THURSDAY, JULY 5, 1906.

SOME RECENT PHILOSOPHY.

(1) *The World's Desires, or The Results of Monism.* By Edgar A. Ashcroft. Pp. xii+440. (London : Kegan Paul, Trench, Trübner and Co., Ltd., 1905.) Price 10*s.* 6*d.* net.

(2) *The Scientific Temper in Religion, and Other Addresses.* By the Rev. P. N. Waggett. Pp. xii+286. (London : Longmans, Green and Co., 1905.) Price 4*s.* 6*d.* net.

(3) *The Reconstruction of Belief.* By W. H. Mallock. Pp. xii+314. (London : Chapman and Hall, Ltd., 1905.) Price 12*s.* net.

(4) *The Unit of Strife.* By E. K. Garrod. Pp. v+194. (London : Longmans, Green and Co., 1905.) Price 3*s.* 6*d.* net.

(1) THE first of these volumes need not detain us. The work is dedicated, by permission, to Prof. Haeckel, and Mr. Ashcroft emulates his master in the range and discursiveness of his work. One would have thought that the "Riddle of the Universe" had settled, at least for a modern monist or realist, the majority of the topics here discussed—unless, indeed, the presence of two books in many ways so similar is a part of the riddle to which it is desirable to direct attention. We note that Mr. Ashcroft is able to tell us that "the system of Plato displays few living qualities."

(2) Mr. Waggett's work is one of the very best of its type, viz. of the books that seek to reconcile religion and science. The author's chief characteristics are his boldness and his anxiety that there should be no nervousness or hysteria among the religious-minded when their faith is confronted by the facts of science. "We ought to be positively alarmed at any appearance of unbroken agreement between religion and science." "There is not in the Bible ever any contrast between reason and faith. . . . In point of fact, faith is a kind of knowledge, and not only so, but it is the model and type of all sure knowledge." There is no theological interest, Mr. Waggett maintains, in weakening any particular theory about the physical world. In regard to the gulf between the organic and the inorganic—the classical treatment of which is a famous chapter in "Natural Law in the Spiritual World"—Mr. Waggett has already made terms even with Mr. Burke's radium experiments on sterilised bouillon, experiments on which, at the same time, he passes some acute criticisms. "Our faith would not be shaken if the gulf which lies for thought between organic and inorganic matter were for thought to be bridged; for it has never rested upon this or any other interval." Mr. Waggett is suggestive, too, in dealing with the problem of freedom, pointing out that without freedom there can be no error and no knowledge.

(3) A small part of Mr. Mallock's work was dealt with in the "Notes" columns of this journal when it appeared in the pages of the *Fortnightly Review*. Both the clerical and the philosophical attack on the negative conclusions of science have failed, Mr. Mallock declares. On the other hand, current science has no influence on practical life, and all that is best in modern civilisation is to be traced to the three beliefs of theism, viz. the belief in human freedom, in God, and in human immortality. But if the principles of science be only carried to their logical conclusion, it is clear that everything that now happens must have been pre-arranged in all previous molecular conditions of things, and that this pre-arrangement is due to mind and purpose. The last part of the work deals not unsuccessfully with the difficulties generally urged against a belief in the goodness of the Deity, and the author concludes his suggestive volume with forecasting the difficulties which Christianity has still to face—most of all, the difficulty of competing with a new religious eclecticism. Mr. Mallock is to be congratulated on a work which will undoubtedly add to his reputation.

(4) The strife of which the title of this work speaks is the struggle for existence. The title is the one ambiguity, perhaps the one defect, of what is, on the whole, a very clear and suggestive book. Its writer is concerned mainly with the problem that in man as compared with the lower creation "the quality of fitness to survive has in some way become modified"; "an agency has come into play which had not asserted itself on the same lines in the struggle for life before the appearance of man." What are the modification and the agency referred to? The answer seems to be that in man most clearly of all living things the unit in the struggle is not the individual, but the community, gradually expanding from the family to the tribe, the nation, the empire, and that in close correspondence with this development and expansion there has gone the increasing recognition of law and of some higher power, which is the kernel of all religion.

But this brief analysis almost does injustice to the closeness of the argument and the excellence of the illustrations by which the argument is enforced. The scientific analogies are not overdrawn—the great defect of some similar works—not even in one amusing passage where the author compares the walls of Babylon to the external defences of the crustacean, and points out that at a more advanced stage of development protection is given rather by moving masses acting on the offensive, just as for the most part the vertebrate organisms have abandoned the methods of the crustaceans and of insects protected by a horn-like covering.

One statement on p. 90 appears somewhat inexact. The author, showing how an ideal may lose the power of expansion by being enclosed and case-hardened, writes thus:—"Thus to the Israelite, while they retained their lofty monotheistic conception, Jehovah became the Deity exclusively of their own race. He was the Lord of Hosts who warred always on their side against their enemies." On the whole it seems wise to distinguish some things which

are here confused, the *henotheism* (as it is called) of the earlier period of Jewish history which regarded Jehovah only as one among many Gods, the one who fought on the side of the Israelites, and who ought to be worshipped by them; and, contrasted with it, the later and truly monotheistic ideal of the prophets, which emphasised the *solity* of Jehovah. It would, at any rate, be difficult to harmonise our author's account with any of the accepted readings of Jewish history, traditional or critical. Part of the page ought probably to be re-written.

TIDES AND WAVES.

A Practical Manual of Tides and Waves. By W. H. Wheeler. Pp. viii+201. (London: Longmans, Green and Co., 1906.) Price 7*s.* 6*d.* net.

THE author of this book is a well-known civil engineer, whose practice has been largely concerned with works on the sea coast and tidal rivers. The practical side of the subject treated has consequently required and received from him long and close study; his intention in this volume has been "to give as practical an account as possible, free from all mathematical demonstration, of the action of the sun and moon in producing the tides: and of the physical causes by which the tides are affected after their generation, and of their propagation throughout the tidal waters of the earth." To these subjects the principal portion of the work is devoted; in a comparatively short section the author deals also with wave phenomena, in a manner likely to be useful to practising engineers, and not lacking in interest to a much wider circle of readers. Mr. Wheeler has given much time and thought to the production of the work, and the bibliography of his subjects (contained in an appendix) indicates a wide range of reading. In the text itself a great mass of useful information and data is summarised; this is supplemented by several valuable appendices giving results of tidal and wave observations as well as formulæ of use in engineering practice. A good index makes reference easy to the principal features of the book, and adds much to its value to readers for whom it has been chiefly designed. In one particular the scheme of the author is open to criticism: he has aimed at making "the subjects dealt with in the separate chapters complete," and this has involved some repetition of statement. Probably the explanation is that in some cases papers prepared for separate publication have been embodied in the book; but although the repetition (as the author says) may have "been avoided as much as possible," his scheme for completeness in individual chapters necessarily involves it, and in a book such as this is the result is not altogether satisfactory. This is a small drawback, however, to a work of considerable merit that will undoubtedly be welcomed by the engineering profession as a book of reference bringing together within small compass a great mass of useful information drawn from widely-scattered sources.

A historical sketch of the development of tidal science is first given ranging from the work of Copernicus to that of Sir George Darwin and Mr. Moxly. Next come descriptions in popular language of "the making of the tides," the "propagation of the tidal wave," and the mean level of the sea and range of the tides. All these subjects are illustrated by facts and figures drawn from actual observations. The effect of wind and atmospheric pressure on the tides is considered at some length, as a matter of considerable importance to engineers. Mr. Wheeler has endeavoured to formulate a rule as to variations to be expected with a given force of wind and height of tide; and considers that roughly "the effect of a moderate gale is to raise or lower the tide according to its direction as many inches as it would rise in feet under normal conditions." He gives some striking instances of abnormal tides due to gales of long continuance, the heights attained in some cases exceeding the tide-table heights by six to eight feet. In December, 1904, for example, at Grimsby, the morning tide was raised nearly seven feet, and at Hull, as well as on the Thames, about five feet above normal level by a heavy gale from the north-west. An investigation is also made of the recorded observations of variations in tides accompanying variations in atmospheric pressure, and the conclusion is reached that "it is not possible to lay down any general law applying to all parts of tidal waters." Mr. Wheeler considers that "although variation in pressure may be a primary cause of the alteration in the height of tides . . . yet the wind is a safer and more ready guide for the immediate purpose of navigation."

The chapter dealing with "River Tides" is one of the most interesting in the book, and from the nature of the case is chiefly based on actual observations. Mr. Wheeler traces the progress of the ocean tidal wave up a river channel, and shows how the distance to which the wave action reaches depends on the condition of the channel and the depth of the low-water stream. He describes the "ponding back" of the current in the river by the advance of the tidal wave, and demonstrates the necessity for the duration of the flood tide in rivers being less than that of the ebb. The phenomena of "double flow" are explained, and a distinction made between the propagation of a tidal wave up a river and the tidal current. These movements of river water are accompanied by transport of material carried in suspension, and from the engineering side this is a question of great importance which Mr. Wheeler discusses fully.

Closely related to tidal currents are tidal "bores," which occur in certain rivers. These are very fully described by the author, who summarises the conditions necessary for the full development of a bore as follows:—A considerable rise of tide, a converging channel with a rising bed, the depth of water decreasing as the channel is approached, or a sand bar over which there is not sufficient depth of water to admit of the passage of the approaching tidal wave. Under these conditions, in place of a gradual rise of the water at the entrance to the river, the arrival of the tide is accompanied by a breaking wave with a crest several feet in height, which when formed advances rapidly up the channel. In the Tsien-Tang-Kiang River,

China, the range of spring tides is about twelve feet at the mouth; but the tidal wave becomes compressed in advancing towards the head of the estuary, and reaches twenty-five feet in height at ordinary springs and thirty-four feet when an onshore gale is blowing. The bore is said to enter the river at the rate of 14¼ miles an hour, and during the first hour the rise of tide is ten feet. Its approach can be heard for a distance of fourteen or fifteen miles. The Severn bore is too well known to need description. Its height has been estimated at three to four feet, and velocity at seven to eight miles an hour.

In another section the author deals with wave motion: first with wind waves and secondly with seismic and cyclonic storm waves. As a civil engineer, his chief interest is with the effects of wave motion upon harbour works, coast defences, and other constructions; but these chapters also give an excellent summary of the theory of deep-sea waves and the results of observations on their dimensions and speeds. Some of the facts recorded as to damage done by wave action are very striking. During the construction of Plymouth breakwater, blocks of stone weighing from seven to nine tons were carried over the top through a distance of 138 feet and deposited inside the breakwater. At Bilbao a solid block of the breakwater weighing 1700 tons was overturned. The partial destruction of the north pier at Tynemouth furnishes another illustration; in that case there can be no doubt that the depth below still-water level to which wave disturbance was likely to go in that locality had been considerably underestimated. As to earthquake and cyclonic waves, Mr. Wheeler has collected a large amount of information of an interesting character, and he deals at some length with "solitary" ocean waves, which he thinks are chiefly due to submarine disturbances. The great majority of the solitary waves that have been observed in the North Atlantic were in a line between places subject to volcanic activity. One of the latest examples of the destructive effect of a solitary wave occurred in October, 1905, to the Cunard liner *Campania* on her outward voyage to New York. A fresh gale was blowing on the Grand Banks of Newfoundland when the ship was suddenly struck by an enormous wave; she lurched over, the water swept over the deck several feet deep, five passengers were washed overboard and twenty-nine others seriously injured. This wave was said to have reached as high as the funnels, but in the circumstances accurate estimates could hardly have been made.

The final chapter deals with tides as a source of power. The author gives full accounts of applications of the principle that have been made at various times, but his conclusion is that the attempt to utilise tides on a large scale with existing mechanical appliances cannot be considered as coming within the lines of commercial economics. In this conclusion he has the support of general engineering opinion.

On the whole, Mr. Wheeler has succeeded in the object he had in view, and has "produced a handbook that will be of interest and practical service to those who have neither the time nor the opportunity of investigating the subject for themselves." W. H. W.

ELECTRICITY METERS.

Electricity Meters. A Treatise on the General Principles, Construction, and Testing of Continuous Current and Alternating Current Meters for the Use of Electrical Engineers and Students. By Henry G. Solomon. Pp. x+323. (London: Charles Griffin and Co., Ltd., 1906.) Price 16*s.* net.

UNTIL a few months ago the literature on the subject of electricity meters was entirely confined to articles in text-books on electrical engineering, and the advent of a book dealing exclusively with this subject is therefore a matter of importance to those interested in the distribution of electrical energy. In the book just published by Messrs. Griffin, Mr. H. G. Solomon has written a clear and comprehensive treatise on the principles and construction of this most important piece of electrical apparatus.

The first chapters are introductory, and deal mainly with the theory of action of the more important types. In chapter ii. an important section on the behaviour of three-wire energy meters is deserving of attention. The errors in reading due to want of balance, both as regards pressure and current on a three-wire system, when the shunt coils of a three-wire meter are connected respectively across the outers, and between the middle wire and the outer, have been worked out. In the appendix figures are given which show the percentage error in different cases, and the advantage of connecting the shunt coil directly across the outers is clearly proved. The fact that there is any error at all with this arrangement has hardly been recognised, though for switchboard meters the matter is certainly one of importance. The following chapters contain descriptions of the various types of quantity and energy meters for continuous current circuits, and are largely reminiscent, as writing of this kind must always be, of manufacturers' pamphlets.

Mr. Solomon has very wisely excluded all historical and out-of-date meters from this part of his book, and the section contains a clear description, fully illustrated by many excellent drawings, of the meters which the central station engineer has to use and to test. The author is to be congratulated on having almost entirely eliminated illustrations of the outer cases of the instruments which he describes, a type of illustration, unfortunately, all too common in some other works on kindred subjects. Chapter vi. contains a description of continuous meters for special purposes. The last section deals with tramcar meters. The practical importance of this type of meter is hardly yet well recognised. As Mr. Solomon says:—"The careless manipulation of the controller and brake is a matter of serious importance, resulting in a considerable loss of energy. By properly recording the actual energy taken by the cars, and keeping records of the motor men, a saving amounting to from 10 to 20 per cent. of the total used can be effected." The descriptions of the best known types of meter for this purpose are somewhat disappointing.

The chapters dealing with the theory of single phase and polyphase meters is complete and satisfactory. All the best known methods of measuring alternate current power are described. A matter of some importance is the effect of wave shape on the accuracy of registration; errors due to this cause may amount to 5 per cent. or more with meters of the induction motor type when running on non-inductive load, while the same meters record quite accurately when supplied with a sine wave of potential difference. The chapter dealing with tariff meters is full of useful information for the central station engineer, and the subject is well treated. The Hopkinson doctrine (one might almost call it an axiom) that "the charge for a service rendered should bear some relation to the cost of rendering it" is fundamental, but one of the chief disadvantages in its application in the Wright maximum demand system is, as Mr. Solomon says, that "the average consumer experiences considerable difficulty in understanding it, and the attitude of the consumer cannot be ignored."

Chapter xi. gives a description of a large number of pre-payment meters, and in the next chapter tariff and hour meters are dealt with in the same way. In the penultimate chapter some special mechanical features in meter design are described, for the obvious reason that "the proper working of a meter depends on its mechanical as well as its electrical design." The subject of meter testing is discussed at some length in the last chapter.

The book should be of great value both to students and to central station engineers who wish to know something about the instruments in use on their supply systems.

A NEW VOLUME OF THE "FAUNA OF BRITISH INDIA."

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by Lieut.-Colonel C. T. Bingham. Rhynchota, vol. iii., Heteroptera-Homoptera. By W. L. Distant. Pp. xiv+503; figs. 266. (London: Taylor and Francis, 1906.)

THE present series of works was initiated and carried on for upwards of twenty years under the able editorship of the late Dr. W. T. Blanford, and as this is the first volume issued under the supervision of his successor, Lieut.-Colonel C. T. Bingham, this seems to be a fitting opportunity to summarise the progress that has already been made. In Vertebrates eight volumes have appeared—one on Mammalia, by W. T. Blanford; four on Birds, by Eugene W. Oates and W. T. Blanford; two on Fishes, by Francis Day; and one on Reptilia and Batrachia, by G. A. Boulenger. In Invertebrates ten volumes have appeared—one on Butterflies, by C. T. Bingham; four on Moths, by G. F. Hampson; two on Hymenoptera, by C. T. Bingham; one (half-volume) on Arachnida, by R. I. Pocock; and two on Rhynchota, by W. L. Distant.

Respecting future arrangements, Colonel Bingham announces that four volumes on Beetles (including a volume on Phytophaga, by M. Jacoby), a second volume on Butterflies, by Colonel Bingham, and a volume on Land Shells, by the late Dr. Blanford and Colonel Godwin-Austen, are in preparation, of which it is hoped that the volume on Butterflies and a half-volume on Longicorn Beetles may be issued during the current year.

