THURSDAY, APRIL 15, 1897.

SUBMARINE CABLE LAYING AND REPAIRING.

Submarine Cable Laying and Repairing. By H. D. Wilkinson, M.I.E.E. Pp. 401. (London : *The Electrician* Printing and Publishing Company, Ltd., 1896.)

THIS is not a scientific treatise on the electrical principles involved in submarine telegraphy; it covers, however, rather more ground than is set forth in the title, being also some sort of text-book for the electrician engaged in cable work. Mr. Wilkinson has treated his subject entirely from an up-to-date point of view, without attempting to show what has led to the present state of affairs, which, by the way, are the same—fundamentally speaking—as they were some thirty years ago. The method of working cables by machine transmission is not dealt with here; neither must the reader expect to find any matter relating to the duplex system of Messrs. Muirhead and Taylor, or that of others.

That portion which bears on construction might be more ample with advantage, especially as there are many engaged in submarine telegraphy who have never seen a cable made from start to finish. This remark particularly applies to the preparation and construction of the component parts of the insulated core, whether of gutta-percha (by Willoughby Smith's process or otherwise) or of vulcanised india-rubber, as well as of their collection in the state of nature. Much useful instruction is afforded with regard to the copper composing the conducting wire in a paper on electrical conductors, read by Mr. W. H. Preece, F.R.S., before the Institution of Civil Engineers in 1883.[1] Mr. Wilkinson has well, though briefly, described the constitution and application of the jute serving applied to the core of the iron sheathing, and of the outer covering, besides that of Bright and Clark's compound. The author has nothing to say on the subject of hempen cables, as suggested by Bullivant and afterwards by Trott and Hamilton. This silence is, however, justified by the fact that though a trial has been given to the latter in mid-Atlantic, the experiment has not culminated in further use. A cable without any iron armour appears, on the face of it, to be admirably adapted to recovery from great depths. The best quality of hemp decays, however, in salt water, even when by itself, to an extent sufficient to make the picking up of such a cable an almost impossible feat—not to mention the difficulties in the way of laying it down at a suitable angle.

No doubt Fig. 27 is intended to represent the ordinary close-sheathed type of the present day, but it rather suggests one of the alternate iron and hemp (low specific gravity) combinations, such as were once in vogue with a view to easy laying and recovery, but which, it is satisfactory to know, has long since been abandoned owing to its lack of durability.

Mr. Wilkinson gives us a strong chapter or two regarding submarine survey and sounding work, with good descriptions of the apparatus employed. At the present time, however, the line is supplied in lengths of as much as 7000 fathoms, thus rendering splices quite unnecessary in all depths so far dealt with. Nowadays, we also find that, provided a sinker is selected with sufficient weight for the depth, it will descend at a rate which will ensure the striking of bottom being readily observed. It is, therefore, no longer essential that the drum holding the wire should be particularly light; indeed, it is usually made of a sufficiently substantial character to permit of the wire being coiled direct on to it. Moreover, Lord Kelvin's plan of balancing the weight of wire outboard by weights added to the brake, has long since been abolished. The only proper method of preserving specimens of the bottom—partly for after-examination under a microscope—is to force the sample, *immediately* after recovery, direct from the "sounder" into an open glass tube, to be afterwards closed at both ends with corks, and hermetically sealed. The sample, when examined at any time, is then a true record of the bed of the ocean from whence it came. This plan was brought forward some years ago by Lieut. D. Wilson Barker, R.N.R. The water and mercury piezometers of Mr. J. Y. Buchanan come in for notice here. For a future edition, Mr. Wilkinson might find profit from a study of Mr. Buchanan's papers with reference to the various sounding and survey expeditions he has accompanied in H.M.S. *Challenger*, on the west coast of Africa and elsewhere. In this connection, the author and reader may also be recommended to peruse a paper, contributed by Lieut. Anthony Thomson, R.N.R., to the Sixth International Geographical Congress (1895), entitled "Remarks on ocean currents, and practical hints on the method of their observation." The importance of noting the nature, and measuring the strength, of deep-sea currents is better understood now than it used to be. It can, in fact, scarcely be over-estimated. In several instances of cables, past as well as present, much trouble and many repairs might have been saved had these matters been duly considered previous to laying. For further information regarding sounding work in its connection with submarine telegraphy, the reader should apply himself to a paper on the subject by Mr. Edward Stallibrass, in the *Journal* of the Society of Telegraph Engineers, 1887.

The various systems of landing shore ends under different conditions are all well set forth in this book; and, moreover, clearly illustrated.

Paying-out apparatus is gone into at some length. The cardinal principles, as first defined and put into practice, are closely identified with the names of Newall, Bright, Edwin Clark, Canning, Clifford, Appold, Amos, Siemens, Jenkin and Webb. The laws which govern the rate of paying out under given conditions are partially touched on in this treatise, though no reference is made to the heated controversy which arose in 1876 between Messrs. Longridge and Brooks, on the one hand, and the late Dr. Werner Siemens, on the other, as to whether the friction introduced by a body moving in fluid varied as the *square* of the velocity, or merely as the velocity. It is usually considered that the longitudinal

[1] *Mins. Proc.* Inst. C.E., vol. lxxv.

coefficient is a result of something between the two, perhaps rather nearer to Dr. Siemens' theory.

Mr. Wilkinson does not seem to be very clear as regards the waters in which teredoes may be expected. This is a question of temperature rather than of depth. Brass taping was first applied for this purpose to the core of some of the "Eastern Extension" Company's cables in 1879 by the Telegraph Construction Company; but it should be understood that this is only used for those types deposited in waters above a certain temperature. By bringing home picked-up cables, however, and laying them afterwards in another part of the world, the germs of the teredo and other boring nuisances sometimes present themselves in places where they had not previously appeared.

Mr. Wilkinson is evidently of opinion that you should find your cable before you make it, for he starts off with a goodly selection of the implements of war as regards the various forms of grapnels employed. To these he should add that of Mr. Henry Benest. As a cutting and holding grapnel, it has done admirable service.

Let us now turn to the electrician's side of the question. The electrical portion of the book is very complete as regards testing, and especially in methods of fault localisation; but it might be more so with reference to the apparatus. The new universal galvanometer of Mr. H. W. Sullivan, on the suspended coil principle, is well illustrated, but not quite correctly described. In the first place, unlike the Thomson marine galvanometer, there is no ironclad cover. Messrs. Weatherall and Clark's ingenious damping device for the "Marine" instrument is dealt with, showing how sensitiveness may be maintained though a suspension is made dead-beat. The principle and working of Varley slides are beautifully illustrated on p. 267, after the manner shown by Mr. W A. Price.[1]

Testing keys are dwelt on *ad infinitum*. With regard to the battery employed, surely Leclanché cells of any size, with an internal resistance of as much as 5 ohms, are unusual, if the cells are in good condition. Why does Mr. Wilkinson introduce the legal volt here? Surely in this class of work the old B.A. unit may be adhered to? For testing batteries, the author should remember that it is only Muirhead's method (and the modifications of Kempe and Munro) which are free from the objection of running down the battery during the test in such a way as to vary the E.M.F., and so give false impressions. Mr. Wilkinson describes a test of his own, on p. 223, for simultaneously testing the resistance and electro-motive force of a battery, which certainly looks hopeful.

In speaking of thirty seconds as a time allowance for making a "bridge test" during repairing work, it must be remembered that on anything like a long length of cable (and especially if partially coiled up), it takes a material time for the line to acquire its true potential throughout. This book gives a certain amount of information regarding the physical and electrical effect of temperature and pressure on gutta-percha, besides references to the present writer's contributions on the subject by way of explanation. It should be remembered, however, that, in selecting a type of core, the proportions are almost entirely governed by economical considerations for a given "K R" to effect a certain working speed with a limiting factor of safety from a mechanical standpoint.

With regard to the localisation of faults, Mr. Wilkinson gives us admirable accounts of the more recent methods of Sir Henry Mance, C.I.E., Mr. A. E. Kennelly, and others; besides the fall of potential test, due to Mr. Latimer Clark, with the special modification (for ship to shore work) of Mr. J. Rymer-Jones. The author does not, however, appear to show that in fault-testing a great number of observations should be made, besides various methods adopted for checking purposes; neither does he point out that no values should be used in after-calculations which appear, by comparison with the rest, to be untrustworthy. It is also advisable to discard results from one test which appear valueless by comparison with those obtained from the other methods adopted. No hard and fast rules can be made for fault-testing; much must be left to the individual judgment of the electrician according to prevailing conditions, character of fault, &c. Though a fault may have a low resistance, it is sometimes as variable as a high resistance fault; and, if so, it gives equal trouble to locate. One great point to be aimed at is, of course, to make the observations at the moment when the fault is least variable. With reference to Kennelly's break test, experience seems to show that the distance of the break from the testing station, in no way detracts from the value or efficiency of the test—notwithstanding Mr. Wilkinson's remarks. For other ways, however, it is well if the fault be fairly near. If the resistance up to the fault be great, then the battery power should be made in proportion, according to Ohm's law for a given required current. Mr. Wilkinson's limitation to the voltage employed in this test would, under certain conditions, be liable to materially reduce the value of the test from a point of accuracy. In a future edition the author should describe the reproduction method of taking Kennelly's test. It is in several ways preferable to working with the bridge, especially with a variable fault, as observations are made much quicker. Again, it involves the use of only one (dead-beat) galvanometer, thereby simplifying the carrying out of the test, besides reducing the chances of error. With Sullivan's galvanometer, this method, even on board ship, is found to give excellent results. Elsewhere in the book the author well describes and illustrates Mr. Willoughby Smith's ship and shore test during laying operations, besides the modification of the above, for fault-testing, as devised by Mr. H. A. Taylor.

The author also deals cursorily with land lines, describing the underground and beach systems of the Eastern Telegraph Company (as devised by Messrs. Clark, Forde, and Taylor), besides those of the present writer. Moreover, in this connection the Saunders and Bright Lightning Guards are respectively described.

Finally, so far as it goes, Mr. Wilkinson and the *Electrician* Printing and Publishing Company are to be congratulated on the above book as a treatise containing a vast amount of practical information in comparatively few words, such as are well adapted for study by the submarine telegraph engineer and electrician. The illustrations are admirable and almost entirely

[1] "A Treatise on the Measurement of Electrical Resistance," by W. A. Price. (Clarendon Press, Oxford.)

original. In the writer's opinion, the principal change required, before launching another edition, is a complete alteration of the order of the chapters, backed up, perhaps, by a slight amplification of the index.

CHARLES BRIGHT.

THE HISTORY OF GEOGRAPHY.

The Dawn of Modern Geography. By C. R. Beazley. Pp. xvi + 532. (London: Murray, 1897.)

THE practical value of scientific geography has, during the last few years, become so evident to all classes, that the number of students of this fascinating subject has increased to an almost incredible extent, and the growing popularity of the Royal Geographical Society is a standing proof of the fact. The men who travel for the sake of duty or pleasure hasten to communicate to this body the results of their notes and observations, and their "papers" or books supply us with details, often most minute, of the remote countries and regions which we have for long considered to be inaccessible.

Supplied as we are with abundant information about the present conditions of the habitable globe, it is, perhaps, a little difficult for us to bear in mind how small were the beginnings of modern geography, and how little is known about them.

As the documents which formed the libraries and private property of individuals in Egypt and Western Asia become better known to us, we realise that a great caravan commerce was carried on between the peoples of countries which we have hitherto thought to have been entirely separated by impassable deserts and trackless mountains. But though we may recover the names of places by the score, we know nothing about them, and can only dimly guess at their positions; and we find trade or religion, or both, were the causes which induced men to move to any considerable distance from their native cities. Victorious armies brought home specimens of the animals and plants and trees from the countries whither they had marched, but their annalists tell us nothing of the situations of the scenes of their conquests.

The first to set down in writing in our own times a connected account of ancient geography was the late Sir Henry Bunbury; and now, following in his steps, Mr. Beazley has produced an interesting volume in which he has undertaken to trace the history of exploration and geographical science from the conversion of the Roman Empire to A.D. 900.

After the introduction come four chapters which describe the travels of pilgrims, merchants and missionaries; one chapter is devoted to the pseudo-science of the "Dark Ages," and another to Muslim and Chinese geography. The narrative is fully illustrated by a large series of reproductions of early maps. The revision of the whole of Chapter vi., on "Geographical Theory," together with Mr. Beazley's account of the history and use of mediæval maps for the whole book—although Mr. Beazley omits to state the fact—is due, we understand, to Mr. C. H. Coote, of the Map Department of the British Museum. Mr. Beazley could not have fallen into better hands, for Mr. Coote's experience in this branch of cartography is unrivalled.

Mr. Beazley's general sketch of the subject which he gives in his introduction is excellent; it is carefully done, and what is almost as good, there is an absence of "fine writing" throughout, which befits the work. He has read widely, and his remarks will form a useful guide to the early geographical literature of Europe, both in manuscript and print. When, however, he undertakes to discuss Oriental texts and literature, it at once becomes clear that he is only quoting at second-hand, and we feel that it is not his fault that he does not do full justice to the early Oriental missionaries. Whether there be historical evidence of the fact extant or not, it is quite certain that some of the Apostles and their immediate successors made their way into Armenia, Mesopotamia, Persia and the Far East. Already before the end of the second century of our era Bar-daisân, who was born at Edessa A.D. 134 or 154, became a Christian missionary in Armenia, and he wrote polemical treatises against the polytheism of the heathen. Before the end of the third century Mâr Mattai had founded his famous convent on Jebel Maklûb near Nineveh, and there is proof that several other religious houses existed in the neighbourhood at this period.

From a passage in "Arnobius" (ed. Leyden, 1651, lib. II, p. 50) it is pretty clear that Christians existed in the Seres (China), Persia and India; and if this be so, which there is no good reason to doubt, many missionaries must have travelled over the country between Palestine and China, or at least voyaged to the latter country by sea. Early in the fourth century Mâr Awgîn set out for the East with seventy disciples, and founded a great religious house near Nisibis, and about 363 A.D., with Sapor's consent, he sent out seventy-two missionaries to found monasteries in Shiraz and Huzistan. A century later Christianity had extended along the shores of the Persian Gulf as far as the Island of Bahrên,, and the Gospel had been preached by Nestorian missionaries in the south of the Arabian peninsula.

The monastic history of Thomas of Marga would have supplied a number of important facts bearing on the early travels of monks who went from the East to visit the Scete desert and Palestine, and Assemani's dissertation in "Bibl. Orientalis" would have given Mr. Beazley many more. As to the genuineness of the Singanfu bilingual inscription there is no doubt whatever, and we may remark that the Patriarch Ḥĕnân-Îshô' II. died in 780, and not in 778, as we are told on p. 217, note 3; the first Nestorian bishop was consecrated in China in the seventh century. All these are, however, matters which Mr. Beazley may put right in a second edition; and we hope that some attempt will be made to alter barbarisms like "Jesu Jabus" (p. 213), "Anan-Yeschouah" (p. 217), and "Massoudy" (p. 458), &c. And why does Mr. Beazley hesitate to identify "Doul-Karnain" with Alexander the Great? Alexander claimed Ammon of Egypt as father, and a well-known title of this god is "provided with two horns," a phrase literally translated by the Arabic "Dhu'l karnên."

We gather from a footnote that Mr. Beazley intends to continue this "History of Modern Geography"; and if this be so, we shall welcome a further contribution to the literature of this important subject by so able a writer. In conclusion, we cannot help remarking that the index is so small as to be almost useless.

THE GLACIERS OF NORTH AMERICA.

Glaciers of North America: a Reading Lesson for Students of Geography and Geology. By Israel C. Russell, Professor of Geology, University of Michigan, Pp. x + 210. (Boston, U.S.A., and London: Ginn and Co., 1897.)

A GOOD summary, in a convenient form, of what has been ascertained about North American glaciers, has been for some time a desideratum. Prof. I. C. Russell has supplied it in a volume of moderate size, well illustrated, and written in a cautious and critical spirit. As he points out in his opening words, North America, in reality, affords more favourable conditions for the study of existing glaciers and the records of ancient ice-sheets than any other continent. It affords excellent examples of the three types into which glaciers may be distinguished—namely, Alpine, Piedmont, and Continental. Of the first, specimens are abundant in the mountain system of the West, from "pocket editions" in the peaks of the High Sierra to the huge Seward glacier in Alaska. The latter region also supplies good instances of the Piedmont type, in which, as the name implies, the ice-streams of mountain valleys become confluent on a lowland; while Greenland is a grand case of the "Continental" ice-sheet. Of each of these types Prof. Russell gives careful and lucid descriptions, in the course of which he notices or discusses the more important phenomena of ice action. We must confine ourselves to mentioning only two or three, which bear more especially on general questions. We observe that he draws a distinction between osars and kames, applying the former term to continuous ridges, often many miles long; the latter to irregular hills with basins between. Both are mainly composed of water-worn materials, and are connected with ice-sheets; both exhibit stratification, more or less oblique and cross-bedded; on the surface of both large angular blocks have often been dropped, but the osar, he thinks, has been formed by streams flowing in sub-glacial channels; the kames, by deposition in cavities beneath the ice or in open channels on its margin. Prof. Russell also gives an excellent account of drumlins, those curious elongated mounds, mainly composed of "till," which are among the ice-age puzzles. Of these he suggests as a "working hypothesis" the following explanation. Débris embedded in an ice-sheet tends to impede its movement. If, then, any portion of the latter, owing to local causes, contains an exceptional amount of adventitious material, it may behave in some respects as a large boulder (which, however, is gradually stretched out), the purer ice flowing past and around it. Then at last it may be stranded near the end of the sheet. The contained ice slowly melts, and leaves behind an elongated mound of "till." The hypothesis explains several facts, but is not without its own difficulties, on which, however, we must not enlarge. It is certainly ingenious, and it deserves careful consideration. He gives an excellent description of the Malaspina Glacier, one of the Piedmont type, in Alaska. In its neighbourhood marine shells are found embedded in a boulder deposit, high above sea-level. Prof. Russell does not think it necessary to employ an ice-sheet to bring these shells inland from the bed of the Pacific, and remarks that they indicate very considerable upheaval in quite late geological times. We commend this part of the volume to those glacialists of Britain who repudiate almost with scorn the possibility of an important submergence at a date so recent as the glacial epoch. Perhaps in future we shall hear less of rampant ice-sheets at Gloppa and Moel Tryfan!

As regards Greenland, a good summary is given of the observations of Peary, Nansen, Chamberlin, and others, as well as some excellent and extremely suggestive remarks about buried masses of ice in Kotzebue Sund. We should not, however, be quite so ready to admit the possibility of the central ice in the former country being almost as thick as its surface is high above the sea. Surely it more probably conceals a country similar to, but on a larger scale than, Scandinavia, in which case the watershed would be towards the middle. There is a very clear summary of the diverse views on glacial physics. Prof. Russell concludes these by an "eclectic hypothesis," in which a tinge of sarcasm, perhaps unconscious, seems perceptible. May not the difficulties of the subject be augmented by defective knowledge and an imperfect terminology? Fluid and solid are necessary distinctions in practice and in mathematics, but we cannot be so sure where the border-line lies, how far it depends on circumstances, or even if it has a real existence. But we must conclude. We may hesitate in accepting Prof. Russell's conclusions on one or two points, but not in heartily thanking him for this clearly-written volume, which ought to find a place on the bookshelves of every student of ice and its work.

