THURSDAY, APRIL 9, 1896.

A LIFE OF LOUIS AGASSIZ.

Life, Letters, and Works of Louis Agassiz. By Jules Marcou. With illustrations. 2 vols. Pp. xxxii + 620. (London: Macmillan and Co., 1896.)

BIOGRAPHIES of Agassiz have not been wanting. In 1885 his widow published a "Life and Correspondence"; in 1893 Dr. F. Holder wrote a "Life and Work," a smaller book, which was reviewed in these pages (NATURE, vol. xlviii. p. 52); while biographical sketches, short and long, are numerous. But in M. Marcou's opinion, to quote from his preface,

"No true life of him has yet appeared: nearly all have been too eulogistic, while, on the other hand, some rather severe strictures and criticisms have incidentally appeared in articles purporting to give the life of some of his associates, or dealing with some special questions of natural history. . . . The true history of Agassiz has not yet been written."

So the task has been taken in hand by M. Marcou, who has executed it in the spirit of the "candid friend," and takes good care that the worshipper, while called upon to notice the gold, shall be in no danger of overlooking any spots of dross in the precious metal of the image. No illusion is any longer possible. We go away convinced that Agassiz was very far from faultless, a man of great strength, with a considerable share of human weaknesses, and that M. Marcou is a very superior person.

Which of the many pictures is the most true, only those who knew Agassiz intimately can judge. It may be permitted, however, to doubt whether his family will feel themselves under an overpowering debt of gratitude to M. Marcou. Granted that he does full justice to Agassiz' genius—his acuteness of observation, his extraordinary memory, his eloquence, perseverance, and powers of work—still he turns the search-light so full on his weaknesses, that they seem almost as prominent as his excellences. But does this serve any good purpose? Some of these weaknesses were inseparable from the nature of the man. Let us grant that he was unbusinesslike in his habits, that money passed through his fingers like water through a sieve, that he was always crying "give, give," even as "the daughters of the horseleech"—was this for his own enrichment, or to serve his own ends? No, it was for the sake of science; the great aim of his life was to procure abundant specimens for study, and, in America, to build up a splendid museum. Granted that he was injudicious in the selection of his assistants, and that his arrangements with them, or rather want of arrangements, sometimes led to trouble—surely the one was an error on the side of a generous trust, the other was pardonable, when the exigencies of the case are considered. How during the stress and poverty of his earlier life could Agassiz have obtained helpers had he not instituted a cœnobite establishment of some kind? How could he make very precise bargains with men to whom he could offer no stipends; who came more as fellow-workers than as assistants? Any one who has read one of the biographies already in existence can see that Agassiz sometimes made mistakes in dealing with his fellows, that he was not a good man of business, and was imprudent, we might say reckless, in matters of finance; but his imprudence was for the cause of science, not to minister to his own ease or luxury. The audacity with which he faced immense difficulties, ran risks that seemed hopeless, and almost courted ruin, if trying to relatives, friends, and even legislators, demands a lenient judgment from those who have profited by his efforts, and who recognise the greatness of his services to science.

There are of course occasions when the saying, *De mortuis nil nisi bonum*, must not be observed, when it is necessary to speak plainly of men whose work is ended. There are faults, about which a biographer cannot be silent—falsehood and treachery, gross selfishness or flagrant immorality. But of these no one can accuse Agassiz. There are times, too, when it is a duty to call attention even to the errors in science which the dead have committed; namely, when a school of this or that prophet is seeking by the glamour of their master's name to paralyse the honest worker and to check the progress of knowledge—but no one has done that wrong to the memory of Agassiz. Posterity, then, does not need that his mistakes should be proclaimed upon the house-tops; it knows them already; it is content to be thankful for the good work which he did, and to say, in regard to the bad, "Which of us shall first cast a stone against him?"

But M. Marcou himself has views on scientific controversies, and where Agassiz takes the same side, is not parsimonious in praise. For instance, Agassiz held certain views as to the origin of species opposed to those of Darwin. No opportunity is lost of belittling the latter; a chapter is even devoted to this purpose. We are virtually told that both Darwin and his supporters were more prone to evolve theories out of their inner consciousness than to make careful observations. Here is a sample of M. Marcou's condemnation.

"The most enthusiastic propagators and apostles of the new gospel were not naturalists at all, with the exception of the systematic botanist, Asa Gray. Not one of them was a zoologist, in any sense of the word. Agassiz was too much a naturalist to accept a number of mere suggestions until they were scientifically proved by exact observations."

So we learn, among other pieces of interesting information, that the evidence obtained in the more recent deep-sea dredgings is adverse to Darwin's views as to the origin of species, that had he been right the transmutation of species ought by this time to have been demonstrated by experiment; nay, that even his hypothesis regarding the formation of atolls has been proved erroneous. As to the first, M. Marcou's remarks seem curiously inconclusive; as to the second, they indicate considerable misapprehension of Darwin's views; as to the third, perhaps room still remains for difference of opinion. Darwin's hypothesis as to the origin of species and the origin of atolls may not be "the whole truth and nothing but the truth," but we believe many authorities, quite as respectable as M. Marcou, continue to regard them as at least a long step in that direction. But nothing very good, our censor hints, could be expected from Darwin and his followers.

"Physically Cuvier and Agassiz resembled each other in possessing enormous heads and largely developed

brains, while neither Lamarck nor Darwin were abnormal as regards the size and development of the head. In a crowd Cuvier and Agassiz always attracted attention, and were distinguished at once as uncommonly fine-looking men, while Lamarck, Darwin, and Huxley passed unnoticed."

We will remember Mrs. Malaprop on comparisons, and content ourselves with observing that a crowd in which Darwin and Huxley would have passed unnoticed, must indeed have been composed of remarkable men.

To put the matter shortly, the history of personal squabbles, and the indications of M. Marcou's censorious disposition loom far too large in this book. He cannot let slip a chance of having a fling at somebody, and evidently our nation in some way or other has incurred his displeasure. This, for instance, is how he comments on Murchison's objections to the general applications of Agassiz' views on the extent of land ice: "Precisely what was to be expected from the English geologists, who are always strongly disinclined to accept any new truth, if discovered by foreigners." Considering that for not a little time prior to this date (1840) English geologists had been busily employed in combating mistaken notions—chaotic menstrua, sedimentary basalts, craters of elevation, *et hoc genus omne*—largely manufactured on and imported from the continent, they may be pardoned for some prejudice in favour of home-made scientific goods. Again, in 1846, we are told, as if it were a fault, that Agassiz saw plainly during his short stay in England that "although the English leaders of science were extremely courteous and friendly to him, it was absolutely useless to expect from them the offer of any scientific position." Were they to be blamed? Was not a man so improvident and reckless in money matters as M. Marcou depicts Agassiz, almost sure to be a failure among men with the business-like habits of the English? Would not his trick of occasionally talking brilliant scientific nonsense—we take this also on M. Marcou's authority—have raised doubts as to the solidity of his knowledge among the more phlegmatic British men of science? Was there any reason, at that time, why they should import teachers from the continent? In America things were different; there the study of science was almost inchoate; the workers were few; the generation of men who now can hold their own in every branch of science against the rest of the world, were then at school or unborn. But even an award of the Copley medal to Agassiz calls forth a covert sneer from his biographer—"It was certainly well placed this time"—as though that were not usual.

But enough—the book has its good points; it supplies some *lacunæ* in Agassiz' life, it contains some interesting letters, and it reprints one or two documents not easy of access; notably his *Discours de Neuchâtel* on the Ice-Age, which, however, would have been more fitly placed in an appendix; it gives a very full list of his writings, but—it leaves an unpleasant taste in the mouth. A critical history of Agassiz' work in science, and of his contributions to natural knowledge, would have been valuable. This book is too much occupied by the details of controversies and disputes which few desire to remember, and is too obviously affected by the spirit of a partisan, to fulfil adequately any such purpose.

T. G. BONNEY.

FERMENTATION STUDIES.

Practical Studies in Fermentation; being Contributions to the Life-history of Micro-organisms. By Prof. Emil Chr. Hansen, Ph.D. Translated by Dr. A. K. Miller, F.I.C., and revised by the author. Pp. xiv + 277. (London: E. and F. N. Spon, 1896.)

THE recondite researches of scientific men are usually of too abstruse a nature to tempt their authors to exhume them from the ponderous journals to which they have been committed, and present them to the general public.

With regard to bacteriological investigations, however, the case is different, and the eagerness with which such researches are followed, has justified the appearance of such special works as Prof. Hansen's "Practical Studies in Fermentation," in which a connected account is given of original investigations scattered through divers journals and periodicals.

The appearance for the first time of an English edition of this important work, is rendered additionally welcome by the fact that such an acknowledged authority on the subject as Dr. Miller has undertaken its translation. Hansen's name is now so universally associated with pure yeast culture, that it is difficult to realise that a little more than ten years ago he was fighting his way to obtain permission from Jacobsen, the owner of the Old Carlsberg Brewery, to carry out experiments which have now rendered this brewery famous throughout the world.

Step by step, however, in the teeth frequently of vigorous opposition, Hansen has revolutionised our conception of the practice of brewing, substituting a sound scientific basis for custom hitherto directed by empiricism and tradition.

His researches on yeasts and their systematic selection and classification, have enabled the brewer to guard himself against many of those maladies in beer, which Hansen was the first to show were not necessarily attributable to bacterial contamination, but were directly dependent upon the presence of so-called wild yeasts, whilst the substitution of pure yeasts for the heterogeneous mixture previously in use, has, in his own words "helped to raise the industry, a point of great interest to the intelligent brewer."

Naturally after the identification and classification of yeast species, the next step is their successful preservation. This Hansen has found is most effectually carried out in ten per cent. solutions of cane-sugar, and so-called "stock" yeasts can be retained in this manner for upwards of fourteen years without suffering any detriment, and can be propagated at will in beer wort, and sent all over the world. Ingenious methods have been devised for the transport of yeast, and so successful have been the results, that yeast samples have been sent by Jörgensen and others from Copenhagen to South America, Asia, Ecuador, and Australia, without any deleterious effect being produced.

It would not be within the scope of the present brief notice to enter into any detailed description of the numerous and varied problems in connection with yeast fermentation which Hansen has so patiently and successfully attacked; but to the bacteriologist the discussion of the diseases of beer produced by alcoholic ferments

will doubtless prove of special interest, giving, as it does, a concise account of the history of researches commenced over a hundred years ago, which prepared the way for the advent of Pasteur, and which have conducted Hansen on to his special line of investigation.

Of great importance in all bacteriological researches is the individuality of bacteria and the variations which may be introduced by suitable means in their morphological and biological character. But whilst the impressionable nature of bacteria renders their education so particularly attractive, it also complicates in divers ways their successful investigation. Now Hansen has been led to devote a great deal of attention to the variations which are inducible in yeasts, in consequence of the suggestion that the disease yeasts, so undesirable to the brewer, may in reality only be degenerate forms of the true brewery yeasts, and that, therefore, the introduction of pure cultures cannot ensure the absence of these malignant forms. But Hansen states that although he has studied for many years the cultivation of pure yeast on a large scale, he has never seen any signs of the brewery yeasts developing forms like those characteristic of disease yeasts, that on the contrary, under the conditions obtaining in the brewery, they always retained their specific character; and he concludes by saying, "the theories of the degeneration and transformation of yeast have thus, in this respect, proved to be quite untenable."

Yet irregularities do occur in the brewery yeast itself which cause great annoyance to the brewer, and in most cases there is no clue to their cause.

That yeasts, like bacteria, are capable of artificial modification, has been repeatedly shown by Hansen. Thus he found that yeast grown in aërated wort behaved normally in the brewery as regards clarification and attenuation, whilst that grown in non-aërated wort lost, for a time at least, these functions. Again, on submitting a yeast, *Sacch. Pastorianus I.*, to particular conditions, it completely lost its power of forming spores, whilst at the same time its capacity to produce films in old wort cultures disappeared.

It is obvious of what great importance is an intimate knowledge of the conditions which are able to modify the character of yeast cells, for, even with pure cultures, the brewer is yet unable to perfectly manipulate the working of his yeast, although the elimination of unfriendly varieties has materially lightened his difficulties.

Recently the old question has been revived by Juhler and Jörgensen as to the origin of yeast cells, and it is yet a question to which we have no final answer whether they are to be regarded as independent organisms, or only forms of development of the higher fungi. Fifty years ago the latter view was held by Bail, Hoffmann, and others, but at present Juhler's and Jörgensen's observations on the development of yeast cells from the *Aspergillus oryzæ* have not been confirmed, for Klöcker and Schiönning repeated their experiments, but failed to observe the development of yeast cells.

Until we shall be in a position to trace out the parentage of yeast cells, we cannot aspire to arrive at a complete understanding of the conditions which determine their individual characteristics. The same difficulty faces the student of bacteria; whether the differences, sometimes so slight, but, as far as our means of observation at present extend, apparently quite constant between otherwise such similar forms of bacteria, are fundamental or produced from the same form by conditions of which we have no knowledge, is still one of the problems of which we have no satisfactory solution.

Just as Hansen has been able to present us with a form of yeast from a spore-producing parent which will not form spores, so, for example, Roux has introduced us to sporeless anthrax; whilst in bacterial fermentations, Percy Frankland has shown that by suitable treatment the progeny of a fermenting organism can be made to yield up its power of fermenting particular solutions, and that only by resorting to special treatment can its fermentative powers be restored to it.

In the case of the sporeless yeast, and sporeless anthrax, and the non-fermenting bacteria, it would be impossible, on casually meeting with them without a previous acquaintance with the facts, to avoid regarding them as different species of yeast and bacteria from the familiar spore-producing yeast, and anthrax, and fermenting bacteria respectively, yet we know as a fact that they are in reality but variations from the parent form in each instance.

It is obvious, therefore, how important is a knowledge of the pedigree of these minute particles of living matter to enable us to rightly appreciate their character, reckon upon their conduct, and determine their claims to be regarded as separate species.

Prof. Hansen is at present engaged in preparing a special account of his researches on these variation phenomena in yeast, and the conditions which control them; and the work cannot fail to prove of great importance not only to the practical brewer, but to all interested in the study of micro-organisms.

PALÆONTOLOGY AT THE BRITISH MUSEUM.

Catalogue of the Mesozoic Plants in the Department of Geology, British Museum (Nat. Hist.). The Wealden Flora. Part II. *Gymnospermæ.* By A. C. Seward, M.A., F.G.S.. 8vo. Pp. xi + 259; pl. 20, and 9 illustrations in text. (London, 1895.)

Catalogue of the Fossil Fishes in the British Museum (Nat. Hist.). Part III. *Containing the Actinopterygian Teleostomi of the orders Chondrostei* (concluded), *Protospondyli, Ætheospondyli, and Isospondyli* (in part). By A. Smith Woodward, F.G.S. 8vo. Pp. xlii + 544; pl. 18, and 45 illustrations in text. (London, 1895.)

THESE two catalogues, the last additions to the long series of palæontological monographs published by the Geological Department of the British Museum, testify to the value of the work there done under the supervision of Dr. Woodward. The two volumes illustrate, moreover, the strikingly different points of view from which palæontological problems are regarded. Mr. Smith Woodward's catalogue is zoological in its aims and methods, while in Mr. Seward's, though the methods are biological, the most generally interesting results are geological.

The first volume of Mr. Seward's catalogue of the Wealden plants described the Algæ, Characeæ, Equisetinæ, and Filicinæ; the present volume concludes

the account of the flora of that period, by the description of the Cycads and Coniferæ. The complete absence of Angiosperms from the Wealden is disappointing and surprising, for it was unquestionably at that period that the higher flowering plants were evolved. Both in the Potomac beds of America and in rocks of the same age in Portugal, there are remains of monocotyledons and dicotyledons. Angiosperms have been also recorded from the Wealden; but Mr. Seward, after a careful consideration of the evidence, dismisses it as invalid. Mr. Seward's catalogue contains a full description of all the known plants from the Wealden series, and he is to be congratulated on having expanded his catalogue into a complete monograph of the whole flora, which numbers seventy-six species. The present volume contains the description of twenty-four Cycads and seventeen Conifers, of each of which as full an anatomical account is given as the material allowed; the genera are discussed in detail, and important additions made to the knowledge of their structure and affinities, as in the case of *Otozamites* and *Bennettites*. Mr. Seward gives a full bibliography. He discusses the relations of the British flora to their foreign representatives, their geological position, and their evidence as to the climatic conditions under which they lived. His conclusions on these subjects are of great interest. He says the climate was apparently tropical, and that the temperature must have been considerably warmer than that which rules in the Wealden district at the present day (p. 239). It is barely necessary to point out, that geologists have always included the Wealden deposits in the Cretaceous; but Mr. Seward tells us that "the evidence of palæobotany certainly favours the inclusion of the Wealden rocks in the Jurassic series." This conclusion is in accord with that of other lines of palæontological evidence, and it may be hoped that Mr. Seward's pronouncement will hasten the inevitable dismemberment of the Wealden series into two groups, the equivalents respectively of the Neocomian and Portlandian series.

If we miss in Mr. Smith Woodward's catalogue the geological conclusions which render Mr. Seward's so interesting, it is certainly superior to it in one respect; viz. the conciseness, and precision of the diagnosis of orders, families, genera, and species. In such catalogues we too often only have the synonymy and indefinite descriptions of specimens, instead of definite, accurate diagnoses. In this respect Mr Smith Woodward's work is a model. The arrangement is strictly zoological, and thus the volume will be mainly of interest to students of icthyology. The main task of the volume is to trace the gradual evolution in the Actinopterygi from the lower Chondœstrean type to that of fish which approximated to the Teleostei. Mr. Smith Woodward describes the successive modifications of the Mesozoic fish fauna, whereby this evolution has been effected. His classification therefore represents, not an *à priori* scheme as to the probable life-history of the fauna, but an actual life-history as revealed by the records of the rocks. In groups of animals where the fossil remains are sufficiently abundant to enable this to be done, this is the ideal system of classification. Mr. Smith Woodward introduces such revolutionary changes into the families and orders, that he has been obliged to abandon the attempt to show the relations of the divisions he accepts, to those of his predecessors, by synonymic tables. The author is greatly to be congratulated on his treatment of such genera as *Acipenser*, *Amia*, and *Lepidosteus*. As members of these genera still survive, they can be dissected and their anatomy studied in detail. Hence it has been the custom to take them as the types of the Chondrostei, Protospondyli, and Ætheospondyli respectively. But as these living genera are only degenerate, or at least remarkably specialised forms, they give a very misleading idea of the typical members of the Actinopterygi. Mr. Smith Woodward, therefore reduces them to their proper position, as aberrant offshoots from the main stem. This volume is a bulky one, and it is impossible in a brief abstract to give any idea of the amount of new information it contains. The anatomical structure of each genus is carefully worked out, so that the systematic conclusions are based on morphological characters. Many of the more important genera are also illustrated by restorations, while the series of diagrams of the cranial osteology are most instructive.

Reference must also be made to the thirty-eight clear and artistic plates, which have been drawn by Miss G. M. Woodward for the two catalogues.

