The white snow coverings of the polar regions and the persistent rivers of great continents are permanent records of nature's endeavour to distribute more nearly equally over the globe the supply of solar heat. From a general point of view rainfall or snowfall in the temperate and arctic zones may be regarded as an index, perhaps a spasmodic one, of the general circulation from the tropical regions towards the poles, and to that extent as the counterpart or correlative of the kinetic energy of the trade winds which represent the flow towards the equatorial region. The transformation of energy in rainfall is on a vastly greater scale than that displayed by the trade winds. Supposing that the trade wind at St. Helena is a mile high, the energy represented by the year's flow in a slice of the current a mile in width would be about equal to that represented by a year's rainfall on a single square mile in the neighbourhood of London. Of these two indices of the general process of distribution of solar energy, the one is the steadiest, the other the most fluctuating of all meteorological phenomena, and any indication of an underlying relation between them, which is, in a way, a necessity of the general process of circulation, would be of great meteorological interest and might be of immense economic importance.

So far as I have carried it, the study is perhaps

merely tantalising, but I should like to present the case as it occurred. When the figures for the average wind velocity were being put together, I inquired about the variation from year to year. The monthly values had not been combined, and a glance showed the last year (1903) to be one of exceptionally high velocity. For the complete year, since calculated, it is twenty-one miles per hour; the average for the twelve years is eighteen miles per hour. I noted 1903 as the year of heavy rainfall in this country, and asked about 1893, the year of drought, especially in the spring months. I found the wind velocities at St. Helena were for the first half

Jan.	Feb.	Mar.	Ap.	May	June	
16	14	—	15	14	—	in 1893,

as against

Jan.	Feb.	Mar.	Ap.	May	June	
21	20	16	20	16	19	in 1903.

The first two are the lowest velocities of those months on record; the others are low, but not the lowest. The blanks mean that the instrument was not working properly. This suggested some sort of connection, a stronger trade wind being associated with a heavier rainfall in this country. I obtained the monthly values and plotted the several years' variation. There was unmistakable evidence of a large seasonal variation with a maximum in September and a minimum in May. I plotted the average seasonal variation of the St. Helena wind for the twelve years, and against it the seasonal rainfall in the south of England for thirty-five years, which I happened to have at hand. The curves are reproduced in the figure (Fig. 1). The similarity is surprising. Of course, the seasonal rainfall is not the same in all localities, even in the British Isles. Somewhat similar curves are, however, to be found for Stykkisholm, in Iceland, and for Hakodate, in Japan, so that the case was not quite an isolated one. I was, therefore, not without hope that the evidence for organic connection would develop with further investigation. When plotting the curves of wind velocity for individual years, I noted that 1898 was an exceptional year, because it had two maxima of wind velocity, one in March and one in October, instead of the usual single one in September. Some information that I had for Southampton seemed to indicate a similar state of things for rain in England (south) in that year. I had the monthly rainfall figures for England (south) computed for each year, and looked at once to those for 1898. Here are the figures for the two variables compared for that year.

St. Helena wind velocity—

Miles per hour

Jan.	Feb.	Mar.	Ap.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
19	19	22	20	19	16	16	15	22	24	20	20

South of England rainfall—

Inches

Jan.	Feb.	Mar.	Ap.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0·71	1·58	1·12	1·39	3·59	1·46	0·49	1·37	0·99	3·48	3·67	2·86

There is unmistakably the second maximum of rainfall. It is in May, generally the driest month, two months after the unusual second maximum of wind velocity at St. Helena. The ordinary autumnal maximum of rainfall is delayed a month until November, just as the wind maximum is delayed a month until October.

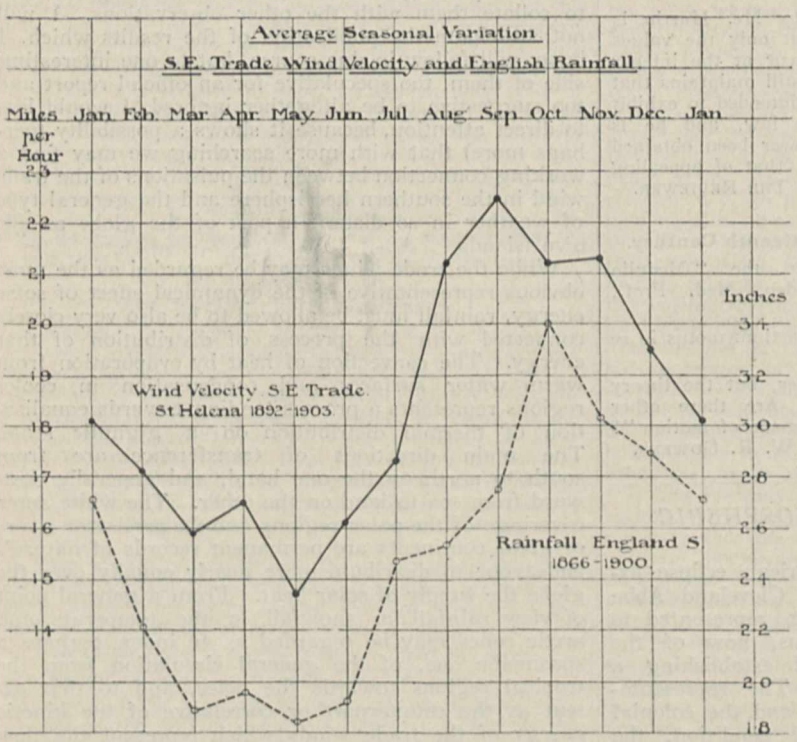

FIG. 1.

As a test case this seemed to be almost conclusive and the connection to be put beyond doubt, but in meteorological matters there are many disappointments. Some goblin seems to be in possession of this castle in the air; we see a glimpse of light; knock at the door; the goblin opens it almost wide enough to let us in, and then he slams it in our faces with a laugh. One can almost hear the mischievous Puck crowing to the

"Captain of our fairy band,
Helena is here at hand,
And those things do best please me
That befall preposterously."

There is even a faint echo of the wicked exclamation

"Lord, what fools these mortals be!"

When one turns from the average of years to the individual years, after the curious test case of 1898 one must confess that while the seasonal variation is maintained fairly well in the trade wind, year by year, one cannot recognise it in the rainfall. There appears, perhaps it is hardly necessary to say so, to be no regular seasonal variation in a single year of English rainfall. Any month may be the wettest month or perhaps the driest, and so a fitful parallelism is rudely interrupted by a wet July or some unaccountable abnormality. The phenomenally wet year, 1903, is truly the year of greatest trade wind velocity, but the order of wind velocity is not regularly the order of rainfall values; one wonders whether the recorder has always been working as one would wish; and when the monthly rainfall average is taken for the twelve corresponding years instead of the thirty-five years, the curious

subsidiary maximum in April so neatly reproduced in the St. Helena wind has disappeared, owing principally, be it said, to an abnormally dry April in 1893.

Yet the evidence in favour of a connection can hardly be pure coincidence. The little rain maximum in April is not mere illusion. The fact that a seasonal variation of rainfall does show itself in the average of a few years has a meaning, and that its phases are closely similar to those of the arterial pulsations of the general atmospheric circulation accords too much with what may be called common sense to be altogether devoid of significance.

Sooner or later we shall catch the nimble imp that jeers at us to-day, and, if I mistake not, when he is caught we shall make him tell us something of the real secrets of these atmospheric relationships.

There are two considerations that may be mentioned. A disproportionately large fall of rain is sometimes regarded as an accident of little or no influence upon general meteorological conditions, but in view of the enormous quantities of energy involved that view can hardly be seriously maintained. It is true that on some days we get thunderstorms with heavy rain distributed in a most irregular manner, and for these at present no satisfactory explanation can be given, but it should be looked for seriously. Secondly, the rainy movements of the atmosphere in this part of the world are, as already mentioned, a south to north movement and a west to east movement. Perhaps we may in time be able to disentangle the effects of the various causes and find the regular sequence at present overlaid by the influence of secondary disturbing causes.

I have ventured to put forward these suggestions, which I frankly confess are deplorably bizarre, because my readers may have at their disposal methods, that I am ignorant of, by which a crucial test may be applied to the question whether there is any definite and, shall I say, useful connection between the pulsations of the south-east trade wind and the rainfall of north-western Europe.

W. N. SHAW.

TWO BOOKS ON ANIMAL BIOGRAPHY.[1]

IN the second of these two works the author expresses the opinion that the first question which will be asked by the reader is whether the various anecdotes are strictly true. The question that presents itself to our mind is whether such books will be read at all, and if so by whom? The professional naturalist, we dare venture to say, will have nothing to do with them; they are not apparently intended for children, and for our own part we confess that to read them for either pleasure or instruction is about the last thing we should think of doing. They are what may be called "animal novels," and thereby differ to a considerable extent from the old-fashioned "animal biographies," under which heading we have, however, ventured to include them. In each instance the author takes a number of more or less well-known animals, and recounts their ordinary everyday life, so far as it can be interpreted, Mr. English giving this for the most part in what are supposed to be the creature's own words, while the American author mingles verbal with descriptive narrative. Both works are, no doubt, excellent in their own particular way; and, for the sake of authors and publishers alike, we trust that a sufficient number of readers exist to whom this style of writing appeals with infinitely greater force than it does to ourselves. To such we may commend each of the two works, for, in the respective subjects, we find little to choose between them.

Mr. English, very appropriately, confines himself to British animals (including mammals, birds, fishes, insects, &c.); and although we cannot congratulate him on the title he has selected for his volume, we are pleased to be able to record our high appreciation of his skill as a photographer, and of the excellent manner in which his pictures have been reproduced.

FIG. 1.—The Wood-mouse. From English's "Beasties Courageous."

The photograph of the wood-mouse herewith presented to our readers is absolutely exquisite, and cannot be surpassed. Moreover, it is by no means a solitary example of excellence, every picture in the book being of high quality, although some are, of course, better than others. As a picture-book of various types of British animal life the book would be hard indeed to beat.

Mr. Long, on the other hand, takes for his subject some of the more striking animals of the Arctic districts of North America, which he calls for the most part by their native Indian names, after the manner of "Hiawatha."

The first six chapters are, for instance, devoted to the white wolf, under the title of "wayeeses, the strong one"; but it is a little remarkable to note that in the glossary at the end of the volume this name is spelt "wayeesis." Other chapters follow on the wild goose ("waptouk"), the fisher-marten ("pequam"), the salmon, &c. All bear the impress of truth, and relate the experiences of one who has seen the animals in their native wilds. The most striking incident is perhaps the one depicted on the cover of the book, where the author had the good fortune

[1] "Beasties Courageous; Studies of Animal Life and Character." By D. English. Pp. viii+121; illustrated. (London: Bousfield and Co., Ltd., 1905.) Price 5*s*. net.

"Northern Trails; some Studies of Animal Life in the Far North." By W. J. Long. Pp. xxv+390; illustrated. (Boston, U.S.A., and London: Ginn and Co.). Price 7*s*. 6*d*.

to see a wolf spring at night upon a jutting crag, where, silhouetted by the full moon behind, it gave vent to its "terrible howl." The illustrations in this volume are by that well-known artist Mr. C. Copeland, whose facile and truthful style stands in no need of any commendation of ours. These illustrations render Mr. Long's volume an attractive book for the drawing-room table at this season of the year.

SECONDARY SCHOOLS AND ENDOWMENTS.

AN INTERESTING TRANSFER SCHEME.

A SOMEWHAT novel proposal has been formulated for the transfer of an endowed school, with its property and funds, to an "education authority" other than a Local Education Authority under the Education Acts of 1902–3. This proposal relates to the Subordinate School at Rugby.

It appears that, for some time, there has been a movement in the locality with a view to the establishment of a technical school so as to organise systematically the scattered forces already at work. The Warwickshire County Council offered a grant of 1000*l.* towards the erection of such a school, while the governing body of Rugby School offered 500*l.* and a site on the grounds of the Subordinate School for the same purpose. These offers, however, failed to secure adequate local agreement—hence the above-mentioned transfer proposal.

According to the notice in the *London Gazette*, the governing body of Rugby School will apply to Parliament for an enabling Act "for the establishment, constitution and incorporation of an 'education authority,'" to whom that governing body may transfer the Subordinate School with its property and funds, and to whom they may make annual or other payments or contributions. This "education authority" would contain representatives of the governing body of Rugby School and of other local bodies (*e.g.* the County Council of Warwickshire, the Urban District Council of Rugby); any doubts or questions which might arise between the various bodies represented would be determined by the Board of Education. The "education authority" is to conduct the school "as a school for higher or secondary education . . . shall afford a good commercial education for students . . . and shall maintain the teaching of English, Latin, at least one modern foreign language and Greek, unless and until the governing body" (*i.e.* the governing body of Rugby School) "shall consent to the discontinuance of Greek." Other conditions relate to (1) the maintenance, by the governing body of the Rugby School, for the benefit of the students of the Subordinate School, of the existing system of major foundationerships at Rugby School; (2) the continuance of the engagements of the existing staff of the Subordinate School; (3) the borrowing, upon the security of the trust property, by the "education authority" of such sums for additions, improvements, &c., as may be needed—these powers to be subject to the conditions imposed by the Board of Education; (4) the maintenance at the Subordinate School, by the "education authority," of the existing system of foundationerships and scholarships tenable at that school.

