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THE GOLD COAST OF WESTERN AFRICA.

Nine Years on the Gold Coast. By the Rev. Dennis Kemp, late General Superintendent Wesleyan Missions, Gold Coast District. Pp. xv + 279. (London: Macmillan and Co., Ltd., 1898.)

The Gold Coast, Past and Present. By George Macdonald, late H.M. Director of Education for the Gold Coast Colony and Protectorate, &c. Pp. ix + 352. (London: Longmans, Green, and Co., 1898.)

THE Gold Coast of West Africa and the Loango Coast of South-west Africa are regions of especial interest to the ethnologist, for in these he is not, as he is in the majority of African regions, dependent on such fragments of information as he can gather from books written by travellers, who, to him, seem deliberately, malignly determined to give as little of the sort of information an ethnologist wants as possible; and only too frequently give that little in a manner that arouses suspicion in the mind of a cautious student.

However on the Gold Coast and the Loango Coast the ethnologist is not dependent on the traveller, having at his command a mass of information: concerning the first, in the works of seventeenth century writers, grandly supplemented in this century by those of Sir A. B. Ellis, Reindorf, Buchholtz and others; and concerning the second, in the works of the Roman Catholic missioners, who for some 200 years (1490–1670) held that region, and in this century these have been supplemented by the works of Adolf Bastian. Bastian, be it granted, is a jungle of information, lacking the brilliant lucidity of Ellis, and he has led many astray, from neither they, nor he, knowing that the fetish of the Loangoes and of the whole of the Fiot tribes is a school of fetish differing very markedly from other schools, and particularly from that of the tribes Ellis dealt with. Nevertheless, Bastian's work is monumental and exact.

The two books dealing with the Gold Coast that are now before us, in addltion to dealing with an interesting region, are especially valuable in being not the works of travellers spending busy, hurried, worried sojourns in the country, but of men resident there for considerable periods, and of a class thrown by their occupations into contact with the natives in ways which compel the acquisition of detailed knowledge concerning them.

We will take "Nine Years at the Gold Coast" first, both on account of its exceptional charm, and of its being the longest record of experience there which has been published since Cruickshank's great book.

All who know West Africa know that the Rev. Dennis Kemp is one of the great African missionaries, the man who by the power of his personality and his skill in organisation has made the Wesleyan Mission at the Gold Coast one of the most thriving and successful missions in Africa. It is necessary to mention this, because you get no hint of the fact directly from Mr. Kemp. The writer, a person who has, more than most men, come under adverse criticism from Mr. Kemp, well remembers his stating at the end of a warm argument, that he believed in three things—the Christian religion, the British constitution, and Mrs. Kemp, and this he displays amply in his book. At the same time, however, he displays quite unconsciously those qualities which have enabled him to do so much good service—a perfectly honest, simple, manly spirit; militant, but suffused with an abiding chivalry. This latter quality, indeed, he displays almost too much, particularly when it comes to the representatives of other missions. Any one acquainted with the state of affairs between the Roman Catholics and the Wesleyans on the Gold Coast, might have reasonably expected that at least the former mission would not receive a kindly reference; but, no, the Rev. Dennis Kemp arrives there by praising the nuns.

It must not, however, be surmised that Mr. Kemp is so uniformly benign as to be uninteresting to the unregenerate reader; far from it. He says some exceedingly harsh things about white traders and natives; but he also gives us, so frankly, many stories of native honour and kindly helpfulness, that they almost take the sting out of his general remarks on the character of the African. He says also:

"I do not remember meeting with a merchant who was altogether regardless of the welfare of the natives. I have met with many who have taken the deepest interest in their advancement."

So we may conjecture that even traders are not hopelessly bad in Mr. Kemp's eyes.

Mr. Kemp's criticism on native character is interesting, but we venture to think that on the whole it is too severe. Cowardice, theft, and lying, are certainly not its most prominent characteristics; but it must be remembered that the people of whom he is writing, the Tshi and Gâ speaking peoples, are people who have been subjected to the disintegrating effects of alien culture. To the north they have been played on by the Muhammedanised Berbers of the Western Sudan; to the south by Europeans of divers kinds. That after some 400 years of this sort of thing the Gold Coast native should be as good as he is, is a thing highly to his credit, and that he also preserves a quantity of excellent fetish is a subject of congratulation to the ethnologist.

The main interest of the book to us here is the amount of fetish information which it gives. Of course it does not give one-quarter as much as it might; for example, Mr. Kemp frequently mentions, with pleasure, the conversion of a fetish priest, and adds that these men confess their past impositions; but Mr. Kemp keeps those confessions to himself in an irritating manner. Still there is much highly interesting information given, and although "Nine Years at the Gold Coast" is naturally written from a missionary standpoint, this does not detract from its value, for never for one moment does Mr. Kemp's point of view lead him to telling half-truths; when he once mentions an incident, you have it whole with all its instructive, pathetic and amusing atmosphere. Never for one moment does he fail in his belief in the efficacy of mission work; never for one moment is he pessimistic about it, or anything else, though he will tell you things about the mission convert that a more nervous man would omit. Here, for example, is a delightful story.

"The account of a palaver between two Christians which is not given in the Annual Report, but it is furnished by the superintendent who assisted at the settlement of the matter. Vendors in the market-place are for the most part representatives of the gentler sex. It sometimes happens that two, or more, will engage in hot dispute. Their angry voices may be heard above the din of a thousand of their sex peacefully engaged in lawful trade. There was an occasion when, as at Philippi, Sisters Euodias and Syntyche were not 'of the same mind.' 'Softly, softly,' said one to the other, 'we are Christians; let us go to the minister.' To the minister they went. The elders of the church were summoned, and then for a time superfluous steam was allowed to escape in yells, shrieks, and frantic gesticulations. Care was taken that the disputants were separated by at least a table or a desk, so as to prevent the one doing bodily harm to the other. In a few moments comparative order was restored, the whole case stated, the opinions of the elders expressed, and the outside world knew nothing of what had occurred."

That this was a great improvement on the ordinary market-place row, there is no doubt; and the vision of the active elders interposing desks and tables between the ladies is very pleasing. Most cordially also do we recommend the account given by a colleague of Mr. Kemp's, of his experiences when taking over a district to all those who think missionaries lead a life of luxurious calm.

"The house had been deserted for some time. The white ants had attacked the floor, and dry rot had set in. When I put my foot on the floor, it went below; as also did three of the legs of the chair in which I attempted to sit. The roof served little purpose but for the study of astronomy. The house swarmed with mosquitoes, and the 'kotokrodu' in legions had taken up their abode in the missionary's bed-chamber. There were myriads of black ants conveying mud from my walls to make themselves a home in my room. On sweeping the floor by means of a plank placed crosswise, I removed buckets full of refuse, and in doing so disturbed swarms of beetles, many as big as miniature clock-weights. There were rats galore, and one snake. There was a vampire, which I succeeded in securing; it measured twelve inches by two. . . . Night came on, but it was made hideous by the unearthly yells of a pair of jackals. Dropping upon an old bed, which had seen no linen for a long time, I gathered the mosquito curtain around and essayed to sleep. But I had made my calculation without reckoning with the buzz of mosquitoes and the visits of rats. I had thought that the bed was for my use, but a mother of the rodent tribe and her family were there to dispute the point with me. As, however, might and right prevailed, my visitors took their revenge on my under-clothing, and left by the morning little but buttons, and, as the Irishman says, a bundle of holes stitched together."

Mr. Kemp's book also contains an interesting description of the Ashantee country and of many journeys made into the bush, and to the many towns of the Gold Coast, and it abounds with anecdotes of personal experience. All these together go to give us a vivid picture of life in that region, making the book at once interesting to those who need not go there, and highly useful to those who must.

The main interest of the remarks Mr. Kemp makes on fetish, lies in his bringing forward so prominently the influence of coincidence in supporting the belief in it. The series of stories and the accounts of charms given in the pages 100-133 bring this point out very clearly, and are well worthy of study. And although Mr. Kemp's definition of fetishism is not what one could call sympathetic, in the main it is exceedingly accurate.

"Unlike the religions of other heathen countries, fetishism is represented by very few idols. It is a most unusual thing to see a pagan adoring a block of wood or stone. No heathen temples adorn the land, no elaborate ritual accompanies the ceremonies, no sacred writings are found in which the traditional beliefs of the ancients might be expressed. The religion, which is one of the lowest forms in existence, consists mainly of superstitious beliefs—largely aided by witchcraft—which have been handed down from generation to generation by a succession of priests, who delude the credulous minds of the people by their fraudulent practices. Fetishism is essentially spirit-worship, but of so debasing and demoralising a type as to be hardly distinguishable from devil-worship. As stated in an earlier chapter, the heathens certainly acknowledge their belief in a Supreme Being, the Creator of all things, with Whom, however, it is quite impossible to hold any communication. They live in constant dread of subordinate deities, who are always prepared to visit with wrath the individual or nation at large. The residences of these beings are known as fetish."

This last statement is so correct, at any rate for West and South-west Africa, that the student of this great nature religion called fetishism should constantly bear it in mind, as it will save him from the errors that have arisen from customary use of this word.

The beautiful series of illustrations in this book also add greatly to its interest and value; and we sincerely hope before long Mr. Kemp may be induced to give us further information, particularly those confessions of the converted fetish priests.

We have not left sufficient space to do justice to Mr. MacDonald's book. It is, with the exception of having no index, a most excellent and careful arrangement of material, that in its scattered state is available only to those who have time and opportunity to work in libraries. Mr. MacDonald has devoted much time and care to placing this material at the service of people, who though not having ready access to libraries yet are in touch with the affairs to which authorities like Ellis, Bosman, and Reindorf refer. In addition to doing this, Mr. MacDonald gives an immense amount of thoroughly useful and practical local information, thereby making this book of his a thing no one dealing with the Gold Coast can dispense with. We wish he had given us more personal comment on affairs there; but the fact of his position and long residence on the Gold Coast makes us take what he chooses to quote without comment from other writers as things proved to be true by his experience. We should like to point out his statement on p. 4, where he says the Ivory Coast is "now known as French Guinea." This is not the case entirely. In 1890 the French possessions in West Africa were, for administrative purposes, divided into Senegal, the French Sudan, French Guinea with Dahomey. But the term French Guinea is customarily restricted to the Fouta Djallon region, and the region Mr. MacDonald refers to is still known as the Côte d'Ivoire. Mr. MacDonald's observations on the Kru tribes are also slightly misleading. It is a matter of regret that so many white men, with so many opportunities of studying these interesting tribes, do not do so; confining themselves to

superficial observation and stereotyped opinion. Certainly we should have hesitated to say:

"Of all the African tribes belonging to the West Coast, the Kru boy lends himself most readily to imitation of the European."

The resistance of these tribes to alien culture being exceedingly marked. Be it granted the Kru man will acquire all the European clothes he can while he is away on his term of service; the influence these things have on him is, as Dr. Wrenchen would say, "merely external," and the secret of his going ashore at "we country" on his return there, got up in the extraordinary costume he does, lies in his relations not being able to appropriate his personal property; his general property, the things he cannot wear, are their prey. The State organisation of the Kru tribes is a subject of especial interest. In all West African tribes the tendency of property to become family instead of individual is strongly marked; but, owing to the isolation the Krus have enjoyed in their own country, it is to be found in its most marked state amongst them. Mr. MacDonald also repeats the customary accusation against them of cowardice; but in this connection it should be remembered, firstly, that the Kru men met down the Coast away from their homes, as labourers and canoe-men, are of the class called by them *Kedibo*. They are the young men of the communities; they have in their own country little influence, or power, until they have amassed enough wealth to rise to the grade of the fighting-men, the *Sedibo* class, and when they do this they usually remain at home in "we country"; and the courage of the *Kediboes*, even as Mr. MacDonald, indeed, states, when it comes to surf work, is undoubted. Secondly, it must be remembered that all African fetish worshippers are apt to dislike being killed in any way far away from home; at home they do not so much object. The explanation is simple. Away in an alien land their funeral rites cannot be properly carried out, and therefore they stand the chance not only of losing their lives, but their souls into the bargain. We only mention this matter, however, in order to induce so able an observer as Mr. MacDonald to bring his attention to bear on the interesting subject of the Kru tribes, for information regarding them is of high ethnological importance. M. H. K.

A HERPETOLOGY OF EGYPT.

Zoology of Egypt: Volume First, Reptilia and Batrachia. By John Anderson, M.D., LL.D., F.R.S. Pp. lxv + 371; 59 pls. (London: Quaritch, 1898.)

WHEN, some six years ago, Dr. Anderson undertook the investigation which has resulted in the noble work now published, our knowledge of the herpetological fauna of Egypt was very meagre indeed, and could not compare with that of the neighbouring countries such as Tunisia, Algeria, and Syria. A list of the reptiles and batrachians of Egypt showed an imposing array of species, many of which now prove to be merely nominal, but these were represented in museums by a small number of specimens, few of which bore indications of exact localities. In fact, such material as then existed was quite inadequate for a study of the distribution as required by modern zoology, and the most important subject of variations and delimitation of species could not be attacked.

The author's first task was therefore the bringing together of a large number of specimens, from as many parts of the country as possible, and this was carried out by him with extraordinary energy during successive visits to Egypt in the winters 1892 to 1895, his personal investigations extending even to Suakim, beyond the limits of Egypt proper. Not only did Dr. Anderson himself and with the help of natives succeed in collecting a very large series of specimens, many of which were brought home alive and could be sketched in natural colours and attitudes, but he was also fortunate enough to enlist the co-operation of many residents and visitors interested in natural history matters; the result being the splendid collection the bulk of which has been presented to the British Museum, a second, nearly complete set having been reserved for the Museum of the Egyptian Government School of Medicine at Cairo.

The work comprises not merely an account of all the reptiles and batrachians of Egypt proper, but also includes those that are known to occur on both sides of the Nile as far south as Wadi Halfa, to which the species met with in the district of Suakim, on the littoral of the Red Sea, are added. The few species that have been accorded from the Nile Valley as far south as Khartum, Kordofan, and Sennaar, are incidentally noticed.

Egypt forms part of a zoological sub-region, extending from the western confines of the Sahara to the desert tracts of North-western India, combining features of the two regions to which it is transitional, viz. the Palæarctic and the Æthiopian, with an endemic element specially adapted to desert-life. One of its striking features is its poverty in batrachians, the valley of the Nile from Khartum to the Delta possessing only three species of the tailless order, one of which has a wide distribution in Europe and Asia, the two others being found over nearly the whole of Africa south of the Sahara. Tailed batrachians, represented in the British Museum by some undetermined Salamandrine larvæ stated to have been collected at Ramleh, near Alexandria, have escaped Dr. Anderson's diligent search in the Mediterranean littoral. The reptiles are represented, within the geographical limits adopted in this work, by one crocodile, two chelonians, forty-two lizards, three chameleons, and twenty-eight snakes, numbers not above those of previous estimates, the additions made by the author being counterbalanced by the relegation to synonymy or the degradation to varietal rank of many a form looked upon by previous herpetologists as a species.

Of the two categories of systematists suggestively if inelegantly designated as "lumpers" and "splitters," Dr. Anderson must unhesitatingly be classed among the former. Although, we think, he occasionally goes a little too far, as when he hints at the possible specific identity of *Chamaeleon calcarifer* and *Ch. calyptratus*, *Acanthodactylus savignyi* and *A. pardalis*, *Echis carinatus* and *E. coloratus*, his treatment of the difficult subject of species commends itself to the philosophical naturalist as affording a much clearer insight into the problems of distribution and variation than could be obtained with the opposite system so much in vogue at

the present day. As examples we would point especially to his masterly accounts of *Ptyodactylus hasselquistii* and *Chalcides ocellatus*, which may be recommended for study to any who should still doubt the derivation of what are called species, or who, unable to devote themselves to original investigation of this kind, and influenced by statements of ignorant or prejudiced writers, persist in looking upon species as definite units in nature. In these examples we see how forms that are so different in their extremes, in size, scaling, and coloration combined, that one would unreservedly refer them to distinct species, are connected by such insensible gradations that it is with the greatest difficulty, and only by drawing arbitrary limits, that we are able to break up the series into a number of varieties; and how these chains of varieties correspond with the direction of definite lines of geographical distribution. In order to render the degree of individual variations more readily intelligible, long lists of measurements and tabulations of details of lepidosis are appended; these tables will prove of lasting value, from the care and completeness with which they have been drawn up.

It is only to be regretted that this exhaustive treatment of variations outside the limited range of Egypt has not been carried out through the whole work, as it would have yielded highly interesting results in the case of *Latastia longicaudata*, *Eumeces schneideri*, *Mabuia quinquetaeniata*, *Naia nigricollis*, and *Bufo regularis*. In fact, a little inconsistency in the general plan—some families being characterised whilst others are not—together with the omission of anatomical details which an author so well qualified to deal with these matters might have been expected to furnish, are among the few defects we notice in this admirable work.

The coloured plates, forty in number, mostly the work of Mr. P. J. Smit, equal, if some do not even surpass, the best that have ever been published of a group of animals particularly difficult to depict in life-like attitudes. We would specially commend, as high examples of artistic skill combined with scrupulous attention to details, pls. xiv. (*Uromastix aegyptius*), xxix. (*Chamaeleon vulgaris*), and xxxviii. (*Zamenis diadema*). Numerous black plates and figures in the text, drawn by Messrs. J. Green, Smit, and Groenvold, complete the illustrations, one specimen at least of every species known from the area dealt with being represented.

The introduction, dealing with the physical features of the region, is illustrated by a series of exceedingly beautiful photographs in electrotype, as well as by a map showing all the localities whence the specimens described were obtained.

Appearing at the moment when the whole nation is rejoicing over the re-establishment of Anglo-Egyptian rule beyond the limits of Egypt proper, this first instalment of a work on a fauna too much neglected since the days of the famous French expedition, will be especially welcome. It is therefore to be regretted, in view of the increased interest which will no doubt henceforth be taken in the natural history of Egypt, that the small number of the issue—100 copies only—will render the circulation of the book more limited than it deserves.

G. A. BOULENGER.

A BOOK WITH TWO NAMES.

Quick and Easy Methods of Calculating. A Simple Explanation of the Theory and Use of the Slide-Rule, Logarithms, &c. With numerous Examples worked out by Robert Gordon Blaine, M.E., Assoc.M.Inst.C.E., &c. (London: E. and F. N. Spon, Ltd. New York: Spon and Chamberlain, 1898.)