T. G. BONNEY.

OUR BOOK SHELF.

Hydraulic Machinery. By R. G. Blaine. Pp. viii + 383. (London: E. and F. N. Spon, Ltd., 1897.)

THE term hydraulic machinery is generally confined to the machinery employed for storing up water under pressure, the arrangements for transmitting this power to a distance, and the various machines worked by means of the water pressure thus provided; and the utilisation of this form of power was mainly initiated by Lord Armstrong, whose portrait is given at the commencement of the book. This application of power has proved very serviceable for the intermittent operations required at docks, such as the working of dock gates, swing bridges, lifts, coal hoists, cranes, and capstans, and for raising passenger lifts, large canal lifts, and hydraulic graving docks. Moreover, hydraulic power has been very advantageously employed for various operations on board ship, namely, loading and discharging, steering, the working of big guns, and the movement of turrets; and it has furnished a very rapid and efficient means of riveting. Accordingly hydraulic machinery, as commonly understood, has a wide range; but the author has treated it merely as an important branch of a still wider subject, relating to the flow and measurement of the discharge of water, and the various machines in which water is an active or a passive agent. Only ten sections, out of the thirty-one into which the book is divided, comprising about 170 pages, are devoted to hydraulic machinery in its limited sense; and the rest of the book deals with the general principles of hydraulics, the hydraulic press, hydraulic jacks, the flow of water from orifices through pipes and in open channels, the methods of measuring discharge including water meters, jets, water wheels, turbines, pumps, and hydraulic rams and brakes. The book is illustrated by 272 clear figures and diagrams in the text, and is provided with a suitable

index. Though the book covers too wide a field to afford a thorough treatment of special subjects, it furnishes a useful, concise introduction for students to the general principles of hydraulics, and the machines relating to water.

The Story of the Chemical Elements. By M. M. Pattison Muir, M.A. Pp. 189. (London: George Newnes, Ltd., 1897.)

THIS book forms one of a series constituting a "Library of Useful Stories," and the object of the author has been to "put forth in some kind of orderly sequence a few of the chief guiding conceptions of chemistry" as exemplified by familiar things and phenomena. Mr. Muir deals with his subject in a philosophical spirit, but we fear he assumes too much of the same spirit in his readers for the book to prove really attractive to people unacquainted with chemistry. It is difficult to expound the elements of chemistry otherwise than by experiment—impossible, in fact, to do so satisfactorily—and we should imagine that the readers for whom the book is intended are of the kind that require very careful wooing. Nearly one quarter of the book is devoted to carefully marking out the distinction between elements and "not-elements," and between physical and chemical change; and though much pains have been taken to interweave homely and attractive illustrations, we doubt very much whether the desired end will be reached. Distinctions of the kind in question cannot be said to be intrinsically interesting, and we think that the author exaggerates both their importance and the nicety of treatment required for the main purpose of his book. The task attempted by Mr. Muir is, as already remarked, a hard one, and when we recall the opinions which he has so often expressed concerning the right method of teaching chemistry, we cannot suppose the task to have been entirely congenial. A. S.

Physics: an Elementary Text-Book for University Classes. By Dr. C. G. Knott. Pp. vi + 351. (London: Chambers, 1897.)

IN taking up such a book as that of Dr. Knott's, one cannot help feeling that the attempt to treat such a subject as physics within the limits of a book of between three and four hundred pages, must be attended with extreme difficulty. When, on further perusal, we notice that this work contains references to such subjects as contours, determination of the mean density of the earth, the theory of the formation of mirages both erect and inverted—to mention only a few of those matters which the elementary text-book usually leaves out of consideration—we are struck with amazement. But though it might be said that Dr. Knott treats "*de omnibus rebus et quibusdam aliis*," he has succeeded beyond expectation in making his book not only readable but attractive. To one who has read the subject in other works, or who has attended a series of lectures, it will prove most useful as a help to revising his knowledge and giving him a general view of the whole science, which every year makes it more difficult to obtain; and we feel certain that many a student of physics will be grateful to Dr. Knott for furnishing him with such a useful compendium.

Le Déterminisme biologique et la Personnalité Consciente. By Félix Le Dantec. Pp. 158. (Paris: Alcan, 1897.)

THIS volume is a sequel of the author's "Théorie nouvelle de la vie," which was published last year. The most interesting feature of that theory was the doctrine that constructive activity of living substance was to be regarded as the chief accompaniment of work, while destruction of tissue took place chiefly during rest. In this work consciousness is regarded as an epiphenomenon which in no way interferes with biological determinism. The author assumes the existence of a molecular consciousness which arises from atomic consciousness, and, by a process of fusion, passes into plastidular consciousness, or that of the lowest living organic element. The consciousness of man or of the higher animals is regarded as the sum of the individual consciousness of the neurons of which the nervous system is composed, and is dependent on the arrangement of the neurons. Starting from these assumptions, the author adopts the views of Duval and Ramon y Cayal, and explains such modifications of consciousness as sleep and altered personality by differences in the relations of the neurons to one another.

Report of Observations of Injurious Insects and Common Farm Pests during the year 1896, with Methods of Prevention and Remedy. By Eleanor A. Ormerod, F.E.S., F.R.Met.Soc., &c. Pp. 160. (London: Simpkin, Marshall, Hamilton, Kent, and Co. Ltd., 1897.)

MISS ORMEROD'S reports are so well known among economic entomologists, that it is almost unnecessary to state that the latest of her valuable volumes (the twentieth) furnishes interesting and serviceable information upon the insect pests prominent in 1896. One of the worst insect attacks of the season was that of various kinds of caterpillars to leafage of forest and fruit trees. In various localities in Kent, Sussex, Surrey, Hampshire, and other counties, in May last, hundreds of trees were stripped of their leaves by caterpillars of the Oak-leaf Roller Moth, the Mottled Umber Moth, and of the Winter Moth. Miss Ormerod describes the life-histories of these pests, and the measures used to prevent the attacks. A very important account is given of the occurrence of "Onion-sickness," arising from the presence, in the bulbs, of the Stem Eelworm, known in this country as causing "Tulip-rot" in Oat-plants, and "Stem-sickness" in Clover. Among other insect pests described, with the means of exterminating them, are the Codlin Moth—one of the yearly troubles of the fruit-grower; Beet Carrion Beetle, which has taken to feed on potato leafage; White Cabbage Butterflies, German Cockroach, Common Earwig, Caddis Worms, Pear and Cherry Sawfly, and Surface Caterpillars.

Miss Ormerod pays an affectionate tribute to the memory of her sister, whose death last August deprived her of a constant companion ever ready to assist her in the investigation and illustration of the life-histories of injurious insects.

Grasses of North America. By W. J. Beal. Vol. ii. Pp. 706. (New York: H. Holt and Co., 1896.)

THE first volume of Dr. Beal's "Grasses of North America" was published in 1887, and was a work intended more especially for farmers and students, comprising chapters on the physiology, composition, selection, improving, and cultivation of grasses and clovers. The present volume may be regarded as a separate work. It is confined to the Gramineæ, and constitutes a monograph of the North American grasses, native and introduced, with an illustration of each genus. Some idea of the magnitude of the task may be gathered from the fact that the native grasses alone of North America number about 1275 species, included in about 140 genera; while in Europe there are only 47 genera and 570 species. The author brings to his subject a wide practical knowledge, which will make the work of great value to systematic botanists. There is a useful chapter on the geographical distribution of North American grasses, and a copious bibliography is appended.

The Culture of Vegetables for Prizes, Pleasure, and Profit. By E. Kemp Toogood, F.R.H.S. Pp. 127. (Ulverston: William Holmes, 1897).

COTTAGE gardeners will find in this little volume many useful hints on varieties of alimentary plants, soil-working, rotation, manures, garden pests, and vegetable culture generally. The book is a trustworthy and practical guide, dealing with methods alone, little attention being given to the principles underlying them.

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.*]

Organic Selection.

IN certain recent publications,[1] an hypothesis has been presented, which seems in some degree to mediate between the two rival theories of heredity. The point of view taken in these publications is briefly this:—Assuming the operation of natural selection as currently held, and assuming also that individual organisms through adaptation acquire modifications or new characters, then the latter will exercise a directive influence on the former quite independently of any direct inheritance of acquired characters. For organisms which survive through adaptive modification will hand on to the next generation any "coincident variations" (*i.e.* congenital variations in the same direction as adaptive modification) which they may chance to have, and also allow further variations in the same direction. In any given series of generations, the individuals of which survive through their susceptibility to modification, there will be a gradual and cumulative development of coincident variations under the action of natural selection. The adaptive modification acts, in short, as a screen to perpetuate and develop congenital variations and correlated groups of them. Time is thus given to the species to develop by coincident variation characters indistinguishable from those which were due to acquired modification, and the evolution of the race will proceed in the lines marked out by private and individual adaptations. It will appear as if the modifications were directly inherited, whereas in reality they have acted as the fostering nurses of congenital variations.

It follows also that the likelihood of the occurrence of coincident variations will be greatly increased with each succeeding generation, under this "screening" influence of modifications; for the mean of the congenital variations will be shifted in the direction of the adaptive modifications, seeing that under the operation of natural selection upon the preceding generation, variations which are not coincident tend to be eliminated.[2]

Furthermore, it has recently been shown that, independently of physical heredity, there is among the higher animals a process by which there is secured a continuity of social environment, so that those organisms which are born into a social community, such as the animal family, accommodate themselves to the ways and habits of that community. Prof. Lloyd Morgan,[3] following Weismann and Hudson, has employed the term "tradition" for the handing on of that which has been acquired by preceding generations; and I have used the phrase "social heredity" for the accommodation of the individuals of each generation to the social environment, whereby the continuity of tradition is secured.[4]

It appears desirable that some definite scheme of terminology should be suggested to facilitate the discussion of these problems of organic and mental evolution; and I therefore venture to submit the following:—

(1) Variation: to be restricted to "blastogenic" or congenital variation.

(2) Accommodation: functional adaptation of the individual organism to its environment. This term is widely used in this sense by psychologists, and in an analogous sense by physiologists.[5]

(3) Modification (Lloyd Morgan): change of structure or function due to accommodation. To embrace "ontogenic variations" (Osborn), *i.e.* changes arising from all causes during ontogeny.

(4) Coincident Variations (Lloyd Morgan): variations which coincide with, or are similar in direction to, modifications.

(5) Organic Selection (Baldwin): the perpetuation and development of congenital coincident variations in consequence of accommodation.

(6) Orthoplasy (Baldwin): the directive or determining influence of organic selection in evolution.[1]

(7) Orthoplastic Influences (Baldwin): all agencies of accommodation (*e.g.* organic plasticity, imitation, intelligence, &c.), considered as directing the course of evolution through organic selection.

(8) Tradition (Lloyd Morgan): the handing on from generation to generation (independently of physical heredity) of acquired habits.

(9) Social Heredity (Baldwin): the process by which the individuals of each generation acquire the matter of tradition, and grow into the habits and usages of their kind.[2]

Princeton University, March 13. J. MARK BALDWIN.

[1] H. F. Osborn, *Proc.* N.Y. Acad. of Sci., meeting of March 9 and April 13, 1896; also *Science*, November 27, 1896. C. Lloyd Morgan, "Habit and Instinct," October 1896, pp. 307 ff.; also *Science*, November 20, 1896. J. Mark Baldwin, discussion before N.Y. Acad. of Sci. meeting of January 31, reported in full in *Science*, March 20, 1896; also *Amer. Naturalist*, June and July 1896. The following brief statement has been prepared in consultation with both Principal Morgan and Professor Osborn. I may express indebtedness to both of them for certain suggestions which they allow me to use, and which I incorporate verbally in the text. Among them is the suggestion that "Organic Selection" should be the title of this letter. While feeling that this co-operation gives greater weight to the communication, at the same time I am alone responsible for the publication of it as it here stands.

[2] This aspect of the subject has been especially emphasised in my own exposition (*Amer. Naturalist*, June 1896, pp. 447 ff.).

[3] Introduction to "Comp. Psych.," pp. 170, 210; "Habit and Instinct," pp. 183, 342.

[4] "Mental Development in the Child and the Race," 1st ed., January 1895, p. 364; *Science*, August 23, 1895.

[5] Prof. Osborn suggests that "individual adaptation" suffices for this; but that phrase does not mark well the distinction between "accommodation" and "modification." "Adaptation" is used currently in a loose general sense.

[1] Eimer's "orthogenesis" might be adopted, were it possible to free it from association with his hypothesis of "orthogenic" or "determinate" variation and use inheritance. The view which I wish to characterise is in some degree a substitute for these hypotheses.

[2] Prof. Lloyd Morgan thinks this term unnecessary. It has the advantage, however, of falling in with the popular use of the phrases "social heritage" and "social inheritance." On the other hand, tradition seems quite inadequate; as generally used, it signifies that which is handed on, the material; while in the case of animals, we have to deal mainly with the processes of acquisition. "Social heredity" also calls attention to the linking of one generation to another. However, I think there is room for both terms. For further justification of the terms "social heredity" and "organic selection," I may refer to *Amer. Naturalist*, July 1896, pp. 552 ff.

Unfelt Earthquakes.

THE Icelandic earthquakes, on several occasions mentioned in NATURE—*e.g.* November 5, 1896—have been recorded also by the horizontal pendulum (system v. Rebeur) of Strassburg. I give the dates in Greenwich M.T.

1896.		h.	m.	s.			h.	m.	s.	
Aug. 26.	Begin	11	22	9	p.m.	End Aug. 27	0	58	37	a.m.
	Max.	11	22	37	,,	until	0	13	47	,,
,, 27.	Begin	10	50	18	a.m.	End	11	50	18	,,
	Max.	11	1	32	,,	Succeeded by a series of tremors until	12	39	38	p.m.
,, 31.	Begin	8	17	50	,,	End	11	38	2	a.m.
	Max.	8	29	56	,,	,,	9	42	12	,,
Sept. 5.	Small disturbance at						12	50	0	p.m.
,, 6.	Begin	0	31	34	,,	,,	0	41	4	a.m.
	Tremors succeeded Sept. 6 and 12.									
,, 12.	Begin	8	17	54	,,	End	10	41	6	,,
	Deduct max.	8	39	38	,,	to	10	34	22	,,
,, 13.	Begin	5	28	56	,,	End	6	3	16	,,

The whole of September was very troubled; small perturbations were observed on the 7th, 8th, 14th, 16th, 19th; greater ones on the 22nd, 24th, 25th. The time of the perturbations above agrees very well with the disturbances of the Paris and Edinburgh pendulums.

Prof. Milne (NATURE, February 25), asks for information about some earthquakes observed in February 1897, in the Isle of Wight, in Italy, &c. They disturbed very much the new pendulum of Strassburg, system Ehlert, as described in *Beiträge zur Geophysik*, vol. iii. 209 (Leipzig, Engelmann). The system consists of three horizontal pendulums, smaller than Rebeur's, but much heavier, in one box, each set up 120° from the other, and directed the first from E. towards W., the second from N.W. towards S.E., the third from S.W. towards N.E. The movements are photographically recorded, and very much enlarged.

The disturbance of February 7 was unusually large. It commenced on the first pendulum (E. to W.) at 7h. 49m. 50s. a.m., and ended at 8h. 46m. 19s. a.m.; after-shocks were felt until 9h. 41m. 39s. a.m. The perturbation showed two maximum-periods, each divided into two parts. The second pendulum (N.W. to S.E.) was disturbed from 7h. 45m. 25s. a.m.; maximum, 8h. 2m. 8s. until 8h. 24m. 28s.; end, 8h. 40m. 20s.; after-shocks from 9h. 26m. until 9h. 54m.

The greatest disturbance appeared at the third pendulum (S.W. to N.E.), with oscillations 6 cm. large; the maximum, with two well-defined periods, was from 8h. 23m. 52s. until 9h. 8m. 43s. a.m. Tremors followed until 11h. 30m. a.m.; the preliminary tremors of this pendulum, commencing 7h. 45m. 25s. a.m., showed three well-marked maxima. Other very small tremors preceded, the pendulum being troubled all the preceding night, perhaps by the winds.

On February 11, there was a small disturbance on the second and third pendulum 11h. 39m. 48s.; February 13, a very great one on all three pendulums from 2h. 31m. 54s. until 3h. 8m. a.m., with oscillations up to as much as 2·1 cm., and preceded on pendulum three by a preliminary motion, on February 12, from 11h. 2m. 2s. p.m. until 11h. 34m. 38s. p.m.

A very great perturbation was observed on February 19, on the third pendulum, from 10h. 11m. until 10h. 39m. p.m.; and on February 20, from 0h. 11m. 15s. until 1h. 20m. 10s. a.m. The first pendulum (E. to W.) had a very great motion from 0h. 11m. 16s. until 1h. 49m. a.m., February 20, followed by a long series of tremors. The second pendulum was not in activity.

Dr. Ehlert (Strassburg) has put the box with the three pendulums on a short, stout, isolated sandstone pillar, to avoid the earth-waves being concealed or wholly annihilated by the frictions and elastic motions taking place in a large pillar of masonry; and the pendulums, set up in such a manner, give very accurate records of vibrations, change of level, &c. They can be made extremely sensitive. The whole instrument may be purchased for 51*l.*, with recording apparatus and lamp (Strassburg, I. and A. Bosch); and I should like to recommend it, for the seismic survey of the world, for each station of this international survey. The distinct directions and movements of the three pendulums are showing (1) each motion of the earth-crust coming from whatever an azimuth; (2) the chief direction of the seismic wave; (3) the temporary figure of the wave; (4) their splitting-up in different trains of waves. They are disturbed also by vertical shocks.

G. GERLAND.

Strassburg, March 31.

Relationship between the Masses and Distances of the Four Outer Planets.

LET the mean distance of Jupiter be the unit of measurement for the four outer planets. The distances are then as follows.

Jupiter.	Saturn.	Uranus.	Neptune.
1	1·8338	3·6869	5·7765

Now take the following numbers as the masses—

Jupiter.	Saturn.	Uranus.	Neptune.
312	92·513	13·604	15·969

and multiply the masses into the distances. We then obtain

Jupiter.	Saturn.	Uranus.	Neptune.
312	169·65	50·157	92·245
J	S	U	N

Let the last series of numbers be J, S, U, N, respectively. Then

$$U S = N^2 \quad \ldots\ldots (1)$$
$$U J = N S \quad \ldots\ldots (2)$$
$$U + N + S = J \quad \ldots\ldots (3)$$

In fact, the numbers are in geometrical progression, having a common ratio R = 1·8391. So that

$$U R = N \quad \ldots\ldots (4)$$
$$U R^2 = S \quad \ldots\ldots (5)$$
$$U R^3 = J \quad \ldots\ldots (6)$$

The common ratio 1·8391 is nearly the mean distance of Saturn 1·8338, and is one of the solutions of a biquadratic equation

$$x^4 - 2x^3 + 1 = 0.$$

G. E. SUTCLIFFE.

The Hermitage, Coorla, Bombay, March 19.