A good deal of misgiving has been manifested locally in regard to the foregoing proposal, but it seems to us to be a step in the right direction. We confess that, as to nomenclature, the words "education authority" do not commend themselves to us as a suitable description of the new body to whom it is proposed to make the transfer. But the objects which may be secured under the proposal now foreshadowed are great indeed. To have obtained a gift which, if capitalised, would amount to between 50,000*l.* and 70,000*l.*, and to be enabled to utilise such resources to promote the educational and industrial progress of the town and neighbourhood of Rugby, are matters for sincere congratulation. The representative character of the new "education authority" will ensure the quickening of an intelligent interest in, and zeal for, that technical and higher education which the townsfolk of Rugby are seeking—including the actual provision of a technical school.

It is rather difficult to appraise rightly the action of those who have been disposed to reject an arrangement which, as we hope, is now about to be consummated. Possibly, upon reflection, they will become conscious, as has been the case with other erstwhile opponents, of the opportunities that are within their grasp. For this transfer provides not only that ladder which educationists are so anxious to erect for all those who can climb it, and who may thus be equipped for their several callings, but it will provide also an excellent object-lesson in regard to educational endowments and their administration for the public welfare. With potential issues like these, it is to be hoped that the inhabitants of Rugby and the neighbourhood will brace themselves for an effort in educational administration which shall inspire other localities to grapple earnestly with more exacting conditions.

NOTES.

LIEUT.-COLONEL PRAIN, I.M.S., F.R.S., took up the duties of director of the Royal Botanic Gardens, Kew, on December 16. Sir W. Thiselton-Dyer will continue to take charge of Government advisory work until March 31 next.

AT an Investiture held by the King on Monday, Prof. G. H. Darwin was invested with the insignia of a Knight Commander of the Order of the Bath (K.C.B.), and Sir Felix Semon with those of a Knight Commander of the Royal Victorian Order. His Majesty subsequently decorated the commander, officers, and several other members of the National Antarctic Expedition with the medal in commemoration of the expedition.

A SERIES of meetings for the informal discussion of important contributions to meteorological literature, particularly those by colonial or foreign meteorologists, has been arranged at the Meteorological Office by the director, Dr. W. N. Shaw, F.R.S. Two meetings have already been held, and seven others will be held from January to April of next year. The subjects suggested for discussion are of great interest to students and investigators of meteorological problems, and the director invites exchange of views upon them.

THE next meeting of the French Association for the Advancement of Science will be held at Lyons from August 2 to August 7, 1906, under the presidency of Prof. Lippmann.

WE regret to see the announcement that Mr. Lewis Wright, author of well known books on "Light" and "The Induction Coil in Practical Work," and of several works on the scientific breeding of poultry, was accidentally killed by a passing train at Saltford railway station, near Bristol, on Saturday, December 16.

A LARGE and influential committee of leading representatives of science in many parts of the world has been formed with the object of placing a monument to the

memory of the late Prof. Ernst Abbe at Jena between the Volkshaus erected by him and the optical works to the development of which he devoted his life. Zeiss instruments are in themselves monuments to Abbe's work wherever they are used, but there are probably many men of science who will welcome the opportunity of contributing to the establishment of some permanent representation of his personality in the place which he made famous. Subscriptions in support of the scheme should be sent to Dr. Gustav Fischer, Jena.

AMONG the letters from the honorary members of the Essex Field Club read at the meeting at Chingford on December 9 and referred to in our last issue (p. 157) was a very appreciative one from the veteran naturalist Dr. Alfred Russel Wallace, who had been attached to the club from the period of its foundation, and who had lectured at its meetings and taken part in many of the excursions and discussions. It is of interest to note that Dr. Wallace gave a preliminary account of his work on insular faunas and floras, being the substance of his book "Island Life," at a meeting of the club on January 4, 1881. In his recently published life he refers also to the fact that before his departure for America in 1886 he gave the club a lecture on the subject of variation, one of the chapters of his subsequent work on "Darwinism."

PROF. MELDOLA, F.R.S., presided over a "science dinner" given by the Maccabæans on December 16. After the loyal toasts, the chairman said the Maccabæans are a society composed primarily, though not entirely, of Jewish professional men, bound together by ties of race and religion. This race has contributed much to the advancement of philosophy and of science. It is the race which gave Maimonides and Spinosa to philosophy, the Herschels to astronomy, Ferdinand Cohn to botany, the Meyers and many others, including Brühl, to chemistry, and Lippmann and Herz to physics. Prof. Meldola concluded by giving the toast of "Science," coupled in the first place with the names of the representatives of scientific institutions represented in the room, and afterwards with individual representatives. Sir W. Huggins, K.R.S., and Sir A. Geikie, F.R.S., responded for the Royal Society, the Duke of Northumberland for the Royal Institution, Major P. A. MacMahon, F.R.S., for the British Association, Mr. J. J. H. Teall, F.R.S, for the Geological Survey, Sir J. Evans, F.R.S., for anthropology, Sir Henry Roscoe, F.R.S., and Sir William Ramsay, K.C.B., F.R.S., for chemistry, Prof Poulton, F.R.S., for biology, Prof. Starling, F.R.S., for physiology, and Prof. Ayrton, F.R.S., for applied science.

SEVERAL subjects of scientific interest were discussed at the conference on smoke abatement and the exhibition of smoke-prevention apparatus held on December 13–15 in the hall of the Horticultural Society, Westminster. The inaugural address was to have been delivered by Sir Oliver Lodge, F.R.S., but he was prevented by indisposition from attending. Some manuscript notes by Sir Oliver Lodge were read to the meeting by Sir William Richmond. These notes dealt with fog as a destructive agent, and the proposal that smoke and fog should be precipitated by electrification of the air. The right way to deal with a town fog, according to the author, was not to produce it. The connection between fog and the imperfect combustion of solid fuel was then illustrated, and the need for improved methods of burning fuel insisted upon. At the same meeting the question, "Is London fog inevitable?" was discussed by Dr. W. N. Shaw, F.R.S. On the second day numerous papers were read, and of these may be mentioned stoking and smoke abatement, by Commander W. F. Caborne; the abatement of smoke in factories, by Dr. Rideal; the artificial production of persistent fog, by the Hon. Rollo Russell; destructive effects of smoke in relation to plant life, by Miss Agar and Mr. A. Rigg. At the third meeting of the conference Sir John Ure Primrose made a plea for a systematic analysis of the air of towns. He said that samples of the rainfall collected in Glasgow now show no traces of free acid, whereas only a few years ago similar samples were found to be strongly acid. This improvement in the city's atmosphere is due chiefly to the check the Alkali Acts have imposed upon the emission of acid gases by chemical and metallurgical works. The exhibition of smoke-abatement appliances included grates, stoves, cooking plant, heating flues, chimney construction, and smoke-consuming and smoke-preventing apparatus.

IN the note on the contents of the *Zeitschrift für wissenschaftliche Zoologie*, vol. lxxx., part ii., published in our issue of December 7, Mr. S. Hlava's paper is stated to have been on the Radiata, instead of the Rotifera.

"THE Formation of Local Illustrative Collections in Museums" is the title of an article by Mr. J. Maclauchlan, of Dundee, in the October issue of the *Museums Journal*, which may be commended to the best attention of the governing bodies of provincial institutions of this nature, who, in many cases, are too apt to convert them into mere "curiosity-shops," or who attempt to usurp the functions of large museums by the display of a more or less ill-arranged general natural history collection. The rating of museums and public libraries is another question discussed in the same issue.

THE most interesting announcement in part iii. of the first volume of the *Journal of the Federated Malay States Museums* is, perhaps, the identification of a tooth of the Indian Pleistocene *Elephas namadicus* from Perak. Dr. C. W. Andrews being responsible for the determination, there can be no reasonable doubt as to its correctness; and this being so, the matter is of considerable interest as tending to link up the extinct proboscidean fauna of India and Burma with that of Borneo, Java, and Japan. In the same issue Mr. Bonhote describes a new rat, Mr. Ogilvie-Grant a new whistling-thrush, and Mr. H. C. Robinson a new tree-partridge, all from the Malay Peninsula or adjacent islands.

THE greater portion of the November issue of the *Quarterly Journal of Microscopical Science* is devoted to three instalments of a long paper on the formation of spicules, the author, Mr. W. Woodland, dealing in this instance with calcareous sponges, Alcyonium, and the sea-urchin larva. The relation of triradiate spicules to the dermal cells to which they owe their origin is beautifully illustrated in the plates, and it is shown that, as in the case of the simpler types, the triradiate form is directly related to the conformation of the secreting agency. As to the use of these triradiate spicules, it is pointed out that the hollow cylinders of which sycon-sponges consist are liable to be swayed by the movements of the water, and that were these oscillations to become excessive the organism would be injured. Moreover, as the oscillations are both vertical and horizontal, support in each of these directions is essential. "Both of these elements are supplied by the numerous triradiate spicules contained within the sponge-wall, for it invariably follows from their conformation that if one ray be vertically disposed, then the two companion rays will lie in lines only deviating from the horizontal

by an inclination of 30°, and hence the three rays practically constitute two axes, respectively lying in the required vertical and horizontal directions." It will be remembered that in a recent note we referred to the views of an author who regarded these triradiate spicules as an instance of over-specialisation.

THE *Journal of Economic Biology* is the title of a new serial, edited by Mr. W. E. Collinge, and published by Messrs. Dulau and Co. For some time, and more especially since the foundation of the Association of Economic Biologists, it has been evident that workers in the subject to which the new serial is devoted frequently experience difficulty in finding suitable means of making their labours known to the public, especially when illustrations to their papers are required, and it is to meet this want that the venture, to which we wish cordial success, has been made. In the opening article Prof. A. H. R. Buller discusses the destruction of wood-paving in roadways by a kind of dry-rot produced by the fungus known as *Lentinus lepideus*. In the second article the editor describes some very remarkable varieties of the currant-moth produced by change of food and temperature, while in the third and last communication Mr. F. V. Theobald describes new gnats from various parts of the world.

WITH the October issue the publication of *Climate* came to an end, an amalgamation having been effected with the *Journal of Tropical Medicine*, which in future will devote four of its issues annually to the special subjects hitherto dealt with in *Climate*.

THE *Journal of the Royal Sanitary Institute* for December (xxvi., No. 11) contains the second part of a paper on the administration of the Food and Drugs Acts by Mr. Wellesley Harris which should be very useful to students of public health, the mortality statistics of boot and shoe workers in Northampton by Dr. Beatty, a note on the recent literature of plague by Colonel Notter, and an article on school hygiene by Dr. Elkington.

IN an interesting article on the revival of phrenology in the *Fortnightly Review* for December, Mr. Stephen Paget reviews the subject and refers to Dr. Bernard Höllander's book on the mental functions of the brain. Gall it was, celebrated for his anatomical studies of the brain, who originated what is known as phrenology, a study very different from the present conception of localisation of function in the brain, as Mr. Paget points out. From the wreck of Gall's work Dr. Höllander has saved many well recorded cases of localised injury or disease of the brain with exaggeration or diminution of this or that one function—cases such as led to the discovery of the speech centres. But when Dr. Höllander asserts that his book may have an important bearing on the development of mental science, on the treatment of lunacy, &c., Mr. Paget considers that he is claiming much more than can be admitted.

ON the subject of the conditions essential to the best production of Para rubber, Mr. H. Wright has compiled some useful data in vol. iii., No. 6, of the Circulars of the Royal Botanic Gardens, Ceylon. It would appear that richness of soil is not so important as altitude and temperature, since by the annual shedding of its leaves the tree returns a large amount of material to the soil. With regard to temperature, the trees thrive best in Brazil in a mean temperature about 25° C., while, as to altitude, the limit of successful cultivation in Ceylon is placed at 2000 feet above sea-level.

THE superintendent of the botanical department, Trinidad, in the Bulletin (October) refers to a new variety of coffee, *Coffea robusta*, received from the Congo River, West Africa, that has been successfully propagated at the experiment station. A stock of nearly two thousand plants offered for distribution was quickly disposed of to planters. In the same journal Mr. W. R. Buttenshaw, writing on the subject of selection by means of vegetative propagation, instances a few of the improvements that have been effected by continuous selection of cuttings and by bud selection. A distinction is drawn between the sudden emergence of a sport and gradual development by careful selection.

WITH the object of ascertaining whether a commercial fibre can be prepared from banana leaf-sheaths, it is announced in the *Agricultural News* (October 21) that prizes for the best samples of fibre will be offered at the agricultural show to be held in the course of this month in Barbados; the fibre will be extracted from the dwarf banana, as this is the species cultivated there. In the last number of the journal, which, owing to an alteration in the sailings of the Royal Mail steamers, is dated November 11, a note appears on the cigarette and biscuit beetles. The former, *Lasioderma serricorne*, does not confine itself to tobacco, but feeds also on leather and drugs, and the biscuit beetle, *Sitodrepa panicea*, shows similar tastes.

THE report for the year 1904 of the director of the botanic gardens in Sydney, New South Wales, has been received. Amongst the list of interesting plants that have flowered during the year are *Diplachne Peacockii*, an indigenous grass recently discovered, *Paspalum cochinchinense*, another grass that, judging from the vigorous growth made in a dry season, may prove as valuable for fodder as *Paspalum dilatatum*, *Eucommia ulmoides*, the Chinese rubber-tree, and a number of Opuntias that are being cultivated with the object of obtaining a spineless plant. Of the trees planted in the Centennial Park, the most interesting are the Aleppo pines, *Pinus halepensis*, that are being grown as a wind-break.

IN the *Engineer* of December 15 drawings are given of a dredger that has been used by the Dundee Harbour Trustees for more than a century. It is built of oak, and is 68 feet long with a beam of 21 feet, and draws in working order 7 feet 6 inches. The engine is believed to have been built by James Watt.