OUR BOOK SHELF.

The Hymenoptera Aculeata of the British Islands. A Descriptive Account of the Families, Genera, and Species indigenous to Great Britain and Ireland, with Notes as to habits, localities, habitats, &c. By Edward Saunders, F.L.S. 8vo. Pp. viii + 391. (London: Reeve and Co., 1896.)

A GREAT number of books are published at presen relating to the more popular orders of insects, especially British butterflies and moths. Some entomologists, however, devote their attention to the more varied fauna of warmer climates, and publish valuable monographs on the insects of Central America, Asia, or Africa. We are glad to find that others make the less fashionable, if equally interesting, orders of British insects their study; and although there are still many groups, and even whole orders of British insects of which we do not at present possess any trustworthy monograph, their number is lessening year by year. Mr. Saunders deserves special praise for his labours in this direction. After publishing one or two useful works on foreign insects, he turned his attention exclusively to British entomology. He has given us a work on British *Hemiptera*, which is to be followed by one on British *Homoptera*; while the book before us relates to the British *Hymenoptera Aculeata*, the section of the vast order *Hymenoptera* which includes the bees, wasps, and ants, in which the ovipositor is usually modified into a sting in the females, though in some families, as in the first family of ants, the typical *Formicidæ*, the insects do not sting, though some of them bite very severely.

It is not the first time that Mr. Saunders has dealt with the *Hymenoptera*. Synopses of the British Aculeata were published in the *Transactions* of the Entomological Society of London some years ago, in addition to important papers on structure; and the former, enlarged and brought down to date, have formed the basis of the present work. He regards the *Hymenoptera* as entitled, both by their intelligence and structure, to stand at the head of the insect world; and they reach their highest development in the *Aculeata*, which, at present, number 374 British species. Full characters of species and genera are given, including elaborate tables of species. Three

plates of structural details have been added, two of which are devoted to the structure of the mouth in the principal genera of bees. The first, however, which includes details of general structure, very carefully indicated, will prove of the greatest value to entomologists taking up the study of the order *Hymenoptera*. There is a larger edition of the work, with coloured plates of the various species; but of these we cannot speak, as they are not before us while writing. We hope that Mr. Saunders' labours may induce many residents in the country to take up the study of the order *Hymenoptera*, and ultimately to extend their researches beyond *Aculeata* to the far larger and much more neglected, though hardly less interesting, section of *Terebrantia*, which includes the sawflies, gallflies, ichneumons, &c. The parasitic groups are so numerous as to render the *Hymenoptera* probably the largest of all the orders of insects, though they have hitherto received far too little attention from British entomologists.

Ostwald's Klassiker der exakten Wissenschaften, Nos. 67 to 75. (Leipzig: Wilhelm Engelmann, 1895-96.)

WE have before us nine volumes recently added to Prof. Ostwald's very handy and useful series of reprints and German translations of classical papers. No. 67 is A. Göpel's "Theoriæ transcendentium Abelianarum primi ordinis adumbratio levis," published in 1847. This is edited by Dr. H. Weber, and translated into German by Dr. A. Witting. No. 68 should be of interest to chemists, for it contains papers by Lothar Meyer (1864-69) and Mendelejeff (1869-71) on the "Natürliche System der chemischen Elemente." This volume is edited by Dr. Karl Seubert, who adds to it some notes on Newland's work in connection with the discovery of the periodic law. A translation of Maxwell's papers on Faraday's lines of force, read before the Cambridge Philosophical Society in 1855-56, appears in No. 69 of the series, edited and annotated by Prof. Boltzmann. The following volume (No. 70) is taken up with Seebeck's papers (1822-23) on "Magnetische Polarisation der Metalle und Erze durch Temperatur-Differenz," its editor being Dr. A. J. v. Oettingen. No. 71 contains Abel's investigations of the series

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published in Crelle's *Journal* in 1826. In the volume entitled "Chemische Analyse durch Spectralbeobachtungen" (No. 72), Kirchhoff and Bunsen's contributions to spectrum analysis in 1860 are reprinted, with two coloured plates and seven figures in the text. The editor of this volume is Prof. Ostwald. Under the title "Zwei Abhandlungen über sphärische Trigonometrie" (No. 73), translations, by E. Hammer, are given of two papers by Euler—one on the outlines of spherical trigonometry (1753), and the other on general spherical trigonometry (1779). In No. 74, German readers have provided for them a translation of Berthollet's discussion of the laws of affinity (1801), edited by Prof. Ostwald. Finally, Prof. Groth edits a German edition of the work of the Finland mineralogist, Axel. Gadolin, on the "Herleitung aller krystallographischer Systeme mit ihren Unterabtheilungen aus einem einzigen Prinzipe," which forms No. 75 of this valuable series. Our only regret is that English readers have not a similar collection of edited reprints and translations of scientific classics.

The Metric System of Weights and Measures. By G. T. P. Streeter, B.A. Pp. 43. (London: Gee and Co., 1896.)

THIS short treatise is not only concerned with the metric system, but also contains "certain arithmetical principles, problems and formulæ, and an appendix on the common chemical reactions." The arithmetical contents may be useful as a supplement to ordinary books on arithmetic, but the statement of chemical reactions is "cram," pure and simple.

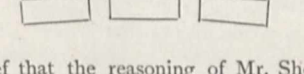
LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Stress in Magnetised Iron.

MR. WILBERFORCE'S letter (NATURE p. 462) raises some points I ought to notice. In treating of the stress and strain, my phraseology has, I think, been extremely "unmaterialistic," in the sense that I have said little or nothing about a magnetic "ether," and have employed rather the language of action at a distance. Maxwell doubtless would have put things very differently, but my own experience has been that when one wishes to avoid confusing ordinary people on such questions as the sign of a stress or strain, the less one says about "ether" the better. My discussion of Maxwell's electrostatic medium (*Proceedings* Edinburgh Math. Soc., vol. xi. p. 107) will show, I hope, that his standpoint is not unfamiliar to me. The question really at issue is the existence and sign of certain strains in *iron* and other gross materials, and I judged Prof. Ewing's mode of presenting the case, which I practically followed, to be as clear as any. If strict Maxwellians object to the association of his name—which I did not originate—with stresses answering to the strains in question, by all means let us use another term, say "Q stresses," so long as their existence is queried.

In the accompanying figure—slightly modified from that on p. 270—suppose for the moment A″ A′, AB, &c., to be straight lines. The conclusion I reached that the stress on the element AB of a uniformly magnetised bar, with air gaps AA′, BB′, is a *tension* meets, I am glad to see, with Mr. Wilberforce's support. This



implies his belief that the reasoning of Mr. Shelford Bidwell (*Phil. Trans.*, 1888, pp. 216, 217), Prof. Ewing ("Magnetic Induction," § 145), and Dr. More (*Phil. Mag.*, October 1895, pp. 349, 350)—who in the places cited have treated the existence of air gaps as immaterial—should have led them to the conclusion that "Q stresses" exist, and that they cause a *lengthening*, not a shortening, of magnetised iron.

Mr. Wilberforce's reconciliation of Prof. Ewing's present views with my own is based, I rather fear, on a fallacy. Let us consider the accompanying figure, still supposed to represent a straight uniformly magnetised bar.

When gaps AA′, BB′ exist, there must, as Mr. Wilberforce says, be forces at A″, B″ to balance the attractions exerted by AB. Let, however, A′ move up to A, and B′ to B, and equilibrium will still exist when the forces at A″, B″ are supposed to be reduced to zero. Hence, Mr. Wilberforce argues, in a continuous bar the "Q stresses" at A and B cease to exist. Let us push the argument a little further. Equilibrium will still exist when equal pressures of any magnitude are applied at A″ and B″, so that apparently the conclusion to be deduced is that the "Q stresses" are pressures *wholly arbitrary in magnitude*, which Euclid, I fear, would have declared to be absurd.

The explanation of the paradox is, I think, that when we treat A′A″, B′B″ as finite, we must suppose the conditions such as to maintain unaltered the state of uniform magnetisation originally postulated, and this does not leave the magnetic stresses at A″ and B″ arbitrary. We may of course use a magnetic bar for transmitting stresses other than the "Q stresses." For instance, if we employ two magnetising coils, carried by the bar itself, their mutual attraction or repulsion will introduce stress into the bar. (This is, I think, analogous to the case of glass and tinfoil introduced by Mr. Wilberforce.) All such stresses must be allowed for, but I think it is expedient when possible to avoid confusing them with the "Q stresses."

Mr. Wilberforce seems to me to attach too much importance to the criterion of equilibrium. The equilibrium of the element AB in the figure would be equally secured whether the stresses transmitted across the air gaps were pressures or tensions.

My illustration of the rotating anchor ring was introduced because Prof. Ewing seemed unable to realise the existence of a uniform stress—whether tension or pressure—in a simpler system than that composed of an outer hollow ring pushing or

pulling, and a connected inner ring pulling or pushing. I do not myself see that the existence of acceleration—in the strictly mathematical sense—in a ring rotating with uniform angular velocity is any real disadvantage; but if Mr. Wilberforce thinks it is, then as an accomplished and not too materialistic mathematician, he will, I hope, be satisfied with the case of a ring formed of matter repelling as, say, the inverse square of the distance.

Judging by what has passed, I think an attempt to put clearly the problem as it exists in a magnetised ring may be of service. Suppose the diagram on the preceding page to represent 3 out of, let us say, 360—or any larger number deemed requisite to justify treating arc and chord as practically identical—equal elements of a ring. When unmagnetised suppose each to be of length l, and to be separated from its neighbours by extremely small air gaps of width λ. The elements may be supposed to lie on a smooth horizontal table. When uniformly and equally magnetised each element will change in length, let us suppose lengthen, by the same amount δl. This lengthening is due presumably to several causes; of which one is the tension which experiments by Dr. Taylor Jones and others have shown to be nearly $B^2/8\pi$, so long as the permeability is large. For shortness, I shall treat this tension as actually $B^2/8\pi$ up to actual contact. The contribution to δl due to this stress may be taken as $B^2l/8\pi E$, where E is an elastic modulus, which, strictly speaking, varies with B. Suppose now B so chosen that $\delta l = \lambda$, so that the width of the air gaps reduces to zero. Then Mr. Wilberforce's view would seem to be that at the instant the gaps close the stress producing the lengthening $B^2l/8\pi E$ becomes zero, and comes into existence again only when the consequent shortening of the elements reopens the gaps; in this way a species of oscillation would ensue. Prof. Ewing, I rather fancy, would suppose the stress to exist until there is absolute continuity of matter. To deal with either view, suppose that at the first instant of contact, by some process of welding which leaves the material unaltered, the 360 elements transform into a solid ring. Call the state just before welding M, and that when equilibrium has ensued after welding N; then the following views seem to be or have been held:

(1) (By Mr. Shelford Bidwell, Dr. More, and Prof. Ewing [originally]) that the ring in N is shorter than my reasoning makes it in M by $2 \times (360\ B^2l/8\pi E)$.

(2) (By Prof. Ewing [now] and Mr. Wilberforce) that the ring in N is shorter than in M by $1 \times (360\ B^2l/8\pi E)$.

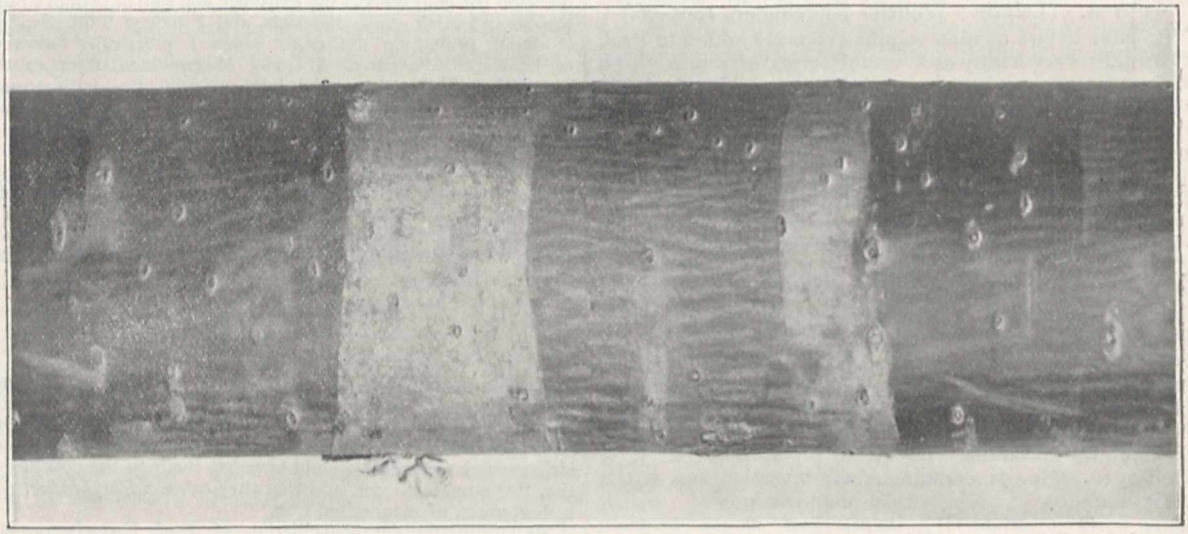
(3) (By, I believe, Prof. J. J. Thomson, Dr. Taylor Jones, and myself) that the ring in N, if shorter than in M, is so by a less amount than $1 \times (360\ B^2l/8\pi E)$. CHARLES CHREE.

March 23.

The Sacred Tree of Kum-Bum.

REFERRING to the letter of Mr. W. T. Thiselton-Dyer, you have published under the title "The Sacred Tree of Kum-Bum" (March 5, 1896, p. 412), I may add that Dr. Kanitz (as I am told by Dr. S. Bretschneider) identifies the tree as the *Ligustrina amurentis*. With the permission of the Vice-President of the Imperial Russian Geographical Society, I send you herewith a photograph (natural size, untouched) of about two-thirds of the piece of the stem of that tree in possession of the I.R.G.S., which received the piece from a lama who visited Kum-Bum late in the autumn of 1894.

The wood is very light, the bark thin (the diameter of the piece being 46 × 47 on one end, 45 × 46 millimetre on the other; the thickness of the back does not exceed 1 millimetre, being the third of it in some places of the circumference), its surface is somewhat rugged, as from desiccation (to be seen on the photo), the outer tissue is grey, translucent, the colour of the bark reddish, the signs *in* it of a golden hue, and can be discerned through the epiderm, but are best seen when the latter is pulled off.



Natural size in breadth, about two-thirds in length, of the piece in possession of the Imperial Russian Geographical Society, St. Petersburg.

A. GRIGORIEV,
Secretary of the Imperial Russian Geographical Society,
St. Petersburg.

A Jamaica Drift Fruit.

IN connection with the article by Dr. Morris on a Jamaica drift fruit, which appeared in NATURE of November 21, 1895, I am able to supplement it by a record of the tree in Trinidad. On March 10, after a personal visit to the vicinity, I despatched Mr. Lunt, my assistant—who may be remembered as being attached to Mr. Bent's expedition to the Hadramaut—to search for the tree or trees stated to have been seen by Messrs. Crueger and Devenish. I am glad to say that I have now Mr. Lunt's report on the trip before me, and still better, I have specimens taken from the trees, which show that *Saccoglottis amazonica* may still be regarded as one of our forest trees. Mr. Lunt followed as directed the course of one of the rivers, and found the tree in more than one place. He was able to bring fresh fruits, leaves and buds, but no flowers were to be had. Mr. Lunt notes that the specimens brought show that the fleshy outer layer or sarcocarp is not, as has been supposed, worn away by water, but owing to its palatable character forms the food of numerous fruit-eating animals, and that on falling to the ground it is further cleaned by ants.

It appears that after the sarcocarp is eaten away the seeds rest upon the ground until the occurrence of heavy floods, when they are washed away by the currents.

The sarcocarp is very pleasant to the taste, and is to be compared very closely with the exterior of many species of the genus Pyrus—as far as I could judge from the single specimen brought home in the green state.

Abundant fresh seeds deprived of the sarcocarp were procured, and a dissection of these shows how accurate are the drawings of Crueger, which were produced in Dr. Morris's article. We hope to secure full sets of herbarium specimens later.

J. H. HART.

Royal Botanic Gardens, Trinidad, B.W.I.

The Rotation-Period of Venus.

DURING the years 1876 and 1878 I paid some attention to Venus at the Kempshot Observatory, and although no distinct markings on the disc were seen in the very small equatorial, yet the following observation may prove valuable:—"1876 October 2, 6 a.m. The planet dichotomised, but the terminator is not straight; the S. horn projects, and the N. horn is rounded off."

By comparing the sketch then made with the drawing, Fig. 1, in the article in NATURE of February 20 (p. 367), there can be no doubt that the broader features in the curvature of the terminator are the same in both. Fig. 1 was taken from a drawing by Signor Mascari, October 12, 1892, or about sixteen years after mine.

Now every eight years the earth and Venus come to nearly their same position again in their respective orbits, for 365·24d. × 8 = 2921·9d., and 224·7d. × 13 = 2921·1d.; and consequently if the rotation-period of Venus be 224·7d., any well-marked permanent feature will become visible every eight years.

The question is whether this curvature of the terminator will prove to be a permanent feature or not under the circumstances detailed above; and for the answer we shall have to wait until the western elongation of Venus in September or October 1900, when observations made at or a little after the time of dichotomisation will show whether the agreement of the drawings in October 1876 and 1892 was a mere coincidence or not.

Jamaica, March 14. MAXWELL HALL.

A Remarkable Meteor.

MR. BACKHOUSE'S observation of the beginning of flight of the slow-moving meteor of March 1 appears to have been from a point 2° south-east of α Canis Minoris instead of between α and β of that constellation, as I at first assumed from the description. This misunderstanding shows the extreme importance of noting meteor tracks according to the best method, viz. that of giving the R.A. and Decl. of the beginning and end points. This is at once simple and effective; it avoids the frequent errors which occur when projecting meteor tracks from descriptions (sometimes ambiguous) of their courses by the stars, and saves endless trouble.

A reinvestigation of the path of the meteor shows it to have commenced its visible career when nearly over York at a height of 55 miles, and it was last seen by the observer at Sunderland when 53 miles high. Mr. Clark at York, however, watched it much further, and after it had passed over Heligoland when its height had again increased to 55 miles. The radiant was nearly on the western horizon, and the meteor, which in the early part of its flight was descending towards the earth, showed a slight ascent towards the end. The average velocity from the two estimates of duration seems to have been about 20 miles per second.

An observation from Kiel or Hamburg would be very useful for comparison, as the meteor at its terminal stages was comparatively near those places, and must have been far more brilliant than it appeared from York and Sunderland.

Bristol, April 3. W. F. DENNING.

Simple Huyghens' Apparatus for the Optical Lantern.

IN his excellent handbook on experimental optics, "Light," Mr. Lewis Wright describes and figures the well-known double-image phenomena to be observed when an ink-dot is viewed through two superposed rhombs of calc-spar. He does not suggest, and I have not seen elsewhere the suggestion, that the experiment is readily adapted to lantern projection. This, however, is the case, and when so projected this experiment is more useful to the demonstrator than that of the double-image prisms, commonly known as Huyghens' experiment, since the apparatus is more simple. There is no colour correction to explain—nothing to occupy the mind of the student but the action of the spar.

