THURSDAY, JULY 14, 1898.

EVOLUTION OF THE MORAL INSTINCT.

The Origin and Growth of the Moral Instinct. By Alexander Sutherland, M.A. Two vols. Pp. xiii + 461, and vi + 336. (London: Longmans, Green, and Co., 1898.)

MR. SUTHERLAND'S work is thoroughly Darwinian, being based on a huge mass of observations which he has selected without apparent bias, marshalled well, and handled judiciously. Few books written since Darwin's time on the evolution of the human mind, are so thorough and comprehensive and well deserving of study. Its chief merit lies in the solid treatment by which the writer confirms and extends the masterly sketch drawn by Darwin in the fourth and fifth chapters of his "Descent of Man," but it is also extremely original in many particulars; and though somewhat diffuse here and there, is interesting throughout. Mr. Sutherland resides in Australia, where it must have been more difficult to obtain that ready access to books and authorities which European students enjoy, and to obtain skilled help in his experiments; he is therefore entitled to a proportionate increase of praise and to much excuse where he is open to criticism.

The main argument and the general results of his inquiry may be stated in a few words, but the fulness of their significance will be imperfectly realised without carefully reading the whole of his book. They are, that a progression in complexity of organisation and faculty is closely associated with the duration of growth, including both the embryonic stage and that of immaturity. Next, that the duration of growth is closely correlated with parental care. It is shown that in the earlier stages of evolution of a species, the parental care is small, but as higher stages of evolution are reached, the amount of parental care successively increases until it grows into parental sympathy, and he argues that it is directly or indirectly from parental sympathy that all morality proceeds. The first of these three steps might rank as a corollary to Von Baer's law, namely that the successive stages in the history of each race are hurried through during the embryonic life of each individual in it. Consequently as the number of stages increases, the length of time required for individual development tends to increase also, though not in the same proportion because the rate of passing through them may and does to some extent become more rapid. The author shows by a large array of evidence that the above presumption is true, and that this essential basis of his further argument may be accepted without hesitation.

Leaving insects aside as creatures of an entirely different mental constitution to our own, and as evolved along different lines from vertebrates, he begins by tracing in detail the first appearances of the parental instinct in various species of fish. He finds—

"Of species that exhibit no sort of parental care, the average of forty-nine gives 1,040,000 eggs to a female each year; while among those which make nests or any apology for nests the number is only about 10,000. Among those which have any protective tricks, such as carrying the eggs in pouches, or attached to the body, or in the mouth, the average number is under 1000; while among those whose care takes the form of a uterine or quasi-uterine gestation which brings the young into the world alive, an average of fifty-six eggs is quite sufficient.

"It must hence be very evident how much better are a few that are tended than a great crowd left without care. And the first link in the chain of reasoning of this book is that in the struggle for existence an immense premium is placed upon parental care, and that not until this has been developed can the higher nervous types become possible."

There is another well-known way, as he points out, by which the life of the young is rendered more secure, namely by assuming mimetic characters and thereby escaping the observation of enemies. But successful mimicry leads to nothing further, and therefore does not enter into the plan of the present work.

He next examines into the case of amphibians and concludes that—

"Among all the non-parental species for which I have obtained information the number exceeds 800 eggs, yet the average of nine species that show parental care is only twenty-seven. Among the viviparous species the number of offspring declines to ten or less in the year."

Up to this point he considers that the story of evolution contains no indication whatever of the existence of real affection, but the true parental sympathy, which is destined to play a most important part in the survival of the nobler species, arises during the next stage.

Birds and mammals are understood to be developed from different points in the scale of reptile life, and the character of the protection they respectively give to their young differs accordingly. Some reptiles incubate their eggs, and birds carry on this process of incubation; other reptiles bring forth their young alive, and mammals follow that method. As their respective types advance in the scale of intelligence and affection, he shows that both birds and mammals present a lengthening period of parental protection, but the mammalian method reaches far ahead of that of the birds. It leads to the monkey, to the savage and to civilised man; the other seems to reach its acme in the bower bird.

In discussing birds, he divides them into three classes of progressive intelligence. The lowest contains the ostrich, emu, &c., which annually lay on the average twelve or thirteen eggs; the medium class includes partridges, petrels, coots, plovers and pigeons, these lay, on the general average, seven or eight eggs; the highest class includes birds of prey, parrots, woodpeckers, sparrows and finches, these lay, on a general average, four or five eggs a year. All birds of the higher grade

"hatch out young ones of abject helplessness, and the continuance of each species is absolutely dependent upon that parental love which is poured out in floods of unmeasured self-sacrifice. Among these birds the gracious charm of family life is first made fully known, and it is no mere chance that, concomitant therewith, comes that delight in throbbing melody which proclaims the fullest tide of joyous life. In all these genera, with their multitudinous species, male and female unite in their care for the tender brood, and show, as a rule, a steady attachment each for the other. Sometimes the male and

female brood on the eggs alternately; while one is sitting the other is not far off; but this occurs only in twenty-eight per cent. of the genera, and these are on the whole of somewhat inferior type. In sixty-five per cent. the female alone undertakes the brooding, but the male is, throughout, her faithful attendant, feeding her assiduously, driving away intruders, and cheering her with the joy of his tumultuous song. In accordance with the teachings of economics, we must regard this division of employment as a sign of progress." . . .

"That family life, which T. H. Green, in his 'Prolegomena to Ethics,' so justly regards as the ultimate basis of moral ideals (p. 257) . . . is faintly seen in a few fish; it is not wholly absent among reptiles, but it is for the first time distinctly observable among the lower birds, increasing ever as the type advances, till we find the nest-life of one of these higher birds to be marked by many graces of an indubitably moral character. The conjugal tenderness of the mated pair, and their unwearied self-sacrifice in ministering to the wants of their offspring, are ethically beautiful. Where these appear in an equal degree in the human couple, we reckon them as a solid fundamental element of goodness. Much else is required of man and woman, but it is no slight praise to say 'he was a kind husband and a devoted father,' or that 'she was a tender wife and a mother of unwearied love and self-sacrifice.'

"The family life, which we see so beautifully developed in these birds, is like the seed, enclosing within itself the full potentiality of all the ethic good to be developed in yet later stages, wherein a growing intelligence makes the young always more and more dependent upon family and social union."

Similarly in mammalian species, the number of offspring decreases with each successive stage of increasing intelligence and parental sympathy. It not only does so in the four orders of monotremes, marsupials, deciduate and non-deciduate placentalia, taken as wholes, but also when they are severally analysed in much detail. It is impossible to go further into this subject within the space at our disposal.

The portion of the book thus far noticed, is but a small part in bulk of the whole, but it will be of superior interest to those who are disposed to argue in a lazy offhand way, that after parental instinct had attained the level reached in the lower savages, its further evolution would be merely a matter of time and of favourable conditions. This was, however, by no means the feeling of the author, for he has taken very great pains and given much anthropological research to trace its actual steps. It is only possible here to give extracts from his summary.

"The process of moral development, as I see it, has been a slow dawning of parental sympathy, whence arises a simple and natural morality which is strengthened by the growth of the sense of duty and other accessory developments of sympathy. Out of the morality thus engendered springs whatever is moral in law, though, fundamentally, law is not moral but retaliatory."

One of the most interesting parts in the later portion of the book relates to the evolution of the sense of chastity. In the course of that discussion he treats lucidly and with great fairness many vexed questions concerning marriage in early times. He is in full concurrence with and gives important contributions to the present reaction against the excessive but clever dogmatisms of McLennan about the universality of marriage by capture, endogamy and exogamy, and the rest. But it is impossible to cope in a short article with the wide range of careful inquiry contained in this really remarkable book. Yet extensive as it is, some additional chapters have been written and afterwards omitted, as the author informs us. Others, too, might have been inserted; for instance, it would be very interesting to trace and describe the origin and purport of superstitious fears in human nature and their bearing on moral instinct.

F. G.

THE ANIMALS OF ESSEX.

The Mammals, Reptiles, and Fishes of Essex. By H. Laver. Essex Field Club Special Memoirs, Vol. iii. Small 8vo. Pp. viii + 138, illustrated. (Chelmsford: Durrant, 1898.)

IN respect of physical conditions Essex is one of the most favourably situated of the eastern counties of England for the possession of a large local fauna, its inland districts presenting variety of station, while it has a large sea-board, forming an estuary into which discharge several more or less important rivers. Indeed, were it not for the pollution of the Thames, the fish-fauna of the county would be even larger than is at present the case, and would reckon among its constituents the lordly salmon itself. Among other special advantages from a naturalist's point of view the county includes Epping Forest, which under its present excellent administration forms a sanctuary for wild creatures of many kinds. And in addition to its natural advantages, Essex is fortunate in possessing a Field Club which includes on its working roll many naturalists of high capacity. It is to a member of this club that we owe the present contribution to a knowledge of the fauna of the county.

So far as numerical completeness is concerned, the author seems to have done his work thoroughly; if he errs at all, it is in mentioning certain species which have admittedly been introduced into the county. The scientific importance of local faunistic works is not, however, to be reckoned by the number of kinds of stray cetaceans and other wanderers they record; but by pointing out the reason why particular species are restricted to particular districts, and in what respects the local representatives of each species recorded differ from their kindred in other districts. In both these respects the work before us fails to come up to modern requirements; since it completely ignores these portions of the subject, and merely gives general notes of little or no value on the animals mentioned. The work may be, and probably is, of considerable interest to the residents of Essex, but can lay no claim to a position of any scientific importance. It may, however, be useful as a foundation on which to build a more important superstructure, when the naturalist arises who will treat the Essex fauna from a broader standpoint.

It is somewhat unfortunate that the work appeared too soon after Mr. Thomas's revision list of the nomenclature of British mammals to admit of the author following the new light. In some cases, such as the retention of *Arvicola* for the voles, and of *Lepus timidus* for the common hare, the author is obviously behind the times. It may be uncongenial, but the sooner amateur

naturalists take to follow the lead of their professional brethren in nomenclatural questions (always reserving the "*Scomber scomber*" principle) the better it will be for all parties. The change is bound to come, and it may as well be accepted gracefully. In making a family "*Arvicolidæ*," the author departs from all authority; and the adding of the name of its founder to each family and order of fishes is an unnecessary redundancy.

The volume is illustrated with several photogravures, all of which are excellent from an artistic point of view, while several afford interesting glimpses of local scenery. If it be regarded merely as a stepping-stone towards fuller treatment, the work may be welcomed as indicating the recognition of the importance of treatises on our local British faunas. R. L.

THE AMERICAN EXCAVATIONS IN MESOPOTAMIA.

Nippur; or, Explorations and Adventures on the Euphrates. By J. P. Peters. Vol. i. pp. xvi + 375; vol. ii. pp. x + 420. (London: Putnam's Sons, 1897–98.)

THOSE who take an interest in Mesopotamian excavations, and in the building up of the history of the ancient empires which flourished in the land "between the two rivers" by means of almost undecipherable cuneiform documents, will welcome the appearance of Dr. Peters' volumes. We must, however, warn the reader that he is not to expect a thrilling narrative like that which the late Sir Henry Layard gave us in his "Nineveh and Babylon," and "Nineveh and its Remains," both of which works were published nearly forty-five years ago, and he is not to look out for vivid tales of the uncovering of the palaces of mighty kings in the presence of hundreds of wondering and enthusiastic natives, nor for anything of the kind. No Mesopotamian traveller can ever hope to attract the attention of the reading public as thoroughly as did Sir Henry Layard, for there is, unfortunately, no second Nineveh to "discover"; though, by the way, its site was not only never lost, but was thoroughly well known. Moreover, the reader must not expect from Dr. Peters a scientific work like Dr. Oppert's "Expédition Scientifique en Mésopotamie," the first part of which appeared in 1859, for the work which he undertook to do in Babylonia and Assyria was not on all-fours with that which the eminent French man of science was called upon to perform. Sir Henry Layard's want of knowledge of Assyrian was made up for by the possession of considerable skill in writing an easily read and popular account of his travels and works; in the early days of the science of Assyriology when he wrote, he was able to put forward theories which in subsequent years scholars like Sir Henry Rawlinson and Dr. Oppert were unable even to mention. Dr. Peters starts, of course, with much better equipment than any one of the three Mesopotamian explorers whose names we have mentioned, for he has all their experience to help him, and an enormous mass of archæological facts, which have been heaped up by several workers, at his free disposal. Notwithstanding these advantages, his work is not a scientific exposition of the results obtained from the excavations by the expedition of which he was the director, nor is it a very readable popular story, interesting by reason of the personal details which it contains. His two volumes are well printed and very fairly illustrated, and they have maps, an index, appendices, &c. Dr. Peters must have given much time and attention to the work before us, and those who are able to wade through some hundreds of heavily-written pages will, of course, thank him for it. It is not our intention to discuss "Nippur" in detail, for many of the results obtained from the excavations carried on at the city of this name by Dr. Peters, and by his distinguished successor Mr. Haynes, have already been made known by Prof. Hilprecht; our object is only to call attention to the excellent work which the Americans have done by establishing a Consulate at Baghdad, and by systematically working through a site.

Just as England owes its unrivalled collections of Babylonian and Assyrian antiquities in the first instance to the private initiative of the British Ambassador at Constantinople about the year 1845, so the fine collections of inscribed tablets and other antiquities which America now possesses are due to the private enterprise of some of the principal citizens of Philadephia. The American expedition was inaugurated by Mr. E. W. Clark, a leading banker of that city, and the scheme was adopted with great vigour and good-will by Dr. W. Pepper; other public-spirited men joined them, and their efforts have been crowned with such success that up to the present time nearly fifteen thousand pounds sterling have been expended by America on archæological researches in Mesopotamia. The chief site of the work of the Americans was at Nippur or Niffer, a city which was situated about fifty miles to the south-east of Babylon, and was the centre of a great and flourishing civilisation some seven thousand years ago. Some of the early explorers had ascertained that the mounds which marked the site of the old city contained remains of buildings, inscribed tablets, &c., but the work of digging them out seriously did not begin until Dr. Peters and Mr. Haynes arrived on the scene. Dr. Peters toiled for several weeks at Niffer in 1891 and 1892, and succeeded in clearing out part of the great Temple of Bel, and in finding a large number of inscribed tablets; the two volumes before us deal practically with the results of his labours. In 1893 Mr. Haynes took over the work, and was so fortunate as to light upon a "find" of thousands of tablets, seals, and other important documents; he was also enabled to lay bare the ruins of the greater part of the ancient city and its temple in such a way that we are now able to understand the plan upon which an ancient pre-Babylonian city was arranged and built. Many tablets and other precious objects had, according to the terms of the agreement between the Ottoman Museum authorities and the Americans, to be sent to Constantinople; but we are glad to learn from Prof. Hilprecht's publications that a substantial number have been allowed to cross the Atlantic as a reward for the money and labour expended by the Americans at Niffer. It is to be hoped that copies of all such documents may be made available for scholars as soon as possible, and that other cuneiform experts in America will follow the example which Prof. Hilprecht has set them. Meanwhile it is to be hoped that a successor to Mr. Haynes and Dr. Peters has been found, and that a good work so well begun may be continued.

OUR BOOK SHELF.

A Manual on General Pathology for Students and Practitioners. By W. S. Lazarus Barlow, B.A., B.C., M.D., M.R.C.P. Pp. xi + 795. (London: J. and A. Churchill, 1898.)

THE book before us is a treatise on general pathology, from which morbid anatomy is practically excluded. To the readers of Cohnheim this subject is familiar; the author has done well to take such a book as a model, and to, so to speak, bring it up to date.

The relation between morbid anatomy and disease has never been doubted. The study of a dead, dilated, hypertrophied and valvularly diseased heart has always been held to be of immense value to the student of medicine. It must be admitted, however, that it bears the same relation to disease as a scratched rock does to the action of a glacier. Both are the more or less permanent records of a process. However valuable such records may be, it must be admitted that the demonstration of the behaviour of a heart under conditions more or less exactly imitating disease is also of great value. It is to be regretted that while teaching in morbid anatomy is all-sufficient, instruction in experimental pathology is most often conspicuous by its absence. A careful perusal, however, of Dr. Barlow's work will in no small measure make up for this deficiency, and the student of medicine who wants to do something more than get qualified in a minimum time, will find it very helpful. Although the book is ostensibly written for practitioners, the reviewer is afraid that its contents will only appeal to a relatively small circle of medical practitioners, at any rate at present.

It would be impossible in a short notice to even enumerate the subjects treated by Dr. Barlow. The chapter on osmosis will perhaps appeal most to the general physiological reader; in it is to be found a description of the author's own work in this field of research, and also a fair account of the work of those who hold different views with regard to the function of the epithelium cells involved. The pathology of the circulation is well handled, but contains little of special interest. Under inflammation, chemiotaxis and its relation to phagocytosis are discussed. The author devotes a chapter to the "Pathology of Heat Regulation," at the conclusion of which fever, and tissue change in fever is fully considered. Under shock and collapse, which are viewed in the light of the recent experiments of Roy and Cobbet, transfusion is treated in an original manner. Chapter xii. forms an interesting monograph on the pathology of nutrition, which is dealt with exhaustively. Chapters on morbid secretion and excretion, and the pathology of respiration follow, and the book concludes with a miscellaneous appendix, in which, *inter alia*, ptomaine poisoning is briefly considered.

The book is eminently readable, and although the range of subjects covered by it is very wide, is not wanting in thoroughness. Its value is enhanced by the carefully compiled bibliography which concludes each chapter. It is somewhat to be regretted that it should appear so soon after almost similar subjects have been treated either in Allbutt's "System of Medicine" or in Prof. Schäfer's "New Text-book of Physiology," but this is obviously no fault of the author's. F. W. T.

A Text Book of Entomology, including the Anatomy, Embryology and Metamorphoses of Insects, for use in Agricultural and Technical Schools and Colleges. By Prof. Alpheus S. Packard. Pp. xvii + 729. (London: Macmillan and Co., Ltd. New York: The Macmillan Co., 1898.)

DR. PACKARD has undertaken in this text-book to review and epitomise the vast literature relating to the structure of insects. For such a task special qualifications are necessary; among the rest, unflinching industry, a sound judgment, and a first-hand, practical knowledge of the subject. These qualifications our author exhibits on every page. He has worked long and hard as an investigator; he has a candid mind; and he has spared no pains either upon the collection or the elucidation of his materials. The critic who tries to be wholly impartial may feel compelled to point out a certain slowness to draw general conclusions, which is particularly evident in the concluding section on the causes of metamorphism. This reserve is natural, perhaps laudable, in the writer of an encyclopædic work. Dr. Packard's book will be of the greatest service to students of insect-anatomy, and almost indispensable to future writers on the subject. It is a great store of well-sifted and carefully arranged information, which will guide the naturalist to many a special research which he might easily have passed by in ignorance of its very existence. We must not leave the impression that Dr. Packard has done nothing but condense into a text-book the work of other men. He has made out for himself many interesting and valuable facts, and in no part of this treatise does he find himself altogether remote from his own published researches. The book before us is handsomely printed, profusely illustrated, and furnished with copious bibliographical lists. Together with the very dissimilar treatise by Dr. Sharp in the "Cambridge Natural History," it puts the student of scientific entomology into a far better position than he occupied a year or two ago. Dr. Packard's book, like Dr. Sharp's, should find a place in every library which includes comparative anatomy, and both should be the constant companions of all who occupy themselves with the structure and life-histories of insects. L. C. M.