IN the December number of the *Popular Science Monthly* there is a useful article by Prof. R. D. George, of the University of Colorado, giving an able summary of the existing knowledge of mining and the use of metals by the ancient Egyptians. In the same issue Dr. Charles R. Eastman, of Harvard University, inquires into the rightfulness of regarding Anaximander, the pupil of Thales in the sixth century B.C., as the first who foreshadowed modern ideas of evolution. All estimates present Anaximander as a keen and deeply contemplative student of nature who arrived at a dim adumbration of great truths.

IN the current issue of the *Bulletin de la Société d'Encouragement* Messrs. G. Arth and P. Lejeune give some interesting particulars of a prehistoric mass of metal found near Nancy at a depth of 4½ metres below the surface. The mass weighs about 300 kilograms, and is accompanied by fragments of charcoal and slag. It appears

to have been the base of an ancient hearth in which the metal had been subjected to repeated and prolonged heatings. The metal contains, in addition to iron, 1·212 per cent. of combined carbon, 0·038 per cent. of graphite, 1·670 per cent. of silicon, 0·026 per cent. of sulphur, 0·013 per cent. of phosphorus, and 0·180 per cent. of manganese. It is thus a steel containing a higher percentage of silicon than is now usual. The microscopic examination shows that it belongs to Guillet's first group of silicon steels, pearlite steels consisting of a solid solution of Fe_2S in iron. In the same issue Mr. A. Porlier gives details of the composition of a cast-iron cannon ball found in making the underground railway through the old moat of the Bastille. The cannon ball was absolutely compact, but oxidised throughout, its specific gravity being 4·854 instead of 7·6 as is usual for cast-iron. Under the microscope the cementite appeared in brilliant lines, showing that it had completely preserved its metallic state. The oxidised portions, appearing as black masses, were derived from the pearlite, which in admixture with cementite constitutes ordinary white pig-iron. Analysis yielded:—water, 2·9 per cent.; carbon, 5·9 per cent.; silicon, 0·25 per cent.; manganese, 0·75 per cent.; iron, 72·0 per cent.; and oxygen, 17·45 per cent. The complete oxidation of the cannon ball, without any exterior deformation or fissuration, shows the intense action of diffusion during a century, and enables us to understand how the changes of rocks by metamorphism have been able, thanks to the intervention of infinitely longer periods, to give rise to new rocks of a homogeneous structure.

IN No. 50 of the *Bulletin du Musée océanographique de Monaco* Prof. H. Hergesell gives an interesting account of the method employed by the Prince of Monaco in the North Atlantic last April for ascertaining the conditions of the upper air by means of unmanned balloons sent up from his yacht. Two closed india-rubber balloons were employed; at a certain altitude the upper balloon bursts, or is set free by a simple electrical arrangement, when the lower one, which carries the recording instruments, falls, but has a float attached to it, at about 50 metres below it, and when this reaches the surface of the ocean the balloon is carried along by the wind at a height of 50 metres, and then the yacht has to chase it at full speed. Out of five cases specified by Dr. Hergesell, only one of the balloons eluded the pursuers. Of course, such a procedure can only be undertaken by a vessel having no other object in view, and it is necessary that the air should be clear, and that the velocity of the wind should not exceed the speed of the ship. Such experiments are exciting, but expensive; but some useful results at high altitudes were obtained.

A REMARKABLE dam is under construction at Niagara Falls, where the commissioners of Victoria Park, on the Canadian side of the river, have erected a column of concrete 50 feet high and 7 feet 4 inches square. This column of concrete was built on a trestle that stands 20 feet above the ground-level, and after the material is thoroughly dry the column is to be tipped over into the river to form a dam. The necessity for this work arose from the fact that the City of Niagara Falls, Ontario, and the Niagara Falls Park and River Railway, made complaint to the park commissioners that the works of construction for power development had lowered the water in the joint intake. The approximate weight of the concrete column is 200 tons. Every 8 feet of its height a wooden wedge is inserted in the side, and passes nearly to the centre, each wedge being about 12 inches thick on the outside, tapering to about 6 inches near the centre. The object of these wedges is to break the column into six pieces when it is tipped over. However, these sections will not be allowed to be caught by the current, for running up through the centre of the column there is a very heavy chain, the weight of which is about 800 lb. The purpose of this chain is to hold the sections together when the column is broken in falling. When it is prostrate, the top of the column will be 20 inches above the ground-level, and is expected to raise the water in the intake considerably. The intake is only about 600 feet up from the brink of the Horseshoe Fall, but the dam

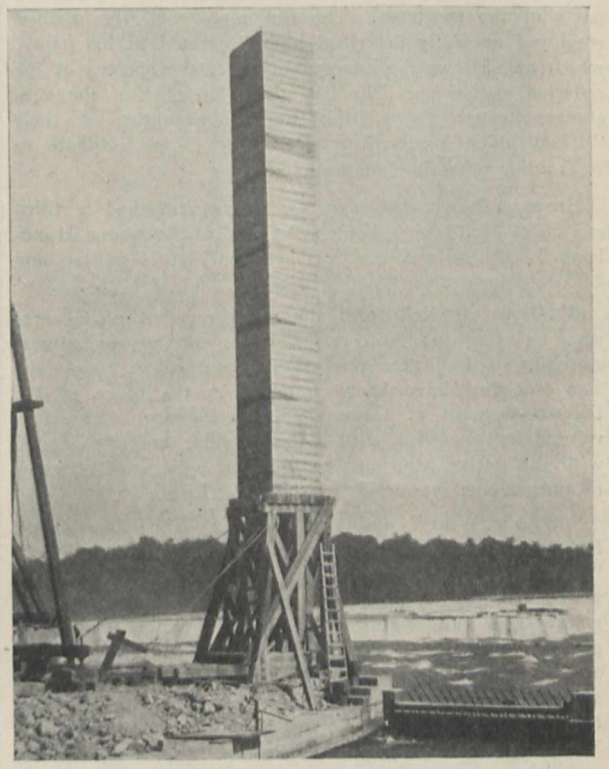

FIG. 1.—A column of concrete built to be tipped over to form a dam at Niagara Falls.

will not affect the flow of the waterfall at that point. When dry, the column will be tipped by operating jacks under the base of the trestle, and when it tumbles it is expected to fall a little up-stream.

WE have received from Messrs. R. and J. Beck, Ltd., a copy of their new illustrated price-list of telescopes. The list contains particulars of numerous astronomical and naval telescopes, object glasses, spectroscopes, transit instruments, small observatories, diffraction gratings, &c., and will be found to be very useful and suggestive to any amateur astronomer who wishes to add a good instrument to his equipment; some of the portable mountings, both equatorial and altazimuth, appear to be very compact and useful. A copy of a photograph of the iron spectrum, taken with a "Thorp" transmission grating, shows the suitability of these replicas for high-class work, and Messrs. Beck undertake to mount the grating copies either on parallel plate glass or on prisms of any desired angle. All kinds of surveyors' instruments are also quoted in this list.

THE results of an interesting research on the selective reflection, by various crystals, in the infra-red spectrum are published by Mr. J. T. Porter, of Johns Hopkins University, in the November number of the *Astrophysical Journal*. It has previously been shown by Prof. E. F. Nichols that in the neighbourhood of 8·5 μ the reflection from quartz is twenty or thirty times greater than in other parts of the spectrum, so that after three reflections from such a surface the spectrum practically contains only radiations of that wave-length. The wave-lengths of the "Reststrahlen," or the rays remaining after reflection, have already been determined for seven other substances by previous workers, and Mr. Porter examined fourteen additional crystalline compounds and found that at least seven of them exhibited unmistakable maxima in various parts of the spectrum. The radiometer and the method employed are fully described and illustrated in his paper, which also shows the energy curves of the spectra of the reflected radiations. The list given for nine of the substances tested shows that the wave-lengths of their "Reststrahlen" vary from 2·30 μ for copper sulphate to 10·31 μ for potassium dichromate.

MESSRS. WHITTAKER AND CO. have published a third edition of Mr. Joseph Poole's "Practical Telephone Handbook." The new edition has been entirely re-written and greatly enlarged.

WE have received from the superintendent of Government printing in India two volumes of the agricultural statistics of India for the years 1899–1900 to 1903–1904. The statistics have been compiled in the office of the Director-General of Commercial Intelligence. The first volume is concerned with British India, and the second with the native States. The volumes will prove of value to statisticians interested in Indian agriculture.

"WHO'S WHO" and the "Who's Who Year-book" for 1906 have now been issued by Messrs. A. and C. Black. "Who's Who" is a familiar work of reference everywhere; its price remains the same, 7*s*. 6*d*. net, but the volume has been enlarged by the addition of eighty-two pages. Interesting additions are made this year to many of the biographies by a record of the number of a person's sons and daughters. Motor and telephone numbers and telegraphic addresses have been added where requisite. The biographical notices of Fellows of the Royal Society and other men of science contained in the volume are of particular interest to us. This indispensable reference book is admirably supplemented by the year-book with its conveniently arranged tables, among which are to be found lists of the learned societies and university professors.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A THIRD NEW COMET, 1905*d*.—A telegram from the Kiel Centralstelle announces the discovery of yet another new comet. Apparently the proximity of this object was discovered from the appearance of its image on a photographic plate exposed on November 29, and examined subsequently. The discovery was made by Mr. Slipher at the Flagstaff (Lowell) Observatory, and the position of the comet on November 29d. 9h. 27m. (Flagstaff M.T.) was found to be

R.A. = 22h. 44m., dec. = 11° 18′ S.

This is situated in the constellation Aquarius, about half-way between λ and τ Aquarii.

The daily movement in R.A. is given as −1° 33′, or 6m. 12s., and in declination as +25′. From this it will be seen that the comet was at that time travelling in the direction of the constellation Aquila.

COMETS 1905*b* AND 1905*c*.—An observation of comet 1905*b*, made by Prof. E. Millosevich on December 13, gave corrections of −2s. and −2′·3 to the ephemeris published in No. 4057 of the *Astronomische Nachrichten*. The observed magnitude was 11·5.

The following set of elements for the orbit of comet 1905*c* have been computed by the discoverer, M. Giacobini, and, together with an ephemeris, from which an extract is given below, is published in the *Comptes rendus* for December 11 :—

T = 1906 January 31·620 (Paris).

$$\left.\begin{aligned} \infty &= 171^\circ\ 23'\cdot7 \\ \Omega &= 89\ 42\cdot0 \\ i &= 42\ 44\cdot3 \end{aligned}\right\} 1905\cdot0$$

$\log q = \bar{1}\cdot72728$

Ephemeris 12*h*. (*M.T. Paris*).

1905	α	δ	log Δ	Brightness
	h. m. s.	° ′		
Dec. 22 ...	15 41 51 ...	+12 27·3 ...	0·1251 ...	2·04
,, 26 ...	16 3 49 ...	+ 9 44·0 ...	0·1153 ...	2·45

THE RECENT AURORA AND MAGNETIC DISTURBANCES.—From an account published in the current number of the *Observatory*, we learn that on November 15, the date of the recent great display of the aurora, the greatest disturbance of the Greenwich magnets which has been recorded during the present year took place. All three elements were affected, a deflection of about 40′ being recorded by the declination-needle at 9 p.m. Of the two considerable streams of sun-spots which appeared near to the place of the great October spot (October 14–27), the one was a little ahead of the central meridian and the other not quite up to it at the time of the disturbance.

PHOTOGRAPHS OF JUPITER'S SIXTH AND SEVENTH SATELLITES.—At the meeting of the Royal Astronomical Society held on November 10, the Astronomer Royal exhibited and explained some photographs of the sixth and seventh satellites of Jupiter, obtained with the 30-inch reflector of the Thompson equatorial at Greenwich.

The results of the provisional measures of the photographs, and their comparison with the angles and distances given by Dr. Ross's ephemeris, the dates, and the exposures are given in No. 1, vol. lxvi., of the *Monthly Notices*. The exposures for the seventh satellite varied from 17 minutes to 177 minutes.

THE INTRINSIC LIGHT OF THE CORONA.—Employing a modified "Mascart" photometer, M. Chas. Fabry determined the relative brightness of the intrinsic light of the corona during the recent total eclipse of the sun. As a result, he found that at a distance of 5′ from the edge of the sun, and in the neighbourhood of the solar equator, the light of the corona has an intrinsic value of about 720 candle-power. Comparing this with the mean intrinsic value of the light of the full moon (viz. 2600 candles), he obtains the ratio 0·28 : 1, a value which confirms Prof. Turner's ratio of 0·25. To illustrate the great difficulty which attends the photographing of the corona in full sunlight, M. Fabry compares the value he thus obtained with the accepted value for the brightness of the sky near to the sun, and arrives at the conclusion that even the most brilliant parts of the corona are probably some 2000 times less bright than the sky on which they are projected (*Comptes rendus*, No. 23).

SUGGESTED NAME FOR NEPTUNE'S SATELLITE.—Writing to the *Observatory*, M. Fouche suggests that Neptune's satellite should be named after the most renowned of Neptune's sons, *i.e.* Triton. He states that this name has already been used for designating the satellite by several well known astronomers.

THE "COMPANION TO THE OBSERVATORY," 1906.—As in former years, the well known "Companion to the Observatory," published by Messrs. Taylor and Francis at 1*s*. 6*d*., contains all the data that an ordinary astronomer is likely to require in the briefest and handiest form. Messrs. Denning, Maw, and Lœwy have again provided the data referring to "Meteor Radiants," "Double Stars," and "Variable-star Ephemerides" respectively, and Dr. F. E. Ross's ephemeris for Jupiter's sixth satellite is given amongst the other tables which deal with the satellites of the major planets.