THE author makes his title, "Quick and Easy Methods of Calculating"—at least, that is all that is in large print on the title-page; but the binder calls it, on the outside of the book, "The Slide-Rule." The binder is right. The author gives a very short account of some methods of shortened arithmetic, in which he points out that it is unnecessary to work out the results of an observation with very great or unlimited accuracy when the observation itself is subject to well-known possible errors. He might have traced the connection between the desired accuracy of the arithmetic and the probable accuracy of the observation as dependant on its form, but he has not. There is a simple non-algebraical and very clear explanation of logarithms; then the real object of the book, an explanation of the slide-rule, follows. As in all explanations of the slide-rule that are published, however clear and obvious they may be to the user of the slide-rule, there is, of necessity perhaps, such an amount of detail and of rule as to possibly scare any would-be user of this invaluable instrument with the fear that he could not hope to remember it all. The writer of this notice has always felt that this difficulty can only be overcome by half an hour's personal explanation, in which case a book becomes unnecessary; however, for those who cannot meet with this personal assistance, the little book before us is clear, logical and accurate. A great number of examples, mainly derived from the engineering laboratory, are given, which serve both to show the great scope of the slide-rule and as exercises in its use.

By way of criticism, the writer would point out that to find cube roots it is preferable to use the slide inverted to set 1 on C against the cube on A, and find at what part of B and D identical readings face each other. Any reading except 1 can be found twice on A, and three places on B and D can be found for the cube roots of *n* 10*n* and 100*n*. The rule that the writer has always given in order to know where to read is as follows: If the cube has 1 (4, 7, &c.) digits the cube root will be found on D to the left of the left possible setting on A. If it has 2 (5, 8, &c.) digits the cube root will be found on D between the possible settings on A, and if 3 (6, 9, &c.) it will be found on D to the right of the right setting on A. This very simple rule has the advantage of never failing. Unfortunately the rule, as given by the author for the less convenient method with the slide not inverted, does not answer, except by chance, for the example he himself gives to illustrate it; for, according to this rule, $\sqrt[3]{638} = 8{\cdot}6 +$ (as given without the + by the author) or $= 1{\cdot}855$, but this is really $= \sqrt[3]{6{\cdot}38}$.

The writer has always felt that though rules for the number of digits may be worth formulating, they are not worth using or remembering; also that the memory is needlessly taxed by any system of instruction such as is

given in the book under notice, even though the principles are perfectly explained, where every different operation has the necessary setting of the rule explained or expressed by a diagram as a different setting or operation. If once the common rule applying to all logarithmically divided scales, whether of numbers, their powers, or of trigonometrical functions, whether ascending together or some inverted, is made clear, the sixth or slide-rule sense has a chance of being developed, and then there is no occasion to remember rules any more.

The author does not mention even the existence of a P line in some rules, which make calculation with fractional indices, or indeed indices of any magnitude as quick and direct as simple proportion, nor does he refer to Lanchester's radial cursor, which enables the slide-rule to be employed for calculations on heat engines and thermodynamics generally so that any adiabatic has its coordinates numerically presented, and even entropy is simply presented.

The quick and easy methods of calculating title is belied by there being no mention of any arithmometer.

C. V. B.

TECHNICAL BACTERIOLOGY.

Manual of Bacteriological Technique and Special Bacteriology. By Thomas Bowhill, F.R.C.V.S, F.R.P.S. Pp. xii + 284. (Edinburgh: Oliver & Boyd, 1899.)

THE scope of this manual may be gathered from the following brief summary of its contents:—Introduction; classification and morphology of bacteria; methods of sterilisation. Part i. Principles of bacteriological technique. Part ii. The preparation of nutrient media, and methods of cultivating bacteria. Part iii. Special bacteriology. Part iv. Mould fungi. Part v. Yeast fungi. Part vi. Protozoa or animal parasites.

The first eighty-six pages deal with bacteriological technique, and the author is to be congratulated on having placed the subject before his readers in a clear and concise manner, and in such a way as greatly to facilitate reference. Moreover, there is much that is new, or comparatively new, in this portion of the manual: *e.g.* method for inoculating rabbits for the diagnosis of rabies; Bowhill's method of staining flagella and bacteria simultaneously with orcëin; Roth's method of examining butter for tubercle bacilli; Neisser's method for the differential diagnosis of diphtheria bacillus in cover-glass specimens; points to be observed in describing an organism; inoculation of animals (subcutaneous, intravenous, into the lymphatics, into the serous cavities, &c.), observation of animals after inoculation, and post-mortem examination of animals.

The methods of examining air, water and earth are not treated as fully as might be wished. In examining soil, Fraenkel's method only is described. Fraenkel advocates the direct mixture of the soil with the nutrient gelatin. But the number of bacteria per gramme of surface soil is over one million. Hence to obtain separate colonies it is evident that either an almost imponderable fragment of soil must be used, or else an exceedingly large amount of nutrient material. There can be little doubt that the only practical method is to dilute the soil very largely with sterile water, and to make cultivations from the resulting mixture of soil and water.

Elsner's method for separating *B. coli* and *B. typhi abdominalis* is given, but the phenol-gelatin method, which many observers find more useful, is not described in this section of the work. In Part iii., however, reference is made to the method of separating the typhoid bacillus by carbolising the water, and incubating it with an equal part of sterilised peptone-salt solution, and thereafter making Elsner potato-gelatin plate-cultures. No description appears to be given of the method of filtering large quantities of water through a sterile Pasteur filter, brushing the surface of the filter with a sterilised brush into a few cubic centimetres of sterile water, and from the filter brushing suspension of bacteria and water, making *surface* plate-cultures in phenol gelatin.

The terminology adopted as regards the number and arrangement of the flagella of bacteria, which, as the author states, is borrowed from that applied to the Protozoa, is open to some criticism, and is hardly to be recommended.

The second and most important section of this manual deals with Schizomycetes, Blastomycetes, Hyphomycetes, and Protozoa.

It might be anticipated that a veterinary surgeon of Mr. Bowhill's reputation would give an account of some of the diseases caused by micro-organisms which affect the lower animals, and which are either not described at all, or are described in an imperfect manner in the ordinary text-books of bacteriology. Nor is this hope in vain, for the author writes lucidly and with all the authority of an expert about such diseases as swine fever, swine plague, swine erysipelas, pleuro-pneumonia contagiosa bovis, broncho-pneumonia bovis, grouse disease, &c. Moreover, glanders, diphtheria and tuberculosis, as they affect man and animals, are ably dealt with.

It is to be regretted that the author has given no description of *B. enteritidis sporogenes* (Klein), especially when it is considered that the spores of this anærobic micro-organism are found in the excreta of some of the lower animals, and that it appears to be causally related to acute diarrhœa in man. As the author is well up to date in nearly all respects, we hope to find this omission remedied in a future edition. That a new edition will soon be called for need not be doubted, as there is certain to be a large demand for a work of such sterling merit as this one undoubtedly is.

In the concluding portion of the book—Part vi., Protozoa—an excellent account is given of Texas cattle fever, plasmodium malariæ, &c.

We cannot give unstinted praise to the illustrations. Some, indeed, are very good, but many of the photo-micrographs are disappointing. However much we may welcome the author's orcëin method of simultaneously staining bacteria and their flagella as an aid to the differential diagnosis of bacteria, we cannot, to judge by the results, regard it as a good method where reproduction is aimed at. The author represents *B. coli communis* as multi-flagellated. The true *B. coli communis* has only one to three flagella.

While we have ventured to indulge in a few possibly adverse criticisms, we are careful to conclude with the

remark, namely, that no student, or even expert, not only in veterinary but also in medical and sanitary science, can afford to be without a copy of this excellent manual.

The type, paper, and binding, reflect great credit on the publishers. A. C. HOUSTON.

OUR BOOK SHELF.

Elementary Botany. By G. F. Atkinson, Ph.B. Professor of Botany in Cornell University. Pp. xxiii + 444. (New York: Henry Holt and Co., 1898.)

THIS is one of the best little books of its kind it has been our lot to look through for a long time. Pleasantly written, admirably printed and illustrated, it forms an excellent introduction to the study of the science of botany, and Prof. Atkinson is to be congratulated on the way which he has fulfilled the task he has set himself.

The book opens with a general account of a plant-cell and protoplasm, and the student is led through a simple course of vegetable physiology to investigate the ways in which plants live, move, and have their being. This method of beginning with physiology is novel, and there is a great deal to be said for it. It is calculated to arouse the interest which in the minds of all inquiring people, be they children or adults, always accompanies experiment. Prof. Atkinson has wisely limited his selection of experiments to those which require apparatus of only the simplest kind, but they are for the most part experiments which give an insight into the marvellous organisation and concomitant functional complexity which are characteristic of plant-life in general.

Then there follows an elementary account of the main groups of the vegetable kingdom, illustrated by well-chosen types. But the author by no means limits himself merely to these, and the connections and relationships of the different groups are clearly indicated. The chapters on Gymnosperms, which include a good account of the occurrence of antherozoids in Gingko and in the Cycads, are especially good.

The chapters on the general morphology of the flowering plant are perhaps rather advanced, and it might be questioned whether a little more attention to external morphology might not be desirable. The part of the book specially dealing with natural orders strikes us as the least attractive part of the book; but also it is far the most difficult, within narrow limits of space, to render either interesting or educationally valuable. Possibly in a future edition of the work the author may see fit to expand this part by the inclusion of more indications of the facies of, as well as of the trend of differentiation in, the different natural orders, even if the characters of biological interest have to be omitted.

The latter class of characters (biological) are, however, specially treated in the division on Ecology. In this part of the book the author has brought together, in addition to well-known examples, the fruits of his own observation in a country in which such research cannot but yield fruitful results. And the advanced, as well as the elementary, student will find much that is new and interesting in these last chapters. Of course the treatment is brief, but it is useful; the figures and many (not, however, all) of the illustrative photographs from nature are quite admirable.

From the above brief sketch it will be seen that the book is one which thoroughly deserves to be commended as calculated to attract instead of (as is too often the case) repelling the beginner. J. B. F.

Animals of To-day, their Life and Conversation. By C. J. Cornish. Pp. xii + 319. (London: Seeley and Co., Ltd., 1898.)

MR. CORNISH is such a bright and entertaining writer, and has also the art of looking at well-worn subjects from such new points of view, that the republication of this series of articles from the *Spectator* may be welcomed by the zoologist as well as by the general reader. The author, it need scarcely be said, makes no pretence to study animals from a purely scientific or systematic standpoint; and regards the various domesticated breeds as meriting fully as much attention as their wild relatives. The adaptation of animals to their surroundings, the manner in which they exist under what appear to us unfavourable conditions, their speed, their antipathies, their susceptibility to human diseases, and their mental capacities and disabilities, form, indeed, some of his favourite subjects. But he also gives dissertations on the beauty and suitability to their uses of several domesticated breeds; while his chapters on acclimatisation, game-preservation, and, above all, on the terrible devastation inflicted on big game by "skin-hunters," are of almost absorbing interest.

In the commercial aspect of the subject, Mr. Cornish shows that while myriads of South African animals have been recklessly exterminated for the sake of their skins, yet that in Australia, where the marsupials are killed off in thousands from necessity, their valuable furs are for the most part wasted. And here it may be mentioned that, in referring to the commercial quotations of South African skins, the author makes merry at the inclusion of those of the "quagga," on the ground that the animal so-named is now extinct; but he ought to have known that at the Cape this title is universally applied to Burchell's zebra.

As beasts of burden for routes like that to the Klondike, the author speaks enthusiastically of the reindeer and Bactrian camel. Of the latter animal he observes that Englishmen have no practical experience; but if he had read the records of the second Yarkand expedition, he might have somewhat modified this statement. Wider reading might, indeed, in several cases have been an advantage to the author. For instance, in the chapter on "Thirsty Animals" he is very sceptical as to the power of any mammals to exist for a length of time without access to water; suggesting that the well-known instance of the giraffes in the Kalahari may be due to the presence of undiscovered sources of water in the interior of that desert. Had he been acquainted with Mr. W. T. Blanford's observations on the existence of certain Indian mammals in waterless districts, his scepticism might have been removed. Again, in another place, he is under the impression that wild dogs (*Cyon*) are nearer to domestic dogs than are wolves and jackals.

Such slight blemishes detract, however, but little from a very entertaining and instructive volume. Had we more writers of Mr. Cornish's stamp, the popularity of zoology, great as it undoubtedly is, would probably be largely augmented; and his present work can scarcely fail to increase his reputation as a successful writer. R. L.

Text-book of Algebra. By G. E. Fisher, M.A., Ph.D. and I. J. Schwatt, Ph.D. Part I. Pp. xiv + 684 (Philadelphia: Fisher and Schwatt, 1898.)

ON the whole this is a sound and instructive book. In the chapters on first principles the distinction between signs of operation and signs of quality has been very properly emphasised by a special notation, instead of being ignored; the treatment of systems of equations is excellent; and that of surds is much better than usual, although exception might be taken to some of the notation, and the existence of $\sqrt{2}$ as a definite number cannot be proved (as the authors seem to think) by considering the diagonal of a unit square. The book is rather unequally written, and errors sometimes occur which contrast curiously with the accuracy which generally prevails. Thus in the proof of the remainder theorem the same symbol Q is used for two entirely different things; it is assumed without proof that if r is a proper fraction r^m be-

comes infinitesimal as n increases indefinitely; and it should have been stated explicitly that i is a *definite* symbol obeying the law $i^2 = -1$, together with the usual laws of operation, and that if a is positive $\sqrt{-a}$ is understood to mean $\sqrt{a} \odot i$. If these last precautions are not taken, it cannot be proved, for instance, that $\sqrt{-a} \times \sqrt{-b} = -\sqrt{ab}$, and, in fact, the authors' treatment of this identity is defective. Then such problems as "factor $a + b$" are perfectly unmeaning, especially after chapters on surds and complex numbers; probably the answer intended is $(\sqrt{a} + i\sqrt{b})\,(\sqrt{a} - i\sqrt{b})$, but any number of others might be constructed, for instance $(\sqrt{a} + \sqrt{b} + \sqrt[4]{4ab})\,(\sqrt{a} + \sqrt{b} - \sqrt[4]{4ab})$, and so on. It ought to be unnecessary to say that all questions on factors should be put in a perfectly definite way.

It is a pity that the elementary theory of graphs has not been included; every teacher who has tried the experiment must have realised the value of plotting off the graphs of even the simplest functions such as x, x^2, $x/(1-x)$, and so on. Another remarkable fact is that not a single word is said about partial fractions: this is a serious omission, and, in fact, a whole chapter on rational functions might be added with advantage.

This volume ends with a chapter on the binomial theorem for a positive integral exponent. The examples are very numerous, and appear to be well graded: they are intended to provide teachers with alternative sets for different years. The student should on no account try to work them out *seriatim*. G. B. M.

Distribution de l'énergie par courants polyphasés. By J. Rodet. Pp. 338. (Paris: Gauthier-Villars, 1898.)

THE present work is perhaps, in point of thoroughness of treatment, the best on this subject we have yet seen. It is written, not as an introduction to a hitherto unknown subject, but as an account of a well-established branch of engineering.

In this country, the comparative absence of water-power near our industrial centres, and the resulting small demand for long-distance power-transmission, has led to a relative indifference to this important subject. What limited field for such transmissions does exist, seems at present to arise rather from the vastness of our towns, than from the existence of available water-power.

The economy in electrical transmissions of energy, which accompanies the employment of high-pressure currents, has led to the use of the readily-transformed alternating current. And while, as M. Rodet remarks, electric lighting can be carried out equally well with single-phase currents as with polyphase, yet, for purposes of motive power, the absence of a good motor to run on single-phase circuits, and the excellence of the rotary field motor, necessitates the use of polyphase currents by which alone the rotary magnetic field can be produced.

Starting with an historical summary, M. Rodet deals successively with generator, line, and motor. While keeping the essentially practical aspect of his subject in view, and citing from time to time, by way of illustration, the conditions of actual installations, the author, nevertheless, does not hesitate to launch into ample theoretical investigations where he deems these called for. At the conclusion of the main part, a short but interesting chapter on meters for polyphase currents is given.

Of more general interest, however, are the descriptions of installations. These form a most interesting conclusion to the work. We observe that just one quarter of the examples selected by the author as types for description are two-phase transmissions; the rest are three-phase installations, and these include several of importance in south-west France.

The illustrations are for the most part simple and clear. English readers will feel the lack of an alphabetical index, and would prefer to have titles to the illustrations. The work should, however, prove of great value to engineers who wish to make a special study of polyphase current machinery. D. K. M.

My Horse; My Love. By Sarah Buckman-Linard. Pp. xii + 227. (London: T. Fisher Unwin, 1898.)

IT is a little difficult to classify Mrs. Buckman-Linard's book. It is not a treatise, nor a text-book, nor a story. It is written in a conversational style not always easily followed. Here is a sentence which demands exceptional powers of perception:—"In some the odour is perceptible to themselves only, while in others it is such a powerful means of defence as to make the pursuing victim wish he had never been born, which floods cannot drown nor fires quench, if any part escape, and only six feet of earth can extinguish" (p. 22). The book is divided into chapters, but the title of the chapter is little indication of its contents; *e.g.* Chapter ii. is headed "Facilities for Breeding in America," and after a few generalisations on the subject mentioned in the title the following questions are dealt with:—Is it possible that human beings have the same diseases as horses? Are the symptons easily recognised (reference is made to the symptons of glanders)? Is it possible to mend a broken leg? Chapters are also included on jockeys, the Derby day, and training. At the same time there is a quantity of information about the horse, scattered here and there in the volume; and if it had been systematically arranged in half the compass, it might have proved useful.

Matter, Energy, Force and Work. By Silas W. Holman. Pp. xiv + 257. (New York: The Macmillan Company, 1898.)

PROF. HOLMAN here addresses students and teachers of physics and chemistry on the concepts and definitions of physical science. Some knowledge of the experimental side of the subject and its phenomena and laws is assumed, and the logical expression and sequence of the ideas put forward should prove of great value to engineers, and others who have to apply physical and chemical knowledge, in enabling them to think clearly when dealing with the fundamental ideas on which all successful practice must be based. The book is divided into two parts: the first is concerned with a consideration of matter, motion, energy, force and work; the second with the kinetic theory of gases, Le Sage's theory of gravitation, the vortex-atom theory, and the nature of energy and matter. Prof. Holman describes the first part as "a sporadic attempt at clear, consecutive setting forth of individual thought," the second as intended "to give more concreteness to the concepts than could properly be introduced into the first part." The volume deserves to be widely read.

