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THURSDAY, JUNE 3, 1875

THE ARCTIC MANUAL

Manual of the Natural History, Geology, and Physics of Greenland and the Neighbouring Regions. By T. Rupert Jones, F.R.S., and W. G. Adams, M.A., F.R.S. Edited by Prof. T. Rupert Jones, F.R.S., under the direction of the Arctic Committee of the Royal Society. (Published by authority of the Admiralty, 1875.)

THE Arctic explorers, to whom we must all give a hearty God-speed now they have started on their journey, besides being supplied with "Instructions" as to the points on which information is most required, and as to the manner in which they may best obtain it, have had compiled for them a most comprehensive "Manual" of what has already been done with regard to the natural history and physics of the northern regions. The time devoted to this work has been short, but the compilers have made the most of it, and their names are guarantees that the information is as complete as possible.

The book consists of a series of reprints of the latest and most trustworthy papers that have been written on the various subjects included. No other form of "Manual" would have been half so useful, even if there had been time to compile it. The limited area within which the exploration is to be conducted has made it possible to include all these in one handy volume. What would not an ordinary naturalist give to have all the previous work that had been done upon the district he was visiting collected together for him, instead of his having to search for it over scattered volumes? and how much more valuable it would be if it were revised up to the latest date by the authors themselves. This is what has been done for the Arctic naturalists, who will be cut off for years from all books but those they take with them, and to whom this work will therefore be of inestimable value. Of course we are not to understand that all that has been written on the natural history and physics of the Arctic regions is here reproduced; that would have been impossible: but in the first part complete catalogues are given, without the descriptions of the genera or species that have been named from Arctic specimens; and the second part, to which less time has been allowed, and which is less complete, contains only the most important portions of the papers or works from which extracts have been made.

It is not the Arctic voyagers, however, who alone will benefit by this Manual. Those who will follow them in thought in their perilous but splendid undertaking will find their interest increased, if this be possible, by the many questions for solution which its perusal will raise in their minds, and they will the more easily compare what was known *before* the expedition with that which we hope will be known after its return.

We proceed to give our readers some idea of the contents of this "Manual." Although the list of papers is no doubt scanty compared with what might be formed of more temperate climes, many no doubt will be astonished that so much has been done in the natural history of these inhospitable regions, far more in proportion than the observations of physical data.

The first part, devoted to Biology and Geology, is divided geographically into three sections; the first, on West Greenland, including Davis' Strait, Baffin's Bay, Smith's Sound, and Kennedy Channel; the second, the Parry Islands and East Arctic America; and the third, East Greenland, Spitzbergen, Franz-Joseph Land, &c. All these between them have 111 illustrative papers, many being double ones. They are arranged in each section zoologically, the first paper being by Dr Robert Brown, on the Mammals of Greenland, of which there appear to be thirty-one now known, exclusive of introductions by the colonists; all but seven of which inhabit the sea. This paper is followed by two others by the same author, published about the same time (1860), containing his accounts of the species and habits of the Whales, Seals, and Walrus. Many such accounts have been published; they are always read with interest, and we have no doubt much further light will be thrown by the expedition on these animals, some of which are as yet only known by their skulls sent home to museums. There are six species of Greenland Seals, all sufficiently distinct to be placed in different genera, though one is often confounded with another. The chief are the Common Seal (*Callocephalus vitulinus*), the Saddleback, the male and female of which are of different colours, the Grey Seal, and the Bladder-nosed Seal, the latter of which was till lately represented in the Zoological Gardens by a living specimen. There is also the Walrus, large numbers of which used to inhabit British waters during the crag period, but of which only two have as yet been brought alive to England, where they survived but a short time. The Cetacea are more numerous, having sixteen representatives, including the Dolphins and Porpoise. Dr. Brown gives interesting details respecting several of these, of which we need only mention the voracity of the Killer (*Orca gladiator*), out of whose stomach Dr. Eschricht took thirteen porpoises and fourteen seals, the voracious animal having been choked by the skin of a fifteenth. A case is known in which they attacked a white-painted herring-boat in the Western Islands, probably mistaking it for a Beluga or White Whale.