Turning from this highly satisfactory record of progress to the volume before us, we find that it concludes the suborder Heteroptera (the true Bugs), with families 17 to 24, Anthocoridæ, Polyctenidæ, Pelogonidæ, Nepidæ, Naucoridæ, Belostomatidæ, Notonectidæ, and Corixidæ, including collectively sixty-two species; and commences the suborder Homoptera with the families Cicadidæ and Fulgoridæ, of which collectively 570 species are described. There still remain three families of Trimerous Homoptera—Membracidæ, Cercopidæ, and Jassidæ—to be dealt with in a future volume, as well as the Dimera and Monomera, comprising the families Psyllidæ, Aphididæ, Aleurodidæ and Coccidæ. With the exception of the Anthocoridæ and the curious bat-parasite *Polyctenes lyrae*, Waterh., the Heteroptera described in this volume are all aquatic, including the curious water-scorpions, water-boatmen, and the great *Belostoma indicum*, Lep. and Serv., which attains a length of three and a half inches, and is perhaps the largest heteropterous insect found in India, though some of the allied South American species are larger.

Our British species of the suborder Homoptera, of which the froghoppers may be taken as typical, are all small insects, the largest, our only British representative of the true Cicadidæ (*Cicadetta montana*, Scop.), a scarce and local insect, only measuring an inch and a quarter across the wings. But many of the Indian species of Cicadidæ and Fulgoridæ are much larger, the largest Indian Cicada, *Pomponia intermedia*, Dist., measuring seven inches across the wings.

Although many species of Cicadidæ are more or less spotted, and more or less opaque towards the base, yet the tegmina and wings are, in most instances, almost entirely transparent. In a few species, however, they are opaque, and brightly coloured. But in the Fulgoridæ, or Lantern-flies, many of which are of considerable size, measuring two or three inches in expanse, the wings are often opaque, and varied with such bright colours that they might easily be mistaken for butterflies or moths by persons ignorant of entomology. Indeed, one species, *Aphana caja*, Walk., has received its name from its superficial resemblance to a tiger-moth.

Many Fulgoridæ exude a white waxy substance, which is sometimes very abundant and conspicuous. Others, such as the true Lantern-flies or Candle-flies, are conspicuous both for their bright colours and for the long projection on the head of many of the species. Some have short wings, others very long and narrow ones. Mr. Distant's figures are without colour, but they give a very good idea of the wing-

venation and curious forms of a very interesting but still much neglected group of insects. These figures have been drawn by Mr. Horace Knight in his usual admirable style.

We have much pleasure in commending this volume (in which a large number of new genera and species are figured and described) to all entomologists who are interested in exotic insects. W. F. K.

OUR BOOK SHELF.

Plants and their Ways in South Africa. By Bertha Stoneman. Pp. ix+283. (London: Longmans, Green and Co., 1906.) Price 3*s.* 6*d.*

THE schools in Cape Colony and in other South African colonies are already indebted to the publishers of this volume for several useful educational books. Although this book, and one on geology, are the only ones issued under the title of the "South African Science Series," Messrs. Longmans have previously published an elementary botany and a book on South African flowering plants. The present volume by Miss Stoneman is written for younger children than the two former. The treatment of the subject on an elementary physiological and ecological basis is quite the most suitable, and the author displays considerable originality, although at times she develops a crudity of expression.

A chapter on seeds forms the introduction to the physiological considerations of growth; leaves and their functions are then discussed, and four ecological chapters precede the morphology of flowers, fruits, and seeds. The latter half of the book is devoted to classification, limited wisely to a description of the principal orders, and the writer has drawn up tables for differentiating all the genera mentioned; these are exceedingly useful, but the key for distinguishing the orders according to Bentham and Hooker's system, and the synopsis based on Engler's arrangement, would be more suitable for advanced students.

One of the chief merits of the book lies in the natural manner in which rather difficult subjects, such as the law of correlation of growth, are introduced; also every opportunity is taken to base instruction on practical experiment. Certain mistakes or mis-statements occur that might have been avoided with a little more circumspection, and the mis-spellings are more numerous than is consistent with careful reading; but these defects are slight, whereas the author has succeeded in giving plenty of character to the book, and has written with the object of stimulating observation and inquiry on the part of the reader. The book is well supplied with illustrations, of which a fair proportion has been specially drawn or prepared.

Lectures on Compass Adjustment. By Captain W. R. Martin. Pp. 98; with three charts. (London: George Philip and Son, Ltd., 1906.) Price 5*s.* net.

IN this book is reproduced a series of eight lectures on compass adjustment in iron and steel ships, delivered at the Royal Naval College, Greenwich, to the classes of senior officers as well as to navigating officers up to the year 1902. There can be no question that these lectures, profusely illustrated by diagrams and supplemented by practical instruction by means of models, were in many ways of great value to officers whose career was bound up with the navigation of ships, where the compass might be either a treacherous guide or a means of safety when adjusted and cared for as the author describes. No doubt the lecturer was able to answer questions asked by his audience and to enlarge upon difficult points to their mutual advantage, but now, when these aids are absent and the student has to read lectures with modified diagrams, it is incumbent on the author of them to write clearly and with precision.

Turning, however, to the text, it can hardly be said that the author has succeeded in making his meaning sufficiently clear in many places. Among the more important of these the following require mention:—"The magnetic force of the earth is of course everywhere acting in only *one* direction" (the italics are the author's), a very misleading assertion. The expression "the line of dip is horizontal at the magnetic equator" is unsatisfactory. Again, what is the student to understand from the words, "the compass, may be regarded as a north seeking particle"?

In lecture vi., following wrong premises, it is stated that at a steering compass in H.M.S. *Powerful* the coefficient $\lambda = 0.790$ would be increased to 0.968 after correction by spheres. To obtain such an increase of directive force has long been eagerly sought after in vain, but, unfortunately, observation in the present case shows that a value of about 0.830 is near the truth after correction. Again, the results of observations made as described on p. 70 could not be used in constructing chart No. 1 with any degree of accuracy. With the large number of observations from observatories and results obtained with absolute instruments in the field, as well as relative observations at sea, there is no need to trust to inferior results.

The last lecture is devoted to the methods of adjusting a compass with large errors, but it must be remarked that the directions given are not generally agreeable with the practice of recent years. For example, for all purposes connected with the heeling error, the dip circle has long been discarded in favour of the heeling-error instrument.

Finally, it will be observed that the equipment of torpedo-boat destroyers and torpedo-boats with the liquid compass is not referred to. This is probably an unintentional omission which may be remedied in future editions of this work. E. W. C.

Lotus Blossoms. A Little Book on Buddhism. By Maung Nee. Pp. vi+103. (Rangoon: Printed Privately, 1906.)

A DAINTY booklet in which a number of passages from various Buddhist writings have been gathered together under different headings. As indicative of the high tone and lofty character of the teaching in the Buddhist writings, the following sentences may be quoted: "Strive with all your strength, and let not sloth find a place in your hearts." "The wise man does not remain standing still where he has made a beginning, but ever reaches forward towards fuller enlightenment." "Idleness is a disgrace." These are classed under the heading "correct aim," but equally sound morality can be read in all the sections.

Hydrographic Surveying. Methods, Tables, and Forms of Notes. By S. H. Lea. Pp. 172. (New York: Engineering News Publishing Company; London: Archibald Constable and Co., Ltd., 1905.) Price 8*s.* net.

THIS is an excellent volume, and thoroughly describes the more complicated branch of hydrographical work, such as rivers, lakes, &c. The book touches very lightly on ocean surveying, and apparently is not intended as a work on this subject. Several of the terms used are not often met with in English works, being American technical terms; but these soon become familiar, and, as usual, are very descriptive and to the point. H. C. LOCKYER.

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.]*

Osmotic Pressure.

IN the issue of NATURE for May 17 (p. 54) appears a communication by Mr. Whetham in which he attempts to consign actual experimental work on osmotic pressure to the humble *rôle* of showing how far the assumptions made in so-called thermodynamical proofs can be realised experimentally. Among other things, the attempts to apply thermodynamic reasoning to osmotic processes involve the assumption of a membrane which is semi-permeable and which at the same time is quite passive, that is to say, which shows no selective action. Now in my paper (referred to in NATURE for May 3, p. 19) I have demonstrated conclusively by experiment that in actual osmotic processes the selective influence of the membrane is always present, and is the determining factor as to whether osmosis will take place at all, and, if so, in what direction. In studying that paper, the reader will also see that *the more nearly a membrane is semi-permeable in character in practice, the greater is its selective action. In fact, it is the pronounced selective action of the membrane which makes it approximately semi-permeable.* This being the case, it is evident at once that thermodynamic reasoning cannot be applied to actual osmotic processes, and that the experimental work on osmotic pressure does not play that humble *rôle* to which Mr. Whetham would consign it.

Mr. Whetham sees perfect semi-permeable membranes (1) in the surface of growing crystals of pure solvent which separate from a solution when it freezes, and (2) in the free surface of a solution of a non-volatile solute as it evaporates, and states that "from these two facts follows the validity of the thermodynamic relations between osmotic pressure on the one side and freezing point and vapour pressure on the other." Now I must insist that the formation of crystals from a solution, or the concentration of a solution by evaporation, are not osmotic processes. There are, in fact, no actual membranes or septa involved in these processes, and to regard them as "osmotic" in character only causes much confusion, for they have nothing in common with an actual osmotic process, in which a membrane—an additional phase with specific selective action—is always present as a determining factor.

In how far it is allowable to apply thermodynamic reasoning to the evaporation of a solution or the formation of crystals from a solution I shall not attempt to discuss here, for it is quite outside the main subject with which my paper deals, namely, the nature of osmosis and osmotic pressure. For the same reason I shall not enter upon a discussion of Mr. Whetham's contention that the theory of electrolytic dissociation "rests upon electrical evidence, and by such evidence it must be tried." In this connection it may suffice to refer the reader to the paper which I have prepared at the request of the Faraday Society (see Trans. Faraday Soc., vol. i., also *Phil. Mag.* for February, 1905), in which I have directed attention to the fact that, in creating the theory of electrolytic dissociation, the actual phenomena of electrolysis have played a minor part.

Concerning the remarks made in NATURE of May 17 (p. 54) by Lord Berkeley and Mr. Hartley, I should like to state that, so far as I am aware, the only direct measurements of osmotic pressure which they have made are some preliminary results published in vol. lxxiii. Proc. Roy. Soc., pp. 436–443. In their article in vol. lxxvii. Proc. Roy. Soc., p. 156, I find no direct measurements of osmotic pressure, but simply results of vapour-tension measurements from which osmotic pressures have been computed by means of a modification of a formula of Arrhenius. Of the results given in the two papers mentioned, there is but one case that is comparable, namely, that at concentration 420 grams sugar per litre, the other determinations having been made at different concentrations, so that they are not comparable. Furthermore, all their direct osmotic-pressure measurements were made without stirring, and they are consequently not at all final. I have also in my paper directed attention to the fact that copper ferrocyanide membranes imbedded in porous porcelain are particularly unsuitable for making conclusive direct measurements of osmotic pressure. In these circumstances, it appears that their claim that they have shown experimentally that aqueous solutions of cane sugar give the same osmotic pressure, whether observed directly or deduced indirectly from their vapour-pressures, is not well founded.

As to the computation which Lord Berkeley and Mr. Hartley make concerning one of my experiments, I would state that they assume as a basis for their calculation that the slight amount of sugar found in the outer liquid occurs there because the solution, as such, has passed through the septum. Now this assumption is entirely untenable in the light of the numerous experiments given in my paper illustrating the nature of the osmotic process, and their criticism is consequently worthless. LOUIS KAHLENBERG.

University of Wisconsin, Madison, June 15.

The Olfactory Sense in Apteryx.

ABOUT a year ago I stated in your columns (May 18, 1905, p. 64) that I was trying to have experiments carried out with the object of ascertaining whether the olfactory sense of the kiwi is perceptibly developed, as one would suppose it to be from certain structural peculiarities in which the bird is unique, viz. the great relative size of the olfactory lobes of the brain and the great size of the olfactory capsule as seen in the skull.

I wrote to the curators of Little Barrier and Resolution Islands, which are reserved as sanctuaries for birds, asking each of them to try certain experiments for me with the object, first, of finding out whether the kiwi exhibited any preference for particular species of earthworm, and, if so, whether any difference in odour, or noticeable difference in colour, was perceptible to them (the curators). I asked whether it was possible to deceive the kiwi in any way by appealing to its sense of smell, while excluding those of sight, hearing, and touch, and formulated a few simple experiments with this end in view.

I recently received a reply from the curator of Resolution Island, in Dusky Sound, who is a careful observer of the habits of birds. Mr. Richard Henry experimented with the larger South Island bird, *Apteryx australis*, usually termed the roa-roa, in opposition to the other South Island bird, the small grey kiwi, *A. oweni*. The former feeds chiefly on earthworms, the latter on grubs of various kinds. Mr. Henry placed a number of earthworms at the bottom of shallow buckets and covered them with four inches of earth. When such a bucket was placed on the ground the roa got quite excited in its hunt through the earth, probing to the bottom for the worms. It must be borne in mind that, according to several good observers, the roa (and kiwi) is practically blind during the day time, and, moreover, the bunch of hair-like feathers at the base of its snout intervenes between its eyes and the ground in this operation, while Mr. Henry states that it makes such a "sniffling noise" that it would be unable to hear a worm, even if the latter made any disturbance in the soil. There remains, therefore, the possibility that the tip of the beak is highly sensitive, and that it finds the worms by touch.

But Mr. Henry writes that the bird seemed readily to be aware whether worms were below the earth without touching the soil, for "when I put down a bucket of earth without worms in it, the bird would not even try it; but the moment a bucket containing worms (covered with earth) was put down the roa was full of interest in it," and commenced to probe at once with its long beak.

Further, Mr. Henry took several dead worms that had been severely pressed by the spade in digging them up the previous day, and put them at the bottom of a bucket of earth, and at the end of half an hour the roa had not left a scrap of worm behind. He tried the roa with a bucket of earth that had been searched by it on the preceding day, but the bird "would not even look at it." Then he placed a couple of worms under the earth at the bottom of the bucket, and again allowed the roa to have access to it;

this time the bird went to work promptly, "as if he knew the worms were there."

I had suggested, amongst other experiments, that he should rub a living worm over some substance that the kiwi does not usually eat, such as bread, so that it should be flavoured and scented by the earthworm juice, and then conceal it; but he has not yet, apparently, carried out the experiment.

Previously to my request Mr. Henry had experimented with a roa that he had trained to eat meat. He "planted" pieces of meat in drills three or four inches deep, and next day found them gone, "though the ground was not raked over by the bird, but probed where the meat had been hidden. This was in an enclosure whither other creatures had no access. If, when the bird was at rest, though hungry, he threw a piece of meat or an earthworm near it, it seemed at once aware of the presence of food, would wake up and reach in the right direction, touching the ground from time to time with the tip of its beak until it came in contact with the meat.

Although other and more crucial experiments are needed—and these could more readily be made in England (at Tring, for instance) under careful supervision—yet I think the above affords a certain amount of evidence for the existence in Apteryx of a keen sense of smell.

I may add that Resolution Island is quite an unget-at-able place; it is visited about three or four times a year, twice by the Government steamer on its round-trips to supply lighthouses, &c., and occasionally by other vessels at irregular times, so that four or five months may intervene before a reply is received to a letter. For instance, in reply to my letter dated April 30 I only received an answer in October. I once tried to arrange to visit the island, but the uncertainty of getting back to the mainland in any reasonable time was so great that I had to give up the idea. I hope someone in England will undertake further experiments in this direction.

W. B. BENHAM.

Otago University Museum, Dunedin, N.Z., May 6

Molecular Changes in Nickel Steel.

MR. MILNE, chronometer maker in Manchester, has kindly given me permission to send you the following interesting information. About two years ago he made a clock having a rod pendulum of Dr. Guillaume's invar steel (iron nickel alloy). It was carefully adjusted, and was recording time in a most satisfactory manner. Recently the gut of the driving weight tore, and the clock received a shock whereby the rate was altered a few seconds per day. This might be due to some mechanical movement. After re-adjustment had been effected, it was found that the pendulum was undercompensated for changes of temperature, and it appears as if the coefficient of expansion, which was said to be 0·0000008 per 1° C., had increased.

The second case is a watch the balance wheel of which was made of invar steel and brass. In March, 1904, it was rated by the National Physical Laboratory, when it was found that there was no middle temperature error. Now, after two years' working, this error is +1·08 seconds per day, ordinary steel and brass balances having a middle temperature error of about 2½ seconds per day. The details are as follows:—

Temperature	1904 Rate	1906 Rate
40°	+0·6	+1·08
90°	+1·6	+0·36
Mean	+1·1	+0·72
65°	+1·1	+1·80
Middle temp. error . .	0·0	1·08

C. E. STROMEYER.

"Lancefield," West Didsbury, June 28.

MANX ARCHÆOLOGY AND NATURAL HISTORY.