X-Ray Photography.

IT may interest the readers of NATURE, that it is possible to take shadowgraphs (so-called) instantaneously without any special arrangement of induction coil or deviation in the form of Jackson tube.

The apparatus used consists of 10-inch Apps' induction coil, a Jackson focus tube supplied by Messrs. Newton (one of a set of twenty-five I have in my possession), and a set of small secondary batteries, about 30 ampère hour capacity, six cells in the set. The induction coil is of the ordinary type with ordinary commutator.

For the purpose of obtaining these results in such short exposures, a special choice of tube is necessary, working the tube for a considerable period before desired condition is arrived at, and that condition judged by experience, for no ampère measurement will give the information. The tube must be strongly heated by a spirit lamp, and when the desired condition (tube being of course connected with coil) is arrived at, the exposure must take place.

(1) By instantaneously turning current on and off.

(2) By interposing a ½-inch iron plate between tube and object to be shadowed, removing plate for the exposure.

Having carefully timed the exposures, I have been able to repeat the experiment with assured success. For some time past I knew that hands and arms of children could be taken in from twenty to thirty seconds, but have now succeeded in taking children's hands in half a second (showing all bones and cell tissue of bones), and adults' hands, bones of wrist, and even arms, with exposure of only one second, again showing cell tissue of bones.

It is interesting to note that everything connected with the production of these results was made in England.

WILLIAM WEBSTER.

Art Club, Blackheath, March 30.

A New Scientific Club.

MY attention has been drawn to a circular in favour of a new Club, in which my name appears as one having consented to become a member. I know nothing of the Club, nor have I in any way authorised the use of my name.

12 Arundel Gardens, W., April 9. W. RAMSAY.

DEEP-SEA FISHES OF THE NORTHERN ATLANTIC.

THE examination of the deep-sea fishes which have been collected by means of the dredge or trawl during the last twenty-five years, has now been almost completed; at least the results of this examination, as far as it has gone, are now before us, and form the most interesting and attractive portion of the ichthyological literature of our time. The harvest reaped by the various expeditions, surveys, and private enterprises, which have been fitted out to explore the mysteries of the sea, has far exceeded the most sanguine expectations, and it is satisfactory to find that the six or seven volumes devoted to ichthyology have been placed before the public in a style and with a wealth of illustration worthy of the interest attached to the subject. The first to appear was the volume descriptive of the deep-sea fishes collected during the Norwegian Expedition to the North Atlantic from 1876 to 1878, by R. Collett (Christiania, 1880, 4to, pp. 166, with five double plates); this was followed, in 1887 by the Report on the Deep-sea Fishes collected during the *Challenger* Expedition (1873–76), in which were incorporated the proceeds of the Faeröe Channel Exploration (1880 and 1882) (London, 1887, 4to, pp. lxv. + 335, with 73 plates); the collections made by the French expeditions of the *Travailleur* and *Talisman* (1880–83) were described by L. Vaillant (Paris, 1888, 4to, pp. 406, with 28 plates); in the Indian Ocean, H.M. Indian Marine Survey steamer *Investigator* has added largely to our knowledge of the bathybial fauna from year to year since 1885, the collections being described by A. Alcock in a series of papers which appeared in periodicals, and were supplemented afterwards by "Illustrations," of which three parts, with fifteen plates in quarto, have been issued under the authority of the Director of the Royal Indian Marine in Calcutta, 1892–95; finally, the collections made in the North Pacific by the U.S. Fish

Commission steamer *Albatross* (1890–93) have been reported upon by C. H. Gilbert in the annual reports of that Commission.

The past year has been signalised by the almost simultaneous appearance of three works, by which our knowledge of the deep-sea fishes of the Atlantic north of the equator has been vastly increased, and which we propose to notice more particularly in the present article.

By far the most important of those three publications is "Oceanic Ichthyology,"[1] a work devoted to the discussion of the material that has been brought together since the year 1877, by the naturalists on board of the steamers of the United States Fish Commission and Coast Survey. It is almost superfluous to remind our readers that the merit of having organised the systematic investigation of the North-Western Atlantic, and of having continued it for so many years, is mainly due to the late Prof. Baird, his successor Colonel McDonald, the late Dr. Brown Goode, and Prof. Alex. Agassiz.

In "Oceanic Ichthyology" all the species from the Atlantic are fully described, or at least diagnosed, unless they are long- and well-known forms. Incorporated with them are the Bathybial and Pelagic forms inhabiting other oceanic areas, and hitherto not found in the Atlantic; but the authors treat of them only in a more or less general fashion, the species being usually mentioned by name only. The illustrations—417 in number on 123 plates—are very well drawn, though of no particular artistic merit, many being reduced copies in outline from other works. But the work, as it is, is a most valuable contribution to the literature of oceanic zoology, not merely for the scientific student, who will find in it a mine of information, but for all "who go down to the sea in ships, and occupy their business in great waters." If in its production attention has been paid to economy, the great object has been attained thereby of bringing the work within reach of a number of persons to whom the corresponding parts of the *Challenger* Reports will be inaccessible. As the edition seems to be as large as the publications of the U.S. National Museum usually are, and as the work seems to have been distributed with the same lavish liberality, there will be no vessel in the U.S. navy—we hope no vessel in the navy of any nation—engaged in the exploration of the ocean which has not a copy on board.

The American work covers the same ground as the two Reports of the *Challenger* series, which were respectively devoted to the Deep-sea and Pelagic fishes, and even a part of the *Challenger* Shore-fishes, as quite a number of species living above the 100 fathoms line, for instance certain flat-fishes, have been admitted into the work. The authors combine both those kinds of fishes under one term, viz. *Oceanic fishes*, which are defined as "those deep-sea and pelagic species which dwell in the open ocean far from the shore, either at the surface, at the bottom, beyond a depth of 500 feet, or, if such fishes there be,[2] the intermediate zones." By the term deep-sea fishes are understood only "those which are found at a depth of 1000 feet or more, without reference to the question whether or not they also occur in shallower water. The limit of 500 feet is taken for convenience in the study of the origin of local deep-sea-faunas." *Pelagic* fishes are termed "those which live far from land and at a distance from the bottom, rarely approaching the shore except when driven by wind or current. It is those which are most closely associated with the plankton. . . . Some of them, which occur at considerable depths, we call bathypelagic."

We doubt very much whether any appreciable advantage is to be gained by this modification of our more simple method of classifying the marine fish-fauna. The littoral passes into the pelagic and deep-sea-faunas, the pelagic into the deep-sea so gradually, that any line of division that may be proposed, must appear more or less artificial; and this obstacle to classification is not overcome by increasing the number of zones. I believe no malacologist of the present day maintains the eight zones, proposed by E. Forbes; with the increase of our knowledge his boundary-lines were wiped out, although they seemed fully justified at the time when that great genius generalised from the wealth of his own original observations. In the *Challenger* and other Reports, the 100 fathoms line has been selected as the upper limit for the deep-sea-fauna, because we have the positive knowledge, that at that line some of the abyssal conditions obtain, viz. absence of light, absence of surface-disturbance, absence of plant-life. It is obvious that these conditions must operate upon organisms permanently living under them, although many surface forms descend below that line, without any part of their organisation being affected by their temporary sojourn. One of the principal factors which will have to be taken into consideration in determining zones of distribution will be, as is generally admitted, temperature; and since we have been placed in possession of a great number of data of the temperatures of certain depths in definite localities, perhaps the attempt would not be premature to ascertain the zones for that portion of the bathybial fauna which is known to live at the bottom. As to the so-called mid-water fishes, the study of their distribution cannot be attempted until some means of capture is devised, by which the question of their existence, and of the limits of their vertical range is definitely settled.

As far as fishes are concerned, a distinction between pelagic forms and fishes of the plankton cannot be maintained with any advantage. But whether such a distinction be made or not, it is difficult to understand on what grounds the authors have omitted every mention of the important group of flying fishes (*Exocetus*), whilst the dolphins (*Coryphæna*) and other similar pelagic fishes find a place in their list.

An idea of the great labour expended in the preparation of this work may be gathered from the number of species treated therein. We have not counted the species described or referred to, but the authors state in their introduction that "more than 600 (?) different kinds of fish have been obtained from the depth of 1000 feet and more"; further, in the list of "new species" they enumerate 153 species, chiefly from the Western Atlantic[1]: a number which, taken without critical examination of the species, is but little less than that of the species described as new in the corresponding *Challenger* Reports.

Among the new species are a number of very singular forms. Although many of them represent, according to the view of the authors, types of distinct families, the majority are, at any rate, closely related to previously known genera.

The vertical and horizontal distribution is given under the head of each individual species, very often in great detail, for which the authors deserve our best thanks. But they would have added to the usefulness of their

[1] "Oceanic Ichthyology, a Treatise on the Oceanic and Pelagic fishes of the world, based chiefly on the collections made by the Steamers *Blake*, *Albatross*, and *Fish Hawk* in the North-Western Atlantic," with an Atlas of 417 figures, by George Brown Goode and Tarleton H. Bean. (Washington, 1895,* 4to, pp. xxix. + 553. It forms a special volume of the Bulletin Series of the United States National Museum, and is also issued as vol. xxii. of the Memoirs of the Museum of Comparative Zoology at Harvard College, with the same title, but dated "Cambridge, U.S.A., September 1896." *

[2] Called mid-water fishes, *Challenger* Report, p. 33.

* Questions of priority are sure to arise hereafter, and therefore it is just as well to be certain as to the actual date of publication. In the last letter which we received from one of the authors, the late Dr. Brown Goode, and which is dated August 9, 1896, he says: "I am sending you the *first copy* of our 'Oceanic Ichthyology.'" The copies of the work sent out by the Smithsonian Institution reached England towards the end of the year.

[1] Singularly, *Psychrolutes paradoxus*, described some thirty years ago from the Pacific, is also included in this list of "new species"; on the other hand others are omitted.

work, if they had collected the information as to the bathymetrical limits of the deep-sea forms in some conspicuous form, as has been done in the *Challenger* or some of the *Blake* Reports. With the absence of such a list or table, we have also to regret that the authors have abstained from giving us an account of the general results of their observations; an account which would have been all the more valuable, as it would have proceeded from competent men who were able to form a sound judgment from their personal intimate acquaintance with the subject. They evidently laboured under great disadvantages: they (as they state) had commenced the work in 1881, revising and rewriting it thrice; it was written at odd hours snatched from administrative duties, always under the pressure of haste; whilst later, serious illness delayed its printing. Under such circumstances it is not to be wondered at, that not a few errors, of commission and omission, have crept in, which the authors would or could have avoided if they had been in a position to apply themselves with care proportionate to the magnitude of their task. Thus even the *Challenger* Report on the pelagic fishes seems to have come to their knowledge at a time when it was too late to fully utilise it, as might have been done, at least, in the Appendix at the end of the work. Under *Lycodes muræna* all reference to the *Challenger* description and figure, and to its abundance in the Færöe Channel is omitted. Of other blunders of a more or less serious nature, we will mention one only, viz. the use of the same figure for two fishes of different families. Fig. 42 is a reduced outline-copy taken from the figure of *Alepocephalus niger* in the *Challenger* Report; the same figure, but with the addition of scales, is reproduced under No. 52, where it does duty for *Bathythrissa dorsalis!*

But this is not the place to enter critically into errors which in due time will be corrected by the specialist; they may be annoying to him, but will little interfere with the usefulness of the book to every one interested in the subject, and will not weaken the impetus which this work cannot fail to give to the prosecution of oceanic ichthyology. We have to deplore the premature death of one of the authors, Dr. Brown Goode; but it is some satisfaction to know that he lived, at least, long enough to see the completion of a work which must have been to him, as it is to us, and as it will be to posterity, the lasting record of his untiring devotion to one of the great tasks of his life, viz. the exploration of the marine fauna of his country. There was no more earnest and unselfish searcher of truth; and we have no doubt that, had he been spared, he would have redeemed his promise to work out the general results of his study of the pelagic and bathybial fish-faunas.

The second publication[1] to which we draw attention, treats of oceanic fishes of the Eastern Atlantic. It is part of a series of volumes published by the Prince of Monaco, and descriptive of the results of the cruises which he undertook in the yacht *Hirondelle* in the years 1885 to 1888. Profiting by the experiences of the British and American expeditions, and personally possessing an intimate knowledge of every technical detail, he adapted his vessels especially for deep-sea work, and fitted them with the most perfect apparatus. In the volume before us the fishes are described which were collected, during the period named, between the Bay of Biscay and the Azores, and between the Azores and Newfoundland; they are ninety-five in number, of which about one-half are bathybial or pelagic. Prof. Collett, to whom the examination and description of these materials were entrusted, has carried out this task with the same care which has rendered his Report on the Fishes of the Norwegian North Atlantic Expedition so valuable a contribution to our knowledge of the distribution of deep-sea fishes, as well as of their distinctive characters and structure. Six new species have been added to the Atlantic fauna in the present report. Some of the deep-sea forms were captured by a method not employed in previous expeditions, viz. by sinking baited traps to a depth of 1000 fathoms, thus securing species which, for some reason or other, were never captured by the trawl of the *Hirondelle*. We cannot conclude this short notice without referring to the great artistic beauty of the illustrations of the work; neither can we refrain from expressing our admiration of the scientific spirit which has led the Prince to devote so much of his leisure and wealth to the advancement of knowledge.

We have included the last of the three publications on deep-sea fishes in the present notice, in order to show that even at a small expenditure of time and money excellent results may be obtained in oceanic exploration. The cruise of the French ship *Caudan* was an undertaking of very modest pretension. Being much in need of deep-sea material for purposes of instruction, R. Koehler, Professor of Zoology at the University of Lyons, organised a short cruise in the Bay of Biscay. The sums required to defray expenses for the necessary apparatus were obtained by donations from scientific institutions of Lyons, Nancy and Toulouse, whilst the Minister of the Marine placed the steamer *Caudan*, of 650-horse power, at the disposal of Prof. Koehler for a fortnight. In this short time (August 1895) M. Koehler, in company with three of his colleagues, employed the trawl thirty times, in depths varying from 60 to 1200 fathoms, and was so successful that the results just published fill a handsome octavo volume of 741 pages and 39 plates. Its title is "Résultats scientifiques de la Campagne du *Caudan* dans le Golfe de Gascoigne. Par R. Koehler." (Paris, 1896.) The species of fishes obtained, thirty-five in number, are described on pages 475 to 526, and some of the more remarkable forms figured on plates 26 and 27. Five of the species are described as new, whilst the discovery, in the Bay of Biscay, of others known to exist in other most remote parts of the ocean, adds further evidence of the remarkable fact of the uniformity of the abyssal fauna all over the globe.

Prof. Koehler's experiences of the effect of formaldehyde in the preservation of deep-sea fishes, are well worthy of the notice of future collectors. It is well known that the tissues of many deep-sea fishes are of extreme softness and fragility; by immersion in spirits sufficiently strong for preservation, these tissues are much contracted, the natural shape of the fish often being distorted. This is entirely avoided by the use of the usual 40 per cent. formaldehyde, mixed with twenty times its volume of water. The specimens, however, have to be transferred into spirits after some days, because the formaldehyde has been observed to entirely destroy black pigment in a very short time. A. G.

[1] Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert 1er Prince Souverain de Monaco. Fasc. x. Poissons provenant des campagnes du yacht *Hirondelle* (1885-8). Par Robert Collett. Monaco, 1896. 4to, pp. viii + 198. With six double plates.

THE MEMORIAL STATUE OF SIR RICHARD OWEN.

SIR RICHARD OWEN'S whale has been removed from its familiar place in the Natural History Museum, and a fine bronze statue of the great naturalist, by Mr. T. Brock, R.A., now forms the most conspicuous feature on the floor of the central hall of that institution. The first view of the statue, as it is seen from the entrance to the Museum, is not prepossessing. Visitors whose business takes them to either of the departments on the ground-floor, pass by with only an uninteresting view of a skull-cap, a vertically corrugated doctor's robe, and a pair of flaps hanging from the arms, suggestive of the rigid "primaries" of a cherub's wings. The front view of the statue, however, is far more pleasing. Owen

is represented as a teacher: he holds a bone in one hand, while the other is outstretched, as if it had just been pointing to some feature in the specimen; the attitude is easy and natural, so that it does not force itself into notice, and the face at once absorbs attention. The likeness is said to be very successful by some of those who knew Sir Richard Owen most intimately. The lines of the face suggest power and vigour; the deeply-shrunk eyes look intently forward; the whole expression is that of a teacher who is speaking with authority, and expects to carry conviction rather than to win it. At the same time the side view of the face gives a suggestion of that kindliness to which Owen owed so much of his social charm. The selection of the specimen which Owen holds in his hand is happy. It is a *Dinornis* femur, and reminds us that it was after an examination of an odd fragment of this bone that Owen, in 1839, predicted that birds larger than the ostrich would be found to have once lived in New Zealand.

The new statue has one great advantage over that of Darwin, which stands on the staircase at the other end of the hall; for its material is bronze instead of marble. Although marble is perhaps the more useful medium for statues of ideal characters like Donatelli's St. George, bronze appears to give more pleasing representations of individual men.

Mr. Brock is warmly to be congratulated on his successful statue, which will permanently remind the public of the services of the great naturalist, to whose persistent agitation we owe the great Museum, that will ever be the truest monument of his life and influence.

PLAN TO GENERATE ELECTRICITY AT THE NILE CATARACTS.

THE Department of Public Works in Egypt has long been engaged on plans for dams on the Nile to improve the irrigation. Having lately learnt that the vast energy now wasted in the rapids, generally called cataracts, on the Nile might be converted into electric power, and conveyed even to considerable distances, where an economical form of power would tend greatly to the development and wealth of the country, they asked Prof. George Forbes to go to Egypt during the period of high Nile, and to investigate and survey the localities where power might be developed to a point as far south as the Egyptian frontier. Prof. Forbes was asked to report on the capabilities of all the rapids, and prepare plans and estimates for works both in conjunction with, and independent of, the proposed irrigation dams. The Report, which is to be completed by September 1898, will further embody the scheme for transmitting the electric power to places where it is wanted.

The principal demands for power which are immediately apparent are (1) for railways, (2) for pumping in connection with irrigation, and (3) for the large sugar factories which are now established. The existence of this power will doubtless also stimulate other industries.

Prof. Forbes has satisfied himself, by personal inspection, that the works required would not be too expensive, and that the economical distance of transmission reaches the places where there is demand for power. The high and low Nile conditions are very different, but this presents no insurmountable obstacle. At the first cataract the available power is at high Nile 500,000 h.p., at low Nile 35,000 h.p.

The pumping works to be started will reclaim vast areas, and raise additional crops on areas now cultivated.

For 4000 years every improvement in the condition of Egypt has come from the Nile and irrigation. So it will be in the future. But it must also be remembered that the sugar-cane industry has already developed to an important extent of late years. The factories use a great deal of power, and the lands growing cane require irrigation by pumps. Here there is an immense field for using cheap power.