HYDROLOGY IN THE UNITED STATES.

WE have referred on previous occasions to the very complete way in which hydrological research is carried out in the United States, and to the value of the reports that are made from time to time by the officers having charge of the works.[1] We have been favoured with twenty-five further reports recently issued. The greater part of these refer to the water resources, and to the surveys being carried out by the departments in the different States. These are principally of local interest, although they contain a great deal of information useful to those engaged in water supply. Some of these reports, however, relate to matters that are of more general interest.[2]

Paper 119 contains an index to the hydrographic progress reports, 1888–1903, and paper 120 a review and index to papers relating to underground waters published by the United States Geological Survey, 1879–1904.

Report No. 110, on the hydrology of the eastern United States, contains twenty-three short papers by nineteen geologists and physicists connected with the eastern section of this division of hydrology. The most interesting of these papers is that which relates to the methods used in measuring the velocity, direction, and quality of underground water.

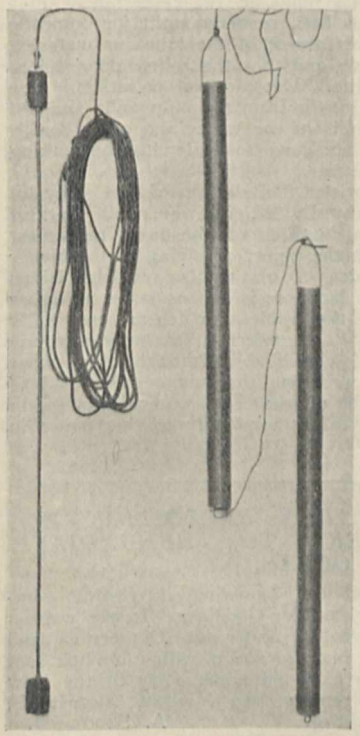

FIG. 1.—Electrode and perforated brass buckets used in charging wells.

The Discharge of Sewage into Porous Strata.—In one of the papers, by S. W. Callie, is recorded the experiments made to ascertain what would be the effect of discharging town sewage into pervious strata on the water supply of the neighbourhood drawn from wells.

The town of Quitman derives its water supply from a well in the limestone at a depth of 123 feet from the surface. A section of the soil shows 2 feet of surface sand, 60 feet of clay, 15 feet of sand, and 43 feet of water-bearing limestone.

The authorities of the town were seriously considering the question of disposing of the town's sewage by means of deep wells into the porous strata. The writer of the paper was engaged to report as to what effect this would have on the water supply. For this purpose he adopted the chlorine process. Seven wells in the locality were selected for making the experiment, the water in which was found to stand at a lower level than that in which the chlorine was to be introduced. Samples were taken from these wells, and the normal amount of chlorine determined. Two tons of salt were then put into the test well in the form of solution during a period of five days. Special precautions were taken in the method of introducing the salt to ensure complete saturation of the water. The normal chlorine at the well from which the water supply for the town was drawn was 5·44 parts in a million. Four hours after the introduction of the salt in the test well the chlorine began to increase, reaching a maximum of 6·80 parts in twelve hours, and continued to show an excess during the five days, after which it

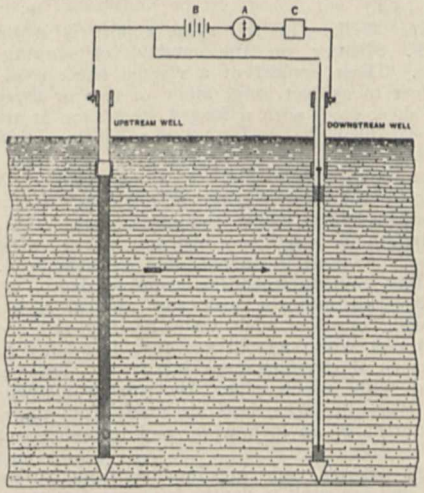

FIG. 2.—Diagram illustrating electrical method of determining the velocity of flow of ground water. The ground water is supposed to be moving in the direction of the arrow. The up-stream well is charged with an electrolyte. The gradual motion of the ground water toward the lower well and its final arrival at that well are registered by the ammeter A. B is the battery, and C a commutator clock which is used if A is a recording ammeter.

gradually subsided to its normal quantity. At two of the other wells a similar excess of chlorine was found, but at the other wells no change in the character of the water took place.

The general conclusion arrived at was that if sewage were discharged into the water-bearing strata it would contaminate all the wells in the locality that had a depth of 120 feet or more, and that if the proposed scheme of the municipality had been carried out it would probably have resulted in a serious epidemic.

Measurement of Underground Currents.—A paper by Charles S. Slichter gives a description of the underflow meter used in measuring the velocity and direction of underground water.

For the purpose of measuring the underground flow in any locality test wells are sunk consisting of 1½-inch or 2-inch tubes. These pipes are in lengths of 6 feet or 7 feet, with long threads and heavy wrought nipples. The well points are 4-feet brass jacket points of wire gauze. The tubes are driven with a ram weighing from 150 lb. to 250 lb., the movement of the tube being aided by a water jet. Four wells were driven from 4 feet to 6 feet apart in a triangular form, one at the apex and the other three at the base of the triangle. The deeper the wells the greater the distance apart at which they were placed.

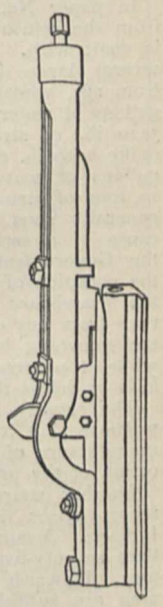

FIG. 3.—Perforator for slitting well pipes.

The up-stream well is charged with a strong electrolyte such as sal ammoniac, which passes down stream with the underground water to the lower wells (Fig. 1). Each of the down-stream wells contains within the well point an electrode consisting of a nickel brass rod ⅜-inch thick by 4 feet long, insulated from the casing by wooden spools. This electrode communicates with the surface by means of rubber-covered copper wire, and connects with a recording ammeter. As the electrolyte reaches one of the down-stream wells its appearance is at once recorded by the

[1] "Water Supply and Irrigation in the United States" (NATURE, January 7, 1904); "Relation of Rainfall to Run Off" (July 28, 1904); "Floods in the Mississippi Valley" (November 3, 1904); "Hydrology in the United States" (December 22, 1904).

[2] "Water Supply and Irrigation Papers," Nos. 99 to 132. (Washington: Government Printing Office, 1904–5.)

meter, the time occupied in passing from the upper to the lower well being thus found, and giving the rate of flow of the water.

Further details of observations of underground flow as carried out by this method are given in paper No. 112, by Homer Hamlin, with numerous illustrations of the apparatus used.

Stove-pipe Wells.—In the same report is a paper by Charles S. Slichter on the method of sinking stove-pipe wells. These consist of a riveted sheet steel starter from 15 feet to 25 feet long, made of two or three thicknesses of sheet steel with a forged steel shoe at the lower end. The rest of the casing consists of two thicknesses of sheet steel made into riveted lengths of 2 feet, one set of sections being made just so much smaller than the other as to permit them to telescope together. Each outside section overlaps the inside section 1 foot. This casing is sunk, length by length, by hydraulic jacks, which press on the upper sections by means of a suitable head. After the well has been sunk to the required depth, a cutting knife is lowered into the well and vertical slits are cut in the casing opposite such water-bearing strata as may have been met with; a well 500 feet deep may have 400 feet of screen if circumstances justify it. The perforator is handled with 3-inch pipe. By raising slowly on the line with hydraulic jacks, cuts are made from three-eighths to three-fourths of an inch wide, and from 6 to 12 inches long.

The well casings vary in diameter from 17 inches to 14 inches, and are sunk to depths from 500 feet to 1400 feet, the yield of water varying from 300,000 to 3,000,000 gallons in twenty-four hours. The cost of a 12-inch 500 feet well is about 140*l.* for labour and 100*l.* for materials, the drillers being paid 1*l.* and the labourers 10*s.* a day. The soil where these wells are in use consists of mountain débris, clay, gravel, sand, and boulder.

Pollution of Streams by Waste from Factories.—Paper No. 103 contains a review of the laws in operation in the different States of America for the prevention of pollution of inland waters. The broad legal principles under which anti-pollution statutes become operative are explained, and important Court decisions are quoted to show the authority upon which certain deductions in the report are founded.

In paper No. 133 the special stream pollution arising from the refuse water from the "straw board" factories is dealt with. In Indiana, Ohio, and Illinois there are several large factories engaged in making pasteboard from rye, wheat, and oat straw. For this process 40,000 gallons of water are required to wash 1 ton of straw, and 3200 lb. of straw and 560 lb. of lime are required to make 2000 lb. of board. In an ordinary factory 2,000,000 gallons of water are used daily, which carries with it 19 tons of straw waste and 10 tons of lime. This waste generally runs into a neighbouring stream, and is the cause of a serious amount of pollution. The report of the Government Commissioner for Fisheries states that the pollution of the streams in Indiana by the refuse from the strawboard mills, oil mills, and pulp mills is greater than from any other source. The refuse from these covers the spawning beds and prevents the eggs from hatching, while it penetrates the gills of the living fish and either kills or drives them away from the streams.

The remedy is by chemical precipitation of the waste products, but it is contended that the small profit on the manufacture of strawboard does not permit of the application of the process required.

Another source of water pollution dealt with in this report arises from the overflow from the oil wells in Indiana. Around the city of Marion there are no less than seventy-five oil wells in a few square miles of territory. Upwards of 300 surface and rock wells in this area are suffering contamination from this source. The strata in this district consists of sand and gravel for about 50 feet, then clay for about 80 feet, and below this limestone. The water supply of the town and neighbourhood is derived from water in the limestone, and there is a constant flow of underground water. Oil occurs near the top of the formation. Beneath the oil is salt water. In order to form a reservoir for the oil the limestone is entered some distance, and the most successful wells are those which are drilled deep enough to allow a large amount of oil to collect, so as to be above the upper level of the brine. These oil wells are generally 1000 feet deep, the oil rising to within 600 feet or 700 feet of the surface. When the well is bored it is "shot" with nitroglycerin, which breaks up the limestone and forms fissures and small cavities which act as reservoirs into which the oil flows. The surface effect of the shooting is the violent ejection of salt water and oil, often to the extent of thousands of gallons. The oil and salt water then sink into the soil where it is porous, and finally reach the surface zone of underground flow, where they partake of the general movement of the water toward the main line of underground drainage, and cause its pollution. The brine and oil pumped from these oil wells is discharged into a settling tank. The oil, owing to its lighter specific gravity, settles at the top and is drawn off, the brine being discharged into any neighbouring creek or stream, or is allowed to sink slowly into the ground, in either case becoming a serious source of pollution to the water supply of the neighbourhood.

Paper No. 121 relates to the pollution of Lake Champlain, by M. O. Leighton. The report was made in consequence of complaints made to the Government that the water of the lake has been rendered unfit for domestic consumption; that the usefulness of the lake for watering cattle has been destroyed; and that the refuse poured into it is destructive to fish life. The cause of pollution is due to the waste discharged into it from the pulp mills situated on its banks. The analysis of the water and other details are interesting to those who have to deal with the making of pulp and similar industries.

Paper No. 122 is entitled "Relation of the Law to Underground Waters," by D. W. Johnson, and contains an outline of the main features of the laws respecting underground waters with the object of giving to the owner of such waters some idea of his rights and obligations concerning them. Such legal decisions as serve to show the relation of the law to the problems which are essentially geological in character are referred to. Underground waters are defined and classified. Although this paper refers to United States practice, there is a great deal of information that would be of service to water engineers in this country. We shall refer more fully to this paper in a future number.

THE PERCY SLADEN EXPEDITION IN H.M.S. "SEALARK" TO THE INDIAN OCEAN.

I HAVE just received the following interesting communication from Mr. Stanley Gardiner. It was written from Port Victoria, Seychelles, under date October 28, and is the fourth report of his expedition which he has sent home. Mr. Gardiner is expected home early in the New Year. For his earlier reports, see NATURE, August 10, October 5, and November 9. A. SEDGWICK.

Cambridge, December 1.

During the ten days that the *Sealark* left us at Coetivy while she was coaling in the Seychelles, we as thoroughly as possible collected the animals and plants of both the land and reef. The island was higher than any we had up to that time visited, having wind-blown sand ridges and hills up to 80 feet above sea-level, arising on a flat coral reef. Although situated only about 130 miles to the south of the Seychelles Islands, the land fauna and flora are almost the same as on the islands of the Chagos Archipelago, being scarcely richer in either. The plants, of course, in the main necessarily govern the fauna, and it would appear to us that they are in their turn governed rather by the nature of the soil—coral and coral sand—than by their proximity to continental land. On the other hand, the reefs of Coetivy showed in every group of marine animals a more varied fauna than those of the Chagos, while very nearly all the species of the latter seemed to be present. The reef on the eastern, or seaward, face of the island was of a rather different character from any we had as yet seen (or from any I have seen in the Pacific), being covered with a grass-like weed, locally termed "varech." There was also on the same part a

considerable variety of other algæ, but the edge and outer slope were, as elsewhere, covered by corals and nullipores. The reef, however, to the west, where there is a flat extending out for some miles with about 16 fathoms of water, closely resembled similarly situated reefs in the Chagos, but the greater variety of its organisms was equally marked, though individual species were much less common.