The Way the World Went Then. By Isabella Barclay Pp. xiv + 153. (London: Edward Stanford, 1898.)

THE author of this volume did not live to see it through the press, and the MS. has been edited by two lady friends, who contribute the preface and a summary of three pages, in which they state what they think the author would have included in the second part of her work had she lived. It would be unkind to subject a volume produced under these conditions to severe criticism, and we will merely say that, although the book affords evidence of a fervent desire to present the earth's history in a simple and interesting manner, it is seriously misleading in many matters of fact, and unequal in treatment. The volume is daintily bound, and has some attractive illustrations.

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.*]

Fourier's Series.

IN reply to Mr. Love's remarks in NATURE of October 13, I would say that in the series

$$y = \sin x + \tfrac{1}{2}\sin 2x + \ldots + \frac{1}{n-1}\sin(n-1)x + \frac{1}{n}\sin nx,$$

in which $\frac{1}{n}\sin nx$ is the last term considered, x must be taken smaller than π/n in order to find the values of y in the immediate vicinity of $x = 0$.

If it is inadmissible to stop at "any convenient nth term," it is quite as illogical to stop at the equally "convenient" value π/n.

ALBERT A. MICHELSON.

The University of Chicago Ryerson Physical Laboratory,
Chicago, December 1.

I SHOULD like to add a few words concerning the subject of Prof. Michelson's letter in NATURE of October 6. In the only reply which I have seen (NATURE, October 13), the point of view of Prof. Michelson is hardly considered.

Let us write $f_n(x)$ for the sum of the first n terms of the series

$$\sin x - \tfrac{1}{2}\sin 2x + \tfrac{1}{3}\sin 3x - \tfrac{1}{4}\sin 4x + \&c.$$

I suppose that there is no question concerning the form of the curve defined by any equation of the form

$$y = 2f_n(x).$$

Let us call such a curve C_n. As n increases without limit, the curve approaches a limiting form, which may be thus described. Let a point move from the origin in a straight line at an angle of 45° with the axis of X to the point (π, π), thence vertically in a straight line to the point $(\pi, -\pi)$, thence obliquely in a straight line to the point $(3\pi, \pi)$, &c. The broken line thus described (continued indefinitely forwards and backwards) is the limiting form of the curve as the number of terms increases indefinitely. That is, if any small distance d be first specified, a number n' may be then specified, such that for every value of n greater than n', the distance of any point in C_n from the broken line, and of any point in the broken line from C_n, will be less than the specified distance d.

But this limiting line is not the same as that expressed by the equation

$$y = \lim_{n=\infty} 2f_n(x).$$

The vertical portions of the broken line described above are wanting in the locus expressed by this equation, except the points in which they intersect the axis of X. The process indicated in the last equation is virtually to consider the intersections of C_n with fixed vertical transversals, and seek the limiting positions when n is increased without limit. It is not surprising that this process does not give the vertical portions of the limiting curve. If we should consider the intersections of C_n with horizontal transversals, and seek the limits which they approach when n is increased indefinitely, we should obtain the vertical portions of the limiting curve as well as the oblique portions.

It should be observed that if we take the equation

$$y = 2f_n(x),$$

and proceed to the limit for $n = \infty$, we do not necessarily get $y = 0$ for $x = \pi$. We may get that ratio by first setting $x = \pi$, and then passing to the limit. We may also get $y = 1$, $x = \pi$, by first setting $y = 1$, and then passing to the limit. Now the limit represented by the equation of the broken line described above is not a special or partial limit relating solely to some special method of passing to the limit, but it is the complete limit embracing all sets of values of x and y which can be obtained by any process of passing to the limit.

J. WILLARD GIBBS.

New Haven, Conn., November 29.

FOURIER'S series arises in the attempt to express, by an infinite series of sines (and cosines) of multiples of x, a function of x which has given values in an interval, say from $x = -\pi$ to $x = \pi$. There is no "curve" in the problem. Curves occur in the solution of the problem, and there they occur by way of illustration. There are two sorts of curves which occur. In the first place, taking $\phi(x)$ as the function to be expressed by the series, and $f(x)$ as the sum of the series, we have the curves $y = \phi(x)$ and $y = f(x)$, the graphs of the two functions. These coincide wherever the series expresses the function; but, if the function $\phi(x)$ is one which cannot be expressed by a Fourier's series for all values of x in the interval, the curves do not coincide throughout the interval. In the second place, taking $f_n(x)$ as the sum of the first n terms of the series, we have the family of curves $y = f_n(x)$, the graphs of $f_n(x)$ for different values of n. As n increases the graphs of $f(x)$ and $f_n(x)$ approach to coincidence in the sense that, if any *particular value* of x is taken, and any small distance d is specified, a number n' may then be specified such that for every n greater than n', the difference of the ordinates of the two curves is less than d. But this is not the same thing as saying that the curves tend to coincide geometrically, and they do not in fact lie near each other in the neighbourhood of a finite discontinuity of $\phi(x)$. It is usual to illustrate the tendency to discontinuity of $f(x)$ by noting the form of the curve $y = f_n(x)$ for large values of n, but the shape of this curve always fails to give an indication of the sum of the series for the particular values of x for which $\phi(x)$ and $f(x)$ are discontinuous. This is the case in the example cited by Prof. Willard Gibbs, where all particular values between $-\pi$ and π are equally indicated by the curve $y = f_n(x)$, but the sum of the series is precisely zero.

May I point out that there is some ambiguity in the expression "the limiting form of the curve" used by Prof. Willard Gibbs? Taking his example, it is quite true that n' can be taken so great that, for every n greater than n', there is a point of C_n within the given distance d of any point on the broken line, but this statement is not quite complete. It is also true that a number n can be taken great enough to bring the point of C_n on *any assigned* ordinate within the given distance d of its *ultimate position* on the broken line, but it is further essential to observe that no number n can be taken great enough to bring *every* point of C_n within the given distance d of its ultimate position on the broken line. The number n which succeeds for any one ordinate always fails for some other ordinate. Suppose, to fix ideas, that we take a point on C_n for which $y = 1$, and x is nearly π, so that $\pi - x$ is less than d, and keeping x fixed, observe how y changes when n increases; it will be found that, for values of m very much greater than n, the ordinate of C_m, for this x is very nearly π, and we can in fact take m great enough to make this ordinate lie between π and $\pi - d$. In words, the representative point, which begins by nearly coinciding with a point on a vertical part of the broken line, creeps along the line, and ends by coinciding with a point on the oblique part of the broken line. This will be the case for every value of x, near $x = \pi$, with the single exception of the value π. Thus, in the passage to the limit, every point near the vertical part of the broken line disappears from the graph, except the points on the axis of x. This peculiarity is always presented by a series whose sum is discontinuous; in the neighbourhood of the discontinuity the series does not converge uniformly, or the graph of the sum of the first n terms is always appreciably different from the graph of the limit of the sum.

In this way the graph of the sum of the first n terms fails to indicate the behaviour of the function expressed by the limit of this sum, and we may illustrate the distinction between the two, as Prof. Willard Gibbs does, by considering the intersections of the graph with lines parallel to the axis of x. Keeping y fixed, say $y = 1$, we may find, in his example, a number n, so that there is a corresponding value of x differing from π by less than d, and then, allowing n to increase indefinitely, we shall get a series of values of x, having π as limiting value. But this limiting value is *not attained*. In Prof. Willard Gibbs's notation, the equation $2f_n(x) = 1$ has a root near to π when n is great, and n can be taken so great that the root differs from π by less than any assigned fraction; but the equation

$$\lim_{n=\infty} 2f_n(x) = 1$$

has no real root. In fact Prof. Willard Gibbs's "limiting form of the curve" corresponds to limits which are not attained; but the limiting form in which the vertical portions of the broken line are replaced by the points where they cut the axis of x corresponds to limits which are effectively attained. It is the

latter limiting form, and not the former, which is the graph of the sum of the Fourier's series.

The matter here discussed is perhaps that referred to by Prof. Michelson in NATURE of October 6, but I did not understand his letter so. In regard to his present communication, I agree with him if he means that it is just as necessary, in tracing the part of the curve C_n near the vertical part of the broken line, to take a particular value of n, as it is to keep x within a narrow range of values corresponding to n. But this admission is not equivalent to admitting that an infinite series may be summed by stopping at any particular term. Rather it confirms the conclusion, explained above, that the graph of the sum of the infinite series contains no vertical line.

December 22. A. E. H. LOVE.

The Schmidt-Dickert Relief Model of the Moon.

THE present location of the Schmidt-Dickert relief model of the moon is probably not generally known in Europe. Webb's "Celestial Objects for Common Telescopes" (edition of 1896) states that the model is in Bonn, and this impression probably generally prevails. As a matter of fact the model has been for about twenty years in America. It has been on exhibition only at rare intervals during the time, however, and hence has been lost sight of. By a disposition recently made of it, it has fortunately become available to students of science and the public generally. Through the generosity of Mr. Lewis Reese, of Chicago, it has been presented to the Field Columbian Museum, and is now installed in this institution.

The model is in the form of a hemisphere about nineteen feet in diameter, and upon its surface are shown, in proportional relief, over 20,000 distinct localities. In his original description, Dr. Schmidt, the eminent selenographer, states that the details were based on the chart of Beer and Madler, but many features were added from his own observations. He also states that he carefully guided and watched over the work of construction, and with his own hand tested its correctness in all essential particulars. These statements give sufficient assurance of the accuracy of the model, and the confidence with which it may be studied. It is probably the best substitute extant for a trip to the moon. OLIVER C. FARRINGTON.

Field Columbian Museum, Chicago, December 12.

Maxwell's Logic.

IN a paper on the experimental verification of Ohm's law (Brit. Assoc. Report, 1876), Maxwell makes the following statement.

"Assume that the resistance of a given conductor, at a given temperature, is a function of the strength of the current. Since the resistance of a conductor is the same for the same current, in whichever direction the current flows, the expression for the resistance can contain only even powers of the current."

It seems to me that such an argument is not applicable to a case of this kind.

Consider, for example, the flow of a liquid along a capillary tube. We might define the resistance of any portion A B of such a tube to be the ratio of the difference of pressure between A and B to the quantity of liquid flowing across any section in unit time.

Now would it not be equally legitimate to apply the above reasoning to this case, and prove that the resistance of a capillary tube could not vary as the first power of the velocity? Although of course, there may be no physical analogy between flow of liquid and electric current. Again, imagine a uniform wire A B along which a current of electricity is flowing, the ends A and B dipping into mercury cups (say). Now, instead of reversing the direction of the current, let the wire be turned end for end. Surely there is no difference between this and the previous case, and yet the current in the wire is reversed.

JOHN LISTER.

Royal College of Science, London, South Kensington, S.W., December 12.

LORD IVEAGH'S GIFT.

THE announcement, made in the daily papers last week, of Lord Iveagh's intention to devote the princely sum of 250,000*l.* to the endowment and promotion of bacteriological research in England, has arrested the attention of the country and of every class of the community. The humane and enlightened sentiments that have actuated Lord Iveagh, and the liberal manner in which these have been given effect, constitute a unique claim to the gratitude and appreciation of his fellow countrymen.

The distinction of such gifts had hitherto remained, and appeared likely to remain, the prerogative of America and American millionaires. The open-handed liberality of Rockfeller, Armour and many others has enabled the United States to provide endowment for research and to equip laboratories on a scale of completeness unattempted in the mother country, whilst on the continent the scientific worker has long found encouragement and support in State-aided institutions. The result has been that in bacteriological as well as other branches of inquiry England has lagged behind.

Lord Iveagh's decision to devote the proposed endowment to an Institute that had been endeavouring with inadequate means to carry out the work with which he sympathises, has met with widespread approval. It is now seven years since the British Institute of Preventive Medicine was founded with the view of establishing in England a national home for bacteriological work and inquiry. The scheme received its inception at a meeting held at the Mansion House, and from the first obtained the sympathy and support of eminent men of science and members of the medical profession. A fund was raised at the same time to provide poor patients with the means of proceeding to Paris to undergo the Pasteur treatment for rabies. This fund is still administered by the Institute, and no year has passed without several claims being made for its help.

The new Institute was duly incorporated under the Companies Act, and a Council was appointed to further its objects—first amongst these being investigations in connection with the prevention and treatment of infectious diseases. The Council elected represented all branches of scientific work likely to be benefited by bacteriological investigation, and the work of the Institute was thus at the outset wisely placed on the broadest possible basis.

The services of Lord Lister, as Chairman of Council, and of Sir Henry E. Roscoe, as Hon. Treasurer, have been of inestimable value to the fortunes of the Institute. The liberality of the Grocers' Company and of private individuals, along with a handsome donation from the Trustees of the late Mr. Berridge, enabled the Council to take steps to acquire a building site. A favourable site was acquired on easy terms at Chelsea, through the liberality of the Duke of Westminster, and building operations were commenced. The amalgamation of the College of State Medicine with the Institute was effected at the same time, and in this way temporary premises were acquired at Great Russell Street for the initiation of work. The Institute occupied these premises during four years, and the various departments to be established at Chelsea were successfully organised through the efforts of a small but zealous staff. The discovery by Behring of the antidiphtheria serum, and its beneficial use abroad, led the Institute to undertake its preparation for the first time in this country. A farm was rented at Sudbury, near Harrow, and provided with laboratory and stabling accommodation, and the preparation of the serum commenced. A public appeal was made for funds, and a sum of money, sufficient to pay the initial expenses of the new departure, was raised. The work of the antitoxin department of the Institute has since then greatly expanded—the antistreptococcus and antitetanus serum being now prepared, as well as the diphtheria serum, and placed at the disposal of medical men. The Institute also undertook the preparation of tuberculin and mallein for diagnostic purposes.

The work undertaken in the antitoxin and other departments proved a serious drain on the resources of the

Institute, and the Council, after careful consideration of the financial position, most reluctantly decided to abandon completion of the original plan of the Institute, and to leave it an unfinished building. The plans were accordlngly modified by the architect, and a portion of the building was proceeded with and completed last year. The Institute took possession of the new building in May of this year, when the fittings of the main laboratories were completed. The fittings of the building, as it at present stands, are now all but completed. A most promising start has been made, and the facilities for investigation and instruction are being widely taken advantage of.

The Jenner Memorial Committee decided last autumn to transfer any funds it might receive to the Institute. The Council, in view of this, decided to alter the title to the Jenner Institute, and in this way to commemorate permanently the memory of Jenner and his work. The necessary legal formalities were completed on the 6th inst., and the Institute from that date continued its work as the Jenner Institute of Preventive Medicine.

Lord Iveagh was a generous contributor to the Jenner Fund. At the same time, the financial outlook was by no means rosy—working expenses had greatly increased at Chelsea; the salaries of the staff were insufficient, and subscriptions were coming in slowly. These facts were causing serious anxiety to those responsible for the management of the Institute. On December 20, Lord Lister was able to communicate to the Council of the Institute Lord Iveagh's munificent offer, along with the conditions attached to it. The public announcement of this noble gift and its cordial acceptance was made by Lord Lister and Sir Henry Roscoe in a letter to the press on the 23rd inst. The letter states that the bequest is given on the condition that in future the control and mangement of the affairs of the Institute be placed in the hands of a new Board of seven Trustees, three of the seven to be chosen by the Council of the Institute, three by the donor, and one by the Council of the Royal Society.

It is further proposed that the building of the Institute at Chelsea be enlarged, and the original scheme of the same completed; that the sadly inadequate salaries of the director and other members of the staff be increased, and that valuable scholarships and studentships in connection with the Institute be established. There are, of course, many details to be arranged and settled; but it will be seen that the scheme is far-reaching, comprehensive and carefully thought out, whilst the conditions attached are by no means onerous.

The rare modesty of the donor will not, we feel sure, prevent the realisation of the general wish that his name be gratefully and permanently associated with the beneficent work he is about to inaugurate.

Amongst the first results will be, as desired by Lord Iveagh, the completion of the Chelsea building; and the foundations being already laid, this can be proceeded with without delay. The provision to be made for an adequate emolument to the members of the staff, along with the establishment of scholarships and studentships, will furnish an incentive and encouragement hitherto lacking to workers in this field. Many promising researches have of necessity been postponed at the Institute, through the difficulty in finding sufficient assistance to carry them out. Large questions can now be attacked, and the time ungrudgingly given to their elucidation by properly trained experts. A small stream of research work has issued from the Institute; this will be widened and deepened. The students, who have come from all parts of the country and the empire for instruction in bacteriology and preventive medicine, will increase in numbers with the unique facilities that will be placed at their disposal.

The establishment of a British and Imperial Institute of Bacteriology is now within a measurable distance of realisation. The present building at Chelsea contains, amongst its main features, the following departments:—(1) The bacteriological laboratories, devoted to bacteriological investigation and instruction in connection with medicine, public health, and the pathology of disease. (2) The chemical and water laboratories, dealing mainly with water, soil, air, and food, in their hygienic aspects. (3) The Hansen laboratory, dealing with the practical applications of bacteriology to agriculture, brewing, dairy and other industries. (4) Research rooms for advanced workers, and museum and lecture theatre. (5) The requisite facilities for experimental work and investigation in connection with the causation and prevention of disease.

This work will now be placed on a sure and permanent basis, and the Institute will be brought fully abreast with the best foreign laboratories devoted to bacteriology. Through Lord Iveagh's munificence, the objects for which the Institute was established can now be developed on a scale commensurate with their importance.

ALLAN MACFADYEN.

GEORGE JAMES ALLMAN.