IN the year 1886 the House of Keys passed an Act entitled "The Museum and Ancient Monuments Act." I well remember hearing of it, because in the course of that year I visited the Isle of Man for the first time, in order to see some newly discovered Ogam inscriptions. It proved for me the first of a series of visits to the island with the view chiefly of studying Manx Gaelic and Manx folklore. I got to know the island and its people, and noticed among other things the efforts made by two or three men with taste and zeal for archæology and history to interest the Manx people in the relics of antiquity for which the Isle of Man is famous. On one of my rambles, which led me to a public school, I remember being much struck by finding hung on the walls drawings of hatchets, hammers, and other instruments of the ages of Stone and of Bronze, accompanied with letterpress descriptions of them. They were intended to interest the more intelligent of the children in such objects, and especially to help them to recognise them when accidents exposed such treasures to view. It struck me how desirable it was that the same thing should be done in the public schools of this country, but I am not aware that it has ever been done. This example of the Isle of Man is well worth following, but I fear that the present is not a favourable moment for recommending anything so far removed from the burning question of the day. But the present war of creeds and dogmas will, it is to be hoped, be followed by a period of peace when the promoters of education may be allowed to devote more attention to some of the historical aspects of its more secular side.

The first Manx archæologists I came in contact with were Canon Savage and Mr. A. W. Moore, who has since not only become Speaker of the House of Keys, but established the right to be considered the historian of the island. I found them inspired and led by the experienced hand of Prof. Boyd Dawkins. They have been since joined by other and younger men, such as Mr. Kermode, who has made the study of the runic crosses of the island his own. He published a valuable book on them in 1892, but he chose to call it a catalogue of them and of the inscriptions, and now a larger work of his on the same subject is passing through the press, and will contain as illustrations numerous plates and a great number of outline figures. The list of the trustees of the Manx Museum and ancient monuments includes other men of light and leading in the island, such as Mr. Ring, the Attorney-General, not to mention that they have always had the Bishop on that body, and enjoyed the support of successive Governors of the island, including among them the well-known historian, Sir Spencer Walpole. These men have always endeavoured to interest the Manx people in their ancient monuments, and they have succeeded to a great extent, but a great deal still remains to be done in the same direction. The pride of ownership is very strong in a Manxman: perhaps it is in all small nationalities—at any rate, I have noticed it not only in Man, but also in my own country, the Principality of Wales. What may be the explanation I do not know, but a member of a small nationality is a more considerable portion of that nationality than if he belonged to a larger nationality, and perhaps that has something to do with the greater difficulty which he finds in rising to the idea of giving up to the nation anything of which he is the exclusive owner. That is, however, not what I was coming to, but to the fact that, in

spite of the pride of ownership, the safe keeping of the object owned is by no means guaranteed either in Man or Wales. But to confine my remarks for the present to Man, I may say that I have known a sad case of perversity of this kind in the matter of a piece of most valuable antiquity, which I abstain from describing more minutely. This is within my own knowledge, and I think no superstitious feeling entered into the matter; but in a case I have heard of it is possible that an element of superstition mixed itself with the mere sense of ownership. I was told years ago that an ancient burial urn had accidentally been exposed partially to sight, but that the owner could not be persuaded to allow it to be carried away to a museum. At the same time he would do nothing to protect it from being damaged by boys shying stones at it or from other dangers. Here there may have been a superstitious fear of removing anything supposed to be connected with the dead. At all events, it will serve to illustrate one of the grave difficulties which those have to face who want to see the relics of antiquity brought to places of safety.

This leads me to mention the last "Report of the Manx Museum and Ancient Monuments," which lies before me, dated March 6, 1906, signed by the chairman, Mr. Moore, and the hon. secretary, Mr. Kermode. It shows very clearly how far the trustees have got with their scheme, and what its objects are. These, as the title suggests, are two—the safe keeping of the ancient monuments, and the exhibition of them for the education of the Manx people, or rather of a wider public still; for nobody can, for instance, be said to have completed his study of runic crosses and Scandinavian epigraphy without visiting the series in the Isle of Man, the most central spot in the British Isles, and one most easily accessible from Liverpool and the north of England. Under the first heading a "Scheme for the Better Preservation of the Manx Sculptured and Inscribed Stones" has been adopted by the trustees, subject, of course, to alteration in detail where found necessary, and to the consent of the rectors and vicars of the parishes concerned. This scheme seems really to consist of so many separate schemes as there are parish churches with important monuments of antiquity near them. Even had there been a spacious museum ready to receive all the stone monuments of the island, no Manxman would probably entertain the notion of removing thither the more important runic crosses such as the group at Kirkmichael. So the arrangement which finds favour is that of constructing sheltered places for them near or within the churchyards where they stand. The work has been done already in some instances, and it may all be expected to be completed in the course of the summer. The Tynwald Court has unanimously voted, for the carrying of it out, 250*l.*, and 150*l.* more are expected from voluntary contributions.

Thus far of the protection of the larger of the ancient monuments in their respective localities. The smaller objects of antiquarian interest ought to find their safe keeping in a museum, but to meet this want less progress has been made. It is now some ten years since the trustees adopted a memorandum to the effect that the Manx Museum should consist of local objects to illustrate fully the archæology and natural history of the island, and the buildings requisite for the purpose should have a minimum area (including galleries) of 5000 square feet, and cost no less than 5000*l.* They also agreed that such an institution, being purely national, not municipal, should be provided partly by public subscription, partly by a grant from the revenue, and partly by the rates of the town in which the museum was to be established. The town, they thought, should be Douglas, and the cost of maintenance, estimated at 250*l.* per annum, should come out of the revenue, not out of the rates. The question of ways and means was in due time discussed, but nothing seems to have been done even by the town of Douglas, which was at one time eager to have the museum. In the meantime Governor Henniker placed a portion of Castle Rushen, at Castletown, at the disposal of the trustees for the purpose of a temporary museum. In fact, the nucleus of a collection had been stored there since the time of Governor Loch. Other articles, however, had been stored at the Government Office in Douglas and in Peel Castle; but the former have been added since to the Castle Rushen collection, which has been still further increased by the generosity of benefactors, especially Canon Savage.

So for the present Castle Rushen, a famous mediæval fortress, is the insular museum, and it is curious to read that the banqueting hall, that had witnessed scenes "of revelry by night," has the fine and very perfect example of the "Irish elk" from Poortown standing in the middle of the floor—it is, if I am not mistaken, not the only "Irish elk" found in the island; I have heard it said that one was presented by one of the Scottish kings of Man to Edinburgh. Among contents on a less colossal stage are the valuable casts of the early sculptured stones and inscribed monuments found in the island, a hundred and twelve in all—and the casts are already too few, for at least two more cross slabs have been discovered since the drafting of the report. In fact, this is one of the most encouraging aspects of the whole business. The collection is steadily increasing as the result of gifts, purchases, or loans, as the catalogue testifies. But here comes the difficulty, for, as the trustees point out, even for the purposes of a local archæological collection making any approach to completeness the space is insufficient for the methodical exhibition of it to the best advantage. This leaves out of consideration other aspects of the museum question, for the trustees are forced to add that though they are very willing to receive and store geological and local natural history objects, they are at present unable to exhibit them. Manx archæologists are only just in time to save the crosses of the island, but every year much is being lost for ever for the want of a museum, and the loss is not only that of Man, but of the archæology of the British archipelago as a whole.

But how is the museum to be provided? There seems to be no prospect of the island setting one up, even at the modest expense of 5000*l.*, and as to that figure I should guess that the bare building required would cost that sum, not to mention the furnishing, which would probably cost another 5000*l.* Before all I ought to have mentioned the site, for which, if it is to be at Douglas, I would rather not indicate any sum. Suffice it to say that the money difficulties are such that I can only make one suggestion, and that is, that the Imperial Government should take the matter in hand. What it has done for the island of late besides affording it and its herring fleet general protection I know not; but it is understood that the island, besides paying the expenses of its own Government, pays direct to the imperial exchequer 10,000*l.* annually, besides a very large income from royalties and other sources of revenue which discharge perennially into the coffers of the Crown. Having alluded to these disbursements, it is needless to point the moral. All lovers of fair play will agree with me that it would be but reasonable for the central Government to come to the help of the Manx people in the matter of its antiquities and natural history, and the sooner the better.

JOHN RHYS.

THE SOUTH AFRICAN MEDAL OF THE BRITISH ASSOCIATION.

WHEN the members of the British Association were in South Africa last August and September, it occurred to someone of the party that it would be well to commemorate our visit by founding a medal for South African students. I am sorry that I cannot remember to whom the credit of this admirable suggestion is due, but the officers at once adopted it with enthusiasm. Papers explaining the proposal were first circulated through the special trains on our way from Durban to Johannesburg, and a substantial sum was promised in a very short time. The proposal was subsequently laid before those who did not happen to be travelling in the special trains, and ultimately before all the members of the British Association.

On our return to England, a meeting of the subscribers was summoned, and a committee was appointed to consider the manner in which the fund should be applied. It was resolved that the South African Association for the Advancement of Science should be asked to accept the trusteeship and administration of the fund, and to undertake the annual award of the medal which was to be struck.

The income of the fund was to be in aid of scientific research among South African students, and it was thought that the medal would commemorate appropriately the fact that the recipient of the award was of such promise as to have been deemed worthy of the confidence placed in him.

The South African Association has cordially accepted the duties in question, and a medal, shown in the illustration, and to be struck in bronze, has been designed by Mr. Frank Bowcher.

The total sum subscribed by the members of the British Association amounts to 859*l*., but the fund will receive a further substantial augmentation, as I shall now explain.

Before the meeting of last year, the several South African colonies subscribed a large sum in aid of the expenses of the members intending to come out to South Africa, and this sum was supplemented, although on a less liberal scale, by a subscription in England. The total of this special South African fund was a little more than 9000*l*. It is expected that, when all the accounts are settled, the unexpended balance will come to about 500*l*. It is clear that this balance ought to be returned to South Africa in some way, and a resolution has been passed by the council of the association that the unexpended balance shall be devoted to the augmentation of the medal fund. The expenses attendant on the design of the medal have amounted to about 100*l*., and it is hoped that more than 1200*l*. will remain for transmission to South Africa. As a higher rate of interest on safe investments is obtainable there than here, a substantial annual sum will be provided in aid of research.

The cordiality of our reception in South Africa surpassed all that could possibly have been foreseen, and we in England are glad to be able to establish this small foundation as a memorial of the most remarkable of the many annual meetings of the British Association.

G. H. DARWIN.

Mr. Frank Bowcher's Designs or the South African Medal of the British Association.

THE EARTHQUAKE IN SOUTH WALES.

THE earthquake which occurred in South Wales on June 27 at about 9.45 a.m. ranks among the strongest shocks of which we have had any experience in this country. It was felt over the whole of Wales, and throughout the greater part of the west and south-west of England. Judging from the accounts which I have already received, the disturbed area must extend some distance to the north of Liverpool; towards the east it includes Northampton and Maidenhead, and approaches to within about twenty miles of London, while the southern boundary lies in the English Channel to the south of Dorset, Devon, and Cornwall. I have not yet obtained any observations from Ireland, but there can be little doubt that the shock was sensible over most of the counties of Wicklow and Wexford. A first rough estimate makes the disturbed area nearly circular in form, about 280 miles in diameter, and about 60,000 square miles in area.

The shock, which affected a region greater than the combined areas of England and Wales, was naturally of considerable strength within the central district. It is too early to make any estimate of the total damage to buildings, but the first reports show that a very large number of chimneys were thrown down, especially in Swansea, where the number is said to amount to several hundred. From Kidwelly on the west to beyond Neath on the east, and from Glanamman on the north to beyond Swansea on the

south, it will probably be found that few towns and villages have escaped some injury. The isoseismal line of intensity 8, or the curve which bounds the area of slight damage to buildings, seems to be roughly elliptical in form, about twenty-eight miles from east to west and eighteen to twenty miles from north to south, or a little more than 100 square miles in area.

Nearly all the strongest British earthquakes belong to the class which have been called "twin" earthquakes. They originate within two foci, which are nearly or quite detached, with their centres, as a rule, about eight or ten miles apart. But the chief peculiarity about them is that the two impulses which cause them take place almost simultaneously, or, if not quite so, that the second impulse occurs before the vibrations from the first focus have time to reach the other, the two impulses being thus due to a single generative effort.

From the descriptions which have been given there can, I think, be no doubt that the recent shock was a typical twin earthquake. Many hundreds of observations will be required to determine the positions of the twin foci, and to ascertain which focus was first in action. But, so far as the evidence already collected allows us to judge, the foci appear to have been situated along a nearly east and west line, and are probably coincident with an east and west fault, passing close to Llanelly, Swansea, and Neath. It would be useless at present to attempt a more exact definition of the originating fault, but it is clearly connected with the great Armorican system of crust-movements, which attain their maximum in Brittany and mid-Devon, and, as they enter South Wales, begin to die away. In this district, as Mr. Aubrey Strahan remarked in his address at the Cambridge meeting of the British Association, the chief disturbances are of post-Carboniferous age. That they are still occasionally continued, though on a much smaller scale, the recent shock bears ample testimony.

It is evident from the above account that the earthquake presents several features of considerable interest to geologists. The district is also one that affords unusual opportunities for the study of the nature and effects of the shock in deep mines, and it is to be hoped that our somewhat scanty knowledge will be advanced in this respect.

I take this opportunity of stating how greatly my investigation of the earthquake would be assisted by the contribution of records from different places, and especially from the workings in the mining districts. The points on which I wish to obtain information will be found in many local newspapers, but I shall be glad to send forms on which descriptions may be conveniently entered if application is made to me at 16 Manor Road, Edgbaston, Birmingham.

CHARLES DAVISON.

PROFS. N. S. SHALER AND I. C. RUSSELL.

GEOLOGICAL science, and America in particular, has suffered a severe loss in the deaths of two university professors, N. S. Shaler, of Harvard, and I. C. Russell, of Michigan.

Prof. Nathaniel Southgate Shaler, who was born in Newport, Kentucky, on February 20, 1841, graduated at Harvard University, and served two years as an artillery officer in the Union Army during the Civil War. Subsequently he pursued the study of natural science, to which he had been attracted at the Lawrence Scientific School in Cambridge, took the degree of Sc.D. in 1865, and became in 1868 instructor in zoology and geology in that school, and also professor of palæontology in Harvard University. While retaining this professorship, he was in 1873 appointed director of the second Kentucky Geological Survey, a post he held until 1880; and in 1887 he became professor of geology in Harvard University, and occupied the chair until his death this year at the age of sixty-five. When little more than twenty years of age he discussed the age of the rocks in Anticosti, in a paper read before the Boston Society of Natural History, and in 1865 and following years he brought before the same society his views on the elevation of continental masses, arguing that sea-bottoms on which sedimentation was taking place were areas of depression, and that prominent lands undergoing denudation were areas of uplift. He discussed the formation of mountain chains (1866), and maintained that while the continental folds were corrugations of the mass of the earth's crust, the mountain chains were folds only of the outer portion of the crust caused by contraction of its underlying part, and that the formation of mountain chains would be promoted by the subsidence of the ocean's floors, fractures and dislocations being thereby produced along their borders (see G. P. Merrill's "Contributions to the History of American Geology," 1906). In a subsequent paper (1875) Shaler suggested that the transfer of weight to the land by the accumulation of an ice-sheet would influence terrestrial movements. He also discussed the possibility of the Japan current flowing at the close of the Glacial period over what is now land about Bering's Strait, and thus modifying the climatic conditions. He issued memoirs and reports on the geology of Kentucky (1876, &c.), and in later years dealt with a great variety of subjects, scientific and practical, including the classification of lavas, the fossil brachiopods of the Ohio valley, soils, the geological history of harbours, peat-deposits, road-stones, the features of the earth and moon, &c. He was author of important reports on the geology of Cape Cod district (1898); (with J. B. Woodworth) geology of the Richmond Basin, Virginia (1899); and (with A. F. Foerste) geology of the Narragansett Basin (1899). He wrote also "Outlines of the Earth's History" (1898); "Sea and Land: Features of Coasts and Oceans, with Special Reference to the Life of Man" (1895); "Study of Life and Death" (1900), and other works of a more or less popular character.

Prof. Israel Cook Russell, whose death occurred at the age of fifty-three, was born at Garrattsville, in New York State, on December 10, 1852. He graduated at the University of New York in 1872, and after further study at the School of Mines, Columbia, was appointed a member of the U.S. expedition to New Zealand (1874–5) to observe the transit of Venus. His attention, however, was given mainly to the study of physical geology. On his return from New Zealand he became assistant professor of geology at the Columbia School of Mines, and in 1878 was appointed assistant geologist on the U.S. geographical and geological survey west of the one hundredth meridian. From 1880 to 1892 he served as geologist on the U.S. Geological Survey, and in 1892 he became professor of geology in the University of Michigan. His earlier papers (1878) dealt with the physical history of the Trias in New Jersey, and with the intrusive nature of the eruptive rocks, in which he recorded the presence of a solid hydrocarbon. One of his more important works was a sketch of the geological history of the former Lake Lahontan, which in Quaternary times occupied an area of nearly 8500 square miles in N.W. Nevada (1883); he wrote also on the glaciers of Mount Rainier (1898), and on the geology of the Cascade Mountains (1900). Of later

papers mention may be made of his observations on the Snake River plains, on the water-bearing strata of Idaho and Oregon, and on the volcanic eruptions of Martinique and St. Vincent. He was author of separate and more popular works on the lakes, glaciers, volcanoes, and rivers of North America.

NOTES.