My method is to take two small rhombs of a thickness of 1½ inches or more, and mount them near together in such a way that one or both can be rotated. I use by preference a small parallel beam from the parallelising lens, and between this lens and the rhombs, close to the latter, is placed a thin metal plate having an aperture of a size depending on the thickness of the rhombs. The thicker the rhombs the larger, of course, can be the aperture. The rays, after passing through the pieces of spar, are focused by the ordinary objective so as to give sharp images of the aperture in the plate. Rhombs can often be found whose cleavage faces are quite perfect enough to allow sharp images.

It is evident that a single rhomb in the position here indicated may be made to serve nearly or quite all of the purposes of the double-image prism—may sometimes, indeed, to the advantage of the demonstration, replace the analysing Nicol. This fact has its obvious usefulness in the present scarcity of Iceland spar.

F. W. MCNAIR.

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THE MANAGEMENT AND PROTECTION OF FORESTS.[1]

II.

THE working plan of coppice woods is a simple matter. The area is divided into as many compartments as there are years in the rotation. If the coppice is cut, when it has attained the age of fifteen years, fifteen compartments are formed, and every year the old wood on one compartment is cut, after which the coppice shoots grow up to form the new crop. The rotation is determined by the species composing the coppice, and the class of material required, and the yield depends upon the areas cut over, which are equal, where the quality of the locality is uniform, unequal in inverse proportion to the quality, where the quality varies.

In the case of high forests, matters are more complicate, and a brief indication of the main subjects that must be attended to, may serve to explain what is done. A thorough examination of all portions of the forest, its previous treatment, soil, climate, and other conditions, which influence the growth of trees, an accurate and detailed survey of the growing stock, and, lastly, the market for timber and other produce, and the labour available for forest work, are the points which must be examined in the first instance. The next subject is the study of the lines of communication, roads, and water-courses to be used for the transport of timber; and, lastly, the subdivision of the forest into blocks and compartments. A forest to be manageable must consist of compartments of moderate and fairly uniform size. On level ground regular rectangular figures are most convenient; in a hilly country, compartment boundaries must follow the configuration of the ground. Obviously it is in every respect convenient that, wherever practicable, compartment boundaries should coincide with export roads; the sooner, therefore, a system of roads is projected and traced on the ground the better, the traces serving as compartment lines, though the roads need not be built until cuttings are made in the compartments adjoining them.

Simultaneously with the division of the forest into blocks and compartments, the method of treatment must be considered, the choice of species, and the sylvicultural system, particularly with regard to the regeneration of the forest, and the arrangement of cuttings. Large forest areas will generally have to be divided into several working sections, each with its own system of treatment—say one working section for coppice woods,

[1] "A Manual of Forestry," by William Schlich, C.I.E., Ph.D. Vol. iii. (pp. xix + 397). "Forest Management," by William Schlich. Vol. iv. (pp. xix + 593). "Forest Protection," by W. R. Fisher, B.A. (London: Bradbury, Agnew, and Co., 1895.) (Continued from p. 515.)

another for coppice under standards, a third for high forest of spruce or Scotch pine, worked on short rotations, with clear cutting and planting; others, again, for high forest worked on a long rotation, under the selection and shelter-wood compartment systems.

Two prominent points to be settled in a working plan are to determine the rotation and the annual yield. As regards the rotation—that is, the age at which the timber should be cut—the requirements of the market must be consulted in the first instance. It has already been mentioned, that where pit-props find a ready market, coniferous woods may profitably be grown on a short rotation of 50 to 70 years. Where building wood of moderate dimensions pays best, a rotation of from 80 to 100 years will be more profitable. Oak timber, on the other hand, takes a long time to attain a marketable size, and afterwards, with advancing age and increasing diameter, continues long to increase in value. Where it is intended to regenerate forests by self-sown seedlings, trees must of course be allowed to attain that age at which they bear good seed in sufficient quantity; nor must they be allowed to remain after the production of good seed has diminished.

These considerations follow as a matter of course. A more difficult question is, within these limits, to decide upon the most suitable rotation. It might be thought that the simplest plan would be to divide the total income expected during the rotation, less the expenses incurred, by the number of years in the rotation, and to select that which gives the largest mean annual net income. Adopting the data given on page 513, which represent the growth of a Scotch pine forest on land of middling quality, the mean annual net income under a rotation of 80 and 100 years would be as follows:—

$$\frac{2225 + 4 + 36 + 67 + 86 + 91 - (60 + 3 \times 80)}{80} = 27{\cdot}61 \text{ shillings.}$$

$$\frac{3376 + 4 + 36 + 67 + 86 + 91 + 95 + 94 - (60 + 3 \times 100)}{100} = 34{\cdot}89 \text{ ,,}$$

Under this mode of calculation, which takes no account of interest, the mean annual net income increases with the length of rotation, and this increase continues until volume- and value-increment become so much reduced that they will no longer cover the increased outlay. This result, however, does not agree with what has previously been explained. If, as ought to be done, interest is taken into account, a rotation of 80 years is that which, in the case here assumed, yields the highest net rental, and is hence financially the most profitable.

The rotation to be adopted is, it may readily be imagined, a fertile subject of controversy, which often gives rise to animated discussions among foresters in Germany. The author is in favour of what is commonly called the financial rotation, under which the forest capital (soil and growing stock) yields the highest interest, and under which, as explained above, the soil expectation value and net soil rental culminate. But Dr. Schlich justly observes that purely financial interests must in many cases be modified by considerations of a different character.

How the annual yield, that is the timber which may be cut annually or within certain periods, is determined in the case of coppice woods, has already been indicated. In the case of high forest, three different systems are generally followed. The first of these the author designates as the allotment of woods to the different periods of a rotation. A rotation of 80 years is divided into four periods of 20 years each. It will serve to make matters clear, if we assume the existence of a normal forest with an even distribution of age classes. To the first period would be assigned in such a forest all woods between 61 and 80 years, to the second those between 41 and 60 years, and so on, so that the fourth class would comprise the youngest woods under 20 years. Such a regular forest, however, does not exist, and what in reality is done, is to assign the oldest woods to the first period, and to distribute the others according to their age, as well as can be done. A number of compartments, stocked with old timber, are thus assigned to the first period, and care is taken to allot to each period approximately equal areas, which, if there are great differences in the quality of the locality, are reduced to a common standard. The woods placed in the first period are then measured, their volume calculated, and the increment for half the number of years in the period is added. The total volume divided by 20 gives the mean annual yield during the first period. The cuttings in the woods assigned to each period are arranged so as to suit sylvicultural requirements and economic considerations. The allotment of compartments to periods can obviously be made by volume instead of by area. In that case old woods are measured, and the proper increment added. For younger woods the volume, which will stand on the ground at the time of cutting, is calculated from yield tables. Equal volumes are assigned to each period, the oldest woods being allotted to the first, and the youngest to the last period. The compartments allotted to one period, whether by volume or by area, will not necessarily be contiguous; they will often be scattered over the whole forest. Whether the allotment to periods is regulated by area or by volume, a framework must be constructed, showing during which period each wood is to be cut. Hence this system is commonly known as the framework system. However irregular the forest may have been; at the end of the rotation its condition will approximate to the normal state. Thus the system introduces order, and is yet elastic, leaving sufficient latitude in the location of cuttings during each period.

The second system regulates the yield according to increment and growing stock. The legitimate yield of a forest during a given period in the first instance depends upon the quantity of timber produced during that period. During one year more should not, as a rule, be cut than the quantity represented by the sum total of the annual increment laid on in all portions of the forest. In a normal forest, with a regular succession of age classes, the legitimate annual yield is equal to the annual increment. In a forest, however, which, though well stocked, only contains the younger age classes, the produce of which is not marketable, no yield is possible, though the annual increment may be considerable. Again, in a forest where the older age classes preponderate, it is not only permissible, but it is in most cases necessary, to cut considerably more than the total annual increment. This principle has long been recognised, and as early as 1788 the management of the Austrian State forests was based upon it. When the older age classes preponderate, it is proper to fix a period, during which the surplus old growing stock shall be removed. If this period is called a, and I the actual annual increment, then the legitimate annual yield of the forest is

$$= \text{I} + \frac{\text{actual growing stock} - \text{normal growing stock}}{a}$$

This, which is known as the Austrian assessment formula, is still used in many public and private forests of Austria and Germany. Space forbids further discussion of this and similar methods. Suffice it to say that under this system no framework is needed, and that on this principle it is best to determine the yield for a short period only. Hence in those forests, where this system has been adopted, the yield is generally determined for ten years, and at the expiration of this time a new working plan is made.

The third system, which is in force in the State forests of Saxony, was originated by Cotta in 1811, and has been

brought to its present state of perfection by Judeich, for many years until his death in 1894, Director of the Tharand Forest School, one of the ablest foresters of Germany. Its leading idea is to treat each wood, or each compartment, or each group of compartments, on its merits, the management of the whole forest representing a summing-up of the treatment laid down for each wood. It has already been stated that a large portion of the State forests in the kingdom of Saxony are nearly pure spruce forests, managed on a very simple system by clear cutting and planting, and that most of them are worked on a rotation of 80 years. At first sight elaborate working plans might seem to be superfluous under these circumstances; it might be thought sufficient if a suitable area of the oldest woods were cleared and planted annually. However, had the forests been worked in this manner, without safeguards against storms and insects, their condition would not be what it actually is, nor would the financial results be so satisfactory. Pure spruce woods are apt to be blown down. Spruce plantations are apt to be destroyed by the pine weevil, and it was to a great extent the necessity for guarding against damages from these causes which led to the development of the present system in Saxony. On the spurs and in the valleys of the Erzgebirge and the other mountainous regions of Saxony, where most of the State forests are, the direction of the prevailing winds, though generally westerly, is greatly modified by the configuration of the ground. Accordingly the cutting series, in which all clearances proceed against the wind, must be most skilfully arranged, so as to guard against damage. Again, in order to guard against the ravages of insects, the principle of breaks in the successive clearances has been consistently carried out. When in one spot a cutting has been made, the adjoining area is not cleared until the young wood on the first area has become completely established. The result consists in numerous cutting series, separated by severance cuttings, and numerous clearances of limited extent. An essential feature in this, as in the second system, is that the yield is determined only for a period of 10 years. The woods proposed for cutting during that period are carefully examined. According to Judeich's plan, the question whether a wood should be cleared is determined by purely financial considerations. Dr Schlich, however, very properly urges that other considerations also should have due weight. Obviously a regulator is necessary, to prevent too large an area being assigned to one period. This regulator is obtained in a very simple manner. The total area is divided by the rotation. For a forest of 2400 acres, worked under a rotation of 80 years, 300 acres would be the area cleared during a period of 10 years.

The system here sketched is simple and effective, but, like all systems, the results depend upon the manner in which it is worked. The young woods must be complete and vigorous, and though the outlay in forming them, is multiplied seven-fold in 80 years under the operation of compound interest, even at the low rate of 2½ per cent., undue economy in this first operation, and in the subsequent tending of the woods, would result in waste and diminished net revenue from these magnificent estates.

Thus far the management of forests has been discussed, as if timber were the only legitimate forest produce. This, however, by no means is the case. Large plantations have been made in Assam by the Forest Department, ever since 1870, of *Ficus elastica* for the production of india-rubber. Myrobalans, the fruit chiefly of *Terminalia chebula*, is an important article of forest produce in Western and Central India. The Scotch pine forests which surround the old town of Nürnberg, are important, less on account of the timber which they produce, than because the annual fall of needles furnishes litter to the peasants in the vicinity, who chiefly depend upon the growth of vegetables, and who use the dry needles as a substitute for the straw which they do not produce. In the drier regions of India, a commencement was made in 1874 to protect woodlands for the specific purpose of furnishing cattle fodder in times of drought. Had these attempts been carried on with sufficient vigour and perseverance, they might have contributed largely to mitigate the sufferings of the agricultural population during seasons of deficient rainfall, which in most parts of the Indian Empire occur from time to time.

Other articles of produce obviously demand other systems of management. With these, however, forest proprietors in the United Kingdom at present have no concern. Their interest is to produce timber of the best description, and to sell sufficient quantities to attract purchasers at regular intervals. A beginning can only be made by actual experience. Should any proprietor have the courage and foresight to ask the author of the manual here reviewed, or any other really competent and experienced forester, to take in hand his forest estates, and to organise their management on a well-considered plan, the result would certainly induce others to follow suit. In a matter of this kind, example is better than teaching, and the sooner a commencement is made, the better for the landed interest of Great Britain. Patience, however, and plodding perseverance, are indispensable conditions of success in forestry. Timber takes many years to attain marketable size, its growth in volume and value is slow, and the money returns are moderate. These are the chief reasons why systematic forestry is not yet respected in Great Britain. In this, as in other matters, the pressing needs of the moment stand in the way of undertakings which would, slowly but surely, advance the future welfare of the country.

THE PROTECTION OF FORESTS.

We now pass to the consideration of that branch of forestry which deals with injurious external influences, and with the measures that may be adopted to guard against them. These matters form the subject of Mr. Fisher's volume. In the introduction a brief account is given of the earliest attempts at forest protection, sacred groves, and game preserves. Sacred groves are found in many parts of India. In the moister regions, where forests are abundant, we find them, as Mr. Fisher correctly observes, in the hills south of the Brahmaputra river, but also in other districts; for instance, upon the Javadies and other hill ranges of South India. In the regions with a dry climate, as in Rajputana, the sacred groves of *Anogeissus pendula* are an ornament of the country, and have often proved a boon to the people by providing cattle fodder in seasons of drought. Old game preserves have in many instances been transformed into useful forests. The forests of Babul, *Acacia arabica*, on both sides of the Indus River, were originally formed and maintained as the game preserves of the Ameers of Sind, and are now of considerable importance in that dry and otherwise forestless country.

Part i. is devoted to the protection of forests against man. The destruction of forests through other agencies is insignificant, compared to that accomplished by the improvident cupidity and careless ignorance of man. These tendencies of mankind the entire manual is intended to counteract, in so far as it teaches how forests should be maintained and managed. The present volume only deals with special matters in this respect, the protection of forests against encroachment, damage, misappropriation, irregular and excessive exercise of rights of user.

Part ii. deals with protection against animals. Here the chapters relating to insects are the most important. The damage done to forests by caterpillars and beetles must be seen in order to be believed. The Nun Moth (*Liparis monacha*) has for several centuries been known as one of the most formidable enemies of spruce forests in Germany, Austria, and Russia. It is also very

injurious to the Scotch pine, and likewise feeds upon the leaves of the beech and other broad-leaved trees. From 1888 to 1891 this caterpillar appeared in such enormous numbers in the spruce woods of South Germany, particularly of Bavaria, that over large areas the trees became entirely denuded of their leaves, and were killed. In the Ebersberg Park, a densely stocked forest, spruce with a small proportion of beech and Scotch pine, forming a compact area of 16,510 acres, 4700 acres were completely bare, while on 7400 acres the trees were severely damaged. The timber that had to be cut on this area, in consequence, amounted to 53,000,000 cubic feet, more than half the normal annual yield of the State forests in the kingdom of Bavaria. Timber-cutters were brought from all parts of the country, and lodged in temporary barracks built in the forest. A railway seven miles long was constructed into the heart of the devastated area; tramways were laid upon the rides separating the compartments, and portable lines were used to bring out the logs. At the same time the Nun had devastated other extensive areas in Bavaria and the adjoining districts of Württemberg, necessitating the cutting of large quantities of timber. The news of these events created great uneasiness among timber traders, and a disastrous fall in timber prices was anticipated. This, however, was to a great extent guarded against by the prompt and carefully-planned measures taken by the Bavarian Government. The annual cuttings in the Bavarian State forests were at once considerably reduced, and the action thus taken was aided by the circumstance, that the timber of the Ebersberg Park has a very good name, and justly so, for the stems are well-shaped, clean, without knots, and the wood is even-grained. Most of the large timber was sent across the Alps by the Brenner line, and found a ready market in Italy. The smaller pieces were sold to paper factories to be converted into wood pulp, and what was only fit for fuel was collected at the great depôt that supplies the town of Munich with firewood. The cleared areas have since been planted up, and except that the working plan of the forest was completely upset, no permanent damage was done by the calamity.

If the timber of Conifers killed by caterpillars is not cut at once, it is apt to be much injured by bark beetles. In the present instance this was avoided; but formerly, with the means of communications less developed, and the plan of action less prompt and less comprehensive, the ravages of *Tomicus typographus* and other bark beetles have greatly intensified the mischief. In North Germany and in Russia the principal devastations by the Nun, and by the bark beetles in its wake, have been recorded in 1688 (Altmark), 1794 to 1797 (Southern Thuringia), 1837 to 1840 (the greater part of Germany, from the North German Plain to the lake of Constance), 1845 to 1867 (Western Russia and Eastern Prussia, extending over forest areas aggregating 32,000 English square miles).

The moth lays about 150 eggs, and, as is the case with other species (for instance, *Orgyia antiqua*), the male and female insects of one brood attain the perfect stage on different dates, necessitating the inter-breeding of different broods, and thus insuring a vigorous development of the pest. A succession of warm dry springs, with weather otherwise favourable to the life of the insect, brings about the rapid multiplication of the Nun, and, unfortunately, the protective measures are difficult, and their success uncertain.

Fortunately, the Nun has formidable enemies. A number of birds eat the eggs—up to 200,000 eggs have been found on one tree; but only the starling eats the hairy caterpillars on a large scale. Of insects, parasitic *Diptera* (*Tachinidæ*) are exceedingly useful in destroying the caterpillar wholesale. The most powerful ally of the forester, however, has in most cases been an epidemic disease, which breaks out among the caterpillars when the multiplication has attained its climax. They congregate in large masses at the tops of trees and branches, where they die without making any attempt at feeding. In the diseased caterpillars several species of bacteria have been found in large numbers; attempts have also been made to inoculate healthy caterpillars with these bacteria; the success, however, has not been sufficient for practical purposes.

Equally mischievous, not, however, in spruce woods, but in those of the Scotch pine, is the Pine Moth (*Gastropacha Pini*), a species, Mr. Fisher states, not found in Great Britain. Formerly the Pine Moth was dreaded as the greatest enemy of the extensive pine forests of Northern and Middle Germany. Fortunately, however, when its life-history became better known, a simple and most effective remedy was devised. The eggs are laid early in August; the caterpillars, which come out about the end of that month, proceed at once to feed on the needles; but, being small, the damage done at this season is not considerable. When night frosts commence, they descend from the trees, and spend the winter months ensconced in moss or dry needles near the foot of the stem. In spring, aroused by the warmth, they ascend the trees and eat them bare in no time. The average consumption by one caterpillar is estimated at 1000 needles. What is done by way of protection against this pest, is to prevent their ascending the trees in spring, and this is effected by putting broad bands of tar, grease and glue, mixed, round the stems, the outer rough bark having first been scraped off to present a smooth surface. These sticky bands the caterpillar cannot get over, and in this manner nearly the whole of the pine forests in the plains and broader valleys of Germany are now protected against the ravages of this insect. The pine woods on the hills, having generally a mixture of other trees, are safe from the attacks of the Pine Moth.

