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PARKE'S PERSONAL EXPERIENCES IN EQUATORIAL AFRICA.

My Personal Experiences in Equatorial Africa as Medical Officer of the Emin Pasha Relief Expedition. By Thomas Heazle Parke, Hon. D.C.L. (Durh.), &c. With Map and numerous Illustrations. (London: Sampson Low, Marston, and Company, Limited, 1891.)

A FAIRLY large literature has now seen the light in which we have had numerous details about the expedition sent out for the relief of Emin Pasha. All of the as yet published volumes treating of this subject have been to a very great extent based only on personal experiences, being more or less expanded from notes taken at the time; it thus happens that of the history of this famous expedition it is difficult to obtain any general survey. As a contribution, however, to such a survey this book of Dr. Parke's is welcome. As the medical officer in charge, the exigencies of the many trying circumstances that arose rendered it necessary that he should attach himself most constantly to the sick camp, and so his narrative comes in to tell us of trials and hardships undergone, of which in Stanley's "Darkest Africa" we of necessity heard but little.

In order that one may be able to appreciate the facts enumerated in this volume, the reader should bear in mind that the expedition across Africa was in stern reality several expeditions backwards and forwards through the most trying portion of this continent. Under the leadership of Mr. Stanley the officers selected left England late in 1886, but at the last moment the medical officer in charge was compelled to abandon the expedition, and in Cairo, Stanley, who had seen Parke in Alexandria, where the latter was on duty as a member of the British Medical Staff, appointed him as one of his officers.

Of the journey to Cape Town, and from thence to the mouth of the Congo, little need be said, nor, indeed, are there any special facts of interest about the voyage up the river to Yambuya, where the entrenched camp was formed which was handed over to the care of Barttelot and Jameson. This portion of the journey took four months and a week; there was of course a certain amount of new experiences, some deaths among the native army, some accidents there were both by land and water, but these are all told within a compass of the first seventy pages.

From Yambuya the land journey to the Albert Nyanza commenced, Mr. Stanley taking with him Nelson, Stairs, Jephson, and Parke, intending to return for the rear column, which had instructions to make their way slowly onwards in an eastern direction. Tedious was the progress made, paths had to be cut through the bush, one after another of the leaders and many of the men suffered much from fever. There was plenty of game in the forest, judging by the footprints, but already there was some scarcity of provisions. At Avisibba there was an encounter with the natives, when Lieutenant Stairs was shot in the chest by an arrow, from which peril he recovered, though it was not until long months afterwards that the broken off arrow's head was extracted by Dr. Parke. This part of the journey took four weeks, but after a day's rest at Avisibba the march was again resumed, the next halting stage being at an Arab encampment, marked in the map as Ugarrowa, from the name of the chief. This march was still through the forest, but along the course of the river, and it lasted over four weeks. During it the effect of the cold and wet weather began to tell upon the Zanzibaris; the constant tramping through the forest was also extremely depressing, malarious marshes and swamps had to be waded through, and even worse, the camps at night had often to be pitched by their very edges. To all these troubles the want of food was added; of animal food there was almost none. At times hornets and ants came in swarms, and were more dreaded than the arrows of the natives. At Ugarrowa's camp a number of men had to be left, while the rest of the party went on without delay to Ipoto. Within a fortnight afterwards the hardships told so severely on the travellers that when the river navigation came completely to an end at the junction of the Ihuru and the Ituri to form the Aruwimi, itself a large confluent of the Congo River, fifty-two men who were unable to march were left behind with Captain Nelson, himself an invalid. This dreadful spot was afterwards known as Nelson's Starvation Camp. The rest of the party pressed on, and in ten days reached Ipoto, but through all these days there seems to have been but one great struggle to support life with a minimum quantity of food, men dropt from starvation; their rifles and loads were then taken by others, and they were left.

At Ipoto there were three chiefs, head men to Abed Bin Salim, and the people were all Manyuema. Food was to be had—goat flesh, fowls, Indian corn, and beans—and nine days were spent here before the next move lakewards. Jephson left on October 26, 1887, to return to bring Nelson and all that might be surviving of his men. Mr. Stanley on the following day started for the lake, leaving Parke behind to attend to the sick army that Jephson was to bring up from Nelson's Starvation Camp, and then Jephson was to press on after his chief with all the then available men. Parke now found himself little better than a prisoner in the hands of the Manyuema, with the prospect in store of his troubles being increased by the return of the invalids with Jephson, and the additional horror of knowing that all he obtained from the Manyuema in the way of food could only be paid for by drafts on an uncertain future. On November 3 Jephson came into camp with Nelson, but with only three or four of the band of fifty-two who had been left behind at Starvation Camp. This frightful destruction from starvation took place at a spot within, even for feeble men, a three days' journey from their friends at Ipoto. On November 7 Jephson left Ipoto with forty-eight men, leaving Parke and Nelson behind with twenty-four cripples and three boys. For nearly three months long these men had to live through the greatest miseries and privations; sickness added to semi-starvation made existence almost insupportable, and the reading of this portion of Parke's notes is about the most saddening in the book. It is a pity that it should be interrupted by some eighteen pages of a very second-rate account of "bac-

teriology" ; but we almost forgive this irrelevant intrusion in admiration of the way in which he bore his many and great trials ; and we find ourselves happy when we read that on January 25, 1888, Stairs appeared on the scene with a column of fine-looking men, fat, muscular, and glossy-skinned, these being the very same who had left Ipoto as skeletons only three months ago.

Ipoto was left without regret, but with friendly farewells, on January 27. Stairs's able men had the boat to carry ; the feeble folk crawled on as best they could ; some days two miles, other days three or four, or even six, would be got over ; one day one man would lie down and die, another day two would follow the example ; but at last, on February 8, Fort Bodo was gained.

Mr. Stanley and Jephson had it in excellent order ; six tons of Indian corn were stored up in the granary ; there was a rich supply of plantains over a radius of a couple of miles ; there was a good water supply, and even a stock of milch cattle, three cows, and about twenty goats. The camp was in a clearing of the forest ; a plan of it will be found in "Darkest Africa" ; there was one road leading to it from Manyuema, and another which led in the direction of the Albert Nyanza ; the huts were good ; each had a good veranda, which furnished some shade. While arrangements were being made for Mr. Stanley's second visit—this time with the boat—to the lake, he took seriously ill ; and it was a month before, thanks to his constitution and the care of his doctor, he was again able to think of advancing. Nelson was then left in care of the fort. Stairs had been sent back to Ugarrowa's camp to bring up the men who had been left there, and he was to abide with Nelson at Fort Bodo until Stanley's second return.

On April 2, 1888, the second march to the Albert Nyanza began ; the force numbered 122. In eight days the Ituri River was reached, and on the next day the open plain, and for the first time for twelve months Parke was out of the dark forest.

We need not dwell on the journey through the hilly country, on the first views of the Mountains of the Moon, and of the lake, nor of the meeting with Emin Pasha, for all these facts have been related at greater length in Mr. Stanley's volumes, but it being arranged that Stanley should return to Yambuya for the rear column, and bring them up to the lake before the general return to Zanzibar should be commenced, he and Dr. Parke started back through the forest on May 24, leaving Jephson behind with Emin Pasha ; the men at this time appear to have been in good condition, so that Fort Bodo was reached in about ten days' march ; the natives on the route back were friendly, and one day was devoted to helping some of the chiefs in a feudal fight.

At Fort Bodo, Stairs and Nelson were found "looking fit," but many of the people, some of whom had been brought by Stairs from Ugarrowa's camp, were suffering from fever and bad ulcers. From this fort Mr. Stanley departed on his memorable journey to Yambuya on June 16, leaving Stairs in command at Fort Bodo, with Nelson and Parke to assist. Fifty-seven men were left in their charge, and Stanley's directions were that when Jephson came to Fort Bodo, which he had arranged to do within two or three months, then all the party were, as soon as could be, to return with all the loads to the lake, and remain there with Emin Pasha until Stanley came up from Yambuya. This part of the volume is full of interest, as it gives us for the first time an idea of how a period of just over six months was spent in this fort ; for, as matters turned out, Jephson with Emin Pasha being made prisoners, was unable to come to them, and they waited in some impatience, until at last the leader himself appeared with the remnant of the party from Yambuya. Parke accompanied Stanley on his way to Yambuya as far as the Manyuema camp (Ipoto), to collect some of the goods which had been left behind during his former residence there.

From Ipoto Mr. Stanley went west, and Parke returned to Fort Bodo, bringing with him not only the goods he went back for, but some seed rice, some goats, and, not least, a female dwarf, one of the pygmies, whom he had purchased for a handful of beans, twelve cups of rice, and six cups of corn. He also had full instructions from his chief ; among these latter were orders to "Plant, sow, and plant, as though you were going to make a long stay at Fort Bodo. If Jephson comes, well, you can go along with him. If Jephson does not turn up, you have abundance of food for yourselves." It took Parke ten days to get back to Fort Bodo, and on July 6 the long watch began.

By August 9 the men were so broken down by the prevailing ulcers that it was impossible to go out after any game, for there were not enough of them to form a guard ; twenty-five were "badly sick" out of the fifty-five. There seems, judging by the statements on p. 256, to have been a somewhat slack surveillance of sanitary matters about the camp, which, from the plan made by Stairs, was one apparently easily kept clean ; a stream abounding in small fish ran not far away ; but Parke declares that "the Zanzibaris owe a great deal of their physical ill-being to their timidity and laziness." The officers in charge did not by any means escape their share of sickness, and first Parke was laid up, and then Nelson, and lastly, Stairs. On September 5, Ali Jumba came to Stairs and told him that the men proposed, first, that fifteen of the strongest of them should go with one white officer to the edge of the forest, and, if they found the natives friendly, that they should then push on to Emin, asking him to come on and relieve the others at the fort ; or, secondly, that all the men should leave the fort, and convey the loads by a system of double journeys, until they should arrive at some good banana plantation, where they should make a camp, and remain until relieved either by Stanley or Jephson. The men made these proposals, because they said they could get little or no food at Fort Bodo, and that they would die of starvation unless some move was made.

On a consultation, it was resolved that neither of these ideas of the men were practicable, and that there was no fear of starvation, as there was corn already in store to furnish a small quantity to each man of the party until the new corn should be reaped. When October came, all hopes of Jephson making his appearance were abandoned, and no thoughts as to the true cause of his non-appearance seem to have entered their minds.

December 18 was the day on which Mr. Stanley said he expected to return to Fort Bodo, and on the 20th he appeared. He was looking careworn and haggard to an extreme degree. Bonny was the only one of the staff

with him; and there now came the sad story of the sorrowful fate of the rear column. The long confinement in the fort had at last come to an end; and after but three days, which were spent in getting in stragglers and packing up, Fort Bodo was burnt, and this little oasis of cultivation in the dark forest was abandoned to its fate.

By January 9, 1889, Kandekore was reached, the progress being but slow, owing to the number of sick men, and here Parke was left again in charge of what he calls a "Convalescent Home," with Nelson to keep him company. This "Home" was made fairly comfortable, and was not left until February 12, when Rashid, the head chief of the Zanzibaris, arrived from Mr. Stanley with a number of Zanzibaris and Mazambonis. Parke now heard for the first time of how Emin Pasha and Jephson had been taken prisoners, and had been sent to Rejaf. All hands were soon employed procuring food for the next few days' march, and Kandekore was abandoned on the 12th, the party joining Mr. Stanley on February 18.

The much-wished-for journey to the coast commenced on April 10. There was a mixed multitude, old people and quite young children, but they were only well on the march, when a return of the illness which brought Mr. Stanley so near death's door at Fort Bodo, delayed the expedition at Mazzamboni's camp until May 8. Some difficulty was experienced in crossing the Semliki River, which flows into the Albert Nyanza, the graphic account of which crossing will be familiar to the readers of Stanley's volumes. On August 20 the expedition was at Usambiro, a missionary station, where a rest of a couple of days was taken, and at which station Dr. Parke's regular diary ceased, owing to an attack of ophthalmia, which clung to him until he reached the coast. They arrived at Bagamoyo on December 4, 1889, and here the unfortunate accident happened to Emin Pasha, who was fortunate though in this, that Dr. Parke was near him, and by his careful nursing and skilled attention brought the Pasha through a most serious illness. After Emin Pasha was in a fair way to recovery, Dr. Parke became alarmingly ill, but was able to sail for Suez in January 1890, and arrived in Cairo on the 16th of the same month, after an absence of nearly three years. The volume appropriately finishes with a warm and grateful acknowledgment of his great indebtedness to the several companions of his dangerous journeys; of one and all of whom he has something pleasant and kind to say. Under trials and troubles of no ordinary nature that had so constantly surrounded them, each did for the other what he could, and long after the painful episodes are forgotten, those of a pleasurable nature remain, stored up in the memory.

No man could wish for greater thanks than those which Mr. Stanley paid his friend the doctor. The unqualified delight with which Mr. Stanley acknowledges that his devotion to duty was as perfect as human nature was capable of, is recorded in the first pages of "Darkest Africa." These praises of his chief were echoed far and wide among Parke's friends and associates at home, so as if it were possible to make up for those many sad and weary days spent by him in the forests and deserts of Africa.

And now, if our task was only to lay before our readers a brief account of what they will find in detail in this volume, it was at an end; but it appears to us to be our duty not to leave certain features of this book without criticism. After what we have written, it need not be insisted upon that, as an officer of the Emin Relief Expedition, Dr. Parke did his duty in a splendid manner, and it was as a matter of right that a full measure of praise should be meted out to him therefor. Opinions will differ if it was equally his duty to publish all his rough notes, extending to over 500 pages, as a supplement to Stanley's work; and still more will opinions differ as to whether he was at all entitled to give English-reading people the contents of his note-book, making no change whatever in them, excepting the necessary ones in the "elementary departments of orthography and syntax." We cordially grant that the history of how this journal was put together demands and should receive many excuses for "its many shortcomings in style and arrangement," but we also think that the author should have hesitated long and taken good advice before he printed all the facts and statements that now must remain on record for ever, and, we feel bound to add, many of which should never have been permitted to appear in print in such a work.

Most of the blemishes to which we thus refer could have been easily avoided by the smallest amount of care in editing, indeed the reader of the proofs might have queried the repetitions and contradictions that cannot fail to have met his usually sharp eyes; others that it might have been considered impertinent for such a one to point out would have been pruned of their offensiveness by the suggestions of any cultured friend. It is difficult without offence to be so plain-spoken as to fully justify these remarks, yet the coarse allusions to certain physiological and pathological phenomena in this volume —not occurring here and there, but scattered very generally through it—must plead our justification. No doubt but in the journal of a medical officer one expects to hear of the diseases to which those under his charge succumbed, and of the various accidents which befell them, and we could pass by the tedious little repetitions of such, as being the result of a day-to-day record; but no such excuses are possible for such references as those about the Monbuttu pygmy during the preparation for operating on Lieutenant Stairs; and it may be, perhaps, a matter of taste if particulars such as are given of the condition of the author when ill at Fort Bodo, or of Nelson's sufferings and his own at Ipoto, are in good style, except in a professional treatise.

It is also a subject of profound regret, but not one for censure, that our author seems to have had no knowledge of animal or plant life, nor even, unless when in the company of Emin, any taste for a study of his fellow-man; we might add that he even exhibits a contempt for such studies, for on more than one occasion he alludes to Emin's natural history investigations as "bug hunting"; Had it been otherwise, what opportunities there were for destroying that monotony from which he suffered, and what value even some slight knowledge of plants might have been to one who for months had to subsist on vegetable food; even the knowledge that the pygmy woman possessed was of some service, and she evidently was intelligent enough to have enabled the author to have made out with her aid a short vocabulary of her native language.

The account of the few scraps of the leaves and stems of the plants used by the pygmies to poison their arrow-heads, and of those used as antidotes against these poisons, which had been collected by Parke, is by Mr. E. M. Holme, and is reprinted from the Pharmaceutical Society of Great Britain's Journal. The poisons were prepared from the bark of *Erythrophlæum guineense*, Don., from the leaves of probably *Palisota barteri*, Benth., from the bark and stem of the tips of the young shoots of a thorny creeper, possibly belonging to the genus Combretum, from the scrapings of the bark of some unknown species of Strychnos, and lastly from the seeds of the first-named tree. The antidote to this poison-extract was prepared from the leaves and young bark of three distinct plants, but the material brought back by Dr. Parke was not sufficient to allow of even a guess being made as to two of them, and Prof. Oliver suggests that the third may belong to the genus Unona. The illustrations throughout the volume are feeble, if we except the two charming sketches by Mrs. Stanley, and the view of Ruwenzori from a sketch by Stairs; but the rest of the illustrations are of the ordinary make-up type that we do not nowadays expect to find in a serious book of travels.

THE AUSTRIAN ECONOMISTS.

An Introduction to the Theory of Value. By William Smart. (London: Macmillan and Co., 1891.)

IT has recently become generally known to English students of economics that a school of writers existed in Austria, who strenuously opposed the more extreme views of the German historical school, and devoted their attention to the study and improvement of economic theory. By enabling a larger number of English students to acquaint themselves with the writings of the Austrian economists, Mr. Smart, who is Lecturer on Political Economy in Queen Margaret College, Glasgow, has conferred on them no inconsiderable service. He has already translated the acute and instructive, though difficult and perhaps excessively polemical, treatises of Dr. Böhm Bawerk, on the nature of capital and of interest; and now, in the little volume before us, he introduces us to a theory of value "on the lines of Menger, Wieser, and Böhm Bawerk." The theory, he states in his preface, "is that enunciated by Menger and Jevons, and worked out by Wieser and Böhm Bawerk." It claims to give a more adequate explanation of value than that formerly supplied in economic treatises. It approaches the problem from the side of demand, rather than, like Ricardo and his followers, from that of supply. It declares that "value depends entirely on utility," and that the kind of utility, which is all-important in determining value, is "marginal utility." This conception, which may be found in the pages of Jevons' "Theory," under the title of "final utility," has certainly proved in his hands and in those of his English successors, and his Continental forerunners like Gossen, and contemporaries like Walras, to be a very suggestive and fruitful conception; and its discovery and exposition may be fairly said to have revolutionized one side of the problem of value—which is the central problem, so to say, of economic study. The conception is more fully elaborated and more scientifically expounded by the distinguished writers who compose the Austrian school, and Mr. Smart traces the outlines of their theory with care and lucidity.

Value, as he shows, may be *subjective*, or relative to the well-being of a person, or *objective*, when it forms a relation of power or capacity between one good and another. The "valuable" and the "useful" are not synonymous terms, but the latter is a larger class including the former, where the useful is so limited as to be the indispensable condition of satisfaction of a want. The scale of value, accordingly, differs from a scale in which wants are classified as "necessaries, comforts, and luxuries"; for the "fundamental and limited wants of life" are "precisely the ones for which Nature makes the most abundant provision." It is the want which is least urgent among the wants satisfied, which measures the value of a good; in other words, it is its "marginal utility." But we must be sure, in estimating this marginal utility, that we know what is really the good we are valuing. A good may be put, perhaps, to different and distinct kinds of uses. The highest use will then have the preference, and the "marginal utility" will only be determined respectively along the distinct subordinate lines of the various uses. Or, again, many, and perhaps most, goods are "complementary," in the sense that several contribute to one satisfaction; and the determination of their separate value becomes in consequence far more complex; and, when we pass from *subjective* to *objective* value, the complications increase in number and variety, although one and the same fundamental law still holds good.

In this, and other similar ways, the Austrian economists have undoubtedly succeeded in giving a more scientific character and wider range to the conception of final or marginal utility. But the question still remains, whether they have fully solved the problem which they have set themselves to determine. They will only allow the older doctrine, which found an explanation of value in "cost of production," to be regarded as strictly subordinate to the principle of "marginal utility." The "causal connection," they maintain, runs from product to cost, and not from cost to product. Consumption is the final object and aim of production, and the side of demand is more important than that of supply. And so it is "marginal utility," which is the "universal and fundamental" law of value, and "cost of production" is a "good secondary law as regards the vast majority of goods produced"; and it is so because goods of the "second" and "higher orders," as they distinguish the goods which are the means and materials of production rather than the articles of immediate consumption, may be employed in the production of more than one kind of goods of the "first order."