From the Mammals we come to the Birds, the notes on which are contributed in a separate paper by Prof. Alfred Newton, the list being compiled by him from all available sources. The number of true denizens reaches sixty-three, of which, however, only forty-seven occur within the Arctic circle, and not more than thirty-six, if so many, may be expected in Smith's Sound. These are printed in a thicker type to draw attention to them, and short notes are given by which they may be distinguished even by those observers who are not professed naturalists. Prof. Newton is very severe on the former expeditions for "so ingloriously missing their glorious opportunities" in ornithology, "through the absence of special naturalists;" but this will not apply to the present one.

For the catalogues of the Fishes and most of the remaining classes of animals we have to go to Denmark, Drs. Lütken and Mörch, of Copenhagen, being the chief authorities on these branches—and they have both revised their lists to the latest date. The former writer has in preparation an "Ichthyology of Greenland," and the list of fishes here given is only provisional till that is completed. The number reaches seventy-eight, the greater number of course being Teleosteans, and many

inhabitants of great depths, and consequently rare in collections, eighteen only being well represented in those of Britain.

Dr. Mörch's list of the Mollusca, including land, freshwater, and marine forms, reaches a total of 216, which are arranged after his own modification of Latreille's classification. As this is not the classification usually adopted or known in England, it may be well to indicate it. The Mollusca proper are divided into five classes. The first, *Androgyna*, Mörch, includes the five orders: *Grophila*, Fér., or land shells; *Hygrophila*, Fér., or freshwater shells; *Ptenoglossata*, Trochsel; *Gymnobranchia*, Cuv.; and *Pteropoda*, Cuv. The second class, *Dioica*, Latr., is divided into the three orders, *Tænio-*, *Toxo-*, and *Rhachiglossata* of Trochsel, after the characters of their tongues. The third class, *Exocephala*, Latr., is divided in the same way, into *Rhipido-* and *Heteroglossata;* while the remaining two classes, *Cephalopoda* and *Acephala*, are undivided, although there are enumerated species of the different orders as usually distinguished in the latter class. The *Brachiopoda* figure for four species in addition to the above, under the title of *Brachionopoda*. The *Tunicata* number thirteen species, and require revision, while the *Polyzoa* mount to sixty-three. Of the Insects nothing is recorded since Schiödte's list in 1857 of 114 species; of Arachnida there are almost none but a few Acari. The list of Crustacea is a large one, and has been revised by Dr. Lütken for this Manual. The whole number is 184, of which no less than seventy are *Amphipoda*. Yet this list is plainly incomplete, the *Ostracoda* being represented by one species only, while in the next paper Dr. Brady enumerates twenty-four from their shells. The other classes of animals have similar lists. In the Annelids most families are represented by a few species; the various Entozoa are tabulated. The Echinoderms are thirty-four, containing only one Echinid: the remaining lists are short ones, except that of the fixed Hydrozoa, and the Sponges, which are pretty numerous. It is useless, of course, to catalogue "species" of Foraminifera, and only a few notes are accordingly given of the various generic forms which have been met with at various depths, with a description of the nature of the materials in which they occur.

From animals we pass to plants. The first paper is the well-known one by Dr. Hooker, "Outlines of the Distribution of Arctic Plants," from the Linnean Society's Transactions for 1861, which has been reprinted with little alteration, chiefly from want of time, the more recent discoveries being given in foot-notes. The list of flowering plants contains those from the districts of Arctic East America and Greenland only, which number 552, of which about two-fifths are Monocotyledons, and the remainder Dicotyledons. Mr. Taylor's paper, on the Plants of Davis' Strait, though without the generalisations of the former, gives more details on the habitats and localities of the specimens; but this paper also is one of old date (1862). The Cryptogams are enumerated in various papers on the several sections to which separate students usually devote themselves; the most important being Dr. Lindsay's, on the Lichen Flora of Greenland and other Arctic Regions, from the Transactions of the Botanical Society of Edinburgh for 1869. As lichens will grow where nothing else will, their various species may naturally be expected to make a large figure in an Arctic flora; and so they actually do, as they number by themselves half as many as all the flowering plants together. The Diatoms, which in their vast numbers cause the discoloration of some portions of the Arctic seas, form the subject of another interesting paper by Dr. Brown.