The Scotch pine has many enemies besides the Pine Moth. During the summer of 1895 the Pine Noctua (*Noctua piniperda*) and the Pine Looper Moth (*Geometra piniaria*) have appeared in immense numbers, the former between Darmstadt and the Main River, and the latter in the forests near Nuremberg, as well as in the Rhine Valley.

Among insects which attack young plants, the Pine Weevil (*Hylobius abietis*) is one of the most mischievous. The larva does not do much damage, but the beetle is found in large numbers in plantations of spruce and Scotch pine up to six years of age, killing the plants by gnawing the bark all round the stem, down to the root. It lays its eggs on stumps and roots, and the best protection is to give him as little opportunity as possible for breeding in the vicinity of young plantations. Small felling areas and intermittent fellings ought to be the rule; when a clearance has been made, the adjoining area should not be cut until after the lapse of three to five years.

Of the Cockchafer (*Melolontha vulgaris*) the beetle does some damage by eating the foliage of broad-leaved trees, particularly of the oak; but the chief mischief is done by the larva, which eats the roots of plants. A fungus (*Botrytis tenella*) some years ago in France was found to infest the larvæ, and at one time it was hoped that it might be possible, by inoculating larvæ with the spores, to spread the infection, and thus to destroy a large portion of the brood. Experiments have been made with great care in France, in Switzerland, and at Berlin, but hitherto without practical success.

Part iii. discusses protection against plants, forest weeds, climbers, parasitic and epiphytic phanerogams and fungi. In tropical and sub-tropical forests huge woody climbers play an important part, and are often very mischievous. They bend and twist the trees on which they have found their support, and finally, by their

dense luxuriant foliage, smother them. Several species of epiphytic ficus enclose the stem of teak or other useful trees by a network of aërial roots. The extirpation of climbers and epiphytes forms an important part of a forester's duty in India. Our North Europe climbers, the honeysuckle and *Clematis Vitalba*, are innocent representatives of those gigantic enemies of the forester in warmer countries.

Green parasites, such as *Viscum* and *Loranthus*, probably in a manner contribute their share towards the nourishment of the tree upon which they have established themselves, and some botanists have even gone so far in their appreciation of this symbiotic arrangement, as to claim for the mistletoe the gratitude of the apple-tree, upon which it lives. Be that as it may, in the Southern Schwarzwald, chiefly at lower elevations, *Viscum album* to such an extent infests the Silver Fir that many trees are killed, and that much of the timber is rendered useless by the haustoria of the parasite. And on the Nilgiris of South India several species of *Loranthus* have attacked the plantations made on those hills of the Australian *Acacia melanoxylon*, killing a large number of trees.

The damage done to trees by fungi has of late years justly attracted much attention. *Phytophthora omnivora*, de Bary, closely allied to the potato pest (*P. infestans*) attacks the seedlings of the beech and other broad-leaved trees, and destroys them wholesale in May and June, especially if protracted wet weather sets in.

Æcidium elatinum, Link, is the fungus which infests the Silver Fir, manifesting itself in two different ways—by an abnormal hypertrophy of the branches, known as witches' brooms, and by canker or diseased swellings of the stem. The trees attacked with canker are worthless for timber, and the damage is very considerable. Nothing, however, can be done in the matter, save to destroy the branches bearing witches' brooms, and to cut out all trees attacked by canker. Fortunately, the system of management which suits the Silver Fir best, selection fellings, or gradual cuttings under shelter woods, permits the removal of canker trees.

The dreaded Larch disease is chiefly caused by a fungus (*Peziza Willkommii*, R. Hartig). Wounds made by the Larch Miner Moth, *Tinea* (*Coleophora*) *Laricella*, facilitate the entry of the spores into the tissue.

Broadly speaking, the most effective protection against the ravages of insects and fungi is a correct system of management. One important result, arrived at by long experience, in this respect, is that all other circumstances being the same, mixed woods are less exposed to such ravages than pure woods, consisting of one species only. Short-lived plants, such as our field crops, are exposed likewise to damage by insects or fungi; but, in the case of trees and shrubs, the damage is intensified, because they furnish food and other circumstances favourable for the multiplication of the pest, not during one season only, but continuously. This has been our experience hitherto, in the case of forests, as well as in the case of plantations of coffee, tea, cinchona, or other woody plants. The vineyards of Europe are a case in point. *Oidium Tuckeri*, Berk., commenced its ravages in South Europe in 1851, nearly destroyed the vineyards of Madeira, and probably was the fungus which, in 1856, put an end to the cultivation of the grape in the valley of Kunawar in the North West Himalaya. During the last ten years, two pests, a fungus and an insect, both introduced from North America, have done enormous damage—*Peronospora viticola*, de Bary, and the dreaded *Phylloxera vastatrix*, Planch. The coffee plantations of Ceylon have been annihilated between 1869 and 1880 by that terrible fungus *Hemileia vastatrix*, Berk. In Java, where this fungus has also made its appearance, without, however, doing much damage, other trees are invariably planted with the coffee, and this to a certain extent is also done in the coffee plantations of Coorg and the Wynād. In the extensive and magnificent tea plantations, which now cover the Assam valley, it formerly was the custom to preserve belts of the original forest on broken ground and along ravines, and the experience of foresters in Europe points to this plan as an important safeguard against the spread of fungus and insect pests. Among foresters in Germany and in other countries on the continent of Europe, the conviction has now generally gained ground, that every effort must be made to maintain mixed woods, consisting of several species, where they exist, and in pure forests to introduce a mixture of other species, wherever such is practicable. The object is to make the conditions for the multiplication and spread of insects and fungi less favourable than they are in pure forests, consisting of one species only.

The forester, unfortunately, has to contend with other enemies besides man, animals, climbing plants and fungi. The heat of the sun, drought, frost, snow and ice, storms and fires, smoke and acid fumes of factories and furnaces are destructive to an extraordinary degree, and often entirely upset his plans of operations. And in addition to all this, some species are subject to endemic widely-spread disease, such as the needle-shedding of young Scotch Pine plants, the cause of which has not yet been ascertained. All these matters are dealt with in the concluding parts of Mr. Fisher's book.

The recollection of the storms which blew down enormous masses of timber in Scotland in 1893 and 1894, ought to invest this portion of the book with special interest. Here again a correct system of management affords the best protection. Cutting series of moderate extent, adapted to the configuration of the ground and to the locally prevailing wind direction, severance cuttings timely made—these are the principal measures by which the extensive pure spruce forests of Saxony and Thuringia have, it is true, not been absolutely protected against storms, but protected so far, as such is possible in pure forests consisting of a shallow-rooted species that is easily blown down.

Protection against fire is not a matter of great practical importance in the moist climate of Great Britain. Mr. Fisher has, nevertheless, very properly treated it somewhat fully, and has also alluded to the work of fire protection in India. The peculiar feature of the climate in most provinces of India is the long dry season, at the end of which grass, leaves, herbs, are as dry as tinder. The natural results are the annual jungle fires of the hot season, an institution as old as the civilisation of the country. To the annual fires it is due that fully stocked and healthy forests were the exception, when the first attempts at regular management were made, and that the main portion of the so-called forests were groups of trees, separated by vast areas of scrub and grass land. Moreover, the majority of the older trees were unsound, hollow and crippled, the soil was hard and impoverished, and it was clear that protection against fire was the most important task to be accomplished, if real improvement of the forests was to be effected. The attempt, however, to put an end to this time-hallowed institution met with powerful opposition on all sides. Colonel Pearson, the Conservator of Forests in the Central Provinces, was the first to succeed in keeping out fires from the Bori forest in the Satpura hills. This was in 1865, and a few years later the effect of continued protection in that district was marvellous. This and other forests which have thus been really protected, are now dense compact masses of healthy trees and bamboos, which can with advantage be subjected to regular management. The total area of fire-protected forests in the British Indian Empire in 1893 amounted to 27,438 square miles, which is nearly three times the area of State forests in the kingdom of Prussia.

Proprietors of forest lands in Great Britain and in the

United States of North America will do well to bear in mind the success of fire conservancy in India. Systematic forest management is a difficult undertaking, which has many enemies. Nevertheless success is possible, and if these forestry manuals facilitate the attainment of success in this business, their authors will have reason to be well satisfied with their work.

DIETRICH BRANDIS.

THE DEVELOPMENT OF BUTTERFLIES UNDER ARTIFICIAL CONDITIONS.

THE effects which cold and heat, applied to the pupa, produce in the colours and patterns of the imaginal wings, have been studied for many years and by many naturalists. Weismann in 1875 published an account of his own experiments, and those conducted by others, in an essay which was published in this country in 1882 among the "Studies in the Theory of Descent," translated and edited by Meldola.

The experiments described by Weismann have been repeated and greatly extended by Merrifield (*Trans.* Ent. Soc. Lond., 1888, 1889, 1891, 1892, 1893, 1894), while Dixey has published interesting observations on the phylogenetic significance of some of the results obtained (*Ibid.*, 1893, 1894).

While these careful and successful experiments were being conducted in this country, Standfuss of Zurich has been independently engaged on the same research, employing in many cases the very species which had been used by Merrifield. Standfuss's paper, appearing in 1894, has been translated by Dixey, and, after revision by the author, has been published, with an introductory note by Merrifield, in the pages of *The Entomologist* for March, April, and May 1895. The editors of this journal are to be congratulated on the effort they have made to lay before their readers some of the interesting results of entomological research conducted by continental naturalists. We may hope that the attempt which has been so successfully made, will be frequently repeated.

(1) *The Egg.*—The eggs of four species of moth (*Arctia fasciata*, *Dasychira abietis*, *Lasiocampa pruni*, and *L. pini*) were exposed to a high temperature, 34° C. (93° F.), as they were being laid, and subsequently up to the time of hatching. The larvæ hatched in two-thirds or less of the normal time, and although the temperature remained normal, 25° C. (77° F.), throughout the subsequent stages, 71 per cent. of *fasciata*, 90 of *abietis*, 100 of *pruni*, and 81 of *pini* emerged as imagos in that year, the remainder hybernating as larvæ; as against 23, 12, 64, and 28 per cent. respectively, when eggs from the same parents had been laid and kept at a temperature of 22° C. (72° F.) and at 25° C. during the subsequent stages. This persistence throughout the later stages of the hurrying-up of development, when the conditions which originally started it had ceased at the beginning of larval life, is very remarkable, and it is unfortunate that the author should have contented himself with giving his results in percentages instead of the actual numbers obtained. This criticism applies to nearly all the results recorded in the paper.

There was no evidence that the imagos were otherwise influenced by the condition of the ova.

(2) *The Larva.*—Experiments with an increased temperature generally shortened the period of larval development and reduced the size of the imago. From these experiments the author infers that the great difference in size between certain closely allied species (*e.g. Boarmia consortaria* as compared with the much larger *B. roboraria*) has been produced by the larvæ reacting in a different manner under changes of temperature, so that some acquired long and the others short larval periods. It would appear that the evidence in favour of this conclusion has not been sufficiently sifted, and that certain obvious difficulties raised by this interpretation have been overlooked.

Certain changes in form, colour, and marking are also described as following the temperature conditions of the larvæ. In these cases, however, the author does not appear to be giving the results of his own experiments, but reasoning from the differences observed in the several broods of many species appearing at different seasons, and especially contrasting the forms produced from hybernated larvæ with those produced without hybernation. In these cases it is the duty of the naturalist to determine by means of artificial experiments whether the observed changes are entirely due to conditions of temperature, and whether the larval stage alone is of importance.

Many experiments were made with foods, polyphagous larvæ being fed on poisonous or acrid plants, on such abnormal diet as raw meat, or on plants which had absorbed solutions of various substances. The perfect insects "often enough showed a failure in size or general colouring, but in no case any noteworthy variation in tint or pattern."

The effects of light transmitted through glass of different colours were negative, although the larvæ were exposed to these conditions "from the time when they were quite small."

(3) *The Pupa.*—By far the most complete results were obtained by subjecting the pupa to various degrees of temperature.

The effects obtained with *Papilio machaon* and *Vanessa antiopa* are of especial interest, inasmuch as Merrifield's material had been inadequate and his results, as regards these species, negative.

Seventeen pupæ of *P. machaon*, kept at a temperature of 37° C. (98°–99° F.) from the time when the cuticle hardened at the beginning of pupation, produced in seven to ten days fifteen insects, which were much lighter in colour than usual, owing to the development of a yellow powdering which obscured many of the dark markings on the upper and under sides of the wings, and the body. Changes in form are also described, including a marked lengthening of the "tail" of the hind wing. "Some of these specimens . . . bear a perfect resemblance to those that fly in August in the neighbourhood of Antioch and Jerusalem." The pupæ subjected to cold (for twenty-eight days) produced only two imagos, and these resembled the Swiss and German forms emerging from hybernated pupæ.

The pupæ of *Vanessa antiopa*, after being exposed to heat (37° C. or 98°–99° F.) for forty-eight hours, produced, ten days later, butterflies in which the marginal blue appeared to be reduced, and the yellow border broadened, but in neither case to a greater extent than in nature. Among these individuals, however, 2 per cent. presented a very remarkable variation, which Standfuss has named var. *daubi*. This well-marked form is constantly produced when the pupæ were exposed to heat (as above) for sixty hours, and then kept at a temperature of 24° C. (75° F.). Such pupæ produced the var. *daubi* in twelve days. The upper surface of both wings is greatly darkened, becoming almost black, the blue spots are much reduced and have a violet tinge, but the most remarkable change occurs in the yellow border, which is extremely darkened, so as to leave, in extreme cases, only a small remnant of yellow scales. The under side is as much darkened as the upper; and certain changes in the form of the wings are also described.

Cold produced very different effects according to the time of exposure. The most interesting results, and those which most strongly suggest the appearance of allied species (*V. urticæ*, *V. polychloros*), followed the shortest exposure of twenty-nine to thirty-four days in the refrigerator. In these cases the brown ground colour became lighter, and the blue spots (much enlarged on the

fore wing) acquired dark borders. At the same time traces of dark spots, like those of the allied species, appeared in certain individuals, while the under side, especially of the hind wing, underwent changes which are also described in *V. io*, gaining a pattern in brown scales which recalled that of *V. polychloros*, &c. A longer period (thirty-nine days) produced far less interesting results, the blue being increased, the yellow border diminished, and the ground colour darkened. Forty-four days in the refrigerator produced more marked effects in the same direction, the blue spots of the hind wing being so increased that they project into the yellow border. The ground colour of both upper and under sides is much darkened. This beautiful variety is called by the author var. *roederi*.

As regards other species of butterflies, Standfuss's results afford valuable confirmation of those obtained by Merrifield. Thus heat (37° C.) produced light-coloured imagines of *Grapta C-album* with less sharply-defined markings and less deeply indented wing margins; while cold produced opposite effects, the dark colours of the under sides of the wings being often "mingled with moss-green tints."

In *Vanessa polychloros*, heat (37° C.) reduced the marginal blue spots and the dark wing-border, and brightened the colour of the upper sides of the wings, cold producing the opposite results.

In *V. urticæ*, more extreme effects in the same direction were witnessed, heat causing an approach towards the var. *ichnusa*, and to a certain extent towards *V. io*; while cold produced butterflies which recalled the North American *V. milberti* It was noteworthy that pupæ kept on ice for forty-two days (emerging thirteen to fourteen days afterwards), produced less deviation from the normal than those which had been exposed for only thirty-two days, and emerged nine to ten days afterwards. In neither case is there any record of the numbers of individuals made use of.

In *V. io*, heat produced little result, while cold (thirty-five days in refrigerator) caused most interesting changes in the direction of *V. urticæ* and *V. polychloros*. A longer period of cold (forty-two days) still further intensified these changes, which affected the under as well as the upper sides of the wings, the well-known uniform darkness of *V. io* giving place in the most extreme examples to a sharply-defined pattern in brown scales, far more suggestive of the above-mentioned species of *Vanessa*.

In *Vanessa atalanta*, heat greatly reduced the blue in margin of the fore wing, widened the red band, and reduced the apical white spots; thus approximating towards *V. callirrhöe*. Cold (thirty-one days) conversely increased the large white spot, reduced the red band by the encroachment of dark shades, and increased the blue. A longer period of cold (forty-two days) produced ten almost normal insects and a single extreme form. It would therefore appear that less effects were, on the whole, produced by the longer period, although the materials for a valid comparison are absent, inasmuch as the author only informs us that there was "much individual variation" in the results of the shorter period.

In *Vanessa cardui* a higher temperature (40° C. = 104° F.) was made use of for two periods of six hours, alternating with one of twelve hours at the normal temperature (about 22° C. = 72° F.). Only two pupæ out of forty-two failed to emerge, although twelve produced crippled butterflies. Four specimens were of the var. *elymi*, the remainder normal. In another experiment with 36° to 37° C. for sixty hours, a remarkably pale form was produced; while in other cases the red colour, often acquiring a brownish tinge, was increased in extent on both upper and under surface of the wings. Cold (twenty-three days), on the other hand, darkened both sides of the wings. A longer period of cold (twenty-eight days) produced, on the whole, rather more extreme effects.

In *Argynnis aglaia*, heat (four days at 36° C.) produced very little effect, the ground colour of the upper sides of the wings being lighter, the greyish-green shades of the under sides darker and more conspicuous than usual. After twenty-eight days of cold, only three uninjured insects emerged from twenty-one pupæ; in these the ground colour was unaltered, the black spots at the base of the fore wing enlarged, while the greyish-green shades, described above, gained a brown tinge. After a longer period of cold (forty-two days), two insects emerged from twelve pupæ, and these showed far more extreme effects in the darkening of both upper and under sides of the wings.

The pupæ of *Dasychira abietis* were killed by heat 37° C., while cold (forty-two days) tended to darken the insects.

Some experiments were also made upon the effects of comparative dryness and moisture upon the pupæ. Large numbers of pupæ of *Saturnia pavonia* were kept very dry from June to the end of September, and were then exposed to moisture; a treatment which the author believes, from repeated experiments, causes about 1 per cent. of the moths to emerge in about ten to twenty days, instead of hybernating. In these moths the pattern was "not sharply outlined, but more or less washed out and confused."

Towards the end of the paper the author gives a brief and general account of the results obtained by subjecting the pupæ to heat and cold. He summarises the various classes of effects as follows:

(1) "Seasonal forms" similar to those which are known to occur in nature (*V. C-album* and *P. machaon* to some extent).

(2) Local forms and races similar to those which occur constantly in certain localities (*V. urticæ*, *cardui*, and to some extent *P. machaon* and *V. antiopa*).

(3) Entirely exceptional forms or "aberrations," also occurring from time to time in nature (*V. io*, *V. cardui*, *argynnis aglaia*).