But it is doubtful whether the Austrian economists have really grasped, in its fulness, the conception of cost of production which was formed by Ricardo and his followers; and whether, by insisting on the exclusive importance of "marginal utility," they are not giving us a one-sided representation of the facts of the case. In the eagerness with which they have seized and proclaimed the new ideas, it is doubtful whether they have not unduly

neglected the old; and whether a combination of what is sound and true in both may not rather be needed in order to attain the whole truth. It is doubtful whether supply does not react upon demand as much as demand on supply; whether the consideration of disutility, implied in the conception of cost of production, is not equally important with that of utility, and equally deserving of distinct investigation; whether, in fine, the efforts and exertions of producers to supply wants are not as potent a factor in advancing civilization, and as creative of new wants, as the pressure of wants and desires themselves. The Austrian writers allow so much—though perhaps they here exhibit some lack of distinct statement—to the influence of "cost of production," that they might, it would seem, go a little further, and place it on an equality with the principle of marginal utility. They would then, perhaps, recognize what Prof. Marshall, in his broader, and, as it appears to us, more philosophic, exposition of value, calls the fundamental symmetry of the laws of the forces working on both sides, which is exhibited in the analogy between "marginal utility" and "marginal cost of production," and a law of "diminishing returns" and one of "decreasing utility." They would, in short, without sacrificing altogether the vast amount of trouble bestowed by Ricardo and his followers on one side of the problem, assign a proper, and not an exclusive, emphasis to the side which they had themselves done so much to elucidate. For these reasons we consider Mr. Smart's modest conclusion—that "the last word on value has not been said by the Austrian school"—to be as sound and as pertinent, as his exposition of their views is clear, pointed, and suggestive.

OUR BOOK SHELF.

Across Thibet. By Gabriel Bonvalot. Translated by C. B. Pitman. Two Vols. (London: Cassell and Co., 1891.)

AFTER the return of M. Bonvalot and Prince Henry of Orleans from the East, so much was said of their journey that we need not now repeat any of the details of M. Bonvalot's narrative. It may suffice for us to commend the book very cordially to the attention of readers who like to wander in imagination with travellers in remote parts of the world. M. Bonvalot, as his translator says, has those qualities of courage, self-command, tenacity, knowledge of human character, and good humour, which go to make up the successful traveller; and he writes of his achievements so simply and naturally that there is nothing to interfere with the reader's full enjoyment of his story. The travellers, as everyone interested in geographical exploration will remember, started from the frontiers of Siberia, and in the course of the journey which brought them to Tonquin passed right through Tibet. Their route lay to some extent over ground which no European had ever before traversed, and this is, of course, the portion of his subject on which M. Bonvalot writes most carefully and effectively. The work has been translated in a clear and pleasant style, and it is enriched with many interesting illustrations.

Light. By Sir H. Trueman Wood. "Whittaker's Library of Popular Science." (London: Whittaker and Co., 1891.)

WE have here a popular and interesting account of many of the facts relating to the nature and properties of light. The subject is treated in a way that will induce many readers to glance through its pages, even if they do not more carefully peruse it; while many a more advanced student will read the chapters on double refraction and polarization, lenses, and interference and refraction. Of other points touched on, we may mention spectrum analysis, optical instruments, chemical effects of light, fluorescence and phosphorescence—all of which are delightfully treated by the author.

In the appendix will be found a list of the more elementary and popular works on the subject, which should prove useful to those who wish to extend their knowledge.

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.*]

Opportunity for a Naturalist.

WILL you allow me to say that the letter which you kindly inserted under this head in your issue of December 24, 1891 (p. 174), has brought me many replies? After considering them, I have made arrangements with Mr. O. V. Aplin (member of the British Ornithologists' Union, and author of "The Birds of Oxfordshire") to proceed to Uruguay in August next. Mr. Aplin will reside for six months on an *estancia* in the province of Minas, and devote himself primarily to birds, but will also collect insects and plants. P. L. SCLATER.

3 Hanover Square, W.

Dwarfs and Dwarf Worship.

IN the slow course of post in this Protectorate I have just received copies of the *Times* of September 3 containing Mr. R. G. Halliburton's paper on "Dwarf Races and Dwarf Worship," and of September 14 and 22, containing subsequent correspondence on the same subject. Having crossed the Atlas Mountains at several different points, and approached the district which is indicated by Mr. Halliburton as the original home and hidden sanctuary of his diminutive and venerated people, I have read his paper with much interest and may perhaps be permitted to criticize his conclusions. My chief during my expedition to Morocco, that distinguished traveller Mr. Joseph Thomson, is, I believe, at present in Katanga, and therefore more inaccessible than I am; but when he is able to speak on the subject, his judgment on the case which Mr. Halliburton has very elaborately set up will not, I am confident, be different from mine.

Mr. Halliburton begins with a statement that is at once startling and decisive. The information he has collected puts it, he says, beyond question that there exists in the Atlas Mountains, only a few hundred miles from the Mediterranean, a race of dwarfs only 4 feet high, who are regarded with superstitious reverence or are actually worshipped, and whose existence has been kept a profound secret for 3000 years. Such an emphatic assertion ought to rest on clear and irrefragable evidence; and I read Mr. Halliburton's paper in constant expectation of the proofs of his remarkable discovery, but reached the end of it without coming on a shred of testimony in support of his contention, of the slightest value to anyone acquainted with Morocco and the Moors. The paper is highly discursive, and abounds in what seem to me far-fetched and irrelevant speculations, on the connection between ancient Moorish poems and Greek mythology, on the derivation of the Phœnician deities, and on the meaning of Moorish habits and customs; but the only evidence, confirmatory of its thesis, adduced in it and in Mr. Halliburton's subsequent letters, amounts to this: that six Europeans have seen dwarfs in Morocco; that an indefinite number of natives have romanced about dwarfs in their usual way; that there are in Morocco artificial caves—presumably dwellings—of such small size as to suggest that they must have had very short inhabitants; and that there have come down to us from antiquity traditions as to Troglodytes who dwelt in the Atlas Mountains.

Mr. Halliburton's European witnesses are unimpeachable; and had my friend Mr. Hunot, whose knowledge of the country is extensive and accurate, distinctly said that there is a race of dwarfs in Morocco, I should not have ventured to con-

tradict him. But all that Mr. Hunot says, in the long paragraph quoted from his letter, is that he recollects an adult dwarf of about the height of a boy of ten or eleven years of age who lived and died in Mogador. All that Captain Rolleston says is that he saw in Tangiers a dwarf of about thirty-five or forty years of age 3 to 4 feet in height, and of an unusually light complexion. All that Mr. Carleton says is that he has seen a dwarf at Alcazar. All that Sir John Drummond Hay says is that he hunted up at Tangiers some Sus and Dra people who had seen dwarfs. All that Miss Day says is that she had done the same at Telcmen. All that Mr. Harris says, of his own knowledge, is that he has seen two dwarfs—one at Fez, about 4 feet 2 inches in height, and of a light brown colour ; and the other, about whom no particulars are given, somewhere in the country. All that Miss Herdman, whom I had the pleasure of meeting at Fez, says is that she has never seen a dwarf in Morocco, but that she has heard of one, and has drawn out tales about a tribe of dwarfs from her native servants. All that Mr. Halliburton himself says to the point is that he has seen and measured a very timid and obliging dwarf of about thirty years of age, 4 feet 6 inches in height, and of a peculiar reddish complexion, in Tangiers.

Let me add to Mr. Halliburton's list of European witnesses. I have myself seen two dwarfs in Morocco—one in Fez, and the other in some northern town (I cannot for the moment recollect which, and have of course no papers to refer to). The first of these might perhaps have passed as a true dwarf—a man of small size, but well proportioned, like Tom Thumb ; but the other was certainly a disease-dwarf, with a large unshapely head and trunk, and little bowed legs, like Canny Elshie, or the Wise Wight o' Mucklestane Moor. Rickets are not unknown in Morocco. I have no doubt that that malady is common in certain districts periodically visited by famine or devastated by war, and in which infant feeding is not conducted on scientific principles ; and the probability is that men and women of stunted and distorted growth are more numerous in proportion to population in Morocco than they are in England. The wonder is to me that the number of instances of the occurrence of dwarfs in Morocco, which Mr. Halliburton in his long-continued researches has been able to establish, is so exceedingly small ; and that one dwarf, for example he of Fez, has, like a stage army, to do duty several times over. But had he succeeded in identifying ten times the number of dwarfs that he has actually traced out, he would only have proved that dwarfs exist in Morocco as in all other countries, and would not have advanced a step towards proving his proposition that there is a tribe of dwarfs in the Atlas. I know a little Scotch town in which there are three dwarfs ; but it would be scarcely legitimate to infer from that fact that there is a concealed clan of MacManikins in the Grampians. That the dwarfish condition in the dwarfs described by Mr. Halliburton was an accidental variation, and not a racial characteristic, is rendered more than probable by the fact that two of them—the only two who are reported to have had families—had offspring of normal stature.

The native reports about dwarfs and dwarf tribes, which Mr. Halliburton sets forth in much detail, are obvious fictions—of the kind which the professional story-teller pours forth copiously every day in the Soko in scores of Moorish towns and villages, only adapted, of course, to the requirements of an eager English listener. The names of the reporters are not given, nor are the opportunities they possessed of obtaining the information they convey explained ; while some of the practices they attribute to the dwarfs—such as finding of treasure by writing on wood, and the feeding of horses on dates and camels' milk with the view of rendering them swift of pace—I have heard ascribed to tribes in the Atlas that are certainly not composed of dwarfs.

Morocco is the hot-bed of fable, and infested by the cock-and-bull, and I can picture to myself the grave delight with which the natives questioned by Mr. Halliburton would stimulate his curiosity and then satisfy it. Mr. Halliburton emphasizes the fact that he is a Q.C., and accustomed to cross-examination ; but British perjury and Moorish mendacity have little in common, and are to be fathomed by entirely different methods. The way in which he measured the Tangiers dwarf, Jackin (he actually took 2 inches off his height because a native who was present told him that Jackin had raised his heels to that extent while being measured), casts some doubt on his powers of observation ; while the extracts from his diary show that no process of sifting has been carried out, but that everything favourable to his theory has been thankfully received. I would undertake to collect in Morocco in a month's time native testimony in support of the existence of a tribe of giants in the Atlas, or of a tribe of men with six digits on each hand, quite as specious and convincing as that which Mr. Halliburton has accumulated in favour of the existence of a tribe of dwarfs. Even if the natives interrogated by Mr. Halliburton had no wish to deceive or to please him, much would depend on the intelligence and honesty of his interpreter, and on the exact terms employed. Only those who have tried can realize how difficult it is to get precise information on any subject out of natives of Morocco.

If the caves in Morocco are to be regarded as at one time the dwellings of dwarfs, then it is clear that dwarfs must at one time have been in complete possession of the country, for such caves are to be found all over it. The most remarkable of them which I have visited at Tassimet, about two days' journey from Demnat—caves which Europeans had never before explored, and which were excavated in a rock by the side of a waterfall—were in many instances too small even for the accommodation of dwarfs ; and as they yielded to our digging fragments of bone and of pottery, it seemed probable that they had been places of sepulture and not of habitation. Such caves have also undoubtedly been used sometimes for the storage of grain, like the underground metamors ; and the invariable answer returned to our inquiries about their origin was that they had been made by the *Romi*, or Christians. Never on any occasion did I hear them ascribed to dwarfs.

The classical tradition that there were dwarfs in the Atlas is unworthy of serious consideration in the absence of any observation suggesting that it had other than an imaginative foundation. "Nearly all the myths of Greece," says Mr. Halliburton, "are laid in Mount Atlas," and monsters more extraordinary than dwarfs must have dwelt there if these myths are to be received as of historical authority.

I have tried to prove that the evidence given in favour of the existence of a tribe of dwarfs in the Atlas is utterly trivial and untrustworthy ; and I shall now endeavour to show that the evidence that can be called to discredit that hypothesis is cogent and convincing. The dwarfs are described by Mr. Halliburton as brave, active, agile, swift-footed, as possessing a vigorous breed of ponies, as experts in the pursuit of the ostrich, and as trading in the Sahara and at Tassamalt. Is it to be believed that being all this, and being very numerous—there are, Mr. Halliburton says, about 1500 of them in Ait Messad, about 1500 at Akdeed, about 1000 at Ait Messal, about 500 at Ait Bensid, and about 400 in three Akka villages—is it to be believed, I ask, that these swarming and enterprising dwarfs would have allowed themselves to be bottled up in a cleft in the Atlas Mountains, so that only half-a-dozen specimens of them have found their way to the great towns to the north of the Atlas, where are to be found numerous representatives of all the other Atlas tribes? Is it to be believed again, that the existence of such a peculiar and notorious tribe, known, Mr. Halliburton tells us, to all Moors, should have been concealed from all the inquisitive travellers who have penetrated into the interior of Morocco, to be revealed to Mr. Halliburton standing at its outer gateway? Leo Africanus, whose account of Morocco is marvellously minute and accurate, and who enumerates its tribes, has not a word to say about dwarfs. De Foucauld, who visited Akka, is equally silent about them ; and so is Rohlfs, who explored the valley of the Dra. Not one traveller in Morocco has ever heard even a rumour or dark hint relating to them.

Thomson and I spent some months in the Atlas in constant communication with natives of every class, and in all the strange legends, histories, and adventures narrated to us by the camp brazier, in the *fondak* or the *kasba*, there was never a distant reference to a Moorish Liliput ; and be it remembered our servants knew that we had a keen eye and ear for curios, human and inhuman. In all our wanderings in the Atlas we never met a dwarf, and indeed, at a great gathering of people at which we were present, at the feast of Aid el Assir at Glawa we were much struck by the height of the men. Mr. Aissa, who is quoted by Mr. Halliburton as having seen one of the tribe of dwarfs east of Demnat, was our interpreter for three months, and conversed with us with the utmost freedom on all conceivable subjects, and he never adverted to this dwarf story. I have had several long talks with Mr. Hunot, whom Mr. Halliburton also quotes—conversations covering a wide range of topics, amongst them the origin of the caves already alluded to—and he certainly at that time had no belief that they had ever

been tenanted by dwarfs, or that there was any dwarf tribe in the country. It is especially noteworthy that Du Bekr, the confidential agent of the British Government at the Court of Morocco, replied to Sir William Kirby Green that no Moor had ever heard of a race of dwarfs in the country. Sir William knew how to interrogate a Moor, and as he accepted Du Bekr's statement, I have no doubt that Du Bekr was speaking the truth.

Until the existence of a race of dwarfs in the Atlas Mountains is proved, it is idle to indulge in guesses at the reasons which have led to the fact of its existence being jealously kept secret; so I shall not follow Mr. Halliburton in the argument by which he seeks to show that the race has been regarded with superstitious reverence, and so kept apart. In all countries, at all times, I believe dwarfs and deformed persons have been looked at askance by the ignorant and superstitious. In Scotland they were regarded as fairies of a brutal and malignant type; and in Morocco I have no doubt they have been credited with the possession of the evil eye and of other pernicious powers. But to maintain that a tribe of them has ever been held sacred and worshipped in the heart of a Mahometan country that is fiercely fanatical is to do violence to our fundamental conceptions of Islam.

Mr. Halliburton's statements about the origin and habits of his supposed tribe of dwarfs are not more worthy of discussion than his theory of the causes which have led to their concealment. They are derived from native sources of the most tainted description, and are either pure inventions, or concoctions of truth and falsehood. We are told that a tribe of acrobats—the Ait Sidi Hamed O Moussa (the tribe of the son of Moses)—is an offshoot of the Aglimien dwarfs, living between the Dra and Akka; that they are a rather small race with a light red complexion; and that dwarfs perform with them in Southern Morocco, but avoid the coast towns where Europeans are; and that they are smiths and tinkers. Now, the paragraph setting forth these statements contains just as much error and confusion as it is possible to cram into so many words. The Sidi Hamed O Moussa are not a tribe at all, but the followers of a saint whose Kuba is not far from Taradant. Their troupes are made up of men drawn from various parts of the country; and it would be as correct to regard the Jesuits as a tribe, and describe their ethnic characteristics, as it is to assign distinctive features to the Sidi Hamed O Moussa. Then, as a matter of fact, they are not unusually small men, they are not smiths and tinkers, and they never have dwarfs performing with them either in town or country. I saw several troupes of them in Southern Morocco, and can testify that they are of average size and of the usual Moorish tint; that they follow a more profitable trade than that of tinkering; and that they have no dwarfs among them.

Mr. Halliburton strongly advises European travellers and tourists to abstain from any attempt to enter the districts of Morocco inhabited by the dwarfish race, as they would inevitably, while doing so, be murdered or robbed, whether Moslems, Jews, or Christians. The advice is judicious, for open-mouthed travellers of any persuasion, in quest of dwarfs, are not unlikely to be murdered or robbed in any part of Morocco except in those coast towns to which Mr. Halliburton has apparently confined his own wanderings in the country. European travellers of another sort, however—resolute, incredulous men, explorers, and pioneers of trade and commerce—will certainly before long penetrate all those regions where the dwarfish race has been located by Mr. Halliburton. Remembering what I have heard on good authority of the resources of some of those regions, and the indications I have seen of the mineral wealth of that region to the south of the Atlas where Mr. Halliburton has placed the original home of his dwarfs, I feel disposed to exclaim, like the old sailor in Millais's famous picture "The North-West Passage": "It can be done, and England ought to do it!" When, however, these regions are opened up, I feel sure that, amongst much that is wonderful in them, there will be found no tribe of dwarfs hemmed in by religious sentiment.

To those interested in the generation and growth of myths in modern times, and under Congress culture, Mr. Halliburton's dwarf-story cannot but afford an instructive study.

HAROLD CRICHTON-BROWNE.

Macloustie Camp, Bechuanaland, November 15, 1891.

Sun-spots and Air-temperature.

IT is now widely believed by meteorologists that a certain relation exists between the solar sun-spot cycle and the air-temperature of the earth, such that to a minimum of sun-spots corresponds, approximately, a maximum of air-temperature, and *vice versâ*. From the comprehensive researches of Dr. Köppen on the subject some time ago, it appeared that this relation is most clearly proved in the case of the tropics, the evidence becoming less as we go north and south. Mr. Blanford showed recently in NATURE (vol. xliii. p. 583) that the evidence in the case of India has of late years greatly increased in force.

In a climate so variable as ours it is not, perhaps, to be expected that the existence of such a relation should be very patent and obvious. And there may be some legitimate doubt whether its existence has yet been demonstrated. It is in the hope of possibly advancing the matter somewhat that the following facts are presented.

If we decide to take for our consideration a part of the year instead of the whole, we shall naturally select the hotter part; the part in which the solar action is greatest (just as we might expect to find, and do find, better proof of the relation in tropical than in cold countries). I select the four months June to September. The data used are, Mr. Belleville's observations of Greenwich mean temperature from 1812-1855, which are, it should be noted, reduced to sea-level (see Quart. Journ. of the R. Met. Soc., January 1888, p. 27), and thereafter the ordinary Greenwich figures. The average difference (about half a degree) does not materially affect the purpose here set.

Taking the mean temperature of those four months, and smoothing the values by means of five-year averages, we get the second, thick line curve in the upper diagram herewith. The dotted line curve is that of sun-spots, inverted (*i.e.* minima above and maxima below). The vertical scales for these are both to the left.

There is evidently a correspondence between these curves as far as about 1870; maxima of temperature lagging a little, as a rule, behind minima of sun-spots, and minima of temperature behind maxima of sunspots. Since about 1870, the correspondence appears to fail. We look for a temperature-maximum about 1879, and we do not find it.