The Mathematical Theory of the Top. Lectures delivered on the occasion of the Sesquicentennial Celebration of Princeton University. By Felix Klein, Professor of Mathematics in the University of Göttingen. Pp. 74. (New York: C. Scribner's Sons, 1897.)

THE four lectures constituting this little book are worthy of the great occasion which called forth their delivery. Prof. Klein uses the particular dynamical problem of the top as an illustration of the advantages that may be gained by utilising the modern theory of functions in applied mathematics. Instead of being content with analytical processes, he strives to the utmost to give a geometrical form to his formulas, and to make the solution intuitive. He passes beyond the parameters of Euler and Rodrigues to apply to dynamics a system of coordinates which Riemann introduced forty years ago in the discussion of certain geometrical problems. Using also Riemann's method of conformal representation, he gives an insight into the inner nature of elliptic functions, and shows that his new parameters are what he calls "multiplicative elliptic functions"—they miss being doubly periodic by being affected by an exponential factor when t (the time) is increased by a period. By means of these parameters the author attains to a clearer, neater and more complete solution of the problem of the motion of a body about a fixed point than had hitherto been reached, and justly claims that he has resolved the problem into its simplest elements. He also deals with Jacobi's famous theorem, that the motion of the top may be represented by the relative motion of two Poinsot motions (or rotations of a body about its centre of gravity which is fixed).

In generalising to the full the problem under discussion the author deals with the case when the time, t, by being supposed complex, becomes capable of two degrees of variation. In order to get a geometrical representation, he is led to consider the motion of a rigid body in hyperbolic non-Euclidean space.

The last lecture deals with a top whose point of support is no longer supposed fixed, but movable in a horizontal

plane. The hyper-elliptic integrals of this more general problem are interpreted in a similar way to the elliptic integrals of the previous discussion. From the nature of the case, in these lectures, an outline sketch of a large subject is all that can be given, but the lines are traced by the hand of a master; and for filling in the details we must look to the author's treatise, "Ueber die Theorie des Kreisels," which is now in course of publication by Teubner.

William Stokes, his Life and Work (1804–1878). By Sir William Stokes. *Masters of Medicine.* Pp. 256; plate i. (London: T. Fisher Unwin, 1898.)

THE memoir before us is an interestingly written account of a man whom all physicians respect. Stokes was a master of medicine, and the inclusion of his biography in this series shows the wisdom of the editor. The name and work of Stokes are perhaps not as well-known to the modern student of medicine as they ought to be; this is probably due to the fact that not sufficient time has passed for us to appreciate his work, or rather for us to estimate its great value. He worked and taught at the time when exact methods of physical diagnosis were beginning to be applied by the clinician. Pathological chemistry and bacteriology were practically non-existent, and clinical thermometry was in its infancy. The work of Laennec on the stethoscope had attracted the attention of medical Europe, and opened up the enormous field of the correlation between physical signs and symptoms. It is in this particular field that the work of Stokes was done, and his treatise on the diagnosis and treatment of diseases of the chest still remains a classic. With the exception of Laennec's work, which it considerably amplified, this book must be regarded as one of the most noteworthy upon this subject which had until then been written.

To turn from his professional to his private life, the letters which are given us in this biography show us Stokes as a cultured Irish gentleman, forming the centre of a wide circle of friends. The biography is carefully written, and will appeal to all those who are interested in that epoch of the history of medicine to which its subject belongs. F. W. T.

Practical Organic Chemistry. By George George, F.C.S. Pp. 94. (London: W. B. Clive.)

THERE is no date on the title-page of this book, but the preface bears the date May 1898. No scientific book should, however, be published without the year of publication being printed upon the title-page.

The book is intended "for the elementary and advanced examinations of the Science and Art Department." It contains a few experiments on the detection of common elements in organic compounds, on melting and boiling points, organic acids, alcohols, sugars, &c., notes on the methods of examination of mixtures containing organic compounds, and on the preparation of some reagents used in organic analysis. The volume will thus make the student acquainted with the reactions of, and the tests for, common organic bodies.

Food Supply: a Practical Handbook for the use of Colonists and all intending to become Farmers Abroad or at Home. By Robert Bruce. With an Appendix on Preserved and Concentrated Foods, by C. Ainsworth Mitchell, B.A. Pp. xvi + 159. (London: Charles Griffin and Co., Ltd., 1898.)

THIS is the second volume of the "New-Land" Series, edited by Prof. G. A. J. Cole. It is a concise and soundly practical manual of farming in which the fundamental principles of successful agriculture, and of the selection and management of live-stock, are described. It is only paying a compliment to the author to state that the book contains the kind of information published by the Department of Agriculture of the United States, and in such official publications as the *Agricultural Gazette* of New South Wales and the *Agricultural Journal* of the Cape. As we are at present without a central office for supplying information to British farmers, it is the more necessary that the means of education in the science and practice of agriculture afforded by such books as the one under notice, should be widely known. The volume deals with the fundamental principles of most branches of farming, and will prove of service in any part of the world. The forty-nine half-tone reproductions of photographs of representative animals, illustrating the chief breeds of live-stock, will be of particular interest to farmers.

Royal Gardens, Kew. Bulletin of Miscellaneous Information, 1897. Pp. 437 + 68. (London: H.M. Stationery Office, 1897.)

THE well-known *Kew Bulletins* afford the best of evidence of the valuable work done at the Royal Gardens in advising upon possible developments of the natural resources of our Colonies and dependencies. Each *Bulletin* contains a number of plain statements of attempts made to introduce new and commercially profitable plants in suitable districts, of improved methods of cultivation, and of work that men trained at Kew are doing in the various parts of the world to which they have gone from the Royal Gardens. The *Bulletins* issued in 1897 are collected in the present volume, and together they make a worthy contribution to economic botany. Among the contents is a long list of publications issued from Kew during the years 1841–95. This record of accomplished work is an eloquent testimony of the important part which the Gardens take in botanical research, and in developing the resources of the Empire. Several papers on botanical exploration and enterprise are included, and sixty-three pages are devoted to the report of the Royal Commission appointed to inquire into the condition and prospects of the West India Colonies.

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.*]

The Spectrum of Metargon.

WE have delayed in replying to Prof. Schuster's letter in your issue of June 30 in order that we might make further experiments on the subject. We have had the kind assistance of Prof. Schuster, who demonstrated to us the close similarity between the group of green lines in the metargon spectrum and the spectrum of the blowpipe flame. We subsequently satisfied ourselves regarding the similarity of the metargon spectrum and the "Swan" spectrum, shown by carbon monoxide in a vacuum tube. At first sight, Prof. Schuster seems justified in attributing that spectrum to the presence of carbon or of one of its compounds. Yet we think that careful consideration of the following facts will necessitate a suspension of judgment:—

(1) The sample of metargon was mixed with twice its volume of oxygen, and sparked for two hours in presence of caustic soda. This sample, introduced into a vacuum tube after removal of oxygen, still showed the same spectrum.

(2) A little oxygen was introduced into the gas, and the mixture was then admitted to a vacuum tube. Oxygen lines became visible, but no bands of the so-called "carbonic oxide" spectrum. On removing the oxygen by means of phosphorus, the original spectrum appeared with its customary brilliancy.

Thinking it possible that the ordinary spark may not have had a sufficiently high temperature to decompose an imaginary stable carbon compound, a jar and spark-gap were introduced, and sparks passed through a mixture of metargon with twice its volume of oxygen, standing over caustic soda, for six hours. No

contraction occurred, and the spectrum of the gas was unaltered, after removing oxygen.

(3) An artificially made mixture of carbon monoxide and argon —about equal volumes of each—was mixed with oxygen. It was sparked and exploded. It was then further sparked over soda for a quarter of an hour. On introducing the gas into a vacuum tube, after removal of oxygen, no carbon lines or bands were seen, but only the spectrum of pure argon.

The bands in the green of metargon are exceedingly brilliant, and the spectrum is by no means of the character of a subsidiary one. It does not appear to be possible to enfeeble them relatively to the rest of the spectrum.

We have found it possible, in hundreds of cases where it was necessary, to remove traces of carbon compounds from gases evolved in heating minerals—chiefly helium—to remove the carbon bands by "running" the tube, *i.e.* by increasing the intensity of the current until the aluminium pole melted. The green and red bands, under these circumstances, slowly disappear, and the spectrum of helium or of argon, as the case may be, shines out "clean-cut," and shows as bright lines on a black background. This process is impossible with metargon; no change is produced even after long "running."

We must again call attention to the facts that this gas shows the ratio of specific heats 1·66; that it possesses sensibly the same density as argon; and that it is a solid at the temperature of liquid air, boiling under atmospheric pressure.

Although, therefore, we are the first to admit that the spectrum of this gas requires further investigation, yet, from what we have observed, we provisionally adhere to our original view that it possesses the characteristics of a definite chemical individual.

We would take this opportunity of correcting a misprint in the *Comptes rendus*, cxxvi. p. 1762, where the wave-length 5849·6 is attributed to metargon, instead of to neon.

W. RAMSAY.
M. W. TRAVERS.
EDWARD C. CYRIL BALY.
University College, London, Gower Street, W.C.

Liquid Hydrogen.

PROF. DEWAR'S letter in your last issue is such a pronounced personal attack on me, that I feel I ought to deal with the remarks to my prejudice which it contains, though I will try to avoid imitating its tone.

(1) He refers to the statements on which I base my claim to the invention of the self-intensive method as matter which "has already been refuted." I should be glad to know when and by whom. They are clearly numbered 1, 2, 3, 4, in my last letter, and form the substance of my first. At the Society of Chemical Industry Mr. Lennox, though he was present and heard the statements repeated, with every opportunity of contradicting them, did not do so. Prof. Dewar, far from refuting statements 1 and 3, did not even deny them; and his attack on the second (respecting the novelty of the invention) resulted in strengthening it, since it showed that he was reduced to building up an anticipation by taking material from several different sources, having been unable to find any account of the combination before my proposal in November 1894. The fourth statement had not then been made, as hydrogen had not been liquefied. Where then has the refutation taken place? In both his letters to you Prof. Dewar keeps all four statements at a very respectful distance.

(2) Prof. Dewar uses the words "accusations which he was compelled to withdraw when he met me face to face," and "when brought to book at the Society of Chemical Industry." It is quite untrue that I withdrew anything at all. On the contrary, I said that "I had nothing to withdraw," and that my assertions were "a simple and direct statement of historical facts," repeating more frequently than is shown in the printed report that the facts were exactly as I had stated them. As to what took place between Prof. Dewar and his assistant it is obvious that, not having been present, I could have no knowledge; and I can only publish what I know of my own knowledge, or can prove by conclusive evidence. Deductions from the facts must be made by every one for himself, and I reminded Prof. Dewar that as I had published no such deductions I could not withdraw them.

(3) I was not, at the time of my communications to Mr. Lennox, "convinced of the general dishonesty of Royal Institution methods," as Prof. Dewar suggests. I regarded the Royal Institution as one of the temples of science, and Mr. Lennox as its chief acolyte, who might, perhaps, when my offering had been examined and found worthy of acceptance, introduce me to the favourable notice of higher authorities.

(4) What I am "to be understood as saying in the letters you have published," is so clearly set forth in my four numbered statements in your issue of June 23, that Prof. Dewar's doubts on the point cannot be so puzzling as his question implies.

(5) Prof. Dewar's acquaintance with patent-law cases involving a host of partisan expert witnesses and costly counsel is too extensive and familiar to leave him in any doubt as to the reason why a man without means does not begin a prosecution for infringement. I could, however, warn the infringers; and this I did. The protest having been made, I am still free to prosecute when circumstances render it possible and advisable to do so, and the present prospects of low-temperature work make it by no means unlikely that action may yet be taken.

(6) Prof. Dewar's admission, referring to Dr. Linde's method, which he had just heard described, "that the practicability of such a mode of working had never struck him," was made in the opening sentences of his remarks, without any limiting qualifications, but with express inclusion of both "the mechanical ingenuity and knowledge of thermodynamics" involved; so that its only fair interpretation is with reference to the description that had just been given of Dr. Linde's combination, which is, except in details, the same as mine. The force of the admission is not lessened by quoting a subsequent passage which refers to one part of the combination. Dr. Linde and I had invented a combination which made it possible to liquefy air without using any other refrigerant than water. Prof. Dewar admitted that he had never thought out the whole combination. Whatever therefore he and others had done with some parts of it, when the combination came out he ought to have recognised its novelty, instead of endeavouring to piece it together out of old patents and experiments.

(7) Neither M. Solvay nor Prof. Onnes claims to have invented a combination by which continuous free expansion from a nozzle is able, without using other refrigerants, to liquefy air: so that Prof. Dewar misleads his less instructed readers by putting those gentlemen forward as my rivals on the ground that they claim to have used parts of the combination.

My communications to Prof. Dewar's assistant were, however, of earlier date than any publication of Dr. Linde's process. This is the fact of which, with its corollaries, I had hoped to obtain a frank admission from Prof. Dewar, and I would have much preferred that the discussion in your columns had been confined to the points raised in my first letter. Prof. Dewar, however, instead of frankly admitting my claims, as other prominent scientific men have done, or discussing the statements on which they are based, has seen fit to give his attention almost entirely to the more personal elements in the controversy. In two letters he has called my action "dubious" and "not straightforward," and has said that either I am "a singularly dull person" or am consciously imposing "upon the credulity of the world," that I contradicted myself "when brought to book," and that I "was compelled to withdraw accusations" which in fact I explained that I had never made, while refusing to withdraw anything at all. Under these circumstances I think that few of your readers will blame me for asserting the justice of my claims, though I regret that so much of your valuable space should have been occupied by matters of this nature.

W. HAMPSON.

July 1.

The Distribution of Prepotency.

NO numerical estimate appears to have been made of the frequency with which different grades of prepotency are distributed. Breeders are familiar with the fact that certain animals are peculiarly apt to impress their personal characters upon offspring, but how frequently and to what extent this tendency occurs has never, I believe, been investigated. The following attempt is therefore of interest, though not free from objection in minor details. In *Wallace's Year Books* of the American Trotting Horses, lists are given (1) of the sires of offspring, any one of which has succeeded in trotting one mile in 2 minutes and 30 seconds or less, or who has "paced" (= ambled) the same distance in 2 minutes and 25 seconds or less; (2) of the dams of at least two such offspring, or else of one such offspring and one such grandchild. A selection was made from lists (1) and (2) of sires and dams who were them-

selves foaled before 1870 and who therefore were, or would have been, at least 25 years old at the date of the last *Year Book* in my possession, which is for 1896. This is practically a sufficient allowance, giving say 5 years to the foals in which to make their record, and 20 years as the limit of the breeding age of either parent. My selection from list (1) contained 716 sires, and that from list (2) contained 494 dams. Reducing to percentages, the distinguished offspring (standard performers) to 100 sires and to 100 dams from these lists respectively, are tabulated below, disregarding decimals. Thus out of each

Distribution of the Parents of Standard Performers.

	Number of standard performers produced by a single parent, sire or dam.										Total parents.
	1	2	3	4	5	6 to 10	11 to 20	21 to 30	31 to 40	41 to 50	51 and above	
Sires ...	46	17	10	7	3	9	4	1	1	1	1	100
Dams ...	50	35	10	3	1	1	—	—	—	—	—	100

100 selected sires, we see that 46 produce only one standard performer, 17 produce two, 10 produce three, 7 produce four, and 5 produce three. Thus far the distribution of prepotency is not particularly abnormal, and we might have guessed that there would be about 3 cases more, none of which would contain more than from seven to eight standard performers, but the facts are surprisingly otherwise. Although the frequency of the successively larger families decreases with fair regularity, the rate of their diminution is far too slow to be compatible with the normal law of frequency. Instead of the expected 3 cases, each containing six, seven or eight standard performers, we find 17 cases of far higher contents. Thus in the list of 716 sires, the number of distinguished offspring are,—60 to *Blue Bull*, 71 to *Strathmore*, 83 to *George Wilkes*, 92 to *Happy Medium* and 154 to *Electioneer*. Making full allowance for the tendency of breeders to send the best mares to the best horses, the prepotency of the sires just named is enormous, that of *Electioneer* superlatively so. The same results are indicated by the produce of the dams, though the figures are less striking owing to the relative fewness of their offspring. A sire produces some 30 foals annually, a dam only one, while the period of production is presumably longer for the sire than for the dam. Consequently out of the list of 494 dams, the three mares *Emeline* (*sic*), *Minnehaha* and *Green Mountain Maid*, who produced respectively 7, 8 and 9 standard performers, seem as phenomenal as the five horses mentioned above. Again, prepotency is as we should have expected, heritable in a marked degree; thus all of the above five sires except *Blue Bull* are sons of "*Hambletonian* 10," and one of the three mares, *Green Mountain Maid*, was dam of *Electioneer*.

My conclusion is that high prepotency does not arise through normal variation, but must rank as a highly heritable sport, or aberrant variation; in other words its causes must partly be of a different order, or else of a highly different intensity, to those concerned in producing the normal variations of the race. In a sport, the position of maximum stability seems to be slightly changed. I have frequently insisted that these sports or "aberrances" (if I may coin the word) are probably notable factors in the evolution of races. Certainly the successive improvements of breeds of domestic animals generally, as in those of horses in particular, usually make fresh starts from decided sports or aberrances, and are by no means always developed slowly through the accumulation of minute and favourable variations during a long succession of generations.

FRANCIS GALTON.

Zoology as a Higher Study.

THE following, necessarily condensed, comments on Prof. Ray Lankester's criticisms may be permitted.

(1) Prof. Lankester's views on the citation of authorities in text-books have been published before. To the best of my belief "authoritative public opinion," if it had expression, would favour the side of common sense in this matter. A text-book, adapted to the needs of the elementary student, in which the "historical method of exposition" should be followed, and each discoverer awarded his due meed of recognition, is an impossibility, within reasonable limits of size and cost. Our reasons for omitting all references to authorities really were those given in the preface, which I invite Prof. Lankester to re-peruse, not those which he ungenerously ascribes to us.

(2) Where the names of the original authors of figures have not been quoted, and the proximate source from which the block was borrowed or the figure copied has alone been given, the name of the original author is, in most instances, a matter of no consequence whatever. In a very few cases the omission is regrettable.

(3) The main responsibility for the "most astonishing" of the errors which Prof. Ray Lankester has noticed in the text-book, viz. the statement that ossification occurs in the skeleton of Elasmobranchs, rests with me, and not with the two sons of W. Kitchen Parker. The most astonishing thing to the initiated onlooker will doubtless be Prof. Lankester's evident confidence that this is an error.

(4) The "error" with regard to the nephrostome of Lumbricus is Prof. Lankester's. If he will read over that part of the "Text-book" as it would be read by a student, taking the description of *Nereis* as the foundation, he will understand what I mean. "Corresponding segment" is not "same segment."

(5) The criticism of the statement regarding cœlome and hæmocœle in Peripatus would have lost all its apparent cogency had Prof. Lankester quoted only three lines more (see "Text-book," vol. i. p. 561).

WILLIAM A. HASWELL.

The Nature and Habits of Pliny's Solpuga.