ONLY a few names familiar in the scientific world occur in the long list of honours announced on Friday last in celebration of the King's birthday. Lieut.-Colonel D. Prain, F.R.S., director of the Royal Gardens, Kew, and late director of the Botanical Survey of India, has been appointed a Companion of the Order of the Indian Empire. Sir Christopher Nixon, ex-president of the Royal College of Physicians, Ireland, and the author of various papers on diseases of the heart and nervous system, has received the honour of a baronetcy. Among the thirty new knights are Mr. T. Digby Pigott, Emeritus Prof. A. R. Simpson, and Dr. A. E. Wright. Sir John Brunner, a member of the great firm of alkali manufacturers, Brunner, Mond and Co., has been made a privy councillor.

BRITISH merchants and manufacturers anticipated a great development of our trade in the Far East at the close of the Russo-Japanese War last year; but it appears from a special inquiry instituted by the *Daily Mail* that their expectations have not been realised. There has been a noteworthy expansion of trade since peace was concluded last August, but the Japanese have taken care that the chief advantages of it shall be to themselves. They have not only secured the Far Eastern market, but, according to our contemporary, the Japanese Government is laying plans for becoming our rivals as an exporter of goods to India. "The fault," we read, "is chiefly our own. Our Government neither knows what is going on nor takes any measures to protect our interests. It is quite natural that Japan should seek to take the current when it serves, but we, too, ought to have our share of the flood that leads on to fortune, and if the Far Eastern department of the Foreign Office will kindly wake up we may secure it yet." It is evident that the Japanese, with their scientific knowledge and methods, will be as strong in peace as they have proved themselves in war. This is an age when science and system are essential to progress, and the nation that realises it is best equipped for survival in the struggle for commercial supremacy. Only by insisting that the scientific spirit which permeates Japanese education and policy shall be possessed by our own statesmen can our commercial position be made secure against attack or progress be assured, either now or in the future.

IN the House of Lords last week, Lord Onslow asked whether His Majesty's Government proposed to continue to take part, after next year, in the international investigations of North Sea fisheries, and made some observations by way of criticism of the methods of investigation which the International Council has adopted. The gravamen of Lord Onslow's objection to the scheme appears to be that, whilst in his opinion the most promising method of attacking fishery problems is by the collection of statistical information from the commercial fishing vessels and at the ports of landing, in the international scheme the carrying out of accurate investigations at sea by men of scientific education and training on board specially equipped research steamers is regarded as essential to an adequate study of the very complicated problems which present themselves to those responsible for the regulation of the fisheries. The value of such collections of statistical data as Lord Onslow suggests, as an adjunct to work carried out by special research steamers, cannot be doubted, and, judging from the reports already published, appears to be fully recognised by the International Council. But no one with experience of the fundamental necessity of accurate observation and scientific method in dealing with practical problems of this character will, we imagine, for a moment be able to agree with the suggestion that such collections of miscellaneous information, the trustworthiness of which must necessarily vary greatly in different cases, can adequately supersede the observations and experiments of skilled investigators. The results already foreshadowed by the International Council seem to be of a promising character, and Lord Carrington, who replied for the Government, was well advised in postponing the consideration of the question of the continued participation of this country in the investigations until after the full reports have been received.

A MEETING was held on June 27 in support of the National Association for the Establishment of Sanatoria for Workers suffering from Tuberculosis. The secretary announced that the association is receiving the active cooperation of friendly societies. At the present time twenty-eight beds have been bespoken for the General Post Office, fifteen for the Hospital Saturday Fund, and five for the Hearts of Oak Benefit Society. Donations have been received from representatives of the participating classes, and this willingness of the ordinary public to assist men of science in their endeavours to eliminate a dreadful disease will greatly lighten their task. Mr. Chamberlain, in a speech supporting the scheme, pointed out that science has already done a good deal, and, without being too optimistic, it is likely that, from further discoveries and continued exertions of distinguished men engaged in medical research, perhaps in the near future the discovery of some definite specific remedy for the disease will be made. Cholera, diphtheria, and other diseases no longer have their terrors, and consumption may cease to be what it is at the present time. Mr. Chamberlain went on to say that he wished he could make his voice reach some of those who have, not merely too much wealth, but wealth beyond the dreams of avarice, which the possessors themselves recognise they cannot make any possible use of. He urged upon the men of great wealth that there is no possible thing they can do which will bring greater benefit to humanity at large, and give them greater satisfaction, than to endow further great schemes for medical research. While sympathising with the desire to see our millionaires emulating the example of American men of wealth in their support of scientific research, our statesmen should not lose sight of the fact that it is as much their duty to see to the protection of the people from disease as from foreign foes. The endowment of scientific and medical research is as necessary a form of national defence as a battleship, and to postpone the organisation of a State-aided campaign against a scourge like consumption until the generosity of millionaires has been developed is unstatesmanlike and a dereliction of duty on the part of Governments.

THE death of Señor Manuel Garcia in London on Sunday has deprived the worlds of science and music of a man whose work will be remembered so long as the human voice is used and studied. While the throat is capable of emitting musical sounds, and is liable to disease, the laryngoscope invented by Manuel Garcia will hold its unique

place among vocalists and laryngologists. Garcia was born in Madrid on March 17, 1805, and the enthusiastic celebration of his centenary last year was described in NATURE at the time (March 23, 1905, vol. lxxi., p. 491). The King invested him with the insignia of Commander of the Royal Victorian Order, and many other tributes to his great services to mankind were presented to him. While a teacher of singing in Paris, about 1840, Garcia devoted attention to the scientific study of the problems of his art, including the anatomy and physiology of the larynx. The epoch-making paper in which he laid the foundation of the experimental study of the voice was read before our Royal Society in 1855, after he had settled in London and invented the laryngoscope. Intra-laryngeal medication and surgery, says the *Times*, soon followed the discovery of the diagnostic properties of this instrument, and its principles were extended to the elucidation and treatment of diseases of the parts situated between the nose and throat. The importance of the invention was not recognised until two years later, when the attention of the whole world was directed to the laryngoscope. Compensation for the indifference first shown by the medical profession to Garcia's discovery was amply afforded by the centenary celebration last year, when public institutions and societies from every quarter of the globe united to honour the great teacher and investigator.

THE Longstaff medal of the Chemical Society has been awarded to Prof. W. N. Hartley, F.R.S., in recognition of his spectrochemical investigations; the presentation will be made at the first meeting of next session, October 18.

THE death is announced of M. Rayet, director of the Observatory of Bordeaux-Floirac. M. Rayet was also professor of astronomical physics at the University of Bordeaux.

THE council of the Institution of Mechanical Engineers has appointed the president of the institution, Mr. E. P. Martin, as one of its representatives upon the main committee of the Engineering Standards Committee in succession to Mr. E. Windsor Richards, past-president of the Institution of Mechanical Engineers, who has retired.

MR. G. MONTEFIORE-LEVI, of Brussels, formerly a member of the Belgian Senate, and president of the Association of Engineers, has bequeathed a portion, probably exceeding 100,000*l.* in value, of his residuary estate, to be applied for the prevention of consumption.

THE Geologists' Association has arranged a long excursion to the Yorkshire coast, extending from July 21 to July 28. The object of the excursion is to visit the Lias and Oolite sections from Robin Hood's Bay to Saltburn. Members wishing to take part should communicate at once with Mr. H. Kidner, 78 Gladstone Road, Watford. The party leaves King's Cross at 11.30 a.m. on July 21.

AT the annual general meeting held on June 28, the following were elected Fellows of the British Academy:—the Rev. R. H. Charles, Mr. W. J. Courthope, C.B., Mr. J. Fitzmaurice-Kelly, Mr. Andrew Lang, Prof. A. A. Macdonell, Dr. J. E. McTaggart, Canon Edward Moore, and Dr. G. F. Warner. The number of fellows is thus brought up to ninety-four, out of a maximum of 100 allowed by Order of Council.

AFTER the ceremony on June 25, when Mr. Haldane opened the electrical laboratory of the National Physical Laboratory, Sir John Brunner very generously placed the sum of 5000*l.* at the disposal of the committee toward the completion and equipment of the additional buildings for engineering, metrology, and metallurgy, now in course of erection.

THE past week will long be remembered by electrical engineers on account of the international meeting referred to in our last number (p. 207). We have had among us representatives of the electrical industries of France, the United States, Italy, Germany, Switzerland, and Canada, and have been enabled to return in some part the hospitality they have in past years extended to us. A good and varied programme was arranged, and our leading firms assisted by giving free access to their works and in entertaining the visitors. We trust that our guests will look back upon their visit here as no less delightful than those which many of our own electrical engineers still remember with gratitude to their respective countries.

A RAINSTORM of exceptional severity was experienced over the whole of the south-east of England during the night of Thursday, June 28, and the morning of the following day. The rainfall in and around London was as heavy as anywhere. The downpour commenced shortly after midnight, and continued without intermission for eight or nine hours. At Kew the measurement amounted to 2·36 inches, at Camden Town to 2·27 inches, and at the observing station of the Meteorological Office, in St. James's Park, to 2·07 inches. At Greenwich the measurement was 1·85 inches. Other stations reporting heavy falls were Cambridge, with an aggregate measurement of 2·3 inches; Rothamsted, 2·2 inches; Hiclington, in Norfolk, and Epsom, 1·8 inches; and Oxford, 1·7 inches. Previous records only show so heavy a fall in twenty-four hours for London on three occasions during the last fifty years. This severe rainstorm was due to the passage of a shallow cyclonic disturbance across the southern portion of England, and in places the force of a moderate to fresh gale was experienced. At Greenwich the pressure of the wind was 10 lb. on the square foot, at 9 a.m., on June 29. The type of weather was peculiarly characteristic of thunderstorms, but it was only in a few isolated places that thunder and lightning occurred.

ARRANGEMENTS have now been completed for the erection of a commodious laboratory for the study of marine biology at Cullercoats, on the Northumberland coast. A much smaller laboratory, which had been provided by the munificence of Alderman Dent, the chairman of the County Council's fisheries committee, was accidentally burnt down some few years ago, and the proposed building is designed to carry out, not only fishery research, but also general biological studies. The gift of the site and the cost of erection of the building will be borne in a very generous way by Mr. Wilfrid Hudleston, F.R.S., the management being under the control of the Armstrong College at Newcastle. It is hoped that the new building will be ready for use at an early period of the next collegiate session, and that students will in this way obtain a further means of valuable training in practical biology. Cullercoats is, of course, classical ground to the marine biologist, having been the source of much of the material upon which Alder and Hancock's great work on the nudibranchiate mollusca was based.

A CORRESPONDENT writes asking for information as to self-recording instruments of the variations in the direction of the wind, and suggests that no such self-registering

wind vanes are well known to the public. The information required may be found in any good text-book of meteorology, and the letter asking for it is characteristic of the general lack of knowledge with regard to meteorological matters. There are, of course, many recording anemographs which give wind direction, and our correspondent should apply to instrument makers, such as Messrs. Lander and Smith, of Canterbury, or Messrs. Negretti and Zambra, of Holborn Viaduct, E.C., for a price-list. Recording direction anemographs can be seen at work at many observing stations, such as Greenwich, Kew, Oxford, Falmouth, Fleetwood, Holyhead, Manchester, Stonyhurst, and other places.

MANY men of science will be glad to learn that it is proposed to establish some permanent memorial of the late Prof. W. F. R. Weldon, not only of the man himself, but also of the movement with which his name is especially associated, the application, that is, of exact methods of statistical inquiry to the study of variation and kindred problems in zoology. It has been suggested that the memorial should consist of a portrait—medallion or bust—in the museum at Oxford, a cast of which might be placed in University College, London, and of a prize to be awarded periodically to the author of the most valuable biometric publication of recent date. The committee will arrange that subscribers may eventually purchase a reproduction of the portrait. Contributions may be sent to Dr. G. C. Bourne, Savile House, Oxford; Dr. G. H. Fowler, 58 Bedford Gardens, W.; Prof. Karl Pearson, F.R.S., University College, W.C.; Mr. Adam Sedgwick, F.R.S., Trinity College, Cambridge; or to the Weldon Memorial Account, at the Old Bank, Oxford.

A ROYAL Commission has been appointed to consider certain questions affecting the erosion of the coasts of the United Kingdom. The commission is to inquire and report:—(*a*) As to the encroachment of the sea on various parts of the coast of the United Kingdom and the damage which has been, or is likely to be, caused thereby, and what measures are desirable for the prevention of such damage. (*b*) Whether any further powers should be conferred upon local authorities and owners of property with a view to the adoption of effective and systematic schemes for the protection of the coast and the banks of tidal rivers. (*c*) Whether any alteration of the law is desirable as regards the management and control of the foreshore. (*d*) Whether further facilities should be given for the reclamation of tidal lands. Science is represented upon the commission by Dr. T. J. Jehu, lecturer in geology at the University of St. Andrews.

A LIST of Paraguay locusts (Acrididæ), with descriptions of new species, by Mr. L. Bruner, forms the subject of No. 1461 of the Proceedings of the U.S. National Museum.

WE have received copies of two papers, by Mr. H. H. Bloomer, on the anatomy of certain species of Solenidæ, reprinted from vol. xii. of the *Journal of Malacology*. We note that the familiar name *Solen ensis* is replaced by *Ensis ensis*.

THE articles in the June issue of the *Zoologist* are all devoted to birds, Mr. E. Selous discussing sexual selection, as exemplified by the breeding-habits of the ruff, while Mr. Wesché contributes notes on the habits of cage-birds, and Mr. G. W. Kerr continues his notes on the birds of the Staines district.

AN interesting report on the leading zoological gardens of Europe has been issued by the Egyptian Department of Public Works as the result of a mission undertaken last year by Captain Stanley Flower with the view of obtaining information and hints which might prove of use in the establishment under his charge at Giza. While avoiding invidious comparisons, the author has pointed out some features in connection with buildings where particular menageries excel their fellows, and has likewise published lists of some of the more notable animals which came under his observation.

SHIZOPOD crustaceans from the Atlantic slope, by Messrs. Holt and Tattersall, and fishes from the Atlantic slope, by Messrs. Holt and Byrne, form the subjects of the latest issues of Scientific Investigations, Fisheries, Ireland (1904, v., and 1905, ii.), both published this year. The former adds five species to the British list, of which one is new. Although, as the authors remark, the addition of new species of deep-sea fishes to the British fauna is a matter of no real importance, they are enabled to increase the list by no less than sixteen species, of which one is new. The most interesting among these is the salmonid *Bathylagus atlanticus*, previously known only by a single specimen taken off Patagonia by the *Challenger*.

Trudui St. Peterburghs. Obshch. (*Trav. Soc. Imp. Nat. St. Pétersbourg*) for March and April (vol. xxxvii., part i.) contains an illustrated account, by Mr. D. D. Pedaschenk, of a wonderful new pelagic cœlenterate from Java, for which the name *Dogielia malayana* is proposed. Measuring only from one to one and a half millimetres in length, the organism is remarkable for the possession of a complex system of paired branching outgrowths. It is considered to be a highly-specialised member of the Ctenophora. The other papers include notes on glaciation in the western Urals, on a case of artificial formation of sillimanite, and on regeneration in the polychæte worm *Spirographis spallanzanii*.

IN addition to an obituary notice, with portrait, of the late Dr. Max Kaeck, and a report on the museum and gardens for the past year, the contents of the *Boletim do Museu Goeldi* (Para) include a continuation of Dr. J. Huber's account of the Brazilian flora, a synopsis by the same author of the plants of the genus Hevea, a supplement by Mr. A. Ducke to his papers on the social wasps of Para, and a paper by Dr. E. Goeldi on the chelonians of Brazil. Exclusive of the marine forms, the author recognises twenty-one species of the latter as indigenous to the country, all but four of these belonging to the Pleurodira. Perhaps the most important part of this paper is an account of the habits of the great arrau turtle (*Podocnemis expansa*) of the Amazon, from observations made by Major J. M. da Silva Coutinho in 1868.

WITH its second (June) number, of which we have received a copy, the *Haslemere Museum Gazette* has changed its title to the *Museum Gazette*. There are several excellent illustrations in this part, among them figures of the two common British snakes and a reproduction of a photograph of the historical department in the Haslemere Museum, and a number of short articles, dealing chiefly with natural history subjects from an educational point of view. Certain items in these will be read with some surprise by naturalists. We are told, for instance, on p. 65, that "all the gnus are South African, and would

appear to bear the same relation to the buffaloes of that continent that the North American bison does to the American buffalo"; while on the preceding page we are informed that "the camels and llamas form transition species between horses and oxen (ruminants and solid ungulates)." Almost equally original pieces of information occur on other pages.

IN the Bulletin (May) of the Department of Agriculture, Jamaica, a new epiphytic fern, allied to the rare *Polypodium Fawcettii* and *Polypodium dendricolum*, is described by Mr. W. R. Maxon under the name of *Polypodium nesioticum*. Reference is made to a weevil attacking the camphor trees at Cinchona that has been identified as *Hilipus elegans*, a species abundant in Central America, whence it has been probably imported to Jamaica. The Bulletin also contains a note on the coagulation of Castilloa rubber, as well as an article recommending the plantation of Castilloa trees in Nicaragua in preference to Hevea.