IN George James Allman, who died at his residence, Ardmore, Parkstone, Dorset, on Thursday, November 24, at the advanced age of eighty-six, zoological science has lost a zealous and most accomplished worker, the world a great man. He was born at Cork in 1812, being the eldest son of Mr. James Allman, of Bandon, in that county, and was educated at the Belfast Academical Institution, originally for the Bar. As with so many others born to science, he early drifted into paths most congenial to his nature, and accordingly graduated in Arts and Medicine in the University of Dublin. He became a member of the Royal College of Surgeons, Ireland, in 1842, and a Fellow in 1844, and took his M.D. (University, Dublin) and (University, Oxford) in 1847. He from early days displayed a passionate devotion to the study of organic nature, and so highly was he esteemed that during the year of his graduation he was appointed Regius Professor of Botany in the Dublin University. Here the late Professor of Geology, Beete-Jukes, was one of his most intimate friends. Thus embarked on a career of scientific work and investigation, Allman gave up all thought of the medical profession, and ten years later resigned the Dublin chair for that of Regius Professor of Natural History in the University of Edinburgh, with which was incorporated the Keepership of the Natural History Museum, and these combined offices he held until 1870, when he retired into private life. In Edinburgh he was no less a favourite than in Dublin; and his lifelong friendship with the late Lord Playfair, Lord Shand, and many of his most brilliant contemporaries began in that good old town, where he built himself the house in Manor Place, where his clever and charming wife made so happy a home for himself and his friends. During his period of activity in the two great capitals named, Allman laboured with untiring zeal, ever intent on the progress of science and the best interests of those who came under his charge. On his retirement, first to London and afterwards to Parkstone (Dorset), his energy never flagged, the most conspicuous change in his actions being the substitution of the personal care of a small but very picturesque estate of five or six acres at Parkstone, having great possibilities for a naturalist and lover of outdoor life, for the more fatiguing duties of the reception- and drawing-room, encumbent upon him in his professorial capacity. Not that Allman despised the latter, for, on the contrary, while in Edinburgh especially, his drawing-room was the rendezvous of the cultured, drawn together by

the personal charm and gifted influence of his wife, to whom he owed much of his popularity and success. Playfair and Shand may be named among the more regular attendants at these gatherings; but Allman, a born field-naturalist, full of vigour, yearning for the open, found his greatest contentment in the field, and in dredging expeditions, in which both in Ireland and Scotland he took the most ardent interest.

As a worker Allman was untiring and prolific, and between the years 1835–1873, apart from his monographs, which are alone monumental, he produced considerably over 100 papers, mostly to be found in the publications of the Royal and other learned Societies of London, Dublin and Edinburgh, in the *Annals and Magazine of Natural History*, and elsewhere; and while in later years he became less prolific, we find him working to the last, and as late as 1897 contributing (Phœnix-like to the younger generation of naturalists) a paper (*Jour. Linn. Soc. Zool.*, vol. xxv. p. 517) on the hybernaculum of the common snail, embodying a most interesting observation overlooked, because always present, by the multitude who had yearly dissected the animal. Many of the miscellaneous papers by which he will be best remembered are "Reports," such as those of the "Porcupine"; and by association with Bowerbank, the elder Carpenter, Hancock, Hincks, Gwyn Jeffreys, Wyville Thomson, and others, he will be ranked among the earlier pioneers in the study of the marine zoology of Britain, whom he was almost the last survivor. His work upon the fresh-water forms, especially as involving the Polyzoa, and his long intimacy with his great personal friend Busk, is little less noteworthy and historically important. Contemporary of Owen, friend of Huxley, correspondent of the elder Agassiz, truly does it seem that with his decease a link with the historic past has been lost; but among giants who survive him Hooker remains, as one who, with Alex. Agassiz, McIntosh, and Norman, has been his counsellor and friend.

Allman was as versatile as voluminous and proficient, since his papers deal with well-nigh all the great groups of animals, between and including the Protozoa and Mammalia. Recent and fossil forms had for him a like interest; and to have passed as a solid worker from the study of the arteries of the Armadillos through that of a fossil Seal, an Ophiurid, and the Graptolites, to the Peridiniaceæ, working the meanwhile at all sorts of Invertebrates, at questions physiological, anatomical, developmental, and taxonomic, taking by the way the study of parasitism, fermentation, and even of snow-crystal formation, is to have established a record worthy of the emulation of the serious science student. Allman's first paper was a botanical one, "On the Mathematic Relations of Forms of Cells of Plants," and it is worthy of note that in this he in a sense anticipated one of the most recent among our biological departures. He is to be seen at his best as a casual investigator of his time, in his papers on the development and palæontology of the Crinoids and on the Potamogale, a young specimen of which he described. His greater reputation, however, rests upon his monumental investigations into the classification and morphology of the Cœlenterata and Polyzoa, upon which he has left a mark for all time. His first paper on the Polyzoa appeared in 1843—his great monograph on the fresh-water members of the class in 1856; while his first paper on the Hydrozoa was published in 1844, and his epoch-making "Gymnoblastic or Tubularian Hydroids" was completed in 1872. During the thirteen years thus apparently occupied in the preparation of the first and the twenty-eight in that of the second, he was active in the production of numerous papers dealing with both groups of animals, and on the Cœlenterata alone he published up to the period named close upon fifty papers all told. His original descriptions of *Rhabdopleura*, *Myriothela*, *Limnocodium*, sufficient in themselves to have made him famous, stand conspicuous in contemporary scientific literature, and in his reports upon the Hydroids of the *Challenger* expedition and on the Hydroids obtained during the exploration of the Gulf Stream under the direction of the United States Government, his work will remain memorable in the later progress of marine zoology. Of his *magnum opus* the "Gymnoblastic or Tubularian Hydroids," it may be said that its appearance marked an epoch in the history of the scientific investigation of the Cœlenterata. This glorious work, pre-eminent among the magnificent monographs of the Ray Society, came as a revelation to the zoologists of the time. Its classical companions, the "British Naked-eyed Medusæ" of Forbes and the "Oceanic Hydrozoa" of Huxley, had paved the way for its appearance, by extending our knowledge and simplifying our conceptions of the complex structure of the Colonial Hydrozoa. Johnston's "British Zoophytes" was still a leading work of reference on the group, and Reay Greene's "Manual of the Cœlenterata" had enticed to the study of the class many a student who might have strayed into other paths. Allman's monograph, with its 400 pages of text, clear, comprehensive, and logical, with its twenty-three exquisite coloured plates (faithful copies of their author's original drawings, which even in those days had to be engraved in Germany), came as the fulfilment of a great promise. Its first part, dealing in general terms with the morphology, physiology, and chorology of the Hydrozoa, with its masterly "Glossology," ranks among the most perfect and philosophic of all modern zoological treatises. The exquisite beauty of its illustrations, in respect to which it vies with other scientific works of its time, is no less remarkable than the consummate pains bestowed upon its pages. It is a perfectly ideal treatise, finished and artistically complete in all its parts, and it is not too much to say that it revolutionised and placed upon a solid foundation for all time our knowledge of one of the most perplexing of nature's handiworks. Its influence on contemporary investigation in zoology has been far reaching, and had its author achieved nothing beyond it he would have left an ineffaceable mark upon time. Much of the work which constitutes its foundation was done in Irish waters, which thereby became classical ground in the investigation of the British Cœlenterates, so successfully continued at present for the Actinozoa by Haddon and his pupils and associates, and for the Hydrozoa by Brown and the Misses Delap.

Beyond his professorial and research work, Allman was active in the popularisation of zoology. He was among the earlier supporters of the British Association, his first papers having been read before it. He in 1873 presided over its Biological Section, and was in 1879 President of its Sheffield meeting. He was in 1855 appointed one of the Commissioners of Scottish Fisheries, which post he held until the abolition of the Board in 1881, and in 1876 was one of those selected to inquire into the working of the Queen's Colleges in Ireland. During the years 1874–1881 he was President of the Linnean Society, succeeding Bentham. In this capacity he was not altogether a success as a chairman; but by his solicitations on behalf of the Society—and his presidential addresses—he did much to further its welfare. Those on the Protozoa, delivered consecutively during his first two years of office, which, together with his remarkable monograph on the fresh-water Medusa (*Limnocodium Sowerbyi*), which also appeared in the Society's Journal, admirably illustrated by woodcuts from the facile hand of Ferrier, amply testify to his desire to be of use to the Fellows of his Society, so adequately expressed in the peroration to his 1877 address.

Allman served on the Councils of the Royal Societies

of London and Edinburgh, and of the Royal Irish Academy, and he officiated as examiner in natural history for the Queen's University of Ireland, the University of London, the army and navy and Indian Medical Service, and for the Indian Civil Service. He was in 1854 elected a Fellow of the Royal Society, and in 1873 received the Society's Royal Medal. He was in 1877 awarded the Brisbane Gold Medal of the Royal Society of Edinburgh, and in 1878 the Cunningham Gold Medal of the Royal Irish Academy, while in 1896 he received the Gold Medal of the Linnean Society he had served so well. In 1879 there was conferred upon him the Hon. LL.D. of the University of Edinburgh.

On his retirement into private life Allman settled in Dorsetshire, on the genial slope of the ridge overlooking Poole Harbour, there to devote himself to his outdoor pursuits and to horticulture, which was with him a passion; and it is not a little remarkable that he, who in earlier years had committed himself to the views concerning man's place in nature expressed in a short paper he in 1889 read before the Royal Society of Edinburgh, should have had for friend and neighbour in the closing years of his life Alfred Russel Wallace, whose views on Darwinism applied to man were so akin to his own. But it is not in this interesting association of these two great men that the Dorsetshire village will alone be hallowed ground to the zoologist of the future, for it also bears testimony to Allmann's loving devotion to his wife, in a manner which associates her directly with his triumphs and pursuits. For her use he therein had built, midst his beautiful garden, a substantial brick house, with a tiled terrace so arranged that she might sit and read and talk to him while occupied with his favourite pursuits. The garden itself is a perfect picture of undulating beauty, covering an area of some five or six acres, its owner having been particularly careful to avoid all suggestion of suburbanism in its design. Bamboos, a Grumera, rhododendrons of great rarity and value, carefully hedged around for protection against cold and wind, rivulets whose banks are flanked by many a botanical treasure, a stream here, the occasional pollution of which filled him with agony expressed in strongest remonstrance—a pond there, the inhabitants of which were individually the care of its owner—the whole a little paradise—one pictures the grand old man, resolute to the last, seated on his favourite tree stump or rustic seat, as for hours he used to watch the unfolding of the tender bud or the ripple of the innocent streamlet. Every plant was known to him, every label bore his handwriting, and all around was the special object of his tender care.

Great as was Allman's love of nature and freedom, the distinguishing features of his character were his manliness and gentlemanly consideration for others, and in combination with an artistic temperament amounting to the poetic, these gave to his individuality a rare charm. In testimony to the former combination, there stands in his drawing-room, foremost among the treasures he prized most highly, a clock, presented to him on the occasion of his retirement from the Edinburgh chair, which bears the following inscription:

To George J. Allman, Esq., M.D.
Professor of Natural History
In the University of Edinburgh,
This Timepiece is respectfully presented
By a few students
Now and formerly attending his lectures,
As a small mark of their sincere regard for him
AS A GENTLEMAN,
And their admiration of his talents
And ability as a naturalist.
29 July, 1870.

His poetic fancy had led him in his later years to commit his thoughts to verse, which it was one of the concluding ambitions of his life to see in print. But in vain—since the small volume of his poems, which he had printed for private circulation, only reached the house on the day of his decease. As to the literary merits of this opinions might differ, but his verses soar above the peevish Heineësques of Albrecht and the laboured mnemonics of Anderson, two among modern zoologists who have been constrained to write poetry, and they have a special value in that they are the expression of the poetic effusions of his mind prompted by actual work in the field and on the water which made him famous, and of which they are largely descriptive. None other than Johannes Müller, the father of comparative anatomy, has remarked: "Die Phantase is ein unentbehrliches Gut"; and the thought arises that the discipline of biological science soars above that of the more rigid and strictly mathematical in the extent to which it stimulates the imagination, one of the highest of the intellectual faculties.

Allman endeavoured to work to the last, and to the end his brain power remained perfect and his sight and hearing good. It is extraordinary how his eyesight remained practically unimpaired by his constant microscopic work extending over some seventy years. Though latterly weakened by asthma, he would day by day sit at his favourite table and write, and he leaves unfinished a book apparently intended for publication in one of the scientific series. His wife predeceased him in 1890, and he had no family; but he was especially fortunate in the loving care of nieces and others who had learned to take an interest in his life-work, and who afterwards made his home bright and happy. He had this autumn planned some considerable additions to the garden of which he was so fond, dedicating a portion of it to a favourite grand-niece, "Erica," and there can be little doubt that he never imagined himself failing. But a few hours after what proved to be a farewell visit to his dearly beloved plants, he died quietly in his arm-chair. A steady loss of muscular power throughout his whole system during the past few months apparently extended somewhat suddenly to the heart, and took from the world of science an earnest worker, a man in whom the artistic and philosophic temperament were exceptionally combined, and whose name and influence for good will endure. G. B. H.

DR. H. W. VOGEL.

EVERY one interested in photography—and in these days who is not?—must deeply regret that so eminent a worker as Dr. Vogel has passed away. He was one of the pioneers in the band of investigators in what may, perhaps, be called the second period of the development of photography, dating from the time of the daguerreotype to the introduction of gelatine dry plates. When Fox Talbot and Daguerre made known their wonderful methods of making nature draw her own pictures, he was a lad of six or seven years of age, and it was thirty-four years after this that Dr. Vogel announced his discovery that, by the use of certain colouring matters, it was possible to make a photographic plate sensitive to other colours than those to which it had previously been considered as sensitive. This discovery was of so radical a nature that a considerable number of eminent experimentalists were quoted as having failed to corroborate the observation, and the general idea at the time seemed to be that Vogel's announcement was due to an error in his work. At the present day there is no need to enlarge upon the importance of colour sensitisers, for, practically speaking, the whole art of the correct monochromatic rendering of colours by photography, and of the various indirect methods of producing pictures in natural colours by photographic means, are founded upon their use. The fact that it is rather an increase of sensitiveness than the actual conferment of sensitiveness that is effected, and that Dr. Vogel's theory of the action has not commended

itself to other workers in the same field, are only matters of detail that in no way affect the facts established by him.

Dr. Vogel's activity was shown in almost every branch of photography, and in many of its applications. His astronomical work, especially in connection with eclipses of the sun, is well known. The existence and prosperity of the Imperial Technical High School of Photography, at Berlin, is the best of evidence of his work as a teacher. His "Handbook of Photography," "Practical Spectrum Analysis," and other treatises, will long remain as useful guides. The *Photographische Mitteilungen*, which he established in 1864 and conducted himself until quite recently, and the position that at one time he took up as correspondent of other technical papers, show how much he valued and worked for current photographic literature. There are few men who have done such varied and lasting work in connection with photography as Dr. H. W. Vogel.

NOTES.

WE notice with much regret the announcement that Prof. A. A. Kanthack, professor of pathology in Cambridge University, died on Wednesday, December 21, at the early age of thirty-five.

THE French Société d'Encouragement pour l'Industrie Nationale has received a gift of twenty thousand francs from M. Gilbert (of Givet), to be used for the advancement of French industries.

MR. FREDERICK G. JACKSON, the leader of the Jackson-Harmsworth Arctic expedition, has received a knighthood of the first class of the Royal Order of St. Olaf from King Oscar of Sweden and Norway.

A BIOLOGICAL Section for Agriculture and Forestry has been established in connection with the Imperial Sanitary Bureau at Berlin. Dr. Freiherr v. Tubeuf (of Munich) has been appointed botanist, and Dr. J. Behrens (of Carlsruhe) bacteriologist to the Section.

THE death is announced of Mr. John Barrow, F.R.S., at the age of ninety-one. He took an active part in promoting the search for Sir John Franklin, and was the author of several books of travel and descriptions of glaciers in the Alps. He was elected a Fellow of the Royal Society so far back as 1844.

THE following gentlemen have been elected corresponding members of the Zoological Society:—Dr. Ludwig Heck, of the Zoological Gardens, Berlin; Mr. William T. Hornaday, of the Zoological Park, New York, U.S.A.; Dr. Herman von Ihering, of the Musen Paulista, St. Paulo, Brazil; and Prof. Louis von Méhely, of the National Museum, Budapest.

WE learn from *La Nature* of December 24, that a mountain observatory has been erected at Mont Mounier, the highest point of the Maritime Alps, at 2816 metres above the sea-level, and about 90 kilometres north-west of Nice. The cost of the establishment has been defrayed by M. Bischoffsheim, a member of the Institute, who also endowed the Nice Observatory. The mountain station is connected by telephone with the telegraphic station at the village of Beuil, and meteorological observations are regularly made by M. Maynard. As the position is all that can be desired for the purpose, we may hope for some valuable results in connection with those obtained at the Nice Observatory. During the frosts of winter the temperature at the upper station falls to about 36° F. below the freezing point.

A RECENT number of the *Lancet* contains a paper by Mr. A. F. Stanley Kent, entitled "The Specific Organism of Vaccinia." The author has found a diplo-bacillus present in large numbers in the deeper parts of the vesicle. This organism he has succeeded in cultivating in artificial media, and has been able to produce, by its inoculation into animals, vesicles "indistinguishable from those produced in the ordinary course by vaccination with current lymph." Mr. Kent further states that animals which have been thus inoculated subsequently give no reaction when revaccinated with active lymph. Many investigators have been drawn into this field of research, but hitherto the difficulties of deciding the claims of so many rival candidates have proved insuperable. It will be important to have Mr. Kent's results repeated and confirmed by other workers, and there can be no doubt that his suggestive and promising achievement will give fresh energy to the conduct of experiments in this direction.

THE Shanghai Meteorological Society has issued its report for the years 1896 and 1897. The headquarters of the Society is at the Zi-ka-wei Observatory, of which the Rev. A. Froc, S.J., is Director. The observatory receives daily two or three telegrams from forty-two stations, including those from Corea, Japan, Formosa, and the Phillipines, and issues storm warnings to several ports. The present report contains a discussion of two notable typhoons which occurred on September 9 and 29, 1897. The first of these was of unusual violence; it fell like a thunderbolt upon the city of Yokohama, and caused considerable havoc there and in the neighbouring districts. The storm struck the steamship *Empress of India* in lat. 33° 30′ N., long. 137° 5′ E., on the night of September 8–9, and in the course of two hours the barometer on that vessel fell 1·25 inch, and in less than forty minutes the mercury again rose 1·40 inch. During part of its course the storm travelled at a rate of over fifty miles an hour.