A consideration of the rainfall here seems instructive. The smoothed curve of rainfall in those four months (third in the diagram; Chiswick to 1869, thereafter Greenwich) is, in the main, roughly inverse to the temperature-curve, as we might expect. Yet it is difficult to trace a very definite relation between it and the sun-spot curve. Thus, consider the three most salient "crests" in it. The first (in height as well as time), in 1829, is close *before* a sunspot *maximum*, 1830. The second (least salient of the three), in 1861, is close *after* a sunspot *maximum*, 1860. The third, in 1879 and 1880, is close *after* a sunspot *minimum*, 1878. These rainfall variations, indeed, seem to be under some different law, and it will be observed that the last crest comes (the first example in the whole period) just about where we should expect, from previous experience, to find a temperature-maximum. The regular variation of this curve in one direction for several years is a noteworthy feature recently (in 1880 to 1885, and again in 1885 to 1889). Is the curve now near a maximum which will be found to coincide with a further obliteration of the normal correspondence between sun-spots and temperature?

We have thus far considered the group of four months, and they seem to me to support the view under consideration. May we further look for the relation in individual months?

Suppose we see reason in doing so, and make a selection. The most likely month would perhaps seem to be July, as having the maximum temperature; or June, as that month in which the sun is highest.

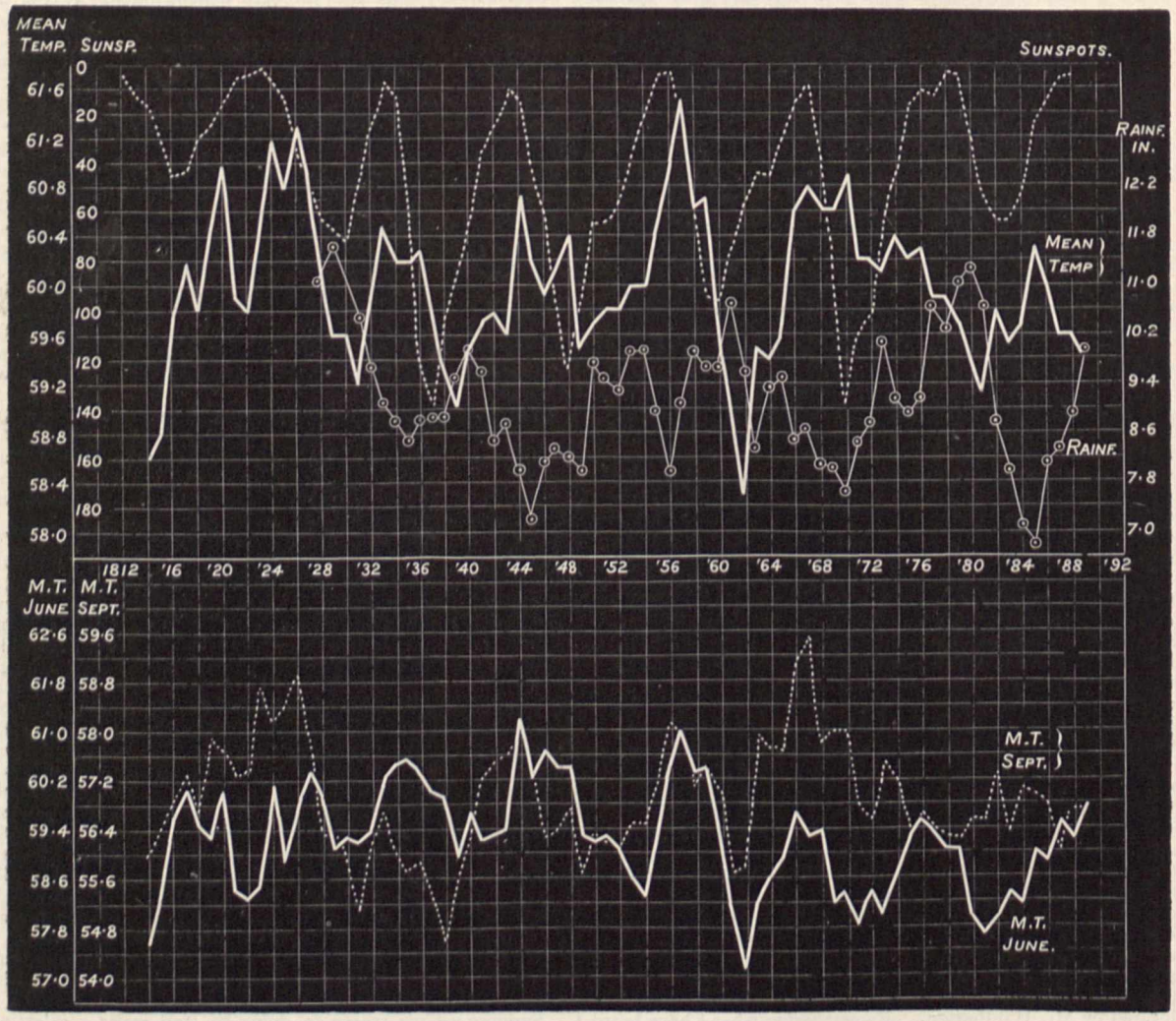
On examining the smoothed curves of mean temperature for each of those four months, we find that June and September show a large amount of the correspondence with the sun-spot curve, while the two others do not show much correspondence. These two curves (June and September) are given in the lower diagram, superposed; the two vertical scales being at the left. June, it will be noticed, presents a wave crest fairly corresponding with each of the six, or seven, sun-spot minima. In the case of September there is a pronounced failure at the sun-spot minimum in 1878.

As a possibly good reason why September might show the relation, while July and August do not (or not so well), I would suggest the fact that September is the month with least cloud. Between May and September, cloud increases to a small secondary maximum in July.

The absence of a maximum of temperature in September

corresponding to the sun-spot minimum in 1878 may, perhaps, be connected, as in the case of the four months' curve, with the rainfall. A smoothed curve of humidity for September rises, I find, to a high maximum in 1880. The June humidity curve does the same, and if it be therefore asked, why we should not have a similar failure in that month's curve, I would invite attention to the fact that the rise to the maximum in the humidity curve for June is a rapid one from the absolute minimum (reckoning from 1858) in 1876; while the rise in September is more gradual from an absolute minimum in 1870. Thus, the wave in June corresponding to the sun-spot minimum in 1878 might be regarded as but partially formed, the growing humidity, or rainfall, presenting its normal culmination.

However this may be (and I do not press these suggestions), it has seemed to me desirable to submit the coincidences presented in the diagram (which I have difficulty in thinking wholly fortuitous, and which are quite in harmony with the general view enunciated by Köppen) to minds more competent to estimate their nature rightly. A. B. M.



The Red Spot on Jupiter.

ON January 4 last, at 5h. 43m., the red spot on Jupiter was estimated to be on the central meridian of the planet. The predicted time, given in Marth's ephemeris (*Monthly Notices*, March 1891), is 5h. 32·6m., so that the spot was 10·4m. late, and this means a decided slackening in its motion of rotation during the present apparition. On August 7, 1891, I saw the spot pass the central meridian at 11h. 32m., or only 2·3m. after the time indicated in Marth's ephemeris. In the interval of 5 months, during which 362 rotations were performed, the mean period has been 9h. 55m. 42s., which is nearly 1 second greater than the rotation period of this marking as observed here during any previous opposition. In 1890 I determined the period as 9h. 55m. 40·2s., which differed very slightly from that derived from my observations in 1887, 1888, and 1889. It now appears, however, that a marked retardation has occurred, and it remains to be seen whether this will be maintained until the close of the apparition.

The spot continues to be a fairly conspicuous object, and it retains its oval outlines, but it is not nearly so dark and definite as it was in the years from 1878 to 1881.

Bristol, January 10. W. F. DENNING.

The Implications of Science.

DR. MIVART complains that in my last letter I merely affirmed without arguing. This is in a measure true as, to

economize your space, I only gave the skeleton of the argument, but I hoped I had said enough to indicate at least the general outline of my logical views. But as this seems not to have been quite the case, may I now explain myself a little more fully?

I may remove a slight misunderstanding at once. I said our knowledge of our own continuous existence *in the present* is to each of us a necessary truth. Dr. Mivart reads this as if I had written "our continued existence in the future"! That we cannot be annihilated while we know that we are existing is, as I shall presently show, *not* a mere consequence of the law of contradiction. If this law is of any use at all in proving the conclusion, it would certainly be useless without a second premiss, viz. that we are existing; and this latter is the premiss which is a necessary truth.

I suppose everyone will acknowledge that a definition is essentially an arbitrary assertion, and that therefore a definition can by itself give no real information. But a well-understood term does not consist of a definition alone. Its definition may be laid down, as a list of items of connotation (or denotation), and the other part of its meaning, which may be called its import, that is its denotation (or connotation) must be discovered by experience; and the knowledge so acquired is real, not only verbal, knowledge. Now it is possible from a number of definitions *alone* to deduce a series of propositions. These, like the definitions from which they were deduced, give by themselves only verbal information—they are all truisms—and before they can be made of any practical use, certain real assertions, assigning real import to the terms, and so expressing real knowledge, must be added to the premisses. Thus, if we wish to determine whether any given proposition is a truism, or conveys real information, we have only to examine the definitions of its terms. If these are found to be inconsistent with each other, the proposition is a contradiction in terms, and must be rejected. If the definitions are not inconsistent, but are independent of each other, the proposition can only be intended to assert the identity of the import of its terms—it therefore conveys real information, which may either be true or false. Lastly, if the definitions can be shown to be dependent on each other, the proposition is equally true whatever import its terms may have, or even if they have no conceivable import at all. It is a truism. If, however, *by the aid of other real propositions* any real import can be given to its terms, it may have objective, or subjective, applications; but the objectivity or subjectivity is introduced by those other propositions, and is not a property of the original truism.

Take, for example, the proposition, "Everything must either 'be' or 'not be'"; or the proposition, "Twice two is four." The truth of either of these propositions depends solely on the definitions of its terms, as I pointed out in my last letter, and this is why I cannot regard them as objective truths. Of course I do not doubt that if I had lost an eye I should not remain in the same condition as I was before. But, although "no man out of Bedlam would suppose a statement of a general law would inform us about a concrete thing," this is precisely what Dr. Mivart does if he regards the above proposition as dependent solely on the law of contradiction. Does he not see that he added the objective element to that law in the phrase, "if he had lost an eye"? "Much virtue in If." The status of the proposition, "Two straight lines cannot inclose a space," similarly depends on the definitions of its terms; but, as I pointed out in my last letter, these terms may be defined in two different ways—either by dependent definitions, so making the proposition a truism, or independently so as to make it a real assertion, in which case it might conceivably be false. Dr. Mivart apparently takes the former set of definitions, and then implies that I deduced the latter result from them, which, if he reads my letter again, he will find not to have been the case.

In reply to Miss Jones, I may point out—

(1) It most certainly *is* merely a verbal convention when Miss Jones says, "A and *a* 'are not applicable to the same thing.'" She had herself just before laid down the convention in question, in the phrase, "If A signifies the negation of *a* (whatever A may stand for)."

I do not know why Miss Jones should imagine that I think that "assertions (or denials) of the 'existence' of particular objects are the only real propositions," but perhaps she will understand my view better when she has read this letter.

(2) I certainly hold that "inductions have no logical justification whatever," if by "logic" is to be understood formal, or, as I prefer to call it, symbolic, reasoning. The essence of induction, in my opinion, is the assumption (at first arbitrarily) of an hypothesis to account for observed facts—that is, ultimately, of directly apprehended sensations. The full significance of the hypothesis is elucidated by symbolic reasoning, and the *enumeratio simplex* is applied to the results of this reasoning, and does not, therefore, appear quite in the simple form exhibited by Miss Jones. But it remains equally true that no induction can ever lead to a necessary truth.

(3) Miss Jones's view of mathematical reasoning is exactly that which I wish to combat. We do not, in mathematics, conclude a universal proposition from a single concrete instance. A mathematical formula does not imply the existence of any instance whatever of its application, any more than a definition implies the reality of the thing defined. The formula is deduced from what may logically be regarded as definitions, and one or any number of applications may indeed be found afterwards, but only by the aid of additional real premisses. It is difficult to exemplify this in the case of geometry, because the accepted geometrical methods are so very imperfect, and geometrical conclusions are not always deduced from definitions alone. As I implied in my former letter, some of them are founded on induction. But it must be evident that the truth of, say, De Moivre's Theorem, does not depend on our having *seen* that it was true in any one instance.

(4) If Miss Jones reads her own paragraph (4) again carefully, I think she will see that it is not I who have contradicted myself. I showed that if the definitions of the terms of a certain proposition were altered, the proposition might no longer be true, and that if they were not altered it would always be true. *Argal*, the truth depends on the definitions, and on nothing else.

I did not maintain that it could ever be to anyone a necessary truth that he was writing with a lead-pencil. That would be an objective proposition, such as I was careful to insist could only be proved by induction. It might, however, be a necessary truth to anyone that he *thought* he was writing with a lead-pencil. As to mathematical truths, so far from believing that "in as far as 'real' they are obtained by induction," I expressed my opinion that they are not "real" at all, but all truisms. Any reality in their applications must be added from outside, by real assertions which are not "mathematical." I object to calling truisms "necessary," not because they are possibly false, but because their truth is only arbitrary. On the other hand, when I call "the apprehension of a present fact" a necessary truth, I mean something more than that it is certain—namely, that its contradictory is unthinkable.

EDWARD T. DIXON.

Trinity College, Cambridge, January 8.

FRESH EVIDENCE CONCERNING THE DISTRIBUTION OF ARCTIC PLANTS DURING THE GLACIAL EPOCH.

LAST summer (1891) I spent some weeks in Western Russia and Northern Germany, in order to ascertain whether the glacial fresh-water deposits of those countries contained any remains of the vegetation which lived there immediately after the inland ice had melted away. The results of my journey being favourable, I have thought it desirable to communicate them to the readers of NATURE; but before doing so it might be convenient to give a brief summary of previous investigations on the same subject.

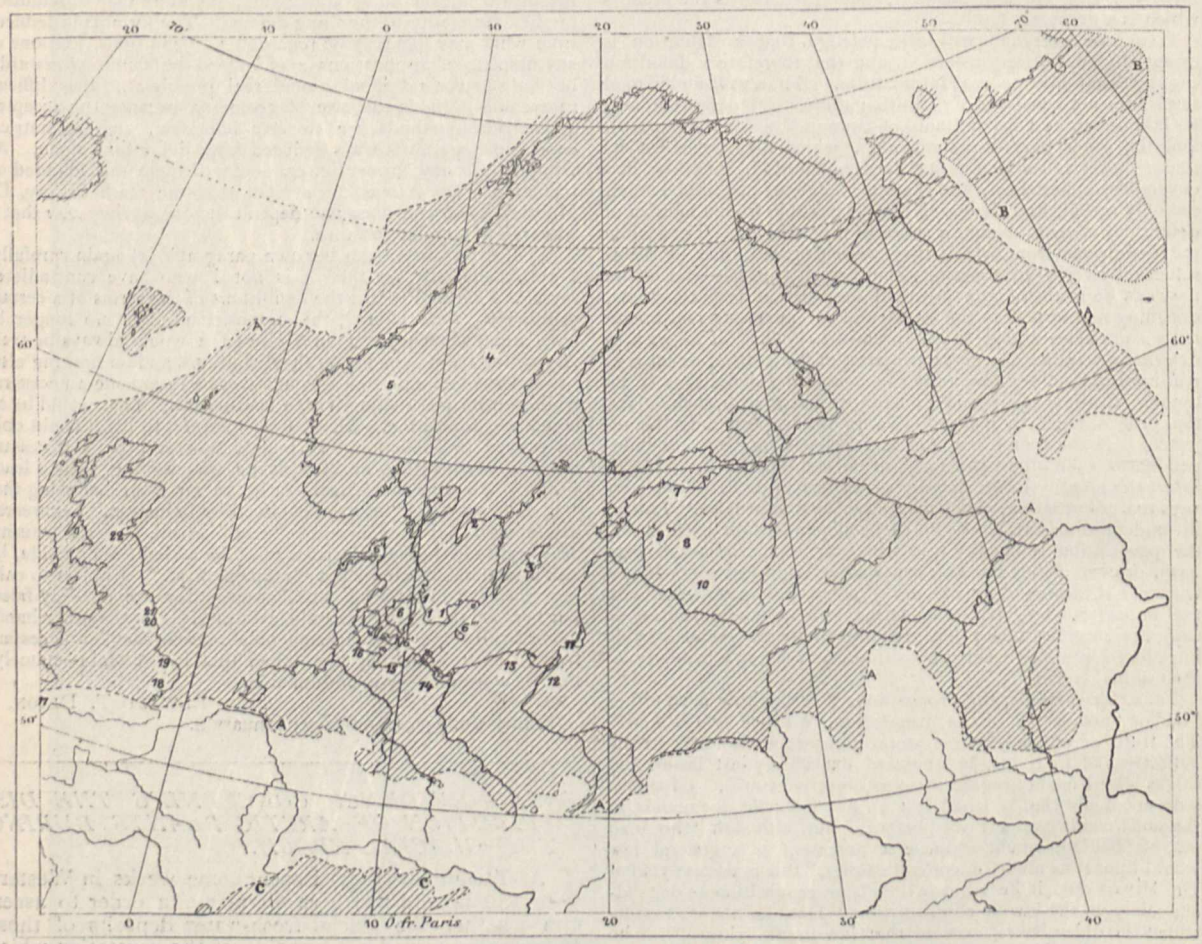
The first discovery of fossil Arctic plants was made in England by Mr. W. Pengelly, who found in 1860, at Bovey Tracey, in Devonshire, leaves of the dwarf birch (*Betula nana*), together with leaves of some willows, as *Salix myrtilloides*, *S. cinerea*, *S. sp. indet.* The leaves were identified and described by the late Prof. Heer,[1] who pronounced the opinion that the presence of *Betula nana* was conclusive evidence of "a colder climate than Devonshire has at the present day." The significance of this discovery was, however, but little appreciated until the researches mentioned below again

[1] Philosophical Transactions, 1862, p. 1039. In this paper Heer mentions *Salix repens* (?), but this determination was subsequently altered to *S. myrtilloides*.

called attention to the nature of the vegetation which grew round the margin of the great northern inland ice, on the soil which was left bare when it melted away.

During my first visit to Spitzbergen, in 1870, it occurred to my mind that—supposing the glacial theory were true—the remains of those Arctic plants which, in all probability, formerly existed in the area once covered by the great Scandinavian inland ice, would have been buried in the glacial fresh-water deposits, just in the same manner as the leaves of *Salix polaris*, *Dryas octopetala*, *Polygonum viviparum*, &c., are at the present day carried into the small lakes of Spitzbergen, and buried at their bottoms. On my return from that expedition, I at once examined some glacial fresh-water deposits at Alnarp, in Scania, and was glad to find in them the leaves of *Salix polaris*, *S. herbacea*, *S. reticulata*, *Dryas octopetala*, *Betula nana*, &c.; thus proving that a true Arctic flora had once lived in the southernmost part of Sweden. The next year, after having discovered the same flora in a great many other localities of the same province, I was invited by Prof. Japetus Steenstrup to extend my researches into Denmark; and our joint investigations were soon crowned with success, for we found the Arctic fossil flora underneath some peat-mosses in the immediate vicinity of Copenhagen. In 1872 I discovered leaves of *Betula nana* in a peat-moss near Oertzenhof, in Mecklenburg, and at Kolbermoor, in Southern Bavaria. In Switzerland I also found an Arctic-Alpine flora in a fresh-water deposit at Schwerzenbach, on the low ground between Zürich and Bodensee. The flora was rich in such species as *Betula nana*, *Salix reticulata*, *S. polaris*, *S. retusa*, *S. myrtilloides*, *Arctostaphylos uva-ursi*, *Polygonum viviparum*, *Azalea procumbens*, &c.

From Switzerland I went to England, and first visited Bovey Tracey (17),[1] where I re-found *Betula nana* in the original locality, and also in another little basin close by, together with leaves of *Arctostaphylos uva-ursi* and *Betula alba*. Then I went to the coast of Norfolk, where I was so fortunate as to find *Salix polaris* and *Hypnum turgescens* in the pre-glacial deposits between the boulder-clay and the forest-bed in the vicinity of Cromer (19). This plant-bearing bed has since then been noticed by Mr. Clement Reid, of the Geological Survey, who has named it the "Arctic fresh-water bed," and he has traced



SKETCH MAP SHOWING THE LOCALITIES WHERE ARCTIC PLANT-FOSSILS HAVE BEEN FOUND WITHIN THE AREA ONCE COVERED BY THE GREAT NORTHERN ICE-SHEET.