When we reach the portion of the Manual relating to Geology, we find some part of the information to be of very ancient date, belonging to the days of Flætz-Trap-Formation and other exploded terms, which now convey no information whatever. The interest of these papers, written by Sir Charles Giesecke in the beginning of this century, is mineralogical. He was a careful collector and diligent observer, and his records are still valuable. One of his chief discoveries was an easily fused mineral he named cryolite, which is now an abundant source of aluminium. To this two papers are devoted. Shortly following these we have Dr. Sutherland's paper, no less valuable because some twenty years old, on the Geological and Glacial Phenomena of the Coasts of Davis' Straits and Baffin's Bay, which contains many observations on the ice-phenomena both of small and large masses. The Miocene Flora of Greenland, so admirably described by Prof. Oswald Heer in his "Flora Fossilis Arctica," and catalogued in other works, cannot of course in a small Manual like the present receive more than a comparatively brief notice, nor can it be needed, as it is an essentially standard work. There is also a Cretaceous Flora catalogued from the "Kome Formation" of the north coast of Noursoak Peninsula. Undoubtedly the most interesting paper in this section is that of Prof. Nordenskjöld, extracted from the *Geological Magazine*, in which he gave an account of his fruitful expedition to Greenland in the year 1870. The united papers that detail his experiences are together of considerable length. He made one of the very few attempts that have yet been made to enter the great continental icefield, and succeeded in passing over thirty miles, the interesting details of the journey being here recorded; and much valuable information was thus obtained. The new expedition will have great opportunities of such explorations, which is a reason for regretting the absence from it of any professed geologist. Prof. Nordenskjöld gives an account also of the various strata of the coast, which exhibit beds of Cretaceous and Miocene age, with some basalts which are associated with them. One of the most interesting discoveries made by him was that of three large masses of meteoric iron at Ovifak, of which a woodcut and analyses are here given, with full accounts of its various points of interest. This latter recital is very naturally followed by that portion of Dr. Flight's recent contributions to the *Geological Magazine* on Meteorites, which relates to those found in Greenland. This contains the results of the newer Swedish Expedition of 1871, together with further details about the stones themselves, as compared with other meteorites. The two chief remaining papers in this division are, first, a valuable abstract of geological notes on Noursoak Peninsula and Disco Island, by Dr. Robert Brown, which is only just published in the Transactions of the Glasgow Geological Society, and contains a succinct account of the geology of that part of Greenland as made out by various explorers; and secondly, a

collection of notes by Henry H. Howorth of the several observations that have established the fact of the rising of the circumpolar land.

We have now passed in review the chief portion of this Manual, which occupies 500 out of its 750 pages, and relates to that portion of the Arctic regions whither the explorers are in the first instance bound. The remaining portion of the Natural History division—occupied with Parry Island and East Greenland—consists of shorter papers and far barer catalogues. These perhaps require no observations beyond noticing the fact—recently pointed out also by Mr. De Rance in our columns—that the various geological periods are much better represented in these latter districts, there being Silurian, Carboniferous, Triassic, and Jurassic, as well as Cretaceous and Tertiary rocks; and consequently we have lists of fossils supplied with which any that may be discovered may be compared. The last of the Natural History series is an extract from Mr. Woodward's paper on Glaciation, the object of the insertion of which, as it is entirely theoretical, it is difficult to understand, unless it be to give the explorers some idea of the kind of questions on which some of their geological and glacial observations may be expected to throw light.

There are two things that strike one in reading these long catalogues—(1), that he must be a well-informed naturalist to whom many of the names which belong to all classes and kingdoms of life are anything more than names; and (2), arising from this, what an advantage there is in having specific names at least as far as possible descriptive.