The first cataract is the most important to utilise, but the others must also be taken in hand. As an example, before the Mahdi's time, the province of Dongola had 8000 sakias for pumping water of irrigation, now nearly all gone. These used eight head of cattle each, costing 10*l.* a head. Here is a capital expenditure of 640,000*l.*, which will now be saved by using electric pumps, the cost of which is far less. The construction of the desert railway from Wady Halfa to Abu Hamed would have been robbed of its difficulties as to water and coal if electric instead of steam locomotives had been used.

NOTES

THE first of the two conversaziones held annually at the Royal Society will take place on Wednesday, May 19. This is the conversazione to which gentlemen only are invited.

THE Paris Municipal Council has voted a sum of 5000 francs (200*l.*) towards the cost of installation and maintenance of a laboratory for Röntgen photography at the Trousseau Hospital.

THE Lords Commissioners of the Treasury have authorised an extension of Sir William Flower's term of office as Director of the Natural History Departments of the British Museum for three years from the expiration of his retirement date under the age regulation of the Civil Service.

PROF. W. W. HENDRICKSON, head of the department of mathematics at the Naval Academy at Annapolis, has, says *Science*, been appointed superintendent of the American Ephemeris and Nautical Almanac, in succession to Prof. Simon Newcomb. The retirement of Prof. Newcomb, on reaching the age limit fixed by the naval authorities, has called forth many notices in appreciation of his great contributions to science.

THE sixty-ninth annual meeting of the great German Association of Naturforscher und Aerzte will, it is announced, be held this year at Brunswick, from September 20 to 25. The work will be distributed among thirty-three sections, being an increase of three as compared with previous years. One of the new sections is apportioned to anthropology and ethnology, another to scientific photography, and the third to geodesy and cartography.

LORD LISTER will preside at the anniversary dinner of the Literary Fund on May 5.

THE King of Denmark has conferred upon Dr. Nansen the Gold Medal of Merit with the Royal Crown.

A COMPLETE set of the *Challenger* Reports has been presented to Dr. Nansen in recognition of the eminent services which he has rendered to the cause of scientific exploration in high latitudes by his recent expedition in the *Fram*.

WE regret to have to record the deaths of the following men of science:—Dr. de Marbaix, founder and some time director of the Bacteriological Institute of Boma; Dr. Siuku Sakaki, professor of psychology in the University of Tokio.

WE notice with much regret the announcement of the death of Prof. E. D. Cope, professor of zoology and comparative anatomy in the University of Pennsylvania.

WE note with the highest satisfaction the complimentary remarks which the Colonial Secretary, Mr. Chamberlain, made in the House of Commons on Friday, with reference to the Royal Gardens, Kew. When the vote of 112,291*l.* for Royal

parks and pleasure grounds came before the Committee of Supply, Mr. Burns brought up the question of opening the gardens to the public earlier than 12 o'clock, the hour of opening at present. In speaking upon it, Mr. Chamberlain said: "The hon. member has failed to realise the peculiar position in which Kew Gardens stand; he treats them as if they existed for the benefit of the inhabitants of Kew. That is not the proper merit or claim the gardens has upon our support, but it is as a great scientific establishment. We are very justly proud of the gardens. I have seen almost every botanical garden in Europe, and I think I am right in saying there is nothing in the whole of Europe which can hold the candle to Kew. I am not speaking as to the decoration of the gardens, but as to their scientific value. There is nothing peculiar in Kew Gardens opening at 12 o'clock. A great number of foreign institutions open at 12 o'clock, and some do not open until late in the afternoon. But the point is that if the gardens were opened at the time the hon. member desires they should be opened, we should most materially interfere with their value as a scientific institution, and should interfere with the work of the officials. In my capacity as Colonial Secretary I am continually applying to Kew in reference to the cultivation of all kinds of plants, and I do not hesitate to say that some of the great improvements made in the Mauritius and some of the West Indian Islands are due almost entirely to the advice and assistance received from the Kew officials. It is not fair to attack public servants who are really performing useful duty, and it is not fair to throw on them duties which would detract from their value as advisers of the colonial and other officers of the Government who may from time to time have occasion to apply for their services." Mr. Burns afterwards remarked that his object in urging the opening of Kew Gardens at an earlier hour than 12 o'clock was not only in the interests of visitors to London, but on behalf of the large body of young men and young women who were studying botany and kindred subjects at the polytechnics. Mr. Gladstone said that it was desirable to extend the privilege of visiting Kew Gardens to as many people as possible; but the question was not so simple as was supposed. He had gone into the matter fully when he was First Commissioner of Works, and he found that when the gardens were opened on Bank Holidays at an earlier hour than 12, comparatively few people availed themselves of the privilege. He did not think that sufficient advantage would result from this arrangement to balance the extra cost which would be involved. But it might be possible to give more facilities to societies and students to visit the gardens under special permission. In replying to the suggestions that the gardens should be opened at an earlier hour for students, Mr. Akers-Douglas said that there could be no doubt that arrangements might be made in that direction. He had made special inquiries, and he found that any one wishing to visit the gardens early for scientific purposes was never refused admission. If institutions, such as those which had been mentioned, wished for the purposes of study to visit the gardens, he was sure that they would be admitted, and more than that, he would take care that they should be admitted.

THE second annual congress of the South-Eastern Union of Scientific Societies will be held at Tunbridge Wells on Friday and Saturday, May 21 and 22, under the presidency of the Rev. T. R. R. Stebbing, F.R.S. Particulars can be obtained from the Hon. General Secretary, Mr. George Abbott, Tunbridge Wells.

A MEETING of the Institution of Mechanical Engineers will be held on Wednesday evening, April 28, and Friday evening, April 30. The chair will be taken by the President, Mr. E. Windsor Richards. The following papers will be read and discussed, as far as time permits:—"Mechanical Propulsion on Canals," by Mr. Leslie S. Robinson (Wednesday); "Experiments on Propeller Ventilating Fans, and on the Electric Motor driving them," by Mr. William George Walker (Friday).

THE following are among the lecture arrangements at the Royal Institution after Easter:—Dr. Tempest Anderson, four lectures on Volcanoes (the Tyndall Lectures); Dr. Ernest H. Starling, three lectures on the Heart and its Work; Prof. Dewar, three lectures on Liquid Air as an Agent of Research. The Friday evening meetings will be resumed on April 30, when a discourse will be given by Prof. J. J. Thomson on Cathode Rays; succeeding discourses will probably be given by Prof. Harold Dixon, the Right Hon. Lord Kelvin, Prof. H. Moissan, Mr. W. H. Preece, and Mr. William Crookes.

EFFORTS are being made to establish a national photographic record and survey collection, to be under the direction and in charge of the authorities of the British Museum. It is proposed to form a preliminary Committee to organise the work, and to invite to act upon it representatives of the Royal Society, the Society of Antiquaries, the Royal Photographic Society, the Royal Institute of British Architects, the Royal Archæological Institute, the Royal Geographical Society, the Trustees of the British Museum, and others.

ON Easter Monday the 129th meeting of the Yorkshire Naturalists' Union will be held at Boston Spa, for the investigation of the banks of the Wharfe, from Flint's Mill to White Crag. We take the opportunity afforded by this announcement to call attention to the admirable leaflets which the Union issues to the members previous to its meetings. The circular before us points out the most important features of the geology, botany, vertebrate zoology, conchology, and entomology of the district to be visited, and is altogether a business-like and helpful production. Many natural history societies would do well to take the methods of the Yorkshire Naturalists' Union as their pattern.

A VERY fine specimen of an egg of the Great Auk was sold by auction at Mr. J. C. Stevens' rooms on Tuesday. Bidding began at 100 guineas, and reached 280 guineas, at which price the egg was secured by Mr. T. G. Middlebrook.

AT a recent special meeting of the Royal Scottish Society of Arts, says the *Electrician*, a report by the Committee appointed to adjudicate on the electric meters that had been submitted in competition for the special Keith prize of 50*l.* was read. Nine meters were sent in. These were tested at the Edinburgh central station with continuous and alternating currents. The Committee were of opinion that while several of the meters possessed many points of novelty and ingenuity which might be capable of further development, none of them were of sufficient merit to warrant the Society in making any award.

WE learn from the *Times* that the Council of the Royal Geographical Society have awarded the annual honours as follows:—The Founder's medal to M. Semenoff, Vice-President of the Russian Geographical Society; the Patron's medal to Dr. George M. Dawson, C.M.G., F.R.S., Director of the Geological Survey of Canada; the Murchison grant to Lieutenant Seymour Vandeleur, D.S.O., for his journey of 900 miles in Somaliland and along the Abyssinian frontier in 1893-94; for making surveys of 2073 miles of routes in Uganda, Unyoro, and on the Upper Nile, in 1894-96; and for astronomically surveying 200 miles of practically unknown country in the Niger region, and surveying the new road to Bida and Ilorin from Jebba. The Gill memorial to Mr. C. E. Douglas, for persistent explorations on the western slopes of the New Zealand Alps, extending over twenty-one years

(1874–95); the Cuthbert Peek grant to Dr. Thorvald Thoroddsen, who since 1882 has been continuously exploring Iceland, having at various times covered nearly the whole island; the Back grant to Lieutenant Ryder (of the Danish Navy), for his explorations in East Greenland in 1891 and subsequent years, during which he made important rectifications on the coast, discovered a new series of fjörds, and made important meteorological observations. The following have been elected Honorary Corresponding Members of the Royal Geographical Society:—Prof. G. Della Vedova, Secretary of the Italian Geographical Society; Baron Toll, Russian explorer of the new Siberian islands; and Captain Otto Irminger, President of the Danish Geographical Society.

THE science of experimental psychology, which is zealously pursued in Germany, in the United States, and elsewhere, clearly deserves more attention in this country than it has hitherto received, and it is now proposed that facilities should be afforded for its study at University College. With this object in view a meeting, at which a number of representative men of science were present, was recently held; and a resolution was unanimously adopted expressing the conviction "That, in the opinion of this meeting, it is eminently desirable to establish a laboratory for experimental psychology in University College." An organising Committee, consisting of Mr. Francis Galton, F.R.S., Dr. W. H. R. Rivers, Prof. G. Carey Foster, F.R.S., Prof. Karl Pearson, F.R.S., Prof. E. A. Schäfer, F.R.S., Prof. J. Sully (Secretary), was formed to inquire into the probable cost of the undertaking, and to send out a letter inviting contributions. As the Professors of Physics and Physiology at University College think it possible that they will be able to afford accommodation, at least temporarily, in their laboratories for the teaching of this subject, and that they could assist to some extent by the loan of apparatus, the work could be established at comparatively small cost. It is estimated that an outlay of about 100*l.* would suffice, in the first instance (with the loan of existing apparatus), to provide the equipment necessary for a small laboratory. It is considered, further, that at the outset it may be wise not to attempt more than a course of instruction extending over one term in the year, and that an annual sum of about 100*l.* would enable the Committee to secure the services of an instructor for a single term in each year, and to commence work. For funds to do this the Committee have made an appeal for help to those who are interested in psychological investigations. Cheques should be sent to the London and South Western Bank, Limited, Hampstead Branch, 28, High Street, Hampstead, N.W., to the account of the "Psychological Laboratory, University College."

LIEUT. PEARY'S plan to reach the North Pole has been approved by the American Geographical Society. It has recently been explained by him as follows:—He wishes to proceed along the west coast of Greenland to the northernmost settlement, and there secure five or six young married couples to establish a new settlement as far north as the steamer can conveniently proceed, probably on some island in the Archipelago, and within the distance of 360 miles from the Pole. The settlement will be provisioned for three years, and will include only one, or perhaps two whites, besides himself. All will live together in Eskimo fashion, and will await, for years if necessary, a condition favourable to making the journey over ice on sleds, which can be accomplished at the rate of ten miles a day, so that seventy-two days will suffice to go and return. The ship is to visit the station every year with fresh stores of provisions, but the stock on hand will suffice to support the party in case of failure to reach them for one year, or even two. The expense of the undertaking, if protracted for several years, is estimated at less than 150,000 dols., with a probability of very large reduction from this amount uccess is soon attained.

IT is understood (states the *Times*) that the order recently promulgated by the Board of Agriculture concerning the muzzling of dogs in the metropolitan area is only the first step in a comprehensive scheme for giving effect to the recommendation of Mr. Whitmore's Departmental Committee, "that the time has come and the circumstances are opportune for the Board of Agriculture to make a determined and systematic attempt to stamp out rabies." In view of the expression of opinion placed on record by the Committee that such an attempt "will not involve universal muzzling, inasmuch as there are districts where rabies have never appeared," but that the Board of Agriculture "should have regard to the country as a whole, and should impose muzzling over considerable areas, irrespective of the boundaries of boroughs and counties," it is obvious that great discrimination must be exercised in determining the districts in which precautionary measures are needed. From the reports which Mr. Long has received, however, it is clear that London is not an exceptional case; and a muzzling order may shortly be looked for, embracing the whole of South Lancashire and possibly a portion of Cheshire as well. Another area likely to be scheduled at no distant date is that of which Birmingham is the centre.

WHEN mine host in the ideal country inn, which all of us seek but none of us find, brings up a bottle of crusted wine covered with cobwebs and dust, this outward and visible sign is taken as convincing evidence of age. We grieve to have to record that the trust may now be misplaced. A *Bulletin* (No. 7) of the Division of Entomology of the U.S. Department of Agriculture says that in France and Pennsylvania an industry has recently sprung up, which consists of the farming of spiders for the purpose of stocking wine cellars, and thus securing almost immediate coating of cobwebs to new wine-bottles, giving them the appearance of great age. This industry is carried on in a little French village in the Department of Loire, and near Philadelphia, where *Epeira vulgaris* and *Nephila plumipes* are raised in large quantities and sold to wine merchants at the rate of ten dollars per hundred. This application of entomology to industry is one which will not be highly commended.

THE immense advance that has taken place in the accommodation provided for large vessels at the principal ports of this kingdom, may be realised by drawing attention to the fact that a steamship is now under construction which is to be 25 feet longer than the *Great Eastern*, which proved such a white elephant to all who had to do with her, owing to her size and draught, that she was finally broken up and sold for old metal. The *Oceanic*, now under construction by Messrs. Harland and Wolff, at Belfast, for the White Star Fleet, is to be 704 feet in length, or 65 feet longer than any other steamer yet built, and her gross tonnage will exceed 17,000 tons. It is anticipated that she will maintain an average speed of 20 knots, or over. This vessel would be able to steam, in case of need, 23,400 miles at 12 knots an hour, or practically round the world, without coaling.

THE specification of the patent taken out in the names of the late M. Dansac and M. Chassagne, for the process of producing photographs in colour, is reprinted in the current number of the *British Journal of Photography*. It will be remembered that the process was described as based upon the property of selective colour absorption superinduced by (1) treating the plate upon which the negative was taken with a special solution; and (2) treating the positive print with the same solution, the successive application of the blue, red, and green colouring solutions producing the natural colour effect on the print. Our contemporary points out, however, that there is no

reference in the inventors' description to the treatment of the negative or the unexposed plate with any special solution. The process appears to consist in treating a silver print or glass transparency with five specially prepared solutions, the compositions of which are described in the specification.

THOSE who have studied rocks from the point of view of their magnetic properties, have long been aware of the existence of certain isolated portions, or zones, endowed with intense magnetisation, the distribution of which, in general, bears no fixed relation to the direction of the earth's magnetic field. The theory, frequently advanced, that these singular points owe their magnetisation to discharges of lightning, has received a remarkable confirmation at the hands of Dr. G. Folgheraiter. As the result of numerous observations of the remains of walls and ancient buildings in the Roman Campagna, Dr. Folgheraiter finds that these structures frequently exhibit singular points and zones in every respect identical with those observed in rocks. The presence of singular *points* in walls might be accounted for by supposing that they had existed in the stone before it was used for building; but this explanation is incapable of accounting for the singular *zones* in which a number of adjacent stones, as well as the mortar connecting them, were found to be so powerfully magnetised, that even a small detached portion of the mortar was capable of deflecting a compass-needle through 180°. These zones could only have derived their magnetisation after the wall had been built, and the presence, in some cases, of cracks down the wall in the neighbourhood of the singularities, such as would be caused by lightning, tends to confirm the present theory of their origin.

The classification of cubic curves is due to Newton; but while many papers dealing with curves of the fourth degree are to be found in various mathematical periodicals, these have usually left the appearance of the curves largely to the reader's imagination. We have, therefore, much pleasure in calling attention to a dissertation by Dr. Ruth Gentry, of Bryn Mawr College, "On the Forms of Plane Quartic Curves" (New York: Press of Robert Drummond, 1896), containing a complete enumeration of the fundamental forms of these curves, and thus achieving for quartic curves what Newton accomplished for cubics.

THE papers read before the London Mathematical Society from November 1895 to November 1896, have just been published in vol. xxvii. of the Society's *Proceedings*. As we regularly give a brief account of the meetings of the Society, it is unnecessary for us to do more now than call attention to the publication in full of the papers referred to in our reports.

AMONG the eight valuable papers in the new number of *Science Progress* (April) is one, by Prof. E. B. Poulton, on "A Remarkable Anticipation of Modern Views on Evolution." It clearly appears from the article that James Cowles Prichard, distinguished for his researches in anthropology and ethnology, must be given a very important place among the pioneers of evolution. The second volume of his "Researches into the Physical History of Mankind" (second edition, 1826) contains a most interesting contribution to the history of evolution, and it seems to have been overlooked entirely until Dr. Maurice Davis called Prof. Meldola's attention to it. A careful examination of the work leads Prof. Poulton to conclude that "Prichard apprehended with perfect clearness that domesticated races of animals and plants have been produced by the selection of man, and not by favourable surroundings, careful training or cultivation. He believed in the possibility of organic evolution, and supported it by excellent arguments which still have the strongest weight to-day. He even recognised the operation of natural selection, although he assigned to it a subordinate *rôle*. The most important anticipation is, however, the masterly discussion on the transmission of acquired characters, a discussion in which the distinction between acquired and inherent or congenital characters is clearly drawn, and many of the most difficult cases are fully argued out, the conclusions reached being those independently arrived at by Prof. Weismann over half a century later."

A VERY good portrait of Darwin, reproduced from a photograph by Mrs. J. M. Cameron, forms a supplement to the current number of the *Academy* (April 10).

THE *Journal of Botany* for April gives an interesting sketch, and a portrait, of the life of Mr. H. Boswell, of Oxford, the bryologist, who died on February 4, in his sixtieth year.

WE learn, from the *Journal of Botany*, that the Foreign Office has issued a Report on the Botanical Aspects of British Central Africa, by Mr. Alexander Whyte, treating of the economical side of the subject.

THE methods in which the natives of New Caledonia cultivate yams and taro is described by M. Glaumont in *L'Anthropologie* (1897, Tome viii. p. 41). To irrigate the latter, long, wide ditches are dug of varied form; some are in spirals, others quite labyrinthiform.

AS examples of results obtained by means of a pin-hole camera, some photographs reproduced in the *Amateur Photographer* (April 2) are remarkably good. The pictures accompany two articles, by Mr. George Davison and Mr. H. C. Shelley, on pin-hole cameras and their use.