A, margin of the great northern inland ice at the climax of glaciation; B, margin of the Uralo-Timan glacier (according to Nikitin); C, margin of the glaciers of the Alps.

(1) Several localities (more than thirty) in Scania; (2) Rangilstorp, near Vadstena; (3) Fröjel, in the isle of Gotland; (4) several localities in Jemtland; (5) Leine, in Norway; (6) several localities in Seeland; (6′) Möen; (6″) Northern Jutland; (6‴) Bornholm; (7) Kunda, in Esthonia; (8) Samhof and Kinzli, in Livonia; (9) Pingo and Wieratz in Livonia; (10) two localities at Rjeshiza, Government of Vitebsk; (11) Kuhrische Nehrung; (12) Schroop, in Western Prussia; (13) Krampkewitz, in Pomerania; (14) Neetzka and Oertzenhof, in Mecklenburg; (15) Nantrow, in Mecklenburg; (16) Projensdorf, north of Kiel; (17) Bovey Tracey, in Devonshire; (18) Hoxne, in Suffolk; (19) several localities at and near Cromer, Norfolk; (20) Holmpton, Yorkshire; (21) Bridlington, Yorkshire; (22) localities near Edinburgh.

[1] The figures within parentheses refer to those on the accompanying sketch map.

it in some other places on the coast of Norfolk. Besides *Salix polaris*, Mr. Reid has also found in it leaves of *Betula nana* and seeds of some other plants. At Hoxne, in Suffolk (18), Messrs. Reid and Ridley have discovered *Salix polaris*, *S. myrsinites*, and *Betula nana*, together with many other species in a glacial fresh-water deposit of a precisely similar character to those in Southern Sweden. Again, in 1879, I found leaves of *Betula nana* in a peat-moss at Bridlington (21), and the same plant has been found by Mr. Reid at Holmpton (20). According to a statement of Mr. Reid, *Salix herbacea* was found some years ago by Mr. Bennie in an inter-glacial deposit at Hailes, about three miles from Edinburgh. Finally, during this present year (1891), Mr. Reid has himself discovered a rich Arctic flora, yielding *Salix polaris*, *S. herbacea*, *S. reticulata*, *Azalea procumbens*, and *Betula nana*, in lacustrine deposits immediately above the boulder-clay near Edinburgh (22).[1]

Returning to Sweden, a great many new localities yielding Arctic plants have also been found in Scania since 1871, partly by myself, partly by Dr. Gunnar Andersson and others, so that the number of localities in Scania (1) now exceeds thirty. In Ostrogothia, leaves of *Betula nana* and *Dryas octopetala*, &c., were found in 1886 in a calcareous tufa near Vadstena at Lake Vetter (2); and in the isle of Gotland (3), Mr. R. Sernander, in 1890, discovered leaves of the same species in a fresh-water deposit overlain by the curious gravel-bed containing *Ancylus*. In Jemtland, Mr. A. F. Carlson, in 1885 and 1886, discovered leaves of *Dryas* and *Salix reticulata* in calcareous tufa in several localities (4) far removed from the regions where these species now exist. In Norway nothing whatever was known of the ancient Arctic flora until last summer (1891), when, according to Prof. A. Blytt, leaves of *Dryas octopetala* were found in calcareous tufa at Leine (5). In Denmark the continued researches of Prof. Steenstrup have added many new localities (6) to the original ones mentioned above, not only in Seeland, but also (from a private communication made to the author) on the isle of Möen (6′), in Northern Jutland (6″), and on Bornholm (6‴). Turning to Switzerland, Prof. C. Schröter, of Zürich, has discovered three new localities for the glacial flora, and in 1880 I myself found leaves of *Salix herbacea*, *Dryas octopetala*, and *Betula nana* in a fresh-water deposit near Hedingen (Canton Zürich), and leaves of the last-mentioned species underneath a peat-moss at Wauwyl (Canton Luzern), and in peat at Le Chaux de Fonds.

It ought also to be mentioned that Prof. M. Staub, of Buda-Pest, has lately described a fossil glacial flora from the Southern Carpathians, which, besides seeds of *Pinus Pumilio* and *Pinus Cembra*, also contains leaves of *Dryas octopetala*, *Betula nana*, and *Salix myrtilloides*, together with fruits of *Tofieldia borealis*, thus proving the existence of a somewhat colder climate than the present one.

In 1880, I discovered a locality at Neetzka, in Mecklenburg, not far distant from Oertzenhof where I had found *Betula nana* in 1872. The new locality (14) yielded *Dryas octopetala*, *Salix reticulata*, *Betula nana*, *B. odorata*, and *B. verrucosa*; together with leaves of *Myriophyllum*, some other *Salices* and mosses, such as *Hypnum scorpioides* and *H. fluitans*. According to the manner in which the samples of clay were gathered, it is very possible that the species mentioned belong to different horizons.

Neetzka and Oertzenhof being the sole localities in Northern Germany which until then had yielded fossil Arctic plants, while nothing whatever was known of the existence of Arctic plant-fossils in Russia, Prof. O. Drude, of Dresden, in 1889 expressed the opinion[1] that the margin of the great northern inland ice might have been surrounded, not by an Arctic flora, but by a forest growth; and further, that such a growth may even have existed on the surface moraines of the inland ice itself.

I have[2] lately tried to show, however, that this hypothesis is erroneous; but with the conviction that facts would prove the best arguments, I resolved to visit those portions of Western Russia and Northern Germany which I had not previously examined, and, thanks to the liberality of the Swedish Society for Geography and Anthropology, who gave me the balance of the *Vega* fund, I have been enabled to carry out my project, with the results communicated below. As my collections are, however, only partially worked out as yet, the present notice must be considered as only preliminary.

The circumstances under which the Arctic plant-fossils occur are pretty uniform, and it may therefore be convenient to state them at once, instead of giving a description for every locality. In those parts of Western Russia and Northern Germany which I visited, the ground almost everywhere consists of a true *moraine profonde* (till) which has never been covered by the sea. Though marine glacial deposits are consequently absent in this area, fresh-water deposits, which have been formed in ancient lakes or ponds, are very abundant. These deposits consist generally in their lower part of a bluish clay or sandy clay, sometimes distinctly laminated, while the colour of the clay in the upper part is generally somewhat yellowish. This fresh-water clay is often covered by white shell marl, principally derived from the shells of fresh-water Mollusca; sometimes, however, by mud containing the remains of microscopical Algæ, fragments and excrements of insects and other minute fresh-water animals. Then comes the peat, terminating the deposit above—sometimes developed as a true peat-moss; at others, only as a peaty mould 1 to 2 feet thick. In places the peat is totally absent, *i.e.* the fresh-water lake has been entirely filled up by the alluvial clay before the formation of peat had begun.

The Arctic plant-fossils are found principally in the clay, sometimes also in the white marl or mud, whilst only *Betula nana* ascends into the peat. Some fresh-water Mollusca are found together with the Arctic plants—namely, some species of *Pisidium*, *Limnæa ovata*, *Anodonta* or *Unio*, sometimes also *Cyclas cornea*. By studying the distribution of the Mollusca in the different horizons, the order of immigration of the different species can be ascertained, and we know now very well the manner in which this has taken place in Southern Sweden. Besides Mollusca, the Arctic plants are often accompanied by remains of beetles and by Ostracoda, such as *Cytheridea torosa* and others; and in one locality in Scania I have also found abundant remains of *Apus glacialis*. Finally, it is in this horizon that the remains of the reindeer are principally found in Southern Sweden, Denmark, and Northern Germany.

When travelling in Esthonia and Livonia I had the advantage of being accompanied by the well-known geologist, Akademiker Fr. Schmidt, of St. Petersburg, and the success of our investigations was largely due to his advice. The Arctic plant-fossils were first discovered at Kunda in Esthonia (7), where the fresh-water marl and clay are used in the preparation of cement. The upper part of this deposit has yielded a great many bone implements of Neolithic age, which were described some years ago by the late Prof. Grewingk, of Dorpat, and antlers of reindeer are likewise present. The Arctic plants were obtained at a depth of 17½ feet below the

[1] It is curious that *Dryas octopetala* has not yet been reported from the glacial plant-fossils of Great Britain, although it abounds in the glacial fresh water deposits of Sweden, Denmark, Germany, and Russia; and although the plant still lives in the mountains of Scotland, Yorkshire, and Wales. May not, however, the leaf from Crofthead which Mr. Mahony has identified with *Scutellaria galericulata* (*Géol. Mag.*, vol. vi. p. 392) in reality have been a leaf of *Dryas*? The leaves of *Scutellaria* can hardly be preserved in the fossil state.

[1] *Petermann's Mitteilungen*, 1889, pp. 282–290.

[2] *Engler's Botan. Jahrbücher*, Bd. xiii., 1891, *Beiblatt* Nr. 29.

surface, *Salix polaris* being the most common form. Of other species found, the following have, up to the present, been recognized: *Salix herbacea*, *Dryas octopetala*, *Betula nana*, *Polygonum viviparum*, *Saxifraga cæspitosa* or an allied species, mosses, &c.

From Kunda we went to Hellenorm in Livonia (8), where we were welcomed by the old Siberian traveller, A. Th. van Middendorff, who took a great interest in my researches. On the day of our arrival Prof. Schmidt found a leaf of *Salix reticulata* in a bed of clay at Samhof. In another clay-bed in the vicinity, at Kinzli, I found *Dryas octopetala*, *Betula nana*, *Salix* sp., mosses, &c.

Then we went to Fellin (9), where I found the Arctic plants at two different localities, Pingo and Wieratz. The species obtained were *Dryas octopetala*, *Betula nana*, *Salix reticulata*, *Potamogeton* sp., &c. I then parted from Prof. Schmidt, and went to Rjeshiza (10), in the Government of Vitebsk, accompanied by Dr. J. Klinge, of Dorpat. In Rjeshiza we were welcomed by Dr. E. Lehmann, a skilful botanist; and on the very day of our arrival we discovered the following Arctic plant-fossils, *Dryas octopetala*, *Betula nana*, *Polygonum viviparum*, &c., in two different localities in the vicinity of the town. My ignorance of the Russian language made it impossible for me to continue my researches further eastwards into the interior of the country, and I consequently turned westwards to Königsberg, in Eastern Prussia. There Prof. A. Jentzsch reminded me of the discovery of *Hypnum turgescens*, in an alluvial deposit at Kuhrische Nehrung, made by Berendt many years ago. As this is a mountain species, it is possible that it may have been found in a glacial fresh-water deposit, and this locality has consequently been indicated on the sketch map (11).

Accompanied by Prof. A. Jentzsch, of Königsberg, and by Prof. H. Conwentz, of Danzig, I now went to Marienburg, in Western Prussia, and at Schroop (12), about 10 kilometres south-east of this town, a locality yielding Arctic plant-fossils was discovered. They occur here under precisely the same conditions as in Scania or at Kunda, in Esthland; *Salix polaris* and *Dryas octopetala* being found in the lower strata, whilst *Betula nana* occurs somewhat higher. The next locality discovered was at Krampkewitz (13), near Lauenburg, in Pomerania, whither I had gone with Prof. Conwentz. The plant-fossils found were *Dryas octopetala*, *Betula nana*, and some others.

Owing to heavy rains, a visit to Breslau proved fruitless, and for the same reason the fresh-water deposits near Waren and Rostock were inaccessible, but acting on the advice of Prof. E. Geinitz, of Rostock, I examined a small peat-moss at Nantrow (15), north-east of Wismar, where I found *Betula nana* and some *Salices* in mud and sand underneath the peat. The following day I examined the sections at the great North Sea–Baltic Canal at Holtenau, north of Kiel (16), under the guidance of Prof. R. v. Fisher-Benzon, of Kiel. We succeeded in finding two fresh-water basins yielding plant-fossils. The first basin, of which only a small portion now remained, contained fruits of *Betula nana*, together with some other species, not yet determined, but probably indicating a sub-Arctic climate. In the other basin, which was also cut through by the canal, the glacial fresh-water strata underneath the peat were laid bare, yielding abundant leaves of *Salix polaris*, sometimes intermingled with those of *Dryas octopetala*, mosses, &c.

In view of these facts, thus briefly communicated, I think it may be accepted as proved that the Arctic flora flourished on the plains south and east of the Baltic round the margin of the ice-sheet, and some time after the inland ice had melted away (see the accompanying sketch map). There can also be hardly any doubt that this same flora may have lived round the margin of the great northern inland ice at the climax of the glaciation. For otherwise it is difficult to understand how it could have obtained so great an extension as from Suffolk to Kunda, in Esthonia, or why it should have flourished during so long a time after the amelioration of the climate, which caused the melting of the ice, had commenced. The fresh-water deposits with Arctic plants are sometimes so thick that they probably indicate an interval of several thousand years, during which the Arctic flora prevailed. If the margin of the ice-sheet at the climax of glaciation had been surrounded by a forest growth, this ought still more to have existed round the margin of the retreating ice. But as we have shown that this is not the case, we are entitled to conclude that the Arctic flora formerly flourished, not only round the margin of the great northern inland ice, but probably also over a part at least of the area between this ice and the glaciers of the Alps. In connection with this, it ought not to be overlooked that the Arctic tundra-fauna, which Prof. Nehring discovered at Thiede, underneath the steppe-fauna, perfectly harmonizes with this view, as this locality is situated relatively near to the outermost margin of the great northern ice-sheet. The existence of *Salix polaris* in Suffolk and Norfolk may also be considered as a strong argument for the same hypothesis. Thus the theory advanced by E. Forbes so far back as 1846—that the Alpine flora of Europe, so far as it is identical with the flora of the Arctic and sub-Arctic zones of the Old World, is a fragment of a flora which was diffused from the north, and that the termination of the glacial epoch in Europe was marked by a recession of an Arctic fauna and flora northwards—may now be regarded as definitively proved.

A. G. NATHORST.

CYCLONES IN THE ARABIAN SEA.[1]

THIS discussion was undertaken primarily by the Meteorological Office with the object of throwing some light on the very exceptional storm which was experienced at Aden in the summer of 1885, but advantage was taken of this opportunity to produce synchronous weather charts of the Arabian Sea for a limited period, since it was felt that such charts would be of especial interest, dealing as they do with a part of the ocean which is subject to the regular change of monsoon winds. The charts also exhibit the occurrence of a second cyclone which had originated over the eastern portion of the Arabian Sea before the full effect of the first disturbance had passed away. The Gulf of Aden and the northern portion of the North Indian Ocean are rarely visited by cyclones or typhoons, and consequently the occurrence in these waters, in the summer of 1885, of a violent cyclone, causing the loss of several vessels, among them the German corvette *Augusta*, and the French despatch-boat *Renard*, attracted considerable attention. The number of ships' logs which have been collected and utilized in the preparation of the charts is 239, and the information has been obtained from all available sources, including our own Navy and mercantile marine, and those of many foreign countries. For the first few days of the period discussed, the normal conditions were apparently prevailing over the Arabian Sea, the wind was north-westerly near the Indian Peninsula, but the south-west monsoon was blowing steadily near the African coast and for some distance over the sea on the western side of the district. Until about May 20, the weather in the neighbourhood of Ceylon seems to have been quiet, and the wind fairly steady from the south-westward. On the 20th, Her Majesty's ships *Briton* and *Woodlark* experienced somewhat disturbed weather at Trincomalee, the squalls attained the force

[1] "Daily Weather Charts for the Period of Six Weeks ending June 25, 1885, to illustrate the Tracks of Two Cyclones in the Arabian Sea." (London: Published by the authority of the Meteorological Council, 1891.)

of a moderate gale from the north-westward, and much thunder and lightning occurred. Unsettled weather continued from the 21st to the 24th, and from this day a storm area can be clearly traced travelling to the westward. The cyclone reached its greatest violence on June 2 and 3, when the barometer is reported as reading 27·86 inches in close proximity to the centre of the disturbance. A hurricane occurred at Obokh during the evening of the 3rd, and it was reported that all the houses but one had been blown down, and trees had been uprooted. The position of the storm area is not only marked throughout its passage across the Arabian Sea by the cyclonic circulation of the winds, but also by the rain area which accompanied the disturbance; the rate of progress of the storm from May 24 to June 3 was rather less than seven miles an hour.

The second cyclone which is shown by the charts appears to have originated not far distant from Ceylon at the commencement of June, and on the 4th a strong south-westerly gale was blowing on the equator in the longitude of 76° E. This storm can be traced for the next ten days, during which time it passed to the northward and westward towards the entrance of the Persian Gulf. The weather was very disturbed over nearly the whole of the Arabian Sea from the 9th to the 13th, and the area of the storm was much larger than in the case of the Aden cyclone, and gales were experienced from the coast of Africa to that of India, extending over a distance of about 1500 miles. The synchronous weather charts for the last few days of the discussion, after the cyclonic disturbances had passed away, show that the south-west monsoon had extended over the whole of the Arabian Sea, whereas in the middle of May it was limited chiefly to the western side.

Each daily chart contains the observations from several ships in the Red Sea, where the wind direction and other elements of the weather are very instructive. The southerly march of the northerly or north-westerly wind, which throughout the whole period prevails over the northern portion of the Sea, and the gradual backing down of the southerly winds in the southern portion of the Sea are well shown. The northerly wind in the northern portion of the Red Sea often attains the force of a gale, but there is no instance in the charts of the southerly winds attaining gale force. The air temperature is generally higher in the Red Sea than over the more open water in the Arabian Sea, the reading of the thermometer commonly reaching 90°, and on June 14 the temperature at 10 o'clock in the morning was 102° over the open sea, nearly abreast of Musawwá. The charts show many other points of interest, among these the flow of the current under the influence of disturbed weather as well as when the sea is comparatively quiet, and doubtless the volume will throw some additional light on the winds and weather in this part of the world, where at present the meteorological changes are not too well understood.

ON VAN DER WAALS'S ISOTHERMAL EQUATION.

IN reply to Prof. Tait's criticism (NATURE, December 31, 1891, p. 199) of my paper (December 17, p. 152), I wish to say that I certainly do not consider Van der Waals's b as an absolute constant. Perhaps it may be interesting to show how the limits of its variability can be determined.

Leaving aside the question of the attractive forces, which probably has been sufficiently elucidated in the course of this discussion in the columns of NATURE, and considering gases as aggregations of elastic spheres, then in the formula—

$$p_1(v - xb_1) = \tfrac{1}{3}\Sigma mu^2 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

x can be proved to be equal to 4 for large volumes and *small* pressures.

Again, in the case of *extremely large* pressures, when the volume is nearly reduced to the smallest possible dimensions, it is easy to see that a formula—

$$p_1(v - \mu b_1) = \tfrac{1}{3}\lambda \,.\, \Sigma mu^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

must hold good, where $\mu b_1 = 3\sqrt{2}/\pi \,.\, b_1 = 1{\cdot}35\,..\,b_1$ represents the space in which the spherical molecules can be inclosed when they are motionless, and λ is a certain numerical coefficient whose determination might present some interest, and perhaps is not beyond the scope of mathematical analysis. (For one-dimensional motion $\lambda = 1$.) Be this as it may, putting (2) in the form—

$$p_1\left[v - \left(1 + \frac{\lambda - 1}{\lambda} \,.\, \frac{v - \mu b_1}{\mu b_1}\right) . \mu b_1\right] = \tfrac{1}{3}\Sigma mu^2, \quad . \quad . \quad (3)$$

it is clear that in *this* case x approaches the value $\mu = 1{\cdot}35$.

Now surely, for *intermediate* volumes and pressures, xb_1 cannot be considered as a constant; still, along the large range of these pressures, the correction required must be called *relatively* slight, and the more so as it is beyond doubt that a considerable part of the change from 4 to 1·35 takes place near those extreme pressures where, according to (3), x may be very variable. Whether at the critical volume this coefficient has undergone already a practically important change from its original value, 4, seems to me a question which cannot easily be answered by purely theoretical considerations.