(4) Phylogenetic forms, not now occurring on the earth, "but which may either have existed in past epochs, or may perhaps be destined to arise in the future" (*V. io*, *V. antiopa*, *V. atalanta*).

This portion of the paper, although of interest, is not equal to the experimental portion, and cannot be in any way compared with Dixey's careful consideration of the results of Merrifield's experiments.

It is to be hoped that Dr. Standfuss will continue his experiments on this most interesting subject. E. B. P.

A NEW SYNOPSIS ANIMALIUM—DAS TIERREICH.

FROM rough calculations lately made by the contributors to the *Zoological Record*, it would appear that some 360,000 species of animals have been described by naturalists up to the present date. To arrange all these species on a uniform system, and to add descriptions and other necessary particulars to each of them, would appear to be almost an herculean task. Yet it has been undertaken, we are told, by the German Zoological Society, which has entered into an agreement with Messrs. Friedländer and Son for the publication of such a work. Prof. F. E. Schultze, of Berlin, has been selected as general editor of "Das Tierreich," and will be assisted by numerous sub-editors in the different departments of zoology. Each of these sub-editors again will invite the assistance of specialists in the groups assigned to his charge, so that a very large number of naturalists will assist in this gigantic undertaking. It is proposed to issue the first parts of the work in 1897, and it is expected that at least twenty-five

years will elapse before the undertaking can be brought to a conclusion.

On looking down the list of contributors whose services have been already secured for "Das Tierreich," we see, as might have been expected, that they are mostly Germans. But a certain number of English and French naturalists, and some from America and Italy, have already given their adhesion to the plan, and have undertaken to furnish certain portions.

The language employed will be, as a rule, German, but contributions in English, French, and Latin will also be received.

In order to show the general style of the proposed work, Messrs. Friedländer and Son send out along with the prospectus a synopsis of the small group of *Heliozoa*, prepared by Dr. Fritz Schaudinn, of Berlin. So far as we can judge from this portion of the work, the information which it is proposed to give will be exactly what is required for such a manual, and the whole work, if carried out upon this plan, will be of the greatest value to zoologists.

One little criticism we may venture to make on the proposal. The title, we think, is not a very well-chosen one. Bronn's well-known and important work ("Die Klassen und Ordnungen des Thierreichs") has already monopolised the selected name, although in Bronn's days the new mode of writing it had not been introduced. A good Latin title, such as "Synopsis" or "Index Animalium" would have been better, and would have given to the work a more cosmopolitan character. Indeed, we believe that it would have been much better to have used Latin throughout the work, as the common language of science. There are many working naturalists in France, Italy, America, and England who do not understand German. But every one who has been to school acquired sufficient knowledge of Latin to understand a Latin diagnosis. And the proposed work will consist mainly of diagnoses.

NOTES.

THE first of the two annual conversaziones of the Royal Society will take place on Wednesday, May 6. This is the conversazione to which gentlemen only are invited.

MR. W. C. MCDONALD has just given the McGill University, Montreal, further reason to be grateful for his unbounded generosity. We understand that he has offered to build and equip a building for chemistry and mining on the same scale as the engineering and physics buildings, which the University owe to his munificence, involving a cost of about £52,000. In addition to this, he has decided to found a chair of Mining Engineering and a chair of Architecture, and has added the sum of £31,000 to the endowment of the University. The completeness and liberality with which the physics and engineering departments of the McDonald buildings are equipped may be judged from an article which appeared in these columns in 1894 (vol. l. p. 558). We cherish the hope that Mr. McDonald's generous benefactions will create a spirit of emulation among those who are able to advance scientific education and research in this country by providing the necessary means.

THE well-known American naturalist, Mr. D. G. Elliot, and party left London for Somaliland on the 27th ultimo. The object of Mr. Elliot's expedition is to obtain a series of antelopes and other larger African mammals for the Field Columbian Museum of Chicago. Mr. Elliot had originally intended to go to Mashonaland for this purpose, but the recent troubles in South Africa induced him to change his plans. He will land at Berbera, and proceed southwards over the high plateau to the Shebeyli River, where he expects to find giraffes and Grévy's zebras. Mr. Elliot will endeavour to return to the coast by the valley of the Juba River, in order to procure examples of the recently-described Hunter's antelope (*Damaliscus hunteri*). Mr. Elliot takes with him a taxidermist from Chicago, and has secured in London the services of Mr. Dodson, who accompanied Dr. Donaldson Smith during his recent adventurous expedition in Lake Rudolph.

THE Liverpool Marine Biological Station at Port Erin is now quite full. The naturalists who have gone there to work, for the Easter vacation, are Prof. G. Gilson (Louvain), Mr. Arnold Watson (Sheffield), Mr. E. T. Browne (University College, London), Prof. Weiss, Mr. Gamble, Mr. Burtt, and Mr. Mellor (from Owens College, Manchester), Mr. Kermode (Ramsey), Mr. Clubb (Liverpool Museum), Mr. C. E. Jones and Prof. Herdman (University College, Liverpool). Several students from University College, Liverpool, are expected later. The tides have been exceptionally low, the weather is good, and the Committee have arranged several dredging expeditions, one of which will be to the deep water between the Isle of Man and Ireland.

THE death is announced of Mr. George Holt, who endowed the chair of Physiology in University College, Liverpool, and contributed altogether about £25,000 to the resources of the College.

ONE of the New York medical colleges has already incorporated instruction in the use of X-rays in surgery as a part of its regular curriculum.

AMONGST the experiments on Röntgen X-rays made during the past month by Italian physicists, several contributions may be cited which either tend to confirm the results established by other workers, or to establish new results. Signor A. Roiti describes (*Atti R. Acad. Lincei*) a series of experiments now in progress bearing on the question as to where these rays emanate. The principal conclusions arrived at are: (1) That fluorescence does not necessarily accompany the emission of X-rays; (2) that the rays are only emitted when kathodic rays impinge on certain substances, notably glass, aluminium, mica, platinum, and porcelain. Signor Roiti establishes some interesting results relating to the leakage of electricity which takes place when X-rays fall on a charged body. When the body in question is placed in a vessel from which air is exhausted, this leakage effect is found to diminish rapidly after the pressure falls below a certain limit, showing that the leakage effect depends on the presence of molecules, by which electricity is conducted from the charged body to the containing vessel.

OUR American correspondent writes, under date March 27:—"Reports are received of the favourable action of the Senate Committee with reference to the proposed National University, preliminary appropriations being recommended for 1897 and 1898. This measure is one which has often heretofore been broached at Washington, and has been so often deferred as to seem to many a hopeless scheme. Present indications, however, point to some real progress, and encourage the hope that something will at last be accomplished.—Progress in science seems to pervade all departments of the Government. Another notable move is the introduction into the Post-office at Washington, of cancelling stamps which indicate every day the weather forecast, and of course the stamps are changed from day to day. This scheme will be put in operation within a few weeks.

"THE site selected for the new free public library of New York, which has recently been so amply endowed, including the Astor and Lenox libraries and the Tilden bequests, is that of the old reservoir on the corner of Fifth Avenue and West Forty-second Street. At a public hearing before the

Mayor of New York, on March 25, the choice was approved by him; and application will be made to the Legislature for permission to use this site, which will no doubt be granted, as the old reservoir is now disused.

"THE annual exhibitions of the New York Academy of Sciences are now the scientific event of the year. The third annual exhibition was held on March 26, at the American Museum of Natural History. As a matter of course, the display of radiographs and radiographic apparatus attracted the most attention, and the lecture of the evening was by Prof. Pupin on the X-rays. A large and interesting array of exhibits was made in other departments. As space forbids any systematic report, a few salient features include the following: The new elements, argon and helium, were shown by electrical illumination, and their spectra exhibited. The astronomical exhibit included fine photographs of star clusters, and spectra of stars, planets, &c. A photograph was shown of a meteor trail at Arequipa, Peru, September 6, 1895. Improved apparatus for investigations in astronomy, physics, and experimental psychology included many novelties. A series of pictures giving restoration of extinct mammals was pronounced by palæontologists the most complete and accurate ever made. The exhibits in geology, mineralogy, and botany were numerous and interesting. President John I. Stevenson made a brief address, appealing to citizens of New York to move in the matter of securing a permanent home for the Academy.

"MR. BRYAN LAWRENCE, who died at New York, March 10, left a large number of bequests to various Roman Catholic charities, including several educational institutions. The larger educational bequests are 5000 dols. each to the American College at Rome, Italy, the R.C. Seminary, Westchester County, N.Y., and the American University (R.C.) at Washington, D.C.—Brigadier-General Thomas L. Casey, retired, for many years chief of engineers of the United States Army, dropped dead in the new congressional library building at Washington, March 25. He was engaged in superintending the construction of the building. The Washington monument, 555 feet high, being the highest structure in America, was completed by him some years ago, after a long delay in the work previous to his connection with it. General Casey was a Fellow of the American Association for the Advancement of Science.

"A NOVEL series of experiments is in progress at Wesleyan University, Middletown, Connecticut, to determine the nutritive and caloric value of food, and many other questions relative to nutrition and other vital processes. For this purpose a calorimeter is employed, consisting of a copper-lined box, measuring inside $7 \times 4 \times 6\frac{1}{2}$ feet, thus giving 182 cubic feet of air, within which space a man is confined for several days at a time. It is fitted with glass windows of three thicknesses. Fifty litres of air per minute are pumped in. Food is passed in three times a day through an air-tight tube, and is carefully weighed, as are all the exudations and excretions, and the quantity of heat is measured. A telephone enables the subject to converse with the outer world. The experiments are conducted by Prof. Wm. O. Atwater, and the expense is shared by the Department of Agriculture of the United States, Wesleyan University, and the Storrs Experiment Station at New Bethel. A careful record is kept of every action of the subject—of his hours of sleep, minutes of exercise, respiration, appetite, &c. To this end there are two watchers and two assistants, a watcher, who is a professor in the university, and an assistant being constantly present."

AT the Royal Institution, on Tuesday next, April 14, Prof. James Sully will begin a course of three lectures on "Child-Study and Education"; on Thursday, April 16, Prof. Dewar will begin a course of three lectures on "Recent Chemical Progress"; and on Saturday, April 18, Prof. W. B. Richmond, R.A., will begin a course of three lectures on "The Vault of the Sixtine Chapel." The Friday evening meetings will be resumed on April 17, when Prof. G. Lippmann will deliver a discourse on "Colour Photography."

THE next course of Cantor Lectures at the Society of Arts will be delivered by Prof. Henry A. Miers, on Monday evenings, April 13 and 20, the subject being "Precious Stones." The points to be dealt with are: (1) The properties which make precious stones esteemed among minerals; (2) the properties by which precious stones are recognised; (3) the distinction of stones which may be confused, as garnet and ruby, jacynth and cinnamon-stone, zircon and lux sapphire, garnet and olivine, tourmaline and diopside, &c. The lecture will close with some remarks on artificial stones. Mr. James Swinburne will deliver a course of Cantor Lectures on "Applied Electro-Chemistry," on Monday evenings, April 27, May 4, 11, and 18. Among the papers arranged for the meetings of the Society after Easter are: April 22, "The Perfected Photochromoscope and its Colour Photographs," by Mr. F. E. Ives; April 29, "Fruit Drying or Evaporation," by Mr. E. W. Badger. Papers at subsequent meetings will be read by Captain Abney, on "Orthochromatic Photography"; by Mr. Hudson Maxim, on "High Explosives and Smokeless Powders"; and by Mr. E. W. Moir, on "Tunnelling by Compressed Air."

THE French Association for the Advancement of Science held its annual meeting at Tunis last week, about four hundred members being present. The office-bearers of the Association were received by the Bey on Wednesday, April 1; and the French resident, M. Millet, welcomed the Congress on the following day. The principal streets of Tunis were elaborately decorated in honour of the occasion, and, as hotel accommodation was limited, the Lycée Carnot was placed at the disposal of visitors. The Association met at Algiers fifteen years ago, so the recent meeting was the second one held on African soil. Next year's meeting will take place at St. Etienne.

ON Thursday, March 26, Prof. Guido Cora, of Turin, delivered a lecture on the "Gypsies" (*Gli zingari*), in the Aula Magna of the Collegio Romano in Rome, having been invited by the Società Palombella (founded for the higher education of women). The lecture was attended by the Queen of Italy, the Minister and the Under Secretary of State for Public Instruction. Prof. Guido Cora gave a short but complete history of the question, dealing also with many facts about the origin, manner and habits of the gypsies in every part of the world. He referred in high terms to many British scholars of the subject, and to the importance of the "Gypsy Lore Society" of Edinburgh.

THE twenty-seventh annual meeting of the Norfolk and Norwich Naturalists' Society was held in the Castle Museum on Monday, March 30, the President (Mr. H. D. Geldart) in the chair. Sir F. G. M. Boileau, Bart., was elected President for the coming session. In his annual address, Mr. Geldart discussed the subject of Arctic distribution of flowering plants, especially with reference to the influence of the glacial epoch upon the flora of the British Isles. He concluded his remarks by suggesting, as a simple and likely solution of the difficulties arising from the present distribution of Arctic and Alpine floras, that before the commencement of the glacial epoch, what is now commonly known as the "Scandinavian" flora, but which would be better called the "Arctic" flora, was distributed from land then existing in the neighbourhood of the Pole; that a part of this flora, being well established,

had held its own without migration even to the present time, and that the hypothesis of destruction and migration of plants from north to south and back again was unnecessary to account for the actual facts of distribution.

IN connection with M. Ragonneau's reported explanation of the "mango trick" of Indian native conjurers, it may be interesting to compare his results with Moggridge's observations on the harvesting ants of the Riviera. According to M. Ragonneau, the Indians sow the seed under experiment in earth which has been taken from an ants' nest, and the formic acid present causes it to germinate with extraordinary rapidity, and "grow up into a tree" before the astounded spectator. The French observer states that he has reproduced this experiment in every detail by sowing seeds in earth previously watered with a dilute solution of formic acid. On the other hand, Moggridge found that in seeds stored in the granaries of the Mediterranean ants the process of germination was indefinitely delayed. That their vitality was not destroyed was proved by removing and planting them in fresh earth, when they grew immediately. That ants should be capable of exerting such opposite influences on the growth of seeds is remarkable.

AN interesting investigation on the specific heat of solutions has been given by Herr G. Tammann (*Zeitschrift für Physikalische Chemie*). It is well known that weak solutions of certain electrolytes have a smaller capacity for heat than the water present in them possessed previously to the introduction of the salt, and the object of the investigation is to establish a connection between this phenomenon and the contraction of volume which accompanies the process of solution. This contraction has often been accounted for by the hypothesis of a certain internal molecular pressure. Herr Tammann calculates the specific heat of the water present in a number of solutions of this class on the supposition that their pressure is the *increased* pressure postulated by the above theory, and he also calculates the specific heat of the dissolved substance, that of the mixture being deduced by adding the thermal capacities of the two components. The theoretical values thus obtained are found to agree closely with the values experimentally found by observing the solutions themselves, and it is inferred that contraction is the sole cause of the diminution of specific heat arising from the presence of the dissolved matter.

AS an addition to the information about Northern Norway, contained in Dr. Reusch's article in NATURE of March 5, we give the following data as to cloudiness, communicated to Mr. Lawrence Rotch by Prof. H. Mohn, Director of the Norwegian Meteorological Institute, and sent by him to *Science*. Prof. Mohn writes: "For Sydvaranger, the nearest place to Vadsö at which meteorological observations have been made, the amount of cloud on a scale of 0 to 10, and the chance in percentages of its occurrence are as follows:—

August 8, 8 p.m.				August 9, 8 a.m.		
Amount of cloud.		Chance.		Amount of cloud.		Chance.
10	...	45·5	...	10	...	45·5
8	...	13·7	...	9	...	9·1
7	...	4·6	...	8	...	4·6
5	...	4·5	...	7	...	9·1
3	...	9·1	...	6	...	4·5
2	...	4·5	...	4	...	4·6
0	...	18·2	...	3	...	4·5
				2	...	9·1
				0	...	9·1
		100·1				100·1

Sydvaranger lies on the south side of the Varangerfjord, and Elvenes is the name of the posting station. Vardö, lying on the north side, is not to be recommended, having too often fog or clouded sky. In the interior of Finmarken the sun is lower than at Varangerfjord." Although the astronomical conditions of low altitude of sun and short totality are not good, yet Mr. Rotch thinks the meteorological conditions just noted compare favourably with those of stations in Japan, where the eclipse occurs later in the day and totality lasts longer.

FROM materials collected by the Meteorological Office from merchant ships' logs since the year 1854, from data contained in the logs and Remark Books of the Royal Navy since 1830, and from other sources, the Meteorological Council have prepared monthly current charts for all oceans, which will certainly prove of much value to navigators. The Hydrographic Office of the Admiralty has undertaken to generalise the large amount of material which has been collected, and already the charts for the Indian Ocean have been published. These generalised sheets show the average direction and rate of the currents, and other details; much valuable information has hitherto been masked by the grouping of the data for longer periods. They show, for instance, that near the African coast there is no month between January and July in which the rate of the Agulhas current does not occasionally reach 100 miles in 24 hours, and also that it follows very different routes after reaching the latitude of the Cape. The currents of the Bay of Bengal are shown to be subject to very abrupt changes with the change of the monsoon, but do not follow the precise direction that might be expected. In January there is a well-marked southerly drift near the coast, while in February the current assumes an entire change of direction, and sets to the northward. Similarly, important changes are shown to exist in the current round the southern part of Ceylon.

AN ingenious and novel method, which it is hoped may prove of service in distinguishing genuine cholera-vibrios from their numerous rivals, has been recently introduced by Prof. Pfeiffer and Dr. Vagedes. Taking advantage of the now recognised fact, that the serum derived from cholera-immunised animals contains anti-cholera substances, Dr. Pfeiffer has traced the effect produced outside the body from cholera-vibrios when brought into intimate contact with such serum in artificial cultures. For this purpose broth, to which highly active cholera-serum was added, was inoculated with cholera-vibrios, and the effect watched under the microscope in hanging-drop cultures. The vibrios, usually so active, were almost immediately deprived of their powers of movement, and after twenty minutes' exposure to a higher temperature in the incubator, all traces of motility had vanished, although no morphological difference could be discovered in their appearance. When, however, such drop cultures were allowed to remain for twenty-four hours in the incubator, the vibrios were found to have almost completely regained their old activity, indicating that the original inimical effect produced by the serum had to a great extent been overcome. Dr. Pfeiffer states that this remarkable influence of the cholera-serum was only apparent with true cholera-vibrios, all the other numerous descriptions of allied vibrios which were examined being totally unaffected. Further extensive trials must be made before passing a final opinion upon this new method of cholera diagnosis, and Dr. Pfeiffer has expressed his willingness to assist all such investigations by supplying cholera-serum of the requisite degree of strength, to those who desire to carry out similar experiments.