Leaving Coetivy on September 25, we proceeded to a point about midway between Madagascar and Farquhar Atoll, both to ascertain the depth and the compass variation. The latter was almost the same as at Mauritius, situated 9 degrees to the south, while the depth, 1856 fathoms, precludes the idea of any close connection between the two localities. Farquhar, which we then visited, was (as, indeed, were all the reefs we subsequently saw) remarkable for its almost completely covered "varech" reefs, both rim and lagoon. Its land attains a height of more than 70 feet, and is clearly of the same formation as that of Coetivy; it shows no trace of elevation, and it has not been formed, as has been stated, by submarine deposits. The section of the reef also showed the outer slope to be quite similar to that of other atolls.

From Farquhar we proceeded to sound between the chain of islands that extends between Madagascar and the Seychelles, and which would appear to indicate a line of former connection. Between Farquhar and Providence, 32 miles, we found 890 fathoms, and between the latter and Alphonse-François, 155 miles, 2170 fathoms, while there were already soundings of 952 fathoms between Alphonse and the Amirante Group, 46 miles, and of 1150 fathoms between the latter and the Seychelles, 32 miles. As the depth on either side is only about 2300 fathoms, any connecting ridge is comparatively low and of doubtful importance.

Providence was particularly interesting, being simply a great reef, 28 miles long by 7 miles broad to the 100-fathom lines. Off it we took twelve dredgings, obtaining a rich fauna down to about 100 fathoms, below which the bottom was exceedingly barren of life. From one dredging at 744 fathoms, 3 miles to the west of the reef, we obtained about 5 cwt. of stones, the largest about 2 feet in diameter. We have here no means of properly ascertaining their nature, but similar rock has not, so far as we are aware, been hitherto described off any coral reef. It is almost entirely insoluble in acids, and is largely formed of different crystals, organic deposits practically not entering into its composition. Some masses looked like solidified ash or clay, while others *appeared* rather like volcanic bombs. All were more or less coated with manganese, but we do not know its thickness, preferring to keep the specimens intact for proper examination on our return to England. However, it is clear that the existence of this rock in such a position will have to be carefully considered in connection both with the formation of Providence Reef and with the existence of any former land connection between the Seychelles plateau and Madagascar.

Pierre Island, 17 miles to the west of Providence Reef, and with a depth of 1088 fathoms between, is peculiar in having no fringing reef. It is simply an elevated coral island, reaching to a height at present of about 30 feet, surrounded by overhanging cliffs, so that landing is extremely difficult. Its rock is entirely coral.

Alphonse and François are sandbanks on the rims of two reefs, scarcely 2 miles apart. Both reefs are of atoll formation, the lagoon of Alphonse (not shown in any chart) being 3 to 8 fathoms deep and of considerable size.

The Amirante Islands are likewise sandbanks, no parts of any being more than 10 feet above the high-tide level. The hills represented in the separate enlarged plans of D'Arros, St. Joseph, and Desroches do not exist, and probably owe their presence thereon to the imagination of the draughtsman.[1] Desroches is really an atoll by itself, lying 10 miles to the east, and being separated by a channel 874 fathoms deep. The rest of the islands and reefs lie on a bank about 50 miles long by 20 miles broad, with an average depth of about 30 fathoms. Eleven separate reefs reach the surface, of which St. Joseph alone has a lagoon, being really a small atoll with about 4 fathoms of water in the centre. With the exception of Eagle, D'Arros, and Bertant, all the reefs lie on the edge of the bank, but its edge is in most places covered by at least 8 to 10 fathoms of water. Its slope is steeper than is customary off coral reefs, no possible dredging ground existing between 60 and 500 fathoms.

All the islands of the Amirante Group, with the exception of Marie-Louise and Eagle, are now planted for cocoanut oil, but the indigenous vegetation still remains in places. The land plants and animals are almost the same as at Coetivy and in the Chagos, the additions due to the

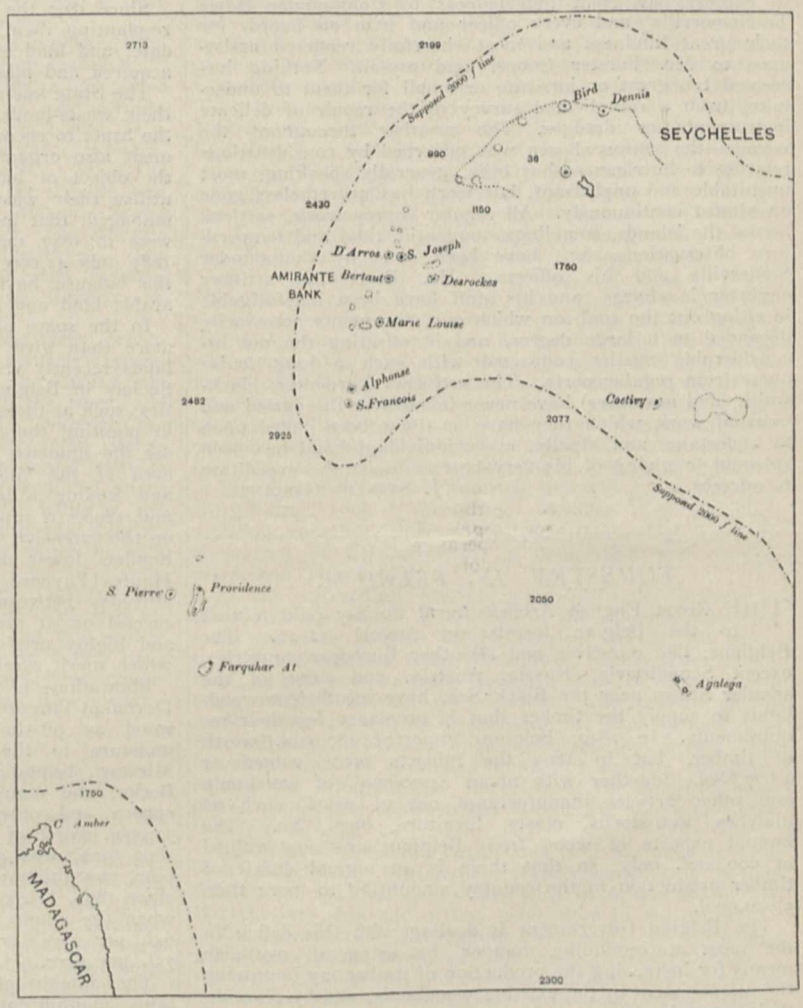

FIG. 1.—Chart of the Indian Ocean between Madagascar and the Seychelles.

[1] If we had had any idea of this earlier, we should have probably visited Cosmoledo and perhaps Aldabra.

proximity of Africa and the Seychelles being relatively few. The marine fauna and flora was markedly richer than even at Coetivy.

Of other work, we have taken about sixty dredgings off the islands we visited down to more than 800 fathoms, and tow-nettings at various depths to more than 1000 fathoms. We have consequently rich collections, but obviously no estimate of them can be at present formed. We have also serial temperatures in a series of positions, and water samples have been taken throughout down to various depths. Magnetic observations have also been secured at intervals along the line between Madagascar and the Seychelles.

As we are now leaving H.M.S. *Sealark*, I would like to express our great indebtedness to Commander Boyle T. Somerville and every officer and man on board for their great kindness and most cheerfully rendered assistance to Mr. Forster Cooper and myself. Nothing has seemed too great or intricate or small for them to undertake, from a complicated survey to the repair of delicate instruments or dredges. The weather throughout the voyage—the season chosen was governed by considerations relating to hurricanes—has been, generally speaking, most unsuitable and unpleasant, but work has nevertheless gone on almost continuously. All regular survey work, sections across the islands, soundings, magnetic, tidal and temperature observations, &c., have been done by Commander Somerville and his officers. Mr. Beer, the artificer engineer in charge, and his staff have been indefatigable in eking out the coal, on which our movements necessarily depended to a large degree, and in effecting the not inconsiderable repairs connected with such a long cruise away from regular ports. The artificers (carpenter, blacksmith, and armourer) have never failed over the varied and unusual work which they have at times been called upon to undertake, and, finally, every individual hand has been splendid in giving of his very best to assist the expedition to success.

J. STANLEY GARDINER.

FORESTRY IN BELGIUM.

THE Royal English Arboricultural Society paid a visit to the Belgian forests on August 12–22. The Belgians, like ourselves and all other European countries, except Scandinavia, Russia, Austria, and some of the smaller States near the Black Sea, have insufficient woodlands to supply the timber that is necessary for their requirements. In 1840, Belgium imported 187,920*l.* worth of timber, but in 1893 the imports were valued at 4,677,880*l.*, together with about 1,200,000*l.* of wood-pulp and other articles manufactured out of wood, such as matches, gun-stocks, masts, furniture, bark, &c. The annual exports of wood from Belgium are now valued at 600,000*l.* only, so that there is an annual deficit of timber production in the country amounting to more than 5,000,000*l.*

The Belgian Government is dealing with this deficit in the most statesmanlike manner, by using all available means for increasing the production of timber, by improving the management of the existing woodlands, and by planting their waste-lands.

The areas of woodlands in Belgium, according to the agricultural statistics of 1895, are as follows:—

Nature of proprietor	Area in acres
State	62,600
Communes	395,455
Public establishments	17,380
Private owners	828,300
Total	1,303,735

The area of forests in Belgium is therefore about one-sixth of the total area of the country.

The small area of the Belgian State forests is chiefly due to the fact that, between 1815 and 1830, when the country was united to Holland, the Government sold all the State forests, and the present area of State forests has been bought back from private owners through the wise policy of the first king, Leopold I.; this has been continued recently by the present Government, which purchases suitable private woodlands whenever they are for sale.

In 1850 there were the following areas of waste-land in Belgium; I have not been able to obtain more recent figures:—

	Acres
State	17,140
Communal	145,267
Private	423,322
Total	585,729

Since 1897 the State has been acquiring waste-lands and re-planting them, 212,960*l.* having been so invested up to date, and land to the extent of 15,317 acres having been acquired and planted.

The State has no power of compelling communes to plant their waste-lands, but important subsidies are granted by the State to encourage them to do so. The Forest Department also organises annual sylvicultural conferences with the object of inducing communes and private owners to utilise their waste lands. This has been so successfully managed, that in the province of Luxemburg, where there were in 1847 126,000 acres of waste-land, by the end of 1887 only 42,000 acres of waste remained in the province, the balance having been converted into 49,000 acres of arable land and pastures and 35,000 acres of woods.

In the space of this short article it is impossible to do more than give a mere sketch of the interesting woodlands recently visited by the Royal English Arboricultural Society in Belgium. It would interest British municipalities, such as those of Liverpool and Leeds, that are engaged in planting the catchment areas of their waterworks, to see the immense tract of woods that cover the catchment area of the Gileppe, a stream rising in the Ardennes and feeding a large reservoir, constructed between 1869 and 1898, to supply water for the population that carries on the extensive woollen industry in Verviers and the other hamlets lower down. The planting with spruce of the Hautes Faynes, or peat district of the Hertogenwald, at altitudes between 1600 and 2160 feet, which is being carried on at the rate of 1000 acres annually, is a vast and highly original work, the rapidity and excellence of which merit careful study.

Plantations of Austrian pine on the very dry and hot Devonian limestone rocks, near Rochefort, supply valuable wood as pit-timber, and afford shelter and increased moisture to the neighbouring farms. The domain of Mirwart, belonging to an Antwerp family named von der Becke, and managed by Dr. Schlich, where millions of spruce and other trees have been planted to replace 32,000*l.* worth of inferior timber that was cut out between 1892–1902, was also visited. Here, forty acres of Scots pine, now thirty years old, has already yielded in thinnings, since 1891, 11*l.* per acre net, while in another eight years, when the whole will be felled as pit-timber, it will yield 64*l.* per acre, or a total return, including thinnings, of 75*l.* per acre.

The domain of Chenoy, belonging to Mr. Boël, contains magnificent beech, oak, and ash standards over coppice. The underwood is sold as pit-timber. Oak trees containing 100 to 140 cubic feet (solid measure) are not uncommon, and some of the ash standards are quite as large. These trees sell standing at 2*s.* and 2*s.* 6*d.* per cubic foot. Abeles (*Populus alba*) up to 80 feet in height are not uncommon, and sell at 9*d.* per cubic foot. It is a curious feature of these woods that whenever the aspect is south or west, the poor Tertiary sandy soil (Bruxillien), from which the fertile superficial loam has been washed, will yield only pines or birch, while immediately the aspect changes to north or east, and the loam remains *in situ* over the sand, splendid broad-leaved woods are produced. In the valleys, Silurian rock crops out from below the sand, all the usual intermediate strata being absent. There we saw a considerable area of Scots pine wood, about forty years old, the trees of which are being pulled up by their roots by a machine, "La

déracineuse Lobo." This operation costs 4*d*. per tree uprooted; but the poles are thus a foot longer than those that are simply felled, and the roots are used for fuel, while the land can be at once planted, without waiting three years from fear of the pine-weevil (*Hylobius abietis*), which otherwise breeds in the stumps, and then destroys the young crop planted to replace the felled trees.

The last forest visited by the society was the Forêt de Soignes, one of the most magnificent beech forests in Europe. The oldest crops consist of columnar beeches 130 years old, 130 to 140 feet high, averaging 4½ feet in girth at chest height, and containing per acre 7000 cubic feet (quarter-girth measure). This forest of 10,210 acres yields a net annual revenue of 18,000*l*. for timber alone; the game, chiefly roebuck, rabbits, and pheasants, is fully worth 4*s*. an acre, but is retained for the King.