In my opinion, in all cases except in that of large volumes the formula (1) is preferable to a formula

$$p_1 v = \tfrac{1}{3}\left(1 + \frac{4b_1}{v} + \frac{\sigma b_1^2}{v^2}\right) . \Sigma mu^2, \quad . \quad . \quad . \quad (4)$$

even if the numerical value of σ could be exactly calculated; therefore the question at issue does not simply turn on the introduction or rejection of terms of the order β^2/v^2, and it was looking at the matter from this point of view that in my paper I once called a formula of the form (1) the *true* one as distinguished from a formula of the form (4), and not from any formula given by Prof. Tait. Certainly, none of the isothermal equations given by different authors can be named *true* in the sense of representing with absolute exactness the conduct of real gases; and of course, when more constants are introduced in these equations than are contained in that of Van der Waals, a better approximation to the conduct of these gases may be reached.

In conclusion, I beg to add a few words about Prof. Tait's third remark. It seems to me that he has no right to identify the process of putting arbitrarily $\gamma = \beta$ with that of calculating the correction indicated by Prof. Lorentz.

D. I. KORTEWEG.

Amsterdam, January 6.

NOTES.

SEVERAL scientific meetings have been postponed in consequence of the death of the Duke of Clarence. Prof. W. E. Ayrton, F.R.S., was to have delivered his inaugural address, as President of the Institution of Electrical Engineers, on January 14. It will be delivered at a meeting of the Institution on January 28. The annual general meeting of the Royal Meteorological Society, fixed for the 20th, will be held on the 27th, when the President, Mr. Baldwin Latham, will deliver an address on "Evaporation and Condensation." The annual meeting of the Entomological Society is also adjourned from the 20th to the 27th.

THE forty-fifth annual general meeting of the Institution of Mechanical Engineers will be held on Thursday and Friday evenings, February 4 and 5, at 25 Great George Street, West-

minster. The chair will be taken at half-past seven p.m. on each evening. The President, Mr. Joseph Tomlinson, will retire, and will be succeeded by the President-elect, Dr. William Anderson. The following papers will be read and discussed, as far as time permits:—Notes on mechanical features of the Liverpool water-works, and on the supply of power by pressure from the public mains, and by other means, by Mr. Joseph Parry, water engineer, Liverpool (Thursday). On the disposal and utilization of blast-furnace slag, by Mr. William Hawdon, of Middlesborough; communicated through Mr. Charles Cochrane, past-President (Friday).

THE German Mathematical Association (Deutsche Mathematiker-Vereinigung) propose to hold their annual meeting in the autumn of this year at Nuremberg, and at the same time an Exhibition of Mathematical and Physical Models and Apparatus is to be brought together under the auspices of the Government. This Exhibition will resemble that of the Loan Collection, held at the South Kensington Museum in 1876. At Nuremberg the corresponding Germanisches Museum is available for the same purpose. The German Mathematical Association request the concurrence and assistance of those persons and institutes interested in the subject in this country, so as to make the Exhibition as complete and representative as possible.

THE American Institute of Electrical Engineers has passed a resolution declaring its intention to co-operate with "the World's Congress Auxiliary" in the effort to secure the gathering of an International Electrical Congress at Chicago in 1893, and pledging itself to do everything in its power to make the Congress a successful and worthy representation of the best electrical science and practice in all parts of the world. According to a prospectus issued by the World's Congress Auxiliary, the Congress will deal with "scientific and technical electricity, telegraphy, telephony, electric light, electric power, and other forms of electrical application, with appropriate chapters and sections for the proper consideration of each."

THE friends of Prof. Baird, the late Secretary of the Smithsonian Institution, will regret to hear that his widow, Mrs. Spencer F. Baird, died at her home in Washington on December 23, 1891.

M. DE QUATREFAGES, the well-known anthropologist, died on Tuesday, January 12. He was born in 1810, and studied medicine at Strasburg. Afterwards he became Professor of Zoology at Toulouse, where he had settled as a medical practitioner. In 1855 he was made Professor of Anthropology and Ethnology at the Jardin des Plantes, Paris. He had already been admitted to the Academy of Sciences in 1852, and he was an honorary member of many foreign learned Societies. Numerous friends and pupils were present at his funeral, and addresses were delivered by M. Milne-Edwards, and other men of science. The most famous of his writings are his "Crania Ethnica" and "Études des Races Humaines."

MR. W. L. SCLATER, Deputy-Superintendent of the Indian Museum, Calcutta, has been appointed Curator of the Museum and Lecturer on Biology at Eton College.

IN a letter on "A Difficulty in Weismannism," published in NATURE on December 3, 1891 (p. 103), Prof. Hartog quoted some passages from a private letter he had received from Prof. Weismann. To this letter reference was made in a subsequent communication by Mr. A. H. Trow (p. 175). Prof. Hartog has sent us Prof. Weismann's letter, but we do not consider it necessary to print it, as the correspondence is now closed.

AN important and interesting paper on Chinese fibres appears in the new number of the *Kew Bulletin*. It seems that at Chinese ports there is much confusion as to the origin and classification of these fibres, different fibres sometimes bearing the same name, while the same product often bears different names at different ports. This confusion is apparently due in part to the fact that European traders have used the terms "jute" and "hemp" in a generic rather than a specific sense; in part to the fact that the duty on "jute" is only "2 mace per picul," whereas "hemps" pay 3½ mace. The subject has lately been carefully investigated at Kew, and further inquiry is about to be made at the Chinese ports under the direction of Sir Robert Hart, Inspector-General of the Chinese Imperial maritime Customs. At Kew much help has been derived from specimens sent by the Acting Consul at Chefoo, Mr. Alexander Hosie, a report by whom is included in the paper in the *Bulletin*. A memorandum on the jute and hemp of China, by Dr. Augustine Henry, is also given. The question is one of considerable practical importance, as the confusion which prevails cannot but tend to hinder the development of trade.

ANOTHER interesting paper in the *Kew Bulletin* is on Ipoh poison of the Malay peninsula. It consists chiefly of a valuable report by Mr. Leonard Wray, Junior, Curator of the Perak Government Museum, who has sent to Kew an admirable series of specimens. The report is printed in advance of the results of the examination of the presumed poisonous fluids, which has again been undertaken by Dr. Sidney Ringer, F.R.S., Professor of Clinical Medicine, University College, London.

DR. BROWN LESTER, who accompanied the Gambia Delimitation Commission, made a botanical collection fairly representative of the flora in the neighbourhood of the River Gambia, as far as the dryness of the season would permit. The specimens have been determined at Kew; and a list of the determinations, with Dr. Brown Lester's brief notes, is given in the *Kew Bulletin*. From a botanical point of view, the collection, according to the *Bulletin*, is not of very great interest; but it is said to afford a useful picture of the character and productions of the country traversed.

IN an appendix to the latest number of the *Kew Bulletin*, a list is given of the staffs of the Royal Gardens, Kew, and of botanical departments and establishments at home, in India, and in the colonies, in correspondence with Kew. On two former occasions a list of the same kind has been issued in the *Kew Bulletin*; and it has been found of considerable value, as it affords a convenient means for placing on record the official titles and designations of the officers concerned, and renders possible the notification of the changes that take place in the several appointments. The new list includes an enumeration of the officers that have been selected to carry out the recently-organized botanical survey of India, with the districts allotted to each one. There is also a fuller list of officers in charge of gardens in Native States. The organization of the botanical department of the Leeward Islands brings into one group the several botanical stations existing in those islands.

MM. LABORDE AND RONDEAU have given, in the *Revue Mensuelle d'Anthropologie*, an account of recent experiments on the poison of the arrows of the Sarro savages, in the Upper Niger valley. Specimens were brought back by Lieutenant Jaime. From the physiological experiments performed, it would seem that the poison is identical with that of *Strophanthus*.

SEÑOR F. P. MORENO, who has been investigating some ancient graves in the Argentine Province, Catamarca, has found various objects which are likely to be of considerable importance in the study of American archæology. He has secured 86 human skulls, 400 vases, 420 stone implements, 15 copper implements, and 110 objects made of bone. The skulls are of two different types, one set resembling those found in the graves at Ancon, Peru,

another those of Indians in Chaco and in the south of the Argentine Republic. All are brachycephalic, and many have been artificially distorted. The skulls of the Peruvian type are the later of the two groups. It is evident, however, that before the appearance of the Peruvian element in what is now Catamarca the population were in a much higher position than the Indians of the present day. They built strong fortresses, like those which are found in Arizona and New Mexico, and the traces of their dwellings indicate a comparatively advanced stage of civilization. Many of the remains remind Señor Moreno of the Mexicans, others seem to show some affinity between the people and the Chibcha, while others are of a quite peculiar character. He has given a provisional account of his results in the *Revista de la Plata*, 1890-91.

MR. JAMES F. HOBART contributes to the January number of the *Engineering Magazine*, New York, an interesting article on the paper-making industry. He notes that while in 1881 the United States produced only 5,315,400 pounds of paper, it produced in 1891 not less than 15,219,580 pounds. Even this rate of production is exceeded by Germany. Mr. Hobart, however, thinks there are indications that the United States will lead the world in the production of paper before the end of the century.

THE new number of the *Board of Trade Journal* contains some extracts from a valuable report by the French Agent at Victoria on the salmon industry in British Columbia. Among the details noted by him is the fact that the best fish are almost always taken on the outflow of the river in the place where the fishermen endeavour to meet the fish on their arrival from the sea. A boat is often filled with several hundred fish in a single drift net of from 400 to 500 metres. It is calculated that on certain days the total of the Fraser fishery amounts to not less than 150,000 salmon, which are passed through all the different phases of preserving, and are ready to be forwarded for the market on the same day. An ingenious apparatus used to take the salmon, chiefly on the Columbia River in the United States, is described. A large wheel, fixed at a certain distance from the bank, is put in motion by the current. The blades of this wheel are provided with a network of iron wire intended to raise from the water any large object coming in contact with them. A sort of bar-work starting from the wheel is so placed as to increase the strength of the current in such a manner as to force the fish passing on this side of the river to go in this direction. The salmon, wishing to cross the very rapid stream where the wheel is placed, is raised out of the water by the iron wire on the blades. In the rotary movement the salmon is carried to the centre of the wheel, whence an inclined plane conducts it into vast open reservoirs placed in the stream, where it can be kept alive for some time. A system of pulleys provides for the raising of these reservoirs, the water flows out, and the salmon is carried in boat-loads just as it is required for preparation.

THE U.S. Consul at Bordeaux gives, in a recent report, some interesting information about the wines of the Medoc district. He notes that this district, between the sea on the one hand and the Garonne and Gironde Rivers on the others, is called Medoc (*quasi medio aquæ*), because nearly surrounded by water. It is the northern termination of the extensive tract of sand-hills and marsh-land called "Les Landes," extending from Bayonne north, which changes to a bank of gravel on approaching the left bank of the Garonne, and contains some of the most precious vineyards in the world. The soil is of light pebble, and, indeed, on the spots where some of the best wine is produced it appears a mere heap of quartz mixed with the most sterile quality of earth. The best wine is not produced where the bush is most luxuriant, but on the thinner soils, where it is actually stunted, and where weeds disdain often to grow. Here the vine retains the sun's heat about its roots after sunset, so that its juices are matured as much by night as by day. The accumulation of sand and pebbles of which this soil is composed is apparently the spoils of the Pyrenean rocks, brought down by the torrents tributary to the Garonne and other great rivers, and deposited in former ages on the borders of the sea. At a depth of 2 or 3 feet from the surface occurs a bed of indurated conglomerate, which requires to be broken up before the vine will grow.

THE latest publication issued by the Meteorological Council contains the harmonic analysis of hourly observations of air temperature and pressure at British Observatories. The computations as originally undertaken were designed to supply the analysis of the hourly observations made at Greenwich Observatory which were published in 1878; but subsequently it was determined to extend the investigation so as to include the observations made at the seven Observatories maintained by the Meteorological Office for a series of twelve years. The onerous work of calculation has been considerably diminished by means of the mechanical analyzer designed by Sir William Thomson, and by special formulæ, tables, and a slide rule prepared by General R. Strachey, Chairman of the Council. A drawing of the scale, and an explanation of its application, are given in the preface to the work.

THE Meteorological Council have just issued a useful publication entitled "Ten Years' Sunshine in the British Isles, 1881-90." The observations have been taken at forty-six stations, well distributed over the country—except for Scotland and Wales. At the great majority of stations the instrument used is the Campbell-Stokes sunshine-recorder, which focusses the sun's rays, by means of a glass ball, on to a card fixed in a brass frame. The instrument records only bright sunshine, which burns the card when no mist is present, or no cirrus or other clouds obstruct the rays. The tables show that December is the most sunless month of the year. Jersey stands first on the list of stations, as it does in nearly all other months of the year, having 23 per cent. of possible duration, while Dublin has 21 per cent., and St. Ann's Head 20 per cent., and London has a miserable record of 2 per cent. A great increase is noticeable in February, when Jersey has the greatest amount, viz. 31 per cent., and London the least, 9 per cent. In April, London begins to compare more favourably with other places situated in the suburbs, and May is the sunniest month of the year, while June and July are by no means as sunny as might be expected. August is a good month, except in the north-west of Ireland and Scotland. September and October exhibit a considerable decrease, and November is the only month in which the Channel Islands are not the most sunny part of the British Isles. The sea-coast generally is more sunny than inland parts, while large manufacturing cities, such as Glasgow, compare badly with stations in their neighbourhood. In the late autumn, Ireland generally receives more sunshine than the most of England.

IT is useful, in relation to meteorology, to note the date of commencement of various harvest operations. A French Abbé, M. Buvé, has recently suggested a consideration of the quantity of sugar produced in certain plants as a means of determining the meteorological elements concerned in this process. The physiology of the sugar beet is now pretty well known; and, according to M. Marié Davy, one may estimate pretty closely the yield of this plant by means of calculations from the heat and illumination to which it has been subject. Conversely, the Abbé points out, we might determine the heat and light received, through the quantity of sugar produced. Fiscal operations, determining the yield of sugar, would facilitate the process. Again, it is suggested that the yield of honey might be considered in the same relation—the quantity of it in flowers depending greatly on sunshine, wind, rain, &c., while the state of the

atmosphere favours or hinders the work of bees. The summers of 1889 and 1890 are cited as presenting a marked contrast with regard to both beet-sugar and honey, in correspondence with weather-conditions; the earlier year was a highly prosperous one, the latter quite the opposite.

IN the Report, just issued, of the U.S. Commission of Fish and Fisheries, on the fisheries of the great American lakes in 1885, it is noted that in Lake Michigan there is no fishing through the ice in the southern end of the lake, but that in the northern end, especially in Green Bay and along the north shore, this fishery is extensive. For twenty years it has given employment to a very large number of men living in the neighbourhood of Green Bay, and many fishermen from other localities have found work there during the winter months. During the winter season the bay used to present greater activity than the surrounding land, hundreds of shanties and temporary huts being built for shelter. Dealers drove about from place to place on the ice to purchase the catch, and merchants sent waggons with provisions for the fishermen. At the height of the season it was not uncommon for the fishermen to bring their families out to the fishing quarters, where they would remain for some weeks, all hands helping to keep the nets in repair. For several years this fishery, owing to the diminished quantity of white-fish, has been less extensive, and the fishermen engaged in it at present generally live at home, owning a horse and sleigh, which enable them to visit their nets daily.

AT a recent meeting of the Field Naturalists' Club of Victoria, Baron von Mueller advocated strongly the protection of insectivorous and native birds in the colony. He thought that this object might be attained, not only by putting a comparatively heavy tax upon guns and by more strictly enforcing the present laws, but by the initiation of some scheme which would enlist the sympathy and co-operation of all persons interested in the subject. He suggested that a distinctive badge might be worn by members if such a union were ever formed.

THE Académie Royale des Sciences, des Lettres, et des Beaux Arts de Belgique has issued its *Annuaire* for 1892. It contains, besides much information as to the organization and activity of the Academy, biographical sketches of deceased members, with remarkably good portraits.

AN interesting memoir is contributed by Dr. Merz, of Zurich, to the current number of the *Berichte*, concerning the compound of nitrogen and magnesium, generally known as magnesium nitride, Mg_3N_2. Magnesium, like boron, appears to possess a somewhat powerful affinity for nitrogen. Some years ago Deville and Caron, during their distillations of magnesium for the purpose of obtaining the pure metal, observed the presence of small transpar ent crystals, containing only magnesium and nitrogen, upon the surface of the distilled metal. More recently, Briegleb and Geuther have shown that nitride of magnesium in an amorphous form may be prepared by heating magnesium filings in a porcelain boat placed within a porcelain tube traversed by a stream of nitrogen. Dr. Merz now describes two extremely simple methods of obtaining the nitride, suitable for lecture demonstration, and also some further properties of this interesting substance. A quantity of finely-powdered and carefully dried magnesium, about two grams in weight, is placed in a wide piece of combustion tubing about twenty centimetres long, closed at one end. Attached to the open end of this tube by means of a wide caoutchouc connection is a narrower tube closed by a caoutchouc stopper, through which passes the nitrogen delivery tube. A short side-tube blown upon the narrower tube carrying the stopper serves for the exit of the gas, and is connected by narrow caoutchouc tubing with a long vertical tube bent round parallel to itself, the open end of which dips beneath the surface of some coloured water. The air is first displaced from the whole apparatus by means of pure dry nitrogen, and when this is accomplished, the combustion tube containing the magnesium, laid nearly horizontally, is heated by means of a triple Bunsen burner. After two or three minutes have elapsed from the attainment of a red heat, the speed of the current of nitrogen may be slackened by means of a screw clip placed somewhere in its path, when the coloured water will rapidly rise in the vertical tube, attaining a height of ten feet, if the tube is so long, in a couple of minutes, thus exhibiting in a graphic manner the rapid absorption of the nitrogen by the magnesium. On allowing the experiment to proceed for upwards of an hour, almost the whole of the magnesium is converted to nitride, the small remainder reacting with the glass, and producing a black mirror of silicon. Magnesium nitride obtained by this method is a light, voluminous, friable, and yellowish-gray-coloured substance when cold, but reddish-brown while hot. When exposed to the air, it smells strongly of ammonia, owing to its decomposition by the moisture present. When a little water is poured upon it, great rise of temperature occurs, together with hissing, increase in volume, and evolution of steam, just as when quicklime is slaked. Ammonia is also evolved in large quantities, and white magnesium hydrate remains. The decomposition by means of water is most effective when performed at the bottom of a large flask, which rapidly becomes filled with ammonia gas; the moment a little hydrochloric acid is introduced upon a feather or other convenient carrier, the flask becomes filled with dense fumes of ammonium chloride. Dr. Merz further shows that the nitride may likewise be obtained by heating magnesium in a current of dry ammonia to a temperature considerably lower than that which is required in the case of free nitrogen, and very much lower than that employed by Briegleb and Geuther in some similar experiments made by them. As soon as this temperature is attained, a brilliant incandescence occurs, and the flame may be removed; hydrogen is evolved in a rapid stream, and 95 per cent. of the magnesium is converted in three or four minutes to nitride.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus* ♂), a Sooty Mangabey (*Cercocebus fuliginosus* ♀) from West Africa, presented by Canon Taylor Smith; a Moustache Monkey (*Cercopithecus cephus* ♂) from West Africa, presented by Mr. Alfred Lloyd; a Silver-backed Fox (*Canis chama*) from Damaraland, South Africa, presented by Mr. E. Aubrey Hart; two Virginian Opossums (*Didelphys virginiana*) from North America, presented by Mr. John Brinsmead, F.Z.S.; a Common Jay (*Garrulus glandarius*), British, presented by Mr. Charles Faulkner; a Great Titmouse (*Parus major*), a Coal Titmouse (*Parus ater*), a Blue Titmouse (*Parus cæruleus*), British, presented by Captain Salvin; a Bonham's Partridge (*Ammoperdix bonhami*) from Western Asia, deposited; a Bronze-winged Pigeon (*Phaps chalcoptera* ♀) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

MOTION OF STARS IN THE LINE OF SIGHT.—Prof. H. C. Vogel, in *Monthly Notices R.A.S.* for December 1891, fully describes the method used at Potsdam for determining the velocity of stars in the line of sight, and states the chief results that have been obtained since the work was begun in 1887. In order to insure great stability with the smallest possible weight, the frame of the spectroscope is made of cast steel. The camera is also constructed of steel, and the dark slides are of brass. It may be worth remarking, however, in this connection, that stability would have been secured if aluminium had been used instead of steel and brass, and this with a little more than one-third the weight. A spectroscope similar to Prof. Vogel's, but

with an aluminium frame, has been made for the Observatory at Kensington, and gives every satisfaction. The comparison spectrum used at Potsdam has been furnished by a Geissler tube placed directly in the cone of rays of the refractor, at a distance of 40 cm. from the slit, the tube being at right angles to the optical axis of the refractor and the slit. The slit is set parallel to the line of the diurnal motion, and width is given to the spectrum by making the driving-clock move slightly slower or faster than its proper rate. A uniform exposure of one hour has been employed, the proper intensity being obtained by changing the rate of the driving-clock, so that the error increases with increase of brightness. The photographs are measured with the aid of a microscope having a sliding apparatus on its table, movable by a fine micrometer screw. One revolution of the screw corresponds to a difference of wave-length of 0·324 $\mu\mu$, which, expressed in miles per second, is 139·13. After describing the methods of measuring the displacement of lines in stars of different types of spectra, Prof. Vogel brings together the results which have formed the subject of several previous communications. It is said that the probable error in the determination of the radial velocity of a star of Class II. is ± 1·34 miles per second, and for stars of Class I., ± 2·31 miles. Measurements have been made independently by Prof. Vogel and Dr. Scheiner, and each star has been observed on the average 3·3 times, wherefore it is concluded "that the probable error of the definitive values for both spectral classes will amount to less than one mile." A list of the observed velocities of forty-seven stars will soon be published. The mean motion in the line of sight is 10·6 English miles per second; six stars have a velocity less than 2 miles per second, and five greater than 20 miles. α Tauri heads the list with a velocity of about + 36 miles per second. Fifteen of the stars have a positive, and thirty-two a negative motion.