HERR J. BRUNNTHALER, of Vienna, has issued a very copious "Jahres-Katalog" of the Vienna *Kryptogamen-Tauschanstalt*, in German, French, and English, consisting of a very long list of species in the various families of Cryptogams offered in exchange or for purchase. The locality of the collection is in all cases given, and several new species of Fungi are described.

WE have received the Annual Report of the Royal Botanic Gardens, Trinidad, for 1896. Among interesting items of information is the rediscovery in the island of *Sacoglottis amazonica*, thus establishing the source of one of the "drift-fruits" discussed in the Reports of the *Challenger* Expedition, as being found by various collectors in the Caribbean and other seas.

PROF. W. A. HERDMAN, who has done a little work in prehistoric archæology in the Isle of Man and elsewhere, threw out the suggestion, at a recent meeting of the Liverpool Biological Society, that the "Calderstones" near Liverpool originally were part of a dolmen; a visitor present on that occasion corroborated this view, and the evidence has since been collected by Prof. Herdman in the *Transactions* of that Society.

A MYKENÆAN painting on a calcareous slab is described by M. Salomon Reinach in *L'Anthropologie* (1897, Tome viii. p. 19). It represents five marching warriors, who carry circular shields, and who are poising their javelins as if on the point of throwing them; below are five ill-drawn animals. M. Reinach hopes that it will soon be possible to clearly distinguish between Achæan and Ægean or Pelasgian finds. He refers the painted slab to the former culture.

THE study of iron carbide has for a long time occupied the attention of chemists, the general result of whose researches has been to show that steel contains a crystalline carbide corresponding to the formula Fe_3C. Curiously enough, although this was one of the first metallic carbides known, it has proved t be the last to be prepared in quantity by direct synthesis. When pure iron and carbon are melted together in the electric

furnace and allowed to cool slowly, the ingot contains only about 1 per cent. of combined carbon, although the presence of a considerable quantity of graphite shows that the mass, when fluid, contained a much higher percentage. In preparing diamonds by rapidly cooling a solution of carbon in iron, M. Moissan noticed, in the central portion of the casting, signs of crystallisation recalling the appearance of the boride and the silicide of iron. It thus appeared probable that the carbide of iron could exist at a very high temperature, but was almost completely decomposed on slowly cooling to the solidifying point of the casting. Following up this observation, M. Moissan heated pure iron for three minutes in a carbon crucible with a current of 900 amperes at 600 volts, the mass being then taken from the furnace and poured directly into cold water. The ingot was crystalline in structure, containing from 3 to 4 per cent. of combined carbon, but no graphite. From this the carbide was separated, by a modification of the method of Mylius, Fœrster and Schwenz, in brilliant crystals of exactly the composition Fe_3C (*Comptes rendus*, April 5). Water has no action upon this, even at 150°, but hydrochloric acid gives a mixture of hydrogen and methane. The experiment is stated by M. Moissan to be free from danger, but is hardly likely to be frequently repeated in the laboratory on account of the enormous currents required, representing, indeed, upwards of 700 horse-power.

FATHER SIDGREAVES has issued his report on the meteorological, magnetic, and other observations made at the Stonyhurst College Observatory in 1896. It is curious that the instruments at Stonyhurst seem to object to furnish positive evidence of phenomena, either terrestrial or celestial. Tracings of the horizontal magnetic direction and force were examined in connection with several distant earthquakes; but Father Sidgreaves says he has found nothing in the movements of the magnets that could be attributed to any but magnetical disturbance. Even the nearer earth tremor of December 17, 1896, made no impression on the Stonyhurst magnetic curves. Over 350 photographs of stellar spectra were obtained during the year with the compound prism spectrograph in combination with the Perry-Memorial objective.

AN admirable series of leaflets on birds, edited by Mr. H. E. Dresser, has been published by the Society for the Protection of Birds. Part I. contains short and popular articles, written by well-known ornithologists, on owls, woodpeckers, starling, swallows, kingfisher, osprey, dippers, nightjar, titmice, kestrel, and plovers. The leaflets will do good service in interesting the public in our feathered friends, and in preventing the wanton destruction and possible extermination of beneficial species. At the end of the collection of leaflets is a concise and clear statement of the Acts and Orders which have been made for the protection of eggs and birds in the different counties.

THE following new editions of scientific works have recently been published:—"Stones for Building and Decoration," by George P. Merrill. (New York: Wiley and Sons. London: Chapman and Hall.) This book has already been reviewed in NATURE (vol. xlv. p. 222, 1892); the present edition, however, contains over fifty more pages than the original. It deals almost entirely with stones found in North America, or imported, and used in the United States for building and ornamental purposes.—"Collected Contributions on Digestion and Diet," by Sir William Roberts, F.R.S. Second edition. (London: Smith, Elder, and Co.) All the contributions the author has made, either in the form of lectures or papers, to subjects relating to digestion, dietetics, and dyspepsia, are brought together in this volume. An article on the opium habit in India, which appeared as an "annexure" to the Report of the Royal Commission on Opium (1895), has been appended to the new edition.—The eighth edition of an "Elementary Text-book of Physics," by Prof. W. A. Anthony, Prof. C. F. Brackett, and Prof. W. F. Magie, has been published by Messrs. Wiley and Sons. The book contains a concise and instructive statement of the fundamental principles of physics. It possesses many good features, and may be used with advantage as a text-book of physics for the higher classes in schools and colleges.

THE Cambridge University Press will publish very shortly: "The Life-Histories of the British Marine Food-Fishes," by Dr. W. C. McIntosh, Professor of Natural History in the University of St. Andrews, and Mr. A. T. Masterman, Assistant Professor and Lecturer in Natural History in the same University.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*, ♂), a Levaillant's Cynictis (*Cynictis penicillata*), a Jackal Buzzard (*Buteo jacal*), a Cape Grass Owl (*Strix capensis*), two Hoary Snakes (*Pseudaspiscana*), two Yellow Cobras (*Naia flava*), a Puff Adder (*Bitis arietans*) from South Africa, presented by Mr. J. E. Matcham; a Red-footed Ground Squirrel (*Xerus erythropus*) from West Africa, presented by Sir Archibald Lamb; a Larger Tree Duck (*Dendrocygna major*) from India, presented by Mr. W. Jamrach; two Barbary Turtle Doves (*Turtur risorius*) from Africa, presented by Mr. W. S. Berridge; a Crested Porcupine (*Hystrix cristata*) from West Africa, an Argus Pheasant (*Argus giganteus*, ♀) from Malacca, a Red and Blue Macaw (*Ara macao*) from South America, an Indian White Crane (*Grus leucogeranos*) from India, deposited; four Tufted Ducks (*Fuligula cristata*), European; two Red-backed Buzzards (*Buteo erythronotus*) from South America, two Barred-shouldered Doves (*Geopelia humeralis*) from Australia, purchased; a Markhoor (*Capra megaceros*, ♂) from North-east India, received in exchange; a Mouflon (*Ovis musimon*, ♂), four Coypu Rats (*Myopotamus coypus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF JUPITER'S FIFTH SATELLITE.—Prof. J. M. Schaeberle, writing from the Lick Observatory to the *Astronomical Journal* (No. 398), gives the results of his observations relating to the fifth satellite of Jupiter. These measures will furnish considerable data for correcting the mean motion of the satellite, even if no other observations be secured at the present season. Marth's ephemeris was found still to be in good agreement with the observed place, the error in time of elongation being less than four minutes. The observations were made on February 27 of this year, and were begun within half an hour of the satellite's greatest elongation.

HARVARD COLLEGE OBSERVATORY REPORT.—We have received the fifty-first annual report of the director of the Astronomical Observatory of Harvard College, Prof. E. C. Pickering, to the president of the University. A glance at this shows one what an immense amount of useful work is being done at this observatory, and how great a scope is included in it. The two subjects to which special attention is called, are the successful erection of the Bruce photographic telescope in Peru, and the establishment of a series of circulars, which have for their object a prompt means of announcing discoveries made at the observatory or its branch stations, and other similar matters of interest. The usual routine work has been continued with the well-known energy displayed by the director in all departments. Thus with the East equatorial, among other observations, 4192 comparisons have been made to determine the form of the light curve of the Algol variable W Delphini, 3436 of U Cephei, and 1616 of Z Herculis and 1748 of T. Andromedæ. The photographs taken with the 8-inch Draper telescope numbered 2508, while the 8-inch Bache telescope has been employed in obtaining 2770 stellar spectra. Among these many very interesting objects have been discovered, several of which have been previously referred to in these columns. The 13-inch Boyden tele-

scope, situated at Arequipa, has also been very extensively used, the chief work being the photography of the spectra of the brighter southern stars with one, two, and three prisms. The report further describes the work done at the meteorological stations, and concludes with a brief summary of the recent publications, and those which are in or nearly ready for press.

THE INTERNATIONAL UNIFICATION OF TIME.—The question of France adopting Greenwich time, or, as they would prefer to call it, Paris time, minus nine minutes twenty-one seconds, seems to be still in the air. Nearly all other countries have come into line on the subject, with the exception of Spain and Portugal. These last-mentioned would, no doubt, soon complete the harmony if only France would take the lead. England, Belgium, Holland, and Luxemburg possess to-day West European time. Central European time is adopted by Italy, Switzerland, Germany, Denmark, Norway and Sweden, while Russia (nearly to one minute), Roumania, Bulgaria, and European Turkey use Eastern European time. In Japan the legal time is nine hours in advance of Greenwich, and in Australia and New Zealand the time zones used are 8, 9, 10, and 11 hours earlier than Greenwich. Canada and the United States have for some years used four zones, namely, 4, 5, 6, 7, and 8 hours behind Greenwich time. An article summing up the information on this question of time is contributed to the *Revue Scientifique* (No. 14, April 3), and the question of the advisability of adopting Greenwich time is strongly advocated by the writer, M. Ch. Lallemand. In his summary he mentions the probable motives that have led M. Boudenoot, deputy of the Pas-de-Calais, to submit to the Chamber the following proposition, which is more simple than that which has been previously suggested, namely: "The legal time in France and in Algeria, is the mean time of Paris retarded by nine minutes twenty-one seconds." The writer's concluding words are: "Reduced to this and stripped of all which could hurt the susceptibilities of the most delicate, one may hope that this projected reform will meet with the reception that it deserves, both by Parliament and the public; that is to say, the unanimous approval of *tous les hommes de progrès*."

KOCH'S RECENT RESEARCHES ON TUBERCULIN

DURING the last couple of weeks there have appeared in the various lay and medical journals long accounts of an improved method of preparing and using tuberculin. Koch and his assistants, no doubt disappointed at the results of the premature application of the tuberculin treatment, have, for seven years, worked away steadily to try to counteract some of the damage done by irresponsible enthusiasts in 1890. How far they have succeeded will be gathered by those who carefully weigh the work that has now been published. Disregarding Koch's instructions that the cases of tuberculosis to be subjected to the tuberculin treatment should be carefully selected, and that tuberculin should not be tried in any but comparatively early cases, physicians threw aside tuberculin as being not only of no use, but absolutely injurious, and taking into consideration the class of case on which it was tried they were right. The febrile reaction may or may not have been injurious in the majority of cases, but in a certain proportion it was undoubtedly associated with exacerbations of the disease and a general deterioration in the condition of the patient. A few workers, however, have all along maintained that in properly selected cases the exhibition of tuberculin has undoubtedly proved beneficial, whilst as a diagnostic agent, especially in tuberculosis of cattle, it has opened up the possibility of gradually eliminating tuberculosis from our farms and dairies. Tuberculosis, however, has never been brought into line, as regards the production of immunity, with tetanus, anthrax, diphtheria, and certain similar diseases. But a step in advance in this direction has now been made by Koch, as is evidenced by the publication of his most recent work. He points out that in the case of tubercle, unlike many other diseases, an infection, in place of protecting, rather predisposes to new attacks of the disease. On the other hand, there appear to be certain conditions, such as those met with in acute miliary tuberculosis, under which the tubercle bacilli disappear; from this he argues that immunisation only takes place when, as in general tuberculosis, the whole body is invaded by great masses of tubercle bacilli, which thus come in contact with comparatively healthy tissues. Having determined this, it becomes necessary to find out whether the products of the bacillus failing to give immunity, the substance contained in the bodies of the bacilli are the immunising agents. By means of a decinormal soda solution, he partially broke down, or extracted, the tubercle bacilli; with the fluid thus obtained (T.A., or alkaline tuberculin), he made a series of injections, and found that this substance acts very much as did his original glycerine tuberculin, producing both local and general reactions, but acting more powerfully; and he found that relapses were undoubtedly less frequent when this substance was used than when the original tuberculin was injected. If the remains of the bodies of the tubercle bacilli were left in this fluid, abscesses were formed when large quantities were injected, but such abscess formation was immediately prevented when the fluid was filtered. The tuberculin in this form, however, required to be used in a fresh condition, and, therefore, could not be applied on any very extensive scale. The bodies of tubercle bacilli he found are covered with a layer containing two sebacic (fatty) acids, one of which is soluble in dilute alcohol, and is easily saponified; the other, soluble only in boiling alcohol or ether, is not so readily saponified. These fatty acids form a layer which protects the bacillus, and prevents its being absorbed from the seat of injection, with the result that it remains and sets up a powerful local suppurative reaction. By pounding these organisms in a dry condition, then adding distilled water and centrifugalising, then by drying the sediment and repounding until the whole of it is dissolved, Koch has been able to obtain the substances of the bodies of the bacilli in an absorbable condition. These substances, he says, appear to be divided into two sets: those contained in a whitish, opalescent, transparent supernatant fluid, which contain no bacilli, and a muddy deposit, which contains the solid bacilli. The upper layer contains most of the substance soluble in glycerine. This upper layer is very like the ordinary tuberculin, and acts like that substance, but more powerfully; whilst the lower layer, or the tuberculin remainder (T.R.), has an even more distinct immunising effect. Used in very large doses it produces a general reaction (rise of temperature, loss of appetite, &c.); but used in smaller doses, gradually increasing as quickly as the patient's condition will allow, and avoiding a general reaction, it sets up an immunity against the T.R. substance; indeed, Koch shows that any case which can be rendered proof against T.R. can also be rendered proof against the tubercle bacillus itself. Without going into the question of dosage, it may be insisted that this substance should never be given so as to produce a rise of temperature of more than half a degree. If the disease is advanced the substance appears to exert little or no effect, but as a protective agent and as a curative agent applied at an early stage of infection, a certain proportion of experimentally infected guinea-pigs could be beneficially influenced. So far, as with tuberculin, the best results have been achieved with cases of lupus (or skin tubercle), and here the improvement obtained has been far greater than that produced by the use of tuberculin, though Koch guards his position by saying that though many of the cases may be regarded as cured in the ordinary sense of the word, it is, he thinks, premature to use the word cure before a sufficient time has passed without a relapse. It is, however, important to note that in none of the numerous cases treated were the patients injuriously affected. There was a steady increase in weight, and the variations of temperature, so marked in the tubercular patient, were distinctly diminished, and the general condition of the patient improved.

The interest that attaches to these experiments does not end at this point, for it is evident, if an immunity against the action of the bacilli and their poisons can be obtained, that the treatment of tubercle may ere long be brought into line with the treatment of some of the other specific infective diseases, and that by an extension of Koch's and Maragliano's methods still further advances in the treatment of tubercle may be made. What will strike those who have followed the development of Koch's method of treatment from the time that he discovered the bacillus to the present moment, is the ingenuity, perspicacity, and tenacious adherence to one idea that has characterised the whole of Koch's reasoning and experiments. It is not too much to say that through his early work we have the hope that tuberculosis may gradually be eradicated from cattle, whilst as the result of his later experiments there appears to be some promise that for the human subject protection against the ravages of tuberculosis and even cure may be obtained.

G. SIMS WOODHEAD.

SOME EXPERIMENTS WITH KATHODE RAYS.[1]

THE extensive employment of the focus form of Crookes' tubes as the most efficient known means of generating X-rays, has rendered advisable the more complete investigation of the kathode ray discharge in tubes of this description.

Hitherto, the usual method of investigating the characteristics of a kathode ray discharge apart from its mechanical properties, and beyond what is visible to the unassisted eye, has been by allowing the rays to fall upon a screen of some brightly fluorescent material, such as glasses of various descriptions, or screens covered with fluorescent salts. With all of these the maximum amount of fluorescence appears to be produced by such comparatively weak kathode rays, that in some cases the special effects produced by the more powerful rays seem to be more or less entirely masked, while the well-known phenomenon of the fatigue of fluorescent substances, when exposed to the more active rays, conduces to the same result.

Surface Luminescence of Carbon when exposed to Kathode Rays.

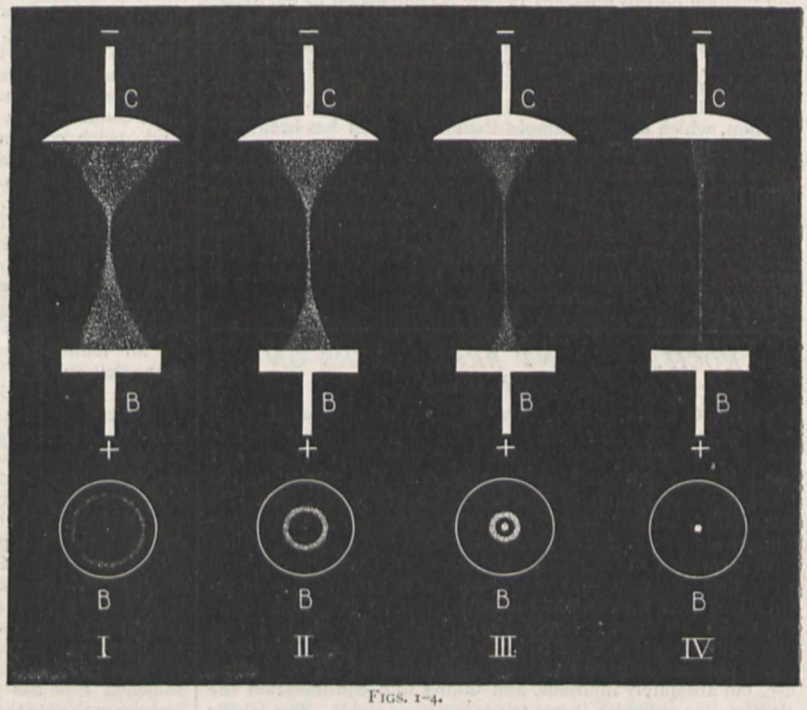
I have found in some cases that by replacing the usual screen, made of or covered with fluorescent material, by one of ordinary electric light carbon, much appears which was previously invisible. When a concentrated stream of powerful kathode rays are focussed upon a surface of carbon in this manner, a very brilliant and distinctly defined luminescent spot appears on the surface of the carbon at the point of impact of the rays, the remainder of the carbon remaining black. This luminescent spot seems to have a very close relation to the fluorescent spots on glass and on other fluorescent materials under similar influence. The effect is evidently a purely surface effect, as when the kathode stream is rapidly deflected by means of a magnet, the luminescent spot on the carbon moves with no perceptible lag. Further, though, as is also the case with glass, the whole of the carbon becomes gradually heated to a considerable extent if much power be employed for a long period of time, these luminescent spots are instantaneously produced on carbon of very considerable brilliancy with but a comparatively low power. Again, just as glass is known to become fatigued under the influence of kathode rays, so that after a time it refuses to fluoresce so brightly as before, so carbon is similarly fatigued, though only after having been very strongly acted upon. Carbon, like glass, also recovers its property of giving a surface luminescence to some extent, though it does not seem to entirely recover, at any rate, at all rapidly.