THE investigation of the fungi that prey upon scale-insects has its practical aspect, as already some of these fungi have been successfully employed in the United States as remedies against scale-pests. They are probably unimportant in temperate regions, but in the tropics they are widely spread, as may be gathered from an account contributed by Mr. J. Parkin to the Annals of the Royal Botanic Gardens, Ceylon, vol. iii., part i., reviewing the subject generally and making special reference to Ceylon forms. All the fungi so far determined fall under the Ascomycetes, and most of them belong to the Hypocreales, the best-known genus being Nectria. Other genera are classed with the *fungi imperfecti*, although they are probably conidial stages of the Hypocreales.

IN accordance with the announcement that papers on systematic botany and monographs concerned with Philippine plants will be published as supplements to the Philippine Journal of Science, a supplement to the first volume contains a list of plants collected in that portion of the island of Luzon lying upon the north-west side of Manila Bay known as the Lamao forest reserve, where it is intended to investigate various forestry problems. The compilation has been prepared by Mr. E. D. Merrill, with assistance from specialists, from material recently obtained by different collectors. Out of the total of a thousand species of phanerogams, representing more than six hundred genera, 45 per cent. are classed as endemic and 54 per cent. as trees. Obviously there are few genera with many species, Ficus and Eugenia being two exceptions.

IN the *Bulletin de la Société d'Encouragement* (vol. cviii., No. 4) there is an illustrated description of a remarkable testing machine of 270 tons constructed for the University of Illinois. It is 11 metres high, and will test for compression pieces 7½ metres long, and for tension pieces 6·6 metres long, provided that the elongation does not exceed 20 per cent. There are also dimensioned drawings of the 10,000 horse-power turbine at Snoqualmie Falls. It weighs about 86 tons, and has an efficiency of 84 per cent.

THE three latest Bulletins of the admirable series issued by the Peruvian Corps of Mining Engineers have been received. In Boletin No. 32 Mr. F. Malaga Santolalla describes the ore deposits and coalfields of the province of Celendin, one of the smallest but richest of the department of Cajamarca. The ore deposits are numerous, but little exploration has been carried out owing to difficulties of transport. In Boletin No. 33 Messrs. C. W. Sutton, J. J. Bravo, and J. I. Adams describe the geology of the province of Callao. An account is also given of the triangulation of the province. The base line of 2½ kilometres at Playa Brava was measured with a 100-metre steel band, and the angles were measured with an 8-inch theodolite reading to two seconds. In Boletin No. 34 Mr. H. C. Hurd submits a report on the possibility of increasing the quantity of water available for irrigation in the valley of the Chili, in the department of Arequipa.

THE current issue of the Records of the Geological Survey of India (vol. xxxiii., part iii.) is a number of more than ordinary interest. Mr. L. Leigh Fermor gives some notes on the petrology and manganese ore desposits of the Sausar Tahsil, Chhindwara district, Central Provinces, in which he puts on record petrological descriptions of certain types of rocks, chiefly of the metamorphic and crystalline series, and gives an account of the eleven manganese ore deposits known to occur in this area. Several of them are of economic importance. Six beautifully reproduced plates of rock photomicrographs accompany the paper. Mr. P. N. Datta describes the geology of parts of the valley of the Kanhan River, Central Provinces, and gives a geological map of the area. Mr. L. Leigh Fermor describes a specimen of manganite from the Sandur Hills, Madras Presidency, which is of special interest inasmuch as the occurrence of this ore in India has previously been recorded but twice. In the miscellaneous notes the occurrence of gypsum in the Vindhyan series at Satna is recorded, and accounts are given of ores of antimony, copper, and lead from the Northern Shan States; of gems from the Tinnevelli district, Madras; and of cassiterite-granulite from the Hazaribagh district, Bengal. The great increase in the exports of manganese ore from India is also noted, brought about by failure in the Russian supplies following the internal disturbances. The manganese ore exported from India in 1905 amounted to 281,735 tons, against 154,829 tons in 1904.

WE have received from Prof. J. A. Pollock and Mr. S. H. Barraclough, of the University of Sydney, a reprint of an interesting paper read by them before the Royal Society of New South Wales on a hollow lightning conductor crushed by the discharge. The tube, 1·8 cm. in outer diameter, made of copper 0·1 cm. thick, was crushed in a symmetrical manner, showing the characteristic appearance of a tube which had collapsed under external pressure. The crushing appears to have been due to the electrodynamic action of the current. The material of the tube was probably plastic at the time of collapse. If so, the current is calculated to have been one of about 20,000 amperes; if not, the current would have been one of about 100,000 amperes.

Himmel und Erde for April contains an interesting article by W. Gallenkamp, of Munich, on the results of recent rainfall investigations. This paper does not deal with statistics in the usual manner, but refers to experiments by Lenard and Defant on the determination of the size of raindrops and on the velocity with which they fall. The size is determined by measuring the wet patch made on blotting paper, assuming that a drop of a given size will always produce a similar patch. The result arrived at is that the weights or volumes of the drops have a definite proportion to each other, *e.g.* if unity is taken as representing the smallest drops, the weights of the

other drops are found to be 2, 3, 4, 6, &c., times that weight. *Generally speaking*, the absolute size of the drops exhibits very small differences; the smallest weigh about 0·11 mg., and the weights of the others are multiples of that value, as explained above. In a lasting downpour the largest drops weigh about 1 mg. With respect to the velocity at which the drops fall, the rate is not at all proportional to the weight; those of 0·11 mg. to 1 mg. fall at the rate of 2·7 metres to 4·4 metres per second, while those of exceptional weight, say 65 mg., only fall at the rate of about 8 metres per second. These rates only hold good during calm air; in an ascending current of 2·7 metres per second the smallest drops would remain suspended. The latter part of the article deals with Mr. Wilson's experiments on the ionisation of the atmosphere as the probable prime cause of the formation of rain. A note on the size of raindrops will also be found in vol. xviii., p. 242, of the Quarterly Journal of the Royal Meteorological Society.

An interesting contribution to the study of the nature of solution and of osmotic pressure is contained in a paper by Mr. C. S. Hudson in the *Physical Review* (vol. xxii., No. 5). The conception of Prof. Hulett that the low vapour-pressure of solutions indicates that these solutions are under a negative pressure is extended to explain the depression of the freezing point of water by the addition of a dissolved substance. It would appear at first sight that a negative pressure would occasion a rise in the freezing point, because an increase of pressure causes a lowering of the melting point of ice; but this reasoning is not correct, because the ice which freezes from a solution is under atmospheric pressure, not negative pressure, and only the solution may be regarded as being subjected to the negative pressure. By using Prof. Poynting's calculation of the change of freezing point caused by an increase in the pressure on the ice alone, it is shown that the molecular depression of the freezing point of water caused by the addition of a dissolved substance is exactly equal to that corresponding with a negative pressure exerted on the solvent, and equal in magnitude to the osmotic pressure. The osmotic pressure thus corresponds with a positive tension exerted on the liquid by the dissolved solid. A general thermodynamic investigation of the process of freezing is also contained in the paper.

A fourth edition of Mr. C. F. Townsend's "Chemistry for Photographers" has been published by Messrs. Dawbarn and Ward, Ltd.

OUR ASTRONOMICAL COLUMN.

Search-ephemeris for Finlay's Comet.—In No. 4100 of the *Astronomische Nachrichten* M. L. Schulhof publishes an approximate daily ephemeris for the coming apparition of Finlay's comet. The time of perihelion passage is taken as September 8, and the ephemeris covers the period June 18 to August 1; two contracted ephemerides are also given for T = September 4·0 and T = September 12·0. Owing to its expected close approach to the earth, the comet should be in an excellent position for observing later in the year.

The perturbations since the last apparition of this comet have not been taken into account in the present ephemeris, but a more accurate ephemeris is promised in an early publication. According to that now published, the comet is at present (July 5) apparently near to δ Aquarii, which rises about 11 p.m., but by the end of the month it will have passed into Cetus, and will be about half-way between θ and Mira Ceti.

Stereoscopic Measurement of Proper Motions.—A detailed description of the stereo-comparator method of determining the proper motions of stars is given by Prof. Max Wolf in No. 4101 of the *Astronomische Nachrichten*, where he also gives and describes the first results obtained by the method. A pair of photographs, arranged for the stereoscope, which accompany the paper show the effect of proper motion beautifully, for a star which has moved 19 seconds of arc in fourteen years appears to be considerably behind the general plane of the surrounding stars. With an especially constructed micrometer, the observer is able to determine the amount of the proper motion in right ascension and declination.

Prof. Wolf shows in a table the values measured and the results obtained for ten stars of about the tenth magnitude, and also for two other stars, Nos. 75 and 74 in Prof. Kobold's list. Comparing the meridian-observation results for the latter with the stereo-comparator values, he shows the trustworthiness of the new method thus:—

	Kobold 75		Kobold 74	
	Proper motion (in secs. of arc)	Position angle	Proper motion in secs. of arc)	Position angle
		°		°
Meridian circle ...	2·23 ...	162·0	0·88 ...	199·3
Stereo-comparator	2·21 ...	157·1	0·91 ...	183·2

This is very satisfactory, especially when one remembers that on the scale of Prof. Wolf's plates 1 second of arc is represented by only 0·004 mm.

Radiative Power of the Sun's Disc.—In No. 4, vol. xxiii., of the *Astrophysical Journal*, Prof. Julius describes a new method for determining the radiative power of the different parts of the solar disc. Briefly, the method consists in recording the intensity of the solar radiation at definite intervals during the progress of a total solar eclipse. Then every increment (either positive or negative) of the intensity is solely due to the radiation coming from that strip of the disc through which the limb of the moon has appeared to move during the corresponding interval. As the geometrical form of each of the strips is easily determined, the amount of each of the concentric zones (into which the disc is previously divided) contained in any one strip may be found. The total radiation from each zone is then determined by a suitable mathematical solution. This method was tried at Burgos during the last eclipse, and, despite the unfavourable meteorological conditions, the results lead Prof. Julius to hope that under suitable conditions it may be found very satisfactory.

New Forms of Astrographic Object Glasses.—In No. 4100 of the *Astronomische Nachrichten* M. Emil Schaer describes a novel method of constructing a short-focus astrographic objective. Two lenses of the usual crown and dense flint glasses are employed; the crown is placed in front of the flint, and the back surface of the latter is silvered, so that the photographic plate has to be placed in front of the combination at the combined focal distance. M. Schaer has tried this method with two discs of 280 mm. (about 11 inches) aperture, made for him by M. Mantois, and, by suitably figuring the back surface of the flint before silvering it, has obtained an objective of 89 cm. focal length which is practically free from aberration effects, and has a large light-gathering power. To obviate unnecessary reflections, the two lenses were stuck together.

Another innovation in the construction of objectives is announced in No. 597 of *Science*, where it is stated that a Hungarian chemist, after many years' experimental work, has succeeded in manufacturing perfectly satisfactory fluid lenses. The fluid is hermetically sealed between two hard glass surfaces, similar to watch crystals, the glass being chosen so that the combination is achromatic.

The inventor claims that an objective, equal in practice to any yet made, of 1·50 metres aperture can be made in a few weeks at a cost of 2000 or 3000 marks (*i.e.* about 150*l.*).

These lenses are already being manufactured, and are giving satisfactory results, in Austria, and patents are being taken out in other countries where they are soon to be introduced.

THE GREAT TYPHOON IN THE PHILIPPINE ISLANDS IN SEPTEMBER, 1905.

THE Bulletin of the Manila Observatory for September, 1905, prepared under the direction of the Rev. J. Algué, S.J., affords a striking example of the way in which any abnormal features of the weather are completely masked in monthly, or even shorter, mean values. An inspection of the latter would lead to the conclusion that the month of September was quite normal notwithstanding the occurrence of the terrible typhoon on September 25–26, which was probably the most violent of any yet experienced, not even excepting that of November 5, 1882, the worst previously on record. We gave a brief note of the storm soon after its occurrence, taken from newspaper reports, but the following further particulars from a discussion by the Rev. M. S. Mata, S.J., assistant director, may be of interest.

The disturbance appears to have originated in long. 142° E. and between lat. 11° and 12° N. on September 22, and its path over the Pacific was approximately from east to west; it reached the land on the evening of September 25, and swept across the archipelago in a south-easterly to north-westerly direction, reaching Hainan, in the China Sea, on the evening of September 28. The breadth of the storm was about 100 miles, the centre passing about twenty-four miles south of Manila; the average velocity of translation was 13·5 miles an hour. The first indication of its approach at Manila was on the morning of September 25, when the barometer registered a notable fall of pressure. On the previous day the readings were very high; an anticyclone so well defined had rarely been observed over the Philippines. On the morning of September 26 (at which time telegraphic communication to the south-eastward was already interrupted) the fall became alarming, and continued until 2h. p.m., at which time the minimum (29·21 inches) was reached, the mercury having fallen about 0·7 inch since 9h. p.m. of the previous evening; after a short pause the mercury rose again very rapidly. Between noon and 3h. p.m. the gusts of wind attained a rate of about 103 miles an hour. The rainfall in twenty-four hours amounted to 4¼ inches, of which 2·3 inches fell between 3h. and 5h. p.m., after the passage of the vortex, the wind changing from east-north-east to south-east, with rapidly rising barometer.

The s.s. *Pathfinder* was overtaken by the storm in San Bonifacio (lat. 12° 10′ N., long. 125° 30′ E.), and recorded some notable oscillations of the barometer; at 8h. a.m. on September 25 the reading was 29·78 inches, and the mercury fell rapidly until 7h. 37m. p.m., when the minimum of 27·17 inches was registered. There was a comparative lull in the wind for three or four minutes, and then it blew more fiercely than ever, with a rapid change of direction from north-by-west to west, and drove the ship ashore; in a few minutes the wind shifted to south, and by midnight the barometer had again risen to 29·61 inches. Immense damage was caused by sea and land, especially at the eastern stations. We reproduce an illustration of the destruction of the observatory at Legaspi (lat. 13° 9′, long. 123° 45′); the sea, which had not risen so high for thirty years, rushed into the town with extraordinary force, some parts being submerged to a depth of 2½ feet to 5 feet. At many other places not a single building was left uninjured, and some of the largest trees, which had withstood all previous storms, were uprooted.

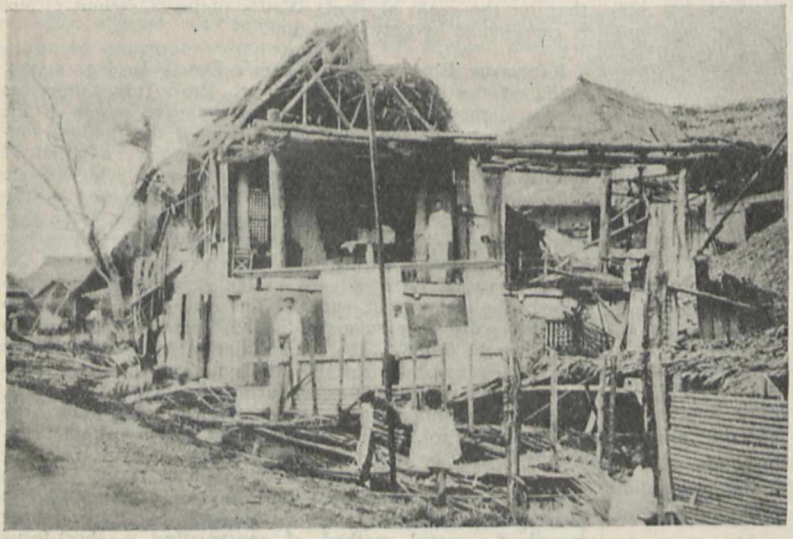

FIG. 1.—Meteorological Station of Legaspi, after the typhoon of September 25–26, 1905.

THE NEW BUILDINGS OF ARMSTRONG COLLEGE, NEWCASTLE-ON-TYNE.

THE new buildings of Armstrong College, to be opened by the King on Wednesday next, July 11, consist of the front wing of the college, together with the large public hall immediately behind the front. The imposing front block of buildings, about 100 yards in length, faces nearly west, and is on the border of the open space known as the Castle Leazes. In the middle of the college front, rising to a height of 120 feet, is the handsome Sir Lowthian Bell tower. The chief entrance is at the base of the tower, and gives access to a spacious vestibule which communicates with the north-east and south-west wings, the principal staircase, and the large public hall to be used for lectures meetings, and examinations.

The front wing consists of four floors. On the ground floor to the north of the entrance are the principal's room, the council room, the staff common room, and a large common room for men students. To the south of the entrance are the secretary's office, the college office with strong room, and the electrical engineering department. This last consists of a lecture room, and a spacious laboratory with wide gallery on one side. On this gallery is the main electrical distribution board, to which leads are brought from every part of the building. There is a second laboratory of the same size in the basement beneath. Outside the college, on the basement level, is built a house for storage cells. Over the ground-floor corridor, in connection with this department, is a large photometric room fitted up with suitable appliances for carrying out tests in a complete manner. Access to this room is obtained from the gallery of the ground-floor laboratory.