A SHORT paper by Mr. H. W. Seton-Karr, on his discovery of evidences of the palæolithic stone age in Somaliland, appears in the latest number of the *Journal* of the Anthropological Institute (vol. xxv. No. 3, 1896). His observations show that stone implements in Somaliland are found scattered all over the country, but probably mostly below the present surface, within a district included roughly between the Red Sea and lat. 9° 30′ N., and between E. long. 44° and 45°. Dr. Gregory made a collection of obsidian implements in Masai-land, but these were all neolithic; and he points out that, as no palæolithic implements

have been recorded from Tropical Africa previous to those described by Mr. Seton-Karr, if the identification of some of the specimens as palæolithic is verified, the discovery is a very important one.

IN nearly every county of Central and Northern Indiana there occurs a kind of black soil, often spoken of as "bogus land." It is also sometimes called "alkali," but not correctly, for the land has none of the essential characteristics of alkali soil. The improvement of these hitherto unproductive black soils is the subject of a *Bulletin*, by Mr. H. A. Huston, published by the Agricultural Experiment Station of Purdue University, Lafayette, Indiana. It is asserted that thousands of acres of such soil are susceptible of amelioration to such an extent as to be made the most productive maize lands in the State. The use of straw or kainit has proved very profitable as a means of temporary improvement, but for permanent improvement a resort to efficient drainage—and that of a special kind—is essential. It is strongly recommended that, before incurring any other outlay, a preliminary survey of each area should be made, and the system of improvement determined according to the results of such survey.

PROF. H. G. SEELEY, F.R.S., will begin the summer course of lecture-excursions with the London Geological Field Class at the end of April. The subject of the series will be the Physical Geography and Geology of the Thames and its Tributaries. This is the eleventh annual course. Mr. R. Herbert Bentley, 31 Adolphus Road, South Hornsey, N., is the hon. secretary to this society, which gives a systematic course of teaching in the open country.

THE *Proceedings* for 1895 of the Agricultural Research Association, the organ of the Research Station, Glasterberry, Milltimber, Aberdeen, contain reports by the Director, Mr. Thomas Jamieson, on the securing of crops, on the permanence of manure, on the "furrow-system" of sowing grain, on the mechanical conditions of soils as affecting the growth of plants, on the mechanical analysis of soils, and on new manures.

THE Danish Meteorological Institute has recently published a valuable series of observations made in the Isle of Denmark, Scoresby Sound, lat. 70° 27′ N., long. 26° 12′ W. From September 18, 1891, to July 31, 1892, meteorological observations were made every hour, under the direction of Mr. C. Ryder, the chief of the expedition. The mean temperature of the six months from November to April ranged between 1°·4 and – 13°·9 F. From the beginning of May the cold began to diminish, and in July there was only a frost on one day. The absolute minimum occurred on March 7, when the thermometer fell to – 52°, and the absolute maximum amounted to 58° on July 13. The wind was usually very light, while calms were very prevalent, amounting to about 80 per cent. Snow, and occasionally rain, fell on 131 days out of 318 ; neither hail nor thunderstorms occurred during the period of observation, but fog and mist were very frequent, especially between December and June. Aurora borealis occurred on 142 nights out of 183 between October and March ; this phenomenon is made the subject of a special discussion.

THE additions to the Zoological Society's Gardens during the past week include a Moustache Monkey (*Cercopithecus cephus*, ♂) from West Africa, presented by Mrs. Polini ; two Rhesus Monkeys (*Macacus rhesus*, ♀ ♀) from India, presented respectively by Mr. C. Harmer and Mr. C. T. Trevalyan ; a —— Boa (*Boa* ——) from Dominica, presented by Mr. W. Weldon Symington ; a Barnard's Parrakeet (*Platycercus barnardi*) from Australia, deposited ; a Raccoon-like Dog (*Canis procynides*) from Japan, two Elliot's Pheasants (*Phasianus ellioti*, ♂ ♀), two Bar-tailed Pheasants (*Phasianus reevesi*, ♂ ♀) from China, two Rosy-billed Ducks (*Metopiana peposaca*, ♂ ♂) from South America, purchased.

OUR ASTRONOMICAL COLUMN.

THE ROYAL OBSERVATORY AT EDINBURGH.—The new Royal Observatory, which has been in course of erection on Blackford Hill, to the south of Edinburgh, during the last four years, was formally opened by the Secretary for Scotland, Lord Balfour, on Tuesday. A short article in the *Times* reminds us that the observatory owes its origin to the presentation to the Scottish nation by the Earl of Crawford of the splendid collection of instruments in his private observatory at Dun Echt, in Aberdeenshire, which was followed by the appointment of Dr. Ralph Copeland, the superintendent at Dun Echt, as Astronomer Royal for Scotland and Professor of Astronomy in the University of Edinburgh in 1889. As there was not sufficient accommodation for the new instruments in the old buildings on the Calton Hill, it was resolved to erect a new observatory worthy of the nation and of Lord Crawford's munificent gift. A Government grant of £33,000, afterwards increased to £36,000, was obtained, and the Town Council of Edinburgh granted on easy terms a site deemed in all respects suitable, on the eastern crest of Blackford Hill, which possesses exceptional stability, a convenient elevation, and unusual purity of atmosphere, the smoke nuisance intruding itself only in one day out of eighteen.

The buildings consist of the observatory proper, the official residence of the Astronomer Royal, the residence of the assistant astronomers, and subsidiary buildings. The observatory is a T-shaped building, the head of the T facing the north with a frontage of 180 feet, and having at each end a telescope tower, of which the eastern is 75 feet high and 40 feet in diameter, and the western is 44 feet by 27 feet. The former contains the most important instrument in the observatory—a new refracting telescope of 15-inch aperture. The latter contains the reflecting telescope, removed from the Calton Observatory, which has an aperture of 2 feet, and which is to be used in astro-physical researches.

Among the other instruments in the observatory are a meridian circle, 8½ inches in diameter ; a self-recording anemometer ; an ingenious chronograph ; the telescope with which the late Prof. Piazzi Smyth made most of his observations on the Calton Hill ; several good spectroscopes ; a reversing transit instrument ; and the clock, connected by wire with Greenwich, which fires the daily time-gun at Edinburgh Castle and drops the time-ball on the Nelson Monument. Connected with the observatory, there is a well-equipped photographic laboratory, and a library with accommodation for some 30,000 volumes, which is already well furnished with the treasures of the Dun Echt collection.

COMET PERRINE-LAMP.—The Perrine-Lamp comet was observed at the Astro-Physical Observatory, South Kensington, on the 1st inst., and spectroscopic observations were made by Mr. Shackleton. On account of the faintness of the comet the spectrum was weak, but a fair amount of continuous spectrum was seen, with three maxima in the green blue, which in all probability correspond to the carbon bands, as they had the same relative positions ; this, however, could not be verified by direct comparison.

BOGGIANI'S RECENT EXPLORATIONS AMONGST NATIVE TRIBES OF THE UPPER PARAGUAY RIVER.

THE country along the upper course of the Paraguay has recently been attracting the attention of men of science. A short time ago naturalists were aroused by the wonderful discovery made by Dr. Bohls of *Lepidosiren paradoxa*, that rarest and strangest of fish, living in abundance in lagoons in the Lengua territory of the Gran Chaco, not very far from the right bank of the Paraguay.

I now intend to give a short account of the ethnological results of the explorations of an Italian artist, Cavaliere Guido Boggiani, who, little more than three years ago, lived amongst two of the less-known native tribes, further north, on both sides of the Paraguay River. They are the *Chamacocos* and the *Caduveos*. Boggiani brought home extensive ethnographical collections from both, which he has described in lectures delivered at Rome and Florence, recently published in elegant

and richly illustrated monographs, in which much new information is given on those two previously ill-known tribes.[1]

The *Chamacocos*, of whose singular long-handled stone axes and stone chisel I published an account some years ago in the *Archives internationales d'Ethnographie* of Leyden, inhabit the neighbourhood of Puerto Pacheco, on the right bank of the Paraguay River, now ceded back to Bolivia, their territory lying between 20° and 21° S. lat. They are, however, true nomads, and wander north and south along the main river, but generally from that inland. Their affinities appear to be with the lost *Zamucos*, who formed part of the Chiquitos confederate missions, which flourished about 150 years ago; but up to a quite recent date (*circa* 1885), the *Chamacocos* were quite unknown. The origin of this name is obscure; it is not that by which the tribe calls itself, if such a collective name exists. Boggiani found that the names *Múria*, *Ibitéssa*, and *Ennima* were given to sections of the tribe.

The first Hispano-American settlers at Puerto Pacheco, who dubbed the natives as *Chamacocos*, became aware of the existence inland of a wilder people, whom they called *Chamacocos bravos*. These were not infrequently raided upon by the *Chamacocos mansos* (*i.e.* civilised), who carried off their children to sell as slaves, and pillaged their camps. Boggiani has found out that this is a kindred but distinct tribe from the *Chamacocos*, speaking a different language; their true name is *Tumanà*, and it appears that the singular long-handled stone axes, which have come into European hands through the *Chamacoces*, are mostly, if not all, taken from them. Further inland, beyond the *Tumanà*, Boggiani was informed that an agricultural settled tribe, the *Tinnàru*, lived, in whom he suspects the real descendants of the *Zamucos* may be found.

The Bolivian settlement at Puerto Pacheco was formed in 1885; it had hardly begun to prosper when the Paraguayans took possession, and re-named the place Bahia Negra. A few years later, Boggiani and an Argentine friend got a concession from the Paraguayan Government, and formed two wood-felling stations in the neighbourhood. It is thus that my friend came in contact with the *Chamacocos*, most of his workmen belonging to that tribe. Boggiani's descriptions of the country and the natives are vivid, the fruit of a refined artist's genuine admiration of a virgin country and wild men. These he depicts as splendid specimens of humanity; tall, perfect in shape, with skin of a bronzed reddish tinge; long black hair, worn tied in a knot behind, in a thick queue, ornamented with feathers, or flowing loose. The women, who, as usual amongst savages, are the beasts of burden, are less handsome, and wear their hair short. No clothing is worn by either sex, except rough sandals of Peccary skin when on the tramp, and a profusion of feather ornaments and necklets of seeds, &c., on festive occasions. As most of the natives of tropical America, the *Chamacocos* excel in the "Arte Plumaria," and it would be difficult to describe in words the beauty of their combinations of bright-coloured feathers of the parrots, toucans, and trogons, with the grey of the rhea, the glossy black of the musk duck, the lovely pink of the spoonbill, and the white plumes of the egrett. Amongst other curious ornaments, one of the strangest is the rattle of the *Crotalus*, for which these people have quite a predilection; for I have seen it dangling amongst feathers in diadems, armlets and leglets, united in bunches as ear-pendants (Fig. 1), and even tied on axes or clubs. I have never heard of other American tribes putting the caudal appendage of the dread rattlesnake to such use. During their dances the *Chamacocos*, besides small gourds containing stones, use belts made with loosely-strung carapaces of small tortoises, or the hoofs of stags. They make rude pottery with the hand, the potter's-wheel being quite unknown to them.

Formerly the *Chamacocos* lived in constant dread of the *Mbaya* or *Caduveos*, then a powerful predatory tribe, located on the opposite side of the Paraguay River, but who frequently raided the Chamacoco territory, carrying off young men and women as slaves. Now the white man, with his diseases and evil propensities, is their worst foe. Boggiani, however, appears to have been a general favourite with them. From his descriptions, the *Chamacocos* appear to be, on the whole, an inoffensive and happy people, and show off their exuberant spirits in frequent dancing and singing bouts. They have various games, one of which may be described as a kind of lawn tennis.

[1] Guido Boggiani, "I Ciamacoco, Conferenza" (Roma, 1894): "Viaggi di un artista nel l'America meridionale, I Caduvei" (Roma, 1895); "I Caduvei, studio" (Roma, 1895).

Besides the singular stone axes with long, flat hard-wood handles, which appear to belong properly to the *Tumanà*, are called *Nò scico*, and may be considered more like war-clubs than cutting implements, the weapons of the *Chamacocos* are plain clubs, wooden spears, large bows for shooting arrows pointed with hard wood, and small bows with a double string, used for shooting clay bullets; these for catching birds.

The women make neat bags and reticules of different kinds of netting, also hammocks, used generally for wrapping and carrying larger parcels. The *Chamacocos*, like most savages, make fine cord of various kinds, using mostly the fibres of the *Ybira*; the weaving loom is unknown to them. Their food is heterogeneous, but they have curious superstitions regarding some kinds; thus deer-flesh is only eaten by men, whilst women can feed on birds and small game; children cannot partake of the eggs of the ostrich (*Rhea*). Boggiani has also collected a small vocabulary of the hitherto unknown language of these people.

Boggiani spent two months and a half with the *Caduveos* of the Nabilecche River, mostly at their principal village Nalicche, living as one of them, and enjoying most favourable opportunities for studying the manners, customs, and character of this once powerful and partially civilised tribe, now sorely reduced in numbers and on the wane. It is strange how little has hitherto been known of them and of their country, so much so that even on recent maps the Nabilecche, which runs into the main stream of the Paraguay River some 10 or 12 kilometres north of Fort Olimpo, in Brazilian territory, is not only misplaced but considered a mere branch of the Paraguay. Nalicche is not on the

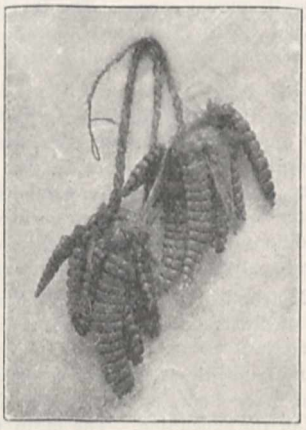

FIG. 1.—Chamacoco ear-pendants of rattlesnake tails.

banks of the Nabilecche, but some distance inland, half way to the Miranda mountains. It consists of a single row of huts slightly bent, united under a common roof of *Yatai* palm-leaves; at the back, separated by boards, are the true huts; the front forms a kind of covered corridor, continuous right through. In front is a square, kept quite clean, at the lower end of which is a spring, which gives the water supply to the village. The country around is a fine wooded and grassy undulated plain, on which the cattle and horses of the *Caduveos* graze. In cleared portions of the adjoining forest are the fields, in which each family cultivates the necessary crops of mandioca, maize, rice, gourds, and sugar-cane, besides papaws and bananas. Poultry and numerous mangy cur-like dogs complete the list of domesticated animals.

The *Caduveos* are known also under the names of *Mbayas* and *Guaycurù*; this last is erroneous, it is the Guarany for "savage." Boggiani believes that they came across the Chaco, and were once in contact with the civilised tribes of Peru; I can hardly follow him as far as that. It is evident, however, that amongst the surrounding wild nomadic tribes the *Caduveos* emerged as a warlike but agricultural people, with fixed residences and certain industrial arts, such as weaving and pottery; in this they excel even to this day. The beauty and variety of their ornamental designs is truly wonderful; Boggiani, as an artist, was particularly struck with this remarkable development in a savage people, and he gives quite a series of fine drawings in illustration of the artistic taste and invention of the *Caduveos*, to be seen on their earthenware and in their very elaborate body and face

painting. As Boggiani justly observes, the decorative art of the *Caduveos* is not the casual result of a complication of rude and primitive designs, but that of a logical study of the harmony and æsthetic combination of lines and figures.

Boggiani, after a long and careful comparative study of the ornamental designs of the *Caduveos*, comes to the conclusion that they show distinct affinities with ancient Peruvian art. In a paper read in September last, at the Italian Geographical Congress,[1] he gives a very interesting account of ornamental designs found on the skin of Peruvian mummies, and comes to the opinion that they were painted, not tattooed, the designs and the process being similar to that practised by the modern *Caduveos*, who stain their skin with the juice of the *Genipa* in ornamental designs of a blue-black colour, which penetrates partially the epidermis, and is sufficiently durable, lasting six or seven days; as the staining process of Genipa-juice, darkening by the action of light, is rather slow, powdered charcoal is added to heighten the effect. The instruments used are small sticks, to the end of which a tuft of cotton-wool is in certain cases tied; the artists are women. A red dye is obtained from the well-known *Urucú* or *Bixa orellana*, but it is far less durable. The *Caduveos* paint thus the feet and lower part of the legs, besides the face; the designs vary *ad infinitum*.

Boggiani describes the *Caduveos* as tall and well-made, of a light bronze colour; the hair is worn short and well combed and greased; the upper incisors are filed to a point; depilation is scrupulously practised. They are cleanly, often bathing and washing their bodies. The men wear a piece of cotton cloth from the waist downwards, held by a belt, richly decorated; the women have, besides, an upper garment covering the breast. Often both men and women have also a kind of *poncho*, which hangs from the shoulders, leaving the arms free. Necklaces, bracelets, and ear-pendants of beads or silver tubes are universally worn; they make their silver ornaments with skill and taste. The men smoke tobacco in cigarettes or in wooden pipes, tastefully carved in wood; the women only chew tobacco. The *Caduveos* were not many years ago skilful weavers of cotton cloth; at present the advent of cheap cotton textiles from Europe has virtually destroyed the native art. Boggiani was, however, able to secure some specimens, and the weaving and spinning apparatus.

As I have noted already, it is in the potter's art that the *Caduveos* excel; it is also the work of women; the ornamentation is rich, varied, and quite peculiar. The designs are traced on the unbaked clay with a cord; red is obtained with oxide of iron, black with the resin of *Palo santo*, white with a kind of chalk. The earthenware of the *Caduveos* presents a large variety in shapes and sizes. The only neighbouring tribe who do anything of the kind are the *Guanà*, but their ware is inferior in all respects.

The *Caduveos* now possess European weapons; bows and arrows are, however, yet in use for the chase and for fishing. Boggiani was able to secure a few rough stone axes, but they were designated as "sky stones," and used for crushing nuts. The *Caduveos* have canoes or dug-outs of different sizes, which they manage with skill. The chiefs, and their descendants also in the female line, form a sort of nobility, now more numerous than the commoners; the lower caste is formed by slaves, often the descendants of captured *Chamacocos*. The head chief is called *Mbaya*, a name which is also applied to the whole tribe; his authority is not great, and much freedom exists amongst the heads of families; even the slaves are well treated, and often ultimately are considered free. One wife is married, and the bridegroom goes to live in the house of the bride, taking with him the family poles, which are driven in the ground in front of the sleeping-place of the newly-married couple; these poles are carved with totemistic designs.

FIG. 2.—Caduveo decorated pottery.

The *Caduveos* are at present much reduced in numbers, and Boggiani foresees their speedy extinction. Many are the causes which have led to this, derived from the contact with the whites; but it must not be forgotten that abortion and infanticide are, unfortunately, but too frequent amongst the *Caduveo* women, who only care to rear one child. They are, besides, cursed with the red man's love for strong drinks. Otherwise they are gay and sociable, delight in dances to the sound of drum and flute, and in a game very much like golf; pugilistic bouts, *coram populo*, are also in great favour, in which men, women and children join.

The *Caduveos* have medicine-men or sorcerers, who monopolise the spiritual and mystic rites, and effect cures. One, whom Boggiani saw practising with a piece of a glass mirror and a bunch of feathers on a dark night, was a *Chamacoco*.