THE effect of approaching storms upon song birds is the subject of an interesting contribution by Mr. C. E. Linney to the U.S. *Monthly Weather Review*. It appears that during the night of August 15–16 very severe electrical, wind, and rain storms prevailed over the northern district of Illinois. An observer in Henry County, Mr. W. W. Warner, noticed that for forty-eight hours before the storm not a sound was heard from the numerous song birds in the district. This observation was so full of interest that Mr. Linney wrote for additional information, with the result that he received numerous letters, some confirming it; others stating that birds sing louder and more persistently before a great storm, and nearly all agreeing that they are more restless than usual at such a time. Mr. Linney has found the following weather proverbs referring to song birds and storms:—When birds cease to sing, rain and thunder will probably occur.—If birds in general pick their feathers, wash themselves, and fly to their nests, expect rain.—Parrots and canaries dress their feathers and are wakeful the evening before a storm.—If the peacock cries when he goes to roost, and, indeed, much at any time, it is a sign of rain.—Long and loud singing of robins in the morning denotes rain.—Robins will perch on the topmost branches of trees, and whistle when a storm is approaching.—The restlessness of domestic animals and barn-yard fowls before an approaching storm is well known, and many of their peculiarities have been noted; but the actions of song birds do not appear to have previously received particular attention.

A FULL and well illustrated account of the manufacture of aluminium at Foyers is contained in *Commerce* for December 14. The works, which were completed at the end of 1896, are now in full operation. The raw material bauxite is obtained in County Antrim, whence it is transported to Larne. At Larne

it is calcined, ground, and treated under pressure with caustic soda solution, whereby sodium aluminate is formed. The clear solution of aluminate is then agitated, and at the end of thirty-six hours deposits 70 per cent. of its burden of alumina. This alumina is dehydrated and heated until it becomes crystalline and non-hygroscopic. In this state it is shipped to Foyers, where it is electrolysed in a bath of cryolite. The total fall of water available at Foyers is 350 feet, and an ample supply at all seasons has been secured by the conversion of two lochs into a reservoir of 4000 million gallons storage capacity—a large engineering enterprise. Seven turbines are at present in action, each capable of developing 700 h.p. when running at 140 revolutions per minute. The dynamos are of large size, the commutators being six feet in diameter, and having 216 segments. Each dynamo has 120 brushes. The carbon electrodes are made by the company at a factory in Greenock. The aluminium turned out at Foyers is not pure enough for all purposes. The refining works are at Milton, in Staffordshire, where plant is provided for an output of four tons daily. Aluminium now at 1*s.* 3*d.* per lb. is bulk for bulk cheaper than copper, brass or tin. The works at Foyers have called into existence a small village, which appears to be well looked after by the directors of the company. It already boasts a club, which provides recreation and instruction for the workmen.

LETTERS have lately appeared in the *Lancet* wtth reference to the colours of newly-born negro children. Several medical men have given the result of their experience, and the evidence shows that at birth the children are of the colour of a light quadroon. In a paper on the natives of the Warri district of the Niger Coast Protectorate, published in the new *Journal* of the Anthropological Institute, it is recorded that "pure negroes when born are pink, like young rats; at the end of about three or four months they become black." Atmospheric conditions thus seem to be necessary to produce the full black colour of the negro.

THE Anthropological Institute has just published the first number of a new series of its *Journal*. Since the foundation of the Institute an illustrated journal has been issued in quarterly numbers, forming, during the twenty-seven years of its existence, a series of as many volumes, containing numerous papers of great scientific value and interest. The old journal was a demy octavo (5½ × 8½ inches), but the new series is larger, being imperial octavo (11 × 7½ inches, nearly). The object of increasing the size is to include ample plates and tables, and bring the journal in general uniformity with the important publications of some of the continental anthropological societies. A number of very interesting papers appear in the first part of the new series, among the subjects dealt with being the ethnography of the Murray Islands, Torres Straits, Australian folk-lore stories, the pigmies of the Upper Welle district of the Belgian Congo, A-bantu and Ashanti skulls and crania, the natives of Tanna, and totemism.

AN interesting paper by Dr. Brinton, on "The Linguistic Cartography of the Chaco Region," has just been reprinted from the *Proceedings* of the American Philosophical Society. The region known as El Gran Chaco, or the Great Hunting Ground, with which the paper is concerned, has always been peculiarly perplexing to students of American aboriginal languages. It lies in northern Argentina and eastern Bolivia, between latitude 18° and 32° South, and longitude 58° and 66° West of Greenwich. Except by the water-ways it is almost impossible to traverse the country, and for that reason extensive tracts of it are still unexplored. Dr. Brinton states that the native tribes who inhabited this region have always been in the lowest stages of culture, depending on hunting and fishing for their subsistence, without settled abodes, migratory and in ceaseless warfare with each other. The self-sacrificing efforts of the Jesuit and Franciscan missionaries have at times succeeded in gathering a few hundred together about some mission, only to be dispersed again on some slight cause. Thus, some years ago, in the middle of the night, the whole of the tribe of Penoquiquias, which had been converted and induced to take up a fixed abode, suddenly disappeared, and were never seen again. Dr. Brinton discusses recent contributions to the linguistic ethnography o the Chaco region, and offers some suggestions for the correct classification of tribes of still uncertain affinities.

ON September 20 and 21, 1897, two strong earthquakes were felt in the island of Labuan, near Borneo, the pulsations of which were registered by magnetographs at Batavia, Bombay and Potsdam, and by various pendulums at Nicolaiew, Catania, Ischia, Rome, Edinburgh and the Isle of Wight. The detailed records are given by Dr. Agamennone in the *Bollettino* (vol. iv. No. 4) of the Italian Seismological Society, and the same writer has investigated the velocity of the earth-waves in a paper read before the R. Accademia dei Lincei (*Rend.*, vol. vii. pp. 155-162). If the initial times be calculated from that given by the Batavia magnetograms, the velocities for both earthquakes would be 28 or 29 km. per sec., but there can be little doubt that the earlier vibrations are not shown on these curves, and that these estimates are consequently too great. Assuming, however, as is probable, that the magnetographs were not disturbed until the arrival of the long-period pulsations, Dr. Agamennone concludes that the first pulsations travelled with a velocity of 4½-6½ km. per sec., and those which constituted the maximum phase with a velocity of 2½-3 km. per sec.

THE Zoological Society have just issued the thirty-fourth volume of the *Zoological Record*, which contains a full account of the zoological literature of 1897, arranged in eighteen sections according to the usual plan of the work. The general editor of this most helpful publication is Dr. David Sharp, F.R.S. The various subjects have been undertaken by Mr. J. A. Thomson, Mr. R. Lydekker, F.R.S., Dr. R. Bowdler Sharpe, Mr. G. A. Boulenger, F.R.S., Mr. E. R. Sykes, Mr. E. A. Smith, Mr. G. C. Crick, Miss Florence Buchanan, Mr. A. W. Brown, Mr. F. A. Bather, and Dr. R. von Lendenfeld; while the general editor himself assumes the labour of the section relating to the Insecta, which occupies no less than 300 pages. The volume is prefaced by an alphabetical list of the abbreviations of the titles of publications used in the *Record*, which thus becomes a list of all the journals, *Transactions*, and other periodicals issued at the present time in which zoological papers are published. The number of these periodicals may be judged from the fact that the list contains 52 closely-printed pages. In this list the principal English libraries which contain copies of these periodicals are mentioned after every title. The volume concludes with an index to the names of new genera and subgenera proposed in 1897 and recorded in it, altogether 1574 in number. The corresponding total last year was 1541. No more useful piece of work could be done by the Zoological Society of London to facilitate the labours of working zoologists, and it is much to be regretted that all branches of science have not similar publications to assist the scientific "working man."

SEVERAL interesting papers on natural history topics appear in the *Transactions* of the Edinburgh Field Naturalists' and Microscopical Society (vol. iii. Part vii., 1898). Miss Sprague describes some common objects for microscopic study; Mr. W. Blacklock also deals with microscopy and some of its uses. The Rev. J. H. Lawrie gives an account of coral and coral-islands, with special reference to the New Hebrides group; and Mr. A. Murray contributes some interesting notes on the

life-history and habits of wasps. His paper contains an account of observations made by him of wasps in their natural state, extending over a number of years, and it thus possesses the merit of original work. In the course of the paper Mr. Murray remarks: "There is one thing which puzzles me much, namely, how a blackbird can stand at the side of a hanging wasps' nest, and tear it to pieces to devour the larva, and yet not be stung to death. The bird does not seem to be annoyed in any way, but if I venture to see what is going on, I am certain to be very much stung—I suppose, for not minding my own business." Among the other papers in the *Transactions* is one by Messrs. T. Scott and J. Lindsay, in which further results of the investigation of the micro-flora and micro-fauna of the Upper Elf Loch, Braids, are given. The paper illustrates the scientific benefits to be derived from a continuous examination of a particular loch or pond.

AT the Whitechapel Free Public Library and Museum, the following free science lectures (with lantern illustrations) have been arranged:—January 10, "How we digest our dinner," by Dr. E. H. Starling; February 7, "A piece of limestone," by Mr. F. A. Bather; March 7, "How animals warn their enemies and signal to their friends," by Cora B. Sanders.

WE have received the Christmas numbers of the *Gardeners' Magazine* and *Amateur Gardening*, both with very beautiful coloured illustrations, and a marvel of cheapness. Each periodical is also illustrated with photographs taken in well-known gardens at home and abroad, drawings of fruits and flowers, and others that will commend themselves to the gardener and horticulturist.

THE works from the library of the late Prof. Mariano de la Paz Graells are offered for sale by Herr Felix L. Dames, Berlin. A catalogue (No. 44) containing a list of works on natural history and zoology, vertebrates, anthropology, travels, and rare Spanish books on the chase and falconry, has just been issued. Lists of papers, &c., on invertebrates, botany, and entomology will be given in future catalogues.

IT will interest microscopists to know that Mr. Charles Baker, maker of optical and surgical instruments and accessories, proposes to commence a new department for lending microscopic specimens, much on the same lines as a lending library. The arrangement should be of service to many amateur microscopists, especially beginners and those living in districts where there are no microscopical clubs or societies.

THE *Agricultural Gazette of New South Wales* for September is largely occupied with an account of the different species or varieties of *Opuntia*, or prickly pear, that have been introduced into the Colony, and the various modes of exterminating them. So great a pest to the farmers has this plant become, that the Colonial Legislature passed, in 1896, a stringent Act imposing heavy penalties on the growth of it, or on failure to extirpate it on cultivated land.

MR. W. J. C. MILLER, who was for many years registrar of the General Medical Council, and had to resign his duties owing to a sudden breakdown, is, we are informed, now in a satisfactory state of health. In announcing his forthcoming work on "Nature Studies" (p. 155), he was referred to as the late Mr. Miller, and we are glad to be able to correct the wrong impression thus conveyed.

A BUNDLE of papers upon the methods and results of teaching speech and the knowledge of language to deaf-mutes has been received from the Volta Bureau, Washington, D.C. It may be remembered that this Bureau was founded in the year 1880 by Dr. Alexander Graham Bell, with the Volta prize of fifty thousand francs received by him for the invention of the telephone. It has for its objects the increase and diffusion of knowledge relating to the deaf, and performs most useful work in furtherance of them. The publications issued by the Bureau show that astonishing results are obtained by systematic instruction on sound principles.

THE *Journal of the Royal Microscopical Society* for December contains a continuation of Mr. Millett's report on the recent Foraminifera of the Malay Archipelago collected by Mr. Durrand, as well as the usual summary of recent researches in zoology, botany, and microscopy. In the latter department the President, Mr. Nelson, gives an interesting account of a binocular microscope designed and made by an amateur, and of an old microscope made by Mr. J. Cuff about the year 1760. This number also contains the very useful list of new terms in zoology and botany introduced during the year into scientific terminology.

FOR the purpose of understanding the effects produced on cultivation and hygiene by the variations of the weather and the changes in the composition of the atmospheric air, the Montsouris Observatory was charged to carry on experiments and investigate problems connected with the climate and hygiene of Paris. The work of the observatory is divided into three sections, which may be roughly described under the headings: physics and meteorology, chemistry, and micrography. Every year the observatory issues a small volume, "Annuaire de l'Observatoire Municipal de Paris," in which is embodied much valuable information based upon the researches and observations carried on under its direction. Containing, as it does, a mine of facts which should prove very useful to scientific workers, the volume for 1899, which includes an account of the work accomplished in 1897, will be welcomed by many.

THE *British Journal Photographic Almanac* has steadily increased in size for the past few years, and the new number for 1899 contains no less than 1508 pages; this, of course, includes the host of advertisements, which by themselves are of interest to the photographer. Many of our readers are probably familiar with this annual publication, and will therefore know how difficult it is to make selections from the large amount of useful information given in it. We may say, with the editor, that the principal features of last year's volume have been repeated, and that all tables, formulæ, and other necessary facts for the photographer have been inserted and brought up to date. The volume contains, as usual, several specimens of reproduction processes, and illustrations of rapid shutter work, but they do not seem to be so numerous as in the previous publications. The Almanac should, however, be found in every studio, for the numerous facts contained in it will frequently be found of service.

THE compact little annual of the *Bureau des Longitudes* for 1899, published yearly by the National Convention to "propre à régler ceux de toute la Republique," is as interesting and complete as ever. It is unnecessary to refer to the detailed contents of the volume, but a statement of the alterations and additions that have been made in the present issue should be of interest. In the astronomical section the list of minor planets is brought up to September 13, 1898, and many details of these bodies, such as name, discoverer, date of discovery, duration of sidereal revolution, mean distance from sun, eccentricity and inclination are given. The table showing the elements of periodic comets has been revised, and a brief history is given of the comets which appeared in 1897. In the section devoted to geography and statistics, new values for the area of France, obtained from the Army Geographical Service, are inserted. M. Cornu has revised his article on electricity, and added a valuable note on electrical units as used in practice. The

articles included in the volume always give special interest to it; they are this year on the following subjects:—On sounding balloons, by M. Bouquet de la Grye; modern French geodesy by M. Bassot; on the large siderostat and telescope of 60 metres focal length and 1·25 metres aperture, which is being constructed by M. Gautier; and, lastly, on the work done at the Mont Blanc Observatory in 1898, by M. Janssen.

THE additions to the Zoological Society's Gardens during the past week include a Puma (*Felis concolor*) from Argentina, presented by Mr. T. S. Nicholson; a Red and Blue Macaw (*Ara macao*) from Central America, presented by Mr. H. Sneggitt; a Gannet (*Sula bassana*), European, presented by Mr. A. Trevor-Battye; a Greek Partridge (*Caccabis saxatilis*) from Greece, presented by Lieut. J. H. Mackenzie, R.N.R.; a Lapland Bunting (*Calcarius lapponica*), a Reed Bunting (*Emberiza schnoeiclus*) European, presented by Mr. F. Chatwin; two Black-winged Peafowl (*Pavo nigripennis*, ♂ ♀) from Cochin China, presented by Mrs. Johnes; a Hallowell's Tree Snake (*Dendraspis viridis*) from the Gold Coast, presented by Mr. J. W. Kaye; an Antillean Boa (*Boa diviniloque*) from the West Indies, three Horsfield's Tortoises (*Testudo horsfieldi*) from Central Asia, deposited; a Triton Cockatoo (*Cacatua triton*) from New Guinea; six Gadwalls (*Chaulelasmus streperus*) from Holland, purchased; three Rosy-faced Love-birds (*Agapornis roseicollis*), bred in the Gardens; an Urial Wild Sheep (*Ovis vignei*, ♂) from Persia, received in exchange.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY 1899:—

January 2. Meteoric shower from Quadrans (Radiant 230° + 52°.)
2. 7h. 14m. Minimum of Algol (β Persei).
4. 15h. 38m. to 17h. 24m. Transit of Jupiter's Satellite III.
5. 19h. Venus at her greatest apparent brilliancy and a fine object in the morning sky. She rises about 3½ hours before the sun, and is situated 10° north of the red star Antares in Scorpio.
7. 17h. 3m. to 17h. 48m. The star 42 Librae (mag. 5·2) occulted by the moon.
9. 19h. Mercury in conjunction with the moon (☿ 2° 56′ N.)
9. 10h. 38m. Partial eclipse of the sun visible at Greenwich.
11 14h. Mercury at his greatest elongation (23° 35′ W.), rising about 1⅘ hour before the sun, and situated 10° east of Saturn, and 19° east of Venus.
11. 19h. 48m. Ingress of Jupiter's Satellite III.
15. Jupiter. Polar diameter 32″·8.
15. Venus. Diameter 35″·4. Illuminated portion of disc 0·332.
18. 12h. Mars in opposition to the sun.
18. Mars. Apparent diameter 14″·4.
19. 8h. 5m. to 9h. 14m. The star μ Arietis (mag. 5·8) occulted by the moon.
22. 15h. 33m. to 16h. 29m. The star 121 Tauri (mag. 5·4) occulted by the moon.
24. 17h. 32m. to 18h. 26m. The star 56 Geminorum (mag. 5·0) occulted by the moon.
25. 5h. 45m. Minimum of Algol (β Persei).
30. 13h. 39m. to 14h. 57m. The star B.A.C. 4006 (mag. 5·7) occulted by the moon.

It may be mentioned as a very unusual circumstance, that during the first half of January all the major planets of the solar system may be observed in the morning sky.

COMET CHASE.—The following is the ephemeris for comet Chase for the ensuing week. The comet is moving in the southern extremity of the constellation of Ursa Major, and lies a few degrees south of the star ξ Ursæ Majoris.

Berlin Mean Midnight.

1898-9.	R.A. (app.) h. m. s.	Decl. (app.)	Br.
Dec. 30 ...	11 2 24 ...	+28° 18′·6 ...	1·1
Jan. 1 ...	3 40 ...	28 39·6	
,, 3 ...	4 49 ...	29 1·1 ...	1·1
,, 5 ...	11 5 50 ...	+29 23·5	

ARTIFICIAL PRODUCTION OF SUN-SPOTS.—In the *Archives des Sciences physiques et naturelles* (November) M. Th. Lullin describes some experiments he has been undertaking with regard to producing the forms of sun-spots artificially. Commencing with the now generally assumed hypothesis that sun-spots are caused by the downfall of cool matter from the higher regions of the solar atmosphere to the lower and more intensely heated gases, he has been investigating the behaviour of splashes of water on a viscous substance, such as barium sulphate placed on a glass plate. An examination of the illustrations which accompany his paper, shows that, even with these crude imitations of the real elements at work, very striking results can be obtained which have their counterparts in actual sun-spots. Thus the striated appearance radiating from the umbra is well obtained, while the appearance of bridges can be easily reproduced. In these experiments there seems every hope that by imitating the results of the falls of separate streams or series of drops simultaneously on to a surface of some liquid of less density, still greater approximation to the actual appearances of solar spots would be obtained.