ORTHOCHROMATIC PLATES FOR ASTRONOMICAL PHOTOGRAPHY.—MM. Fabre and Andoyer photographed the eclipsed moon at Toulouse Observatory on November 13, 1891; and some of the pictures obtained were exhibited by them at the meeting of the Paris Academy of January 11, with a note on the method of production. Collodion-bromide and collodion-chloride plates were employed, both kinds being treated with eosin and cyanin to render them orthochromatic. The former kind of plate was found to be relatively more sensitive to red and yellow rays than the latter, although both were stained with the same dyes. It is proposed, therefore, to use collodion-bromide orthochromatic plates to obtain photographs of Mars, Jupiter and the red spot, and coloured stars.

DREDGING OPERATIONS IN THE EASTERN PACIFIC.

THE *Bulletin* of the Museum of Comparative Zoology at Harvard College, published in June, contains three letters from Prof. Alexander Agassiz to the Hon. Marshall McDonald, United States Commissioner of Fish and Fisheries, on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California. The operations, which were in charge of Prof. Agassiz, were carried on by the U.S. Fish Commission steamer *Albatross*, Lieutenant Commander Z. L. Tanner, U.S.N., commanding.

I.

Steamer "Albatross," Panama, U.S. of Colombia, March 14, 1891.

MY DEAR COLONEL MCDONALD,—We returned yesterday from our first trip. The route extended from Panama to Point Mala, and next to Cocos Island; from there we ran in a southerly direction, then north-westerly to Malpelo Island, and back to the hundred-fathom line off the Bay of Panama. We spent several days trawling off the continental plateau of the Bay. This trip being rather in the nature of a feeler, I cannot tell you just what I think it means. But I believe I can to some extent conjecture probabilities from what has been accomplished.

I have found, in the first place, a great many of my old West Indian friends. In nearly all the groups of marine forms among the Fishes, Crustacea, Worms, Mollusks, Echinoderms, and Polyps, we have found familiar West Indian types or east coast forms, and have also found quite a number of forms whose wide geographical distribution was already known, and is now extended to the Eastern Pacific. This was naturally to be expected from the fact that the district we are exploring is practically a new field, nothing having been done except what the *Albatross* herself has accomplished along the west coast of North and South America. The *Challenger*, as you will remember, came from Japan to the Sandwich Islands, and from there south across to Juan Fernandez, leaving, as it were, a huge field, of which we are attacking the middle wedge. As far as we have gone, it seems very evident that, even in deep water, there is on this west coast of Central America a considerable fauna which finds its parallel in the West Indies, and recalls the pre-Cretaceous times when the Caribbean Sea was practically a bay of the Pacific. There are, indeed, a number of genera in the deep water, and to some extent also in the shallower depths, which show far greater affinity with the Pacific than with the Atlantic fauna. Of course, further exploration may show that some of these genera are simply genera of a wider geographical distribution; but I think a sufficiently large portion of the deep-sea fauna will still attest the former connection of the Pacific and the Atlantic.

I am thus far somewhat disappointed in the richness of the deep sea fauna in the Panamic district. It certainly does not compare with that of the West Indian or Eastern United States side. I have little doubt that this comparative poverty is due to the absence of a great oceanic current like the Gulf Stream, bringing with it on its surface a large amount of food which serves to supply the deep-sea fauna along its course. In the regions we have explored up to this time, currents from the north and from the south meet, and then are diverted to a westerly direction, forming a sort of current doldrums, turning west or east or south or north according to the direction of the prevailing wind. The amount of food which these currents carry is small compared with that drifting along the course of the Gulf Stream. I was also greatly surprised at the poverty of the surface fauna. Except on one occasion, when, during a calm, we passed through a large field of floating surface material, we usually encountered very little. It is composed mainly of Salpæ, Doliolum, Sagittas, and a few Siphonophores—a striking contrast to the wealth of the surface fauna to be met with in a calm day in the Gulf of Mexico, near the Tortugas, or in the main current of the Gulf Stream as it sweeps by the Florida Reef or the Cuban coast near Havana. We also found great difficulty in trawling, owing to the considerable irregularities of the bottom. When trawling from north to south, we seemed to cut across submarine ridges, and it was only while trawling from east to west that we generally maintained a fairly uniform depth. During the first cruise we made nearly fifty hauls of the trawl, and, in addition, several stations were occupied in trawling at intermediate depths. In my dredgings in the Gulf of Mexico, off the West Indies, and in the Caribbean, my attention had already been called to the immense amount of vegetable matter dredged up from a depth of over 1500 fathoms, on the lee side of the West Indian Islands. But in none of the dredgings we made on the Atlantic side of the Isthmus did we come upon such masses of decomposed vegetable matter as we found on this expedition. There was hardly a haul taken which did not supply a large quantity of water-logged wood, and more or less fresh twigs, leaves, seeds, and fruits, in all possible stages of decomposition. This was especially noteworthy in the line from the mainland to Cocos Island, and certainly offers a very practical object-lesson regarding the manner in which that island must have received its vegetable products. It is only about 275 miles from the mainland, and its flora, so similar to that of the adjacent coast, tells its own story. Malpelo, on the contrary, which is an inaccessible rock with vertical sides, and destitute of any soil formed from the disintegration of the rocks, has remained comparatively barren, in spite of its closer proximity to the mainland.

The most interesting things we have found up to this time are representatives of the Ceratias group of Fishes, which the naturalists of the *Albatross* tell me they have not met before on the west coast of North America. The Crustacea have supplied us with a most remarkable type of the Willemoesia group. The paucity of Mollusks, and also of Echini, is most striking, although we brought up in one of the hauls numerous fragments of what must have been a gigantic species of Cystechinus, which I hope I may reconstruct. We were also fortunate enough to find a single specimen of Calamocrinus off Morro Puercos, in 700 fathoms, a part of the stem with the base,

showing its mode of attachment to be similar to that of the fossil Apiocrinidæ. The number of Ophiurans was remarkably small as compared with the fauna of deep waters on the Atlantic side, where it often seems as if Ophiurans had been the first and only objects created. The absence of deep-sea corals is also quite striking. They play so important a part in the fauna of the deeper waters of the West Indies, that the contrast is most marked. Gorgoniæ and other Halcyonoids are likewise uncommon. We have found but few Siliceous Sponges, and all of well-known types. Star-fishes are abundant, and are as well represented in the variety of genera and species as on the Atlantic side of the Isthmus. I may also mention the large number of deep-sea Holothurians (Elasipoda) which we obtained, as well as a most remarkable deep-sea Actinian, closely allied to Cerianthus, but evidently belonging to a new family of that group. We found the usual types of deep-sea West Indian Annelids, occasionally sweeping over large tracts of mud tubes in the region of green mud. Although we dredged frequently in most characteristic Globigerina ooze, I was much struck with the absence of living Globigerinæ on the surface. Only on two occasions during a calm did we come across any number of surface Globigerinæ and Orbulinæ. On one occasion the trawl came up literally filled with masses of a species of Rhabdamina closely allied to *R. lineata*. Thus far, no pelagic Algæ have been met with.

It is interesting to note that at two localities we came across patches of modern greensand similar in formation to the patches discovered off the east coast of the United States by the earlier dredgings of the Coast Survey, of Pourtalès, and of the *Blake*. Having always been more or less interested in pelagic faunæ, and having paid considerable attention to its vertical distribution during my earlier cruises in the *Blake*, I was naturally anxious to reconcile the conflicting statements and experiences of the naturalists of the *Challenger* and *Gazelle* on one side, and my own observations on the other. Both Murray and Studer contended that, in addition to the deep-sea and pelagic faunæ, there was what might be called an intermediate fauna, with characteristic species, having nothing in common with the other two; while I maintained, on the other hand, from my experiments in the *Blake*, that there was no such intermediate fauna, but that the pelagic fauna might descend to a considerable depth during the daytime to escape the effects of light, heat, and the disturbing influence of surface winds, and that this surface fauna on the Atlantic side—off shore in deep water—did not descend much deeper than 150 to 200 fathoms. In order to test this point, Dr. Chun, under the auspices of the Naples Station, made an expedition to the Ponza Islands. Dr. Chun applied to a tow-net an apparatus for closing it, similar to the propeller in use on our thermometer and water-cups. He towed to a depth of 1400 metres, if I am not mistaken, but never at any great distance from the mainland or from the islands of the Gulf of Naples, and came to the conclusion that the pelagic fauna existed all the way to the bottom. At the time, I considered his experiments inconclusive, and was, of course, anxious to repeat them in a strictly oceanic district, in great depths, and at a considerable distance from shore. I had an apparatus constructed by Ballauf, of Washington, similar to that used by Dr. Chun. Unfortunately, in testing it we found the pressure of the tow-net against the propeller shaft so great as to make the machine useless, or, at any rate, most unreliable. Thanks to the ingenuity of Captain Tanner, we overcame these obstacles. He devised a net which could be closed at any depth by a messenger, and which worked to perfection at 200, 400, 300, and 1000 fathoms, and had the great advantage of bringing up anything it might find on its way up above the level at which it was towed. The lower part of the bag alone was closed by a double set of slings pulled by two weights liberated from a bell crank by a messenger. We found that, in towing the net at 200 fathoms for twenty minutes, we got everything in any way characteristic of the surface fauna which we had fished up with the tow-net at the surface. In addition to this, we brought up five species of so-called deep-sea Fishes, Scopelus, Gonostoma, Beryx, and two others, which had thus far been brought up in the trawl, and considered characteristic of deep water. Also a peculiar Amphipod, and the young of the new species of Willemoesia mentioned above. We then tried the same net at 300 and 400 fathoms, and in neither case did we bring up anything in the closed part of the bag, while the upper open part brought up just what we had found previously at a depth of 200 fathoms, plainly showing that in this district the surface fauna goes down to a depth of 200 fathoms, and no farther. Next came our single attempt to bring up what might be found, say within 100 fathoms of the bottom, and Captain Tanner's net was towed at a depth of 1000 fathoms where the soundings recorded 1100. Unfortunately, we deepened our water while towing only twenty minutes to over 1400 fathoms, so that we failed in our exact object. But we brought up in the closed part of the bag two species of Crustacea, a Macruran and an Amphipod, both entirely unlike anything we had obtained before. I hope in the next cruise to follow this up, and determine also the upper limits of the free-swimming deep-sea fauna. In the upper part of the bag (the open part) we brought up a couple of so-called deep-sea Medusæ, which must have been collected at a comparatively moderate depth, judging from their perfect state of preservation.

I can hardly express my satisfaction at having the opportunity to carry on this deep-sea work on the *Albatross*. While of course I knew in a general way the great facilities the ship afforded, I did not fully realize the capacity of the equipment until I came to make use of it myself. I could not but contrast the luxurious and thoroughly convenient appointments of the *Albatross* with my previous experiences. The laboratory, with its ingenious arrangements and its excellent accommodations for work by day and by night, was to me a revelation. The assistance of Messrs. Townsend and Miller in the care of the specimens was most welcome, giving me ample time to examine the specimens during the process of assorting them, and to make such notes as I could between successive hauls, while paying some attention also to the work of the artist, Mr. Westergren. He has found his time fully occupied, and we have in this trip brought together a considerable number of coloured drawings, giving an excellent general idea of the appearance of the inhabitants of the deep waters as they first come up. These drawings can be used to great advantage with the specimens in making the final illustrations to accompany the reports of the specialists who may have charge of working up the different departments. . . .

We left Panama on February 22, and returned to Panama after an absence of twenty days.

II.

"*Albatross*," *Acapulco, April* 14, 1891.

We have reached the end of our second line of explorations. After coaling we left Panama, and reached Galera Point, where we began our line across the Humboldt Current, which was to give us a fair idea of the fauna of that part of the coast as far as the southern face of the Galapagos. With the exception of three good casts, the trawling on that part of the sea bottom proved comparatively poor, nor did the sea face of the southern slope of the Galapagos give us anything like the rich fauna I had expected. Theoretically, it seemed certain that a sea face like that of the Galapagos, bathed as it is by a great current coming from the south and impinging upon its slope, and carrying upon its surface a mass of animal food, could not fail to constitute a most favourable set of conditions for the subsistence and development of a rich deep-sea fauna.

In the deeper parts of the channel between Galera Point and the southern face of Chatham Island, we found a great number of Elasipoda, among them several genera like Peniagone, Bathodytes, and Euphrosyne, represented by numerous species. The Star-fishes of this, our second cruise, did not differ materially from those collected during our first trip, but we added some fine species of Freyella, Hymenaster, Astrogonium, Asterina, and Archasteridæ to our collections. Among the Sea-urchins on two occasions we brought up fine hauls of a species of Cystechinus with a hard test, many specimens of which were in admirable state of preservation. Among the Ophiurans nothing of importance was added, unless I may except a lot of Ophiocreas attached to a Primnoa, and a pretty species of Sigsbea attached to a species of Allopora, from the south side of Chatham Island.

The Gorgonians were remarkably few in number, which is undoubtedly due to the unfavourable nature of the bottom we worked upon. Nearly everywhere except on the face of the Galapagos slope we trawled upon a bottom either muddy or composed of Globigerina ooze, more or less contaminated with terrestrial deposits, and frequently covered with a great amount of decayed vegetable matter. We scarcely made a single haul of the trawl which did not bring up a considerable amount of decayed vegetable matter, and frequently logs, branches, twigs, seeds, leaves, fruits, much as during our first cruise.

Our Crustaceans, from the nature of the bottom, naturally consisted of the same groups of deep-sea types which we obtained before. I may, however, mention a haul containing a goodly number of Nephrops, a genus we had not previously obtained.

Among the Worms the Maldaniæ and Limicolous types were unusually abundant at some localities, the empty mud tubes often filling the bottom of the trawl. Some very large specimens of Trophonia were collected, and remarkably brilliantly coloured (orange and carmine) Nemerteans and Planarians.

The Mollusks were very scanty, and the absence of Comatulæ or other Crinoids was equally disappointing, even when trawling on the extension of the line started three years ago by the *Albatross*, on the eastern face of the Galapagos slope, when on her way from Chatham Island to San Francisco. We took up this line off Indefatigable Island, hoping to obtain from that quarter our best results, but our hauls were very disappointing. The ground proved not only most difficult to dredge upon, but also comparatively barren, and it was not till we got into the oceanic basin again, between the Galapagos and Acapulco, that our catches improved. But even then they were not to be compared with the hauls at similar depths in the Atlantic off the West Indies, or along the course of the Gulf Stream.

Among the Fishes, our most important catches were fine specimens of Bathyonus, of Bathybrissa, of Bathypteroides, and a few specimens of Ipnops in excellent condition.

From the nature of the bottom we naturally expected rich hauls of Siliceous Sponges, but we did not find many, and I do not think there were many novelties among those we have collected. On two occasions, a number of specimens of Ascidians were brought up; among them was a fine white translucent Corinascidia.

Among the Bryozoans, the most noteworthy haul was a number of beautiful specimens of the delicate Naresia, in excellent condition. On the line from the Galapagos to Acapulco we brought up a good many Foraminifera from the mud bottoms. On several occasions the bottom must have been covered with huge masses of a new type of an arenaceous Foraminifer, forming immense curling sheets attached by one edge to stones or sunk into the mud. This Foraminifer seems to increase in size by forming irregular more or less concentric crescent-shaped rings. When it comes to the surface, it is of a dark olive-green colour.

During this second cruise we continued our experiments with the Tanner closing tow-net, in order to determine the lower limits of the surface pelagic fauna, and to determine also if there is any so-called intermediate pelagic fauna at other depths, or within a short distance from the bottom.

On March 25, at a point not quite half-way between Cape San Francisco and the Galapagos, in 1832 fathoms of water, the Tanner net was sent down to tow at a depth which varied from 1739 to 1773 fathoms. The net was towed within these limits for a period of something over twenty minutes. The messenger was then sent down to close the net; time occupied seven minutes. The net was then drawn up to the surface. The lower part of it was found to have closed perfectly, and contained nothing beyond a few fragments of leaves. The lower bag was carefully washed in water which had been strained, and the water examined with all possible care, and sifted again. It contained nothing. The upper part of the net, however, which had remained open on its way up, was found to contain the identical surface things which on former occasions we had found in the Tanner net down to a depth of 200 fathoms. They were a small species of Sagitta, and species of Doliolum, Appendicularia, a huge Sagitta, a large number of Leucifer and Sergestes, and several species of Schizopods and Copepods; two species of Hyperia, probably parasitic on a Salpa, which was also quite abundant; several finely coloured Calanus, some Isopods, and a number of fragments of what must have been a very large Beroe, measuring from five to six inches in diameter; Leptocephalus, several specimens of Stomias, of Scopelus, of Melamphæs, and other species, many of which, like some of the Schizopods, had been considered as typical deep-sea forms. Among the so-called deep-sea Medusæ, several specimens of Atolla and Periphylla were also found in the open part of the net. I may mention also as of special interest a huge Ostracod, allied to Crossophorus, with a thin semi-transparent carapace, and measuring somewhat more than one inch in length. The largest Ostracod previously known is not more than one-third of an inch long. On two other occasions this same Ostracod was brought up in the tow-net from a depth of less than 200 fathoms.

The surface at this point was also examined with the tow-net, and the pelagic animals found to be the same as those brought up in the open part of the tow-net on its way from the bottom. The number both of species and specimens was, however, much less than in the Tanner net. On the following day the Tanner tow-net was sent to be towed at a depth of 214 fathoms. In twenty minutes the messenger was sent down and the net hauled up. The bottom part of the net came up tightly closed. Its contents were examined in the same manner as before in well sifted water, and the water was found to be absolutely barren, while the upper part of the net, which came up open, and was not more than eight or nine minutes on the way, was well filled with surface life. The net contained this time a number of Hyalæas and Criseis, in addition to the things collected the day before. An examination of the surface fauna at this same point with the tow-net showed the presence only in smaller numbers of the same species which the open part of the same net contained, except that there were a larger number of bells and fragments of Diphyes and of Cristalloides than in the Tanner net. The point at which this experiment was made was about 250 miles from the Galapagos, and about the same distance from Cape San Francisco. There were myriads of Nautilograpsus swarming on the surface of the water; they literally filled the surface tow-net. On two other occasions, once at a distance of 350 miles in a south-easterly direction from Acapulco (depth 2232 fathoms), we tried the same experiment with the Tanner net, and invariably with the same result. The net was towed at a depth of 100, of 200, and of 300 fathoms, each time for twenty minutes, the messenger sent down, and the bottom part closed. At the depth of 100 fathoms, the closed part of the net contained practically the same things as the open part of the net; at 200 fathoms, the lower part of the net contained but few specimens of the surface life; and at 300 fathoms, the closed bottom net came up empty.