Boggiani writes well, he is a careful observer, and has proved himself an excellent collector; he is to be sincerely congratulated on the good work he has hitherto done for ethnology, and we cannot but cordially join in the hope he expresses of being able to continue and complete his investigations of the native tribes of the Northern Chaco and adjoining regions.

HENRY H. GIGLIOLI.

[1] G. Boggiani, "Tatuaggio o Pittura? Studio intorno ad una curiosa usanza delle popolazioni dell' antico Peru." Atti del II° Congresso Geografico, Roma, 1895.

A NEW HUMAN SKULL OF A LOW TYPE FROM BRAZIL.[1]

A LOW type of human skull has recently been described by Prof. A. Nehring, which was found near Santos, in Brazil. It occurred in a breccia ("sambaqui"), the exact age of which is uncertain, associated with fish vertebræ, a portion of the lower jaw of a toothed-whale, and a few fragments of other human remains and implements.

The principal measurements given are the maximum length (183 mm.), maximum breadth (135 mm.), minimum frontal (88 mm.), maximum frontal (92 mm.), frontal sagittal arc (118 mm.), and the parietal arc (134 mm.) The cephalic index is thus 77·6. Virchow has also described two skulls from a sambaqui near Santos, with indices of 82 and 79·8; while de Lacerda measured three male skulls from sambaquis in Parana and Santa-Catherina, with the indices of 67, 68·8, 77·2, and two female skulls with 79·7 and 81·4. There is thus great variation among these people, which Nehring regards as individual or partly sexual, and not due to ethnical mixture.

The forehead is low and retreating, the glabella and orbital ridges well developed, and the frontal is greatly constricted behind the orbital region, as in Pithecanthropus. This constriction is also very characteristic of ancient and recent South American skulls (Peixoto and de Lacerda), some of which are absolutely and relatively not broader than Pithecanthropus.

Dr. Nehring, from his studies on the skulls of both sexes and various ages of anthropoid apes and of dogs of different breeds, is of the opinion that the occurrence of a constriction between the orbital and cerebral portions of the skull has direct relation to the strength of the head musculature, and more especially of the jaw muscles. If the skull of a muscular Eskimo dog be compared with that of a pug or a Bolognese lap-dog, it will be found that this constriction is very marked in the Eskimo dog, the zygomatic arches of which are widely outstanding, and all the muscular attachments strongly developed; but the constriction is scarcely noticeable in the pug, and is entirely wanting in the Bolognese lap dog; the two latter exhibit feminine rounded forms of the corresponding parts of the skull, with a feebly developed musculature.

The author compares human skulls with those of middle-aged female chimpanzees and gibbons, and finds a great similarity in the constriction of their respective frontal bones. He justifies this comparison by pointing out that the human skull always remains in a juvenile stage, while that of the ape, especially the male, is strongly modified by the jaw and neck muscles. The human condition is accounted for by the erect position, with the consequent balancing of the skull on the vertebral column, and the reduction in the dentition owing to the artificial preparation of food. According to Nehring, the constriction of the orbital portion from the cerebral portion of the skull of Pithecanthropus does not prove a simian origin.

The face of the sambaqui cranium is strongly prognathous; perhaps this is increased by an abnormality in the arrangement of the teeth, there being seven upper incisors, of which two are placed behind the others, and the third is in the middle of the normal series and has a curious curve on its anterior aspect. Only one of the normal teeth is slightly displaced. Nehring does not regard these as persistent milk-teeth, but as supernumerary teeth.

The whole dentition is strong, in fact it is one of the most powerful of known human dentitions, and the two molar series are parallel to each other, and are not in the form of a horse-shoe. All the teeth are perfectly sound.

The dimensions of the pre-molars and molars come very close to those of Spy No. 1 skull, any difference there may be being in the direction of the dentition of Spy No. 2; thus we find that the exceptional size of the wisdom-teeth in the Spy skulls is also characteristic of the sambaqui cranium.

While the length-breadth dimensions of the new skull agree fairly closely with those of Pithecanthropus, the cranial height is considerably higher, and consequently the capacity, if it could be measured, would be much greater. Looked at from above, the skull is better filled than that of Pithecanthropus, both posteriorly and in the anterior temporal region; there is also a marked difference between the orbital portion of the frontal bone, which somewhat resembles that of the Neanderthal calvaria, and the flat projecting character of that region in Pithecanthropus erectus.

A. C. HADDON.

[1] Prof. A. Nehring: "Menschenreste aus einem Sambaqui von Santos in Brasilien, unter Vergleichung der Fossilreste des Pithecanthropus erectus Dubois." *Verhandl. Berliner anth. Gesellsch.*, 1895-6, p. 710.

THE SURFACE-DIMENSIONS OF AN EARTHQUAKE-PULSATION.

IT is now well known that the effects of a great earthquake are not confined to the more less limited area over which it is perceptible to human beings, or capable of disturbing seismographs. With suitable instruments, the oscillations may be traced for thousands of miles, and there is no reason whatever for doubting that in the future they may be traced (possibly several times) completely round the globe. As to the exact nature of the pulsations, we are still in partial ignorance; but part of the movement certainly consists of a real tilting of the surface of the ground. Prof. Milne regards earth-pulsations as long, low waves, somewhat resembling an ocean-swell; and the object of this short note is to show that, in one case at any rate, his view is correct.

On April 27, 1894, a severe earthquake occurred in North-east Greece, and the pulsations were observed in Birmingham with one of Mr. Darwin's bifilar pendulums (NATURE, vol. l. pp. 7, 246–9). The average period of the pulsations was fourteen seconds, and the maximum change of inclination of the ground in the east and west direction was not less than one-quarter of a second. A comparison of the times at Athens, Birmingham, and other places, shows that the velocity of the first large pulsations was nearly constant, and equal to 3·21 km. per second.

Assuming the form of a right section of the pulsation to be a simple harmonic, the length of a complete pulsation is vt km. where v is the velocity in km. per second, and t seconds the duration of its period. The amplitude of the pulsation, *i.e.* the height of its crest above the position of equilibrium, is easily shown to be $\alpha vt/6^4$ metres, where α seconds is the maximum tilt of the ground with reference to a horizontal plane. In the case of the Greek earthquake, we have $t = 14$, $v = 3{\cdot}21$ and α not less than $\frac{1}{8}$. These figures show that at Birmingham the length of a pulsation must have been 45 km., and the height not less than 4·4 mm.

The estimate of the height is not great enough for two reasons: (1) owing to its suspension in oil, the mirror of the pendulum was unable to perform its full swing during the brief period of the pulsation; and (2) the pendulum showed only the component of the tilt in the east-west plane. When the frame of the pendulum is suddenly tilted through an angle of 2″, the deflection of the mirror at the end of a quarter of a minute is only half the correct amount. If, therefore, we multiply the above result for the height by 3, we shall probably be not far from the true value.

Thus, translated into ordinary units, the largest pulsations of the Greek earthquake at Birmingham must have been about 28 miles long and half an inch in height.

CHARLES DAVISON.

SCIENCE IN THE MAGAZINES.

WITH an article on "The Evolution of the Professions," Mr. Herbert Spencer concludes the series of papers on professional institutions which he has been contributing to the *Contemporary* for some months. The fact which the whole of the papers have aimed at showing, and which is illustrated by the present article, is that society is a growth, and not a manufacture, and has its laws of evolution. "From Prime Ministers down to ploughboys," we read, "there is either ignorance or disregard of the truth that nations acquire their vital structures by natural processes and not by artificial devices. If the belief is not that social arrangements have been divinely ordered thus or thus, then it is that they have been made thus or thus by kings, or if not by kings then by parliaments. That they have come about by small accumulated changes not contemplated by rulers is an open secret which only of late has been recognised by a few and is still unperceived by the many—educated as well as uneducated." In support of this law of the evolution of society, Mr. Spencer cites numerous instances drawn from agriculture, manufactures, commerce, and various professional institutions where advancement has been achieved by spontaneous co-operation of citizens, and not by legislative direction. We have "knowledge developing into science, which has become so vast in mass that no man can grasp a tithe of it, and which now guides productive activities at large, has resulted from the workings of individuals prompted not by the ruling agency but by their own inclinations." So, and in like manner, it is held that the unprompted workings of humanity, and not time-serving legislation, are responsible for real social progress.

Prof. James Sully contributes an amusing article to the *National Review*, on "The Humorous Aspect of Childhood." Some of the stories he tells in illustration of the simplicity and openness of child-nature deserve repetition here. The little boy who, in describing a fat lady, said she was just like a seal, used a singularly appropriate simile; for the human figure bereft by its obesity of the neck and waist divisions does grow seal-like. Then the purely arbitrary character of many of our language-forms affords opportunities for such remarks as that of the small boy who spoke of Charles the First's body having been cut off from his head. Another example of this childish tendency to rearrange things is supplied by the remark of a boy of five, who being asked whether the baby was christened, answered with alacrity, "No, she isn't christened, but she's vaccinated." Children are entirely anthropomorphic, believing that things about them have some mysterious relation to them. This is exemplified by the story of a child who quaintly remarked to an older child that seemed frightened on hearing about earthquakes, "They don't have earthquakes in little towns like this." Prof. Sully remarks on this: "The words suggest that the little comforter conceived of the earthquake as something which was specially designed for human spectators, to throw them into cold shudders, or possibly to electrify them with the delicious excitement of danger, according to their temperaments, and which would not therefore be brought on the scene where there was not a full house, so to speak. The saying seems to me full of the characteristic quaintness of child-thought. It is so deliciously comical to us who know, or fancy we know, what these alarming oscillations of the earth's surface really are, to have them thus turned by the naive conceit of the child-mind into a kind of show. Yet may we not here too detect an exaggeration of something in older people's thought about the universe, and in smiling at the crudity of the child's whimsical fancy be half-quizzing our own occasional lapses from the perfectly detached and unimpassioned point of view of science?" All who are interested in child-thought and child-observation should read Prof. Sully's collection of stories. The pity of it is that our educational system should so effectually crush the faculties of quick and acute observation and logical reasoning possessed by children.

Prof. John Trowbridge describes experiments with Röntgen rays in *Scribner's Magazine*, under the title "The New Photography by Cathode Rays." He refers to the new actinic rays as "cathode rays" throughout his article. An interesting illustration accompanying his article is a double picture of the Röntgen shadow of a turkey's wing, taken by rays from two cathodes slightly separated from one another. By measuring the distance between the double images, the depth of the shot can be estimated by triangulation.

Among the articles of minor scientific interest, we notice one on the boundary dispute between Great Britain and Venezuela in the *National*, by the editor, Mr. L. J. Maxse. This is accompanied by two maps from the recent Venezuela Blue-book. In *Longman's*, Mr. Fred Whishaw has a sympathetic paper on life in a pine-forest in winter. *Chambers's Journal* has its usual complement of information articles, the most noteworthy being on "Toad-Lore," "Modern Gunpowder and its Development," "Pets and Pests in Barbadoes," and "Bird-Catching in Heligoland." The *Humanitarian* has two papers on "University Degrees for Women," in one of which Dr. A. W. Verrall states the case for degrees, while Mrs. B. J. Johnson writes for the opposition. In the *Strand Magazine* is an instructive account of "Diamond Mining in South Africa," by Mr. J. Bucknall Smith. Finally, scientific phonographers will find much to interest them in the clearly-printed pages of the *Phonographic Quarterly Review*.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Education Bill of Sir John Gorst, to which reference has already been made in these columns, makes, it is true, several provisions for secondary education, but it can hardly be supposed that the comparatively few recommendations under this heading are to be the only outcome of the prodigious labours of the recent Commission. The county education authority, the constitution of which was explained in a note last week, may, amongst other matters, aid any school in the provision of secondary education, or, with the consent of the Education Department, may take a transfer of any secondary school. It may also establish such schools; found and maintain scholarships or exhibitions; supply, or aid in supplying, teachers; make inquiries with respect to the sanitary condition of the school-buildings (including boarding-houses) of any school within their county; and make inquiries with respect to the education given by any school within their county. Schools which in the opinion of the Education Department are of a non-local character are, however, excepted. The education authority may then take such measures as they think fit for giving information to the public with respect to the result of such inquiries. The county education authority is to be given power to *aid* any establishment or organisation for the training of teachers, but there seems to be no provision for the formation of new training schools or colleges. Provision is made for the transfer of higher grade board schools to the county authority, either at their own request or that of the School Board concerned. If the education authority desire, they may make it one of the conditions of any grant to a secondary school that representatives of the authority be added to the trustees or governing body of the school. The consent of the trustees being given, such representatives will become for all purposes members of the governing body of the school. It is further arranged that the amount which can be raised under the Technical Instruction Act, 1889, shall not be exceeded. One satisfactory point is that, in the event of this Bill becoming law, it will be impossible to have any further diversion of the money available under the Local Taxation Act, 1890, to purposes other than those of education. These funds are, moreover, to be in the future available for all degrees and kinds of secondary education, and not only for technical instruction.

AT the meeting of the Manchester City Council, held on Wednesday, April 1, Mr. Alderman Hoy reported that the Co-ordination Sub-committee of the Technical Instruction Committee had been dissolved. This Sub-committee was composed of representatives of the principal educational institutions in that city, and has been successful in arranging for the better co-ordination of the spheres of work of these institutions, and has so prevented over-lapping. It has been successful in bringing the School Board into line with the work of the Committee specially concerned with technical education, and has done very valuable work in other ways. We hope to see other large towns following the example thus successfully set by Manchester, for it is certain that by friendly conferences of this sort the best results for education will be obtained. It has been decided to appoint an Advisory Committee in the place of that dissolved, which will comprise the Chairman of the Technical Instruction Committee (Mr. Alderman Hoy), the Chairman of the School Board, the Principal of Owens College, and the High Master of the Grammar School. This Sub-committee will have power to call together the General Committee whenever they deem it necessary in view of any educational emergency.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, vol. ii. No. 6, March 1896.—"The three great problems of antiquity considered in the light of modern mathematical research" is a review, by Miss C. A. Scott, of Prof. Klein's Festschrift for the third meeting of the Association for the Advancement of Mathematical and Scientific Teaching in the Gymnasia, entitled "Vorträge über ausgewählte Fragen der Elementargeometrie." Of course the problems intended are the duplication of the cube, the trisection of an angle, and the quadrature of the circle. The pamphlet is divided into two parts: the first deals with algebraic numbers, the second with transcendental numbers. The analysis is very full, so that the reader gets a thoroughly good idea of Prof. Klein's work. "But while reading this brilliant exposition it is difficult to avoid cherishing a lurking regret, which is possibly very ungracious, that Klein could not himself spare time to arrange his work for publication; for though we have here in full measure the incisive thought and cultured penetration which together make even strict logic seem intuitive, yet at times we miss the minute finish and careful proportion of parts that we feel justified in expecting from him. And yet revision and consolidation might have seriously interfered with the graphic simplicity of these chapters, and left them less adapted to their special purpose." From Miss Scott's account we are thoroughly disposed to endorse her wish that the

pamphlet should be translated for the use of corresponding English associations. Why should not she undertake the task, if she has the leisure?—Prof. A. S. Chessin gives an abstract of Painlevé's Leçons sur l'intégration des équations differentielles de la Mécanique et Applications, and of his Leçons sur le Frottement.—The other articles are a geometric proof of a fundamental theorem concerning unicursal curves, by Prof. Osgood; Notes on the expression for a velocity-potential in terms of functions of Laplace and Bessel, by Prof. J. McMahon, and an additional note on divergent series by Prof. A. S. Chessin.—In the Notes we are told that the German Mathematical Society, at its meeting held at Lübeck, in September last, decided to combine in one volume the official reports of the Vienna and Lübeck meetings.—A list of papers, in addition to that given in vol. i. of the *Bulletin*, completes the tale of papers read at the Vienna meeting (1894), and the titles and names of authors for the Lübeck meeting are also given here.

American Meteorological Journal, March.—The diurnal oscillation of atmospheric pressure at the Peruvian stations of Harvard College Observatory, by Prof. S. I. Bailey. (A note upon this paper will be found in our issue of March 26, p. 493).—Cyclones and anticyclones, by Prof. H. A. Hazen. The author gives an epitome of the theories and researches of the principal investigators, and makes a special appeal for further atmospheric exploration. He considers that the most promising line of research is in connection with the observation of atmospheric electricity, and some useful hints are given with reference to the most promising means of increasing our knowledge by observations on high mountains and balloons, either manned or carrying recording instruments only.

Himmel und Erde, March.—This number contains many attractive contributions.—Herr Paul Spies writes on the Röntgen X-rays, this article being the sum and substance of a lecture delivered by him in the Urania at Berlin. Johann Christian Doppler and the "principle" connected with his name is the subject treated of by Dr. Julius Scheiner. That which is generally known about Doppler's life has been drawn from the biographical notice contained in the almanack of the Kaiserl. Akademie der Wissenschaft in Wien, which was written by the, then, general Secretary of the Academy, Prof. Stroter. With the help of Prof. Safarik, Dr. Scheiner is here able to increase our information on many points of interest, by publishing for the first time some characteristic notes gathered from Prof. Koristka, of the German Polytechnic in Prague.—The *Mitteilungen* contain several astronomical notes. A reference, with an illustration, is made to the Fabricius monument which was erected at Osteel last November. This monument consists of the goddess of astronomy in a sitting position, and looking towards the sky, holding in her right hand a small telescope, and supporting with her left a tablet on which in relief is seen the solar disc with some spots on his surface. The time of rotation of Jupiter and the cosmical origin of meteors form subjects for the next two notes, the latter referring more especially to Niessl's investigation, which appeared in the *Denkschriften der Wiener Akademie*. Two other notes refer to the "Internationale Erdmessung" and to the possible inconstancy of the length of a day, this latter having been raised by Prof. Deichmüller, who considers that very small secular variations may be present, although they have not as yet been detected.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 19.—"On the Spinal-root Connections and Ganglion-cell Connections of the Nerve-fibres which produce Contraction of the Spleen." By Prof. E. A. Schäfer, F.R.S., and B. Moore.

We have investigated, in four dogs, the effects upon the spleen volume of excitation of the thoracic and lumbar nerve-roots.

The following are the results which we have obtained from excitation of the nerve-roots from the second postcervical to the fifteenth postcervical inclusive. In none of the four experiments did excitation of the *second* postcervical (second dorsal) pair produce any contraction of the spleen. In none of the four experiments did excitation of the *fifteenth* postcervical pair produce any contraction of the spleen. In three out of the four experiments a distinct contraction of the spleen was got on stimulation of all the roots on both sides from the third postcervical to the fourteenth postcervical inclusive. This effect was relatively smaller on stimulation of the third and fourth postcervical nerves and of the eleventh to the fourteenth postcervical than on stimulation of the intermediate pairs, the most marked effects being obtained from the sixth, seventh, and eighth pairs. In all cases the effect was got, as already stated, from the nerve-roots of *both sides*, but with each nerve pair it comes out as an almost constant occurrence that a decidedly less marked effect is obtained with the same strength of stimulus upon the right side than upon the left.

We have found that after intravenous injection of small doses of nicotine, the effect upon the spleen of stimulating the nerve-roots may entirely disappear, while stimulation of the splanchnics is still quite effective. We infer, therefore, that the nerve-fibres which produce contraction of the spleen have a cell station in the prevertebral chain of ganglia.