THE HEAVENS AT A GLANCE.—For the last two years Mr. Mee has issued a small card which contained a large amount of useful information arranged in chronological order, showing the amateur at a glance the sequence of astronomical events of interest for the year. Unfortunately the information on this card was not clearly printed, but was simply a reproduction of the original handwriting of the compiler: on this account the card was not such a useful addition to an observatory as it might have been. The new issue for the year 1899 has, however, been altered in this respect, and it is well arranged and clearly printed. The constellations visible, the declination of the sun, the phases of the moon, those planets that are well placed for observation, are given for each month, together with the times of appearance of the most prominent meteor showers, maxima and minima of the principal variables, &c.

These are followed by notes on the sun, planets, eclipses, and others containing just that information that the amateur should find most useful: symbols and abbreviations have been used as little as possible. Equipped with this card, possessors of small telescopes have a useful and simple programme of the astronomical occurrences for the year 1899.

ARE MOLDAVITES OF CELESTIAL ORIGIN?—Herr Dr. Franz E. Suess, of Vienna, has had the opportunity of studying several hundreds of specimens of pieces of moldavite which had previously been found between "Trebitsch and Dukowan, near Mährisch-Kroman." These moldavites, which have a bottle-green, glass appearance, and are inclined to be egg-shaped, were first discovered at the beginning of this century, and very much doubt has been cast on their origin. In the paper before us (*Kaiserliche Akad. d. Wiss. in Wien*, November 17), Dr. Suess describes previous theories of origin suggested, and gives his own reasons for the opinion he has formed. A thorough examination of very many specimens has led him to believe that their surface forms can in no way be explained by weathering or collisions, but that these surface markings seem to be very closely related to the indentations of meteorites. All the surface markings on these moldavites can be explained on the assumption of the influence of an enormous air resistance. Dr. Suess then describes the differences in form of the surfaces he examined, and classifies them under different headings. In concluding his remarks, he suggests that the reason why the origin of these moldavites has not been previously attributed to the same as that of aerolites, can be accounted for only on the curious chemical nature of these bodies. Considering the comparative little knowledge we possess concerning the chemical nature of bodies of cosmical origin, we must conclude that we "must add to the known groups of aerolites a new group, namely moldavites."

It would be interesting to make a spectroscopic examination of some of these specimens, and compare their spectra with those of other meteorites that have been previously examined.

JUPITER AND HIS MARKINGS.

JUPITER is now coming into a favourable aspect in the morning hours. His position about ten degrees south of the equator will, however, be an unfortunate circumstance for European observers. To those, however, who can command an open southern sky, there will be plenty of opportunities for successful research; and, certainly, this magnificent planet deserves all the study that can be possibly devoted to him. In 1899 it is to be hoped that a great number of drawings will be made, and that the latitudes of the belts and spots will be micrometrically determined. We also require a fresh and extensive series of the times of transit of the principal light and dark markings, so that their longitudes and rate of drift relatively to the zero meridian may be ascertained. The latter element requires close attention at every opposition, as the velocities of the various currents are frequently changing, and it is possible they are regulated in definite cycles.

During the last opposition the planet received widespread notice from many observers, including Brenner, Fauth, Gledhill, Hough, MacEwen, Phillips, Comas Solá, Stanley Williams, myself and others. No very special phenomena were presented to arouse so much interest, but the disc was replete with a variety of interesting formations. The equatorial region exhibited an abundant series of dark and bright spots. These were moving more rapidly than similar and probably identical features last year, the difference of velocity being about 10 seconds. It will be important to determine whether a further acceleration of speed occurs in 1899. In 1897 the mean rotation of the equatorial current was 9h. 50m. 34·6s. according to Mr. Williams, while in 1898 the writer found it 9h. 50m. 23·6s.

In the north tropical zone there were several dark elongated spots visible during the last opposition. These completed a rotation in about 15½ seconds less than the red spot. This latitude, about 15° N. of the equator, appears to be very prolific in the production of dark and light spots, which in certain cases remain visible over considerable intervals. During the past few years these markings have presented some difficulties as to their identification, for some of them appear to be subject to variations in form and tint, and perhaps to temporary obscuration. They also, during different oppositions, exhibit a variable rate of velocity. Thus in 1894–5 a very dark and definite spot was seen on the northern edge of the north temperate belt. In the next opposition two other spots, which were known as the "violin" and "garnet" spots, were displayed in the same latitude, though the north side of the belt seemed to have vanished. In 1897 no conspicuous spots were detected in this zone, but several were seen in 1898, and one of these may possibly have been identical with the chief spot of 1894, and with the violin spot of 1895–6, as the following comparison of longitudes and rotation periods, obtained at Bristol, will indicate:—

		Longitude.	Rotation period. h. m. s.
Dark spot ...	1894 November 5 ...	239·1	9 55 37·8
	1895 May 9	226·3	
"Violin" spot	1895 September 26 ...	222·6	9 55 33·8
	1896 February 9 ...	201·1	
	1896–7 Spot apparently invisible.		
Dark spot "A"	1898 March 23 ...	126·7	9 55 27·7
	July 4	94·7	

The decreasing longitude of the spot agrees fairly well, and the rapid increase of velocity is well marked along the series, but the evidence that the objects were identical is certainly not conclusive. If the spot was temporarily hidden in 1896–7, its rate was probably 9h. 55m. 30·7s. It is curious that in 1890 Prof. Barnard found the rate of a dark spot in same latitude 9h. 55m. 30·3s.; while in 1891 Prof. Hough derived a value of 9h. 55m. 27·4s. from a mean of two spots. From a comparison of a large number of rotation periods of this current at different times, it appears a probable inference that the time oscillates between 9h. 55m. 26s. and 9h. 55m. 41s. in a period of about seven years. This is somewhat doubtful, but the variation of rate seems well marked and to give evidence of regular periodicity. It will be especially interesting to redetermine the rotation period during 1899 if spots are still displayed in this latitude.

With reference to the red spot, I re-observed it on November 29 at 19h. 55m., when it was on the central meridian, and followed the zero meridian of System II. by about fifty-three minutes.

The question has often been asked as to whether the great red spot of modern times is identical with Cassini's spot of 1665 and following years? There seems a large amount of significant evidence to support the affirmative view. The observations spread over the 234 years, from Cassini's first observation to the present time, do not afford many connecting-links, but the probabilities are all on the side of identity.

Though the ancient object is generally called Cassini's spot, it was really discovered by Robert Hooke, with a telescope of twelve feet focus and two inches aperture, on 1664 May 9. He detected, "at about nine o'clock at night, a spot in the largest of the three obscure belts of Jupiter, and found that within two hours afterwards the said spot moved east to west about half the length of the diameter." To Hooke, therefore, belongs the credit of discovering this object, and the indication it afforded of fixing the exact time of rotation of the planet. But Cassini took the marking under his special charge, seeing, as he did, the important deductions to be made from it. Observing it frequently in the summer of 1665, he ascertained the rotation period as 9h. 56m. I have gone over many of Cassini's observations, and make the corrected period of rotation 9h. 55m. 47·5s. in 1665–1672. Cassini says he was assured of the preciseness of one mean revolution to one-eighth of a minute. On 1672 March 1, he saw the spot in transit on two occasions (viz. at 7.30 and 17.26), and announced to the French Academy of Sciences on the following day that the spot might be again seen in transit on March 3 at 9.8 p.m. The Academy thereupon deputed two of its more prominent members to verify Cassini's prediction. With this purpose in view, they repaired to the observatory, and, in company with Cassini, actually observed the spot return exactly as foretold by him.

The spot seen by Hooke and Cassini was about one-tenth of the apparent diameter of Jupiter; this would be about 9000 miles, and equivalent to the width of the spot in recent years. The oval shape it now presents may be due to the rapid rotatory motion of the sphere, which we know has the effect of spreading out objects in a longitudinal direction. Several new belts have been formed under the eyes of observers. But in the case of the red spot, its material may have been sufficiently solid to withstand the winding-out process beyond the elliptic form which became its permanent shape.

If the spot which Hooke saw on 1664 May 9, was the same as the relic of the red spot observed at Bristol on November 29 last, then in the interval of 85,670½ days no less than 207,084 rotations have been performed, if we adopt the mean rate as 9h. 55m. 40s. during that long interval. It is quite possible to trace back the spot or its accompanying hollow in the great southern belt to 1831, and a further search amongst old drawings of Jupiter may take its history safely back to the time of Sir William Herschel and J. H. Schroeter. W. F. DENNING.

THE NEW LIVERPOOL MUSEUMS EXTENSION BUILDINGS.

THE present museums buildings were erected in 1860 by the late Sir W. Brown for the splendid natural history collections bequeathed to the City of Liverpool by the XIIIth Earl of Derby in 1851. These were so extensive that the accommodation they required necessitated the building of what was, at that time, one of the largest museums in England outside the Metropolis. Since that date the collections have been constantly added to, not so much by purchases, as by gifts—some of them of the highest value—from donors possessing an interest in natural science, and appreciating, in advance of their time, the importance of that subject as a means of education, with the result that, to-day, every available foot of space in the museums has long been occupied—every cellar even being stored to its utmost capacity—so that any intelligible arrangement of their contents has now become well-nigh impossible. Within the past decade, also, the change in the public attitude has been growing very rapidly towards an appreciation of museums as institutions of high educational value and importance. This is due, no doubt, to the rapid increase of scientific and technological knowledge, and to the advocacy of no one in Europe so specially as Sir William Flower, who, by his writings, and, perhaps, principally by the methods, inaugurated by him, of displaying and labelling the specimens in the Natural History Museum in South Kensington, has made manifest, not the

interest only, but the educational value of the study of natural objects. The Corporation of Liverpool has been one of the first to recognise this advance in opinion in raising the city's museum to the position of a first-class scientific institution, by voting the necessary funds for its proper support, and keeping the collections abreast of the stream of discovery.

The additions—chiefly by purchase—to both the Derby and Mayer Museums have been within the last three or four years so specially numerous that since 1893 it has been evident to the Museums Sub-Committee of the Libraries, Museums, and Art Committee of the Council that increased space was urgently necessary.

The Technical Instruction Sub-Committee then also found itself in the same position in regard to a central school to accommodate the more advanced classes, which were and are now being held in widely separated parts of the city, in buildings most of them ill adapted for teaching purposes.

A special Sub-Committee was therefore constituted in December 1894, empowered to take immediate steps for the extension of the museums, and for providing suitable accommodation for the Liverpool School of Science, Technology, and Art. The credit of overcoming the difficulties which beset the initiation of so large a scheme, and of arranging the preliminaries, is chiefly due to Sir William Forwood.

The New Central Technical Schools and Museums Extension Buildings, Liverpool.

The present museum buildings stand on a rocky plateau sloping abruptly towards the west. By excavating this slope, consisting of Permian rock, down to the level of Byrom Street, sufficient accommodation, three stories in height, could be provided for the Technical Schools, while the museum galleries could be carried forward, on their present level, over the schools. The Technical Schools will thus be distinct and entirely isolated, and have their own entrance in Byrom Street.

This being so, designs with estimates for a building—whose requirements were sketched out by the Director of Technical Instruction and the Director of Museums respectively—were invited from a selected list of architects of eminence in England. In the summer of 1896 the designs of Mr. Edward William Mountford, of London, were awarded the first premium. The handsome and stately building so designed, which is represented in the accompanying illustration, will be 90 feet above the level of Byrom Street, and measuring from north to south 162 feet, and from east to west 190 feet, occupying an area of 27,000 square feet. The galleries of the museum will run in continuity with those in the existing building, and will be undivided in any part of their course by walls or partitions. They will be of horse-shoe shape, and 420 feet in length, 33 feet in breadth; the lower—to contain the Invertebrates—19 feet in height, while the upper—for the Vertebrates—will be 27 feet. The lower floors will be lighted from the side, and the upper from the roof. New and well-appointed laboratories—which, when the first building was erected, had been entirely overlooked, or, at that date, considered quite unnecessary adjuncts to a museum—for the director and his assistants, are also to be provided, as well as new administrative offices.

The new buildings will be of brick, faced with Stancliffe stone from the quarries at Darley Dale, in Derbyshire, the same which furnished the material of which St. George's Hall is built. They will be the largest built by the Corporation of Liverpool for fifty years, and the largest since the erection of St. George's Hall, and, next to it, the largest building in the city. The front to Byrom Street rises from the very edge of the original "Pool," and is close to the site where the old bridge connected Liverpool with the heath.

The ventilation and heating of the buildings will be carried out on a system which provides upwards of four miles of three-inch pipes, discharging into every room purified and warmed air to the amount of 8,000,000 cubic feet per hour. The stairs are of stone, the floors of concrete, and the roof chiefly of steel, so as to reduce the chance of fire to a minimum; in case of which, however, an emergency staircase will provide exit for visitors in the museum.

The work of excavating the rock, of which the slope extending west of the present museums is composed, was commenced on November 1, 1897.

On July 1 last the foundation stone was formally, and very appropriately, laid by Alderman Sir William Bower Forwood, who has for many years been Chairman of the Standing Committee in charge of the libraries, museums, and art gallery, and to whose energy and powerful advocacy, not only the approaching realisation of this much-needed extension of the two departments of technical instruction and the museums are, in a very special manner, due, but also the large increase and development of the two other departments under his chairmanship—the libraries and the art gallery.

On the stone being "well and truly laid," Sir William Forwood gave an interesting address, in which he said the City Council, by that day's proceedings, announced to Liverpool that they believed that technical instruction had come to stay with them; that it was now part of the life of the people; and that it was worthy of that magnificent home. This building

would complete what he believed would be the most unique group of buildings in the world. It was intended for the higher technical education—for educating the captains of labour, and not merely the artisans, in a way that would enable them to meet the competition of Germany. The Germans had had these superior schools for years, and had been turning out a large number of expert and scientific men such as did not exist in England. They, however, hoped to make them exist in Liverpool, and he also hoped that this building would enable them to start in Liverpool many new industries that would give employment to the surplus population, and especially to females.

Speaking of the accommodation which would be afforded to the museum, Sir William reminded them that it had been founded by a bequest by the XIIIth Earl of Derby, some sixty years ago, and had been strengthened year by year by purchase. They were able to display only about one-half of their collections, and even that was so crowded that it was impossible to attempt any classification. This building would enable them to unpack and arrange scientifically the whole of their treasures, and in a short time they would have a museum unequalled out of London. When visiting Rome, Florence, Venice, and Athens, they were attracted there, not by what the Cæsars and Doges had done, not by the spoils of war, but by the monuments of art and the stores of literature which were left behind in these cities. In the same way he hoped that these buildings would tell future generations that, while they had been strenuously engaged in commerce, they had not been forgetful of the intellectual welfare of the citizens, knowing that by doing so they were promoting public morality as well as the material prosperity of the people.

ECONOMIC BOTANY IN NYASALAND.

THE following interesting notes on some of the exotic economic trees and shrubs cultivated in the Residency Grounds, Zomba, British Central Africa, are given by Mr. John Mabon, Government Botanist, in the annual report on the Protectorate for the year 1897–98 (c-9048). Accompanying the notes in the report is a complete list of exotic trees and shrubs growing at Zomba.

The collection of exotic plants grown at Zomba possessing economic value is not at present very extensive, but it is being steadily added to. The Coffee-disease Regulations in force prevent plants or seeds being imported from several tropical centres where we could obtain many valuable things, and the long journey from England hinders us from obtaining plants in Wardian cases from the Kew establishment or any of the large nurseries, except the consignment is taken in hand by some officer of the Protectorate, or the like, who is making the voyage out and sees it safely through. The authorities at Kew, having such unusual opportunities for distributing seeds, frequently forward valuable material to us, and many of the items mentioned emanated from Kew, either as seeds or plants. The list forms an interesting record of the cultural possibilities in the climate of the Shiré Highlands. There are but few countries where one can see such an essentially cool and northern type of vegetation as the Lawson cypress (which bears seed in enormous quantities) growing alongside such an essentially tropical type as the gutta-percha of Malaya (*Dichopsis gutta*). Although it is true the latter does not reach its proper degree of development, yet it is perfectly healthy, and it points to the fact that in the lower and warmer region on the Shiré River it would be a valuable culture.

Many of the items mentioned are only represented by one plant, and many of them are not old enough to have reached the fruiting period. Some of the introductions grow with surprising vigour. For instance, eucalyptus, the seeds of which were sown about six years ago, are now over sixty feet high, and would yield very capable timber if required. The well-known blue gum is not, however, a success here, but it seldom is in these latitudes below the 5000 feet level. Still there remains numerous equally good, and even better, members of this useful genus which we can cultivate with success.

Mauritius hemp (*Furcræa gigantea*) and sisal hemp (*Agave rigida*, var. *sisalana*) grow with great freedom, and while it would scarcely pay to cultivate these valuable fibres at present for the European market, yet if any textile industries arise locally there can soon be plenty of raw material at hand to supply them.

Seeds of the celebrated China grass (*Boehmeria nivea*), a fibre very much in demand now, have been ordered, and it is intended to demonstrate that it is a profitable culture that might be grown in Nyasaland with the object of exportation to the European markets. Arnatto (*Bixa orellana*) fruits with great profusion; the seeds are used in the arts as a dye, and as colouring agent for butter; the supply at present, however, from Colonies like the West African, exceeds the demand.

Fruits are a very important culture in all tropical countries, and the indications point to the Shiré Highlands being suitable for raising the fruits of many diverse countries. The mango (*Mangifera indica*) grows with much luxuriance, but as all the existing plants at Zomba have been introduced recently they have not yet reached the fruiting stage. One tree is expected to yield some fruit this year. The same applies to oranges, avocado pear, and guavas, although at present one tree of the latter is maturing fruits. (On the Buchanan estate, close to the Residency, oranges bear with great profusion, and up till recently peaches were a great success there.) The granadilla (*Passiflora quadrangularis*) fruits freely, and the fig (*Ficus carica*) seems quite at home. The grape vine grows well, and is a recent introduction; we expect to see it fruiting next year. Bananas, it need hardly be remarked, bear with great abundance. Up to the present this is practically the only fruit the native grows.