The second part of the Manual, relating to Physics, requires of course less detail, and is included in a far smaller number of pages. It is not constructed on exactly the same plan as the first part, but consists in a great degree in descriptions of the observations and results, instead of reprints of the original papers; nor is it so exhaustive. It is divided into eight portions, relating respectively to Meteorology, Temperature of the Sea, Formation and Composition of Sea-water Ice, Tides and Currents, Geodesy and Pendulum Experiments, Observations on Refraction and on Air, Terrestrial Magnetism, and the Aurora Borealis. Under the head of Meteorology we have a few scattered notes on the results of the numerous previous expeditions with the thermometer, barometer, &c., and a valuable table on the mean temperatures of various stations for the several months of the year. The information as to the temperature of the sea is still more meagre, and it seems to us that more might have been included with advantage. The papers selected on the Physical Properties of Ice are extremely suggestive and valuable, consisting partly of observations in Arctic regions as to the freezing-points of sea-water, and the compositions of the resulting ice and the remaining liquid, and partly of similar experiments in the laboratory.

The information also on the tides and currents is pretty full, showing what methods have been adopted in various expeditions for determining the former accurately and with what results. There are also papers of suggestions as to the probable directions and amounts of both, and the best places for observation, and on the Meteorology and Hydrography of the Austro-Hungarian North Polar Expedition. The part on Magnetism is on the same model as the last mentioned, and is equally, if not more valuable. The last chapter, on the Aurora Borealis, is the best of all. Besides the ordinarily phenomenal observations already made, great attention is naturally paid to the spectrum of the Aurora, its connection with electrical discharges, together with Angström's views of its origin as explained in NATURE (vol. x. p. 246), and the opinions of Prof. Herschel and Mr. Capron, as well as those of MM. Lemström and Wijkander, deduced from observations made by them in the different Swedish expeditions, all of which are here given as fully as possible.

Such is the book with which, in addition to all others, the Arctic explorers are supplied. It is a library in one volume such as one does not often see. The mass of material it contains is something marvellous, and all is condensed as much as is advisable. The compilers must have had hard work, but they may congratulate themselves on the result. They have practically said to the Arctic voyagers—"This is what we have; go and obtain more for us." May they be successful, and return with a full cargo of information, which, if it were packed as tight as in this Manual, would not take up much room in comparison with its high value.

LAWSON'S "NEW GUINEA"

Wanderings in the Interior of New Guinea. By Capt. J. A. Lawson. With Frontispiece and Map. (Chapman and Hall, 1875.)

IT is not often that a work of fiction calls for notice in the pages of NATURE; but we have here an exceptional case. This book has been favourably noticed in some of the daily and weekly papers as a genuine narrative of travel and an addition to our knowledge of an almost unknown region, and it therefore becomes a duty to inform our readers that it is wholly fictitious. It is not even a clever fiction; for although the author has some literary skill and some notion of the character of savages, he is so totally ignorant of the geography and the natural history of the country he pretends to have explored, and so completely unacquainted with the exigencies of travel and exploration in trackless equatorial forests, as to crowd his pages with incidents totally unlike any that occur to the actual explorer, and with facts altogether opposed to some of the best established conclusions of physical geography. We proceed to give proofs of the accuracy of these statements. First, as to his geography. He starts from a point a little to the east of Torres Straits, of which he is so injudicious as to give the latitude and longitude (both to seconds) from his own observations. He also gives a map of his route, but without scale or meridian line. He describes himself, however, as travelling generally northwards with only such divergences as the country necessitated, and we may therefore take it that his route was nearly north, as it should have been to cross the island. But although he gives no scale to his map, he (again injudiciously) gives the dimensions of a large lake, along one side of which he travelled, as "between 60 and 70 miles long, 15 to 30 broad," which being laid down on his map furnishes an excellent scale, and shows that the total distance from his starting point in a straight line to the place he professes to have reached must have been somewhere between 560 and 620 miles.

Now, the total width of New Guinea is here 380 miles only, and the longest distance possible to go without reaching the sea is just about 620 miles, which takes you to the shores of Geelvinck Bay.

The centre of New Guinea is about 6° S. of the equator, and is almost certainly a forest region throughout and abundantly watered. In this equatorial belt all round the globe the temperature is not excessive, 96° or 98° being the extreme daily limit, while the nights are almost invariably cool (70° to 76°). The greater part of the country here described is, however, said to be open plains with only occasional forest tracts; water was not found for a whole day's journey, even at the foot of a mountain range 10,000 feet high, and the ordinary daily temperature is said to have reached 106° to 109° and 115° in the shade. He describes a terrific storm of hailstones as large as hens' eggs, not on the mountains, but in the low country about 7° S. latitude.