The geographical arboretum at Tervueren merits special attention. Here, 75 acres of good undulating loamy land, with a crop of small oak and other saplings, which serve as a shelter-wood, are being planted with exotic trees. The whole area is subdivided into the Old and New Worlds, and each of these into smaller sections, representing countries running from north to south. Thus the "New World" is first subdivided into the Pacific and Atlantic regions, and the former into Alaska, Rocky Mountains, Pacific coast region, and Chile. The Atlantic region into Canada and the Alleghany Mountains. The Old World comprises Northern, Central, and Eastern Europe, Siberia, Caucasus, the Himalayas, Japan, and N. China.

In each of these regions the characteristic trees, broad-leaved and conifers, are planted in their natural mixture. It is also intended to plant among them the shrubs and herbaceous plants that naturally grow with the trees, and this has already been done for Japan. Mr. Bommer, the curator of the Botanic Museum at Brussels, is in charge of this arboretum. He has an extensive forest nursery where he rears the necessary plants. This bold and scientific design is due to the initiative of the King of the Belgians, who has presented the State with the splendid domain of Trevueren, the management of which he still controls.

The Director-General of Forests, Mr. Dubois, has certainly organised the administration of the Belgian forests in a remarkably progressive way, and the system he has adopted in Belgium is probably more suited than those of France and Germany for the future development of forestry in Britain. W. R. FISHER.

THE CAPE GEOLOGICAL SURVEY.[1]

THE presentation of the ninth annual report of the Geological Commission of the Cape of Good Hope will be welcomed by all interested in the prosperity of one of our oldest colonies in Africa. We have been so long accustomed to see similar surveys started and then abandoned before sufficient information had been obtained to yield permanent results that we were afraid that the publication of this report might possibly have been postponed. The past record of surveys of Cape Colony has, indeed, been a dismal one, so hampered have they been in their prosecution, so undervalued have been the results. Fortunately, necessity knows no law, and there are few portions of Africa which do not possess a more or less fully equipped geological survey.

A considerable amount of new and useful knowledge was obtained in Cape Colony during 1904, though the results are not so complete as they doubtless would have been if lack of funds had not prevented the continuation of the survey in important areas, but where the cost of hired transport was found to exceed the limit of the grant voted for the survey.

In the introduction by the director the main results obtained during the past year are recorded, but all too briefly. How little is known of the different rock groups even in these southern and best known regions of Cape Colony is shown by the discovery of a new set of rocks, termed Nieuwervst series, which are found to be newer than the Ibiquas and Malmesbury series, but older than the Table Mountain Sandstone. The succession in southern Cape Colony, the type region for South Africa, is thus being brought into closer approximation with that of northern Cape Colony and the Transvaal, with a result that cannot fail to be beneficial to both. Further, a closer parallelism is found to exist between the geological history of South Africa and the southern continents than zoologists and geologists dared to hope, but on which each alike confidently felt would be the case.

In the detailed account Mr. Rogers describes the geology of the north-western part of Van Rhyns Dorp. Among the Malmesbury beds a characteristic feature consists of the abundance of crystalline limestones intercalated between slates and phyllites. The account of the intrusive granites and the metamorphic rocks with the associated sillimanite-cordierite schists contains much of interest. The Ibiquas series and the unconformably overlying Nieuwervst series deserve close attention, owing to the light they will probably throw on the Transvaal succession.

In the district of Long Kloof Mr. Schwarz finds the geology to be highly complicated by folding. A somewhat fanciful explanation is offered to account for the elevation of the mountains in this area being no greater than in the less folded regions composed of the same rocks.

In the description of the geology of Aliwal North, Herschel, Barkly East, and part of Wodehouse, Mr. du Toit enters into much detail concerning the stratigraphy and composition of the Upper Karroo beds and the volcanic phenomena associated with them. A great addition to our knowledge of the sedimentary and volcanic beds of the Stormberg series will here be found. By means of the special reptilian contents in the upper portion of sandstones, red and purple shales, mudstones and clays, it has been found possible to subdivide the great thickness of the Beaufort series. For this superior group the term Burgersdorp beds is proposed. Besides their abundant reptilian contents, they are further interesting from the occurrence of Lepidodendron in association with Glossopteris and Thinnfeldia.

In the succeeding Stormberg period chief interest is centred in the careful description of the volcanic outbursts, more especially of that of the volcanic necks. Of these, thirteen are recorded from Wodehouse, twenty from Barkly East, and twenty-two from Herschel, those in Aliwal North being left for further investigation. The description includes most reasonable hypotheses for the formation of the different types of rock infilling the necks. The immense flows of lava and numerous dolerite intrusions receive due attention, the intrusion of the dolerites being placed somewhere between the Middle Jurassic and Lower Cretaceous.

Questions of economic importance will be found to have been thoughtfully considered. It is disappointing to find that so far the coal seams met with in Aliwal North and Herschel are thin and of less value than in the south.

The introduction throughout the report of black and white geological maps of the areas surveyed with a sufficient number of place-names enables the reader to follow the various descriptions with ease. The absence of headlines, and the want of a copious table of contents, constitutes a drawback to the general reader, particularly where the report deals with petrological descriptions.

Those persons who consider that the work of a national survey should be primarily devoted to the economic aspect of the inquiry will doubtless be disappointed at the apparent poverty of the commercial results obtained by the Survey since the date of its commencement in 1896. The explanation is obvious. A national survey cannot be formed for a particular section of the community interested in the discovery of gold, coal, or diamond fields. It is, however, expected of such a survey, and that of the Cape fully realises the expectation, that the maps and memoirs it publishes should represent the most trustworthy and technical information it is possible to obtain as to the geological structure of the country it professes to examine, and on which the practical man who follows must and does base his conclusions. W. GIBSON.

[1] Ninth Annual Report of the Geological Commission of the Cape of Good Hope. Pp. 181. 1904. (Cape Town, 1905.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The list of the scholarships awarded at the twelve larger colleges was issued last Saturday. Excluding exhibitions, sizarships, and subsizarships, the amounts of which are uncertain and the number in many cases undetermined, the amount given away in the twelve colleges amounts to 5430*l.* The seven colleges, Pembroke, Caius, King's, Jesus, Christ's, St. John's, and Emmanuel, gave away sixty scholarships of a total value of 3380*l.*; whilst the Trinity group, consisting of Trinity, Clare, Trinity Hall, Peterhouse, and Sidney, gave away 2500*l.* for thirty-seven scholarships.

The total amount in the former group given for classics is 1560*l.*, for mathematics 1000*l.*, and for natural sciences 620*l.*, the number of scholarships being:—in classics twenty-six, in mathematics seventeen, and in science twelve. The proportion of science to the other subjects is better in the group of five colleges, for their science scholarships numbered ten of a value of 560*l.*, as opposed to sixteen scholarships in classics the total value of which amounted to 880*l.* We have left out of account the comparatively small sum of 340*l.* which was given for history, Hebrew, and modern languages.

DR. H. A. WILSON, senior lecturer in physics at King's College, London, has been appointed professor of physics at the college in succession to Prof. W. G. Adams, who resigned last July.

REUTER'S correspondent at Tokio reports that the resignation of the Japanese Minister of Education has been accepted, and the differences between the university and the Government have thus apparently been settled. Count Katsura, the Premier, has taken the portfolio of education, while retaining the Premiership. The resignations tendered by the professors have not been accepted.

IN a paper read at the American Mining Congress at El Paso, Texas, on November 14, Mr. V. C. Alderson, president of the Colorado School of Mines, urged mining schools to go beyond mere instruction and to enter the field of research. There was not at present, to his knowledge, a mining school in the United States which had a department of research in good working order. There should, he considered, be such a department at a State mining school to work in conjunction with the State Bureau of Mines.

MR. E. ROBINSON, of Boncath, opened a discussion on the question of the establishment of a school of forestry for Wales at the annual meeting of the agricultural society of the university college at Aberystwyth. He said that, if the seven Welsh counties affiliated to the college would vote on an average 300*l.* each and give an annual subsidy of 100*l.* each for eight years, the proposed school of forestry after that period could easily be made self-supporting. The Government, he urged, must come forward to second the efforts of the county councils by advancing money to landowners at a reasonable rate of interest. Mr. J. Herbert Lewis, M.P., said that the question of afforestation is rapidly becoming one of national concern. A departmental committee has made it clear that a shortage in the world's supply of timber may be looked for in the near future, and that millions of acres of waste land in the United Kingdom are suitable for afforesting. Our large municipalities could do much, following the example of the Liverpool Corporation at Vyrnwy, by afforesting the catchment areas of their waterworks.

SCARCELY a week passes without the announcement of substantial gifts to one or other of the universities of the United States. In addition to those mentioned in NATURE of last week, *Science* announces the following donations:—Mrs. Phoebe Hearst has presented to the California State University her archæological and anthropological collection from all parts of the world. It has cost more than 80,000*l.*, and with it she presents to the university 12,000*l.* for the maintenance of a department of anthropology. Hope College, Holland, Mich., recently received 20,000*l.* from Mr. Ralph Vorhees, of Clinton, N.J. A new chemistry hall has been erected for the university of North Carolina by a legislative appropriation of 10,000*l.* Mrs. Clara C. Jacobus has given 5000*l.* to found a fellowship at Princeton University, to be conferred on the graduate student who has reached the highest excellence in his work during the previous year. An anonymous donor has given 2000*l.* to establish a fellowship in chemistry. Mr. Henry B. Loomis has given 2000*l.* to the scientific school of Yale University to establish a fellowship in chemistry.

THE council of the Association of Technical Institutions has issued a report of an inquiry as to the cooperation of employers and technical institutions. A form of inquiry was sent to each of the sixty-five institutions affiliated to the association, to technical institutions and university colleges not thus affiliated, and to some of the large employers of labour whose educational work with their employees was not likely to be connected with the various technical institutions already approached. The answers received to the questions asked on the form of inquiry are analysed under several headings, among which may be mentioned the trades to which the scheme of cooperation applies, the number of students affected by the scheme, the payment of class fees, the provision of books, and leave of absence to attend classes. The report, in its summary of the results of the inquiry, states that if regarded from the point of view of how few of the army of masters appear to interest themselves at all in the technical education of their workers, the record cannot be other than disappointing, especially in view of the different attitude of employers on the Continent and in the United States. On the other hand, if looked at in comparison with the attitude of employers ten years ago, the result is most hopeful. It is interesting in this connection to note that in distributing prizes to the students of the Gateshead higher evening classes, Sir Isambard Owen suggested that it would pay employers to enable their apprentices to work shorter hours by day on condition that they availed themselves of the opportunities for evening instruction. Continuing, he said the great desire of the Plumbers' Company is now to adopt measures for advancing the apprenticeship system, in view of the indisposition of employers, who are keenly competing with each other to obtain plumbing work at a profit, to burden themselves with apprentices, thus ignoring the importance of training the coming generation of plumbers. This pressure of commercial interests over the craftsman spirit constitutes a serious menace to efficiency, not only in the plumbing trade, but in other skilled industries.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 16.—"The Physical and Chemical Properties of Iron Carbonyl." By Sir James **Dewar** and H. O. **Jones.**

The paper contains an account of a study of the properties of iron pentacarbonyl, which has been carried out on the same lines as the previously published investigation on nickel carbonyl. Attention has been directed more particularly to the differences between the iron and nickel carbonyls, such as the difference in formulæ $Fe(CO)_5$ and $Ni(CO)_4$, colour (the iron compound is yellow and the nickel compound is colourless, whereas the salts of the latter metal usually show a much more marked colour than those of the former), and stability, and to the action of light on iron carbonyl.

Pure iron carbonyl is a yellow liquid, which boils at 102°·5 C. and freezes at −20° C. to a yellow solid, which becomes colourless at −180° C. Analysis, vapour density determinations, and molecular weight determinations by the cryoscopic method in benzene show that its formula is $Fe(CO)_5$.

The specific gravity of the compound is 1·4937 at 0° C. and 1·3825 at 60° C.; its critical temperature is 288° C.

The formula $v = 1·974 - 0·5307 (\log 288 - t)$ expresses the relation between the volume of the liquid v and the temperature t° C.

The relation between the vapour pressure p in millimetres of mercury and the absolute temperature T is expressed by the Rankine formula $\log p = 7·340 - 1681/T$.

The critical pressure is calculated to be 29·6 atmospheres, and the critical density 0·49.

The value $\frac{\text{abs. critical temperature}}{\text{critical pressure}}$ is 18·9; this is proportional to the volume of the molecule, and is equal to 5·1 times the corresponding number for carbon monoxide (3·7). The molecular volume of iron carbonyl at its boiling point is 150, so that, taking 7·0 as the volume of the iron atom, 28·6 is the volume of each carbon monoxide group. The molecular volume of carbon monoxide at its boiling point is 35, therefore a greater contraction would occur in the formation of iron carbonyl from liquid carbon monoxide and iron than in the formation of nickel carbonyl under similar conditions.

Vapour density determinations by V. Meyer's method in carbon monoxide, nitrogen, and hydrogen at different temperatures show the effect of increase of temperature and the rapid diffusion of hydrogen in increasing, and of carbon monoxide in diminishing, the dissociation.