I READ with much interest Mr. Pocock's article on "Solpuga" (NATURE, vol. lvii. p. 618). It may be worthy of note that a species of Galeodes is met not infrequently in Southern California, and is one of the few Arthropodous animals that is bold enough to attack and devour the honey-bee. It enters the hive and seizes the bee, worker as well as drone, and soon makes away with it. Were these Arachnoids as abundant as the Robber-flies (Asilidæ), they would be nearly as serious enemies of the bee-keepers of Southern California as are those insects. They are not, however, sufficiently numerous to do any serious mischief, and so are not feared or dreaded.

A. J. COOK.

Claremont, Cal., May 12.

The Weather of this Summer.

IN your notice of Symons's *Met. Mag.* this week, I seem to be credited with (discredited by?) the announcement that this summer will probably be wet. May I point out that it is one thing to announce this, and another to say that in the five years ending with the next sunspot minimum year (say 1901, or thereabouts), there will probably be more wet summers than dry? Further, the two rules cited in the notice are based on data extending from 1816, not merely from 1841.

July 8. ALEX. B. MACDOWALL.

THE NATURAL HISTORY MUSEUM.

THE following memorial has been addressed to the Trustees of the British Museum:—

Sir, My Lords, and Gentlemen,—We, the undersigned, being persons interested in the science of Natural History, venture to address to you the following observations suggested by the retirement of Sir W. H. Flower from the post of Director of the Natural History Museum (British Museum).

It is, in our opinion, of great importance to the welfare of Natural History that the principal official in charge of the national collections relating to this subject should not be subordinate in authority to any other officer of the Museum. The Natural History Collections are in a part of London remote from the National Library and the other departments of the British Museum; the supervision of these collections and the direction of the large staff entrusted with the care of them are sufficient to tax the whole energies of any one entrusted with those duties. For the purpose of facilitating this task and avoiding possible friction, it seems to us necessary that the Directors should meet the Trustees and represent them before Her Majesty's Treasury as the responsible head of a department, and not as a subordinate.

A position such as we have described was held, to the great satisfaction of the scientific world, by Sir William Flower, who succeeded Sir Richard Owen; to abolish it now would involve a great change of policy. We believe that the existing system has given satisfaction to the staff of the Museum and to

the public. Under it the collections have been so administered as to serve the needs of national education and of scientific research in a very efficient manner.

It may be pointed out that the interests presided over by the principal Librarian are totally different from those under the charge of the Director of the Natural History Museum, and that the same man cannot be expected to understand or to represent adequately the needs of two departments so complex and so distinct from one another. The progress which has been made in the Natural History Museum under its present organisation, especially in regard to its development as an instrument of public instruction and enjoyment, would have been difficult under the old system, in which the Head of the Natural History Collections had not a position of independence and freedom. In this connection it is important to remember that the support given to the institution by Parliament must be largely dependent upon public sympathy and approval. Further, it must not be forgotten that while the Natural History Museum has been developed as a place of public interest it has increased its reputation as an institution of first-rate scientific importance in Europe, both by the magnitude and organisation of its collections, and by the researches carried on by the staff within its walls.

This statement has already been signed by—

Dr. G. J. Allman, F.R.S.
Dr. J. E. T. Aitchison, F.R.S.
Dr. John Anderson, F.R.S.
Lieut.-Col. H. H. Godwin Austen, F.R.S.
H. H. Armstead, R.A.
Sir Benjamin Baker, K.C.M.G., F.R.S.
Prof. J. Bayley Balfour, F.R.S.
Prof. Sir Robert Ball, F.R.S.
The Rev. S. A. Barnett.
Right Hon. Lord Battersea.
Prof. Lionel Beale, M.B., F.R.S.
F. E. Beddard, F.R.S.
The Duke of Bedford.
The Rev. G. C. Bell, Master of Marlborough College.
Sir Walter Besant.
Dr. W. T. Blanford, F.R.S.
Edward Bond, M.P., late Chairman of the Technical Education Board, L.C.C.
Prof. T. W. Bridge.
T. Brock, R.A.
Dr. Horace T. Brown, F.R.S.
Sir James Crichton Browne, M.D., F.R.S.
Dr. T. Lauder Brunton, F.R.S.
G. B. Buckton, F.R.S.
R. Brudenell Carter, F.R.C.S.
Prof. W. Watson Cheyne, F.R.S.
Dr. W. J. Collins.
Prof. John Cleland, F.R.S.
Sir John Conroy, Bart., F.R.S.
Sir Martin Conway.
Prof. D. J. Cunningham, F.R.S.
Sir William Crookes, F.R.S.
Prof. W. Boyd Dawkins, F.R.S.
Prof. James Dewar, F.R.S.
F. V. Dickins, Registrar of London University.
H. E. Dresser, Author of "The Birds of Europe."
Prof. J. C. Ewart, F.R.S.
Dr. Robert Farquharson, M.P.
Prof. J. B. Farmer.
Sir Joseph Fayrer, M.D., F.R.S.
Michael Foster, M.D., Sec. R.S.
Sir E. Frankland, K.C.B., Foreign Secretary R.S.
Right Hon. Sir Edward Fry, F.R.S.
A. B. Freeman-Mitford, C.B.
E. Onslow Ford, R.A.
Prof. A. R. Forsyth, F.R.S.
Francis Galton, F.R.S.
Sir Douglas Galton, K.C.B., F.R.S.
Sir Alfred B. Garrod, M.D., F.R.S.
Prof. Francis Gotch.
H. Rider Haggard.
Prof. W. D. Halliburton, F.R.S.
S. F. Harmer, F.R.S.
Prof. W. A. Herdman, F.R.S.
Prof. S. J. Hickson, F.R.S.
M. D. Hill, Science Master, Eton College.
Sir Joseph D. Hooker, G.C.S.I., F.R.S.
Prof. G. B. Howes, F.R.S.
Dr. E. Hull, F.R.S.
Right Hon. Lord Kelvin, G.C.V.O., F.R.S.
Prof. W. P. Ker.
Sir John Kirk, G.C.M.G., K.C.B., F.R.S.
O. H. Latter, Science Master, Charterhouse School.
Prof. G. D. Liveing, F.R.S.
Sir Norman Lockyer, K.C.B., F.R.S.
Sir Leonard Lyell, Bart., M.P.
Prof. A. Macalister, F.R.S.
Sir W. MacCormac, Bart, Pres. R.C.S.
Dr. Maxwell T. Masters, F.R.S.
The Right Hon. Sir Herbert Maxwell, Bart., M.P., F.R.S.
Prof. W. C. McIntosh, F.R.S.
Prof. R. Meldola, F.R.S.
Prof. L. C. Miall, F.R.S.
P. C. Mitchell, Lecturer on Biology, London Hospital.
Dr. St. George Mivart, F.R.S.
Prof. C. Lloyd Morgan.
Sir John Murray, K.C.B., F.R.S.
J. T. Nettleship.
Captain Sir A. Noble, K.C.B., F.R.S.
The Rev. Canon A. M. Norman, F.R.S.
Prof. W. Odling, F.R.S.
H. F. Pelham, M.A., Camden Professor of History, and President of Trinity College, Oxford.
Prof. W. M. Flinders Petrie.
Prof. G. V. Poore.
Prof. Sir F. Pollock, Bart.
T. C. Porter, Senior Science Master, Eton College.
Prof. E. B. Poulton, F.R.S.
Sir William O. Priestley, M.D., M.P.
M. R. Pryor.
Dr. P. H. Pye-Smith, F.R.S.
The Right Hon. Lord Reay, G.C.S.I.
Sir W. Richmond, K.C.B., R.A.
The Most Hon. the Marquis of Ripon, K.G., F.R.S.
Dr. Briton Rivière, R.A.
Prof. W. C. Roberts-Austen, C.B., F.R.S.
Sir William Roberts, M.D., F.R.S.
Sir Henry Roscoe, F.R.S.
The Hon. Walter Rothschild.
Prof. A. W. Rücker, Sec. R.S.
Right Hon. Sir B. Samuelson, Bart., M.P., F.R.S.
Dr. Dukinfield H. Scott, F.R.S.
R. H. Scott, F.R.S.
A. Sedgwick, F.R.S.
Prof. C. S. Sherrington, F.R.S.
A. E. Shipley.
Sir John Simon, K.C.B., F.R.S.
Dr. H. C. Sorby, F.R.S.
The Right Hon. Earl Stanhope.
Sir Herbert Stephen, Bart.
Marcus Stone, R.A.
Prof. Sir George Stokes, Bart., F.R.S.
Lieut.-General Sir Richard Strachey, G.C.S.I., F.R.S.
J. W. Swan, F.R.S.
J. J. H. Teall, F.R.S.
Sir Richard Temple, Bart., G.C.S.I., F.R.S.
Sir Henry Thompson, F.R.C.S., M.B.
Sir Richard Thorne Thorne, K.C.B., F.R.S.
Hamo Thornycroft, R.A.
Dr. T. E. Thorpe, F.R.S.
Everard F. im Thurn, C.M.G.
Prof. J. W. H. Trail, M.D., F.R.S.
The Rev. Canon H. B. Tristram, F.R.S.
Prof. Sir William Turner, F.R.S.
Prof. S. H. Vines, F.R.S.
Prof. C. Waldstein.
Dr. Alfred Russel Wallace, F.R.S.
Prof. H. Marshall Ward, F.R.S.
Prof. R. Warington, F.R.S.
Prof. F. E. Weiss.
Prof. W. F. R. Weldon, F.R.S.
Prof. T. Westlake, Q.C.
Edward Whymper.
Sir John Williams, Bart., M.D.
Sir H. Trueman Wood, Secretary of the Society of Arts.

At a meeting of the Standing Committee of the Trustees of the British Museum, held on the 9th inst., the following letter was directed to be sent to Sir William Flower. It is signed by the Chairman of the meeting, Lord Dillon.

"*British Museum*, *July* 9, 1898.

"DEAR SIR WILLIAM FLOWER,—With profound regret the Trustees accept the resignation of the Directorship of the Natural History Museum which, owing to failure of health, you have been unhappily compelled to submit to them. They had hoped that the remaining term of years which you might have spent in their service would have enabled you to perfect the arrangement of the collections so admirably planned and so systematically developed by you during your fourteen years of office, and they cannot but regard your retirement at this moment as a real misfortune to the Museum.

"They wish to record their high appreciation of your services.

"The rare combination of wide scientific knowledge with marked administrative ability and a sympathetic appreciation of the requirements of the uninstructed public has carried you through a most difficult task. Under your hands the Natural History collections of the British Museum have fallen into the lines of an orderly and instructive arrangement which no one, whether man of science or ordinary visitor, can examine without admiration.

"To you, as a worthy successor of Sir Richard Owen, will attach the honour of having organised a Museum of Natural History which now occupies a pre-eminent position among all the Museums of the civilised world.

"For these devoted services the Trustees thank you. In your retirement you carry with you their lasting gratitude and their sincere good wishes.

"Believe me, Dear Sir William Flower,
"Yours very truly,
(Signed) "DILLON."

ANIMAL INTELLIGENCE: AN EXPERIMENTAL STUDY.[1]

MANY are the writers on animal intelligence, but few have made comparative psychology a subject of scientific investigation by the methods of careful observation and of experiment under conditions allowing of some control. Right welcome, therefore, is Mr. Thorndike's experimental study, of which a brief preliminary notice appeared in NATURE a few weeks ago (vol. lvii. p. 372).

This careful research goes far to confirm the conclusion, to which the present writer has been led, that the method of animal intelligence is one of undiscriminating trial and error, of profiting by chance experiences, and one which depends on the establishment of direct associations—a conclusion which is in close accord with that reached by Prof. Wundt. Mr. Thorndike is, however, somewhat severe in his criticisms of previous writers in the same field, complains that they have made no observations of their own, and says that most of the books do not give us a psychology, but rather a eulogy of animals. "They have all been about animal intelligence, never about animal stupidity." One of the previous writers has, however, said: "And then, as Mr. P. G. Hamerton well remarks, we have to take into account the immensity of the ignorance of animals." Ignorance and stupidity are, of course, by no means synonymous. But it is the former rather than the latter that is so abundantly exemplified in animal life.

In many of his experiments Mr. Thorndike's method was as follows. Very hungry kittens were shut up in box-cages, 20 inches long by 15 broad and 12 high, and food was placed outside within the animals' sight. To get out the kitten had either to pull down wire loops placed in different positions in different cages, or turn a broad button, or press an ordinary thumb-latch, or push down a small platform, or simply pull a string stretched across the roof. These devices (each in its separate cage) were so arranged that on the fitting push or pull the door opened; and fish was the reward of success. In other cages two or three distinct actions on the part of the kitten were required before the door opened. In yet other experiments the kitten was released and fed directly she either licked herself or scratched herself. The object of the investigation was to watch and record the establishment of associations; and the results are plotted in curves, giving the time-intervals between imprisonment and escape in successive experiments.

The curves are far from smooth, as is indeed to be expected where the internal factors are necessarily somewhat inconstant, and where the difficulties to be overcome by the subjects are different in different cases; but they bear out the contention that the method of animal intelligence is to profit by chance experience, and is dependent on the gradual establishment of direct associations. I have endeavoured to extract from some of Mr. Thorndike's carefully plotted data a mean curve for the method of trial and error, and though it does not come out very well, it does serve to indicate that *gradual* sweep towards rapid and assured success, which would theoretically result on this method. In contradistinction to this the curve of rational procedure is quite different. I plotted some curves of this type a few months ago, after reading Dr. Lindley's dissertation on "A Study of Puzzles" (*Amer. Journ. of Psych.*, vol. viii. No. 4). They were for ordinary wire-puzzles, and show a *sudden* leap from failure to success when the trick of the puzzle was discovered and *understood*, and after that some slight improvement in rapidity of success as the manipulative details were mastered.

[1] "Animal Intelligence: an Experimental Study of the Associative Processes in Animals." By Edward L. Thorndike, A.M. (Monograph Supplement to the *Psychological Review*, June 1898.)

Passing reference may here be made to Dr. Lindley's interesting study above mentioned. He finds by observation that the method of the young child is largely that of the animal. Trial and error, chance success, and direct association are predominant. In older children, who are beginning to generalise the results of their experience, rational procedure based on a considered scheme or plan, makes itself more and more felt. Further observation on similar lines will serve to link such results as Mr. Thorndike's with the human psychology of the text-books.

To return to Mr. Thorndike's research. The conditions of his experiments were perhaps not the most conducive to the discovery of rationality in animals if it exist. The sturdy and unconvinceable advocate of reasoning (properly so-called) in animals may say that to place a starving kitten in the cramped confinement of one of Mr. Thorndike's box-cages, would be more likely to make a cat swear than to lead it to act rationally. And he may further urge that where the string passes out of sight and the bolt is hidden from view, the opportunities of understanding the situation are excluded. All the kitten could think would be: here's something loose and unnecessary to the normal constitution of a box; I'll try that on chance. But although I do not deem Mr. Thorndike's method so conclusive for the anti-rationalist view as observation under more natural, and, I may add, more sympathetic conditions, yet the form of his curves affords no particle of evidence for reasoned behaviour.

We may pass over his experiments on dogs and chicks with the barest mention. They serve to support the same conclusions with some differences of detail.

When we come to his psychological explanation of the nature of the associations involved, I find much to agree with but somewhat to dissent from. Where he argues that animals form no free ideas, I am heartily with him. I have myself contended that they are incapable of analysing a situation. And if in interpreting the facts of observation one's language may seem to imply that the sight of an object and its taste are analysed out and then associated, this is due to the inevitable analytic form which the use of words entails. Animals, in my opinion, do not analyse in this way, and do not form "free" ideas. The utmost that we can allow is that certain elements in a complex situation may, under given circumstances, predominate in consciousness over others; and this, not through any process of abstraction, but from the interplay of the nature of the animal and the circumstances of the case.

But when Mr. Thorndike says that "the groundwork of animal association is not the association of ideas, but the association of idea with impulse," I for one, as at present advised, am not prepared to follow him. "Impulse," he defines as "the consciousness accompanying a muscular innervation apart from that feeling of the act which comes from seeing oneself move, from feeling one's body in a different position, &c." Now in the first place this involves the assumption that physiological innervation is accompanied by a specific form of consciousness here termed "impulse." The question is still *sub judice*. But there is, at any rate, much to be said in favour of the view that consciousness is directly stirred only by *afferent* nerve-currents, and that the innervation process is itself unconscious, though its effects are communicated to consciousness by an afferent back-stroke from the motor organs as they move. This alternative view should, I think, have been mentioned, at all events in criticising one who provisionally holds it. On this view the efferent impulse (apart from its effects) cannot be psychologically associated with anything, since it is physiological and unconscious. In the second place, to suppose that one who holds the impulse as such to be purely organic, holds also that "an animal whenever it thinks of an act can supply an 'impulse' to do the act,"

savours, to say the least of it, of improbability. In any case I do not recognise it as my own view. I hold as strongly as Mr. Thorndike that the efferent impulse (as an organic link) is a *sine quâ non* in every case of association in animal psychology, and that no animal can supply it "at will."

A very interesting series of experiments were made with a view to extracting an answer to the question, Do animals imitate? The question is not so easy to answer as it looks. No one with adequate experience can doubt that young birds and mammals perform actions which, from the observer's point of view, are imitative. The sight of an animal performing some simple action is the stimulus which prompts to the performance of a similar action. This I have termed "instinctive imitation." And this Mr. Thorndike would not deny to animals, though he would, I take it, deny (and not without psychological justification) its right to be spoken of as imitation, properly so-called. On this basis are founded the numerous cases of imitation by suggestion where the sight of an action performed is the stimulus to the performance of a similar action. A more complex case is that of the bird which, hearing certain sounds, is not only stimulated to make sounds itself (like a laughing jackass to which one whistles), but gradually to make its own sounds resemble those which afford the stimuli (like the parrot which "draws a cork"). Here it seems that the resemblance itself gives satisfaction—in any case the factor of experiential selection is introduced. In these cases imitation by suggestion is supplemented by a tendency to more exactly reproduce the sound which affords the stimulus—a tendency which seems to be based upon the innate satisfaction which accompanies the act of reproductlon. Thus far, in my opinion, animals can certainly go; but even this, it may be urged, is only pseudo-imitation. True imitation is seen only where a being of set purpose copies a given model, not only reproducing, but intending to reproduce. And it is the presence of true imitation of this type which Mr. Thorndike's experiments were designed to test. They afford, however, no evidence of it. Cats were allowed to see others do the trick of the box-cage. But they themselves, when placed in the cage, took the usual time to effect their escape. Their exit was no quicker from seeing others get out by the performance of certain clawings or pushings. The experiments do not carry complete conviction to my mind, though I regard the conclusion to which they lead as probably correct.

Mr. Thorndike thinks it likely that the primates stand at a higher level in this respect than dogs or cats. "If it is true," he says, "that the primates do imitate acts of such novelty and complexity that only this out-and-out kind of imitation can explain the fact, we have located one great advance in mental development. Till the primates we get practically nothing but instincts and individual acquirement through impulsive trial and error. Among the primates we get also acquisition by imitation, one form of the increase of mental equipment by tradition." My own observations on imitation in monkeys are too few and inconclusive to justify more than a very guarded expression of opinion. I lean to the view, however, that there is, even in them, little evidence of true imitation of the higher psychological type; and that the observed facts may be accounted for by a great extension of "instinctive imitation" suggestion, and behaviour directly founded thereon. I hope Mr. Thorndike will put the matter to the test of well-devised experiment.