On the following day the surface was carefully examined, and the tow-net sent to 175 fathoms, where it was towed for twenty minutes, and the messenger sent down to close it. The lower net came up well filled with the surface pelagic species, which on this day were unusually varied, it having been smooth and calm the previous night, and the morning before the towing was made. This haul was made in the evening, at 8 p.m. The previous hauls had been made at about 10 a.m., in a brilliant sunlight. Again, on April 11, about thirty miles south-east of Acapulco, in a depth of over 1800 fathoms, the Tanner net was sent to a depth of 300 fathoms, and the messenger sent down to close it. There was nothing in the lower part of the net which had been closed, while the open part contained an unusually rich assortment of surface species, and among them a large number of Scopelus, of Schizopods, and of Rhizopods, mainly Collozoun and Acanthometra.

These experiments seem to prove conclusively that in the open sea, even when close to the land, the surface pelagic fauna does not descend beyond a depth of 200 fathoms, and that there is no intermediate pelagic fauna living between that depth and the bottom, and that even the free-swimming bottom species do not rise to any great distance, as we found no trace of anything within 60 fathoms from the bottom, where it had been fairly populated.

The experiments of Chun regarding the distribution of the pelagic fauna have all been made in the Mediterranean, within a comparatively short distance from the shore, and in a closed basin showing, as is well known, special physical conditions, its temperature to its greatest depths being considerably higher than the temperature of oceanic basins at the limit of 200 fathoms, or thereabout, which we assume now to be the limit of the bathymetrical range of the true oceanic pelagic fauna. At 200 fathoms our temperature was from 49° to 53°, while, as is well known, the temperature of the Mediterranean soon falls at 100 fathoms even to about 56°, a temperature which is continued to the bottom in this closed basin. Of course, if temperature is one of the factors affecting bathymetrical distribution, there is no reason except the absence of light which would prevent the surface pelagic fauna from finding conditions of temperature at the greatest depth similar to those which the surface fauna finds within the limit of 200 fathoms in an open oceanic basin.

Arriving as we did at the Galapagos at the beginning of a remarkably early rainy season, I could not help contrasting the green appearance of the slopes of the islands, covered as they were by a comparatively thick growth of bushes, shrubs, and

trees, to the description given of them by Darwin, who represents them in the height of the dry season as the supreme expression of desolation and barrenness. Of course, here and there were extensive tracts on the sea-shore where there was nothing to be seen but blocks of volcanic ashes, with an occasional cactus standing in bold relief, or a series of mud volcanoes, or a huge black field of volcanic rocks, an ancient flow from some crater to the sea; but as a rule the larger islands presented wide areas of rich fertile soil, suitable for cultivation. The experiments at Charles Island, where there is a deserted plantation, and at Chatham Island, where Mr. Cobos has under successful cultivation a large plantation producing sugar, coffee, and all the tropical fruits, as well as extensive tracts on which his herds of cattle, sheep, and donkeys roam towards the higher central parts of the island, show the fertility of these islands. They are indeed as favourably situated for cultivation as the Sandwich Islands or Mauritius, and there is no reason why, if properly managed, they should not in the near future yield to their owners as large returns as do those islands.

I obtained from Mr. Cobos a piece of the so-called sandstone, said to occur on Indefatigable Island, and which of course I was most anxious to see, as the occurrence of true sandstone would have put quite a different face on the geological history of the Galapagos from the one usually received. This I found to be nothing but coral rock limestone, either a breccia, or slightly oolitic, identical with the formation found back of the beach at Wreck Bay on Chatham Island. I found there an old coral rock beach, extending on the flat behind the present beach, composed entirely of fragments of corals, of mollusks, and other invertebrates, cemented together into a moderately compact oolitic limestone, which when discoloured, as it often is, and turned gray, would readily be mistaken for sandstone. This coral rock is covered by just such a thin, ringing coating of limestone as characterizes the modern reef rock of other localities. On nearly all the islands there are a number of sandy beaches made up of decomposed fragments of corals and other invertebrates, and cemented together at or beyond high-water mark into the modern reef rock I have described. The coral is mainly made up of fragments of Pocillopora, which is found covering more or less extensive patches off these coral sand beaches, but which, as is well known, never forms true coral reef in the Panamic district. The only true coral reef belonging to this district is that of Clipperton Island (if we can trust the Admiralty charts), situated about 700 miles to the south-west of Acapulco. But neither at Cocos Island, nor at the Galapagos, nor anywhere in the Panamic district, do we find true coral reefs—nothing but isolated patches of reef-building coral. The absence of coral reefs in this district has of course already been noted by other naturalists, who have been struck by this feature in an equatorial region. Dana has ascribed it to the lower temperature of the water due to the action of the Humboldt current coming from the south, pouring into the Bay of Panama, and then flowing westward with the colder northerly current coming down the west coast of Mexico and Central America. From the investigations made this year by the *Albatross*, I am more inclined to assume that the true cause of the absence of coral reefs on the west coast of Central America is due to the immense amount of silt which is brought down the hill and mountain sides every rainy season, and which simply covers the floor of the ocean to a very considerable distance from the land, the land deposits being found by us even on the line from the Galapagos to Acapulco at the most distant point from the shore to the side or extremities. The mud in Panama Bay to the hundred-fathom line is something extraordinary, and its influence on the growth of coral reefs is undoubtedly greatly increased from the large amount of decomposed vegetable matter which is mixed with the terrigenous deposits.

The course of the currents along the Mexican and the Central and South American coasts clearly indicates to us the sources from which the fauna and flora of the volcanic group of the Galapagos has derived its origin. The distance from the coast of Ecuador (Galera Point and Cape San Francisco) is in a direct line not much over 500 miles, and that from the Costa Rica coast but a little over 600 miles, and the bottom must be for its whole distance strewn thickly with vegetable matter. The force of the currents is very great, sometimes as much as 75 miles a day, so that seeds, fruits, masses of vegetation harbouring small reptiles, or even large ones, as well as other terrestrial animals, need not be afloat long before they might safely be landed on the shores of the Galapagos. Its flora, as is well known, is eminently American, while its fauna at every point discloses its affinity to the Mexican, Central or South American, and even West Indian types, from which it has probably originated; the last indicating, as well as so many of the marine types collected during this expedition, the close connection that once existed between the Panamic region and the Caribbean and Gulf of Mexico.

I have already referred to the physiognomy of the deep-sea fauna, showing relationship on the one side to Atlantic and West Indian types, and on the other to the extension of the Pacific types, which mix with the strictly deep-sea Panamic ones. The western and eastern Pacific fauna, while as a whole presenting very marked features in common, yet also present striking differences. The vast extent of territory over which some of the marine types extend, through all the tropical part of the Pacific, may readily be explained from the course of the great western equatorial current and the eastern counter current, which cannot fail to act as general distributors in space for the extension of a vast number of marine Vertebrates and Invertebrates.

Mr. Townsend made quite a large collection of birds from Chatham and Charles Islands, considering the short time we were there.

As soon as we have reached Guaymas, I shall be able to give you a better *résumé* of the character of the deep-sea fauna of the Panamic region, and of its relationship on the one side to the Pacific fauna and on the other to the West Indian region.

III.

Guaymas, April 25, 1891.

We left Acapulco on April 15 for our third cruise into the Gulf of California, and steamed as far as Cape Corrientes without attempting to do any trawling. The character of the bottom, as indicated on the charts, promised nothing different from what we had dredged off Acapulco, and on the line from there to the Galapagos Islands. We made one haul off Cape Corrientes, bringing up nothing but mud and decomposed vegetable matter. This induced us to keep up the Gulf of California till we were off the Tres Marias. We there made several hauls, and obtained some Umbellulæ, Pennatulæ, Trochoptilum, Anthoptilum, and a fine Antipathes, a few Comatulæ, a large Astropecten, some fine specimens of Urechinus and of Schizaster, a few Holothurians, Lophothuria, Trochostoma, and two species of Elasipoda, besides a few fragments of Gasteropods, with an empty shell of Argonauta.

Among the Crustacea there came up the usual types found living upon muddy bottom, such as Glyphocrangon, Heterocarpus, Notostoma, Pentacheles, Nematocarcinus, Nephrops, together with species of Lithodes and of Munida. The usual types of Limicolous Annelid also were found here, Halinæcia, Terebella, Maldania, and the like, a few Ophiurans, Ophiopholis, and Ophiocantha, a few fragments of Farrea, and a huge Hyalonema of the type of *H. toxeres*. Among the Fishes there were a few Macrurans, Bathypteroides, Lycodes, and Malthe. The trawl was usually well filled with mud, and with the mud came up the usual supply of logs, branches, twigs, and decayed vegetable matter.

On going farther north into the Gulf of California, the nature of the bottom did not change materially, and we found the trawling most difficult from the weight of the mud brought up in the trawl. But occasionally a haul was made which more than repaid us for the time spent on the less productive ones. Two of the hauls are specially worthy of mention, as being characteristic of the deep-water fauna of the Gulf of California, one made in 995 fathoms, and the other in 1588 fathoms. We obtained in these hauls a number of Ophiomusium and Ophiocreas, some fine specimens of Schizaster, a new genus allied to Palæopneustes, and also the same species of Cystechinus, with a hard test, and of Phormosoma, which we had obtained before on the line from the Galapagos to Acapulco. Beside these there came up a number of specimens of an interesting species of Pourtalesia, most closely allied to *Pourtalesia miranda*, the first type of the group dredged in the Florida Channel by Count Pourtalès.

The deeper haul was specially rich in Holothurians, among them a fine large white Cucumaria, some specimens of Trochostoma, several species of Bathodytes, some of them remarkable for their white colour, their huge size, and comparatively small

number of ventral tentacles. With these were numerous specimens of an interesting species of Euphronides. In this haul I was specially struck with the Elasipoda, and the great variety in the consistency of the skin in individuals of one and the same species; it varied in different individuals from extreme tenuity to a comparatively tough gelatine-like consistency. On carefully sifting the mud, we found a number of interesting Foraminifera, and of delicate and minute Gasteropods and Lamellibranchs, fragments of the shell of an Argonauta, and two species of a huge ribbed Dentalium. Among the Star-fishes were specially noticeable a large Brisinga, a long-armed Cribrella, and several species of Astropecten. The usual types of Worms were found in the mud at these greater depths. In addition to a number of Macruroids, we obtained a pink Amphionus, a large black Beryx-like fish, a fine Nettastoma, and a couple of species of Lycodes. The usual surface species of Stomias and of Scopelus also came up in the trawl. Among the Crustaceans were a fine lot of Arcturus, of Colossendeis, of Glyphocrangon, and of a Caridid with a deep blue patch on the base of the carapace, making the strongest possible contrast to the dark crimson colouring of the rest of the body. Blue is a very unusual colour in the deep-sea types, although the large eggs of some of the deep-sea Macrurans are often of a light blue tint.

We brought up in the trawl at various times, and subsequently also in the Tanner net, from depths of less than 200 fathoms, the same gigantic Ostracod which I mentioned in one of my previous letters, several specimens of Atolla, and fragments of a huge Periphylla, which must have been at least 15 inches in diameter. Also a most interesting new type of Bougainvillia, remarkable for having eight clusters of marginal tentacles, but only four chymiferous tubes.

We continued our experiments with the Tanner tow-net. On April 16, about 120 miles from Acapulco, we sent the net to tow at a depth of 175 fathoms, and after towing for about twenty minutes, sent the messenger to close it. On examining the bottom part of the net, which came up tightly closed, we found it to contain practically the same things as we obtained in the surface net at the same spot.

On two occasions we sent the net to be towed at depths of 800 fathoms and of 700 fathoms, the depths at these points being in one case 905 fathoms and in the other 773 fathoms. At the greater depth, the water shoaled somewhat while towing, as the closed part of the net came up partly filled with fine silt; while during the second haul, the twisting of the swivel wound the straps of the weights round the rope, and the net came up open, but must have dragged very close to the bottom, as it contained a fine specimen of Nettastoma, and some Penæids, which we supposed to be deep-sea types. Otherwise the net contained only the customary surface species of Sagitta, Pteropods, Copepods, Schizopods, Tunicates, and Fishes. These two hauls were made about the middle of the Gulf of California, at a distance of some fifty miles in a south-westerly direction from Guaymas.

On April 23, a few hours before reaching Guaymas, we made one more attempt with the Tanner tow-net, at a depth of 620 fathoms, sending the net to be towed at a depth of from 500 to 570 fathoms. We found in this case in the bottom part of the net, which came up tightly closed, a Scopelus, a Penæid, and a Hyalea, while the upper open part of the net contained the same surface species we had obtained before.

My experience in the Gulf of California with the Tanner self-closing net would seem to indicate that in a comparatively closed sea, at a small distance from the land, there may be a mixture of the surface species with the deep-sea bottom species, a condition of things which certainly does not exist at sea in an oceanic basin at a great distance from shore, where the surface pelagic fauna only descends to a comparatively small depth—about 200 fathoms—the limits of the depth at which light and heat produce any considerable variation in the physical condition of the water. The marked diminution in the number of species below 200 fathoms agrees fairly with the results of the *National* Expedition.

The more I see of the *Albatross* the more I become convinced that her true field is that of exploration. She is a remarkably fine sea boat, and has ample accommodation for a staff of working specialists such as would be needed on a distant expedition. The time will soon come when the Fish Commission will hardly care to continue to run her, and I can conceive of no better use for so fine a vessel than to explore a belt of 20° latitude north and south of the equator in the Pacific, from the west coast of Central America to the East Indian Archipelago.

The success of the *Albatross* thus far has depended entirely upon the zeal, energy, intelligence, forethought, and devotion of Captain Tanner, if I may judge of the past by the present. He never spares himself, and he is always ready to make the most of the time at his disposal for the benefit of the special object he has in charge. He looks after every haul of the trawl himself, and will not allow anyone else to jeopard in any way the material of the vessel, or the time it requires to make a haul. That responsibility he assumes himself, and it constitutes his daily work. In looking over the records of the *Albatross* during her voyage from New York to San Francisco, I am struck with the amount of work which has been accomplished. It would be but a just return to Captain Tanner if Congress would make the necessary appropriations to work up and publish all that he has brought together, not only on that cruise, but also what has been left untouched thus far of the immense collections made by him in the Caribbean, and off the east coast of the United States, to say nothing of his explorations in the Gulf of California, on the coast of California, on the coast of Alaska, and in the Behring Sea, from which he has accumulated endless and most interesting material, which no other ship could get together unless she had another Tanner in command.

We reached Guaymas on April 23, in the afternoon, and I parted from the ship with great regret, but more than satisfied with the results of this expedition.

Allow me, in concluding, to thank you most cordially for having given me the opportunity to join the *Albatross* on this extended cruise, and for your kindness in urging the President to allow the vessel to be detailed for this work.

As soon as it may become practicable, I shall send you a full *résumé* of our work, accompanied with sketches of the Tanner tow-net and a detailed chart of the route we followed.

Very respectfully yours,

ALEXANDER AGASSIZ.

THE ORIGIN OF THE ASS, THE CAT, AND THE SHEEP IN CHINA.

AT a recent meeting of the China Branch of the Royal Asiatic Society in Shanghai, Dr. Macgowan, a well-known Chinese scholar, read a paper on the probable foreign origin of the ass, the cat, and the sheep in China. He said that the Chinese, in their numerical co-ordination of concrete and abstract nature, give the "six domestic animals" as the horse, ox, goat, pig, dog, and fowl; which seems to indicate that when that formula was framed, neither cat, sheep, nor ass had been domesticated there. When familiar beasts were selected to denote years of the duodenary cycle, to the "six domestic animals" were added the rat, tiger, hare, dragon, serpent, and monkey, to complete the dozen, as if the ass, sheep, and cat were too little known to meet the object in view, which was the employment of the most familiar representations of animated nature for the duodendary nomenclature. Still more striking is the absence of the ass, sheep, and cat from the twenty-eight zodiacal constellations, which are represented by the best-known animals.

With regard to the ass, there is ample reason to regard it as being excluded from the list of domestic animals because it was not archaic. The hybrid mule is of comparatively modern origin in China, dating back only about a score of centuries. A miscellany of the Sung era states that "the mule was not seen during the Hsai, Shang, and Chou dynasties; that it was a cross between the ass and horse from Mongolia. It is regularly bred in the north, and is worth in the market twice as much as the horse; it is popularly reported that its bones are marrowless, which is the reason of its inability to produce its kind." Again, it is recorded in a Ming cyclopædia: "The mule is stronger than the horse, and is not a natural product of China; in the Han era it was regarded as a remarkable domestic animal." Is it likely that, if the ass existed during the three ancient dynasties, there was no crossing with the horse?

With regard to the cat, Dr. Macgowan proceeded to state that there was a quotation from a standard work which dis-

closes the fact that Yuang Chuang, the pilgrim monk, who, in the seventh century A.D., returned after sixteen years' wanderings in India, brought cats with him to protect his collection of Sanskrit Buddhist books from rats. That account, however, is somewhat invalidated by an anecdote of Confucius, who is related to have one day seen a cat chasing a rat. These conflicting statements are from authoritative sources, and it is impossible to offer a satisfactory explanation. Possibly the cat of Confucian times was only a partially domesticated wild cat. There must have been some ground for the statement of the cat having been brought from India, as it is hardly likely that in all the long period of Chinese history it should be named but twice as a domestic animal. He quotes from Chinese folk-lore on the subject of cats. As cruelty to cats and other animals is followed by retribution, so services rendered to them meet with supernal recognition. As anciently the tiger was sacrificed to because it destroyed wild boars, so the wild cat was worshipped because it was the natural foe of rats; boars and rats being the natural enemies of husbandry. At the commencement of the Sui dynasty (A.D. 581), the cat spirit inspired greater terror than the fox did subsequently. The hallucinations of cat spirit mania prevailed, forming a remarkable episode in Chinese history, only to be likened to the fanatical delusion of witchcraft that frenzied Europe a thousand years later. It was believed that the spirit of a cat possessed the power of conjuring away property from one person to another, and inflicted through incantations bodily harm. The popular belief was intensified and spread like an epidemic, until every disastrous affair that took place was ascribed to cat spirit agency set in motion by some mischievous enemy. Accusations were lodged against suspected persons, and, the slightest evidence sufficing for conviction, the malicious were encouraged to trump up charges against the innocent, until the country became a pandemonium. No one was safe, from the Imperial family down to the humble clodhopper. Even a magnate of the reigning house, who enjoyed the titular distinction of Prince or King of Szechuan, was executed for nefariously employing the agency of cat spirits. In this manner several thousands were immolated before the delusion was dispelled. Happily the period appears to have been of brief duration: incentives such as kept up the witch mania for centuries were wanting in China. Coming down to our own times we find a cat-craft delusion prevailed over a great portion of Chêkiang. "In the summer and autumn of 1847 frightful wraiths appeared throughout the departments of Hangchow, Shaohsing, Ningpo, and Taichow. They were demons and three-legged cats. On the approach of night a fœtid odour was perceptible in the air, when dwellings were entered by something by which people were bewitched, causing alarm everywhere. On detecting the effluvium in the air, householders commenced gong-beating, and the sprites, frightened by the sonorous noise, quickly retreated. This lasted for sveral months, when the weird phenomena ceased." Well did he remember, said Dr. Macgowan, the commotion that prevailed in Ningpo throughout those months of terror. Every gong that could be procured or manufactured for the occasion was subject to vigorous thumping through the live-long night, maintained with vociferations by relays of zealous beaters. This deafening din was but a recrudescence of what had occurred a few generations before—a panic which was only exceeded by that which subsequently prevailed over the entire empire.