Apparent form of the Kathode Ray Discharge in a Focus Tube.

As is well known, in tubes of the ordinary focus type with a single spherical concave kathode, the rays coming off normally to the kathode surface appear to converge in more or less of a cone to a focus, and if the vacuum be not too high, to diverge again immediately in another cone upon the other side of the focus. At higher vacua the rays, after passing the focus, do not appear to diverge again at once, but seem to form themselves into a description of thread which connects the convergent and divergent cones, and is longer or shorter according as the vacuum is higher or lower. The focus, or perhaps more correctly, the point at which this thread commences, seems always to be more distant from the kathode than the centre of curvature of the latter, but the variation in this respect seems to be less and less the higher the exhaustion. This is no doubt due to the mutual repulsion of the rays, and accords with the assumption that the rays consist of charged particles, which travel more and more rapidly the higher the exhaustion. Probably for the same reason, kathodes that are only slightly concave, focus further in proportion beyond their centres of curvature than do deeply concave kathodes, for the same vacuum.

Apparent Hollowness of the Divergent and Convergent Cones of Rays.

When the divergent cone is thrown upon a thin platinum disc, as in the ordinary focus tube, and sufficient electric power—say, from a 10-in. Ruhmkorff coil—is employed, the platinum quickly attains to a red heat. With platinum, either the whole disc becomes uniformly heated, or in the event of the diameter of the cone of rays where it strikes the platinum being small compared with the area of the platinum, that portion of the platinum covered by the base of the cone becomes uniformly heated to a higher temperature than the remainder. This is as much as can usually be seen with platinum, though rather more is sometimes visible with aluminium; but if instead of either metal the disc is made of ordinary electric light carbon, I have found that the luminescent portion of the carbon, instead of comprising the whole disc, or consisting of a uniformly heated circle, will in some cases take the shape of a brilliantly luminescent and apparently white hot ring, with a well-defined dark, and seemingly quite cold, interior. As the dimensions of the cone of rays are increased or decreased by decreasing or increasing the vacuum, the luminescent ring will be found to increase or decrease correspondingly in diameter, at the same time being brighter when small than when large. Further, when the ring is very small it will usually have a very brightly luminescent central spot, with a dark intervening portion between this spot and the ring, and when the vacuum is further increased the ring will gradually close in upon the spot until only the latter remains.



FIGS. 1–4.

Figs. 1, 2, 3, and 4 show diagrammatically these hollow effects for four different degrees of vacuum, 1 being the lowest and 4 the highest exhaustion. The upper portion of each of these figures represents the general appearance of the kathode discharge between the spherical concave aluminium kathode C at the top, and the carbon anti-kathode B at the bottom. Beneath each of the elevational views of the kathode discharge will be found a plan view of the carbon anti-kathode, showing for each condition of vacuum the effect of the kathode discharge upon the carbon anti-kathode, in forming a brightly luminescent hollow ring, gradually decreasing in diameter as the vacuum is increased, until it centres on a point, as already mentioned.

[1] Abstract of a paper by A. A. C. Swinton, read before the Royal Society, March 11.

It may further be remarked that the diameter of the luminescent ring may be increased or diminished, or finally reduced to a point, without altering the degree of vacuum, by moving the anti-kathode away from or towards or finally into the focus of the kathode stream, the appearance of the ring in each of these cases being practically similar to those shown in the figures for a uniform distance with varying vacuum. Similarly it may be shown that the converging cone of rays between the kathode and the focus produce hollow rings upon a carbon anti-kathode exactly as does the diverging cone of rays. When the anti-kathode surface is not at right angles to the line of the discharge, the ring, in place of being circular, takes the proper form of a conic section. The holding of a magnet near the tube distorts the ring from a circular shape and moves its position on the carbon.

From these experiments it appears that both the diverging and converging cones of kathode rays act as though they were not of uniform density throughout their sections, but, at any rate, in some instances as if they were completely hollow.

It should, however, be noted that these hollow effects appear only to be obtained with fairly short focus kathodes, such as are usually employed in X-ray focus tubes, that is to say, with kathodes whose diameter is large as compared with their radius of curvature, so that the rays converge and diverge rapidly to and from the focus. With comparatively flat, long focus kathodes the cones do not show any signs of being hollow, and produce a uniformly luminescent spot upon the carbon of larger or smaller diameter, according to the conditions of vacuum and the position of the screen.

For instance, while kathodes 1·125 inches diameter and 0·708 inch radius of curvature gave in the manner described distinctly hollow convergent and divergent cones, a kathode 1 inch diameter and 1·5 inches radius of curvature gave convergent and divergent cones that appeared to be uniformly solid under all conditions.

On the other hand, with rays from flat kathodes brought to a focus by magnetic means, both convergent and divergent cones are found to produce hollow ring effects.

The Rays cross at the Focus with no Rotation.

In order to investigate the kathode rays in a focus tube still further, and more especially in order to discover whether the various rays from the kathode cross one another at the focus, or diverge again without crossing, and also in order to discover whether there is any twist or rotation of the rays, similar to what has been observed in the case of rays focussed by magnetism, a tube was constructed similar to that used in the previous experiments, with a carbon anti-kathode which was also the anode, fixed at the opposite side of the focus from the kathode, with the focus about equally distant between it and the kathode. The peculiarity of this tube consisted in the fact that a sector of the aluminium kathode, equal to one-eighth of the total area of the kathode, had been entirely removed, as shown at C, Fig. 5. It was expected that on using this tube, with the proper degree of vacuum to form a well-defined ring on the anti-kathode screen, that a portion of the ring, corresponding with the amount of the kathode cut away, would be found wanting; and that by the position of this gap in the ring it would be possible to ascertain whether the rays crossed at the focus, and whether there was any rotation. What actually was observed is shown for three different conditions of vacuum in Fig. 5, B being for the highest, and B″ for the lowest vacuum. As will be seen, the expected gap in the ring was obtained, but with the unexpected addition that the dimensions of this gap, instead of being only one-eighth of the circumference of the ring, was seven-eighths of the circumference. In fact, the amount of ring shown corresponded not with the seven-eighths of the remaining kathode surface, but with the one-eighth of the kathode that had been removed. The portion of ring that did appear was of a length corresponding exactly to the arc of the removed sector of the kathode, according to its greater or lesser nearness to the centre with different conditions of vacuum; and as the portion of ring was in each case exactly in line with the portion of kathode that had been cut away, it would appear that there is no rotation of the kathode beam as a whole, that the rays do cross at the focus; and, further, that when the hollow convergent cone is, as it were, split in this manner, some unexplained action, similar in effect to the existence of a circular surface tension, causes the gap to widen out and the remaining portion of the ring-shaped section of the cone to contract correspondingly, without, however, altering its diameter.

In order to further investigate the matter another tube was made, in which the concave kathode was complete; but the interior of the tube was furnished with a small movable piece of aluminium, which by shaking could be moved up and down the tube between the kathode and anti-kathode, and which, while not quite reaching the centre of the tube, would fill up very nearly one quarter of the circular sectional area of the latter.

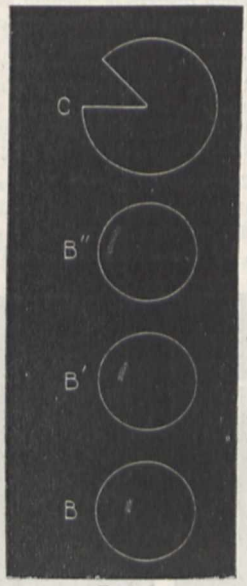


FIG. .

With this arrangement of tube, with the aluminium obstacle placed just at the focus, as shown in Fig. 6, the point of the obstacle just missing the kathode rays, a complete ring was formed on the carbon anti-kathode. On moving the obstacle slightly into the divergent cone, exactly one quarter of the ring on the anti-kathode failed to appear, as shown in Fig. 7, and on the obstacle being further moved in the same direction, the result was not altered.

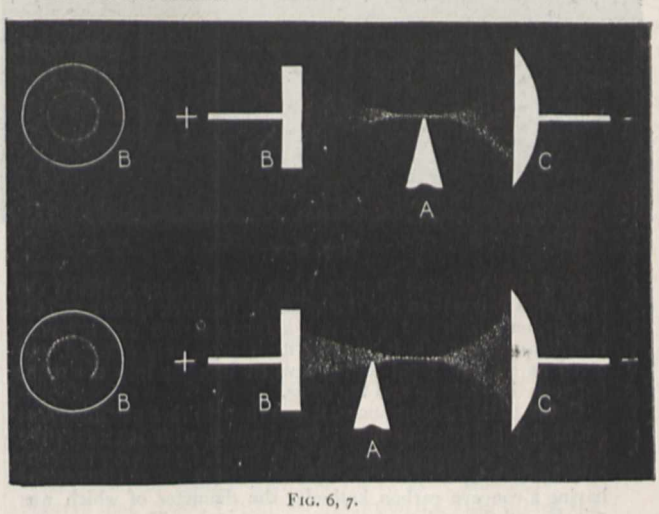


FIG. 6, 7.

As in each of the latter two cases there was no displacement of the gap in the ring, the above showed that there is no rotation of the divergent kathode cone.

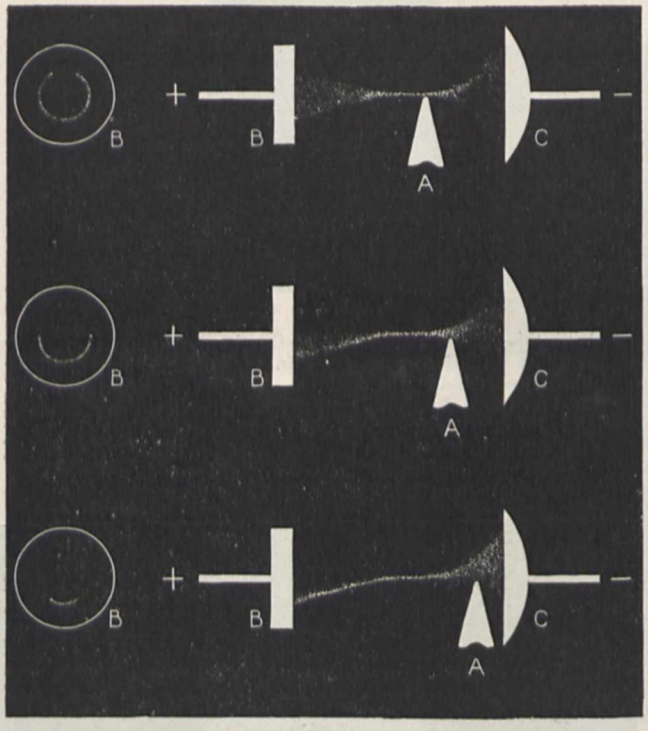
Experiments were next tried with the aluminium obstacle, moved so that its point just entered the converging cone of kathode rays, when a small portion of the ring was cut out; but on the opposite side, as shown in Fig. 8, this confirming the previous experiments, which showed that the rays cross one another's paths at the focus without rotation. Upon moving the aluminium obstacle a little nearer to the kathode, so that

its point entered still further into the convergent kathode beam, one-half of the ring disappeared, as in Fig. 9, while, when the obstacle—which, it should be remembered, blocked only one-quarter of the circular area of the tube—was brought close up to the kathode, only about one-quarter of the ring remained, as in Fig. 10.

Further experiments were tried with the aluminium obstacle both in the divergent and convergent cones, but with the tube exhausted to different degrees of vacuum, when it was observed that when the obstacle was in the divergent cone, a portion of the ring was cut off exactly proportional to the angle subtended by the sides of the obstacle; while when the obstacle was placed in the convergent cone, a much larger proportion of the ring was cut off in each case, this being much more marked with a high vacuum, when the diameter of the ring was small, than with a low vacuum, when the diameter of the ring was large.

The Convergent Cone at Higher Vacua.

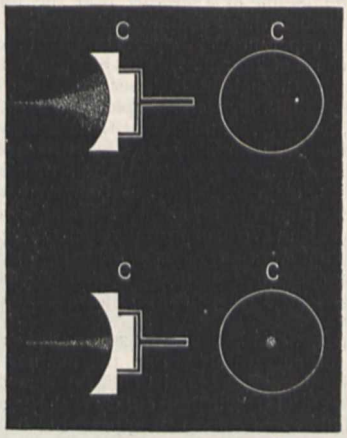
The carbon anti-kathode screen was found useless for investigating the convergent cone of kathode rays at anything but a very low vacuum, by the reason of the well-known difficulty in



FIGS. 8–10.

getting any discharge to pass when the distance between the electrodes is less than the thickness of the dark space; and for the further reason that if the anti-kathode screen was not connected to the anode, it became itself negatively charged, and acted as an additional kathode when brought into the space between the kathode and the focus.

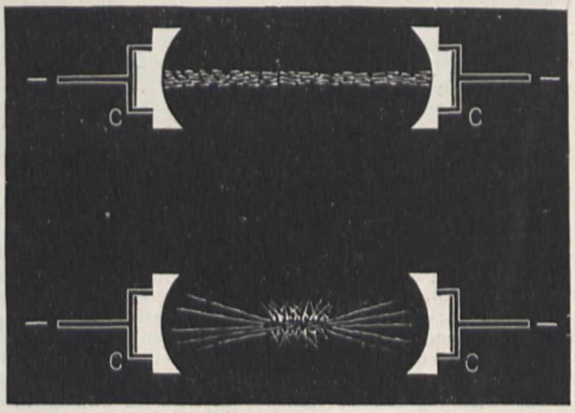
Under these circumstances, it was thought that possibly some additional information might be obtained with regard to the form of the convergent cone at high vacua, by making the concave kathode itself of carbon. A tube was therefore constructed having a concave carbon kathode, the diameter of which was 1 inch, and the radius of curvature 0·75 inch. The appearance of the kathode with this tube is shown for a fairly high vacuum in Fig. 11, in which the kathode itself is shown in section, so as to let the form of the discharge be better seen. As will be observed under this condition of vacuum, which was too high to show any divergent cone, the cone of convergent rays appears to be contracted in diameter at its base, and to come off from the central portion of the kathode only, the remaining surface of the kathode being apparently inactive. This was found to be still more the case at higher vacua, as will be seen from Fig. 12, which shows in a similar manner the form of the kathode discharge in a tube exhausted to a very high vacuum. In this case, as will be observed, the whole of the kathode rays appear to come off from a very small spot in the centre of the kathode. Further, that this small spot is, at any rate, the source of most, if not all, activity, was evident from the fact that it became luminescent exactly in the same manner, but in a less degree, than had previously been observed with a carbon surface upon which kathode rays were concentrated. Whether this surface luminescence of the kathode carbon, at the point where the kathode rays leave it, is due to the violent tearing away of particles of carbon, or to some other cause, it is difficult to say; but the fact that at high vacua the kathode rays come of entirely



FIGS. 11, 12.

—or, at any rate, almost entirely—from only a very small portion of the centre of the kathode, explains the observed fact that, within limits, large kathodes have no advantage over small kathodes in X-ray tubes.

During the carrying out of the above experiments with a carbon kathode, very bright sparks were occasionally seen coming off the kathode and passing through the focus, and it was consequently thought that possibly by placing two concave carbon kathodes facing one another, such particles, by being caused to rebound backwards and forwards continuously between the two, might render the form of kathode stream visible at very high vacua when the stream itself becomes otherwise invisible.



FIGS. 13, 14.

With this view, a tube was made with two concave carbon kathodes, similar to those employed in the last experiment, were placed exactly opposite one another. The anode was placed in an annex, and the two kathodes were connected together by means of a wire outside the tube. At a very high exhaustion, this tube gave very beautiful effects, and showed clearly the form of the kathode discharge at a degree of exhaustion when it is usually in itself quite invisible. Immediately on the current being turned on and the discharge passing, a straight and thin stream of bright golden coloured particles of apparently incandescent carbon passed between small luminescent spots at the

centres of each kathode, as shown in Fig. 13. This did not last for more than a second, when owing, no doubt, to the rapid fall of vacuum the appearance changed to that shown in Fig. 14, and the incandescent particles of carbon could be seen passing backwards and forwards along the convergent and divergent cones of kathode rays, which, at the lower vacuum, proceeded from both kathodes, and spluttering in the centre, where the particles going in opposite directions collided. This appearance lasted for some seconds, becoming gradually fainter as the vacuum fell. By re-exhausting the tube with the pump, however, the original appearance shown in Fig. 13, as also the appearance shown in Fig. 14, could be produced as often as desired. Apparently the particles of carbon become heated to incandescence either by the action of the kathode rays upon them while they are flying through space, or by their friction in passing through the residual gas, and possibly by their mutual collisions, for in the stage shown in Fig. 14, when the kathodes themselves show no luminescence the flying particles appear to be most intensely luminescent when in the centre of the tube. It may be mentioned that after this experiment had been repeated several times, the glass of the tube became perceptibly blackened, which, taken with the fact that a similar tube with kathodes of aluminium showed no stream of bright particles, goes to show that the particles consist of carbon torn off the surfaces of the kathodes.

The Production of X-Rays.

In order to ascertain whether it is necessary that the kathode rays should fall on solid matter in order to produce X-rays, another tube was constructed, similar in all respects to the last, with the exception that the two kathodes were made of aluminium.

It was thought that with this tube the opposing streams of kathode rays might possibly produce X-rays at the point where they met. This does not, however, appear to be the case, as though this tube, when exhausted to so high an extent that the alternative spark in air leapt fully eight inches, gave X-rays in considerable quantity, these rays appear to come entirely from portions of the glass of the tube that were covered with green fluorescence, and not at any rate appreciably from the central point between the two kathodes, where the opposing streams of kathode rays would meet one another.

It seems, therefore, that X-rays can only be produced by kathode rays when these strike solid matter.

No doubt this matter must also be positively electrified.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual spring meeting of the Institution of Naval Architects was held last week in the hall of the Society of Arts, under the presidency of the Earl of Hopetoun, President of the Institution. The meeting extended over the 7th, 8th, and 9th of April. The following is a list of the papers read :—

"Recent Trials of the Cruisers *Powerful* and *Terrible*," by A. J. Durston, Engineer-in-Chief to the Royal Navy.

"Water-tube Boilers in War Ships," by Rear-Admiral C. C. P. Fitzgerald, R.N.

"A Mechanical Method of Ascertaining the Stability of Ships," by A. G. Ramage.

"On the Fighting Value of certain of the Older Ironclads if Re-armed," by Captain Lord Charles Beresford, R.N.

"The Application of the Compound Steam Turbine to the Purposes of Marine Propulsion," by the Hon. Charles Parsons.

"On the Use of the Mean Water Line in designing the Lines of Ships," by A. G. Ramage.

"The Accelerity Diagram of the Steam Engine," by J. Macfarlane Gray.

"Acetylene and its Probable Future Afloat," by Prof. Vivian B. Lewes.