Several interesting problems connected with the psychological interpretation of animal behaviour are briefly discussed, but can only be mentioned here. Mr. Thorndike accepts the conclusion that in animals "memory" is simply what has been termed "reinstating," and involves no true localisation in time or space. "The animal's self is not a being looking 'before and after.'" "Memory in animals, if one still chooses to use the word, is permanence of associations, not the presence of an idea of an experience attributed to the past." This is precisely the conclusion to which the present writer has been led. On the question whether animals are aware of the pleasure or pain that others are feeling, he says that the conduct of animals "would seem to show that they do not. For it has given us good reason to suppose that they do not possess *any* stock of isolated ideas, much less any abstracted, inferred or transferred ideas. These ideas of others' feelings imply a power to transfer states felt in oneself to another, and realise them as there." As thus stated I think his conclusion is correct, though he quotes me in an opposite sense. In my later discussion ("Introduction to Comparative Psychology," p. 320) I expressly exclude any such ejective transference.

In conclusion, some apology is perhaps demanded for reference to my own observations and conclusions in the same field of study. But it is well to preserve historical continuity in a topic, and it so happens that Mr. Thorndike's work has carried further and extended some of my own; and that his leading conclusions are in the main confirmatory of those which I have reached. In the general trend of our opinions we are perhaps more essentially in accord than, in some cases, he seems to suppose. Even our illustrations are sometimes closely similar; both utilising, for example, the consciousness of a man when he is playing tennis as illustrating the probable subjective condition of the conscious but not yet self-conscious animal. And this substantial agreement is not a mere personal matter. Were it such there would be no justification for drawing attention to it. It shows that the method of observation and experiment, on different but parallel lines, has led two independent investigators to results which are on the whole harmonious; and it affords some ground for the hope that comparative psychology has passed from the anecdotal stage to the higher plane of verifiable observation, and that it is rising to the dignity of a science. In any case Mr. Thorndike's research is one of no little value, and will, I trust, be supplemented by further investigations.

C. LLOYD MORGAN.

THE FLORA AND FAUNA OF BRITISH INDIA.

NO portion of the earth's surface surpasses the British Empire in India in the wealth and importance of its vegetable and animal life. Not only is there no other equally large tropical area that has received the same amount of exploration from naturalists, but the territories and dependencies of British India comprise regions with a marvellous variety of climates, from tropical islands like the Andamans and hot plains like the Carnatic, to the snows of the Himalayas and the frigid plateaus of Tibet; whilst the rainfall varies from the "record" 600 inches or more on the Khasi hills to the meagre supply that occasionally damps the arid sands of the Sind desert, where, frequently, for years in succession, rain is unknown. The remarkable antiquity of the Indian peninsula, the greater part of which appears to have been land from the earliest geological times, adds greatly to the scientific importance of the fauna and flora.

Under these circumstances it is not surprising that the variety of plants and animals occurring in India should be very great. There is no other large tropical region with which comparison is possible, because, as already mentioned, there is none of which the natural productions are as well known. Europe (3,800,000 square miles) has more than twice the area of India (1,750,000 square miles), but it has a far poorer flora and fauna, only about 9500 flowering plants being known to occur against 14,500 Indian species; whilst British India and its dependencies contain more than twice as many

species of mammals, nearly three times as many birds, considerably over four times as many batrachia, and about eight times as many reptiles as the whole of Europe. The moths known to be found in Europe are 3040 in number, those of India 5600; and in this case there is no doubt that the Indian list is far from complete.

The interest attaching to the botany and zoology of India makes the circumstance noteworthy that two important works published by order of the Government of India, and at its cost, have been completed within the last six months. These works are the "Flora of British India" and the vertebrate section of the "Fauna of British India." In neither case is the work exhaustive, but each deals with the most important group of plants or animals respectively, the "Flora" containing descriptions of all flowering plants, and the "Fauna" accounts of all vertebrate animals. It is scarcely necessary to say that flowering plants form a much larger proportion of the whole flora, than vertebrate animals do of the entire fauna; but some progress has already been made with an addition to the "Fauna" as originally planned, and with the description of the huge mass of Indian Invertebrata. Except that the plants of the Malay peninsula are included in the "Flora," whilst the animals are omitted from the "Fauna," the British India of the two works is the same, and includes all India proper with the Himalayas, Ceylon, Assam, and Burma.

The "Flora of British India" is a work to which Sir J. D. Hooker has devoted many years of his life, and it is chiefly written by him, portions having been contributed by other botanists, amongst whom are Mr. Thiselton-Dyer, Mr. C. B. Clarke, Dr. Maxwell T. Masters, Mr. J. G. Baker, and the late Dr. T. Thomson and Dr. T. Anderson. The undertaking may be said to have commenced originally by the publication of the first (and only) volume of Hooker and Thomson's "Flora Indica" in 1855; but the present work, which is on a smaller plan, has been brought out in parts, of which the first appeared in 1872, and the last, containing the index, in November 1897. The whole consists of seven thick octavo volumes, comprising altogether over 5000 closely printed pages, and containing descriptions of 14,520 species.

The "Fauna of British India" is on a different plan, and the completed portion, containing the Vertebrata, consists of eight octavo volumes and of over 4100 pages. Of the eight volumes, one contains the Mammals (402 species), four the Birds (1626), one the Reptilia (534) and Batrachia (130), and two the Fishes (1418). The whole is edited by Mr. W. T. Blanford, who is also the author of the volume of Mammals and of two volumes of Birds, the remaining two volumes of the latter being the work of Mr. E. W. Oates; whilst Mr. G. A. Boulenger has contributed the part containing the Reptilia and Batrachia, and the late Dr. F. Day wrote the account of the Fishes. The first part appeared in 1888, and the last volume of Birds has just been issued from the press.

As already mentioned the "Fauna," as originally projected, was intended to contain an account of the Vertebrata alone, and this is now complete. But some years ago the Government of India authorised an extension of the work, on the same plan and under the same editor, to certain Invertebrate groups, with the result that up to the present time four volumes on Moths, by Sir G. F. Hampson, have been published, with descriptions of 5618 species; and one volume on Bees and Wasps, by Colonel C. T. Bingham, containing descriptions of 995 species. Thus at present the series of the Fauna comprises thirteen volumes. No intimation has been given of any additional parts being in preparation. It may be hoped, however, that further additions will be made, and that, so far as is practicable, both the Flora and Fauna may be completely described. A thorough knowledge of the productions of India is as important for economic reasons as for scientific inquiry.

A. KERNER VON MARILAUN.

WE regret to announce that Dr. Anton Kerner von Marilaun, Professor of Botany in the University of Vienna, died suddenly on June 21 in that city from apoplexy. He was born at Mautern, Lower Austria, on November 13, 1831. He acquired at a very early age a considerable knowledge of the flora of his native province, and had already a good reputation as a botanist when still a student of medicine in the University of Vienna. After having taken his degree as Dr. Med. et Chir., he practised for a short time in one of the Vienna hospitals; but finding the medical career not to his taste, he accepted a professorship in the Josef's Polytechnicum at Ofen, Hungary. In 1861 he was called to the chair of Botany in the University of Innsbruck, which he occupied till 1878, when he succeeded Eduard Fenzl as Professor of Botany and Director of the Botanic Garden and Museum at Vienna, in which position he remained up to his death. In 1875 he was elected a member of the Imperial Academy of Science of Vienna; he received the order of the Eiserne Krone in the following year, in recognition of his achievements as a teacher and man of science, and was knighted in 1877, when he added the title "von Marilaun" to his name. When Eichler, the eminent morphologist, died, the University of Berlin invited him to the vacated chair; but Kerner, who had always been a staunch Austrian, declined.

Kerner's principal claims as one of the most prominent botanists Austria has produced, rest chiefly on his researches in phyto-geography and biology—this term to be understood in the narrower sense, in which it is so often used in Germany. Trained from early youth to observation in the field, thoroughly familiar with the Central European flora, gifted with a keen eye for the salient features of vegetation and, at the same time, with an analytic mind ready to break up the general aspect in which a given vegetation presents itself into its elements, he was eminently fitted to develop that particular branch of phyto-geography which deals with the association of plants in so-called plant-formations. This doctrine had just then assumed a definite shape through Grisebach's investigations, although it may well be traced back to Alexander Humboldt. In his book, "Das Pflanzenleben der Donauländer" (1863), Kerner applied with great success the new method to the vegetation of the Eastern Alps and a large part of Hungary, which he had explored in numerous excursions. In a contribution to "Die Oesterreichisch-Ungarische Monarchie im Wort und Bild," which was published under the auspices of the late Crown Prince Rudolf, he worked out in a general way the distribution of the various floras within the monarchy, their principal subdivisions and their history, and he added soon afterwards an excellent map, under the title "Florenkarte von Oesterreich-Ungarn." If he was early a master of descriptive phyto-geography, he was by no means indifferent to the historical side of the science, as his paper, "Beiträge zur Geschichte der Pflanzenwanderungen" (1867), in which he sided with Forbes and against Grisebach and his creation theory, an interesting essay, "Studien uber die Flora der Diluvial-Zeit in den östlichen Alpen" (1888), and several more show. Of his biological researches the most remarkable are those dealing with the relations of flowers and insects.

His splendidly illustrated book, "Schutzmittel der Blüthen gegen unberufene Gäste" (1876), was translated into English ("Flowers and their unbidden Guests"), and, no doubt, gave a powerful impetus to the development of one of the most fascinating chapters in biology. In fact, I believe, nothing appealed more to his constitution of mind than investigations of this kind; for he was endowed with a wonderful amount of imagination which, in that inexhaustible field, found ample

opportunity for asserting itself—now divining the explanation of some puzzle, now losing itself in fanciful flights. Among his other papers of this category, I may mention, as more widely known, "Können aus Bastarden Arten werden?" and "Parthenogenesis einer angiospermen Pflanze" (1876). The latter referred to *Antennaria alpina*, and the correctness of the construction he put on the facts observed has been doubted for a long time; but a paper by Dr. Juel, of Upsala, published just a week previous to Kerner's death, must have given him great satisfaction if it reached him, as the author confirmed fully the disputed points by independent observation and careful microscopical investigation. Among his papers concerning systematic botany may be mentioned one under the title, "Abhängigkeit der Pflanzengestalt von Klima und Boden" (1868), which contains a valuable and highly philosophical essay on the section Tubocytisus of Cytisus; further, his "Monographia Pulmonariarum" (1878), and a very great number of critical notes, which are scattered through his "Vegetations-Verhältnisse des mittleren und östlichen Ungarns und angrenzenden Siebenbürgens" which, began in 1867, run through thirteen volumes of the *Oesterreichische Botanische Zeitschrift*, however, without having been completed. Numerous similar notes are also contained in the "Schedae ad Floram Exsiccatam Austro-Hungaricam," a beautifully prepared collection of Austrian and Hungarian plants, the issue of which proceeded to Century xxii. In his investigations into subjects of systematic botany, Kerner hardly ever ventured beyond the boundaries of his special domain, *i.e.* Austria-Hungary and the adjoining districts. This, perhaps, was partly the cause of his strong tendency towards "Jordanism," or the excessive subdivision into species, of his occasional one-sidedness, such as is often found in strictly local botanists, and of the almost complete absence of any attempt at dealing with groups of a higher order and from a broad standpoint. The only time he tried a problem of this category, namely in the chapter on the "Stämme des Pflanzenreiches," or the phyla of the vegetable kingdom, in his "Pflanzenleben," he was rather unfortunate, and he wisely omitted it in the second edition.

His great work, "Pflanzenleben," well known to the English public from the translation by Prof. F. W. Oliver ("The Natural History of Plants") was in many respects the crowning result of his life-long labours. When he undertook to write the book, which was to be one of a series of popular treatises on natural history, published by the Bibliographische Institut of Leipzig, his plan was to incorporate all his own experiences and observations, many of which were only laid down in rough notes, to assimilate those of other authors, and to produce a standard work which would treat homogeneously all the various phases of plant-life. It was a tremendous task, and must have heavily taxed his constitution, which was not over-strong, although he was scarcely yet past the prime of life when he commenced it. The work is known for its lucid, nearly always fascinating and often classic style, its beautiful illustrations, few of which are not original, its fulness of suggestive matter, its occasional quaint mixture of truth and fiction—of course, unconscious fiction—and its independent conception, and little need be said about it in this place. It is the very embodiment of the genius of its author, and it reflects equally well his strong and his weak points. Measured by it, Kerner might appropriately be called the poet-botanist.

Kerner was an excellent lecturer, who raised the subject of his lecture high above the ordinary level by enlivening the purely morphological and otherwise dry details by constant references to the relations which exist between form and function, and also by his bold and highly artistic draughtsmanship. He was a man of refined culture, but naturally nervous; he came not rarely into collision with others, from the effects of which he, no doubt, ultimately suffered most. Many of his smaller papers are so scattered or buried in all but inaccessible periodicals, and even daily papers, that a careful selection and reissue of those amongst them which are really valuable is very desirable.

OTTO STAPF.

NOTES.

THE Cambridge Anthropological Expedition to Torres Straits arrived at Thursday Island on April 22. The Hon. John Douglas, C.M.G., the Government Resident, did all in his power personally and officially to advance the aims of the expedition, as did also the other Government officials and many others. The Hon. C. T. J. Byrnes, Chief Secretary, sent a cordial telegram of welcome and offers of assistance on behalf of the Government. After a week's delay a start was made for Murray Island, and owing to unfavourable weather it took another week to traverse the hundred and twenty miles between the two islands. The Murray Islanders gave Dr. Haddon a very cordial reception; they appear to understand the main objects of the expedition, and many of them are assisting in various ways. A deserted mission-house is occupied as a dwelling, and it has been converted into a temporary anthropological and psychological laboratory, photographic studio, surgery and dispensary. All the members of the expedition are in good health, and work has commenced in earnest.

THE French Société d'Encouragement has awarded the grand prize of 12,000 francs to M. Moissan for his numerous researches in chemistry; the prize of 2000 francs for the experimental study of the properties of metals and alloys to M. C. E. Guillaume; the prize of 1000 francs for an investigation of albuminoids to M. Fleurent; a prize of 2000 francs to M. Cord for his work on the agriculture and geology of the soils in the department of Lozère; an *encouragement* of 500 francs to M. Capredon for his work on metallurgical chemistry; of 500 francs to M. A. Bigot for his work on enamels; of 1000 francs to M. Pagès for his work on the agriculture of the Cantal Department; and 500 francs to M. Mazel for his work on the agriculture of the Vivarais district.

THE Committee appointed in 1895 to examine and report upon the various monographs submitted in competition for the Loubat prizes to be awarded in 1898 have issued their report to President Low, of Columbia University. The monographs that were formally submitted for examination were the productions of eight different authors; of these the committee consider as being the most meritorious, and as most fully complying with the conditions prescribed for the competition, the treatise on "Stone Implements of the Potomac Chesapeake Tide-water Provinces," by Mr. William Henry Holmes, Curator of the Department of Anthropology in the National Museum at Washington, and to this author therefore the committee recommend the awarding of the first prize, value 1000 dollars. In the opinion of the committee the second prize, value 400 dollars, should be given to Dr. Franz Boas, of the Metropolitan Museum of Natural History of New York City, for his monograph entitled "The Social Organisation and Secret Societies of the Kwakiutl Indians." Special mention is also made in the report to a work by Mr. Alfred P. Maudslay, of London, dealing with the archæology of Central America. This work was not submitted for competition, and is not yet in a complete state, but its great merit is such as to be considered worthy of special mention by the committee.

Science states that the New York City Board of Estimates and Apportionment has authorised the reissue of 375,000 dollars in bonds for the construction of buildings for the botanical garden in Bronx Park. Work on the museum building is being carried forward, the contract calling for its completion early next year.

PROF. VON RÖNTGEN has been awarded the Elliot-Cresson medal of the Franklin Institute of Philadelphia.

SIR GEORGE STOKES, Bart., F.R.S., will deliver his presidential address before the Victoria Institute at the annual meeting on Monday, July 18.

AS we go to press the annual meeting of the Society of Chemical Industry is being held at Nottingham, under the presidency of Dr. F. Clowes. During the meeting the Society's medal will be presented to Dr. W. H. Perkin, F.R.S.

THE French Botanical Association has elected M. G. Rouy of Asnières as its president for the year. The annual meeting will be held from August 3 to 12, and will be devoted to an exploration of the environs of Gap, Brianson, and du Lauteret.

SIR JOSEPH FAYRER, Bart., K.C.S.I., F.R.S., &c., has been elected a governor of Wellington College.

THE U.S. Commission of Fish and Fisheries has made arrangements for a biological survey of Lake Erie. The work will be under the direction of Prof. Jacob Reighard of the University of Michigan, with whom will be associated Dr. H. B. Ward, of the University of Nebraska, Dr. H. S. Jennings, of the Montana College of Agriculture and Mechanical Arts, Dr. J. Shaw, of Ann Arbor, Mr. A. J. Pieters, of the U.S. Department of Agriculture, and a number of other assistants. Experimental work will be a prominent feature of the survey, and among other problems to be considered are the rate of growth of fishes; the food of young fishes reared from the egg, and the changes in their regimen during growth; the source of food of aquatic rooted plants; the life-histories of food fishes reared in aquaria or ponds, and of certain aquatic insects and other invertebrates; the rate of increase of the plankton as a whole, and of its individual constituents. There will also be systematic studies of the habits, migrations, distribution and food of the fishes and other organisms of the lake. At the beginning of the work Prof. Reighard and Dr. Ward will devote a considerable amount of time to plankton problems, especially the perfection of methods and apparatus; Dr. Snow will carry on experimental work on the algæ; Dr. Jennings will undertake experimental researches on the protozoa, and Mr. Pieters will pursue studies of the aquatic flora. The summer headquarters of the survey will be at the Government hatching station at Put-in-Bay, South Bass Island, Ohio. Lake Erie affords an excellent field for work of this character, on account of its varied fauna, diversified physical features, extensive fishing interests, and the recent serious depletion of the supply of certain valuable food fishes. The investigations, it is stated, may ultimately be extended to some of the other Great Lakes.

THE fourth International Congress of Agriculture will be held at Lausanne from September 12 to 17 next, under the patronage of the Swiss Department of Agriculture. The work of the Congress will be divided into the following sections:—Rural economy, agricultural education, forestry, dairying, stock breeding, agricultural industries, viticulture, protection of birds, insect and other pests. Those who desire to join the Congress as members (subscription 20 francs) are requested to send in their names to M. S. Bieler, Director of the Agricultural Institute, Champ de l'Air, Lausanne, before the 15th instant. Copies of the preliminary programme may be obtained in this country on application to Sir Ernest Clarke, Secretary of the Royal Agricultural Society, at 13 Hanover Square, W.