With regard to sheep, Dr. Macgowan said the ancient mode of writing the character for *yang*, goat, was ideographic—four strokes on the top to represent horns, two horizontal strokes representing legs, and a perpendicular one to represent body and tail. The modern form gives an additional parallel stroke, like the word for horse; it is a simple not a compound character, and when sheep came to be known, instead of making a new character, the sheep was called the "Hun-goat," thus indicating its origin and affinity. *Yang*, goat, is often translated sheep, the earliest instances being found in one of the Odes, wherein the Court habiliments of Wen Wang are called "lamb-skins and sheep-skins." This was about 1160 B.C., but it is doubtful if these robes are really the skins of sheep. It is not certain that such was the case, for the skins of goats were used then, as now, for clothes. Hun-goats are not named before the period of the Tang dynasty, say the seventh century A.D. The goat was one of the sacrificial animals, as at present, and was at the first selected for sacrifice when sheep were unknown.

In the discussion which followed, the conclusions of the paper were not accepted by all the speakers; and it was agreed that the subject was one worthy of scholarly investigation.

HAINAN.

THE great island of Hainan, off the south-eastern coast of China, is but little known to Europeans, although since 1877 there has been a treaty port there. Mr. Parker, the Consul at Kiungchow, the port in question, lately made a short journey in the interior of the island, of which he gives some account in a recent report. He travelled about sixty miles up the Poh-Chung River, to within a mile or two of Pah-hi, which is, at most seasons of the year, considered the limit of navigation for all but the smallest craft. He walked round the walls of Ting-an city, one of the disturbed districts during the recent rebellions, on New Year's Day (February 9); they are just one mile in circuit, and differ little from those of other Chinese cities. Wherever he had an opportunity of walking diametrically across lengthy curves of the river he found the inclosed area to be extremely well cultivated; though not so flat, its general appearance recalled many features of the Tonquin delta, especially in its great wealth of bamboos. The productions of the soil are much the same, the papaw, areca-palm, sweet potato, turnip, ground-nut, orange-tree, &c.; but a peculiar Hainan feature is the cocoa-nut palm. Another peculiarity of this region is the ubiquitousness of the dwarf *Pandanus*, probably the same as the *P. odoratissima* of Fiji, the fibre of which is used in the manufacture of grass-cloth, and is usually known to foreign trade here as hemp. Much of the land was under sweet potato cultivation, and every household seemed to possess a few pigs, of the very superior and stereotyped Hainan variety, black as to the upper and white as to the lower part of the body, with a dividing line of grey running along the side from the snout to the tail. These wholesome-looking pigs are fattened on the sweet potato, and do not rely for sustenance upon precarious scavengering, as is the case with the repulsive and uncleanly animals of North China. Land contiguous to the river is irrigated by enormous wheels, forty feet in diameter, of very ingenious construction, moved by the current, needing no attention, and discharging perhaps one hundred gallons of water in a minute into the trough above, day and night without intermission. He passed several large pottery establishments; but as at the New Year all business and cultivation are suspended for a few days, the opportunity was not a very good one for gathering precise information. The temperature during the week ranged between 50° and 60° F. Game seemed plentiful everywhere, and he mentions that a German resident has recently made a very fine collection of about 400 Hainan birds, embracing 154 species, which will shortly be on their way to a Berlin Museum. One of the commonest birds in the river is a spotted white and black kingfisher of large size. Amongst the trees which attracted his attention was one locally called the "great-leafed banyan," which looks remarkably like the gutta-percha tree; the natives seem to use its gum mixed with gambier, in order to make that dye "fast"; but there is some doubt whether it is not the sap of the real banyan-tree which is used for the purpose. A very strong silk is made from the grub called the "celestial silk-worm," or, locally, "paddy-insect." This grub is found on a sort of maple. When full-grown it is thrown into boiling vinegar, on which the "head" of the gut, or "silk," appears; this is sharply torn out with both hands drawn apart, and is as long as the space between them, say five feet; it is so strong that one single thread of it is sufficient to make a line with which to catch the smaller kinds of fish.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Chancellor of the University, acting as Visitor of Pembroke College, has appointed the Rev. Bartholomew Price, M.A., F.R.S., Senior Fellow, and Vicegerent of the College, Sedleian Professor of Natural Philosophy, to be Master of the College in the place of the late Dr. Evans. Prof. Price, whose contributions to mathematics are well known, has long taken a leading part in University business, and his appointment to the Mastership of the College, of which he has been a Fellow since 1843, will be warmly approved.

Postponement of Full Term.—A meeting of the heads of the Colleges and Halls was held under the authority of the Vice-Chancellor at the residence of the Regius Professor of Medicine, Sir Henry Acland. A report having been presented by the medical officer of health as to the great prevalence of influenza in Oxford, and the difficulty of procuring nursing and medical attendance for the patients, it was unanimously resolved to recommend the Colleges and Halls, and the delegates of the non-collegiate students, to postpone the attendance of the undergraduates to the end of the first week in February, being a fortnight later than the time originally fixed.

CAMBRIDGE.—The *University Reporter* of January 19 contains an official notification by Prof. Liveing, F.R.S., Chairman of the Council of Cavendish College, that the College ceased on January 15 to be a recognized Public Hostel of the University.

Mr. Buchanan, University Lecturer in Geography, announces for the present term a course of lectures on the development of land surfaces under climatic and other agencies.

The Special Board for Physics and Chemistry propose to establish two new special examinations for the ordinary B.A. degree, one in chemistry, including certain papers in heat, electricity, and magnetism, and another in physics, including papers in dynamics, elementary chemistry, and more advanced electricity and magnetism. The examinations will include practical work in some of these subjects.

Mr. W. N. Shaw, F.R.S., has been elected a member of this Board, and Mr. S. F. Harmer a member of the Board for Biology and Geology.

SCIENTIFIC SERIALS.

IN the *Journal of Botany* for December 1891, Mr. W. West describes a collection of Freshwater Algæ from Maine, including several new species and varieties; and we have also Mr. W. Carruthers's Report of the Department of Botany in the British Museum for 1890, recording important additions to the herbarium and collections, by purchase, exchange, and gift; among the more interesting being the late Mr. J. Ralfs's type-specimens for his "British Desmidieæ."—Dr. D. H. Scott gives a detailed account of the life and writings of the late Prof. Carl v. Nägeli.

IN the *Botanical Gazette* for November 1891, Mr. E. J. Hill describes the remarkable propulsive power possessed by the "sling-fruit" of *Cryptotænia canadensis*, belonging to the Umbelliferæ, by which the seeds are thrown out to a distance of at least 5 feet; and Prof. Byron D. Halsted, a bacterial disease which is exceedingly destructive to the melon crops and other Cucurbitaceæ in America.——The most important article in the number for December is by Prof. Douglas H. Campbell, on the relationships of the Archegoniatæ, under which term he includes the Gymnosperms, as well as the Muscineæ and Vascular Cryptogams. As in previous essays, Prof. Campbell traces the phylogeny of all the higher forms of vegetable life to the Hepaticæ; both Gymnosperms and Angiosperms having probably been derived through the Ophioglossaceæ, Marattiaceæ, and Isoëteæ.—Prof. C. V. Riley describes the new insect-pest which is committing great ravages on dried plants in herbaria—the larva of *Carphoxera ptelearia*, belonging to the Geometridæ.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, January 5.—Prof. A. Newton, F.R.S., Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the months of November and December 1891. Amongst these attention was called to four Spotted-billed Pelicans (*Pelecanus manillensis*), received from Calcutta, and to a second specimen of the Formosan Fruit-Bat—a species originally described from an example received alive by the Society in 1873.—Dr. E. C. Stirling exhibited some specimens of the new Australian Marsupial (*Notoryctes typhlops*), and gave a short account of the habits of this remarkable animal, as observed in a specimen recently kept in captivity by one of his correspondents.—An extract was read from a letter received from Dr. F. A. Jentink, calling attention to the recent acquisition by one of his correspondents in Java of additional specimens of the rare Bush-Rat (*Pithechir melanurus*).—Mr. Ernst Hartert exhibited a series of eggs of the Common and other Cuckoos, mostly collected by himself and trustworthy friends, and made remarks on the question of the similarity of the eggs of the Cuckoos to those of the owners of the nest in which they are deposited.—A communication was read from Dr. J. Anderson, F.R.S., containing notes on a small collection of Mammals, Reptiles, and Batrachians made during a recent visit to Algeria and Tunisia.—Mr. F. E. Beddard read a paper upon the Earthworms collected by Dr. Anderson during the same expedition. Amongst them were examples of a new species of the genus *Microscolex*. A second new species of the same genus, based on examples collected by Mr. E. B. Poulton, F.R.S., in Madeira, and proposed to be called *M. poultoni*, was also described.—A communication was read from Mr. R. I. Pocock on some Myriopoda and Arachnida collected by Dr. Anderson during the same expedition.—Mr. M. F. Woodward read a paper on the milk dentition of *Procavia* (*Hyrax*) *capensis*. The author showed that Lataste's canine has a counterpart in the lower or mandibular series, and he described for the first time two small vestigial upper incisors. He concluded that the teeth named belong collectively to the first or milk set, and that the formulation of the incisors of this genus as $\frac{2}{1}$ is probably due to the occasional persistence of the second upper milk-incisor.—Mr. Oldfield Thomas gave an account of the species of the Hyracoidea, of which order he had lately examined a large series of specimens. The author recognized fourteen species of this group of Mammals, all of which he proposed to refer to one genus (*Procavia*). Besides these, four geographical sub-species were recognized. A new species was described as *P. latastei*, from Senegal.

Geological Society, January 6.—Mr. W. H. Hudleston, F.R.S., Vice-President, in the chair.—The following communications were read:—On a new form of *Agelacrinites* (*Lepidodiscus Milleri*, n. sp.) from the Lower Carboniferous Limestone of Cumberland, by G. Sharman and E. T. Newton.—The geology of Barbados; Part II. The oceanic deposits, by A. J. Jukes-Browne and Prof. J. B. Harrison.—*Archæopneustes abruptus*, a new genus and species of Echinoid from the oceanic series in Barbados, by J. W. Gregory. This genus belongs to a group of Echinoidea which has given some trouble to systematists, owing to the union of the characters of the orders Cassiduloidea and Spatangoidea; the other genera belonging to the group are *Asterostoma*, *Pseudasterostoma*, and *Palæopneustes*. The evidence of the new Echinoid throws light upon the affinities of these genera. The main points suggested by a study of the new species are: (1) the abandonment of the name *Pseudasterostoma* as a synonym of *Palæopneustes*; and (2) the inclusion of the true *Asterostoma*, *Palæopneustes*, and *Archæopneustes* in the Adete Spatangoidea, whereby the Plesiospatangidæ are left as a more homogeneous family, though bereft of the chief interest assigned to it. A tabular summary of the nomenclature of the group is given. The best-known fossil species of *Asterostoma* and *Palæopneustes* occur in Cuba, in deposits referred to the Cretaceous owing to the resemblance of these Echinoids to the common Chalk *Echinocorys scutatus*. The new genus includes a species from the same deposit, which is probably of the same age as the Bissex Hill rock from which the new species was obtained; this is at the top of the oceanic series, and belongs to the close of the great subsidence. After the reading of this paper, there was a discussion in which the Chairman, Dr. Blanford, Prof. Sollas, Prof. Harrison, Mr. J. W. Gregory, and Mr. W. Hill took part.

DUBLIN.

Royal Society, December 16, 1891.—Prof. A. C. Haddon, President of the Scientific Section, in the chair.—Mr. E. W. L. Holt read a paper on the eggs and larval and post-larval stages of Teleosteans, obtained during the Society's survey of fishing grounds on the west coast of Ireland. Thirty-three species, chiefly food-fish, are dealt with. The eggs of *Gadus esmarkii*, *G. pollachius*, and *Rhombus megastoma*, are described for the first time; those of *Hippoglossa platessoides* (the long rough dab), *Scomber scomber* (the mackerel), and *Caranx trachurus* (the scad), are also described. The development of the long rough dab, turbot, brill, and several other species of flat-fish, is traced upwards, to the assumption of the adult characters, with more or less continuity. The paper concludes with a series of tables containing an artificial classification of the pelagic eggs of British marine Teleosteans for purposes of easy identification.

—A second paper by the same author deals with the shore and deep-sea fishes obtained during the survey, and contains descriptions and figures of some of the more interesting forms. The vertical and horizontal distribution is also discussed, and it is pointed out that the west coast of Ireland is to a great extent the meeting ground of the Scandinavian and Lusitanian or Mediterranean fish faunas. An attempt is made to give a complete list, with references, of all deep-sea fishes which have been taken in Irish waters.—A paper was then read by Dr. E. J. McWeeney, on a method of preparing Hyphomycetes, Saccharomycetes, and Schizomycetes, as museum specimens, with a demonstration of illustrative cultivations. After pointing out that our natural history collections did not, as a rule, contain specimens illustrative of these minute organisms, the author showed that the appearances presented by the aggregate masses formed by their cells could in many cases be made perfectly perceptible to the unaided eye. A collection contained in suitable vessels, comprising nearly ninety specimens, and including *Actinomyces* grown on agar, potato, and turnip, Trichophyton, Acharion, various species of *Saccharomyces*, *Bacillus tetani*, and many others, was then demonstrated. The specimens were prepared by Král, of Prague, and the writer hoped soon to be able to add species from Irish sources.

PARIS.

Academy of Sciences, January 11.—M. Duchartre in the chair.—On the resistance of coiled elastic springs to small deformations, by M. H. Resal.—On the spontaneous oxidation of humic acid and of vegetable soil, by MM. Berthelot and André. If humic acid is allowed to stand in diffused light for a short time, a change of colour occurs, and an appreciable quantity of carbon dioxide is developed. It appears from this that the brown-coloured constituents of vegetable soil furnish carbon dioxide, and tend to become discoloured under the influence of air and sunlight, by oxidizing. The action is said to be purely chemical, and not the result of the growth of microbes.—Some new observations on the estimation of sulphur in vegetable soil, and on the nature of the compounds containing it, by the same authors.—New contribution to the chemical history of the truffle; analogy between the Terfaz or Kama of Africa and Asia and the truffles of Europe, with regard to the relation between the chemical composition of soils and tubercles, by M. A. Chatin.—On the Ecureuil of Barbary, by M. A. Pomel.—On the hypergeometric series, by M. André Markoff.—On plane *réseaux* with equal invariants and asymptotic lines, by M. G. Kœnigs.—On series with positive terms, by M. V. Jamet.—On the use of orthochromatic plates in astronomical photography, by MM. Fabre and Andoyer. (See Our Astronomical Column.)—On the theory of regelation, by M. H. Le Chatelier. The consequence which follows from the formulæ developed is that compressed pulverulent ice, in contact with a liquid or vapour less compressed, experiences an increase of solubility, fusion, or vaporization that brings about an unstable condition of supersaturation, which disappears by the crystallization of the ice in the interspaces: this solution, followed by crystallization, continues until the spaces have completely disappeared and the *névé* has become transformed into a block of ice. The mode of hardening is thus comparable to that of cements.—On a new model of a reversible thermometer for the measurement of deep-sea temperatures, by M. V. Chabaud.—New condensation hygrometer, by M. Henri Gilbault. In order to determine absolute or relative humidity with a condensation hygrometer, the moment at which dew is deposited must be observed, and the temperature of the surface upon which it is formed. Many methods have been proposed to perfect the observation of the moment when the dew appears, but only a few have taken into account the equally important second condition. The author has endeavoured to improve existing methods by causing condensation to take place on a thin sheet of platinized glass, and measuring the variations of electrical resistance of the metal. He finds it possible to determine the dew-point within $\frac{1}{10}$ of a degree by his method.—Loss of the two kinds of electricity brought about by light of high refrangibility, by M. E. Branly.—On metallic borates, M. A. Ditte.—On manganates of potash, by M. G. Rousseau. It appears from the experiments that manganate of potash, heated in the presence of a flux, gives rise to two hydrated manganates. About 600° C., the hydrate obtained is $K_2O,16MnO_2,6H_2O$; between 700° and 800°, $K_2O,8MnO_2,3H_2O$ is produced; and the former compound reappears between 800° and 1000°.—On the reduction of benzine hexachloride; condensation of benzine, by M. J. Meunier.—On the formation of dextrines, by M. P. Petit.—On a new unsaturated fatty acid of the series $C_nH_{2n-4}O_2$, by M. A. Arnaud.—Influence, in bare soils, of the proportions of clay and organic nitrogen on the fixation of atmospheric nitrogen, on the preservation of nitrogen, and on nitrification, by M. P. Pichard.—On the whistling language of the Canary Islands, by M. J. Lajard.—On the pelagic flora of Naalsoëfjörd (Faroe Isles), by M. Georges Pouchet.—On the Upper Cretaceous of the Aspe valley, its age and its relations, by M. J. Seunes.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Anthropological Religion: F. Max Müller (Longmans).—Adventures amidst the Equatorial Forests and Rivers of South America: V. Stuart (Murray).—Power and Force: J. B. Keene (Unwin).—British Flies, vol. i. Part 3: F. V. Theobald (Stock.).—Methods of Gas Analysis: Dr. W. Hempel; translated by L. M. Dennis (Macmillan).—Egypt under the Pharaohs; new edition: H. Brugsch-Bey (Murray).—Life in Ancient Egypt and Algeria: G. Maspéro; translated by A. Morton (Chapman and Hall).—List of Snakes in the Indian Museum: W. L. Sclater (Calcutta.—Manipulation of the Microscope: E. Bausch (Collins).—Magnetic Induction in Iron and other Metals: Prof. Ewing (*Electrician* Office).—The Realm of Nature: Dr. H. R. Mill (Murray).—Annuaire de l'Académie Royale des Sciences, Belgique, 1892 (Bruxelles, Hayez).—The Optics of Photography and Photographic Lenses: J. T. Taylor (Whittaker).—New Fragments: J. Tyndall (Longmans).—The Art and Craft of Cabinet-making: D. Denning (Whittaker).—Electric-Light Cables: S. A. Russell (Whittaker).—Bergens Museums Aarsberetning for 1890 (Bergen, Griegs).—Istituto Chimico Ricerche, 1890–91 (Regia Università degli Studi di Roma) (Rome).—Catalogue of Scientific Papers (1874–83), compiled by the Royal Society of London, vol. ix. (C. J. Clay).—Dynamics of Rotation: A. M. Worthington (Longmans).—Christian Doctrines and Modern Thought: Dr. T. G. Bonney (Longmans).

PAMPHLETS.—Aids to Natural Philosophy: R. S. Trivedy (Calcutta, Auddy).—The Science of Homœpathy: W. B. Picken (London).—The Glory of the Imperfect: Prof. G. H. Palmer (Boston, Heath).

SERIALS.—Journal of the Royal Agricultural Society of England, 3rd series, vol. ii., Part 4, No. 8 (Murray).—Quarterly Journal of Microscopical Science, No. 129 (Churchill).—Journal of the Royal Statistical Society, December (Stanford).—Mind, January (Williams and Norgate).—Geological Magazine, January (Kegan Paul).—Physical Society of London Proceedings, vol. xi., Part 2 (Taylor and Francis).—Ann. des k.k. Naturhistorischen Hofmuseums, Band 6, Nos. 3 and 4 (Wien, Hölder).—Natura ed Arte, No. 2 (Milano).—Journal of Anatomy and Physiology, January (Williams and Norgate).—L'Anthropologie, Tome ii., No. 6 (Paris, Masson).—Brain, Part 56 (Macmillan).—Mineralogical Magazine, December (Simpkin).—Journal of the Chemical Society, January (Gurney and Jackson).—Veröffentlichungen aus dem Königlichen Museum für Völkerkunde, ii. Band, 1–2 Heft (Spemann).—Himmel und Erde, January (Berlin, Paetel).

CONTENTS.