"Problems in Electric Convection." By G. F. C. Searle.

The paper contains an investigation into the distribution of electric and magnetic forces which are called into play when some electro-magnetic systems are made to move with uniform velocity through the ether. Maxwell's theory is employed in obtaining the fundamental equations, and it is found that though the electric and magnetic forces, E and H, have generally no potential, still they can be derived from two functions Ψ and Ω; the differential equations satisfied by these functions are obtained, and are employed to obtain the solutions for various cases and conditions.

Zoological Society, March 17.—Prof. G. B. Howes in the chair.—Mr. Sclater called the attention of the meeting to the prospectus of the great work of the German Zoological Society, to be called "Das Tierreich," spoken of at the last meeting, and gave some particulars as to the mode in which the plan was intended to be carried out. Mr. Sclater also called attention to the appointment of a Committee on Zoological Nomenclature at the International Zoological Congress held at Leyden last year.—A communication was read from Lieut.-Colonel C. T. Bingham, containing a contribution to the knowledge of the hymenopterous fauna of Ceylon.—A communication was read from Mr. Edward T. Browne, on British Hydroids and Medusæ. Mr. A. Smith Woodward read a paper on some extinct fishes of the Teleostean family Gonorhynchidæ.

Entomological Society, March 18.—Prof. Raphael Meldola, F.R.S., President, in the chair.—Mr. C. G. Barrett exhibited a series of drawings of varieties of British Lepidoptera in the collection of Mr. S. J. Capper, of Huyton Park, Liverpool. The drawings, which were beautifully executed, were by Mr. S. L. Mosley, of Huddersfield, and comprised 389 figures, representing 139 species, of which 33 were butterflies and 50 moths.—Mr. J. J. Walker, R.N., exhibited a specimen of *Procas armillatus*, taken on Durland Hill, near Chatham, during the present month.—Herr Jacoby exhibited a specimen of *Loxoprosopus ceramboides*, Guér., from Brazil.—Mr. E. E. Green exhibited the eggs of some species of Locustidæ extracted from the stem of a young cinchona tree at Punduloya, Ceylon. He said the species of the parent insect was undetermined; it was possibly either a *Cymatomera* or a *Cyrtophyllus*, both of which possess large sabre-shaped ovipositors. A slit half inch deep and more than two inches long had been cut into the hard wood, in which the eggs had been symmetrically deposited, edge to edge, with the coloured part inwards. The greater part of each egg was of fine texture, and coloured green; but at the extremity from which the young insect would make its exit the egg-shell was soft, pliant, and beautifully reticulated. Mr. McLachlan and Dr. Sharp, F.R.S., made some remarks on the subject.—Mr. Green read a short paper entitled "Notes on *Dyscritina longisetosa*, Westw." He remarked that drawings of the species had been exhibited by him at a recent meeting of the Society. Dr. Sharp said Mr. Green seemed to think that the insect was an earwig, but he could not accept it as belonging to the Forficulidæ. He thought that further specimens for examination were required before attempting to determine its position, which was quite doubtful at present.—Mr. W. F. H. Blandford communicated a paper entitled "Descriptions of New Oriental *Scolytidæ*."

Linnean Society, March 19.—Mr. C. B. Clarke, F.R.S., President, in the chair.—Mr. Clement Reid exhibited fruits of *Naias marina* from a peaty deposit below mean-tide level in the new docks at Barry, South Wales. In Britain it had only been found living at a single locality in Norfolk, but in a fossil con-

dition it had been obtained in the pre-glacial forest-bed at Cromer.—Mr. Clement Reid also exhibited some wood forwarded by Mr. H. N. Ridley from the jungle near Singapore. It appeared to have been eaten into a honeycombed mass of peculiar character, and was found only in wet places, but always above ground, the entire tree rotting. Neither Mr. Ridley nor Mr. Reid had seen anything like it in England; and the latter, while suggesting that the small lenticular unconnected cavities in the wood were probably caused by insects or their larvæ, thought they were unlike the work of either beetles or white ants.—A paper was read by Dr. Otto Stapf on the structure of the female flowers and fruit of *Sararanga*, Hemsley. The materials utilised consisted of female flowers and fruits of *Sararanga sinuosa*, Hemsley (*Journ.* Linn. Soc., vol. xxx. p. 216, t. 11), which had been collected by the officers of H.M.S. *Penang* in New Georgia, Solomon Islands, and were in excellent preservation. There were also photographs and a description, taken upon the spot, of the tree, about 60 feet high, shortly branched at the top, with terminal, nodding, white-flowered, very compound, and gigantic panicles. The leaves are like those of an ordinary screw-pine. The flowers consist of a rudimentary, sinuously bent, saucer-shaped perianth, and a sub-globose, sinuously lobed gynæcium, with very numerous (70–80), dark, discoid, or reniform stigmas which are arranged in double rows over the dorsal ridges of the main body and the lobes, having between them minute pores which end behind some way below the surface. There are as many ovary-cells as stigmas, each containing one anatropus ovule from the base of the inner angle. The vascular bundles of the gynæcium end below the stigma in a cluster of tracheids, and supply it probably with a viscid or sugary liquid. The base of the pore is surrounded by a compact, thin-walled parenchyma, very rich in plasma. It is suggested that the pollen-tubes grow from the stigma down into the pore, and descend from here through the conductive tissue to the ovule. The ripe fruit is a succulent drupe with numerous pyrenes, in shape like the flower, but much larger. The endocarp is bony, the albumen copious and oily; the embryo is as in *Pandanus*. The complex structure of the flower is explained as a modification of the type represented, *e.g.* in *Pandanus utilis*, and in accordance with Count Solms-Laubach's theory of the flower of the Pandanaceæ. On this paper some critical remarks were offered by Mr. Rendle.—On behalf of Mr. G. S. West, a paper was read by Prof. Howes on two little-known Opisthoglyphous Snakes. The author had examined and compared, in respect of the structure of the buccal glands and teeth, specimens of the grooved and non-grooved varieties of *Erythrolamprus æsculapii*, as recorded by Dr. Günther ("Biologia Centr.-Amer.," part cxxi. p. 166), and he proved that the latter were rightly referred to the species.

Geological Society, March 25.—Dr. Henry Hicks, F.R.S., President, in the chair.—On submerged land-surfaces at Barry, Glamorganshire, by A. Strahan, with notes on the fauna and flora by Clement Reid, and an appendix on the Microzoa by Prof. T. Rupert Jones, F.R.S., and F. Chapman. Excavations for a new dock at Barry have disclosed a series of freshwater or slightly estuarine silts with intercalated peats, below sea-level on the north-eastern side of the island. The site of the excavation was overflowed by the tide until the year 1884, when the docks were commenced. The newest deposits seen are, therefore, blown sand, *Scrobicularia*-clay, and sand or shingle with recent marine shells. These rest on an eroded surface of blue silt, with sedges in position of growth. Four peat-beds occur in this silt, at 4, 11, 20, and 35 feet below Ordnance datum respectively. The uppermost peat contains a seam of shell-marl, partly composed of the shells of ostracoda, and partly of *Bythinia*, *Limnæa*, &c. The second is a mass of matted sedges. The third is a land-surface, and in places consists almost wholly of timber with the stools and roots *in situ*. The fourth is also an old land-surface, as is proved not only by the presence of roots in place beneath it, but by numerous land-shells. A fragment of a polished flint-celt was found by Mr. Storrie embedded in the lower part of the uppermost peat. By a comparison with the existing maritime marshes of the neighbourhood, it was shown that the fourth peat indicates a subsidence of not less than 55 feet. The sea encroached upon the area in consequence of this subsidence. It entered by the lowest of three low cols in the southern water-parting of the Cadoxton River, thus isolating the portion of land now known as Barry Island. A slight further movement would have converted the water-parting into a chain of islands.—On a phosphatic chalk with *Holaster planus* at Lewes, by A. Strahan, with an appendix on the ostracoda and foraminifera by F. Chapman. This rock, which occurs at the base of the upper chalk, at the horizon of the chalk rock, does not exceed 1½ feet in thickness, and persists for a few yards only. In composition and microscopic character it presents a close analogy to the Taplow phosphatic deposit, which, however, occurs at the top of the upper chalk. Like it, it consists of brown phosphatic grains embedded in a white chalky matrix. The grains include a large number of pellets, attributable to small fish, phosphatised foraminifera, chips of bone, &c. Fish-teeth also occur in abundance. To complete the resemblance, the Lewes deposit rests on a floor of hard nodular chalk, beneath which is a white chalk traversed by irregular branching pipes filled with the brown variety. Such "floors" were attributed to concretionary action ensuing upon a pause in the sedimentation. The piped chalk was compared with the structure known as *Spongia paradoxica*. It was concluded that phosphatised deposits may occur at any horizon in the chalk; that the phosphatisation is due to small fishes, attracted by an unusual abundance of food; that they are shallow-water deposits, and associated with a pause or change in the sedimentation. Mr. Chapman furnished a list of 42 species and varieties of foraminifera, and 6 species of ostracoda. The former indicate a deeper water origin than do those of the Taplow chalk. He noted the occurrence for the first time in this country of *Gypsina Coetæ*, Marrson.—On the classification of the strata between the Kimeridgian and the Aptian, by Dr. A. P. Pavlow, Professor of Geology in the University of Moscow. In this paper the author discussed the new evidence respecting the palæontology of the Lower Cretaceous and Upper Jurassic deposits of Russia, which had come to light since the publication, by Mr. Lamplugh and himself, of "Les Argiles de Speeton et leurs Equivalents" (Moscow, 1892).

DUBLIN.

Royal Dublin Society, March 18.—Prof. G. F. Fitzgerald, F.R.S., in the chair.—A paper was read on the Röntgen X-rays, by Mr. Richard J. Moss (see NATURE, April 2, p. 523).—Prof. Arthur A. Rambaut read a note on the rotation period of dark spots on Jupiter.—A memoir on the carboniferous Ostracoda of Ireland, by Prof. Rupert Jones, F.R.S., and Mr. J. W. Kirkby, was communicated by Prof. W. J. Sollas, F.R.S.

PARIS.

Academy of Sciences, March 30.—M. A. Cornu in the chair.—On the properties of the invisible radiations emitted by uranium salts, and by the antikathodic wall of a Crookes' tube, by M. Henri Becquerel. The rays given off by uranium salts are doubly refracted by tourmaline, a parallel experiment with a Crookes' tube giving a negative result.—On the variations in the brightness of the star Mira-Ceti, by M. Duménil.—On the inversion of systems of total differentials, by M. P. Painlevé.—Extension of the theorem of Cauchy to more general systems of partial differential equations, by M. E. Delassus.—On the penetration of gases into the glass walls of Crookes' tubes, by M. Gouy. Glass which has been exposed to intense kathodic rays gives off numerous bubbles of gas on heating.—On the use of non-uniform magnetic fields in photography with the X-rays, by M. G. Meslin.—The time of exposure in photography by the X-rays, by M. J. Chappuis. The effect produced by a Crookes' tube upon a gold-leaf electroscope was studied under varying conditions. An increased action was obtained by concentrating the rays by a strong magnetic field, and especially by replacing the ordinary metallic contact-breaker by a Foucault's interrupter.—Action of the X-rays upon electrified bodies, by MM. Benoist and Hurmuzescu. In reply to criticisms by MM. Righi, Dufour, and Borgmann and Gerchun, the authors have repeated their original experiments with additional precautions, and find that the discharge of an electrified body by the rays is complete, and is independent of the sign of the original charge. Different metals appear to be discharged at different rates, a result difficult to explain by the theory advanced by Prof. J. J. Thomson, that dielectrics become conductors under the action of the X-rays.—On the refraction of the Röntgen rays, by M. F. Beaulard. With a prism of ebonite no clear evidence of deviation could be obtained.—On the diffraction and polarisation of the Röntgen rays, by M. G. Sagnac.—Stereoscopic photographs obtained with the X-rays, by MM. A. Imbert and H. Bertin-Sans.—Determination of the exact position of a foreign body in

the tissues by means of the X-rays, by MM. A. Buguet and A. Gascard.—Experiments relating to the action of the X-rays on *Phycomyces nitens*, by M. L. Errera. This *Phycomyces* was not sensitive to these radiations.—On the Röntgen rays, by M. C. Henry. General considerations as to the nature of the rays, and a *résumé* of their properties.—Reply to some observations of M. Henri Becquerel relating to a note "On the principle of an accumulator of light," by M. C. Henry.—Remarks on the preceding, by M. Henri Becquerel.—Safrol and isosafrol. Synthesis of isosafrol, by M. C. Moureu.—On citronnellal and its isomerism with rhodinal, by MM. P. Barbier and L. Bouveault.—On the macroblasts of the oyster; their origin and localisation, by M. J. Chatin.—On the relations between *Lepismina myrmecophila* and ants, by M. C. Janet.—On the tertiary basin of the lower valley of the Tafna, by M. L. Gentil.

AMSTERDAM.

Royal Academy of Sciences, January 25.—Prof. Van de Sande Bakhuyzen in the chair.—Prof. Lorentz showed a number of photographs prepared by means of X-rays by Prof. Röntgen, of Würzburg.—Prof. MacGillavry presented the dissertation of Dr. D. MacGillavry on the actiology and the pathogenesis of congenital defects of the heart.—Mr. Jan de Vries gave applications of the introduction of a third radius vector into the bipolar system, so that the three poles lie in a straight line.—Prof. Schoute treated Steiner's quartic surface $y^2z^2 + z^2x^2 + x^2y^2 = 2kxyz$.—Prof. Engelmann communicated the result of an investigation made by Dr. H. J. Hamburger into the importance of respiration and peristaltics to the resorption in the intestine. The resorption of liquids in the alimentary canal increases with the intra-intestinal pressure, and disappears altogether when this pressure is artificially lowered to 0 or a negative value.—Prof. Kamerlingh Onnes made, on behalf of Mr. D. van Gulik, a communication concerning an investigation made, under the direction of Prof. Haga, at Groningen, into the cause of the variation of resistance in microphonic contacts brought about by electric vibrations. In investigating the cause of the diminution of resistance through electric vibrations generated in bad microphonic contacts, it has been ascertained that the ends of a current-chain, when brought very close together, attract each other if the wires are exposed to Hertz's waves. The arrangements being made with proper care, the movable ends were seen under a microscope to touch each other as soon as electric vibrations were generated near them. The original air-gap must not be larger than four microns, and a contact arisen in this way offered a resistance of $\frac{1}{4}$ Ω to the current. The removal of the element from the chain had no influence upon the phenomenon. When the air-gap was a few microns too large, then small sparks resulted on the wires being acted upon by the above-mentioned waves. Prof. Kamerlingh Onnes, starting from his theorem that Van der Waals's corresponding states are dynamically similar, inferred that the cooling of the gas in Thomson and Joule's porous plug will, according to their experiments with hydrogen (1862), become zero and turn into heating, with all gases, at sufficiently high temperatures. The author extended the theorem to thermo-dynamical similarity, and thus supplied the means to find the dimensions of an apparatus to liquefy hydrogen, if there is given one liquefying oxygen in a satisfactory manner. Linde's and Dewar's methods were considered from this point of view. The author also commented on his endeavours to get a small self-cooling motor, liquefying oxygen, to be used as a model for apparatus to liquefy hydrogen by doing work adiabatically after the manner of Solvay, and intended to form part of a series of theoretically perfect cooling apparatus. Finally the author pointed out the superiority of Dewar's vacuum-jackets, and their great importance for low temperature work.

February 29.—Prof. van de Sande Bakhuyzen in the chair.—Prof. Suringar described, in connection with previous communications, some *Melocacti*, lately received from the island of St. Martin, and belonging to the tribe of *Melocacti communes*. They most nearly approach to the one described by Link and Otto as *M. communis*, var. *macrocephalus*. They represent two types, which speaker has called *M.* (*communis*) *Linkii* and *M.* (*communis*) *croceus*, the name *conmunis* between parentheses indicating the affinity. From a comparison of the specimens discussed with those the author formerly brought away from St. Eustace, and with the description and drawing by Hooker of specimens from the island of St. Kitts, it appears that in these islands, situated very near each other, distinctly different, constant varieties of the common type have developed themselves. This had induced the author to collect and to critically examine all the older accounts, and especially the drawings by Lobelius (1576) down to Miquel's monograph (1840). In anticipation of the Iconography, which he is preparing, he presented a treatise on the subject, as a fourth contribution to the *Transactions* of the Academy. It treats partly of crook-thorned Melocacti, to which those of Lobelius and Besler belong, and of which the author has found a variety of species in Aruba; partly and especially of *Melocacti* of the *Melocacti communes* tribe, peculiar to the Northern Antilles, and which treatise will be illustrated by two plates.—Mr. Jan de Vries made a communication concerning Cartesian confocal ovals in connection with a hyperboloid of one surface.—Prof. Rauwenhoff communicated the results of investigations, made by Dr. H. F. Jonkman at Utrecht, into the embryogeny of Angiopteris and Marattia.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Island of Dr. Moreau: H. G. Wells (Heinemann).—A Manual of Forestry: Prof. W. Schlich, Vol. 1, 2nd edition (Bradbury).—Die Vegetation der Erde. I. Grundzüge der Pflanzenverbreitung auf der Iberischen Halbinsel: M. Willkomm (Leipzig, Engelmann).—Monographie der Gattung Euphrasia: Dr. R. v. Wettstein (Leipzig, Engelmann).—A Handbook to the Birds of Great Britain: Dr. R. B. Sharpe, Vol. 3 (Allen).—Röntgen Photographs: Profs. Reid and Kuenen (Dundee, Valentine).—Leçons de Géographie Physique: Prof. A. de Lapparent (Paris, Masson).

PAMPHLETS.—Summary Report of the Geological Survey Department for the Year 1895 (Ottawa).—A Laboratory Note-Book of Elementary Practical Physics: L. R. Wilberforce and T. C. Fitzpatrick. I. Mechanics and Hydrostatics (Cambridge University Press).—Kepler's Lehre von der Gravitation; Dr. E. Goldbeck (Halle a/s., Niemeyer).—Flora of West Virginia: C. F. Millspaugh and L. W. Nuttall (Chicago).—The Classification of the Chemical Elements: Prof. O. Masson (Melville).—The Jack Rabbits of the U.S.: Dr. T. S. Palmer (Washington).

SERIALS.—Fortnightly Review, April (Chapman).—Scribner's Magazine, April (Low).—Geological Magazine, April (Dulau).—Imperial University College of Agriculture, Bulletin Vol. ii. No. 5 (Tōkyō).—Reliquary and Illustrated Archæologist, April (Bemrose).—Journal of the Royal Agricultural Society of England, third series, Vol. vii. Part 1 (Murray).—Geographical Journal, April (Stanford).—Phonographic Quarterly Review, April (Pitman).—Zeitschrift für Physikalische Chemie, xix. Band, 3 Heft (Leipzig, Engelmann).—Annals of Scottish Natural History, April (Edinburgh, Douglas).

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