AS has already been announced, the autumn meeting of the Iron and Steel Institute will be held in Stockholm on Friday and Saturday, August 26 and 27. An interesting and varied programme has been prepared by the local committee, and seven papers have been promised, two being by Swedish metallurgists. Mr. Richard Ackerman, Director-General of the Swedish Board of Trade, an honorary member of the Institute, and a Bessemer gold medallist, will read a paper on the development of the Swedish iron industry, whilst Prof. G. Nordenström, of the School of Mines, Stockholm, will submit a communication on the most prominent and characteristic features of Swedish iron ore mining. Mr. C. P. Sandberg will discuss the danger of using rails of too hard a nature, whilst Prof. W. C. Roberts-Austen, C.B., F.R.S., will describe the action of explosives on the tubes of steel guns. The chemical side of metallurgy will be represented by three papers. The first will be by Mr. J. E. Stead, on brittleness in steel produced by annealing; the second by Prof. J. O. Arnold, of University College, Sheffield, on the micro-chemistry of cementation; whilst the subject of the third paper will be the influence of metalloids on cast iron, by Mr. Guy R. Johnson, of Tennessee, U.S.A. An excursion of twenty days' duration will follow the meeting.

AN exhibition of the manufacturing and mineral wealth of the various States and Colonies of South Africa is to be opened at Grahamstown on December 15. It will be divided into five groups or sections dealing respectively with raw materials, manufactures, mining and machinery, natural history and science, and fine arts. The exhibition will remain open until January 21.

IT will be remembered that a few weeks ago Dr. T. E. Thorpe, F.R.S., and Dr. Oliver, of Newcastle-upon-Tyne, were appointed by the Home Secretary to inquire, as experts, into the causes and prevention of lead-poisoning in the Potteries. These two gentlemen have now been invited by the same authority to undertake a similar inquiry into the dangers incidental to lucifer match-making, and have been commissioned to visit some of the factories on the continent.

THE *Electrician* states that the International Submarine Telegraph Memorial Fund has now been closed, and the following amounts have been applied to the objects named: University College, Gower Street, London, to endow the Pender Electrical Laboratory, 5000*l.*; Glasgow and West of Scotland Technical College, to continue annual John Pender Gold Medal, 210*l.*; Glasgow University, to provide annual bursary for student of Glasgow and West of Scotland Technical College who proceeds to Glasgow University, 1650*l.*; marble bust of Sir John Pender, by Mr. E. Onslow Ford, R.A., to be placed temporarily in the Board-room of the Eastern Telegraph Company, and for replica, which has been placed in the reading-room of University College, Gower Street, London, and pedestals for same, 461*l.*

AN electrically-worked underground tubular post for letters and parcels has been designed by Dr. Alfred Brunn and Mr. Viktor Takács, of Budapest, and submitted by them to the Hungarian postal authorities. It has been decided to lay down a trial line from the eastern to the western stations of Budapest, and, if a year's working proves successful, the postal authorities will take over the line, and a scheme for connecting twenty-three offices on both sides of the Danube will be carried out.

THE doctors of Portugal are evidently very much in earnest about the medical and sanitary well-being of their country, as is shown by the number of resolutions carried by them at the close of the recently held National Congress of Medicine at Lisbon on various subjects which, in their opinion, are of pressing public importance. One resolution called on the Government to give effect to the vote of the Chamber of Deputies, that vaccination should be made compulsory in Portugal. Another series of resolutions had reference to the repression of tuberculosis. The Congress urged that permanent committees should be appointed for the purpose of diffusing a knowledge of the means of prophylaxis against that scourge. It further recommended that all tuberculous patients admitted to general hospitals should be placed in special wards. It was also decided to appoint a committee to study the question of the establishment of sanatoria for the treatment of tuberculosis in Portugal. With regard to leprosy, the Congress called upon the Government to organise a system of careful study of the disease, and regular teaching of the means of dealing with it; to take a census of the population; to establish agricultural colonies of lepers, in connection with each of which there should be places where all the means of combating the disease should be taught; to place legal hindrances in the way of marriages between lepers and the descendants of lepers; and to educate the poor to correct notions as to the hereditary and contagiousness of the disease.

THE *Times* of Saturday last contained a report of an address delivered on Thursday before the German Society for Public Hygiene by Prof. Koch on the subject of the plague, in which he dealt especially with his discovery of a plague centre in the Hinterland of German East Africa, whither the disease had been introduced from Uganda. After referring to the plague centres of Hu-nan, Tibet, and the west coast of Arabia, in the vicinity of Mecca, the lecturer went on to lay claim to a fourth centre in Equatorial Africa. It had been found that a devastating disease prevailed at Kissiba, in the extreme north-west corner of German East Africa, close to the Victoria Nyanza. Suspecting that it was the plague, Prof. Koch proceeded from India to East Africa in order to make investigations. With the help of Dr. Zupitza, who made a special expedition to Kissiba, he had been enabled to identify the disease as the bubonic plague. In the case of five persons who had died from the disease anatomical preparations were obtained, and the blood and lymphatic glands of plague-stricken patients were bacteriologically examined. All the ordinary features of the bubonic plague were present. Nine out of ten of those who were infected died. The disease was communicated to rats and to monkeys. It was found that an outbreak of the plague among rats frequently preceded a human epidemic, and, in fact, the rat plague might always be regarded as a warning. A further observation had been made, which was of importance. The inhabitants of Kissiba lived almost entirely on bananas. The banana groves were so thick that they admitted neither light nor air, and were perfect breeding places of the bacillus. It would be most interesting if physiologists could investigate the processes of nourishment and metabolic change which attended an almost exclusive diet of bananas. It had been discovered, however, that Kissiba was not an original plague centre, but that the disease had been introduced from Uganda, as the reports of missionaries who resided there showed. It had existed for a long time in Uganda, but it had recently moved in the direction of Budu. Its introduction to Kissiba had been traced to a native who had visited a friend in Uganda. He returned home and died of the plague, and of a large number of natives who attended his funeral many were infected and perished. It was a favourable circumstance that for the present Kissiba lay somewhat out of the ordinary caravan route.

DR. CAMPBELL MCCLURE, of Glasgow, describes in the *Deutsche Medicinische Wochenschrift* a bacillus which he discovered while making examinations of milk in the laboratory of Dr. Piorkowski in Berlin. In the agar plate cultures it formed brown granular colonies, which also grew well in glycerine agar at 37° C., presenting a white appearance, confluent in the middle and punctate at the margins, and becoming yellow and slimy in three or four days. Milk treated with the bacillus and kept at 37° C. for 48 hours was coagulated and had a strongly acid reaction and an acetous smell. The appearance of a bouillon culture kept for 24 hours at 37° C. was constant and typical, the fluid being slightly turpid with a considerable flocculent deposit on the bottom and sides of the tube. The bacillus could be stained with the ordinary aniline colours, but not with Gram's solution. Cover-glass preparations stained with methylene blue showed a great similarity to the diphtheria bacillus and the pseudo-diphtheria bacillus of Löffler and von Hofmann respectively.

THE current number of the *Lancet* has a note interesting to the vast army of cyclists. After a "spin" along a more or less dusty road the cyclist sometimes experiences a dry and subsequently sore and inflamed throat. Headache and depression often follow, and the symptoms generally simulate poisoning of some kind. When the bacteriology of road dust is considered, these effects are hardly to be wondered at. Hundreds of millions of bacteria, according to the nature of the locality, are found in a gramme weight of dust, and the species isolated have included well-known pathogenic organisms. Indeed, there can be no reason for doubting the infective power of dust when it is known that amongst the microbes encountered in it are the microbes of pus, malignant œdema, tetanus, tubercle, and septicæmia. The mischief to riders as well as to pedestrians would probably be largely averted if, as nature intended, the respirations were rigidly confined to the nasal passages, and the mouth kept comfortably though firmly shut. As investigators have shown, the microbes in the air seldom pass beyond the extreme end of the nasal passage, and consequently never to the larynx or bronchial surfaces. A useful precaution, therefore, in addition to exclusively breathing through the nostrils, would be to douche the nasal cavity, after a dusty run or walk, with a weak and slightly warm solution of some harmless antiseptic.

THE Berlin correspondent of the *British Medical Journal* calls attention to the prevalence of trachoma in the eastern provinces of Prussia, where it often assumes an epidemic character, especially among children in the lower schools. The authorities are at last fully alive to the gravity of the matter, and have determined to spare neither pains nor expense in order to stamp out the disease effectually. Thus the city of Königsberg has for the last six months employed ten ophthalmic surgeons especially for the purpose, and the report of their work just published is most satisfactory and hopeful, showing as it does by figures the results already accomplished. In October 1897, of 17,553 school children examined, 5568 were found to be suffering from trachoma; of these, 1763—10 per cent. of those examined—were serious cases. These latter were treated, some in the hospital, some in their own homes, and some in special trachoma classes. By the middle of February the number of cases had gone down to 1218, of which 345 were serious in character. At the date to which the report extends—that is, the end of April—there were only 826 cases, with 223 serious ones. The number of special oculists has therefore been reduced to six.

THE Photographic Convention of the United Kingdom was held at Glasgow last week, and we are glad to find, from the report of its proceedings in the *British Journal of Photography*,

that so much attention was paid to the scientific side of photography. The President (Mr. John Stuart), in the course of his very interesting opening address, said concerning photography: "It has made the astronomer more than ever master of the heavens. By its aid he has mapped out the starry firmament, and been apprised of the existence of stars the most powerful telescopes had failed to show. In the investigations into the composition of the sun and its corona photography has been an invaluable agent. In the registration of storms in the body of the sun it plays a very important part. In the registration also of the barometric and thermometric variations it is in daily use. . . . Its utility in microscopic work has been abundantly proved of late; bacterial science has made rapid strides by its assistance, and every day seems to produce a more startling discovery than the day before. . . . In the medical profession photography promises to become one of the most beneficent agents science has as yet placed at the service of the healing art. The X-rays, or radiography, are now an indispensable adjunct in every well-equipped medical school. A flourishing society has been started to specialise in this hopeful field, and already developments are daily taking place almost beyond our conception." During the meeting a large number of slides illustrative of solar, lunar, and stellar photography, radiography, and slides in colours by various methods were shown, and everything done tended to bring home to those present the almost universal application of photography to art and science.

WE are glad to learn from *Nature Notes* that the Guildford Natural History and Microscopical Society have practically achieved the object of their memorial to the War Office on the making of Wolmer Forest a sanctuary for the preservation of birds, the War Office having adopted the opinion previously expressed by the Commissioner of Woods and Forests, to which reference has already been made in these columns. The forest came under the management of the Aldershot Game Preserving Association in 1895, since which time all birds have been strictly protected; no birds, except game birds, have been allowed to be shot, and hawks, owls, and other birds have been carefully preserved as far as possible. The heronry has gradually increased from one nest a few years ago to about twenty nests now, and nearly fifty young herons flew from the nest in 1897; foxes are also strictly preserved. The Secretary of the Association states, however, that to make the preservation a success a large area round the outskirts of the forest should be included in the scheme for protection, as at present the destruction of birds and animals is still carried out on private land round the forest.

THE Kew Gardens authorities have many problems submitted to them to solve in the course of a year. Many they succeed in unravelling, but occasionally they are baffled. The June number of the *Bulletin* places on record one of the most curious of the tasks brought before the authorities, and one that they have had but little success with. The specimens referred to in the following letter, which was received from Mr. Kenneth Scott, of Cairo, were carefully examined by Dr. D. H. Scott, of the Jodrell Laboratory, who could only conjecture that they were fragments of the paleæ of some grass. "For some time now malingering Egyptian soldiers have been sent in to the Kasr-el-Aini hospital under my care, suffering from extreme œdema and intense inflammatory injection of the conjunctiva of one or both eyes; the *cornea unaffected*. No discharge from the eye. The condition is entirely unlike that which they also produce by putting in the juice of Euphorbia, slaked lime, seed of 'melocheeya' (*? Corchorus olitorius*) and other things. I obtained the specimens sent you by covering the eye with a thick collodion dressing so as to completely seal it up. The man at the end of five days had evidently feared the inflammation might subside, and therefore raised the dressing and renewed the baneful application, part of which I found on the face of the dressing lying against the eye. I have been entirely unsuccessful in obtaining here any information on the matter, nor have I been able to obtain further quantities of the leaf. The patient either began to fear the consequences of the affair, or his stock of the drug became exhausted, as he in no way interfered with the next collodion dressing which was applied, the eye being quite cured, and the dressing intact after a period of five days."

MR. J. BURTT DAVY has recently presented to the Kew Museum the ingredients of a Chinese prescription purchased by him at China Town, San Francisco, particulars of which, as far as their identification can be made out, may be of interest. The ingredients include fruit-heads of an *Eriocaulon*, apparently *E. cantoniense*. This plant has a reputation in China for various diseases, such as ophthalmia, especially in children, as a styptic in nose-bleeding, and in affections of the kidney. Spiny hooks from the stems of the Gambier plant (*Uncaria gambier*, Roxb.), which have astringent properties, and are mostly used in infantile complaints. Some very thin transverse sections of the stem of *Akebia quinata*, a climbing berberiadaceous plant, also occur in small quantities, as well as the bark of *Eucommia ulmoides* known as the "Tu Chung." Tonic and invigorating properties are ascribed to the latter, and its cost is therefore considerable. Among other ingredients which have not been identified, are crushed flower-heads of a composite plant, and slices of a slender, twig-like stem, probably a willow.

THE *Times* of July 11 states that the sum appropriated by Congress for the service of the United States Department of Agriculture for the fiscal year ending June 30, 1899, shows an increase of 326,300 dollars over that for the fiscal year just ended, the principal additions being for the Weather Bureau and the Bureau of Animal Industry. Under the Weather Bureau provision is made for the establishment of sixteen new stations, and the erection of a small building on the Government reservation at Sault Saint Marie (popularly known as "the Soo").

Engineering has the following interesting note on the most ancient steam engine in existence:—"The oldest engine in the world is in the possession of the Birmingham Canal Navigations, this engine having been constructed by Boulton and Watt in the year 1777. The order is entered in the firm's books in that year as a single-acting beam engine, with chains at each end of a wood beam, and having the steam cylinder 32 inches in diameter with a stroke of 8 feet, and erected at the canal company's pumping station at Rolfe Street, Smethwick. During the present year (1898) this remarkable old engine, which has been regularly at work from the time of its erection to the current year, a period of, say, 120 years, was removed to the canal company's station at Ocker Hill, Tipton, there to be re-erected and preserved as a relic of what can be done by good management when dealing with machinery of undoubted quality. It is worthy of note that the Birmingham Canal Navigations favoured Boulton and Watt in 1777 with the order for this engine, and in 1898, or 120 years afterwards, the company have entrusted the same firm, James Watt and Co., Soho, Smethwick, with the manufacture of two of their modern triple-expansion vertical engines, to be erected at the Walsall pumping station, having 240 horse-power and a pumping capacity of 12,713,600 gallons per day.

ACCORDING to the *Pharmaceutical Journal*, a fresh use for seaweed is claimed to have been discovered by a Norwegian engineer, who exhibited an invention at the Stockholm Exhibition for producing paper-glue, dressing-gum, and soap from seaweed. The first establishment for this branch of manufacture

was, according to his statement, to be erected in the district of Stavanger, but, up to the present, nothing appears to have been done in this direction.

THE total number of chemical works registered in all parts of Germany, according to the latest trustworthy statistics, is 6144, the total number of persons employed by them being 125,440. Amongst the industries of the Hamburg Consular district which have attained to the greatest importance are those for manufacturing various chemical products, such as nitrates, sulphuric and nitric acid, sulphates, boracic acid, artificial manures, pharmaceutical products, dyeing and tanning extracts, essences, and more particularly different kinds of explosives. The factories in that district now employ altogether some 4000 workmen as compared with about 1300 ten years ago, a fact demonstrating once more the rapid strides made throughout Germany by most branches of chemical industry during recent years.

BOG iron ore is worked in the province of Quebec, Canada, and arrangements are being made (says the *Engineer*) to extract manganese from bog ore deposits in the province of New Brunswick. The ore is a soft, wet stuff, containing 50 per cent. of water, and is covered by a thin coating of vegetable earth. The depth of ore varies from 5 feet to 30 feet. When dried the residuum is a fine black powder, too fine to be treated in the blast-furnace, and this has therefore to be made into briquettes, as is done with the fine dust from blast-furnaces and the finely-divided iron produced from low-grade ores by the Edison electrical process. The cementing material used is kept secret. An analysis of the dried ore at 212° F. is given as follows: metallic manganese, 48·240 per cent.; metallic iron, 5·700 per cent.; sulphur, 0·096 per cent.; phosphorus, trace; silica, 1·88 per cent.

THE office of the Bureau of Mines at Toronto has issued a notice to the effect that the first discovery of corundum in Ontario was made late in the year 1896, and exploration work carried on under direction of the Government in 1897 shows that the corundum-bearing lands have an aggregate area of about 50,000 acres. The mineral rights over nearly the whole of this tract are held by the Crown, and they have been withdrawn from sale and lease pending a report on the occurrence of the mineral and the methods of treating it, undertaken by the professors of the Kingston School of Mining. Meantime the attention of prospectors, miners, and capitalists is invited to the district, and, with a view to its development and the establishment of industries in the province for treating and utilising the corundum ore, proposals will be received by the Dominion Commissioner of Crown Lands until the first day of September next.

PROF. KIENITZ-GERLOFF criticises, in the *Biologisches Centralblatt*, Prof. Plateau's attack on the hypothesis that the bright colour of flowers is the principal agent in attracting insects for the purpose of cross-pollination. He maintains that the facts support the conclusions of Darwin, Müller, and Lubbock much more than those of Plateau, the general results of whose observations he sums up as follows: "The new is not true, and the true is not new."

THE U.S. Weather Bureau has published a *Bulletin* (No. 22) on the climate of Cuba, with a note on the weather of Manila. The work has been somewhat hastily compiled by Dr. Phillips, in charge of the section of climatology at the Bureau, and is very useful as showing what information exists, and by giving references as to where it is to be found. There appears to be very little precise meteorological data obtainable for Cuba, excepting for Habana. Observations were begun there by the late Prof. A. Poey, about 1850, and since 1859 have been regularly continued at Belen College. During the ten years 1888–1897 the highest yearly mean temperature was 77°·2, and the lowest 76°·1. The warmest month is July, with an average temperature of 82°·4, and the coldest month is January, with an average of 70°·3. The highest temperature recorded was 100°·6, and the lowest 49°·6. The greatest rainfall occurs in October and June; the yearly average for thirty years was 51·73 inches, but the amount varies considerably in different years. The greatest annual fall was 71·40 inches, and the smallest 40·59 inches. Thunderstorms are of almost daily occurrence in the West Indies, but little damage results from them. Meteorological observations have been made for many years at Manila Observatory. From tables compiled by Prof. Hazen it appears that the average annual temperature is 80°. The hottest month is May, with an average of 84°, and December and January are the coolest months, each with an average of 77°. The highest temperature recorded was 100°, and the lowest 74°. The mean annual rainfall is 75·43 inches, of which more than 80 per cent. falls between June and October. Departures from the average are in some instances remarkable, the extremes varying from 121 to 35·6 inches, while the fall of 61 inches in one September, and only 2 inches in another September is still more remarkable.