On the first floor is the library, with a photographic dark-room adjoining, which is used for lantern-slide and other photographic work. Accommodation is also provided on this floor for the mathematics, the naval architecture, the literature, and the education departments, with their several lecture and private rooms. On the second floor there is provision for the botanical department, consisting of an elementary laboratory, an advanced laboratory, a research laboratory, lecture and preparation rooms with dark-room, and the professor's private room. There are also on this floor lecture rooms for philosophy, modern history, classics, and modern languages, as well as private rooms for the several heads of departments in these subjects. On the third floor is the zoological department, which contains a large room more than 70 feet long, one half of which, towards the front, is used as a zoological museum, and the other half as an elementary laboratory, and also advanced and research laboratories, lecture room,

and professor's private room. In addition, this department has the use of the flat roof over a portion of the floor below. This open space will be utilised for maceration and similar purposes. Associated with the zoological department is the marine laboratory which is about to be erected at Cullercoats, on the coast just north of Tynemouth (see p. 228).

The ventilation of the front wing is provided for by two electrically-driven fans in the tower, which exhaust from the rooms on the several floors. The heating is by means of steam on the new so-called atmospheric system, and the lighting is by 240-volt electric lamps, which can either be supplied from the college central station or from the town supply. Electric arc lanterns are provided in several of the lecture rooms.

The large public hall, in which the chief portion of the opening ceremony is to take place, will accommodate, with the gallery at the south-west end, an audience of about 800.

The foundation-stone of the new buildings was laid by Mr. T. G. Gibson, a member of council and the most generous supporter of the college, on May 2, 1904, and the buildings have been erected to the designs and under the supervision of Mr. W. H. Knowles, of Newcastle.

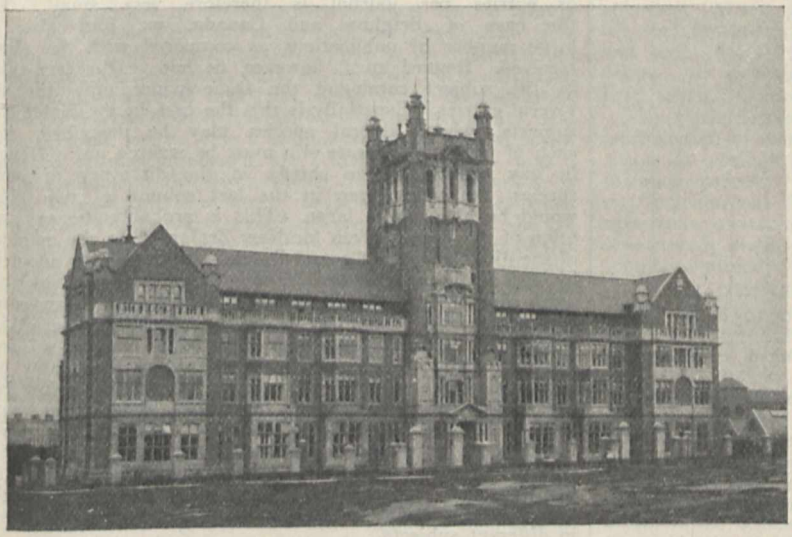

FIG. 1.—New front wing (facing west) of Armstrong College, to be opened by the King on July 11. In the centre is the Sir Lowthian Bell tower.

The cost of the new buildings, together with the fittings, has been nearly 80,000*l*. The funds have been provided by public subscription, and since the buildings are intended as a memorial to the first Lord Armstrong, one of Newcastle's most distinguished citizens and benefactors, the name of the college was in 1904 changed from the Durham College of Science to Armstrong College in the University of Durham. The area of the grounds within which the college stands is between five and six acres. The present buildings occupy about two acres, and more than two acres, excluding roads, &c., are available for the extensions that are being projected. The accompanying photograph shows the front of the college, which forms the west wing.

The number of day students attending the college last session was 539, and in addition about 1100 students attended the evening and special Saturday classes. The college forms an important part of the University of the North of England. The degrees of Durham in science and letters, and its diplomas in agriculture, engineering, and mining are open to students of the college. The Warden of the University (the Dean of Durham) is the president of Armstrong College, Sir Isambard Owen is the principal, and Mr. F. H. Pruen is the secretary.

INTERNATIONAL SCIENCE.[1]

THE pursuit of science has always joined in sympathy men of different nationalities, and, even before the day of rapid letter-post and quick travelling, intercourse, especially by correspondence, exercised a considerable influence on scientific activity. Such intercourse was, however, of a personal and purely stimulating character, and only quite exceptionally was there any direct attempt to organise investigations which required a combination of workers in different localities. Within the last century, however, many problems became urgent which could not be solved without some international agreement, and special organisations came into life which have rendered a service the importance of which cannot be exaggerated.

At present we are confronted with a new difficulty. International combination has become so necessary, and organisations have in consequence increased to such an extent, that they begin to overlap, and there has been some danger of mutual interference. Fear has also been expressed that any attempt to advance knowledge by an organised combination of workers might discourage private efforts, and therefore do mischief rather than good. It must be acknowledged that this danger exists. The proper function of combination must be clearly separated from that of private enterprise, and some general regulating control is therefore called for. The time seems ripe for a general review of the situation.

We may distinguish between three types of international organisations. The first aims simply at collecting information, the second is intended to fix fundamental units or to initiate agreements on matters in which uniformity is desirable, while by the third type of organisation a more direct advance of knowledge is aimed at, and research is carried out according to a combined scheme. Generally, an international association does not entirely fall within any single one of these divisions, but it is useful to draw the distinction and classify the associations according to the main object which they are intended to serve.

The best example of an organisation formed for the purpose of collecting information is furnished by the great undertaking initiated by our Royal Society, and having for its object the systematic cataloguing of the scientific literature of the world, both according to subjects and authors. Twenty-nine countries (counting the four Australian colonies separately) are actively participating in this work by furnishing slips containing the entries which form the basis of the catalogue. A still larger number of countries assist by subscribing to the annual volumes.

The subjects included in the catalogue are classified according to seventeen branches of science as follows :—

A Mathematics	G Mineralogy	N Zoology
B Mechanics	H Geology	O Anatomy
C Physics	I Geography	P Anthropology
D Chemistry	K Palæontology	Q Physiology
E Astronomy	L Biology	R Bacteriology
F Meteorology	M Botany	

Subscribers may either obtain complete sets or any of the separate volumes. The relative popularity of the different subjects is illustrated by the following table, which gives in the different columns for each science the volumes approximately required by each country. The figures are, of course, subject to variations from year to year. The first column shows the number of complete sets subscribed

[1] Discourse delivered at the Royal Institution on Friday, May 18, by Prof. Arthur Schuster, F.R.S.

for, in addition to the separate volumes; these presumably find their way into the university or public libraries.

	Sets	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R
Russia	14	2	2	11	6	18	15	19	20	20	13	8	38	30	5	14	8	8
France	27	4	5	11	17	4	3	10	7	5	6	15	13	12	7	3	18	16
Switzerland	7																	
Canada	7																	
Holland	5	1	2	1	3	1	2	1	2	3	1	4	3	3	1	1	2	3
Greece	2																	
Hungary	4																	
Norway	3			1	1		1						2	4	1	1	2	
India	29	5	4	7	5	2	5	2	3	4	2	5	14	5	2		4	6
United States	62	11	14	17	14	10	11	8	12	10	7	9	12	10	3	3	7	9
Great Britain	29	5	7	18	17	6	8	8	8	5	4	6	6	5	6	6	7	13
Austria	4	1	2	4	2	1	4	3	5	6	2	4	4	5	1	3		1
Cape of Good Hope	6				1			2	2		2			1				
Denmark	6																	
Egypt	1																	
Finland	1	1	2	2	2	1	1	2	3	1	1	1	2	2	1	1	2	1
Germany	44	6	8	14	18	2	5	3	4	5	1	13	9	8	5	2	18	7
Italy	27																	
Japan	15																	
Mexico	5																	
New South Wales	2																	
Nova Scotia	1																	
Orange Riv. Colony	1																	
Poland	1																	
Portugal	1																	
Queensland	2																	
S. Australia	2																	
Sweden	5																	
Victoria	1																	
W. Australia	1																	
Total	315	36	46	86	86	45	55	58	66	59	39	65	103	85	32	34	68	64

The popularity of the special botanical catalogue is remarkable.

We may obtain a rough idea of the scientific activity of different countries by comparing the number of slips received from them during a certain interval. The numbers given in the report published by the International Convention held in London last summer, and referring to all slips received, are shown in the following table:—

	Slips received	Number of journals	Average number of slips per journal
Austria	13,186	535	25
Belgium	2,272	174	13
Canada	537	45	12
Denmark	2,584	40	64
Finland	1,828	33	55
France	60 401	930	65
Germany	213.545	1,397	153
Holland	9,861	70	141
Hungary	2.605	35	75
India and Ceylon	2,699	31	87
Italy	21,238	300	71
Japan	3.043	42	72
New South Wales	2,049	8	256
New Zealand	440	1	440
Norway	2 017	36	56
Poland	5,830	65	90
Russia	25 741	457	56
South Africa	1,872	15	125
South Australia	159	6	26
Sweden	1,939	63	31
Switzerland	5,140	126	41
United Kingdom	56,382	488	116
United States of America	66 071	588	112
Victoria (Australia)	2,858	23	124
Total	504 297	5,508	90

The total number up to March, 1906, has increased to 700,000.

The catalogue begins with the year 1901, but some countries send in their slips rather earlier than others, so that the time interval covered by the investigations to which the table refers is not quite the same for all. Nevertheless, the numbers shown in the table possess a certain interest. I have given in the last two columns the number of journals which different countries take into account, and the ratio of the number of slips to the number of publications. Here again it is difficult to estimate accurately how much value is to be attached to the figures, as there is no uniformity of selection as to what should and what should not be included in the catalogue. Journals which may only very seldom contain any paper which is to be included may unduly diminish the numbers in the last column, which are also affected by the interpretation given as to what is purely technical, and therefore to be excluded. Nevertheless, the comparison between the United Kingdom and France gives the somewhat striking result that, while France is slightly ahead in the number of separate entries it contributes to the catalogue, it takes account of nearly double the number of journals, and the ratio showing the number of entries per journal is therefore very small. In the case of Belgium and Canada, we find also a large number of publications as compared with the slips received. Regard must, however, be had to the fact that in the subject catalogue the same paper may furnish several entries. Especially is this the case in the biological subjects, where several species may be described, for each of which a separate slip must be written out. Hence in any country active chiefly in the discovery of new species the ratio given in the last column of the table would be abnormally large. This is probably the explanation of the figures given for New Zealand. In the opinion of the director of the Central Bureau, the standards adopted by different countries are drawing nearer together as the work proceeds, and before long we may therefore expect to obtain valuable statistical information on the scientific activity in different countries. But this is only an incidental result of the undertaking. It may reasonably be argued that the scientific investigator ought not, before he begins a research, to trouble too much about what may have been done by others in the same direction, but there is no doubt that before publication he should have made himself acquainted with the literature of his subject. A well-arranged catalogue then becomes a necessity, though its value as a means of helping students differs considerably in different subjects.

The governing body of the catalogue is an International Council composed of one representative from each of the countries taking part in the scheme. This council has appointed an executive committee, of which Prof. Armstrong is the chairman.

The Central Bureau for the publication of the catalogue is in London, under the direction of Dr. Henry Forster Morley, who has a staff of thirteen workers under him. There are, in addition, nineteen experts or referees representing the different sciences. The annual office expenses, including salaries, amount to about 2200*l.*; while the expenditure on printing, binding, and publication in the year ending March 1, 1905, amounted to nearly 4900*l.* The two items are just covered by the guarantees of the different countries, which, as already mentioned, take the form of subscriptions for copies of the catalogue, so that it may be said that the central office is self-supporting. After so short a time of working, this success must be a source of considerable satisfaction to Prof. Armstrong and those who have helped to initiate the work; but the expenses incurred in London only represent a fraction of the total cost of the work. Most of the countries establish regional bureaux, which prepare the slips and forward them to London. This really constitutes the most serious part of the work. In Germany, for instance, the Regional Bureau is under the direction of Prof. Uhlworm, one of the university librarians, who is helped by six assistants, and devotes his whole time to the work.

I pass on to an undertaking of a very different kind, but still one which must be included in the class which primarily aims at cataloguing. The accurate determination

of the positions of the stars for a particular period is a work which must precede all exact investigations of their proper motions. Hence it constitutes a fundamental problem of astronomy. The multitude of stars seen on a bright night is bewildering to the casual observer. They are described in poetical writings as innumerable, but when an actual count is made, it is found that their number is really moderate, and it is doubtful if more than two thousand stars have ever been visible to the naked eye at the same time. The use of the telescope considerably increases this number, according to the size of the object-glass or reflecting mirror used. Thus Argelander in his great star catalogue included nearly 324,200 stars which he observed through his telescope of four inches aperture. The advent of photography and the manufacture of suitable lenses to be used in connection with photography increased the astronomical output of a fine night to such an extent that it became possible to make a further and very substantial advance. The International Star Catalogue which is at present being constructed owes its origin chiefly to the hard work of Admiral Mouchez, who was at the time director of the Paris Observatory, and who became converted to the feasibility of the plan by the excellent results obtained by the Brothers Henry, the pioneers in star photography. He was assisted by the energetic support of Sir David Gill, to whom the first suggestion was due. The programme of work was determined upon at an International Conference which met at Paris in the year 1887. Eighteen observatories were to take part in the work, the telescopes to be used were to have an aperture of thirteen inches, and such a focal length that a millimetre on the plate corresponded to one minute of arc. Each observatory had a certain region of the sky assigned to it, and undertook to cover this region four times, twice with plates of short exposure, twice with plates of long exposure, and to measure all the stars appearing on the short-exposure photographs. The long exposures were intended for reproduction in the form of charts, and are only taken by some of the observatories. As there are about 400 stars on each plate, and it takes about 600 plates to cover the share of one observatory once, this means that each observatory has to measure nearly half a million star places, and that the complete catalogue will give the positions of nearly 4½ million stars. This includes all stars down to the eleventh magnitude.

The following is a list of observatories taking part in the work:—For the northern hemisphere, Greenwich, Oxford, Paris, Bordeaux, Toulouse, Potsdam, Helsingfors, Rome, Catania, Algiers. For the southern hemisphere, San Fernando, Tacubaya, Santiago de Chile, Cordoba, Cape of Good Hope, Perth (W. Australia), Sydney, Melbourne.

The work connected with the ultimate completion of the catalogue, and especially the reproduction of the star maps, requires a considerable expenditure. Each country has to make its own arrangements, which in the British Empire usually means that each body concerned has to pay its own expenses. There was, however, in this case some official help. The Astronomer Royal obtained a contribution of 5000*l.* from the Government for the reproduction of charts, and in the case of the Cape of Good Hope the necessary expenses have been met from Imperial funds. Prof. Turner, of Oxford, has obtained a grant of 1000*l.* from the Government grant of the Royal Society, and a further sum of 2000*l.* for publication from the Treasury and the University of Oxford jointly; but the Australian colonies are much hampered by the want of funds, and their work will be delayed in consequence. The four French observatories, on the other hand, are well supported. Each of them has received a Government contribution of 25,700*l.*, making a total of well over 100,000*l.* More than half this goes towards the reproductions of the long-exposure photographs as a series of charts, which, however, have proved to be so costly that they will probably never be completed. Indeed, if completed, their utility may to some extent be impaired by the difficulty of storing them in an accessible manner. Prof. Turner calculates that the series of maps will form a pile of paper 30 feet high, weighing about two tons.

I now pass on to those undertakings which are intended to fix standards of measurement, or to establish a general agreement on matters in which uniformity is desirable. The foremost place in this division must be given to the Bureau International des Poids et Mesures, which was established in the year 1873 at Sèvres, near Paris. This bureau was the outcome of an International Commission constituted in 1869, which had for its object the scientific construction of a series of international metric standards. By a convention entered into by the different countries at a diplomatic conference held at Paris in March and April, 1875, means were created for carrying out the work of verifying standards under a new International Metric Committee, and for the purpose of enabling the committee to execute its duties effectually, as well as of securing the future custody and preservation of new metric prototypes and instruments, the Permanent Metric Bureau was founded. The original cost of the bureau was 20,000*l.*, and the annual budget was fixed at 3000*l.* for the period during which the prototypes were being prepared, after which time it was expected that the expenditure could be reduced to 2000*l.* In 1901, however, it reached 4000*l.*, the maximum to which, by the terms of the convention, the annual budget could be raised. Great Britain did not join the convention until 1884, when it declared its adhesion. A first payment of 1787*l.* was made as entrance fee, and the annual contribution now ranges between 200*l.* and 300*l.* Major MacMahon, to whom I owe the above details, is at present the British representative on the International Committee.

The work carried out at Sèvres is not confined to the reproduction of metric standards, but measurements of precision in various directions have been made with conspicuous success. Scientific thermometry owes much to the International Bureau, and in some respects it may be said that exact thermometry was created there. Prof. Michelson's work, in which the length of the metre was compared directly with the length of a wave of red light, is another classical investigation carried on in the laboratories of the International Bureau. More recently Mr. Guillaume examined the physical properties of alloys, notably those of nickel steel, and proved the possibility of manufacturing a material which shows no sensible expansion with rise of temperature. The importance of metallic rods the length of which does not depend on temperature is obvious, provided they prove to be of sufficient permanence.