His mode of travelling is as extraordinary as his geography. After the statement that in the tropics "early morning and evening are the only times when it is possible to travel," he assures us that he started at 3 A.M., and in the evening continued his journey till 9 P.M. This gives two-and-a-half hours in the morning and the same at night of total darkness, in an unknown, pathless, tropical country, and he even ascends part of a dangerous mountain full of fissures and huge rocks, till nine o'clock at night! The country, too, was full of venomous snakes; and huge scorpions a foot long, whose sting was certain death, were very abundant; and as these last are nocturnal animals, travelling in darkness among fissured rocks and dense vegetation must have been exciting. But then we are told that he carried a lanthorn, and by means of this artificial illumination it is to be supposed the whole party made good progress and baffled the scorpions.

More marvellous still is the ascent of Mount Hercules, 32,783 feet high. He starts with one native from the foot of the mountain at 4 A.M., carrying "food, water, arms, and blankets," and ascends 14,000 feet by nine o'clock! At 15,000 feet they came to snow, but continued on for many thousand feet more, and by 1 P.M. had reached a height of 25,314 feet, the temperature being 22° below freezing. This is certainly good climbing, as it is just 4,000 feet higher than Chimborazo from the sea-level, and more than twice as high as Mont Blanc is above Chamouni. The Alpine Club must hide their diminished heads after this. Of course, having turned back at one o'clock, our travellers arrived safely at their camp at 7.30 P.M. A tinted view of this wonderful mountain forms the frontispiece to the book.

Having digested this Alpine feat as best we may, let us turn to Capt. Lawson's account of the natural history of the island. It may be premised, for the benefit of non-zoological readers, that New Guinea belongs to the Australian region, and that with the exception of bats and a wild pig, all the known mammalia are marsupials, four species of kangaroos, several species of *Cuscus* (an animal somewhat like an opossum), and some smaller marsupial forms being known. The coasts have been visited for centuries, and considerable excursions have been made in the interior of the northern part of the island, while the southern portions have also been several times visited by our various surveying parties. The islands all round it agree in this exclusion of all mammalia but marsupials. But Capt. Lawson tells us quite a different tale. He met with no solitary kangaroo or Cuscus all through New Guinea, but he everywhere encountered deer of several species, wild buffaloes, wild goats, wild cattle of a new species, hares, foxes, a wonderful new tiger, long-tailed monkeys, and huge man-like apes! Of birds we have, quite correctly, Cockatoos and Birds of Paradise, but along with these, pheasants, woodpeckers, and vultures, the two former not known within a thousand, the latter within two thousand miles of New Guinea. The natives, too, have great herds of hump-backed cattle, and far in the interior many of them speak Dutch!

Hardly less absurd are Capt. Lawson's wonderful hunting feats and hairbreadth escapes. The monkeys of New Guinea seem remarkable for waiting to be shot at, although, as the natives have guns and shoot them for food, they would in other countries have become wary. Yet our author goes out with a native chief to shoot monkeys, and in a couple of hours they bag a score and wound several others. Again, in an hour's shooting he kills "thirty-nine ducks, five ibises, two storks, seven kingfishers, and three new birds." The deer are seen in "herds of two or three hundred," the wild goats generally go in "flocks of seventy or eighty!" A herd of at least ten thousand buffaloes was seen, and in a single tree more than a thousand hanging nests of one species of bird were counted, each nest, too, containing several distinct families. Capt. Lawson is tossed and then trampled on by a wild buffalo, and when recovered so that he could "walk a few paces, leaning on the arm of one of his attendants," he goes fishing, and in two hours "pulled out over a hundred fish, the largest a yard long," not to mention many large fish which broke away from the hook. A huge New Guinea tiger gets him in its clutches, but though the animal was larger than a Bengal tiger, he of course escapes, though "drenched with the Moolah's blood." He preserves the skin, which is "marked with black and chestnut stripes on a white ground," and this skin is "one of the few specimens he has succeeded in bringing to Europe." Wonderful birds, snakes, and insects are also described, sometimes very minutely, but not one of them at all resembles any of the known denizens of New Guinea. Here is a butterfly for example: "The largest specimen I obtained, whose wings measured exactly twelve inches across, was black, with a red border to the wings and red bands round the body. In the centre of each wing were three light blue spots arranged in a triangle. The body of this fly was as thick as my thumb, and six inches in length. The feelers were twelve inches in length, *and curled into three coils.*"