PROF. KLEIN, of Göttingen, contributes to the *Nachrichten der K. Gesellschaft der Wissenschaften in Göttingen* a statement of the arrangements that have been made to complete the publication of Gauss's works, consequent on the death of Prof. Ernst Schering, who up till lately has undertaken the work. The remaining unpublished papers on Astronomy are to be edited by Prof. Brendel; those dealing with Theory of Numbers and analysis are taken over by Prof. Fricke, of Brunswick; for Gauss's geometrical investigations Prof. Stäckel, of Kiel, has been secured; Profs. Börsch and Krüger, of the Geodetic Central Institute in Potsdam, have promised their assistance for papers on geodesy; and Prof. Wiechert, recently appointed Director of the Gauss Magnetic Observatory, is to deal with Gauss's papers on mathematical physics. It is proposed to issue three further volumes and a supplementary index-volume; vol. vii. will be devoted exclusively to astronomy; vol. viii. will consist of matter supplementary to previous volumes, especially theory of numbers, analysis, geometry and geodesy; and vol. ix. will be reserved for biographical matter.

A DETAILED report on the growth of sugar-beet, and the manufacture of sugar in the United Kingdom, is contributed by Sir J. B. Lawes and Sir Henry Gilbert to the *Journal* of the Royal Agricultural Society. Reviewing the whole of the facts that are adduced in the paper, both as to the climate and other conditions essential for the production of sugar-beet in sufficient quantity, and of sufficient quality, the authors are disposed to think that, so far as the production of the roots is concerned, it could only be a success over comparatively limited areas, and not throughout the agricultural districts of Great Britain generally. As to the profits of the sugar factories, if established, the cost of roots of good quality would probably be so high as to make it doubtful whether, with the present price of sugar in the market, adequate profits from the manufacture could be expected. In conclusion the authors think that if the sugar-beet industry is to be established with any prospect of success, great caution should be exercised in the choice of the locality or localities, and that the undertakings should, in the first instance, be limited in number and confined to the most suitable localities.

THE latest issue of the *Izvestia* of the Russian Geographical Society (1897, iv.) contains a valuable paper, by Prof. Mushketoff, on the glaciers of Russia in 1896. The plan of the Russian Geographical Society is to obtain every year, if possible, accurate measurements of the state of a number of glaciers, especially in the Caucasus, so as to know with accuracy whether

they increase in bulk, or decrease, and to which extent. For eight glaciers the measurements extend already for the past eight to ten years, and they show that these glaciers have been steadily decreasing, their lower ends having retreated at an average speed of from 9 to 38 metres every year. Taking the northern and the southern slope of the Caucasus separately, the average speeds of retreat are 22 metres a year for the former, and 25 metres for the latter. Several new glaciers were discovered in 1896 by the botanists Bush and Schukin. In Turkestan, the expedition of Lipskiy and Barschevskiy discovered in the Hissar Range a great number of large glaciers, formerly unsuspected, the biggest ones lying at the headwaters of the Yagnob River. Their lower ends descend to altitudes of from 10,500 to 11,000 feet, and their *néves* lie at altitudes of 13,000 feet and more. They are all much smaller now than they have been formerly, as may be seen from the moraines and débris with which they are surrounded. Photographs of the Zerafshan glacier, which were procured in 1896 by Maslovskiy, show that it has considerably decreased since 1881. In Siberia, a number of formerly insufficiently-known glaciers was described by Prof. Sapozhnikoff; the main ones, much greater than the well-known Berel, belong to the system of the Byelukha mountain—the Katuñ glacier consisting of two branches, $3\frac{1}{2}$ and $4\frac{3}{4}$ miles long. The Altai glaciers reach by their lower ends the 6600-feet level. Three big ones were discovered at the headings of the Bukhtarma, and one in the Kimas Range of the South Altai. All are much smaller now than they were formerly.

THE Fauna of the Neocomian Belemnite Beds of Baluchistan is described (in the "Palæontologia Indica") by Dr. Fritz Noetling. Two plates suffice to illustrate the species, which include only *Gryphæa Oldhami* (n.sp.), and four well-known Neocomian Belemnites. A further contribution to the Palæontology of Baluchistan, by Dr. Noetling, is entitled "Fauna of the Upper Cretaceous (Maëstrichtien) Beds of the Mari Hills." As remarked by the author, the species described are of special interest, inasmuch as they shed quite a new light on the geographical distribution of the Upper Cretaceous fauna. Seventy-seven fossil forms have been obtained at present from the strata, and of these sixty-six have been described specifically —of the others only the genus could be determined. Twenty-three plates are devoted to their illustration. No less than twenty-four of the species have been identified with forms previously described, and these naturally are the more interesting. They include *Hemipneustes* (two sp.), *Ostrea acutirostris*, *Gryphea vesicularis*, *Pecten* (*Vola*) *quadricostata*, *Corbula harpa*, *Nautilus sublævigatus*, &c. The author concludes that the strata ("Hemipneustes beds") are of Upper Senonian age, and most probably represent the "Étage Maestrichtien." The fauna bears hardly any resemblance to that of similar age in southern India or northern Africa; it belongs rather to the European province of the Upper Cretaceous sea. This sea was most probably divided by a comparatively narrow land-barrier from the sea in which lived the Upper Cretaceous fauna of southern India, a view first expressed by Dr. W. T. Blanford.

THE Cephalopoda of the Lower Trias of the Himalayas are described by Dr. Carl Diener in a recent memoir of the Geological Survey of India ("Palæontologia Indica"). The fossils figured, in twenty-three plates, as in the above-mentioned monograph, are mostly Ammonites, together with a few species of Nautilus, and one Orthoceras. Among the forms described are *Prosphingites nala*, *Hedenstroemia Mojsisovici*, *Nannites hindostanus*, *Xenaspis* (*Vishnuites*) *Pralambha*, *Ophiceras Sakuntala*, *Koninckites Yudishthira*, *Kingites Varaha*, and *Lecanites sisupala*. The work bears evidence of great care, minute study, and research; but it seems a pity that generic or sub-generic names coined on a more uniform system should not be adopted, even for the sake of the palæontologist who confines his attention to the Order of "Ammonea," to which all the before-mentioned forms belong. Dr. Diener also describes the Permian fossils of the *Productus*-shales of Kumaon and Gurhwal. These shales are intimately connected with the lowest Triassic deposits in the Niti area of the Himalayas, and they rest on an eroded surface of Upper Carboniferous rocks; nevertheless, they contain species of *Productus* of late Carboniferous or Permian type. The fossils are figured in five plates, and they include the well-known European form *Athyris Royssii*.

THE Gasteropoda of the Trias of Halstatt form the subject of a well-illustrated and important monograph by Dr. E. Koken (*Abhandl. der K.K. geol. reichanstalt*, Band xvii., Wien). Twenty-three plates are devoted to the illustration of the fossils, and they include species of *Pleurotomaria*, *Murchisonia*, *Trochus*, *Natica*, *Chemnitzia*, and other genera; and multitudes of sub-genera (as most geologists would prefer to regard them), but the names of these, which are legion, can only be appreciated by the specialist.

RECENT researches on metallic lithium have shown that this metal cannot be distilled in either hydrogen or nitrogen gases, vigorous combination occurring in both cases. The metals of the alkaline earths would appear to behave similarly; so that if it should be necessary to heat these substances in an indifferent gas, argon or helium must be employed. In the current number of the *Comptes rendus*, M. Moissan shows that if pure calcium be heated in hydrogen, the metal takes fire and burns energetically, forming the hydride CaH_2, a transparent crystalline substance which is stable at a high temperature. It behaves as a strong reducing agent, and is violently decomposed by cold water, giving off one-seventh of its weight of pure hydrogen gas. It differs from the corresponding lithium hydride in that nitrogen is without action upon it at a red heat.

THE Cambridge University Press announce a series of monographs upon material obtained by Dr. Arthur Willey, Balfour Student of the University of Cambridge, from New Britain, the Loyalty Islands, and other islands of the South Pacific during the years 1895-97. The work, which will be illustrated, will embody the zoological results of the expedition, and will, it is expected, be completed in five or six parts. The first part (to be published in August) will contain the following contributions: (1) On the anatomy and development of *Peripatus novæ-brittanniæ*, by Dr. Arthur Willey; (2) on a little-known sea-snake from the South Pacific, by G. A. Boulenger; (3) account of the Phasmidæ with notes on the eggs, by D. Sharp; (4) *Metaprotella sandalensis*, n. sp., by Dr. Paul Mayer; (5) report on the Millipedes and Centipedes, by R. I. Pocock; (6) report on the Arachnida, by R. I. Pocock.

THE series of "Museum Hand-books" issued by the Manchester Museum has been added to by a paper on "The Nomenclature of the Seams of the Lancashire Lower Coal Measures," which was read before the Manchester Geological Society in January last by Mr. Herbert Bolton. Many students will doubtless be glad to have the paper in its present handy form.

FROM time to time we have noticed papers, chiefly of local interest, dealing with the Hereford earthquake of December 17, 1896. We understand that Dr. Davison's detailed report will shortly be published by Messrs. Cornish Bros., Birmingham, provided that a sufficient number of subscriptions be obtained to defray the cost of printing.

WE have received from Messrs. H. W. Cox, Ltd., their price list of induction coils and apparatus for producing X-rays. In it is to be found full particulars as to the prices and capabilities of the specialities of this firm.

THE current number of the *Journal* of the Society of Arts contains the first of the series of Cantor lectures, by Prof. Noel Hartley, F.R.S., on "The Thermo-Chemistry of the Bessemer Process."

THE additions to the Zoological Society's Gardens during the past week include two Vervet Monkeys (*Cercopithecus lalandii*) from Natal, presented by Mr. W. Champion; a Great Wallaroo (*Macropus robustus*) from South Australia, presented by Miss W. Jackson; two —— Hedgehogs (*Erinaceus*, sp. inc.) from North Africa, presented by Sir Harry Johnston, K.C.B.; a European Pond Tortoise (*Emys orbicularia*), European, presented by Mr. A. H. Cocks; an Algerian Tortoise (*Testudo ibera*) from Algeria, presented by Mr. G. H. Gude; a Sulphurous Snake (*Phrynonax sulphureus*), a Deadly Snake (*Lachesis atrox*), a Centipede from Trinidad, presented by Mr. R. R. Mole; a Lataste's Viper (*Vipera latasti*) from Algeria, presented by Mr. Carl Hagenbeck; two Yellowish Finches (*Sycalis luteola*) from Brazil, presented by Mr. F. L'hoest; an Arabian Baboon (*Cynocephalus hamadryas*) from North Africa, a Grey Parrot (*Psittacus erithacus*) from West Africa, a Swainson's Lorikeet (*Trichoglossus novæ-hollandiæ*), two Pennant's Parrakeets (*Platycercus elegans*) from Australia, a Thick-necked Tree Boa (*Epicrates cenchris*), a Corais Snake (*Coluber corais*) from Trinidad, deposited; a Giraffe (*Giraffa camelopardalis*, ♂) from Senegal, eight Lateral White-eyes (*Zosterops lateralis*) from New Zealand, two Indian Tantalus (*Pseudotantalus leucocephalus*) from India, two Spotted Pigeons (*Columba maculosa*), a Burmeister's Cariama (*Chunga burmeisteri*) from Argentina, four Wandering Tree Ducks (*Dendrocygna arcuata*) from the East Indies, purchased; a Puma (*Felis concolor*), two Barbary Wild Sheep (*Ovis tragelaphus*), a Burrhel Wild Sheep (*Ovis burrhel*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMETARY NEWS.—In the *Astronomische Nachrichten* (Nos. 3501 and 3504) we find the ephemeris for both of Perrine's comets, namely March 19 and June 14. The former, which is situated in the northern part of Auriga and is visible for the greater part of the night, is gradually receding from the earth and becoming faint. Its ephemeris for the present week is:—

12*h*. *Paris M.T.*

1898.	R.A. h. m. s.	Decl. ° ′ ″	Br.
July 16 ...	5 28 46	+53 48 47	
17 ...	30 46 ...	44 17 ...	0·08
18 ...	32 44 ...	39 48	
19 ...	34 40 ...	35 21	
20 ...	36 33 ...	30 55	
21 ...	5 38 25 ...	+53 26 32 ...	0·08

Perrine's comet, discovered on June 14, is, however, rapidly increasing in brightness and is getting near the sun, rendering observation somewhat difficult towards the end of this month. Its ephemeris for the week, as calculated by Dr. Berberich, is—

12*h*. *Berlin M.T.*

1898.	R.A. (app.) h. m. s.	Decl. (app.) ° ′	Br.
July 14 ...	6 8 45 ..	+44 38·7 ...	2·98
15 ...	13 7 ..	43 52·7	
16 ...	17 25 ...	43 5 6	
17 ...	21 40 ...	42 17·3 ...	3·36
18 ...	25 52 ...	41 27·8	
19 ...	30 0 ...	40 37·1	
20 ...	34 5 ...	39 45·4	
21 ..	6 38 7 ...	+38 52·3 ...	3·96

Wolf's comet, which is situated in Taurus, is gradually increasing in brightness and moving eastwards. This body will approach Mars very closely on July 19, their positions differing in R.A. and Declination by only 1·9m. and 0′·0 respectively, as computed by Herr Thræn. Its ephemeris is as follows:—

1898.	R.A. h. m. s.	Decl. ° ′	Br.
July 14 ...	3 38 1 ...	19 51·8 ...	2·2
15 ...	40 56 ...	48·5	
16 ...	43 50 ...	44·8	
17 ...	46 44 ...	40·9 ...	2·2
18 ...	49 37 ...	36·6	
19 ...	52 31 ...	32·1	
20 ...	55 23 ...	27·5	
21 ...	3 58 15 ...	+19 22·7 ...	2·3

Comet Giacobini, though moving rapidly northwards as regards declination, is becoming now a faint object, being one-half the brightness it was at the time of its discovery.

STARS HAVING PECULIAR SPECTRA.—In a recent *Harvard College Circular* (No. 32) Prof. Pickering publishes a list of stars the spectra of which are described as peculiar. Most of these have great southern declinations, so we give below a short list of the few that can be observed in these latitudes. The stars were all discovered by Mrs. Fleming in her regular examination of the Draper Memorial photographs.

Designation.	R.A. 1900. h. m.	Dec. 1900. ° ′	Magn.	Description.
−12 1500 ...	6 23·7 ...	−12 59 ...	7·7 ...	Type I. Hβ bright.
+ 5 1267 ...	6 25 2 ...	+ 5 57 ...	7·1 ...	,, ,, ,,
− 8 1467 ...	6 28·1 ...	− 8 48 ...	8·5 ...	Peculiar. Variable with small range.
+ 6 1309 ...	6 32·0 ...	+ 6 14 ...	6·5 ...	Type I. Hβ bright.
,, ,, ...	7 13·9 ...	−13 3 ...	,, ...	Type V. Gal. long. 195° 30′, lat. + 1° 11′.
−11 1941 ...	7 22·4 ...	−11 31 ..	8·9 ...	Peculiar. Variable.
− 4 3199 ...	11 59·6 ...	− 5 13 ...	8·7 ...	Type II. Variable.
− 8 5858 ...	22 16·5 ...	− 8 7 ...	8·5 ...	Type III. Hyd. lines bright? Variable.

Two other stars with great southerly declinations, A.G.C. 14145 and 14686, show spectra with bright and dark hydrogen lines. In the former Hβ and Hγ are variable. On June 2, 1893, they were bright and superposed on a broad dark band. On April 17, 1895, and March 17, 1896, these lines, like the other hydrogen lines, were dark. In the latter star the hydrogen lines were also variable. On May 20, 1892, Hβ, Hγ and Hδ were dark. On April 3, 1895, Hβ was bright, and on April 21, 1895, Hβ and Hγ were bright. Hζ and Hη were dark with the edge of greater wave-length apparently bright.

A careful study of the spectra of some of the bright southern stars has enabled Miss Cannon to increase the number of stars containing the additional hydrogen lines first seen in ζ Puppis. Thus in A.G.C. 17572, 3925, 4027, 4202 and 4544 are present and dark. In A.G.C. 8631 and 22763 the lines 4027, 4202 and 4544, and the bands 4633 and 4688 are present and bright. In the stars A.G.C. 10863, 22748 and 22843, the hydrogen lines 3925, 4027, 4202 and 4544 are present and dark, and the bands 4633 and 4688 are bright. In the last two mentioned stars, and also in A.G.C. 9311, 26 Canis Majoris, the band 4633 is described as being double.

THE CONSTANT OF ABERRATION AND STELLAR MAGNITUDES.—In determining the constant of aberration by stars of different magnitudes, using the well-known method of Talcott, Prof. Doberck finds (*Astr. Nachr.*, 3504) that the values decrease as the magnitudes decrease. Thus, using stars averaging 4·4 in magnitude, the value of the constant he obtained was 20″·639 ± 0″·075, with stars averaging 5·4 it was 20″·430 ± 0″·063, and with those of 6·4 magnitude the value was 20″·385 ± 0″·066. Prof. Doberck suggests that perhaps this fact may explain differences in the values obtained at different observatories, such differences being always in excess of their probable errors.

THE ECLIPSED AND UN-ECLIPSED SUN.—In the *Bulletin de la Société Astronomique de France* (for July), M. Deslandres gives an account of the methods he adopts in photographing the entire chromosphere of the sun. As this beautiful method has been previously published, we need only draw attention to the very fine phototypes which illustrate the magnificent results that he has so successfully obtained. *Knowledge* for the same month contains two reproductions from Prof. Campbell's negatives of the solar corona obtained in India this year.

Although these do not give us the details as seen by the unaided eye, or as photographed on a small scale, they serve to show the structure of the lower corona. It is difficult, however, for reproductions such as these to do justice to the original negatives, as much of the fine detail is lost in the process. Prof. Campbell, it will be remembered, was stationed at Jeur, and his chief instrument was a large photographic telescope of 5 inches aperture and 40 feet focal length, the instrument being fixed, and the photographic plate made to follow the sun.

THE PLANKTON OF LAKE MENDOTA.

THE natural history of small lakes has long offered a most promising field for research in an important department of biology, viz. the inter-relations of species of plants and animals in the struggle for existence, and the dependence of both upon the physical factors of their environment. As compared with the majority of land and sea areas, a small lake constitutes a relatively perfect "unit of environment," the different elements of which can be determined with an accuracy impossible in most other cases. It is on this account, we suppose, that the detailed study of lake plankton has rapidly gained so many votaries since the lines of quantitative investigation were laid down by Dr. Zacharias and his pupils. In America, especially, the investigation of lacustrine plankton has been taken up with zeal by a considerable army of workers, the vast network of lakes in the basin of the St. Lawrence and the upper reaches of the Mississippi providing unrivalled opportunities for the most diversified inquiries. The latest[1] contribution upon this subject is at least as interesting as its predecessors, and we propose here to give a short account of Prof. Birge's principal results.

Lake Mendota is a sheet of water 6 miles in length by 4 in width, of moderately uniform depth, varying from about 18 to 24 metres, and without any large affluent. During the winter the lake is usually frozen over for three or four months. In the present memoir Prof. Birge gives an account of the Crustacea of the plankton of this lake. He deals firstly with the seasonal and annual changes in the frequency of the Crustacean constituents of the fauna, and secondly with the horizontal and vertical distribution of the total Crustacean population and of the individual species. In each case he discusses the nature and influence of the various factors which operate in the production of the observed changes. Serial observations and collections were made during a period of two and a half years.