"Nickel Steel as an Improved Material for Boiler Shell Plates and Forgings," by William Beardmore.

"Application of Electrical Transmission of Power in Marine Engineering and Shipbuilding," by F. von Kodolitsch.

The papers were mostly of a practical rather than of a scientific interest. Mr. Durston's contribution on water-tube boilers was a valuable record of the performance of the boilers in the two big cruisers lately added to the Navy. It may be said generally that the Belleville boiler has proved successful in these ships, and has done a little better than return-tube boilers of the type recently placed in the ships of Her Majesty's Navy. The fuel economy has been fair, 1·7 lbs. per I.H.P. per hour ; whilst the weight of boiler and contained water was somewhat below that which has been generally reached in Navy return-tube boilers when run under easy conditions ; but in some cases the boiler weights per I.H.P. of other war vessels have been lower than the figure—22 I.H.P. per ton—recorded of the two cruisers. In the long debate which followed the reading of the paper, it was stated that the Belleville boiler appeared to advantage in the *Powerful* and the *Terrible*, because it was compared with a type of boiler that was ill-designed The general opinion of speakers, however, was that Mr. Durston had scored a great success, and deserved to be congratulated on his courage and perseverance. Admiral Fitzgerald discoursed on the advantages of the Belleville boiler from a tactical and strategical point of view. His opinion was altogether favourable to the new type of steam generator. Lord Charles Beresford, in his contribution, advocated the re-arming of certain old battle-ships with modern breech-loading guns, or else scratching them off the list of effective ships. The preponderance of naval opinion appeared to be in favour of the latter course. Mr. Ramage's paper described a mechanical method of ascertaining stability by means of wooden sections representing mean sections. The method is ingenious, but the principle is not altogether new.

The paper by Mr. Parsons had been looked forward to with great interest, as it was to describe a very wonderful boat, which was fitted with the author's steam turbines in place of ordinary engines. The *Turbinia*, as the boat is named, is 100 feet in length, 9 feet beam, and 44½ tons displacement. The original turbine engine fitted in her was designed to develop upwards of 1500 actual horse-power at a speed of 2500 revolutions per minute. The boiler is of the water-tube type for 225 lbs. per square inch working pressure with large steam space, and large return water legs, and with a total heating surface of 1100 square feet, and a grate surface of 42 square feet ; two firing doors are provided, one at each end. The stokeholds are closed, and the draught furnished by a fan coupled directly to the engine shaft. The weights are remarkable, and certainly have never before been equalled for lightness in any practicable marine machinery. They are as follows :—

Main engines	3 tons 13 cwts.
Total weight of machinery and boiler, screws and shafting, tanks, &c. ...	22 tons
Weight of hull complete	15 tons
Coal and water	7½ tons
Total displacement	44½ tons

The great trouble, as might have been expected from the high rate of revolutions, was with the screws, and Mr. Parsons has only repeated the experience of Mr. Thornycroft with his destroyer, in finding that in all screws there is a limiting speed of blade, due to cavitation, depending upon the slip ratio and the curvature of the back. In order to throw light on this subject, the author had recourse to an ingenious device. Model screws were revolved in a bath of hot water heated to within a few degrees of the boiling point, and in order that the model screw should produce analogous results to the real screw, it was arranged that the temperature of the water and the head of water above the propeller, as well as the speed of revolution, should be such as to closely resemble the actual conditions and forces at work in the real screw, the object in heating the water being to obtain an increased vapour pressure from the water, so as to permit a representation of the conditions with a more moderate and convenient speed of revolution than would otherwise have been necessary. The screw was illuminated by light from an arc lamp reflected from a revolving mirror attached to the screw shaft, the light falling on the screw at one point only of the revolution. The shape, form, and growth of the cavities could be clearly seen and traced as if stationary. It appeared that a cavity or blister first formed a little behind the leading edge, and near the tip of the blade ; then, as the speed of revolution was increased, it enlarged in all directions until, at a speed corresponding to that in the *Turbinia's* propeller, it had grown so as to cover a sector of the screw disc of 90°. When the speed was still further increased, the screw, as a whole, revolved in a cylindrical cavity, from one end of which the blades scraped off layers of solid water, delivering them on to the other. In this extreme case nearly the whole energy of the screw was expended in maintaining this vacuous space. It also appeared that when the cavity had grown to be a little larger

than the width of the blade, the leading edge acted like a wedge, the forward side of the edge giving negative thrust. The turbine ultimately used was of the three-stage compound order, each turbine of the series being a separate motor, though the three worked in series. Each motor actuated its own propeller shaft. The steam was expanded one-hundred-fold. The screws were 18 inches in diameter. The steam pressure in the boiler was 200 lbs., and at the engines 130 lbs. The speed of the boat was 31 knots, which is considerably in excess of any speed hitherto reached if the length of the boat be taken into consideration. The horse-power developed was 1576 as estimated, and no doubt the estimate is very close in view of the advantage Mr. Parsons has had in former trials with electrical machinery. The consumption of steam per I.H.P. per hour was 15·86 lbs., which is a remarkably good result. The indicated horse-power per ton of machinery is 72, which is, we think, in excess of anything either Mr. Yarrow or Mr. Thornycroft have attained with their destroyers, remarkable as are the advances made by these gentlemen in recent times. If, however, the boiler weights were excluded, the advantage of the *Turbinia* would be far more marked. To sum up, it may be said that Mr. Parsons has produced a very wonderful boat; but it remains to be seen how far he can maintain his success when the principle comes to be applied to vessels of a more practical character than his experimental craft. In any case, the steam turbine, in its present form, is hardly applicable to heavy and large vessels; and as yet it has not, as some have rashly asserted, revolutionised the practice of marine propulsion. What it may lead to, if the inventor can reduce the rate of revolutions in a practical and economical manner, remains to be seen. That is the great obstacle to extended success, and if it can be overcome we may expect still greater things from this new motor.

The next paper, by Mr. Ramage, was one of a purely professional interest, and as such will be of value to the ship draughtsman. Mr. Macfarlane Gray's two contributions, like all that comes from his pen, were of interest, but without the diagrams it would be difficult to deal with them. His stability diagram, we understand, is for ships' officers, and we hope that it may be of use to them. We think, perhaps, it will require a more comprehensive explanation of its principles than is given in the paper. The paper by Prof. Lewes was of a purely popular nature.

One of the most important papers was that read by Mr. Beardmore on the last day of the meeting. Its interest was of a purely practical nature, the author giving details of the properties of nickel steel as they affected engineering interests. The material is no doubt admirably fitted for construction work, having both toughness and high tensile strength; but its high price prevents it being at present, at any rate, a competitor with ordinary mild steel for ship-building, excepting in special positions, such as the construction of torpedo craft, for which it has already been used. The last paper on the list described the application of electricity for driving to certain shipyard tools, and showed how in this way advantage might be gained, in regard to coal economy, over the use of steam-driven machines.

The summer meeting this year will be held in London.

A METEORITE FROM NEW MEXICO.[1]

ON nearing Fort Stanton, Arizona Territory, while on a westward journey in 1876, Mr. M. Bartlett, of Florence, A.T., saw a meteor pass through the heavens in a southerly direction and fall, with a report like that of a cannon, on the east side of the Sacramento Mountains.

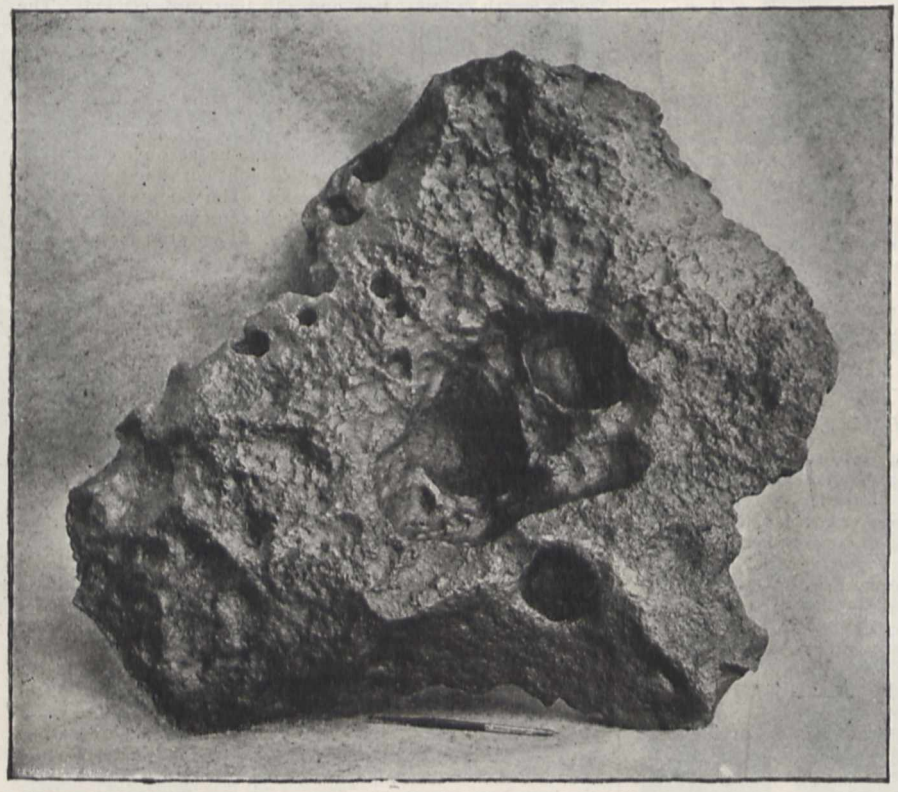


FIG. 1.—The Sacramento Mts. Meteorite. (One-eighth full size.)

The account of it was given by Mr. Bartlett to Mr. C. R. Biederman, and to the latter gentleman is due the credit of securing the specimen to science and furnishing the historical data here given.

Continued inquiry in the Pecos country was fruitless until by chance a small sample of native iron was presented to Mr. Biederman for assay, and proving to be meteoric, led to the locating of the mass through the first finder, a shepherd, named Beckett.

The latter, in a sworn statement, says that he found it while herding in the lower foot-hills of the Sacramento Mountains, Eddy Co., N.M., about twenty-three miles south-west of a place called Badger. It rested on top of a limestone hill, where it had made a depression, and was partly buried. He could find no other pieces. Mr. Biederman, heading a search party, found the mass at the place indicated, and with much labour dragged it six miles over the desert to a wagon road. A long search was made by the party, but nothing else could be found. It is complete, save for about 500 grams of fragments broken off by Beckett, and a piece of 1500 grams sawed off after it came into the possession of the firm of Dr. A. E. Foote. Its appearance indicates that no rupture occurred through an explosion during its flight, nor by the force of the fall. The small fragments mentioned were employed in analysis and the making of a knife.

Description of the mass.—It is a typical example of the class of siderites, weighing complete about two hundred and thirty-seven kilograms, with general dimensions of about 80 × 60 × 20 centimetres. The exterior exhibits in a splendid manner the characteristic markings of meteoric iron. On the flat side,

[1] Note on a new meteorite from the Sacramento Mountains, Eddy Co. New Mexico, by Warren M. Foote. Reprinted from the *American Journal of Science* (January), with illustrations supplied by the author.

shown in Fig. 1, are two cup-shaped pits of 10 to 12 centimetres diameter, which constitute a remarkable feature; the smaller depressions or "thumb-marks" of 3 to 4 cm. diameter, which cover the remainder of the surface, are also reproduced in minute detail.

At the point where the fragments were removed, the octahedral cleavage and lines of crystallisation are noticeable to a degree rarely seen in iron. It is, however, on the etched surface—prepared through treating a polished slab with dilute nitric acid, in the usual manner—that the beauty of the crystalline structure is best seen. In this respect it ranks among the finest of recorded irons, the Widmannstätten figures being exceptionally regular and distinct. The accompanying print (Fig. 2) was made directly from the etched surface. The broad bands of kamacite are symmetrical, the prominence of the interlacing of shining white threads of the nickeliferous iron being especially remarkable, and distinguishing it from the El Capitan meteoric iron, weighing about 28 kilos, and found (Prof. E. E. Howell, *Amer. Journ. of Sci.*, vol. i. p. 253) in 1893, about ninety miles north of the Sacramento range. In the latter iron the percentage of iron is less and nickel greater, phosphorus also being present. For a careful quantitative analysis the writer is indebted to Mr. J. Edward Whitfield (with Booth, Garrett, and Blair, of Philadelphia), who obtained the following results:

Iron	...	...	...	91·39 per cent.
Nickel	...	...	...	7·86 ,,
Cobalt	...	...	...	·52 ,,
				99·77

The mass is perfectly preserved, there being no sign of disintegration or exudation of lawrencite. The sawing done shows it to be quite soft and generally homogeneous. The entire lack of surface alteration proves that it fell at a comparatively recent date, and leads to the conclusion that it is the meteor seen to fall by Mr. Bartlett, whose account led to the discovery.

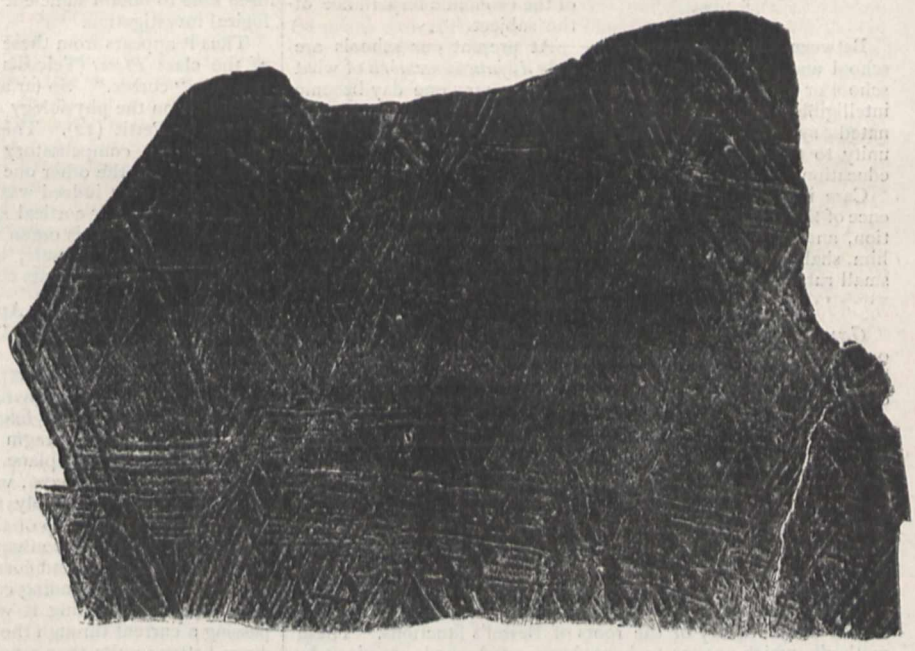


FIG. 2.—The Sacramento Mts. Meteorite. (Printed directly from the etched surface of the iron.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE University of Edinburgh has conferred the honorary degree of LL.D. upon Prof. James Dewar, F.R.S., and Dr. John Wyllie.

THE following are among recent appointments:—Mr. W. J. Pope to be head of the Chemical Department of the Goldsmiths' Polytechnic Institute, New Cross; Dr. Julian Apricio to be director of the Meteorological and Astronomical Observatory of San Salvador; Dr. M. Kirchner to be professor of hygiene in the technical high school at Hanover; Dr. F. Pompeckj to be curator of the palæontological collection in the State Museum at Munich; Dr. F. Koch to be professor of chemistry at Klausenberg.

THE Technical Education Board of the London County Council has decided to institute junior horticultural scholarships tenable at the gardens of the Royal Botanic Society. These scholarships are intended to offer to boys who wish to become gardeners an opportunity of going through a thorough course of training, and they will be awarded, not upon the results of a set examination, but upon a consideration of the record and qualifications of the candidates. Free instruction in horticulture will be provided, with a maintenance grant of 20*l.* per annum to scholars under fifteen and 25*l.* to scholars over fifteen. The scholarships will be awarded, in the first instance, for one year, but will be renewable for a second, or even for a third year, if the progress of the scholar is satisfactory. No candidate will be eligible for these scholarships whose parents are in receipt of more than 250*l.* per annum.

BY an Act passed in 1889, a Commission was appointed for organising and extending the scope and teaching power of the departments of the Scotch Universities, and the effect of the Commissioners' ordinances on the University of Aberdeen was to add a new faculty—that of science—as well as to expand the four former faculties, and largely to increase the building requirements in respect of laboratories, museums, &c., in almost all the departments of the University, while it made no provision for supplying the buildings to accommodate them. The University was, in these circumstances, compelled to build, but had no funds for the purpose. In 1892 Mr. Goschen, then Chancellor of the Exchequer, agreed to give a grant of 40,000*l.* if the public subscribed a similar sum. An appeal was made, and 75,000*l.* were raised, which, with the Government grant, gave a total of 115,000*l.* This amount has been expended, while the works at present in progress entail a further liability upon the University of fully 21,000*l.* To meet this exigency, as well as to complete the buildings extension scheme, and the still urgent necessities of the University, a total sum of at least 40,000*l.* is required; and an urgent appeal has been sent out in the hope that those who are interested in this historic University will assist in the extension of its usefulness. Subscriptions will be received by the honorary secretaries of the Extension Fund: Mr. A. M. Gordon, of Newton, Convener of the County of Aberdeen; and Mr. P. M. Cran, City Chamberlain, Aberdeen.

THE value of science as an instrument of education is now recognised by all educationists who have taken the trouble to consider the matter; but we hasten to say that the scientific knowledge must be gained by individual experience with the objects and phenomena of nature. This principle is so sound that its application is bound to extend. For some years experimental work in elementary science, on the lines suggested by Dr. H. E. Armstrong, has been carried on with great success in about fifteen selected schools under the London School Board. The results have been so satisfactory, that it has been felt that girls as well as boys ought to be given the same training in manipulation and common sense; and to further such an object, a meeting of about two hundred teachers took place on Saturday, April 3. The following resolutions formed the basis of discussion, and were carried *nem. con.*: (1) That there is great room for improvement in the methods of teaching domestic economy as commonly practised in schools, and it is desirable that in

future the teaching should be of a more exact nature, and such as to make the scholars think for themselves about the ordinary affairs of the household. (2) That the time is arrived when it is absolutely necessary to introduce into girls' schools of all grades, and from the outset of the school course, simple but accurate experimental work dealing with domestic matters. (3) That the meeting notes with satisfaction the introduction into the Code of the Education Department of the new subject domestic science as tending to the promotion of the changes suggested in the two preceding resolutions.

A LONG article by Sir Philip Magnus, in the April number of the *National Review*, carries on the crusade in favour of an improved organisation of scientific education and opinion as a means to industrial progress. He does not counsel slavish imitation of German methods, but shows that the advance of German manufacturing industry is largely due to a full and generous recognition of the great part played by science in national progress. It is instructive to compare Germany and England by means of sentences taken from different parts of Sir Philip Magnus' article.