As if to complete his own refutation, our author states that he returned to the coast with a party of natives who were conveying, among other merchandise, skins of "birds, monkeys, &c.," and that two or three Dutch traders, as well as many Malays and Chinese, come there every year. This part of New Guinea is therefore in constant communication with the rest of the world, yet the existence in the island of monkeys, apes, deer, buffaloes, goats, and tigers, has remained totally unknown till the secret was revealed to us by this enterprising and veracious traveller.

ALFRED R. WALLACE

OUR BOOK SHELF

Vestiges of the Molten Globe. By W. L. Green, Minister of Foreign Affairs to the King of the Sandwich Islands. (Stanford and Co., 1875.)

IT is a pity that books of this sort are published, as they can do no good. It is one of that class which attempts to account for the general features of the earth by some extravagant hypothesis, for the proof of which some superficial observations of well-known facts and some show of quotations from well-known writers are all that is offered. Who besides the author can believe that the shape of the earth, deprived of its oceans, would be a tetrahedron, the four angles representing the four continents? Yet the author announces himself as following in the footsteps of Elie de Beaumont in his theory of the *réseau pentagonal*, as the following lucid sentence on page 2 shows:—"The form (of the earth) is included in his *réseau triangulaire*, and is, as I propose to show, the six-faced tetrahedron; the easterly sag or twist of the southern hemisphere on a twin plane, the apparently macled form of the crystal, having caused the lines of relief and depression of the earth's surface to elude solution whilst the *réseau* of that crystal in its simple form alone was applied to them." We quite agree with the author that "only the imperfection of the ideas or of the language in which they are conveyed can prevent the following pages being intelligible to every reader." However untenable De Beaumont's theory was, it was conscientiously and laboriously worked out, and the conclusions were commensurate with the offered proof, even if they were erroneous; but Mr. Green, who would be his follower and improver, jumps to conclusions far wider on the basis of supposition only. The present short volume is only the first part of three that are promised on the figure of the earth, volcanic action, and physiography; and we must hope that the second part, at least, which is to contain "observations of the great active volcanoes and the great extinct volcanic range of the Hawaiian group," which the author must have had good opportunities of making, will be somewhat more solid than this first. Mr. Green is plainly capable of better things than wild speculation, which anyone can make and no one can prove. There are no doubt many remarkable features in the distribution and shape of land and the direction of its coast lines, some of which are here pointed out; but the meaning of these things will only be arrived at by a wider knowledge of facts and sober induction from them. The large map that accompanies the volume shows some of these features well, and is beautifully executed.

Stanford's Elementary Atlases. I. Physical Atlas (sixth edition); II. Outline Atlas; III. Projection Atlas; IV. Blank Sheets for Maps. By the Rev. J. P. Faunthorpe, M.A., F.R.G.S. (London: Edward Stanford, 1875.)

THIS is really an admirable apparatus, not merely for the purpose of teaching the construction of maps, but for the giving of a real knowledge of what Physical Geography means, and for the conveyance of an impressive idea of the prominent physical features of the particular countries embraced in the set of maps. There are sixteen maps altogether, and in the Physical Atlas the chief physical features of the various countries are clearly brought out—mountain ranges, table-lands, and river-courses. The mountain ranges are simply but sufficiently indicated by thick lines, the principal summits being shown by small circles; the table-lands are shown by simple shading. Besides these features, each map contains one or more of the principal cross-sections of the country, which convey a vivid idea of its conformation. Prefixed to the Physical Atlas are a few useful hints on Map-drawing, on Mercator's Projection, on the Shape and Position of the Land Masses, and a few notes illustrating each map. Atlases II., III., and IV. are intended to lead the student gradually to skill in map-drawing, and are well calculated to serve the purpose. Anyone who goes faithfully through the course indicated by this excellent set of books will have a more real knowledge of the main features of the land-masses of the globe than any amount of mere reading can give. The fact that the Physical Atlas has reached a sixth edition, which contains several new maps and additional letterpress, proves that Mr. Faunthorpe's design has been appreciated.