Neglecting isolated individuals, the Crustacean fauna of Lake Mendota consists of eight well-represented species, which may be grouped as (*a*) perennial and (*b*) periodic. The perennial group includes three species of Copepoda (*Diaptomus Oregonensis*, *Cyclops brevispinosus* and *C. Leuckartii*), and two species of Cladocera (*Daphnia hyalina* and *Chydorus sphæricus*). The periodic group consists entirely of Cladocera (viz. *Daphnia pulex*, *D. retrocurva*, and *Diaphanosoma brachyurum*).

Prof. Birge shows by an elaborate series of curves and figures that the Crustacean population undergoes a cycle of seasonal changes which is regularly repeated in successive years—three periods of increase alternating with three periods of decrease in the course of each year. The maxima occur in spring (May), midsummer (July), and autumn (September and October); the minima in winter (December to April), early summer (June or early July), and late summer (late July or August).

The spring maximum is by far the greatest, and is due mainly to the rapid and preponderating increase of *Cyclops brevispinosus*. The summer depression is due to a subsequent rapid decline in the numbers of this species. Renewed reproductive activity on the part of other perennial species leads to the midsummer maximum, which is succeeded by a slow decline, reaching a point of greatest depression towards the end of August. During this period of decline most of the periodic species are introduced, but their numbers do not, as a rule, compensate for the falling off in the number of the permanent species. In this respect Lake Mendota appears to be peculiar, for it often happens in other lakes that the periodic forms are the dominant members of the summer population. The September rise is caused chiefly by the multiplication of *Daphnia* of all species and of *Cyclops*. The rapidity of the subsequent decline to the winter minimum is dependent on a number of different conditions, such as the abundance of the periodic forms present, the rate of fall of temperature, storms, &c. It varies therefore in successive years. But while the absolute number of Crustacea present, and the rapidity of the seasonal changes themselves, vary considerably in successive years, it is undoubtedly an interesting fact, clearly established by Prof. Birge's researches, that the general character of the vicissitudes of the floating population of the lake is remarkably constant from year to year.

The principal factors which determine the numbers of Crustacea in different years are, according to Prof. Birge, (1) food supply, both quantity and quality, (2) temperature, and (3) competition. It would appear that of these factors, the temperature of the water exerts a greater control over the number of Crustacea than does the food, since the number of Crustacea falls off in autumn while food is still abundant. The influence of temperature is felt through its effects upon the reproductive powers of the Crustacea, increased warmth favouring rapid multiplication.

So far as the food supply of the Crustacea is concerned, Prof. Birge assures us that the actual quantity of microscopic plant-life in Lake Mendota is almost always in excess of the demands of the Crustacea. A scarcity of food is brought about by changes in the quality rather than in the quantity of the algæ present, since some forms are more available than others as food for particular species or stages of Copepods or Cladocera. For example, young Crustacea are quite unable to eat *Ceratium* on account of its large size and its hard shell; consequently the regular predominance of *Ceratium* in the late summer is one of the principal causes which brings about the annual decline in the number of Crustacea at this season of the year. The Cladoceran *Chydorus* remains scarce while diatoms or *Ceratium* are the predominant algæ, but abounds when the place of these algæ is taken by Schizophyceæ or *Anabæna*. In seasons when the inedible filaments of *Lyngbya* predominate, there is a marked reduction in the numbers of all Crustacea present, except *Diaptomus*, which manages to maintain its numbers by combining great locomotive powers with effective means of catching food.

Equally interesting is Prof. Birge's account of the vertical distribution of Crustacea in the lake at different seasons. In winter, corresponding with the homothermous condition of the water, the Crustacea are uniformly distributed; but in summer the formation of the "thermocline" (or boundary between the upper stratum of warm, and the lower stratum of cold water) leads to a distinct stratification of the lake into layers inhabited by different types. The layers undergo changes in thickness as the thermocline descends, and these changes affect the distribution of the Crustacea to a marked degree. Moreover the layer of cold water below the thermocline becomes largely exhausted of oxygen by the decomposition of dead plants and animals which sink into this stagnant zone; and it is on this account, rather than on account of the difference in temperature, that the layer below the thermocline becomes largely destitute of Crustacean life. Insect larvæ, however, such as *Corethra*, may nevertheless be found in considerable number below the thermocline, obviously because they can carry a stock of air in their breathing tubes.

Space will not admit of further references, but we have perhaps extracted enough from this excellent memoir to justify our opening remark that the careful study of lake plankton is well worth the expenditure of time and labour such as the author of the memoir before us has clearly devoted to it. W. G.

[1] "Plankton Studies on Lake Mendota. II. The Crustacea of the Plankton, July 1894–December 1896." By E. A. Birge, Ph.D., Sc.D., Professor of Zoology, University of Wisconsin. (*Trans. Wisconsin Acad. Sci.*, xi., 1897, pp. 274 to 448.)

DESTRUCTION OF THE FRENCH OBSERVATORY IN MADAGASCAR.

AN interesting account of the destruction of the French Observatory in Madagascar is contributed by M. E. Colin to a recent number of *Cosmos*.

In October 1895, after the rupture between the Governments of France and Madagascar, the colonists and missionaries of the former country were requested to leave Antanánarivo. The observatory of Ambohidempona, belonging to the French Catholic Mission, was entrusted to the care of the Prime Minister by the priest Mgr. Cazet, together with all the instruments. The two natives, who acted as computers, were instructed to continue the series of observations commenced in 1889. Matters went well and quietly for a time; but after about nine months had elapsed a rumour was circulated by an Indian, a British subject, to the effect that the French before leaving had

hidden a lot of war materials in the cellars of the observatory. After a thorough inspection an electric battery was found in the cellars. However, the absence of instruments of destruction did not allay the suspicions, especially as the story was told at the time the French soldiers were approaching Antanánarivo.

In August, the Madagascan Government sent M. Ramarosaona to make a complete search over the observatory. He found in the north tower six cases with the following inscription on them: "Produits chimiques et photographiques, Brewer Frères, Paris," and at once concluded that this was the ammunition, deciding that the two copper-mounted telescopes were the cannons, and he announced his discovery to the Prime Minister with much pride. The Prime Minister, however, knew that the instruments were really telescopes and not cannons, and expressed the wish to look through one. On seeing how clearly distant objects could be observed, he at once concluded that the instruments were used for watching the manœuvres of the French soldiers. All suspicious instruments and boxes were then taken to the palace; inspectors were frequently sent to the observatory to try and find the hidden war material, but to no effect.

Finally, in September an order was issued from the Queen that the inhabitants of the neighbouring villages were to take the instruments and furniture of the observatory to the college at Ambohipo, and to destroy the observatory, in order that the French, who were advancing on the town, should not find a single shelter. With all possible speed the two men in charge dismounted as many instruments as possible, and packed them ready for transport. The inhabitants, however, were already in the buildings breaking down windows and doors, so that many instruments were broken, and others disappeared. The meteorological observations were continued up to the last moment, and much credit is due to the two assistants, who were indefatigable in their efforts to save as much as possible.

Soon after the destruction of the observatory, of which only a few feet of the walls were left, the French arrived, and an engagement followed between them and the Madagascans; and the position of the latter became so bad that they had to escape to Antanánarivo, leaving behind them their cannons and ammunition, which were afterwards used by the French to bombard the palace.

The next day an inspection was made of the instruments at the college, but most of them were found to have been damaged in transport; so much so, that it was either a case of sending them to France to be mended, or of replacing them by new ones. Most of the other instruments that were taken were returned, and in some cases money was sent to compensate for damages.

The observatory had been at work for a little over six years, and during that time very important observations in meteorology, astronomy, magnetics and geodesy had been made. A subscription is now open for a new observatory and for the College of France at Antanánarivo, and in all probability the new observatory will be dedicated to the memory of the soldiers killed in Madagascar.

TIDES IN THE GULF AND RIVER ST. LAWRENCE.

WE have received a copy of a paper[1] read before the Royal Society of Canada, giving a general description of the results of the tidal observations which are being carried out in the St. Lawrence under the direction of the Canadian Government. In NATURE of April 22, 1897, an account was given as to the origin of this survey and the manner in which the operations were being conducted by Mr. Bell Dawson, the officer in charge of the work, under the direction of the Marine Department of the Dominion. One of the principal objects of the survey is to obtain, by means of self-recording tide-gauges, data for computing trustworthy tide-tables for the use of the navigation.

Tide-tables for two of the stations—Halifax and Quebec—have been issued for the last two years, and for St. John for the present year. Owing to the great variation of the rise and time of the tides at different parts of the Gulf, the pamphlet affords an extremely interesting study of tidal conditions. The regularity with which the tide proceeds to Quebec after it has once entered the mouth of the river is in great contrast with its character while in the Gulf.

The variation in the period of time which the tidal undulation occupies in crossing the open Gulf is twice as great as the variation in the period between Anticosti and Quebec, where the distance is double. The main set of the tide is along the deep-water channel of 100 fathoms, which continues up the river to the mouth of the Saguenay, 130 miles below Quebec. Along the 240 miles from St. Paul Island in Cabot Strait to Anticosti the tide is propagated at the rate of 43 miles an hour; whereas over the 450 miles from Anticosti to Quebec the rate is 82½ miles an hour. The variation in the range of the tide at different parts of the Gulf and river is even more varied. At some of the stations and in the Atlantic the range is from 4 to 5 feet. At Magdalen Island, in the middle of the Gulf, and also in parts of Northumberland Strait, the rise is almost imperceptible; while at Quebec and St. John the range is 26 and 32 feet. The wind is also found to have a material effect on the range and time of the tides, which are delayed or advanced from 1½ to 2 hours in some parts of the Gulf, according to its direction and force. The pamphlet is accompanied by a map of the Gulf and several tidal diagrams.

[1] "Character and Progress of the Tides in the Gulf and River St. Lawrence, as ascertained by Simultaneous Observations with Self-registering Tide-Gauges." By W. Bell Dawson, M.A., Assoc. M. Inst. C.E. (Ottawa: J. Durie and Son. London: Bernard Quaritch, 1897.)

THE DUKE OF DEVONSHIRE ON UNIVERSITY EXTENSION.

A CONFERENCE on University Extension was held in Cambridge last week, and on Thursday, the second day of the proceedings, the Duke of Devonshire presided, and delivered an address, portions of which, taken from the *Times* report, we reproduce:—

LOCAL EXTENSION COLLEGES.

The most important outcome of University extension during the last few years has been the light which it has thrown on the possibility of coordinating, where the circumstances are favourable, various forms of adult education. A few weeks ago his Royal Highness the Prince of Wales opened the new buildings of the University Extension College at Reading, and the presence of a large and distinguished body of representatives of the University of Oxford showed the deep interest taken by the sister University in this new institution, which is the direct result of the University extension movement aided and supported by municipal contributions, local generosity, and the subsidies of the neighbouring County Councils. Special local circumstances and the encouragement given by the Board of Agriculture have given a particular character to the organisation of the Reading College; but the essential fact in its rapid and striking growth has been the part played by the representatives of the University in organising and stimulating local effort and in educing out of various elements a new type of educational institution which associates municipal and local activity with University traditions and prestige. The successful growth of the Exeter University Extension College, which stands in a close relation to the University of Cambridge, and largely owes its increasing educational importance to that connection, is another proof the value of the services which the Universities are rendering to this branch of national education. The differences in the organisation of the Reading and Exeter Colleges show how wisely the methods of University extension work have been allowed to adapt themselves to the various conditions of distinct localities. The operations of the University syndicates have been happily marked by a judicious sense of the need for elasticity and freedom in educational organisation, coupled with an earnest care for high aims and for a high standing of teaching. A good beginning has also been made, in close connection with the University of Cambridge, at Colchester, where the new University Extension College will, it may be hoped, render excellent educational service to the municipality and surrounding neighbourhood.

A VINDICATION OF THE EXTENSION MOVEMENT.

Apart from providing guidance and stimulus in studies for those who would otherwise be deprived of them, the University Extension colleges and courses have proved of great advantage to many who desire to keep up their intellectual interests and to refresh their knowledge. Teachers in the various grades of schools, public and private, are among those who have had

reason to be grateful for the efforts made by the Universities to extend these educational opportunities. And stimulus given to the teachers reacts most beneficially upon the schools and pupils under their care. In educational as in all work it is necessary to have patience in awaiting results. The best results of an improved system of primary or secondary education are not those which are the first to show themselves. And in course of time it is probable that the number of persons desiring to avail themselves of opportunities for continuing their education within easy reach of their own homes and in the leisure hours of life will steadily increase. In the circumstances of our own country, where momentous issues of Imperial policy constantly turn upon the popular vote, it is of high importance that we should encourage by all the means in our power the growth of educational organisations which are providing dispassionate instruction in the duties of modern citizenship and diffusing that kind of knowledge which is necessary to the formation of a discriminating judgment. We do not believe that it is possible to indoctrinate busy people with a systematic knowledge of a dozen or fifteen subjects, to understand any one of which would require a preparatory knowledge of many years. But it is possible to aid intelligent students in every rank of life to gain the elements, the gist, of liberal culture, and to obtain that insight into the vast complexity of human affairs which is the salutary safeguard of intellectual modesty and the best protection against hurried and partial judgments. It is in training and providing the teachers for this great and difficult work of adult popular education that the Universities are rendering one of their highest services to the country. By equipping and sending out these intellectual missionaries, men of high purpose and of high culture, they are really guiding a national movement. Let us not imagine that great educational enterprises realise themselves mechanically—that the merely fortuitous combinations of County Councils or other public authorities will suffice to secure all that is wanted in the training of citizens for citizenship. Material aid of this kind is indispensable. It is a mark of local interest, it secures the further development of that local interest. But by itself it is insufficient. What is really indispensable is leadership. The man, or group of men, must be forthcoming who, in each centre of population, will take the lead and guide the various forces which are at our disposal into wisely-chosen channels of systematic effort. And it is one of the highest duties of the Universities to train and to send forth such men, to give them moral support in their difficult labours, and to attach to their enterprise the weight of academic prestige.

SOME CONDITIONS AFFECTING GEYSER ERUPTION.[1]

The Influence of Hydrostatic Pressure.

BOTH field observation and experiment have contributed to our present knowledge of the physical causes of geyser eruption. The natural history of geyser regions has been summarised by Weed (*School of Mines Quarterly*, New York, 1890, vol. xi. No. 4, p. 289), and the experimental work by Andreæ (*Neues Jahrbuch für Min. Geol. und Pal.*, 1893, Bd. ii. p. 1). Weed concludes that geysers occur only in acid volcanic rocks, and along natural drainage lines where meteoric waters accumulate for discharge. The source of heat is conceived to be escaping hot vapours from slowly cooling lavas, the only known geysers occurring in regions of recent volcanic activity. New geysers originate by the opening of new waterways along fissure planes in the rock, and such new orifices of overflow are continually forming to compensate the diminution in activity of older vents. The cause of the intermittent spouting which distinguishes the typical geyser was originally stated by Bunsen (Tyndall: "Heat as a Mode of Motion"; Appleton, 1888, p. 168); the boiling-point of water rises with increased pressure, hence decreases from the lower end of a water-filled tube upward. If water of a lower stratum, nearly, but not quite, at the boiling point, be lifted by the entrance of steam from below to a level of less pressure and lower boiling point, "the heat which it possesses is in excess of that necessary to make it boil. This excess of heat is instantly applied to the generation of steam: the column is lifted higher, and the water below is further relieved. More steam is generated, and from the middle downwards the mass suddenly bursts into ebullition. The water above, mixed with steam-clouds, is projected into the atmosphere. . . ." (Tyndall, *l.c.*, pp. 169–170).

The accuracy of Bunsen's theory was early confirmed by experiment; and the only mechanism necessary to produce geyser eruption is a tube filled with water, open above and heated below. Many further experiments have been made, however, with a view to explaining the variations observed in the period and interval of geyser eruptions, the relative amount of steam and water, and the effect of artificial stimulants in hastening eruption. Andreæ's experiments were directed toward the imitation of Peale's ("U.S. Geological Survey of the Territories, 1884," vol. xii. part 2) types, a classification based on the form of the basins and the relation of the periods of steam and water in the eruption. It is noteworthy that in most of these experiments, the apparatus recommended has an open basin above, which retains the water thrown out and permits it to *flow back* into the geyser tube.

In Peale's classification no mention is made of the nature of the geyser-spring during the interval of quiescence; in some cases there is continuous overflow or discharge, in others there is no overflow except during eruption. As it may be shown that this fact of the presence or absence of hydrostatic pressure at the geyser vent has an important bearing on the conditions of eruption, the writer would suggest a classification based on this very simple distinction; it is a singular fact that in the published descriptions of geysers this point has been frequently overlooked. If geyser waters represent meteoric drainage, they are affected by the laws of hydrostatic equilibrium. In such case a tube continuously overflowing is in a distinctly different class from one which throws off its waters to join the superficial drainage to the sea only during the period of its occasional or intermittent discharge. The first case is represented by such a geyser spring as "Excelsior," in the Yellowstone Park, a violently boiling cauldron in the hill slope, continually discharging vast volumes of water into the pond below, which in turn drains into the Firehole River; the Great Geyser of Iceland, and the Rotomahana Geyser (destroyed by the Tarawera eruption in 1886) of New Zealand are other types of the continually overflowing class. "Old Faithful" is the type of the second class; its waters may be seen in violent ebullition a few feet below the orifice of the vent, but overflow takes place only during eruption.

Any apparatus designed to imitate accurately either of these must be provided with a supply reservoir having subterranean connection with the geyser tube, by which water may siphon in to replace that discharged. Obviously this replacement takes place in nature: if the water, as asserted, is meteoric, and governed by the same laws that determine the loci of springs, the natural method of such replacement is by the action of gravity. In the case of Excelsior, this subterranean compensation is continuous; the effective head of water at the orifice of exit is fairly constant: in the case of Old Faithful the water-column is in equilibrium, and replacement occurs only after each eruption, when this equilibrium has been disturbed by the ejection of the column.

Experimental Demonstration.

A simple device to illustrate this process was described by G. Wiedemann (*Wiedemann's Annalen*, xv., 1882, p. 173) and mentioned by Andreæ (*l.c.*, p. 4). Wiedemann made no geological comparisons, the apparatus having been constructed for class-room illustration in physics; and most of the geological experimenters have used back-flow apparatus, without supply reservoirs. The essential parts of Wiedemann's apparatus are a water-column heated below, and a supply-tube entering this column and connecting it with a reservoir of cooler, superficial waters. When the excess of steam generated has thrown out the main column, cooler water filters in through the supply tube, and fills the geyser tube to the level of the reservoir. For effective and regularly repeated geyser eruptions, the reservoir level must be maintained a little below the height of the mouth of the geyser tube.