Exotic timber trees are very promising. The red cedar (*Juniperus virginiana*) and West Indian cedar (*Cedrela odorata*) do extremely well, and are important in view of the expected development of the tobacco industry, as they supply material from which first-rate cigar boxes can be manufactured. Kauri pine (*Dammara Australis*), a timber of great value and utility, promises to become a great success here, for seedlings planted a year ago have reached over three feet in height. Mahogany does very well. The good offices of Kew have been requested in obtaining for us a large quantity of seeds in order that we can grow it on a considerable scale and distribute it over the Protectorate. The splendid Mlanje cedar (*Widdringtonia whytei*) grows with unexampled vigour at Zomba, which is at least 3000 feet lower than its native habitat. It is very interesting to find it doing so well here, and points to the fact that in time the hills of Nyasaland above the 3000 feet level can be successfully forested with this excellent timber. Seeds from the trees at Mlanje have been widely distributed amongst Government officers, missionaries, and planters in the Protectorate, as well as to various parts of Southern Africa.

Perhaps enough has been said to indicate the diversity of cultures possible in the Protectorate. The Botanical Department at Zomba is very young yet, but endeavours are being made to render it of service to the country. As it is, it can demonstrate that many plants of commercial importance find a suitable home in the soil and climate of Nyasaland.

THE IRON ORE DEPOSITS OF NORTHERN SWEDEN.

OF the excursions in connection with the last meeting of the Iron and Steel Institute in Sweden, none was of greater interest than the visit to the vast mountains of iron ore at Kiirunavaara and Luossavaara within the Arctic Circle. The party of members invited by the owners of the mines was necessarily limited, and the journey was long and arduous. After travelling 820 miles by railway, the party proceeded in carriages for forty miles over a loose shingle road, then for forty miles more up the Kalix river in boats poled against the stream, and lastly for ten miles on foot. The visit to the mines was made under the guidance of Mr. H. Lundbohm, of the Geological Survey of Sweden, who contributed to the meeting an interesting paper describing the deposits. From this the following details are derived:—

The character of the country is very remarkable. The Kiirunavaara mountain consists of a steep ridge extending for about 2½ miles, divided into a series of peaks varying in height from 270 to 2450 feet above the lake Luossajärvi, which separates it from the gently sloping conically shaped Luossavaara. On the tops of these mountains the ore lies almost entirely uncovered by soil; on the sides it is covered by morainic material and beds of gravel and sand; while the mountains are

surrounded by extensive morasses. The ore occurs in bed-like masses in porphyries of varying character and composition. The total length of the Kiirunavaara ore body is 15,500 feet. The width is usually 330 feet, but in one place it is as much as 840 feet. The dip varies from 45° to 60°. It is estimated that the quantity of ore available above the level of the lake at Kiirunavaara is 215,000,000 tons, and at Luossavaara 18,000,000 tons.

The Kiirunavaara ores differ widely from most Swedish ores. They are unusually hard and compact, and remarkably free from all foreign minerals except apatite. That mineral is, however, exceedingly abundant. Analyses show that ores occur with less than 0·05 per cent. and from 0·05 to 0·1 per cent. of phosphorus in such quantities that they can be mined separately. The bulk of the ore, however, contains 1 to 4 per cent. of phosphorus. The percentage of sulphur is usually 0·05, and sometimes less than 0·02. Titanium varies from 0·32 to 0·95 per cent., and manganese does not exceed 0·32 per cent. The great bulk of the Luossavaara ore is comparatively low in phosphorus, and much of it appears to be well adapted for the acid Bessemer process.

No serious attempt was made to work these deposits before 1880, when a concession was granted for the construction of a railway from Luleå to the Ofoten fjord; but the concession was withdrawn after the railway had been completed from Luleå to the iron mines at Gellivare. This year, however, the Swedish parliament authorised the construction of a railway from Gellivare, past the Kiirunavaara and Luossavaara deposits, to the Norwegian frontier; and the Norwegian parliament has authorised its being continued to Victoria Harbour, on the Ofoten fjord, a port free from ice throughout the year. The distances from the iron ore deposits along the projected line of railway are—to Gellivare, 63 miles; to Luleå, 182 miles; to the Norwegian frontier, 79 miles; and to Victoria Harbour, 120 miles. Within a short period these vast supplies of iron ore will thus be rendered available, and British ironmasters will have within easy reach sufficient ore to last for many generations to come.

ELECTRICAL STAGE APPLIANCES.

THE proposed application of electrical power for mounting plays at Drury Lane, on the lines advocated by Mr. Edwin O. Sachs, has now taken a tangible form in the completion of the first section of the stage installation in time for the impending pantomime.

Mr. Sach's present work refers principally to the stage floor and its movability in sections above and below the footlights. The total area now already movable by mechanical power exceeds 1200 square feet.

The electrical appliances just completed take the form of so-called "bridges," each working independently. Each individual section measures 40 feet by 7 feet, and weighs about 6 tons, of which about 4 tons are counterbalanced. They can travel about 20 feet vertically.

The motive power is from the ordinary electric supply mains over a four-pole motor, developing 7½ horse-power at 520 revolutions per minute. The "bridges" are suspended from cables, and these, working over the motor, allow the former to be raised with the necessary live load at rates varying from 6 feet to 20 feet per minute.

Every possible safeguard has been taken against accident, the "bridges" themselves being so constructed that in the event of derangement of current the appliances can be worked by hand gear. Automatic switches are provided so as not to be entirely dependent on the attendants, and automatic catches will work in case of rope-breaking. Special locking-gear has been installed to hold the "bridges" stationary at certain points, such as stage level, and a very large factor of safety has been allowed in apportioning the strengths and weights in the various parts of the mechanism, having special regard to the ever-increasing scenic requirements under Mr. Arthur Collins's able management.

As regards the economic aspect of the electrical installation, the initial outlay on the system adopted is about half that of continental hydraulic work. The maintenance is minimal, whilst the actual working only costs a few pence per performance. The saving in manual labour on the stage is very considerable, whilst the hygiene of the theatre is materially raised by the absence of woodwork.

METALLIC ALLOYS AND THE THEORY OF SOLUTION.[1]

THE term alloy in its technical sense is used to indicate a solid mixture of two or more metals. The earlier investigators in this field, such as Matthiesen, Richie and many others, worked mainly with solid alloys, and they endeavoured to investigate the change in properties of the alloy, such as conductivity for heat and electricity, malleability, ductility and the like, with successive small changes in composition.

This method, although well adapted to bring out properties of alloys suitable for use in the arts, has not till recently shed much light on the real constitution of this interesting group of substances. Chemists have neglected the subject because the ordinary processes by which they attack problems fail them when dealing with alloys, on account of their opacity, want of volatility and power of being separated from one another by crystallisation. Another difficulty arises from the fact that the resulting alloy has usually the same colour as the metals from which it is produced, except in a few cases, such as the rich purple alloy of gold and aluminium investigated by Prof. Roberts-Austen, and the alloy of zinc and silver noticed by Matthiesen and investigated by Neville and Heycock, which has the property of taking a superficial rose tint when heated and suddenly cooled.

During the past twelve years considerable advance has been made in the study of alloys by investigating some of their properties whilst in the liquid state, such as the temperature at which solidification commences; it is convenient to term this temperature the freezing point. Le Chatelier, Roberts-Austen, Neville, myself and others have all worked in this way. The result of this work may be very briefly stated as follows.

Solutions of metals in one another obey the same laws that regulate the behaviour of solutions of such substances as sugar in water. For example, if we take solutions of sugar of different concentrations, but not exceeding 3 or 4 per cent., we find that within these limits the lowering of the freezing point is nearly proportional to the concentration. Exactly in the same way, if we add to a quantity of molten sodium (freezing point 97° C.) some gold, we find the gold dissolves much in the same way that sugar dissolves in water. On determining the freezing point of the alloy we find that it is lowered in direct proportion to the weight of gold added, notwithstanding the fact that pure gold by itself melts at a temperature of 1060° C. It is remarkable that the effect of increasing the quantity of gold in the alloy continues to depress the freezing point of the sodium, until the alloy contains more than 20 per cent. of gold when the minimum freezing temperature 81·9° C. (eutect temperature) is reached. The case of gold dissolving in sodium may be taken as a very general one, for a large number of pairs of metals have been examined, and with but few exceptions, such as antimony dissolved in bismuth, the effect is almost always to produce a lowering of the freezing point of the solvent metal. By the solvent metal we generally mean the metal which is present in the largest quantity.

A second point in which metallic alloys resemble ordinary solutions is in the fact that the depression of the freezing point is inversely proportional to the molecular weight of the dissolved substance. Thus, if we dissolve 342 grams (molecular weight in grams) of cane sugar in 10 litres of water, and determine the freezing point of the solution, it is found to be depressed a definite number of degrees below that of pure water. But the same depression of the freezing point is produced by the solution of 126 grams of crystallised oxalic acid, or only 32 grams of formic acid, in 10 litres of water.[2] Alloys again appear to obey the same law; thus it is found that if we dissolve 197 grams of gold, or 112 grams of cadmium, or 39 grams of potassium, respectively, in a constant weight of sodium, the freezing point of the sodium will be lowered by almost the same number of degrees in each case. Now the numbers 197, 112 and 39 are the atomic weights of the metals, and it can be shown that these numbers are also probably the molecular weights of these elements. Hence we conclude that metals dissolved in each other obey the same laws as ordinary solutions.

The above facts for the behaviour of solutions of substances

[1] A discourse delivered at the Royal Institution by Mr. Charles T. Heycock, F.R.S.

[2] Although water is used as a solvent by way of illustration in these cases, it should be stated that it is by no means a suitable liquid for such experiments, owing to the changes it brings about in the substances dissolved. In making such experiments it is far preferable to use benzene or acetic acid as a solvent.

in water and organic liquids have been gradually accumulated by the work of Blagden, Rüdorff, Coppet and Raoult, extending from about 1780 to the present time, but no general explanation of them was brought forward until Van 't Hoff advanced the remarkable theory that a dissolved substance was in a condition somewhat analogous to that of a gas, the solvent substance serving the part of the vessel in which the gas is confined, but also exerting other effects.

He further gave strong reasons for believing that substances in dilute solution obeyed the same laws that gases do—*i.e.* the laws of Boyle and Charles for temperature and pressure. Several other theories of solution, besides what may be termed the gaseous theory, have been proposed. Notwithstanding that some weighty objections can be urged against this theory, it is remarkable that we can by aid of it predict the numerical values for the fall of the freezing point of different solvents produced by the solution of other substances, provided that we know the latent heat of fusion of the solvent.

On applying the same reasoning to alloys, we find that the theory holds good, as the table below shows.[1] We see from

Observed Depression in the Freezing Point of a Solvent Metal, caused by the Addition of One Atomic per cent. of a Second Metal.

Solvent		Tin	Bismuth	Cadmium	Lead	Zinc
Depression calculated on theory of Van 't Hoff		3·0° C.	2·08° C.	4·5° C.	6·5° C.	5·11° C.
Metal dissolved	At. Wt.					
Sodium ...	23	2·8	2·0	4·5	1·2	—
Copper ...	63	2·9	1·2	3·6	6·3	1·5 (rise)
Silver ...	108	2·9	2·0	10·8 (rise)	6·6	5·15 (rise)
Platinum ...	195	—	2·1	4·5	6·4	—
Gold ...	197	2·9	2·1	1·6	6·4	3·4 (rise)
Bismuth ...	209	2·4	—	4·5	3·0	5·1

this table that in no cases are the observed depressions of the freezing points greater than those calculated from the theory, but in many cases they fall below this quantity; this latter fact admits of explanation.

On the theory of Van 't Hoff it is necessary that when a solution begins to freeze the pure solvent should separate out first. This admits, in case of aqueous solutions, of simple proof; for if we take a dilute solution of potassium of permanganate and make it freeze slowly, we find that pure colourless ice separates out on the walls of the vessel, whilst the purple permanganate is concentrated towards the centre. This experiment led Neville and myself to try if a similar state of things could be shown for metallic alloys.

We have great pleasure in bringing before the Royal Institution this evening the first announcement of the results we have obtained. For this purpose we took two metals, gold and sodium, the former being very opaque to X-rays, whilst the latter is very transparent to them. A quantity of sodium was melted in a tube, and gold dissolved in it to the extent of about ten per cent. The alloy was then allowed to cool extremely slowly, and sections (about ¼ inch thick) were cut from different parts of the solid alloy and placed between thin plates of aluminium to protect them from the air. These sections were then placed on a photographic plate, enclosed in a light tight bag, and exposed to the action of the X-rays. On developing the plate we found a complete picture of the inside of the alloy. Positives obtained from these negatives are thrown upon the screen. The sodium is seen to have crystallised out in plates, as is evident from its transparency, whilst the opaque gold is seen to have become concentrated in the mother liquor between these plates, where it finally solidified along with some of the sodium.

Very similar results are produced with other pairs of metals, such as aluminium and gold and aluminium and copper. Behrens, Roberts-Austen, Osmond and others have examined alloys, after superficial etching, with high microscopic powers, and they find a similar separation of the constituents.

We thus see that solution of metals in one another follows extremely closely the same laws that regulate solutions with which we are ordinarily familiar. I should like to state here that the matter of this lecture is largely drawn from the work carried out by Mr. Neville, F.R.S., and myself during the past six years.

[1] For the nature of this calculation, *vide* Heycock and Neville, *Chem. Soc. Jour.*, vol. lvii. p. 339. Also Neville, *Science Progress*, October 1895.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The electors to the Linacre Professorship of Comparative Anatomy will proceed to an election in the course of Hilary Term, and candidates are desired to send in their names to the Registrar of the University not later than January 31, 1899. The Board of Electors consists of the Visitor of Merton College (the Archbishop of Canterbury), the Presidents of the College of Physicians and the College of Surgeons, the Waynflete Professor of Physiology, the Regius Professor of Medicine, an elector appointed to represent Merton College, and an elector appointed to represent the Hebdomadal Council. The Hon. G. C. Brodrick, Warden of Merton, has been appointed by Merton College, and the Dean of Christchurch by the Hebdomadal Council.

The electors to the Sedleian Professorship of Natural Philosophy, vacant by the resignation of Prof. Price, will also proceed to an election in the course of Hilary Term, and names of candidates are to be sent in not later than January 31. The Board of Electors consists of the Vice-Chancellor, the President of the Royal Society, the Provost of Queen's College, the Professor of Experimental Philosophy, Savilian Professor of Geometry, an elector appointed to represent Queen's College, and an elector appointed to represent the Hebdomadal Council.

Prof. Elliot and Prof. Rücker have been chosen as the last-mentioned electors.

THE Calendar of University College, London, for the session 1898–99, has just been received. The purpose of the College, as expressed in the Act of 1869, whereby the College was re-incorporated with additional powers, and divested of its proprietary character, is "to afford at a moderate expense the means of education in literature, science, and the fine arts, and in the knowledge required for admission to the medical and legal professions, and in particular for so affording the means of obtaining the education required for the purpose of taking the degrees now or hereafter granted by the University of London." During last session the following new departments were created: Laboratory of Experimental Psychology, Pender Chair of Electrical Engineering, the Edwin Chadwick Chair of Municipal Engineering. It is interesting to note that in the department of applied mathematics, Prof. Pearson gives, in the place of advanced class examinations, subjects for dissertations referring to the mathematical theory of statistics.

MR. W. C. MCDONALD'S benefactions to the McGill University, Montreal, have often been the subjects of notes in these columns, and last week we recorded that he had received the honour of a knighthood in recognition of his gifts to philanthropical and educational objects in Canada. Mr. McDonald's princely gifts to the McGill University include 20,000 dollars to the Workman endowment for mechanical engineering; the erection of the W. C. McDonald engineering building, valued, with its equipment, at 350,000 dollars, and an endowment for its maintenance; the endowment of the chair of electrical engineering with the sum of 40,000 dollars; the erection and endowment of the physics building, valued at 300,000 dollars, and two chairs of physics with endowments amounting to 90,000 dollars; the endowment of the faculty of law with 150,000 dollars; the endowment and equipment of the chair of architecture; a further sum of 150,000 dollars for the maintenance of the engineering building; 50,000 dollars towards the endowment of the pension fund; and the erection of a new building for the Department of Chemistry, Mining, and Agriculture, at a cost of 500,000 dollars, making the total amount contributed to the institution upwards of 1,600,000 dollars.

THE Executive Committee of the Central Welsh Board have unanimously passed the following resolutions, among others, referring to the Board of Education Bill, and have forwarded copies to the Education Department and the Charity Commission, with an intimation that they will be brought before the

Central Board at their half-yearly meeting in April next. "That Clause 1 (2) of the Bill should be amended by omitting the words 'one other person,' in order to insert the words 'two other persons, one of whom shall be a person well acquainted with the conditions of Wales and the wants of the people.'" "That considerable difficulty might arise in the future from the apparently concurrent jurisdiction of the Board of Education and the Charity Commission foreshadowed in Clause 2 (2) and (3), and that it is important therefore that the Bill should be so amended as to provide for a completer fusion of these two bodies." "That the Bill should be so amended as to indicate clearly that there will be no interference with the present organisation of intermediate and technical education in Wales and Monmouthshire under the Welsh Act, and that provision should be made for preserving to the Central Welsh Board the functions exercised by it under its scheme, and under the Treasury regulations already in force, for the inspection and examination of schools in the Principality." "That the Central Welsh Board might properly be regarded as a Consultative Committee, to which matters specially connected with Welsh education might be referred by the Board of Education for consideration and report."

SCIENTIFIC SERIALS.

American Journal of Science, December.—Another episode in the history of Niagara Falls, by J. W. Spencer. The first episode of the river was characterised by a cascade comparable in size to the American Falls, draining the Erie basin alone. The commencement of the second episode was marked by an increase in the volume of water, owing to the drainage of all the upper lakes being turned into the Niagara. Subsequently the fall was increased from 200 to 420 feet. Instead of continuing until reduced to its present height of 326 feet, the author now believes that it was reduced to a lower amount, 250 feet, and subsequently increased. This additional episode accounts more fully for the narrows of the gauge than any previous explanation. The age of the Falls will probably come out a little different from 32,000 years, but their fate will be the same. They will disappear by the lakes being drained into the Mississippi basin by way of Chicago.—An apparatus for measuring very high pressures, by A. de Forest Palmer, jun. The pressure in a Bessemer steel cylinder filled with heavy oil compressed by a tinned-steel screw is measured by a thread of mercury in a capillary tube whose resistance alters with the pressure in a manner previously determined by the author. Pressures upwards of 4000 atmospheres may be thus measured.—The application of iodine in the analysis of alkalies and acids, by C. F. Walker and D. H. M. Gillespie. The reaction between iodine and hydroxides of the alkalies and alkaline earths in hot solution is regular and complete under analytical conditions, not being appreciably affected by the mass action of considerable excesses of iodine. The reaction is best applied in analysis by titrating the alkali with an excess of iodine, removing this excess by boiling, and estimating the iodine in the residue.—Some new tertiary horizons discovered near Punta Arenas, Chile, by A. E. Ortmann. These beds, examined by Mr. J. B. Hatcher, represent two new horizons different from and older than the tertiary beds known as Patagonian, containing a marine fauna completely new to science.—A biotite-tinguaite dike from Manchester-by-the-Sea, Essex Co., Mass., by A. S. Eakle. This dike cuts through the augite-syenite of Gales rock near Manchester. It is six inches wide, and exposed for twenty feet. It is very difficult of access, and is only exposed at low water. The rock has a greenish-grey colour and a slightly greasy lustre, like tinguaites and rocks rich in nepheline. Small phenocrysts of felspar are visible in the somewhat compact ground mass, and also much magnetite, mixed with biotite, occurs in brownish-black patches, giving the rock a mottled appearance.