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. No notice is taken of anonymous communications.*]

The Meteors of November 14

THE writer some time since called attention to the fact that the dates of certain meteoric showers, given by Humboldt and Quetelet as belonging to the November stream, indicated the existence of two distinct and widely separated clusters moving in orbits very nearly identical. The years thus designated were 1787, 1818, 1820, 1822, 1823, 1841, and 1846. As the last two were subsequent to the great display of 1833, the meteors seen were noticed only in consequence of their being specially looked for; and as the number conformable to the radiant of the Leonids is not given, there may be some doubt whether those observed really belonged to the November stream. The former displays occurred before the periodicity of such phenomena had been suspected, and the number of meteors would seem to have been considerable. As the shower of 1787 preceded by twelve years the great meteoric fall witnessed in South America by Humboldt, the group from which it was derived had passed beyond the orbit of Saturn at the time of the latter display. The phenomena of 1818, 1820, 1822, and 1823 indicate that, as in the case of the major group, which passed its descending node between 1865 and 1870, the meteoroids are extended over a considerable arc of their orbit. From November 1787 to the middle of the nodal passage of 1818–1823, is about 33⅓ years—a period nearly the same as that of the principal cluster. These facts alone were regarded by the present writer as giving reasonable probability to the hypothesis of an approximate identity of orbits. In NATURE, vol. xi. p. 407, it was shown that the meteor-showers of October 855 and 856 were probably derived from the stream of Leonids, and it is certainly remarkable that the interval from 855 to 1787 is equal to twenty-eight periods of 33·293 years. Again, the shower observed in China, Sept. 28, A.D. 288, making proper allowance for the nodal motion, corresponds to the same epoch; the interval between 288 and 855 containing seventeen periods of 33·35 years. In view of the fact that the shower from this cluster was due between 1851 and 1855, the following extract from the writer's note-book is not without interest:—

"Newark, Delaware, Nov. 13, 1852. On the evening of the 11th, from 7 to 10 o'clock, an aurora borealis of ordinary brilliancy was constantly observed. About midnight the sky became overcast with clouds, thus preventing our watch for meteors which we were about to commence. On the 12th, from about 3 to 9 o'clock A.M., rain fell almost incessantly. About noon the clouds broke away, and the night between the 12th and 13th was quite clear. During six hours—from 10 P.M. to 4 A.M.—constant watch was maintained at four windows, facing north, south, east, and west. From 10 to 1 o'clock the observations were conducted by Prof. Ferris and myself with assistants. At 1 the place of Prof. Ferris was taken by Prof. Porter, who remained, with myself and assistants, till 4. We observed—

From 10h.	to 11h.	... ...	20 meteors.
,, 11	,, 12	... ...	35 ,,
,, 12	,, 1	... ...	40 ,,
,, 1	,, 2	... ...	52 ,,
,, 2	,, 3	... ...	75 ,,
,, 3	,, 4	... ...	59 ,,
	Total	... ...	281

When the meteors were most numerous, near 3 o'clock, the common point of divergence in Leo was distinctly observed."

I may here add, although the fact is not stated in my memoranda, that the conformable meteors, or a majority of them,

were seen near the radiant, and that they were generally smaller and had shorter tracks than the November meteors observed between 1865 and 1870. The number seen was too small to be called a shower; at the maximum, however, the fall per hour was nearly double that of ordinary nights. In short, I have no doubt that they were Leonids, and think it highly probable that they were derived from a distinct cluster which passed its perihelion in 1787 and 1820. We have therefore nine recorded meteor-falls which indicate the existence of a second cluster of Leonids, viz., those of A.D. 288, 855, 856, 1787, 1818, 1820, 1822, 1823, and 1852. The showers of 855 and 856 may be somewhat doubtful. If derived from the same meteor-cloud as the others, the dates would indicate considerable perturbations either by Uranus or the earth. The displays have been much less conspicuous than those of the major group, and hence the phenomena have been less frequently observed. The period is about 33·33 years, while that of the other swarm, according to Newton, is 33·25 years. Since their separation, therefore, the latter has gained nearly two-thirds of a revolution in their relative motion. The estimates which have been made in regard to the recent entrance of the cluster into the planetary system must consequently be rejected. DANIEL KIRKWOOD