Germany.	*England.*
The recognition of the advantages of scientific and technical education characterises all classes of society in Germany, and none more than employers of labour engaged in productive and engineering industry.	Unfortunately, there is considerable doubt among certain classes of manufacturers, and even among engineers, as to the value of education in assisting industry; and, judging from the treatment in Parliament of all educational measures, it would seem that our legislators are still unconvinced of the economic importance of the subject.
Between the elementary school and the technical high school or university there is an intelligible and well-coordinated system, which gives unity to the entire system of education.	At present our schools are only *disjuncta membra* of what we hope may one day become a system.
Care is taken that the influence of the Minister of Instruction, and of those who advise him, shall penetrate into every small rural School Board.	There is no responsible authority to supervise or grade our several educational institutions, so as to bring them into organic relation with one another.

General Conclusions.—German education is superior to our own in its appliances (schools and their equipment), methods of instruction, and organisation. The instruction is also more closely adapted to the wants and requirements of the people.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, March.—On certain methods of Sturm, and their application to the roots of Bessel's functions, by Prof. M. Bôcher. This is a paper read before the Society at its February meeting, of which the purpose is to call attention to Sturm's methods, rather than to elaborate the details of the theory of the roots of Bessel's functions. These methods, which appear to have been overlooked, are given by Sturm in *Liouville's Journal*, vol. i. p. 136, &c. In addition to the Professor's own work, the paper discusses two recent proofs of theorems, really contained in Sturm's article, given by Messrs. Porter (a graduate student at Harvard) and Van Vleck (*American Journal of Mathematics*, xix. p. 75).—Dr. G. A. Miller, in a paper read at the January meeting, continues his work on groups. The article is on the transitive substitution groups, whose orders are the products of three prime numbers.—Note on the integration of a uniformly convergent series through an infinite interval, by Prof. T. S. Fiske, was also read at the same meeting. It illustrates a communication by Prof. Osgood, which was published in the November number of the *Bulletin*.—Short notices follow, by Prof. F. Morley, of Dr. L. Huebner's "Ebene und Räumliche Geometrie des Masses," and, by Prof. E. W. Brown, of the scientific papers of John Couch Adams.—Some points of interest are brought forward in the usual notes.

IN the numbers of the *Journal of Botany* for February, March, and April, Messrs. W. and G. S. West continue their description of the Fresh-water Algæ collected by Welwitsch in Africa, comparatively new ground; a large number of new and beautiful forms, and several new genera, being described and delineated. Mr. I. H. Burrill commences an elaborate article on the fertilisation of spring flowers on the Yorkshire coast, containing the results of a long series of careful observations, the general conclusions from which will appear in a later number.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 11.—"The Comparative Physiology of the Suprarenal Capsules." By Swale Vincent, M.B. (Lond.), British Medical Association Research Scholar. Received February 18.

The conclusions arrived at are as follows:—

(1) The suprarenal capsule of the mammalia corresponds to two distinct glands in Elasmobranch fishes, the medulla corresponding *in structure and function* to the "paired segmental" suprarenal bodies ("medullary glands" they may be called), while the cortex corresponds to the interrenal body.

(2) In Teleosts the medulla appears to be unrepresented, the known suprarenal bodies ("corpuscles of Stannius") consisting entirely of cortical substance, and corresponding in structure, and most probably in function, to the interrenal body of Elasmobranchs.

(3) The same is most probably true of Ganoids, although I am guided here solely by histological evidence; I have not been able to obtain sufficient and suitable material for physiological investigation.

Thus it appears from these researches that two primary groups of the class *Pisces* (Teleosts and Ganoids) have no "medulla" but only "cortex." So far as I know, the only piece of work published on the physiology of the suprarenal capsules in fishes is that of Pettit (12). This observer has made out a true physiological compensatory hypertrophy of one suprarenal in the eel after the other one has been removed. This renders it probable (what indeed was suggested by histological appearances) that this "cortical gland" has a secreting function. Pettit looks upon this organ in the eel as the fundamental type of the suprarenal capsule, but it appears to me much more probable that it represents cortex alone.

Physical Society, April 9.—Mr. Shelford Bidwell in the chair.—Mr. T. A. Garrett read a paper on a nickel stress telephone. In conjunction with Mr. W. Lucas, the author has experimented upon telephones with nickel magnets. A magnetised nickel rod is wound with insulated wire, and is then fixed vertically by a clamp at its lower end. A wooden diaphragm is rigidly attached to the top of the rod in a horizontal plane. The rod just passes through the middle of the diaphragm, where it is fixed with sealing-wax. The diaphragm is entirely supported by the nickel rod. On speaking against the top of the diaphragm, variations of longitudinal pressure, and consequently of magnetisation, are produced in the nickel, and corresponding undulatory currents are induced in the surrounding coil. The nickel wire is sometimes magnetised by stroking it with a magnet, and sometimes by passing a current through the coil. A diaphragm of pine-wood gives better results than a metallic plate. The instrument does not work well as a "receiver"; an ordinary telephone is used for this latter purpose. The results obtained with a weakly-magnetised nickel rod are much better than those with a strongly-magnetised steel rod, indicating that the undulatory currents are due rather to magnetic variations arising from changes of stress than to the relative motions of the magnet and coil. Dr. S. P. Thompson said that, some years ago, he had worked with a somewhat similar apparatus, using it as a "receiver," with wires of nickel, cobalt, and iron. Cobalt gave the best results; the metallic strips in his experiments dipped into the solenoids without contact with them. This arrangement did not work well as a "transmitter," even when a battery was included in the circuit. In some cases the rods were cut into short lengths separated by brass. Mr. Boys asked how the nickel "stress" instrument compared in clearness and loudness with an ordinary telephone. Mr. Shelford Bidwell had tried a nickel telephone

with a mica diaphragm, depending not upon mechanical stress, but magnetic strain. It did not work well. Dr. Chree thought the "stress" telephone might possibly be improved by choosing the right strength of magnetic field. Mr. Appleyard said the arrangement was interesting historically, because it was, mechanically, almost identical with the original instrument used by Philip Reis as a "receiver." The authors had succeeded in getting it to work as a "transmitter." Their success was probably due to the rapidity with which the magnetisation of nickel responded to very small changes of stress or current. The Post Office electricians had tried to introduce nickel cores into relays, on account of its magnetic sensitiveness; the results, he believed, had not been very satisfactory. Mr. T. A. Garrett, in replying, said the "stress" telephone gave better articulation than an ordinary "watch" telephone, but the sounds were feebler. There seemed to be a field-strength proper to the instrument; he had noticed that the articulation was clearer with three cells than with six.—Mr. W. A. Price then read a paper on alternating currents in concentric conductors. This is a mathematical investigation of a proposed new form of submarine cable. The case is considered of two concentric conductors, interrupted alternately at different points throughout the whole length. In the mathematical treatment, the cable is supposed to be laid in a circular path, and successive charges of electricity are supposed to be applied at some point at the extremity of a diameter of the circle. Expressions are given for the amplitude of the periodic charges arriving at a point diametrically opposite to the first; and for the reduction in amplitude, throughout the whole length of the cable, of an applied E.M.F. The theory indicates that under no circumstances can the "speed" of a cable of the proposed form be greater than the "speed" of a cable of ordinary type. The author has experimented upon an artificial cable connected up to represent the proposed form. The "definition" of signals is considerably better than that obtained through an artificial cable of analogous "weight" and "length" connected up in the ordinary way. Within certain limits the "definition" continues to improve as the number of sections, or subdivisions, of the cable is increased.—Mr. Blakesley said he was sorry the result did not indicate a successful type of cable. He would have been inclined to predict that the amplitude would have decreased with the number of sections. If a number of condensers were joined in series, and one end was subjected to a periodic E.M.F., the amplitude would fall off inversely as the square of the distance. Mr. Price then exhibited a galvanometer support. The instrument was suspended from two india-rubber cords, attached at the top and bottom to cross-bars of metal, thus forming a rectangle. The cross-bars were provided with knife-edges in such a way as to compensate for unequal stretching of the india-rubber. Weights could be added, if necessary, to the support, so as to increase its inertia.—Mr. H. Garrett read a paper, communicated by Prof. W. B. Morton, on the effect of capacity on stationary electrical waves in wires. The author investigates the effect produced when a condenser is inserted at a point in the secondary circuit of the apparatus used by Blondlot for obtaining stationary electrical waves in wires. The positions of successive nodes are determined in the usual way, by a bridge, with a vacuum-tube indicator. When two opposite points of the parallel secondary wires are joined to the plates of a small air-condenser, the nodes approach the condenser on either side. The amount of the displacement of the nodes—that is to say, the extent of the shortening of the apparent half-wave-length—depends upon the position of the capacity along the wire. The effect is *nil* when the condenser is at a node, and a maximum when it is midway between two nodes. The state of affairs at a point of the circuit is obtained by summation of a series of separate disturbances due to the different direct and reflected trains. In obtaining a formula for the conditions of resonance, with which to compare the observations, the author adopts a method from Heaviside. It connects the frequency of oscillation, with the position and capacity of the condenser.—Mr. Shelford Bidwell proposed a vote of thanks to all the authors, and the meeting was adjourned until May 14.

Zoological Society, April 6.—Dr. W. T. Blanford, F.R.S., Vice-President, in the chair.—The Secretary exhibited, on behalf of Mr. A. J. Lawford Jones, a curious cinnamon-coloured variety of the blackbird (*Turdus merula*), which had been captured near Dorking, Surrey.—Prof. B. C. A. Windle and Mr. F. G. Parsons contributed the first part of a paper "On the Myology of the Terrestrial Carnivora," which dealt with the muscles of the head, neck, and fore-limb of eighty-three individuals.—A communication was read from Mr. C. S. Tomes, F.R.S., on the minute structure of the teeth of *Notoryctes*. An examination of its dentition had confirmed the view previously arrived at by other naturalists that this animal has affinities with the *Dasyuridæ* and *Didelphidæ*.—A communication was read from Mr. R. Lydekker, F.R.S, entitled "The Blue Bear of Tibet, with Notes on the Members of the *Ursus arctus* Group." The author described a mounted specimen in the British Museum, which he identified with the *Ursus pruinosus* of Blyth. He also made a survey of the other members of the *U. arctus* group, and came to the conclusion that, with the exception of the extinct *U. spelæus*, they should all be regarded as sub-species rather than species. As they are all structurally similar, they seem, in his opinion, to be merely local varieties and colour-phases of what is essentially one animal.—Mr. G. A. Boulenger, F.R.S., gave an account of the fresh-water fishes collected in Celebes by Drs. P. and F. Sarasin. The specimens obtained were referred to fourteen species, of which four were described as new, one of them forming the type of a new genus of *Atherinidæ*, proposed to be named *Telmatherina*.

EDINBURGH.

Mathematical Society, April 7.—Dr. Sprague, President, in the chair.—The following papers were read: (1) Certain expansions of x^n in hypergeometric series, Rev. F. H. Jackson; (2) the C. discriminant as an envelope, Mr. Jas. A. Macdonald; (3) the factorisation of $1 - 2x^n \cos\alpha + x^{2n}$, Prof. John Jack.

PARIS.

Academy of Sciences, April 5.—M. A. Chatin in the chair.—Periodic solutions and the principle of least action, by M. H. Poincaré.—Preparation of iron carbide by direct union of metal and carbon, by M. Henri Moissan (see p. 566).—On the Innucelleæ or Santalineæ, a subdivision of the Insemineæ, by M. Ph. van Tieghem. The entire group of the Santalineæ comprises fifteen genera, the distinguishing characteristics of which are given.—M. Radau was elected a member in the Section of Astronomy, in the place of the late M. Tisserand.—The Commissions were elected for judging the memoirs sent in for the Godard, Parkin, Barbier, Lallemand, Larrey, Bellion, Mège, Montyon (Experimental Physiology), La Caze (Physiology), and Martin-Damourette prizes for 1897.—On the accidents which may be produced by heating with hot air, by M. N. Gréhant. In several cases of accidents attributable to emanations from heated iron pipes, the air of the room was carefully examined for carbon monoxide. In nine cases out of ten, however, the results obtained were negative, carbon monoxide being clearly present (·04 per cent.) in one case only. Further experiments were then carried out to see whether the method of analysis adopted could detect the passage of carbon monoxide through the walls of an iron stove kept at a dull red heat. The presence of CO was clear, although the air collected contained only ·015 per cent. of the gas.—On a clockwork myodynamometer, by the same.—The drawings on the rocks of the La Mouthe Cave (Dordogne), by M. E. Rivière. The antiquity of the drawings is proved by the fact that they are in part covered by the clay which constitutes the floor of the cave. This clay contains the remains of several species of animals, all quaternary. Three of the drawings were of animals, one of which is undoubtedly a bison (*Bos priscus*). Another drawing represents a kind of hut. Other drawings have been partly exposed, the excavation of which is being proceeded with.—Letter addressed to M. Berthelot by Mr. H. Wilde, F.R.S., concerning the offer of 5500*l.* to be applied to founding an annual prize for a work on Astronomy, Physics, Chemistry, Mineralogy, Geology, or Mechanics.—On mechanical quadratures, by M. B. Baillaud.—On the general theory of surfaces, by M. A. Pellet.—On the deformation of certain paraboloids, and on the theorem of M. Weingarten, by M. Eugène Cosserat.—On linear partial differential equations of the second order with two variables, by M. Cotton.—On the properties of complete functions, by M. Desaint.—On the partial polarisation of radiations emitted by some luminous sources under the influence of the magnetic field, by MM. N. Egoroff and N. Géorgiewsky. The results of M. Zeeman on the polarisation of rays from luminous flames by the action of a strong magnetic field were confirmed and enlarged, as, without the use of a spectroscope, the partial rectilinear

polarisation of the rays from lithium, sodium, and potassium flames, and also the rays from sparks between magnesium electrodes, was proved. Sparks between electrodes of carbon, aluminium, mercury, zinc, bismuth, and iron showed no trace of polarisation with the same Savart analyser.—New cadmium lamp for the production of interference fringes, by M. Maurice Hamy. An improvement on the cadmium tubes used by Michelson in his determinations of the relations between the wave-lengths of light and the metre. No electrodes are carried through the glass, the ends being enclosed by brass caps with graphite packing, and the tube in use being kept at about 350°. The tubes will stand over twenty hours' use without losing any of their brilliancy.—Researches on nickel steels: metrological properties, by M. C. E. Guillaume. The remarkable property of some nickel steels of having a coefficient of expansion nearly equal to zero, naturally suggested the use of these alloys in the construction of measuring instruments. With a view of seeing how far their mechanical properties are suitable, a series of alloys containing from 5 to 45 per cent. of nickel was studied as regards densities and elastic properties.—On the nature of the several species of radiations produced by bodies under the influence of light, by M. Gustave Le Bon.—An induction oscillograph, by M. H. Abraham.—On the variation of the electric state of high regions of the atmosphere in fine weather, by M. G. Le Cadet. The electric field is weaker at altitudes above 1500 metres than on the surface of the earth.—On a new oxide of phosphorus, by M. A. Besson. Although PH_3 does not react upon pure $POCl_3$ at any temperature below the boiling-point of the latter, a reaction takes place if a little HBr is also present with the formation of a lower oxide of phosphorus, apparently P_2O. The same substance is obtained by heating $POCl_3$ and PH_4Br together in a sealed tube at 50°. The new oxide forms a yellowish-red powder, not changed by heating to 100°. The formula was deduced from the analysis of the powder, no evidence being produced, however, to show that this consists of one oxide only.—On metastannyl chloride, by M. R. Engel.—The action of a high temperature upon the sulphides of copper, bismuth, silver, tin, nickel, and cobalt, by M. A. Mourlot. At the temperature of the electric furnace, cupric sulphide is reduced to cuprous sulphide and metallic copper, bismuth and silver sulphides to the metals, tin sulphide to the stannous salt, nickel sulphide to a sub-sulphide Ni_2S. Cobalt sulphide does not give a corresponding salt.—Combinations of ammonia gas and methylamine with the haloid salts of lithium, by M. J. Bonnefoi.—Action of gallic and tannic acids upon some alkaloids, by M. Œchsner de Coninck.—Preparation of sodium carbide and sodium acetylide in the pure state, by M. Camille Matignon.—Observations concerning the temperature of freezing of milk, by M. J. Winter. A reply to MM. Bordas and Génin.—On the non-identity of lipases of different origins, by M. Hanriot.—Two preparations of lipase, the one from blood serum, the other from the pancreas of the dog, showed marked differences in their saponifying action upon butyrin under similar conditions.—Some properties of the ferment causing the decolorisation of wines, by M. P. Cazeneuve. It has been previously shown that the cause of decolorisation of wine (*la casse*) is an oxidising ferment, the action of which is completely prevented by the addition of a small quantity of sulphurous acid to the wine. In the present communication the action of this sulphurous acid is shown to be due to a specific action upon the oxydase, and not merely to its reducing action, since a much larger amount of formaldehyde did not prevent decolorisation.—On a new method of obtaining the essential perfume of flowers, by M. Jacques Passy.—Researches on the development of the archegonium in the Muscineæ, by M. L. A. Gayot.—The law of formation of the transversal valleys in the Eastern Alps, by M. Maurice Lugeon.—The influence of franklinisation upon the singing voice, by MM. A. Moutier and Granier.—The action of currents of high frequency upon the virulence of the streptococcus, by M. Louis Dubois. Cultures of streptococcus showed a marked diminution in virulence after being repeatedly exposed to the effects of a high frequency current.—Action of the X-rays upon the heart, by MM. Gaston Seguy and F. Quénisset. Prolonged exposure to the X-rays has in several cases caused violent and irregular palpitation of the heart.—On the actinomycosic form of the tuberculosis bacillus, by M. M. V. Babes and C. Levaditi.—Note on the grouping of the stars, by M. Delauney.—On an improvement for the production of acetylene from calcium carbide, by M. Lechappe.

DIARY OF SOCIETIES.

THURSDAY, APRIL 15.

LINNEAN SOCIETY, at 8.—On some New Irish Crustacea: A. O. Walker.—On Desmids from Singapore: W. and G. S. West.—Exhibition: Plants collected during Two Years' Residence in Franz Josef Land: H. Fisher.

GEOLOGISTS' ASSOCIATION (Charing Cross, S.E.R.), at 4.30.—Long Excursion to Walmer, St. Margaret's, Dover, Folkestone, and Romney Marsh. Directors: George Dowker, W. F. Gwinnell, Dr. A. W. Rowe, and C. Davies Sherborn.

TUESDAY, APRIL 20.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.

ROYAL VICTORIA HALL, at 8.30.—Africa up to Date: Prof. B. J. Malden.

WEDNESDAY, APRIL 21.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Relation between Cold Periods and Anticyclonic Conditions of Weather in England during Winter: W. H. Dines.—Sunspot Influence on the Weather of Western Europe; A. B. MacDowall.—The Use of Kites to obtain Meteorological Records in the Upper Air at Blue Hill Observatory, Mass., U.S.A.; A. Lawrence Rotch.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Exhibition of Microscopical Entomological Specimens by F. Enoch.

THURSDAY, APRIL 22.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Recent Developments in Electric Traction Appliances: A. K. Baylor. (Continuation of Discussion.)

CAMERA CLUB, at 8.15.—Peeps into Nature's Secrets: R. Kearton.

SATURDAY, APRIL 24.

ROYAL BOTANIC SOCIETY, at 4.

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