The chemical reactions of iron carbonyl are very similar to those of nickel carbonyl, but its stability is greater. Chlorine, bromine, iodine, their compounds with one another and their hydrides react with iron carbonyl giving *ferrous* salts and carbon monoxide; the reaction with bromine takes place more slowly than that between iodine and nickel carbonyl. Neither sulphur nor nitric oxide reacts with iron carbonyl, whereas both react readily with nickel carbonyl. Sulphuric acid, on the other hand, decomposes iron carbonyl more readily than it does nickel carbonyl.

Benzene in presence of aluminium chloride reacts with iron carbonyl, with cold to give benzaldehyde, and at 100° C. to give anthracene, exactly as with nickel carbonyl.

Iron pentacarbonyl alone or in solution in ordinary organic solvents is decomposed by sunlight according to the following equation, $2Fe(CO)_5 = Fe_2(CO)_9 + CO$. The second compound of iron and carbon monoxide is deposited as an orange, crystalline solid from most solvents, but is retained in solution by pyridine. The reaction takes place rapidly under pressures of carbon monoxide up to 150 atmospheres, and yet is very slowly reversed in the dark under small pressures of carbon monoxide. This decomposition takes place slowly at the temperature of liquid air, but if the iron pentacarbonyl or its solutions be heated to any temperature above 60° C., then no solid is deposited and no decomposition occurs. Solutions of iron carbonyl in nickel carbonyl at the ordinary temperature undergo no decomposition and no solid is formed unless the solution contains more than 30 per cent. of the iron carbonyl, when some solid is formed. These solutions are of a much lighter colour than solutions of equal concentration in other solvents, and it is suggested that the two carbonyls may unite to form a compound which is unaffected by light.

The solid iron carbonyl forms lustrous hexagonal plates having a specific gravity of 2·085; its molecular volume is therefore 174.

The solid iron carbonyl when heated alone decomposes at 100° C. into carbon monoxide, liquid iron carbonyl, which is coloured green, and iron; when heated with carbon monoxide under pressure it is completely converted into liquid iron pentacarbonyl.

If the solid iron carbonyl be heated with a solvent such as ether or toluene, a solution of an intense green colour is produced; this green solution on exposure to light deposits the yellow, crystalline, solid carbonyl again. The change from solid to green solution and back again can be repeated indefinitely by the action of heat and light alternately.

Zoological Society, November 28.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—*Exhibitions.*—Photographs of a horse bearing incipient horns: J. T. **Cunningham.** The horns were about ¾-inch in length, the left being slightly larger than the right, and there could be no doubt that they were outgrowths of the frontal bone. The growths were covered with normal skin and hair.—Photographs, taken in the Horniman Museum at Forest Hill, of a sea-anemone (*Anemonia sulcata*) in the process of division: F. **Slade.**—A living albino specimen of the field-vole (*Microtus agrestis*) captured last July in Wales: D. **English.**—A living lizard, *Lacerta muralis*, from Brozzi, province Florence, received from Dr. A. Banchi: G. A. **Boulenger,** F.R.S. The lizard belonged to the typical form of the wall-lizard, but was remarkable for its black coloration above and below. Melanistic forms of the wall-lizard were well known on small islands in the Mediterranean, but, so far as Mr. Boulenger was aware, no black specimen had ever been recorded from the mainland. The scales across the body numbered fifty-eight, and the lamellar scales under the fourth toe twenty-five in the specimen exhibited, these two numbers being sufficient to distinguish the Brozzi lizard from the melanotic insulars previously described.—A living specimen of the violet-cheeked humming-bird (*Petasophora iolota*) brought from Venezuela and presented to the society's menagerie: Captain A. **Pam.** A general account of the habits of these birds, as observed by Captain Pam, in a wild and captive state, and notes on their management and feeding while in confinement.—A named set of the birds collected in Japan by Mr. M. P. Anderson in connection with the Duke of Bedford's exploration in eastern Asia: W. R. **Ogilvie-Grant.** No new species were obtained, but several of the specimens were of special interest as illustrating stages of plumage not represented in the British Museum.—*Papers.*—A transition in the general type of colouring from the wholly black *Colobus guereza* in one direction, through several intermediate forms, towards the black and white *C. caudatus,* and in another direction towards *C. vellerosus*: R. **Lydekker.**—A mounted specimen of the white-maned serow (*Nemorhaedus argyrochaetes,* Heude), of Szechuen, the first example of the species ever received in England, and perhaps in Europe: R. **Lydekker.**—Mammals collected in Japan by Mr. M. P. Anderson for the Duke of Bedford, and presented by the latter to the National Museum: O. **Thomas.** The collection was one of the most valuable for scientific purposes which had ever been received from any one region. More than 600 specimens had been obtained, belonging to 50 species and subspecies, of which several were described as new.—A revision of the fishes of the family Galaxiidæ: C. T. **Regan.** Two genera were recognised, Galaxias and Neochanna, the latter consisting of a single species only. Twenty-eight species of Galaxias were described, including *G. attenuatus,* Jenyns, found on the coasts and in the rivers of Australia, New Zealand and Chili, Patagonia, and the Falkland Islands, and two peculiar to the Cape of Good Hope, five to New Zealand and the neighbouring islands, five to Chili, Patagonia, and the Falkland Islands, and fifteen to Australia and Tasmania. Five species were described as new to science.—The mammalian fauna of China. First paper: J. L. **Bonhote.** The present part dealt with the Murinæ, containing the genera Mus and Micromys, giving descriptions and synonymy, as well as emphasising the distinctive characters by which the various species might be easily distinguished.—Some additions to the knowledge of the anatomy, principally of the vascular system, of Hatteria, Crocodilus, and certain Lacertilia: F. E. **Beddard.**—Descriptions of 111 new species of phytophagous Coleoptera of the family Halticidæ: M. **Jacoby.**

Chemical Society, December 7.—Prof. R. Meldola, F.R.S., president, in the chair.—The constitution of nitrites, part i., two varieties of silver nitrite: P. C. **Rây** and A. C. **Gañguli.** The α variety of silver nitrite is prepared by double decomposition between solutions of silver nitrate and sodium nitrite. The β variety is obtained by dissolving the α variety in boiling water, and from the hot saturated solution the nitrite is allowed to crystallise. The two forms show differences in crystalline structure and mode of decomposition by heat.—The products of heating silver nitrite: E. **Divers.** The author, while accepting Rây and Gañguli's experimental data, dissents from the view that these are two forms of silver nitrite.—A contribution to the chemistry of benzoic sulphinide: F. D. **Chattaway.** When chlorine is passed into a solution of the sodium salt of saccharin, *o*-benzoic *N*-chlorosulphinide or chloroiminosaccharin is precipitated. An account of the properties of this substance is given.—The action of heat on α-hydroxycarboxylic acids, part ii., α-hydroxymargaric acid, α-hydroxypalmitic acid, α-hydroxy-

pentadecylic acid, and α-hydroxymyristic acid: H. R. **Le Sueur.** The aldehydes obtained by the pyrogenetic decomposition of these acids are white solids, readily soluble in the ordinary organic solvents; they form oximes, semicarbazones, hydroxycyanides, and are oxidised to the corresponding acids.—Studies on optically active carbimides, part ii., the reactions between *l*-menthylcarbimide and alcohols: R. H. **Pickard,** W. O. **Littlebury,** and A. **Neville.** *l*-Menthylcarbimide reacts readily with alcohols, and fourteen of the latter have been shown to yield *l*-menthylcarbamates. These reactions have been studied polarimetrically, and the velocity constants of reaction so obtained compared.—The liberation of tyrosine during tryptic proteolysis. A preliminary communication: A. J. **Brown** and E. T. **Millar.** The authors have applied Millar's method of estimating tyrosine by means of bromination to the study of the tryptic hydrolysis of proteids, and find that tyrosine is one of the first products of such action. The quantitative study of proteolysis in this way may throw some light on the existence or non-existence of a tyrosine nucleus in different albuminoses.—Ethyl piperonylacetate: W. H. **Perkin,** jun., and R. **Robinson.** A description of the preparation of this ester from piperonylic acid.—The action of ultra-violet light on moist and dried mixtures of carbon monoxide and oxygen: S. **Chadwick,** J. E. **Ramsbottom,** and D. L. **Chapman.** It was found that under the action of the rays emitted from a quartz mercury lamp a dry mixture of these gases was largely, but somewhat irregularly, converted into carbon dioxide and ozone. With *moist* gases the rate of conversion was slower and more uniform, and more carbon dioxide was formed and less ozone.—Benzoyl derivatives of salicylamide: A. W. **Titherley.**—The constitution and colour of diazo- and azo-compounds: A. **Hantzsch.** A criticism of Armstrong and Robertson's paper, "The Significance of Optical Properties as Connoting Structure" (*Journ. Chem. Soc.*, 1905, 1272–1297).—Note on the incandescent mantle as a catalyst and its application to gas analysis: J. E. **Mason** and J. **Wilson.** The authors describe a modification of Lewes's method (*Chem. News*, 1905, xci., 61) for showing the incandescence of the mantle in an unburnt mixture of alcohol vapour and air. Although less effective, the mantle may be used as a substitute for platinised asbestos in the ordinary lecture experiments for preparing formaldehyde from methyl alcohol vapour and air, and sulphur trioxide from sulphur dioxide and oxygen, and various applications of mantle fragments to the analysis of mixtures of hydrocarbon gases by combustion are given.—The influence of certain amphoteric electrolytes on amylolytic action: J. S. **Ford** and J. M. **Guthrie.** The results of an investigation of the influence of various amino acids on amylolytic action are given.—The estimation of picric acid additive compounds: F. S. **Sinnatt.** The method of Knecht and Hibbert (*Ber.*, 1903, xxxvi., 1549) for the estimation of picric acid by means of titanous chloride has been found to be applicable to picrates and to picric acid additive compounds.—Silver dioxide and silver peroxynitrate: E. R. **Watson.** The author has analysed the anodic product formed during the electrolysis of solutions of silver nitrate, and finds that its composition was correctly represented by Sûlc's empirical formula $Ag_7O_{11}N$. This compound on boiling with water decomposes, forming silver dioxide, a greyish-black powder which may be heated to 100° without decomposition.—The constitution of *o*-hydroxyazo-compounds. Preparation of benzeneazodimethylcoumarin: J. T. **Hewitt** and H. V. **Mitchell.**—Caro's permonosulphuric acid: T. S. **Price.** The author has obtained a mixture containing the potassium salts of sulphuric, permonosulphuric, and perdisulphuric acids. The results obtained by the analysis of this mixture point to the formula H_2SO_5 for Caro's acid.

Royal Astronomical Society, December 8.—Mr. W. H. Maw, president, in the chair.—Account of the results of his recent investigations relating to sun-spot periods: Prof. A. **Schuster.** Besides the recognised 11- or 11¼-year period, the author found various subsidiary periods which recur with great regularity, but which sometimes disappear. A period of about 4¾ years could be traced back to 1749, and other periods of about 8½ and 13 years were also indicated. Possible explanations of the peculiarities of these periods were suggested.—On the astronomical observations recorded in the Nihongi, the ancient chronicle of Japan: E. B. **Knobel.** The astronomical observations contained in this work comprise eclipses of sun and moon, occultations, conjunctions, comets, meteors, &c., and range from A.D. 620 to A.D. 696. There is great difficulty in fixing the dates of the observations owing to the complicated system of chronology, borrowed from China. The year is a lunar one of twelve months of twenty-nine or thirty days, and an intercalary month every thirty-third month, or seven intercalary months in the lunar cycle of nineteen years. The rules for intercalary months are very complicated, and there is therefore much difficulty in reducing the dates to European chronology. Most of the recorded eclipses agree with Oppolzer's tables when the dates are properly reduced.—On the present state of lunar nomenclature: S. A. **Saunder.** The paper showed the anomalies and irregularities in the present system, resulting in difficulties of identification in the case of many of the smaller features on the moon which had been selected as points for exact measurement. It was suggested that a committee should be formed to revise the present system of lunar nomenclature.—Photographs of comet *d* 1905 taken with the 30-inch reflector of the Royal Observatory, Greenwich, shown by Prof. F. W. **Dyson.**—Comparison of the results from the Falmouth declination and horizontal force magnetographs on quiet days in years of sun-spot maximum and minimum: Dr. C. **Chree,** F.R.S.—The president announced that the Rev. C. D. P. Davies was giving a demonstration of his system of testing parabolic mirrors.—Other papers were taken as read.