Wiedemann's Annalen der Physik und Chemie, No. 12.—Genesis of the electric spark, by B. Walter. The author mounts a long sensitive plate on a little car moving on rails and driven by a falling weight. The discharge from an induction coil is so timed that at least two sparks are recorded. The negatives show that each spark consists of several successive discharges in the same direction, at intervals of $2\cdot7 \times 10^{-4}$ secs. The spark is invariably preceded by brush discharges, and in places where the spark is bent, a small brush-like appendage appears, showing that the spark changed its direction in consequence of too large a resistance.—Genesis of the point discharge, by E. Warburg. When a needle-point is mounted in the centre of a metallic sphere and charged to a certain minimum potential, a continuous discharge passes from the point to the sphere. The author finds that the discharge sets in about 0·007 seconds after the potential has attained the proper value.—Properties of the stratified brush discharge in the open air, by M. Toepler. When the current intensity of an influence machine discharge is raised from zero to a high value, the discharge, at first an ordinary brush discharge, takes the form of sparks, and is eventually converted into a stratified "brush light arc," showing white kathode light, scarlet positive light, and anode glow. This is another proof of the essential identity of open-air and vacuum discharges. If the gap is very small, only the spark discharge can be produced.—Tuning-plates as a substitute for tuning-forks at high pitches, by F. Melde. Small square Chladni plates, say 5 cm. wide and 0·5 cm. thick, give high notes whose pitches can be safely calculated from their dimensions. They can also be experimentally determined by the author's resonance method, being made to transfer their vibrations to a rod whose length is adjusted until distinct nodes are formed, made visible by sound. Notes of pitches up to 30,000, and quite inaudible to most ears, can thus be produced and studied.

The Quarterly Journal of Microscopical Science (November) contains papers on the development of the pig during the first ten days, the structure of the mammalian gastric glands, certain green (chlorophylloid) pigments in invertebrates, a larva in the metanauplius stage, and the nephridia of the Polychæta (Part ii.).

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19.—"'Nitragin' and the Nodules of Leguminous Plants." By Maria Dawson, B.Sc. (London and Wales.) Communicated by Prof. H. Marshall Ward, F.R.S.

A study of the nodules found upon the roots of leguminous plants has led the author to an unhesitating confirmation of the parasitic nature of both the filaments and the bacteroids contained in these organs. The filaments, it was found, have no such constant relation to the nucleus of the cells, as was represented by Beyerinck in 1888. By plasmolysis of the root-hairs, the infection tube is shown to have grown into the hair, and not to correspond with the primordial utricle of the hair, a result which proves that Frank was mistaken in regarding the tube as formed from the contents of the hair mingled with fungal protoplasm. By staining with aniline blue and orseillin these tubes and the filaments in the cells were shown to consist of strands of straight rodlets, lying parallel to the longer axis of the filament, and embedded in a colourless matrix. This matrix does not consist of cellulose, chitin, or any form of mucilage. The swellings upon the filaments occur at places where the rodlets have become heaped up, and at such places the filaments eventually burst, liberating the rodlets, whilst they themselves remain as pointed portions, directed towards each other in the cells. After liberation from the filaments, the rodlets become transformed into X, V, and Y-shaped bacteroids. This variety of shape does not occur when these organisms are cultivated outside the plant on a solid medium, but in liquid pea extract, the change from straight rodlets to "bacteroids" occurs in a few days. By cultivating these organisms in drop cultures under constant observation with high powers, these rodlets are seen to multiply by division into equal, or sometimes slightly unequal, halves. By this method the author hopes also to determine whether the change in shape arises from fusion of two or more individuals or by branching. Their multiplication by division leads to the conclusion that these organisms are members of the Schizomycetes; whether or not they are true bacteria must, however, still be undecided until the final stage in their life-history has been fully followed.

The X, V, or Y-shaped bacteroid, when once formed appears to be incapable of further growth. These organisms are aërobic in character, their power of fixing atmospheric nitrogen is to be tested in connection with their growth on silicic acid gelatin.

Commercial "Nitragin" consists of minute micrococcus-like bodies, all straight and immobile. They multiply rapidly on gelatin media, and in pea extract become converted into "bacteroids" as well as straight rods. Nitragin does consist of the tubercle organism, and as a result of the inoculation of either seeds or soil with it, tubercle formation takes place. Crossing of kinds supplied for different genera and species is quite successful within the tribe Vicieæ. In order to test the possibility and conditions of direct infection of the roots, seedling peas, starting both before and after germination, were grown in sterile tubes, by which means the whole plant was kept under control. This method showed that direct infection of quite young radicles is tolerably certain, also of older roots, provided the conditions under which germination occurred are maintained after infection.

In order to secure infection it is not necessary that the organism should pass through the soil, and the age of the root-hair at the time of infection seems to be without effect upon the result. An accumulation of CO_2 round the roots is not the cause of failure in direct infection.

The addition of nitragin to soils rich in nitrates appears to be inadvisable, but a supply of it to soil poor in nitrates results in an increased yield, though better results are obtained if instead of nitragin, nitrates be added to the soil.

Royal Meteorological Society, December 21.—Mr. F. C. Bayard, President, in the chair.—Captain A. Carpenter, R.N., gave an account of the hurricane which caused so much devastation in the West Indies in September last. The cyclone, passing eighteen miles south of Barbados, swept over the southern half of St. Vincent Island, then took a north-west direction towards Aves Island, its rate of progression being about seven and a half miles per hour. From here it pursued a northerly course for 450 miles, passing between Puerto Rico and the Windward Islands. It then swerved to the north-west for 600 miles, when it re-curved to the north-east. Its diameter was eighty miles as it approached Barbados, and 170 miles after leaving St. Vincent. The actual storm-centre (in which the force of the wind greatly increased) was only thirty-five miles in diameter until St. Vincent was passed, but after that the strength of the wind extended to 170 miles from its centre. The diameter of the calm vortex, or "eye" of the storm, was not less than four miles. The storm was accompanied by very heavy rainfall, the amount at St. Vincent being about 14 inches in the twenty-four hours ending at 9 a.m. on the 12th. The barometer at the Botanic Gardens, Kingstown, on the 11th, fell from 29·539 inches at 10 a.m., to 28·509 inches at 11.40 a.m., a fall of 1·03 inches in 1 hour 40 minutes. In Barbados 11,400 houses were swept away or blown down, and 115 lives were lost; and in St. Vincent 6000 houses were blown down or damaged beyond repair, and 200 lives lost.—Mr. W. H. Dines read a paper on the connection between the winter temperature and the height of the barometer in North-western Europe. From an examination of the records of the barometer and temperature at several observatories, extending over many years, the author is of opinion that the winter temperature at a place in Western Europe has no connection with the height of the barometer at that place, and that in winter it is just as likely to be cold when the barometer is below the average, as when it is above the average.

MANCHESTER.

Literary and Philosophical Society, December 13.—Mr. J. Cosmo Melvill, President, in the chair.—Dr. G. H. Broadbent described some microscopical observations he had recently made in the development of a Rotifer (*Philodina microps*) obtained from an infusion of bicycle mud. Two days after the organism was found the ovum was extruded, and was under observation for two days, when it was lost. On the following day another ovum was discovered, and the stages of development were observed day and night (with only seven hours' intermission) for four days, at the end of which period the organism emerged from the ovum fully formed.—Description of a new genus and species of Hymenoptera (*Liaba balteata*) from Chili, by Peter Cameron. The description is based on a single male specimen, which is undoubtedly closely allied to the genus *Nomadina* of the family *Trigonalidae*. This family the author proposes to dlvide into two tribes, *Trigonalinae* and *Nomadinae*, the former containing the genus *Trigonalis*, and the latter the genera *Nomadina* and *Liaba*.—Vestiges of primitive man found near Todmorden, by Dr. J. Lawson Russell. In July last the excavation of a curious "ring barrow" at Blackheath, near Todmorden, Yorkshire, was undertaken by Alderman Crossley and Messrs. Wilkinson and Lowe, of Todmorden, which resulted in the finding of the remains of several cinerary urns. The work of excavation was continued in November by Dr. Russell, who found a number of other urns, four of which, together with the various objects found with them—bone pins, a bronze knife, whetstones, beads of resin, lignite, pot and bone, and also several small vessels enclosed in the urns, of the kind usually known as "incense pots"—have been carefully restored by Messrs. Standen and Hardy, of the Manchester Museum. The urns, which were exhibited at the meeting, are all of different patterns and variously ornamented. The paper was illustrated by about fifty lantern slides prepared from photographs mostly taken on the spot, and showing the position of the urns *in situ* prior to removal, the disposition in the circle of the various objects found, and other features of interest.

EDINBURGH.

Mathematical Society, December 9.—Dr. Morgan, President, in the chair.—The following papers were read:—Systems of circles analogous to Tucker circles, part ii., by Mr. J. A. Third; Cantor's history of Mathematics, vol. iii. part iii. (concluding): a review with special reference to the *Analyst* controversy, by Prof. G. A. Gibson.

PARIS.

Academy of Sciences, December 19.—M. Wolf in the chair.—The President delivered his annual address, and gave a short account of the work of the Correspondants and Associates deceased during the past year. The prizes for the year 1898 were awarded as follows: the Grand Prize of the Mathematical Sciences to M. Émile Borel for his memoir on the part played in analysis by divergent series, M. Maurice Servant being awarded an honourable mention. The Bordin Prize was not awarded; the Francœur Prize was awarded to M. Vaschy, and the Poncelet Prize to M. Hadamard. In Mechanics, the Extraordinary Prize of 6000 francs was divided between MM. Baude, Charpy, Thiébaut, Ravier, and Moissenet; the Montyon Prize awarded to M. de Mas for his researches on the resistance of water to moving boats; a Fourneyron Prize to M. Bourlet, another being divided between MM. Carvallo and Jacob, and an honourable mention to Mr. Sharp. In Astronomy, the Lalande Prize is given to Dr. S. C. Chandler for his researches on the variation of latitude and on variable stars, M. Chofardet receiving an encouragement; the Damoiseau Prize is given to Prof. George Williams Hill for his numerous astronomical memoirs, the Valz Prize to M. P. Colin, and the Janssen Prize to M. Belopolsky. In Statistics, the Montyon Prize is awarded to M. Alfred des Cilleuls, M. Martial Hublé receiving a very honourable mention, and M. Paul Vincey an honourable mention. In Chemistry, the Jecker Prize is divided between MM. G. Bertrand, Buisine and Daniel Berthelot, Dr. C. A. Schott receiving the Wilde Prize. In Mineralogy and Geology, the Vaillant Prize is awarded to M. Cayeaux; and in Botany, the Desmazières Prize to M. G. Battista de Toni, the Montagne and La Fons-Melicocq Prizes not being awarded; but M. le general Paris and Dr. Ledoux-Lebard receive encouragements. In Anatomy and Zoology, the Thore Prize is given to M. Pantel for his contributions to the knowledge of parasitic organisms and their relations with the host, and the Savigny Prize to M. Courtière for his researches on the marine fauna of the east coast of Africa. In Medicine and Surgery, Montyon Prizes are received by MM. Widal, Sécard, Bard, Poncet and Bérard. Mentions are given to MM. Le Double, Variot, and Kirmisson, the Barbier Prize being given to Dr. J. Comby, the Bréant Prize to M. Phisalix, the Bellion Prize to M. Castaing, and the Baron Larrey Prize to MM. Regnault and de Raoult. The Godard Prize is divided between MM. Motz and Guiard, the Mège Prize between MM. Labadie-Lagrave and Félix Legueq, and the Lallemand Prize between Mr. E. P. Allis and M. Thomas. In Physiology, the Montyon Prize for experimental physiology is awarded to M. Tissot, honourable mentions being accorded to MM. Dassonville, Lesbre, Reynaud and Mlle. Pompilian, the Pourat Prize to MM. Courtade and Guyon, and the Philipeaux Prize to M. Moussu. In Physical

Geography, the Gay Prize is given to M. Sauvageau. Of the general prizes, the Leconte Prize is not awarded this year, M. Fremont receiving the Montyon Prize (unhealthy trades), Mme. Curie the Gegner Prize, M. Émilio Damour the Delalande-Guérineau Prize, M. Chaffanjon the Tchihatchef Prize, M. Édouard Branly the Houllevigue Prize, M. Félix Bernard the Saintour Prize, M. Munier-Chalmas the Estrade-Delchos Prize, and M. Mérigeault the Laplace Prize. The following prizes are divided: the Jérome-Ponti Prize between MM. Guichard and Lemoult, the Cahours Prize between MM. Hébert, Metzner, and Thomas; M. Blanc receiving an encouragement, and the Kastner-Boursault Prize between MM. André Blondel and Paul Dubois and M. Paul Janet. The Rivot Prize is awarded to MM. Mérigeault, Defline, Le Troquer, and Gérin.

AMSTERDAM.

Royal Academy of Sciences, November 26.—Prof. Van de Sande Bakhuyzen in the chair.—Prof. Beyerinck, on a contagium vivum fluidum, causing the spot-disease of tobacco leaves. This disease, also known as the mosaic disease of tobacco leaves, may be inoculated into healthy plants by injecting into the stem, near a bud, sap pressed from infected plants. The active virus passes completely through the pores of very dense porcelain, and can even penetrate into agar by diffusion; therefore it cannot be a contagium fixum in the usual sense, but it must be fluid. Out of the tobacco plant it cannot be made to multiply; but in the dividing tissues of the leaf-rudiments and the meristems of the buds it multiplies freely and over a great extent. A very small drop of the porcelain filtrate can render all the leaves of the infected plant entirely covered with spots, and the sap of these leaves would be sufficient for the contagion of an unlimited number of healthy plants. The virus is destroyed by boiling at so low a degree as 90° C.—Prof. Bakhuis Roozeboom, on the phenomena to be observed on the solidification of liquids, consisting of two tautomeric forms. In the case of equilibrium being established between these forms at the temperature of solidification, these phenomena have been treated by Bancroft. A new deduction was given for those cases in which solidification takes place at temperatures at which no equilibrium can be established any more in the liquid, and specially when supposing that one passes from the region of equilibrium through two regions of one-sided equilibrium to the region of non-equilibrium. All the various consequences of slow and quick heating and cooling may be graphically represented.—Prof. Van der Waals deduced from the phase equation for a mixture, given by himself, the laws for Δ_v (the volume contraction on mixing under constant pressure) and Δ_p (the pressure contraction on mixing in given volume), and compared the results, obtained by himself, with the observations of Kuenen and others in the case of mixtures of carbonic acid and methyl chloride. According to Amagat, Δ_v would be $=0$, and according to Dalton's law, $\Delta_p=0$. The results, arrived at by the author, may briefly be summed up as follows: Δ_v is small all along the course of the isotherm, and the amount may be considered a magnitude of the same order. On the other hand, Δ_p follows a course equal to the deviation from Boyle's law, and when the volume is small it approximates infinity.—Prof. Van Bemmelen presented for publication in the *Proceedings* a communication by Mr. F. A. H. Schreinemakers, entitled, "Equilibriums in systems of three components, variation of the temperature of solution of binary mixtures by the addition of a third component."—Prof. Van der Waals, on the errors that may be committed in the determination of the molecular weight from the vapour density in consequence of the deviations from Boyle's and Guy-Lussac's laws.

DIARY OF SOCIETIES.

MONDAY, JANUARY 2.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—On Safety Explosives: Oscar Guttmann.

VICTORIA INSTITUTE, at 4.30.—The Physiography of the Thames Basin: Prof. Lobley.

WEDNESDAY, JANUARY 4.

GEOLOGICAL SOCIETY, at 8.—Geology of the Ashbourne and Buxton Branch of the London and North-Western Railway. Part I. Ashbourne to Crakelow: H. H. Arnold-Bemrose.—The Oceanic Deposits of Trinidad, W.I.: J. B. Harrison and A. J. Jukes-Browne.

SOCIETY OF ARTS, at 7.—Hands and Feet: Prof. F. Jeffrey Bell.

FRIDAY, JANUARY 6.

GEOLOGISTS' ASSOCIATION, at 8.—The Glaciers and Fjords of the Bergen District, Norway: Horace W. Monckton.

QUEKETT MICROSCOPICAL CLUB, at 8.

BOOKS RECEIVED.

BOOKS.—Das Kleinebuch von der Marine: G. Neudec and H. Schröder (Kiel, Lipsius).—The New Gulliver: W. P. Garrison (N.Y., Marion Press).—Practical Photographer, Vol. ix. (Lund).—Die Kalturgewächse der Deutschen Kolonien und ihre Erzeunisse: Prof. R. Sadebeck (Jena, Fischer).—Das Geotektonische Problem der Glarner Alpen: A. Rothpletz, Text and Atlas (Jena, Fischer).—Studien über Säugethiere: Dr. Max Weber, Zweiter Theil (Jena, Fischer).—Sewerage: A. P. Folwell (N.Y., Wiley).—A Text-Book of Physiological Chemistry: Prof. O. Hammersten, translated by Prof. J. A. Mandel, 2nd edition (N.Y., Wiley).—Annals of Coal Mining: R. L. Galloway (*Colliery Guardian* Office).—Fossil Medusæ: C. D. Walcott (Washington).—On the Study and Difficulties of Mathematics: A. de Morgan, new edition (Chicago, Open Court Publishing Company).—Truth and Error: J. W. Powell (Chicago, Open Court Publishing Company).—Lectures on Elementary Mathematics: J. L. Lagrange, translated by T. J. McCormack (Chicago, Open Court Publishing Company).—The Fishes of North and Middle America: Drs. Jordan and Evermann, Part 2 (Washington).

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