Time does not allow me to give an account of the conference and conventions which have led to a general agreement on the standards of electric measurements, but it is a satisfaction to know that these standards are essentially those proposed and first constructed by the British Association. The old British Association ohm no doubt was found to be wrong by more than 1 per cent., but it has remained the prototype of the present international unit, and in principle the old ohm, volt, and unit of current stand as they were given to us by the original committee.[1]

While in the case of scientific units complete agreement is absolutely essential, uniformity is desirable in other cases. There are matters of nomenclature in which confusion has arisen purely from want of general agreement. Thus the great recent improvement in the optical power of telescopes has led to the discovery of many details on the surface of the moon. Small craters or other distinctive features named by one observer were not correctly identified by another, so that at the present time the same name is applied to quite different things by different observers. It is quite clear that an international agreement in lunar nomenclature is called for.

There are other deficiencies of uniformity which perhaps appear trivial, but which yet lead to the waste of a good deal of time. Such, for instance, is the position of the index in scientific books. The index is placed sometimes at the beginning, sometimes at the end, and sometimes neither at the beginning nor at the end. Some books have no index,

1 The original committee was appointed in 1861, and consisted of Profs. A. Williamson, C. Wheatstone, W. Thomson (Lord Kelvin), W. H. Miller, Dr. A. Matthiessen, and Mr. F. Jenkins. In the following year, Messrs. C. Varley, Balfour Stewart, C. W. (Sir William) Siemens, Prof. Clerk Maxwell, Dr. Joule, Dr. Esselbach, and Sir Charles Bright were added to the committee.

some have two, one for the subject-matter and one for names of authors. The loss of time which arises from one's ignorance as to where to look for the index cannot be estimated simply by what is spent on the search, but must include the time necessary to regain the placidity of thought which is essential to scientific work.

It is time we turned to the more serious aspect of those international associations which directly aim at an advance of knowledge. Mathematicians have drawn interesting conclusions from the contemplation of ideal beings who are confined to live on a surface and have no knowledge of anything that goes on outside that surface. Our Euclidean geometry would be unknown to them, and spiritualistic tricks could be performed by anyone possessing, even to a minute extent, the power of controlling a third dimension. It is, I think, worth while investigating the extent of the direct knowledge of a third dimension, which makes us so infinitely superior to the two-dimensional beings. We are able, no doubt, through our eyes, to penetrate the depths of space, but we should be unable to interpret the impressions of our sight if we had not some tangible knowledge of three dimensions, and had not learned to bring the sense of sight and the sense of touch into harmony. But our sense of touch is confined to a very small distance from the ground on which we stand, and independently of artificial means of raising ourselves above the surface of the earth, a layer 6 feet or 7 feet thick represents the extent of our three-dimensional knowledge. Compared with the radius of the earth, the thickness of such a layer is small enough, for it would represent only the thickness of a sheet of paper on a sphere having a radius of 250 metres; compared with the solar system, and even more so with stellar distance, a thickness of layer of 8 feet seems infinitesimal. Yet the infinitesimal is essentially different from the zero, and even were our bodies much smaller than they are we should continue to have the power to interpret three dimensions. These considerations show how important it is for us to increase our knowledge of the earth itself, and to extend it so far as possible to the depth below our feet and the height above our heads.

In passing from the arbitrary units to which we refer our terrestrial measurements of length, to the scale on which we measure the dimensions of the solar system, and from them to stellar distances, the magnitude of the earth's radius or circumference forms an all-important intermediate quantity. One of the first acts of the French Academy of Sciences, founded in 1666, consisted in organising the work of accurately measuring the dimensions of the earth, and this at once enabled Newton to confirm his celebrated theory of universal gravitation. As improvements in the methods of measuring kept pace with the work actually accomplished our knowledge steadily increased, but we are still improving on it. New problems have arisen requiring more minute study, and the measurements of the shape and size of the earth still remain a question of the first importance. The actual surveys and triangulation required for the purpose are of necessity left to the initiative of individual States or to the combination of the States primarily concerned, but the general discussion of results, so far as they apply to the earth as a whole, is entrusted to an International Geodetic Association, which at present consists of twenty-one States. These, together with their annual contributions to the general fund, are entered in the following table:—

	£		£
Belgium	80	Austria	300
Denmark	40	Portugal	80
Germany	300	Roumania	80
France	300	Russia	300
Greece	40	Sweden	40
Great Britain	300	Switzerland	40
Italy	300	Servia	40
Japan	300	Spain	150
Mexico	150	Hungary	150
The Colonies of the Netherlands	40	United States of America	300
Norway	40		

The Central Bureau of this association is attached to the Royal Geodetic Institute of Potsdam, which is under the distinguished direction of Prof. Helmert, who acts as secretary to the association.

The question of measuring the size of the earth depends to a great extent on the measurement of arcs of meridian. So long as we were confined to Europe for the measurements of these arcs they remained necessarily short, but larger and larger portions of our globe have become accessible to the theodolite, and there is especially one arc which is distinguished by the fact that it is the longest possible which can be traced along the land covering the earth's surface. It runs about 30° east of Greenwich, and a large portion of it passes through Africa. Owing to the great energy and enterprise of Sir David Gill, the work of measuring this arc is well in hand, though at the present moment want of funds threatens to endanger its completion. The Egyptian Survey entrusted to Captain Lyons will no doubt receive continued support, and by an arrangement entered into between representatives of the German Government and Sir David Gill at a conference held in Berlin in 1896, Germany undertook to carry out the triangulation through her territory in South-West Africa. I understand this work has been done, and the triangulation of the Transvaal and the Orange River Colony is also complete. There is still a gap in the southern part of Rhodesia, but there is every hope that this will soon be bridged over. The British South African Company has spent 36,000*l.* on the work and thus has very materially assisted an important enterprise. When the African arc is complete it will be connected with the Russian and Roumanian arcs so as to form a continuous chain of 105° extending from 70° north to 35° south latitude. I have to point out, however, that, in the opinion of those best able to judge, the completion of the South African arc is not the only undertaking to which this country is called upon to pay attention. The triangulation of our own island, excellent as it was when first made, has fallen below the accuracy required in modern geodetic work. Until our fundamental triangulation has been repeated, the sums which at present are being spent on the detailed survey might find a better use.

The main result of the recent work has been that, so far as present measurements allow us to judge, the surface of the ocean can be well represented by a surface of revolution, and it is not necessary to assume a more complicated shape. The mean radius of the earth is determined to about 100 metres, which means a possibility of doubt amounting to about 1 part in 60,000.

Geodetic work is, however, not confined to measurements of length, for important information may be derived from an exact knowledge of the acceleration of gravity over its surface. The introduction of the pendulum of short length intended for relative and not for absolute measurement has greatly facilitated this work, and it is hoped that these pendulum observations may be carried out over still more extended regions. India is setting a good example. It has measured two arcs of meridian, and the gravitational work carried out by Captain Burrard, and recently published by the Royal Society, is of primary importance. But otherwise English colonies require encouragement to do more. I am assured that measurements of the gravitational constant in Canada would be of the greatest importance.

The bearing of such work on our knowledge of the earth may perhaps be illustrated by one example. It has often been a matter of wonder how mountain chains such as the Himalayas could rest on the lower strata of the earth without crushing them and forcing them in by the pure power of their weight, and the most plausible theory to account for this was found in the idea first suggested by Pratt, that the mountain chains must not be compared with a large weight resting on an under-structure, but rather with a lighter body partially immersed in a heavier one. Mountains, according to this theory, float in the body of the earth very much like icebergs float in water. The truth of this theory can only be tested by accurate measurement of the gravitational force, from which information may be derived on the distribution of density in the earth's strata near the surface. On the whole, the measurements so far available have confirmed Pratt's hypothesis.

More recently another problem has occupied the atten-

tion of the International Geodetic Association, and, owing to its immediate interest, has absorbed the greater portion of its funds. The astronomical world was surprised by the announcement of Prof. Chandler that he was able to demonstrate from existing observations that the earth's pole describes a closed curve taking about fourteen months to complete a revolution. The possibility of a periodic shift of the earth's axis was foreseen by Euler, who calculated the time of revolution to be ten months; but observations did not show a sensible period of that duration. No one apparently before Chandler tried to see whether another period beyond a small annual one existed. The discrepancy between the calculated ten and the observed fourteen months was cleared up by Prof. Newcomb, who pointed out that Euler's calculation was based on the supposition that the earth is an absolutely rigid body. Any yielding would increase the length of the period; in fact, the earth must be more rigid than steel in order that the period should be as short as fourteen months. This shows how indirect information on the physical properties of the earth may be obtained sometimes in an unexpected manner, the periodic revolution of the pole leading to an estimate of the average rigidity of the interior of the earth. The total displacement of the pole of the earth from its average position is small, never amounting to more than 8 metres. The accuracy with which that displacement can be measured is a testimony to the excellence of our astronomical observations. It is a type of work in which cooperation is absolutely necessary. The subject has received additional interest through the suggestion made by Prof. Milne in his recent Bakerian lecture that seismic disturbances may be caused by the changes in the position of the earth's axis. Considering that the distortions in the earth are sufficient to increase the periodic revolution of the pole from ten to fourteen months, this suggestion is well worth investigation, and the 300*l.* per annum spent by this country in support of the work of the Geodetic Association will be well employed if it allows the vagaries of our pole to be more closely studied and all the dimensional quantities of the surface of the earth to become more accurately known.

The contributions received by the Central Bureau of this association from the participating States amount to about 3000*l.*, and there is a balance which at the end of 1904 amounted to more than 5000*l.* The expenditure during 1905 was nearly 5000*l.*, reducing the balance by 2000*l.* The principal items of the expenditure were formed by contributions towards the maintenance of six stations in the northern and two stations in the southern hemisphere for carrying out the observations relating to the changes of the position of the earth's axis. The whole cost of this service is about 4450*l.* The honorarium of the secretary is 250*l.*, which, together with the cost of printing, postage, and a small item for grants toward special scientific work, makes up the expenditure. No charges are made for office expenses, which are defrayed by the Prussian Government.

The geodetic work indirectly gives us valuable, though only partial, information on the interior of the earth, but it confines itself in the main to the surface of the globe; the investigation of our atmosphere carries us beyond.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. J. P. HILL has been appointed to the Jodrell chair of zoology at University College, London.

AT King's College, London, Dr. C. S. Myers has been appointed professor of psychology (including experimental psychology), and Mr. H. S. Allen senior lecturer in physics.

THE Rev. T. C. Fitzpatrick, dean and supernumerary fellow of Christ's College, has been elected president of Queens' College, Cambridge, in succession to the Bishop of Ely.

A COURSE of five free public lectures is to be given, in accordance with the will of Mr. Brown, in the physiological laboratory of the University of London on July 9, 11, 13, 16, and 18, by Prof. T. G. Brodie, F.R.S., on the "Secretion of Urine under Normal and under Pathological Conditions."

THE trustees of the Brooklyn Polytechnic Institute have, we learn from *Science*, subscribed 160,000*l.* toward the 400,000*l.* necessary to endow the proposed extension of the institute, affording facilities for more advanced work. In addition to this handsome provision for higher education, our contemporary announces that Mr. and Mrs. Jacob Turtellout, of Minneapolis, have offered to give 80,000*l.* to build and endow an academy for the town of Thompson, Conn., and that Dr. Henry M. Saunders, of New York, a trustee of Vassar College, has given 15,000*l.* for the erection of a building as a memorial to his wife.

THE current number of *Macmillan's Magazine* contains an article by Mr. A. C. Passmore on technical education, in which some of the weaknesses of systems of instruction of this type are summarised. The need is insisted upon for adequate preliminary training of a suitable kind for students beginning courses of technology. It is urged that instead of being in such a hurry to provide technical schools it would be worth while to consider the qualifications and fitness of the teachers. The examination system is cited as one of the chief causes conspiring to make British technical education unsatisfactory. But the author appears to be unacquainted with the work being done in many of the great municipal technical schools, and to have ceased his educational observations some ten or fifteen years ago. Conditions at present are better than Mr. Passmore paints them.

AMONG the bequests made by Mr. F. W. Webb, who died on June 4, we notice the following:—2000*l.* to Owens College, Manchester, to establish for the benefit of employees and sons of employees of the London and North-Western Railway a "Webb" scholarship tenable at Owens College, Manchester; 2000*l.* to the University College of Liverpool for a similar purpose there as defined for Owens College, Manchester; 1000*l.* to the Institute of Civil Engineers for providing annually a "Webb Medal," and a premium of books to be awarded for the best paper on railway machinery.

THE annual assembly and prize distribution at University College, London, on Tuesday, July 3, was of more than usual interest from the fact that the friends of Prof. Carey Foster had taken the opportunity of then presenting to the college the portrait of Prof Foster which has been painted by Mr. Augustus John. The presentation was made by Prof. F. T. Trouton, who recalled the fact that Prof. Foster was the first to introduce practical laboratory teaching in physics into England. Many of the methods devised by him in the development of his laboratory courses are to-day recognised as standard ones. For instance, every student has to go through and know his Carey-Foster Bridge as surely and regularly as at school he has to pass the fifth proposition of the first book of Euclid. The example set by Foster was followed in laboratory after laboratory, until to-day there is not a town without its course of experimental physics. Prof. Trouton concluded by hoping that though the portrait represented its subject as an older man than he really is, yet his useful life might be spared until the portrait may become that of a much younger man. The Right Hon. Lord Reay, G.C.S.I., who received the portrait on behalf of the college, referred to the great impetus which the study of physics had received by his work and writings, which are characterised by great clearness and lucidity. More especially he referred to the debt owed to Prof. Foster by the college, of which he became the first principal at a time at which great tact and knowledge were required in connection with the delicate negotiations leading to the incorporation of the college in the University of London. His lordship concluded by presenting a replica of the portrait to Mrs. Carey Foster. Prof. Foster, in acknowledging the presentations, alluded to the interval of fifty-three years since he was first present at a ceremony of the same kind. In one respect the present ceremony was of historical interest, inasmuch as it was the last ceremony to be held by the college before its incorporation. He looked forward to the advantages arising from this incorporation. The prominent defect in the higher teaching in London is the dispersion of the large

resources amongst various organisations which are in some respects rivals. Principal Rücker had recently said that "any organisation to be visible must be on a grand scale." It is only by combination that the colleges of London can hope to attract the support which is so urgently needed.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 8.—"The Microscopic Changes in the Nervous System in a Case of Chronic Dourine or Mal de Coit, and Comparison of the Same with Those found in Sleeping Sickness." By Dr. F. W. **Mott**, F.R.S.
(From the Pathological Laboratory of the London County Asylums.)

The author describes the changes in the central nervous system of an Arab stallion, which acquired the disease by infective coitus. After exhibiting 156 characteristic cutaneous plaques, together with marked symptoms of paraplegia, it died 27½ months after infection. The material was forwarded by Dr. Lingard, director of the Imperial Bacteriological Laboratory of India, who has written an interesting monograph on dourine. A full description of the etiology and clinical symptoms of this disease is contained in this monograph, and an account in detail of this particular case.

Dourine is due to a specific form of trypanosome, affects equines, and is transmitted, like syphilis, by coitus. This is of especial interest, since the *Spirochaeta pallida* has been shown to be the infecting agent in syphilis.

A comparative examination of the tissues of the central nervous system in this disease and in sleeping sickness, experimental and human, appears to show that prolonged trypanosome infection results in a chronic lymphadenitis, followed later by a chronic interstitial inflammation of the lymphatic structures of the nervous system. The morbid process in the case of dourine starts in one seat of primary infection, extends to the inguinal glands, and thence (presumably by the pelvic lymphatics) spreads by the lumbosacral nerves to the posterior spinal ganglia, where it may set up an intense inflammatory process with destructive atrophy of the cells. This destruction of the trophic sensory centres which was found in this case of dourine would account for the cutaneous eruption which occurred during life. It would account also for the marked degeneration of the posterior roots and the sclerosis in the posterior columns, especially in the root zones. The lesion in some respects therefore resembled locomotor ataxy, and it is of interest to note that cases of dourine have occurred in which fractures and dislocations have been observed—due probably to neurotrophic changes. Moreover, there were other signs of chronic irritation observed elsewhere in the spinal cord and nervous system, viz. subpial and septal proliferation of the glia tissue. Marck has described the disease as an infective polyneuritis; there were reasons, however, in this case, for supposing that the motor nerves were not affected by a degenerative change in the same way as the posterior roots.

March 22.—"A Note on the Theory of Directive Antennæ or Unsymmetrical Hertzian Oscillators." By Prof. J. A. **Fleming**, F.R.S.

This paper deals with the theory of bent or unsymmetrical Hertzian oscillators. As is well known, a straight linear oscillator radiates equally in all directions around the axis. It has been found, however, by Mr. Marconi that if an antenna for electric-wave telegraphy is bent so that a short part of its length, rising from the earth, is vertical, and the greater part horizontal, and therefore parallel to the earth, such an oscillator radiates less in the direction in which the free end points than in the opposite direction.[1] This is of great practical importance, and the writer accordingly investigated mathematically the behaviour of a simple case of an unsymmetrical oscillator consisting of three simple oscillators of equal electric moment ϕ superimposed so as to make a doubly bent oscillator of the shape ⊏.