Mathematical Society, December 14.—Prof. A. R. Forsyth, president, in the chair.—Some difficulties in the theory of transfinite numbers and order types: the Hon. B. A. W. **Russell.** The paper deals with the difficulty as to "inconsistent aggregates" and with the question concerning the axiom that every aggregate can be well ordered. It is shown that the difficulties belong rather to logic than to mathematics, and various methods are explained by which steps may be taken towards resolving them.—On well-ordered aggregates: Prof. A. C. **Dixon.**—The Hessian configuration and its connection with the group of 360 plane collineations: Prof. W. **Burnside.** The configuration is that of 9 points in a plane which lie 3 by 3 on 12 straight lines. The first part of the paper is occupied with the establishment of the configuration, and of the nature of the group for which it is invariant, from a geometrical point of view. In the second part it is shown how to construct a configuration of 45 points which lie 5 by 5 on 36 lines, 4 by 4 on 45 lines, and 3 by 3 on 120 lines. From the 45 points 10 Hessian configurations can be formed, and any two of these have one point in common. The configuration is invariant for a group of 360 collineations, which is simply isomorphic with the alternating group on six symbols.—On the representation of certain asymptotic series as convergent continued fractions: Prof. L. J. **Rogers.** The paper is concerned with asymptotic series which represent integrals of the type $\int_0^\infty f(t)e^{-t/x}dt$, where $f(t)$ is a polynomial or is representable by a power series.—The theory of integral equations: H. **Bateman.** The theory is that of the construction of a function ϕ which shall satisfy an equation of one of the forms

$$(1)\quad f(x)=\int_a^b \kappa(x,t)\phi(t)dt,$$

$$(2)\quad f(x)=\phi(x)-\lambda\int_a^b \kappa(x,t)\phi(t)dt,$$

where f and κ denote known functions and λ is a constant. It is shown how to reduce the solution of a linear differential equation to an integral equation of the second type, and that, if is discontinuous in a certain way, a solution of the equation of the first type exists and can be determined.—The imaginary in geometry: J. L. S. **Hatton.**—On a new cubic connected with the triangle: H. L. **Trachtenberg.**

Anthropological Institute, November 21.—*Exhibitions.*—Collection of photographs from Arizona: J. S. **Chase.** These included typical types of the natives, and also illustrated the Mogui snake dance and other ceremonies.—Collection of objects from Siam, including weapons, pottery, and musical instruments: M. **Bidder.**—*Paper.*—Boomerangs: N. W. **Thomas.** The author explained the difference between the return and non-return boomerang, and showed the reasons for the peculiarity of the former kind. Diagrams of the different flights were exhibited, as well as a large collection of Australian boomerangs and African throwing knives.

CAMBRIDGE.

Philosophical Society, November 13.—Prof. Liveing in the chair.—Polarisation phenomena at Guelma in the eclipse 1905 August 30: H. F. **Newall**, F.R.S. The visual observations combined with the photographic records proved that the plane of polarisation of the light diffused by the earth's atmosphere during the eclipse was very nearly horizontal. Photographic records, obtained with a Savart polariscopic camera for the purpose of quantitative measurements of the relative amounts of polarised and unpolarised light in the corona, showed that the polarised portion of the atmospheric light was equal in intensity to the radially polarised portion of the coronal light at a distance of about $1\frac{1}{2}$ diameters from the sun's limb. Thus the phenomena of a radially polarised corona seen through a plane polarised atmosphere are somewhat complicated. The results obtained by photographing the corona through a large Nicol prism, which was set to transmit successively the vertical component and two components which were inclined on each side at 45° to the vertical and consequently perpendicular to one another, not only show the strong radial character of the polarisation of the corona, but also seem to suggest that there is a selective action, and that the prominent streamers of the corona are markedly polarised. A photograph taken with a new form of polarising spectrograph shows a very marked difference in the intensities of the tangential and radial components; but a curious feature in it is that the Fraunhofer lines are not detected in either spectrum, though the conditions are such as must be regarded as very favourable for their detection.—Suggestions for a theory of the Milky Way and the clouds of Magellan: A. R. **Hinks.**—The effect of the lunar deflection of the vertical on latitude observations: B. **Cookson.** The attraction of the moon would cause the plumb-line to be deflected through an angle of $0''{\cdot}02$ at a maximum, if the earth were a rigid body. It is pointed out that observations made for the purpose of determining the constant of aberration and variation of latitude by Küstner's method are suitably arranged for showing this deflection. A series of observations made at Philadelphia is discussed, but fails to show the direct lunar effect, though it shows an oscillation with a period of half a lunar day, which may be due to the attraction of the ocean tides.

November 27.—Prof. Marshall Ward, president, in the chair.—Some experiments on Canal-strahlen: Prof. **Thomson.** Experiments were described showing that when the stream of positive ions which form the Canal-strahlen fall on a solid, slowly moving kathode rays start from the part of the solid struck by the positive ions; again, metals struck by the Canal-strahlen disintegrate, and the metal is deposited on the walls of the discharge tube; ionisation was shown to accompany the passage of the Canal-strahlen. It is suggested that the reason the α particles of radium lose, as shown by Rutherford, their power of ionisation when their energy falls to a value which, though less than the initial energy possessed by the α particles, is enormously greater than the positive ions in the Canal-strahlen, may be that the α particles lose their charge when their velocity falls below a certain value by combining with a negative corpuscle; the value of this velocity is calculated, and it was shown to be between 10^8 and 10^9 cm.-sec. The spectra produced by Canal-strahlen were discussed, and it was shown that though these rays give rise to the sodium lines when they fall upon sodium salts, they do not do so when they fall upon the pure metal.—Experiments on the retention of an electric charge by gases: W. A. D. **Rudge.**—The effect of hydrogen on the discharge of electricity from hot platinum: O. W. **Richardson.** An account of experiments on the ionisation produced by a platinum tube in air when hydrogen was allowed to diffuse from inside the tube. The negative ionisation was unaffected, whereas the positive was increased by an amount proportional to the quantity of hydrogen diffusing through. The experiments indicate that the increase in the negative leak produced by an atmosphere of hydrogen is due to a change produced by the latter in the surface of the metal, possibly by the formation of an electrical double layer. The experiments on the positive ionisation tend to show that the hydrogen dissolved in the metal is in the form of positive ions.—On colour-inheritance in rats: L. **Doncaster.** Among the varieties of domestic rats there are, in addition to albinos, two types of colour, black and brown (grey). The colour in either case is distributed in one of three very constant patterns; rats may be (*a*) self-coloured, with or without a small white mark on the chest; (*b*) coloured above and white below; (*c*) piebald, with coloured "hood" and back-stripe, elsewhere white. In inheritance, brown is dominant over black, and both over albino. Albinos may bear the black or brown determinant, as in mice, rabbits, &c. When a self-coloured rat is crossed with a piebald, the young have the intermediate pattern (*b*); this is a heterozygous form, and when two of this type are bred together they throw selfs, piebalds, and heterozygous young like themselves. Albinos can also bear pattern-determinants, so that an albino bearing "self" bred with a piebald throws heterozygous young of type (*b*). Self-coloured rats may be entirely coloured or may have a white mark on the chest, but since either form can throw the other, it appears that this is a fluctuating character, and that the pure "self" and white-marked form are not allelomorphic with one another.—A preliminary communication on the life-history of *Pleistophora periplanetae* (Lutz and Splendore): W. S. **Perrin.**—On the osmotic pressure of alcoholic solutions: P. S. **Barlow.**—Two wheels connected by an axle rolling on a rough horizontal plane: G. M. K. **Leggett.**—A series of optically active nitrogen compounds containing the allyl group: Miss M. B. **Thomas** and H. O. **Jones.** The investigation of the relation between the constitution and rotatory power of substituted ammonium ions is being continued. A series of five compounds containing the phenyl, methyl, and allyl groups, together with the ethyl, propyl, isopropyl, isobutyl, and isoamyl groups respectively, has been examined.

PARIS.

Academy of Sciences, December 11.—M. Troost in the chair.—On the distillation of gold, the alloys of gold with copper and tin, and on a new method of preparation of the purple of Cassius: Henri **Moissan.** Gold can be easily distilled in the electric furnace, its boiling point being higher than that of copper, but lower than that of lime. By condensation on a cold tube, the vapour is condensed partly in the form of moss gold, partly as microscopical crystals. The general properties of the condensed gold agree with those of finely divided gold. In the alloys of gold and copper, or gold and tin, the copper and tin distil before the gold. By distilling an alloy of tin and gold, a purple of Cassius is obtained in the dry way.—Nepheline syenites from the Los Islands (French Guinea): A. **Lacroix.** The various types of syenite in these islands are discussed in detail, and complete analyses are given for three typical specimens.—The habits of bees and the colours of flowers: Gaston **Bonnier.** According to the author, the contradictory experiments of various observers on the relations between bees and colour are due to a lack of knowledge of the habits of bees. There is a division of labour among the honey-fetching bees, the duty of those first issuing from the hive being to seek out honey, and not to fetch it. After a certain hour all the bees are engaged in fetching and carrying, and none in hunting for fresh sources of honey, and hence in selective experiments of this sort quite different results can be obtained according to the hour of the day fixed for the experiment. The author's own experiments lead to the conclusion that the bees are not influenced by colour in their search for honey.—Spectroscopic observations made during the eclipse of the sun of August 30, 1905: P.

Salet. The spectrum of the prominences showed lines characteristic of helium, coronium, hydrogen, cerium, titanium, calcium, and iron.—On the new Giacobini comet: M. **Giacobini.** Observations and elements of a comet discovered at Nice on December 6.—On the convergence of the regular continued fractions of the function $F(h,1,h',u)$: H. **Padé.**—On the problem of the motion of a homogeneous fluid ellipsoid all parts of which attract each other according to the law of Newton: W. **Stekloff.**—The theory of a solitary wave which is propagated along a horizontal elastic tube: A. **Boulanger.**—The evaluation of the magnifying power of microscopic objectives: L. **Malassez.**—On the co-existence of paramagnetism and diamagnetism in the same crystal: Georges **Meslin.** Experiments are described proving the existence of both para- and diamagnetism in the same crystal of pyrrhotine, and the continuous variation of the magnetic susceptibility with the direction.—The action of a magnetic field on the Goldstein rays (Canal-strahlen): Henri **Pellat.** Some curious and somewhat paradoxical experiments on the Goldstein rays are described. In magnetic fields of low intensity the rays behave exactly like positively charged particles. As the intensity approaches 1000 Gauss, the whole tube appears uniformly luminous, and if the magnetic field is still further increased, the luminosity contracts, but the deviation is in the opposite sense to that which is produced in magnetic fields of lower intensity. The author is at present unable to offer any explanation of the phenomenon.—A new arrangement for obtaining a monochromatic image of a source of light: Albert **Nodon.**—On the solution of platinum in sulphuric acid: Marcel **Delépine.** The action of sulphuric acid containing potassium sulphate upon platinum foil has been studied. The action increases with the amount of potassium sulphate present, probably on account of the higher boiling point of the mixture thus obtained. Ammonium sulphate reduces the solvent effect.—On two iodomercurates of lithium: A. **Duboin.**—On a new compound of fluorine and bromine: Paul **Lebeau.** Fluorine unites directly with bromine giving a compound BrF_3. This trifluoride, in which the bromine may be considered as trivalent, is a colourless liquid solidifying on cooling, and melting at 4° C. The chemical activity of this substance is very great, resembling that of fluorine.—Researches on the formation of metallic lustre on the surface of pottery: L. **Franchet.**—On the bromoborates of calcium: L. **Ouvrard.**—On the limiting states of some dissolved chromic salts: Albert **Colson.**—The action of phosphorus pentachloride on β-naphthol: E. **Berger.** Phosphorus pentachloride acting on β-naphthol at temperatures below 130° C. gives a good yield of the ether, $C_{10}H_7—O—C_{10}H_7$; at temperatures above 135° C. β-chlornaphthalene is formed. The yields are not high, but on account of the low prices of the materials it forms a good preparative method.—On some derivatives of anthracene octahydride and on the perhydride of anthracene: Marcel **Godchot.**—The synthesis of dihydrocamphoric acid: G. **Blanc.**—On acetylcyclohexanone: Georges **Leser.**—Anatomical and physiological modifications produced in certain tropical plants by a change of the place of growth: D. **Bois** and I. **Gallaud.** The necessity of taking into account the anatomical changes produced by a change in the environment of a plant is pointed out, and the errors in classification which may arise. The study of the factors producing these changes is also important in the acclimatisation of plants of commercial value.—Studies on the influence of light on the development of green plants, carbon dioxide being absent and amides added to the soil: Jules **Lefèvre.**—The granular eruptive rocks collected in Grahamsland by the Antarctic expedition of Dr. Charcot: Ernest **Gourdon.**—Exploration in eastern Africa: Maurice **de Rothschild.**—On crystallised hæmatin: MM. **Piettre** and **Vila.** Crystallised oxyhæmoglobin, from the horse, was split up into an albumenoid, globin, and crystallised hæmatin, the pigmented material of the blood, analyses of the latter being given and compared with earlier analyses of amorphous hæmatin of other observers.—The moderating action of catalase on the oxidations produced by extracts from animal tissues: F. **Battelli** and Mlle. L. **Stern.**—On some mineral compounds which behave like the liquefying diastase of malt: J. **Wolff.**—The diastatic hydrolysis of xylane: Gaston **Seillière.** In some molluscs and insect larvæ there exists a diastase capable of hydrolysing xylane to xylose, and for which the name of xylanase is proposed. It is probable that this substance plays an important part in the nutrition of these animals.—The geology of the eastern Pyrenees: Léon **Bertrand.**—On Fontaine-l'Évêque and the caverns of the plain of Canjuers: E. A. **Martel** and M. Le Couppey **de la Forest.**

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 21.

LINNEAN SOCIETY, at 8.—Report on the Vienna Botanical Congress: Dr. A. B. Rendle.—*Cyrtandraceae malayanae novae*: Dr. Franz Kränzlin.—On Characæ from the Cape, collected by Major A. H. Wolley-Dod: H. and J. Groves.—Note on the Distribution of Shortia, Torr and Gray: B. Daydon Jackson.

CHEMICAL SOCIETY, at 8.30.—The Relation of Position Isomerism to Optical Activity. Part V. The Rotation of the Menthyl Esters of the Isomeric Dibromobenzoic Acids: J. B. Cohen and I. H. Zortman.—Azo-derivatives from α-Naphtho-methylcoumarin: J. T. Hewitt and H. V. Mitchell.—The Supposed Identity of Dihydrolaurolene and of Dihydro-*iso*laurolene with 1 : 1 - Dimethylhexahydrobenzene: A. W. Crossley and N. Renouf.—The Slow Combustion of Carbon Disulphide: N. Smith.

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