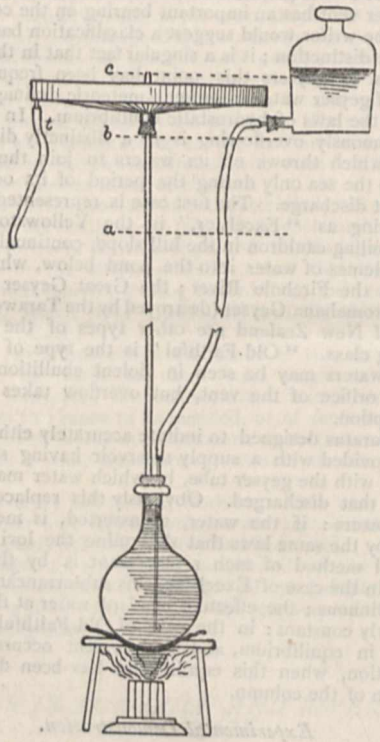
The accompanying figure illustrates Wiedemann's apparatus, as it has been used by the writer. The dimensions are as follows: capacity of each flask, one quart; length of main geyser tube 4 feet, diameter (outside) 5/16 inches; diameter of basin 2 feet; the bottom flares funnel-wise from the centre slightly, and is provided with a ¼-inch outlet tube *t*. The lower flask rests on a sheet of wire-netting over the flame of a

[1] By T. A. Jaggar, jun. (Abridged from the *American Journal of Science*, May.)

four- or six-tube Bunsen burner, and the basin and reservoir bottle are supported above on a wooden frame. The basin is of zinc, and may be raised or lowered so that the mouth of the geyser tube is flush with the bottom of the basin or raised above it as shown. The supply tube is recurved slightly at the bottom of the flask, so that the cold jets which siphon in from the reservoir will not be directed against the glass wall of the flask and break it. The reservoir bottle is connected by rubber tubing with the supply tube, so that the bottle may be freely raised or lowered to various levels indicated by the dotted lines *a*, *b* and *c*.

Experiment 1.—"*Old Faithful*" *Type.*

When heat is applied below, the reservoir level being at *a*, after about 14 minutes an eruption takes place, characterised by violent ebullition in the flask below, ejection of the water-column to a height of about 4 feet and of a mixture of steam and water for a few seconds longer; then the water-level in the reservoir is seen to fall suddenly, a stream is seen to be flowing into the lower flask from the curved tip of the supply-tube, the cooling of the base of the column is accompanied by condensation of steam and downward suction, the water rises



to level *a* again and a period of repose fellows. It should be noted that if the level of the cooler water in the reservoir is at *a*, the expanded warmer water in the geyser tube is somewhat above *a*. The process described is repeated at regular intervals of about 1½ minutes, the duration of each eruption being about 20 seconds. If the water in the reservoir be not renewed, it gradually becomes warmer and the intervals are of shorter duration. In this case, or with the reservoir level somewhat higher, as at *b*, and the geyser mouth raised above the basin, as shown in the figure, we have in miniature the conditions of "Old Faithful."

Experiment 2.—"*Excelsior*" *Type.*

The conditions are altered if we raise the reservoir level to the point shown in the figure, namely, just above the height of the geyser mouth (*c*). In such case there is continuous overflow of the hot water, and if the outlet tube *t* be left open, this will continually flow off; this over-flow must be constantly compensated at the supply tube by cooler water from the reservoir, so that the water in the flask never reaches the boiling point. If the water-level of the reservoir be maintained constant, this circulation will continue indefinitely, and in such case there will be a dome-shaped mass of hot water continually boiling up and overflowing at the geyser's mouth, as in the case of the Excelsior Geyser. Now at this stage, if the water-level in the reservoir be allowed to sink under the drain upon it, it may fall to a level six inches below *c*, without interrupting the continuous overflow; in other words, it may fall back to the *b* level, and yet the geyser will continue to act as a boiling spring, without entering into an eruptive phase. The cause of this is to be found in the differential expansion of the water noted above, and a convectional upflow which acts as a driving-power even against a reversed head, after overflow has once been established.[1] The overflow tube *t* may at this stage be led into the reservoir at the *b* level; this establishes a permanent circulation, the only loss being by evaporation. With the diminution in pressure if the level of the reservoir sinks, there is a tendency towards diminished inflow of cooler water at the supply-tube; this implies rise in temperature of the water at the base of the geyser-column, which tends to augment both volumetric expansion and convectional velocity. Hence there is here a critical point where the hydrothermal and hydrostatic forces are in very delicate equilibrium; if the reservoir is lowered an inch, the overflow decreases, ebullition takes place below, and an eruption of extraordinary violence takes place. The same effect is at once produced by placing the glass stopper in the reservoir bottle, and so checking the atmospheric pressure. When the mouth of the geyser-tube is flush with the bottom of the basin, an eruption may be induced by stopping the overflow tube *t* and permitting the water-level to rise in the basin, thus augmenting the pressure on the geyser-column. Eruptions once started will continue intermittently, if the hydrostatic conditions are maintained constant; if, however, the water-level of the reservoir again rises to a point where continuous overflow is possible at the geyser's mouth, the eruptions will cease and a hot-spring phase will follow.

Field Application of the Results of Experiment.

The two simple experiments described, when compared with the facts of nature, account for the most essential variations observed in the phenomena of geyser eruption. Both are methods of draining the reservoir—the one continuous, the other spasmodic. In the same way the geyser-springs drain off the superficial waters that accumulate from the abundant rainfall of the Yellowstone Plateau. The "Excelsior" cauldron is stated by Hague ("Geol. History of the Yellowstone National Park, *Transactions* Am. Inst. of Min. Eng., vol. xvi., 1888) to discharge constantly into the Firehole River 4400 gallons of boiling water per minute, "and there is no evidence that this amount has varied within the last two or three years (1887)." Weed (*l.c.*) has estimated, on the moderate assumption that one-third of the eruption-column of Old Faithful is water, that 3000 barrels are thrown off at each eruption. Here we have examples of continuous and spasmodic drainage methods, both sending their waters eventually to the Madison River, and re-supplied from a local source.

The geyser basins are topographic hollows, which supply vents for the meteoric waters accumulated in fissures of the decomposed rhyolite. These waters are heated by vapours escaping from the only partially cooled deeper lavas, and are escaping in the form of springs and geysers. In the springs the overflow is occasioned by hydrostatic pressure; in the geysers it is permitted by occasional violent discharge. The transition from one phase to the other may readily be induced, as shown in Experiment 2, by very slight changes in the hydrostatic pressure, *i.e.* variations in the mean level of ground-water (Grundwasserspiegel), or in the local head for any specific case. The head of water may be modified at either the source (supply reservoir) or the orifice of exit; head is diminished by lowering the reservoir through formation of new outlets or through decreased supply, or by building up a cone around the geyser tube. Conversely the head of water may be increased by excessive supply (rainfall) at the reservoir, by clogging of outlets, or by the water finding a new vent at a lower level.

Soaping Geysers.

It has long been known that by artificially confining the steam in small-mouthed geysers of high surface temperature, eruption may be brought about prematurely. In Iceland the Strokr is

[1] Such convection currents gain no momentum without overflow, hence at the *a* level convection played no essential part in the phenomena observed.

thus stimulated by dumping into the neck of the funnel large pieces of turf. In the Yellowstone district, it has been found that a small amount of soap or lye added to the geyser water will frequently hasten eruption. This is explained by Hague ("Soaping Geysers," *Trans. Amer. Inst. Min. Eng.*, vol. xvii., 1889, p. 546) as due to the increased viscosity of the liquid. "Viscosity must tend to the retention of steam within the basin and . . . explosive liberation must follow . . . Viscosity in these hot springs must also tend to the formation of bubbles and foam when the steam rises to the surface, and this in turn aids to bring about the explosive action, followed by a relief of pressure, and thus to hasten the final and more powerful display." Graham (*American Journal of Science*, January 1893, p. 54), as a result of experiments with an artificial geyser, agrees that viscosity has much to do with the confinement of steam, but questions the influence of bubbles and foam.

Experiment 3.—*The Effect of Soap.*

The apparatus was arranged to give regular eruptions as in Experiment 1, with the geyser-tube flush with the bottom of the basin and the water maintained about an inch deep in the basin without overflow. A small quantity of fine shavings of Ivory soap was thrown into the basin: these gradually dissolved and the milky solution was, after several eruptions, sucked into the flask below. The occasional steam-bubbles, which, in pure water, rise rapidly through the geyser-tube and escape at the surface during the intervals between eruptions, were less numerous, very small, and slower in their upward movement through the soapy solution; after five or six eruptions it became evident that the intervals were somewhat shorter (averaging 1 min. 20–30 seconds, instead of 1 min. 30–40 seconds), and the periods very noticeably longer (40–45 seconds, instead of 20 seconds). The ebullition in the flask was more violent than in the case of pure water, and columns of fine bubbles accumulated in the geyser-tube, only to be ejected with a violent sputter and give place to a new accumulation. It was evident that these accumulated myriads of tiny steam bubbles, confined within the tube and adhering to the walls of the tube, formed a cushion opposing considerable resistance to pressure from below.

After the diffusion of the soapy solution had become general, the reservoir (and consequently the geyser-column) was lowered to the level *a*; the intervals were at once shortened to an average of about one minute, in consequence of the rapid accumulation at the surface of the column and *within the tube* of the cushion of steam bubbles. So resistant is this cushion, that as it grows by the addition of new bubbles rising from below, the water column is actually depressed, down to the neck of the flask; here a point is reached where the frictional resistance of the froth cushion and the hydrostatic pressure are balanced. A further accumulation of steam forces up the column of foam, release of pressure permits the water to burst into violent ebullition, and an eruption takes place. From this it would appear that in those geysers where the tube is small, the growth of a cushion of steam soap-bubbles may play a very important part in accelerating the development of eruptive conditions.

Summary.

(1) Geysers and boiling springs are subject to the laws of hydrostatic pressure, in common with other springs.

(2) In a geyser-spring, overflow once established may be maintained by convection even against a reversed head; this leads to a critical point in the spring's mode of discharge.

(3) In this condition, with a constant source of heat, very slight changes in the local head are sufficient to induce a change in the nature of a geyser-spring's mode of action. Such change in the head may be caused by variation in rainfall, by building up a sinter cone by forcing new outlets at lower levels, or by clogging of old conduits.

(4) Geyser basins afford drainage channels for meteoric waters. The drainage takes place by either continuous overflow (hot springs) or spasmodic eruption (geysers). Both types, as well as transitional forms, are represented in the Yellowstone Park.

(5) In general, those geysers which are irregular in their eruptions have continuously overflowing vents; and the most regular geysers have confined waters, which overflow only during eruption. This is explained by the fact that the overflowing vents are under hydrostatic pressure, cooler water from lateral ducts is continually replacing that which flows off, and the ebullition necessary to produce eruption is thus prevented; eruption can only take place in the seasons of minimal inflow of cooler water, when the heat is in excess. Where the water is confined, on the other hand, and the supply of heat constant, cooler water rushes in only after each eruption, and a definite interval is required to bring it to the boiling point at the base of the column. Overflowing and confined springs should be distinguished in any description or classification of geysers.

(6) For the artificial stimulus of geyser eruption, an important effect of the bubble-forming alkalies, in small tubes, is the initial depression of the water-column by the growth of a confined cushion of minute steam bubbles. The release of pressure induced by the final ejection of the froth column causes eruption.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. MERRILL E. GATES has resigned the presidency of Amherst College.

THE following appointments are announced:—Dr. Charles Harrington to be assistant professor of hygiene, and Dr. Franz Pfaff to be instructor in pharmacology and physiological chemistry in Harvard University; Mr. R. A. Emerson to be assistant professor of horticulture at the University of Nebraska.

Science announces the following gifts for educational and scientific purposes:—50,000 dollars, from a source kept secret, to Amherst College, for an academic hall in honour of President Seelye; 20,000 dollars from Mr. H. L. Higginson, treasurer of the J. W. and Belinda Randall Charities Corporation of Monson, Mass., for the erection of a building, or as a permanent fund in connection with the University of Virginia. *Science* also states that two conditional gifts of 50,000 dollars, offered by Dr. D. K. Pearsons, have been secured by the colleges collecting the additional sums required. The endowment of Beloit College is thus increased by 200,000 dollars, and that of Mt. Holyoke College by 150,000 dollars.

THE *Calcutta Gazette* reports that representatives of La Martinière and Doveton Colleges have been appointed to consider the advisability or otherwise of the amalgamation of the two institutions. It appears that for many years these two colleges carried on with efficiency, and at a standard which compared favourably with corresponding schools in England, a large portion of the work of secondary education in Calcutta; but in recent years both La Martinière and Doveton, from causes over which they have had little control, have fallen behind in the race for up-to-date education. Owing to the keen competition of newly-opened hill schools, and the consequent loss of scholars and fees, also owing to heavy reduction in interest on the capital invested in Government securities, these colleges have not been able to keep pace with the requirements of modern education; while, on the other hand, they have been handicapped by heavy expenditure on the up-keep of extensive buildings and the payment of large sums in municipal rates and taxes. To remedy this state of affairs, which every year becomes more serious and pressing, the amalgamation of the two institutions has been suggested, in the hope that the result would be a considerable decrease in expenditure and a consequent gain in discipline and efficiency. It is fully recognised that there are difficulties in the way of the realisation of this scheme, but the Lieutenant-Governor sees no reason to believe them insurmountable. The aims and objects of the two institutions are almost identical, and it is hoped that petty differences of detail may not be allowed to stand in the way of arriving at a common understanding as to some broad scheme of amalgamation on lines which, by uniting the resources of the two colleges, will enable them to provide that standard of European education which it was the intention of their founders to give, but which under existing conditions it is practically impossible that either college alone can supply from its unaided resources.

SCIENTIFIC SERIALS.

THE *Mathematical Gazette*, issued under the auspices of the Mathematical Association, continues to maintain its interesting collection of notes and solutions to problems. The June number, recently issued, contains, in addition to these notes, papers by Mr. H. B. Billups on the connection between the inscribed and escribed circles of a triangle, and by Mr. R. F. Muirhead on relative motion. We should be glad to see more articles in the *Gazette* dealing with questions of general principle, rather than

with neat solutions of special problems; such subjects as the methods of teaching "Progressions" in Algebra might well afford interesting material for discussion.

THERE are several interesting papers in the *Journal of Botany* for June and July 1898.—A figure is given of the newest addition to our phanerogamic flora, *Stachys alpina*.—Mr. H. N. Dixon adds also a new moss (from Perthshire) to the British flora, *Plagiothecium Müllerianum*.—The "Recent Literature on Algæ," by Miss Ethel S. Barton, contributed from month to month, is a useful feature.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 4.—M. Wolf in the chair.—The Perpetual Secretary announced to the Academy the death of M. Ferdinand Cohn, Correspondant in the Botanical Section.—M. Van Tieghem added a short appreciation of the work of the late Prof. Cohn.—Numerical tables for facilitating the development by interpolation of the disturbance function, by M. O. Callandreau.—On the elastic equilibrium of a dam of masonry of triangular section, by M. Maurice Lévy.—On the maintenance of the motion of a pendulum without disturbance, by M. G. Lippmann. A series of instantaneous impulses is given to the pendulum, equal, but of contrary signs, the algebraic sum of the disturbance being equal to nothing. If the impulses are imparted as the pendulum swings through its position of equilibrium, each separate disturbance also becomes vanishingly small.—New observations on the Zeeman phenomenon, by MM. Henri Becquerel and H. Deslandres. In a very intense magnetic field (35,000 C.G.S. units) the bands of nitrogen and cyanogen (the "carbon spectrum") show no signs of doubling nor enlargement, although the rays of the air spectrum were, under the same conditions, strongly divided. Most of the rays examined undergo the division into triplets announced by M. Zeeman; certain rays, however ($\lambda = 3788{\cdot}01$, $\lambda = 3743{\cdot}45$ in the iron spectrum), split up into five. The distribution of these split-up rays, considered as a function of the wave length, shows signs of periodicity.—On the decomposition of water by chromous salts, and on the use of these salts for the absorption of oxygen, by M. Berthelot. Solutions of pure chromous chloride, free from all trace of free acid, give no trace of hydrogen gas, even after eleven years. In presence of a trace of hydrochloric acid, a minute quantity of hydrogen is evolved, which becomes very appreciable at 250° C. Hence acid solutions of chromous chloride cannot be used for the removal of oxygen in exact work, except in the case of hydrogen.—On the reaction between hydrogen gas and nitric acid, by M. Berthelot. Hydrogen is not absorbed by pure nitric acid, either in the cold or at 100°, even after twenty hours contact.—Preparation and properties of calcium hydride, by M. Henri Moissan (see p. 257).—On apple orchards on pasture land, by M. Ad. Chatin.—Notice on the life and work of M. Paul Serret, by M. Darboux.—Velocity of propagation of discontinuities in media at rest, by M. Paul Vieille.—The relation of metallic envelopes to the Hertzian oscillations, by M. Edouard Branly. The Hertzian oscillations are completely arrested, even by a very thin metallic envelope, if the latter is hermetically closed.—Mechanism of the discharge by the X-rays, by M. G. Sagnac.—Irreversible isothermal transformations of a mixture. Development of the conditional relation of equilibrium, by M. A. Ponsot.—On blue glass with chromium base, by M. André Duboin. Account of some experiments on the production of blue glass. The three glasses, $4{\cdot}5SiO_2.Al_2O_3.3BaO$, $4{\cdot}5SiO_2.Al_2O_3.1{\cdot}5CaO, 1{\cdot}5BaO$, and $28SiO_2.9B_2O_3.16BaO.3Al_2O_3$, coloured either with potassium bichromate or chromic oxide, give very fine blue glasses.—On copper selenate and its use in the preparation of selenic acid, by M. R. Metzner. Selenium is converted into selenious acid, and this oxidised in solution with chlorine. Copper oxide is added to this liquid, and evaporation gives fine prisms of copper selenate. Pure selenic acid is obtained from this by electrolysis.—Action of hydrogen upon potassium paratungstate, by M. L. A. Hallopeau. At a low temperature a mixture of the blue oxide with the dioxide of tungsten is obtained. At a higher temperature tungsten bronze ($K_2O.WO_3 + WO_2.WO_3$) is formed.—Volumetric analysis in alkaline solution by a ferrous reducing agent, by M. André Job. The reducing liquid is made by adding an acid solution of ferrous ammonium sulphate to an excess of sodium pyrophosphate. The excess of the iron salt can be exactly determined by standard iron solution. The solution in sodium pyrophosphate is colourless and remains so during the oxidation, and is as energetic in its reducing power as stannous chloride.—Volumetric analysis of a mixture of acid ethyl phosphates and phosphoric acid, by M. J. Cavalier.—On the estimation of phosphoric acid, by M. Henri Lasne. A discussion of the results given by M. Leo Vignon.—On the phenylurethanes of the ethers and nitriles of some oxy-acids, by M. E. Lambling. The urethanes described were the phenylurethanes of ethyl lactate, trichlorolactate, of trichlorolactic nitrile, glycollic ether and nitrile, phenyl glycollic ether and nitrile, and α- and β-ethyl oxybutrates.—On a new combination of acetylene with cuprous oxychloride, by M. R. Chavastelon. By the action of water upon the compound $Cu_2Cl_2.C_2H_2$, previously described, the substance $Cu_2O.Cu_2Cl_2.C_2H_2$ is obtained.—On ethane-pyrocatechol, by M. Ch. Moureu.—On the elimination of chlorides in rickets, by M. Œchsner de Coninck.—Absorption of liquids by textiles, by M. Leo Vignon. Textiles have a specific absorbing power for each liquid, the order of magnitude of this constant being silk, wool, and cotton.—The hematozoa of goitre, by M. E. Grosset. The parallelism between goitre and malaria is shown to be very well marked, and drawings are given of parasitic organisms, hematozoa, always present in the blood of recent cases of goitre.—On the functions of the pancreas in the Squalidæ, by M. Emile Yung.—On the development and structure of the larva of some cheilostomatous bryozoa, by M. Louis Calvet.

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