If V denotes the scalar potential at a point in the field at a distance r large compared with the dimensions of the oscillator, and F, G, and H the components of vector potential, then it is shown in the paper that

$$V = -\frac{\phi}{k}\frac{d\Pi}{dz} + \tfrac{1}{2}\frac{\phi}{k}\frac{d^2\Pi}{dydz}\delta y - \frac{\phi}{k}\frac{d^2\Pi}{dzdy}dz,$$

$$F = 0,\ G = \phi\frac{d^2\Pi}{dzdt}\delta z,\ H = \phi\frac{d\Pi}{at} - \tfrac{1}{2}\phi\frac{d^2\Pi}{dydt}\delta y,$$

where $\Pi = \sin(mr - nt)/r$, and from these expressions the electric (E) and magnetic (H) force at various points in the field can be obtained. The final result is to give expressions for these forces normal to the radius vector drawn in the equatorial plane of symmetry as follows:—

$$H = \frac{1}{r^3}\left[\left(\phi v m^2 r^2\right)^2 + \left(\phi v m r - \frac{M}{z}m^2r^2\cos\theta\right)^2\right]^{\frac{1}{2}},$$

$$E = \frac{1}{kr^3}\left[\left(\phi(m^2r^2-1) + \tfrac{3}{2}\frac{M}{v}\frac{\cos\theta}{mr}\right)^2 + \left(\phi mr - \frac{M}{2v}\left(m^2r^2+3\right)\cos\theta\right)^2\right]^{\frac{1}{2}},$$

where $\cos\theta$ is the azimuthal angle the radius vector makes with the axis of the oscillator reckoned from the direction in which the free ends point. These expressions show that as θ increases from 0° to 180° the values of E and H vary, and are greater when $\theta = 180°$ than when $\theta = 0°$.

Hence there is an unsymmetrical radiation by such an oscillator, greatest in the direction opposite to that in which the free ends point.

Such an oscillator may also be regarded as the combination of a completely closed conductive circuit or *magnetic* oscillator with a straight or open *electric* oscillator. The field of the magnetic oscillator was investigated by the late Prof. G. F. Fitzgerald (see his scientific writings, edited by Prof. J. Larmor, Sec.R.S., p. 128) prior to the date of Hertz's discoveries, and in the discussion at the Royal Society on March 22 on Mr. Marconi's paper, *loc. cit.*, it was pointed out by Prof. J. Larmor that a bent oscillator of the kind above discussed was equivalent in electromagnetic action to a magnetic *plus* an electric oscillator.

May 3.—"On a Static Method of Comparing the Densities of Gases." By R. **Threlfall**, F.R.S.

Since it is a simple matter to make a manometer showing differences of gas pressure of a few centimetres of water, accurate to between 1/100 mm. and 1/1000 mm., according to the construction, it is possible to determine the relative densities of gases by a method similar to the one employed by Regnault in determining the temperature-density variation of mercury.

It is shown that, using gas columns 20 metres long, the difference of density of "chemical" and "atmospheric" nitrogen should be capable of observation. The author has employed the method in a comparison of the densities of producer gas and air, using gas columns about 20 metres in height. The two columns of gas and air respectively were contained in composition pipes twisted together and immersed in water in an outer iron pipe through which a stream of water passed.

In two experiments on two different samples of gas differences of pressure of 0·3458 cm. and 0·3550 cm. of water respectively were observed, and producer-gas densities accurate to about 1/5000th part in terms of the density of air were deduced. The commercial micromanometer made by the Cambridge Scientific Instrument Co. to the author's designs was employed in these comparisons, and, since it is possible to construct an instrument say five times as sensitive, and to use columns of gas at least twice as long without inconvenience, the method should yield values of relative density correct to 1 part in 10,000 without difficulty.

[1] See Proc. Roy. Soc., vol. lxxvii. p. 413, 1906. G. Marconi, "On Methods whereby the Radiation of Electric Waves may be mainly confined to certain Directions, and whereby the Receptivity of a Receiver may be restricted to Electric Waves emanating from certain Directions."

June 7.—"Effects of Self-induction in an Iron Cylinder." By Prof. Ernest **Wilson.** Communicated by Sir William H. Preece, K.C.B., F.R.S.

An iron cylinder 10 inches (25·4 cm.) in diameter is traversed in the direction of its axis of figure by an electric current, which is allowed to become steady. Under the action of a sufficiently large potential difference and non-inductive resistance the *total* current is suddenly reversed and maintained constant, and its propagation to the centre of the cylinder is investigated by aid of embedded exploring coils. The results show that a current of about 500 amperes takes two minutes to become steady over the whole section of the cylinder. The delay is caused by the opposing electromotive forces induced in the mass by the change of the magnetic fluxes produced by the currents interior to the successive annuli. When the total current is small, the induced E.M.F.'s at the centre, for example, occur at once, and then die away. With currents of about 300 amperes a second maximum is developed after about eighty seconds. For gradually increased total currents the second maximum occurs at shorter intervals of time after reversal, and becomes the most prominent feature of the phenomenon.

The results obtained can be applied to cylinders of other diameters than the one experimented upon, and an estimate is made of the time taken fully to make use of the whole section of an iron telegraph wire and steel rails as used in alternate-current traction.

Mineralogical Society, June 12.—Prof. H. A. Miers, F.R.S., president, in the chair.—Sartorite from the Binnenthal: Dr. C. O. **Trechmann.** This mineral has hitherto been held to crystallise in the orthorhombic system, and full descriptions have appeared from the pens of vom Rath and Baumhauer. Solly, later, assigns it to the monoclinic system, without, however, publishing details. Two very perfect crystals, originally attached to each other, were examined and compared with other crystals and with the results of the above-named authors. Both crystals exhibit conspicuous monoclinic habit, and one is a distinct twin. The elements of vom Rath are $: a : b : c = 0{\cdot}539 : 1 : 0{\cdot}619$. The elements arrived at now are $: a : b : c = 1{\cdot}27552 : 1 : 1{\cdot}19487$ with β 77° 48′, in which $a : b : c$ correspond with $c : b : a$ of vom Rath. The twin and composition plane is $a = (100)$, and the twinned crystal is a juxtaposition twin on this face. Further evidence of the twinned structure is afforded by many narrow, twin lamellæ on the above law. Baumhauer records fifty-nine observed forms on this mineral, including thirteen pyramids. On the above two crystals eighty-seven forms were observed, including thirty-five pyramids. There is little agreement in the angles and forms with those of the other five crystals, or with previous observations. In the zone of the prisms (brachydomes of vom Rath), however, there is a close agreement, sufficient to make it very probable that all the examined crystals belong to the mineral sartorite. Further research is necessary on the scarce material in order to show whether two or more morphotropically related minerals may not be involved here.—The occurrence of axinite in the area south of Bodmin, in Cornwall: G. **Barrow.**—Cassiterite pseudomorphs from Bolivia: R. **Pearce.** The frequent occurrence of cindery and cellular cassiterite in Bolivia suggested that the pseudomorphs might be after a sulphostannate, but this is not borne out by the crystallographic examination made by Mr. L. J. Spencer.—Notes on skiodroms and isogyres: Dr. J. W. **Evans.** The author referred to Prof. Becke's paper on the subject, and showed that the derivation of the forms and movements of isogyres (the loci in convergent polarised light of vibrations extinguished under crossed nicols) from the skiodroms (the curves expressing the directions of such vibrations) are simplified when a microscope with revolving nicols is employed, instead of one with a revolving stage.—A pseudomorph of quartz after apophyllite: H. **Hartley** and N. Garrod **Thomas.**—A heating stage for the Dick microscope: H. **Hartley.**—Mr. J. P. **De Castro** exhibited a large crystal of tantalite from Western Australia, and Mr. R. **Pearce** specimens of axinite from St. Ives, Cornwall.

Faraday Society, June 12.—Mr. W. Murray Morrison in the chair.—The electrolytic deposition of zinc, using rotating electrodes: Dr. T. Slater **Price** and G. H. B. **Judge.** An improved form of apparatus for the electrolytic deposition of metals, using a rotating kathode, is described. The ordinary beaker is replaced by a tap funnel of about 100 c.c. capacity, so that the electrolyte can be run off at the end of the experiment, thus obviating the use of a siphon.—A simple form of rotating kathode for electrochemical analysis: Dr. F. Mollwo **Perkin.** The kathode consists of a spiral of platinum wire, or, better, iridio-platinum wire. Nickel wire may be substituted for platinum, and the author recommends its employment in place of the more expensive metal. Attention is also directed to the solubility of platinum anodes, with heavy currents 0·0016 grm. being dissolved in a cyanide solution in thirty-five minutes.—The electrolysis of solutions of thiocyanates in pyridine and in acetone: S. **Binning** and Dr. F. Mollwo **Perkin.** On oxidation of thiocyanates with chlorine, persulphates, &c., a yellow colouring matter—canarine—is obtained. By electrolysis of aqueous acidified solutions of thiocyanates an apparently similar product, which was originally described in 1884 by Lurdow, is obtained. The authors consider that this substance is not identical with the canarine obtained by chemical means, because it shows certain reactions not given by the oxidation product.

Geological Society, June 13.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—Recumbent folds produced as a result of flow: Prof. W. J. **Sollas.** Prof. Lugeon has described a series of recumbent folds so greatly exceeding in horizontal extension their vertical thickness that they are spoken of as sheets; they lie flat one on the other, and those higher in the series extend farther to the front than those below, a feature referred to as "*déferlement.*" The roots of the lower folds are visible in the high Alps adjacent, but the roots of the higher must be sought in the zone of Mont Blanc and the Briançonnais. Thus some of the uppermost folds may have surmounted the obstacle presented by Mont Blanc on their way to the front in the pre-Alps. The features presented by recumbent folds are more suggestive of flowing than bending. Experiments have been made with pitch-glaciers (*poissiers*) in which an obstruction was placed. Folds were produced, one of which was like the Morcles fold behind the Diablerets, another like the Pilatus, and yet another like the Sentis, and the fourth compared with the overslide of the Bavarian front; all four exhibit *déferlement.* The lower limb of each fold is adjacent to the similar limb of its neighbours; but, in another experiment, in which two obstacles were used, the results were nearer to those seen in the mountains, where the lower limb of a superior fold reposes on the upper limb of the fold immediately beneath it.—The Crag of Iceland—an intercalation in the basalt-formation: Dr. Helgi **Pjetursson.** The existence of fossiliferous deposits on the west coast of Tjörnes, N. Iceland, has been known for 160 years. Mörch enumerates sixty-one species of Mollusca, and concludes that the temperature must have been much milder than at present. From the shells, it has been considered that the deposit could not be younger than Middle Reg Crag. Dr. Thoroddsen thinks that these Crags are younger than the Old Basalts of Tjörnes. The author finds, however, that, about 500 feet above the sea, they are overlain by the Eastern Basalts. Thus there is a fossiliferous intercalation occupying part of the great gap between the Tertiary and the Pleistocene rocks. The basal layer of the Pleistocene series is fossiliferous, and has yielded twenty-two species of Mollusca, twenty of which represent a highly Arctic fauna. Certain of the larger basalt-dykes are cut off at the base of the Crag. The absence of the Crag-deposits from other localities is explained by the erosion of the coast-line.

PARIS.

Academy of Sciences. June 18.—M. H. Poincaré in the chair.—Researches on the direct synthesis of nitric acid and nitrates from their elements at the ordinary temperature: M. **Berthelot.** Nitrogen and oxygen were caused to combine at the ordinary temperature under the action of the silent discharge, care being taken that no visible

sparks were produced in the apparatus. In some experiments a confined volume of the mixed gases was used; in others a current of gas was slowly circulated through the apparatus for a period of several hours. In all cases nitric acid was the sole product, and this whether the oxygen or nitrogen was in excess. Oxides of nitrogen, nitrous acid, and ammonia were looked for, but were invariably absent, even when the reaction took place in the presence of potash solution.—The application of the telephone and the Claude-Driencourt astrolabe to the determination of the longitude of Brest: E. **Guyou.** Two chronometers, beating half-seconds, were used for the transmission of time, one being regulated to mean time, the other to sidereal time, in order to allow of the application of the method of coincidences. A microphone placed on the glass of each chronometer enabled the beat to be heard in the telephone at the distant station, two observers furnished with receivers working at each station. It was found that the deviations between the comparisons obtained at the same place by two different observations were generally less than 0·01 second, these deviations being indifferently positive and negative, showing the freedom from an appreciable personal error. The results obtained at both ends are of the same accuracy as those obtained at a single station, showing that there is no advantage in working from both ends.—The action of carbon monoxide at a red heat upon steam, and of hydrogen upon carbon dioxide. The application of these reactions to the study of volcanic phenomena: Armand **Gautier.** At a full red heat (1200° C. to 1300° C.) carbon dioxide is reduced by hydrogen, the reaction being limited when the volume of carbon monoxide produced is half that of the hydrogen remaining. The inverse reaction between carbon monoxide and steam was also studied, the composition of the gas mixture being represented by the equation

$$3CO+2H_2O=2CO_2+2H_2+CO.$$

The bearing of this reaction upon volcanic phenomena is discussed.—Some new properties of malt extract: L. **Maquenne** and Eugène **Roux.** The activity of malt extract, prepared rapidly in the cold, increases on standing, and the advantageous influence exercised by acids is due to the fact that they are favourable to the establishment of this new state of equilibrium.—Some Patagonian fossils. Study of a portion of the Antarctic region: Albert **Gaudry.**—The use of metallic oxides as catalysers in oxidation: Paul **Sabatier** and Alphonse **Mailhe.** If a mixture of a paraffin with oxygen is passed over a column of copper oxide heated to a temperature of about 200° C., the oxide glows, and the reaction continues without further heating of the tube being necessary. The greater part of the hydrocarbon is burnt to carbon dioxide and water, but small quantities of aldehydes and acids are found condensed in the water produced in the reaction.—The experimental production of transmissible varieties of the tubercle bacillus and of anti-tuberculous vaccine: S. **Arloing.** A modified human tubercle bacillus has been obtained, the acquired properties being fixed after the eighth generation. It differs from the original bacillus only in that its pathogenic effects are reduced in intensity. This bacillus has been successfully used since 1902 for anti-tuberculous vaccination of calves.—M. Edmund Weiss was elected correspondant in the section of astronomy in the place of M. Struve.—The coal basin of Sarrebrück and its continuation in French Lorraine: Jules **Bergeron** and Paul **Weiss.**—The deformation of certain tetrahedral surfaces: G. **Tzitzeica.**—Differential equations the general integral of which is uniform: M. **Gambier.**—The equation of Laplace with two variables: Georges **Lery.**—The photography of the infra-red spectrum: G. **Millochau.** In addition to the use of screens proposed by Stefanik, the author makes use of the well-known property of the infra-red rays of destroying the photographic action on an exposed plate. As the effect produced during the preliminary exposure to the actinic rays penetrates further into the film than the reversing effect of the red rays, very thin films of emulsion, coloured red or yellow, were found to give the best results.—A new method for the photography of coins: Eug. **Demole.**—The presence of gold and silver in the Trias of Meurthe-et-Moselle: Francis **Laur.** Analyses of rocks from various parts of this region show traces of both gold and silver. In one case, a limestone grit from a depth of 582 metres, the gold amounted to 39 grams, and silver to 245 grams, per ton.—The reduction of antimony selenide: P. **Chrétien.**—Oxidations with air. The problem of the comparison of velocities: André **Job.**—Heterogeneous equilibria. The formation of phosphonium chloride, ammonium carbamate, and sulphhydrate: E. **Briner.**—The osmotic pressure in colloidal ferric chloride: G. **Malfitano.**—Researches on copper steels: Pierre **Breuil.**—Melezitose and turanose: Georges **Tanret.** Turanose gives glucose and levulose in equimolecular proportions on hydrolysis, and not two molecules of glucose, as usually accepted.—The true nature of the leucins and glucoproteins obtained by P. Schutzenberger in the splitting up of proteid materials: MM. **Hugounenq** and A. **Morel.**—The influence of chocolate and coffee on the excretion of uric acid: Pierre **Fauvel.** The methylxanthines of chocolate and coffee increase the urinary purins, but not the uric acid. They prevent the precipitation of the latter by acids.—The law of increase of volume in trees: François **Kövessi.**—The spectroscopic study of the green pigments of ripe seeds: W. **Lubimenko.**—The structure of the different gall nuts in the Euphorbiaceæ: C. **Houard.**—The larval biology and metamorphoses of *Siphona Cristata*. A new case of internal ectoparasitism: E. **Roubaud.**—The influence of phosphoric acid and of mono- and trisodium phosphates on the nutritive exchanges: Mlle. Bl. **Guende.**—The influence of the ovary on nutrition: MM. **Charrin** and **Jardry.**—The characteristics of the stem of *Adelophyton Jutieri*: Paul **Bertrand.**—The rapidity of torrential erosion: E. A. **Martel.**—The polarisation of the sky during eclipses of the sun: N. **Piltschikoff.**

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