Bloomington, Indiana, U.S.A., April 20

Systems of Consanguinity

IN NATURE, vol. xi. p. 401, I find a notice of the third edition of Sir John Lubbock's valuable work on the "Origin of Civilisation," in which the following paragraph occurs:—"The facts with which he deals in this chapter [a new one in that volume] have been taken from the voluminous work of the American author, Mr. Morgan; but Sir John Lubbock, putting aside Mr. Morgan's theorising, has submitted a view of them of his own. This, in the main, and as far as it goes, we think, he has made out."

In the same article the following paragraph also occurs:—"One of Mr. Morgan's theories (for he has, or seems to have, two which it is no business of ours to reconcile with each other) is, that these systems are, to use the words of Sir John Lubbock, 'arbitrary, artificial, and intentional.'"

These statements, to the last of which with your permission I desire to reply, present the "American author" both harshly and unfairly to the British public. The interpretation of these systems of consanguinity, thus ascribed to me, is not mine; neither is the interpretation given in my work on "Systems of Consanguinity."

There are three or four places, and perhaps more, in that volume in which I speak of the system of a particular people as "artificial and complicated," and as "arbitrary and artificial," without the qualification in each case which should, perhaps, have been inserted. Thus, commenting on the same system (Con. p. 392), I remark that "the chain of consanguinity has been followed with great particularity, that the artificial and complicated character of the system might be exhibited, as well as the rigorous precision with which its minute details are adjusted." One who had read my work through could not have been misled by this statement, which was intended to characterise this system as it appeared on its face, and apart from all considerations respecting its origin. On the next page but one (p. 394) the same statement is repeated and qualified as follows: "As a plan of consanguinity it [the same system] is stupendous in form and complicated in its details; and seemingly arbitrary and artificial in its character when judged by ordinary standards."

In a single and final chapter of that work (pp. 467-510), entitled "General Results," I discussed the three great systems of consanguinity found in the principal families of mankind, and indicated some of the general conditions they seemed to warrant. My interpretation of these systems will there be found. To this chapter a person would naturally turn if he wished to know the views of the author on the precise question whether the systems were to be regarded as artificial or natural. Among other things, it contains what is prudently called a "conjectural solution" of the origin of the Malayan system of consanguinity, and also a similar solution of the origin of the Turanian system. These solutions are presented and discussed in connection with a series of fifteen prominent institutions and customs of mankind, articulated in a sequence in the order of their probable origination. It commences with "I. Promiscuous Intercourse"; "II. Intermarriage, or Cohabitation of Brothers and Sisters;" and ends with "XV. The Overthrow of the Classificatory System of Relationship, and the Substitution of the Descriptive." In it are enumerated several successive forms of marriage, several successive forms of the family, and the three systems of consanguinity in their order of relation. It was designed to illustrate the course of human progress from savagery to civilisation; one form of marriage being followed by another, one form of the family by another, and one system of consanguinity by another. It is a sequence of human progress through the slow accumulations of experimental knowledge.

At the end of the solution of the origin of the Malayan system, which is founded upon the assumed intermarriage of brothers and sisters in a group (the second member of the sequence), occurs the following statement (p. 482):—"Every blood relationship under the Malayan system is thus explained from the nature of descents, and is seen to be the one actually existing, as near as the parentage of individuals could be known. The system, therefore, follows the flow of the blood, instead of thwarting or diverting its currents. It is a natural rather than an arbitrary and artificial system." The reader will notice that it was this form of marriage which created the Malayan system.

Again, at the end of the solution of the origin of the Turanian system, and after showing that the latter was derived from the Malayan, occurs the following statement (p. 486): "If the progressive conditions of society during the ages of barbarism, from which this solution is drawn, are partly hypothetical, the system itself, as thus explained, is found to be simple and natural instead of an arbitrary and artificial creation of human intelligence."

In prosecuting this investigation one of the questions to be determined was whether these systems were artificial or natural. If the former, they are without ethnological value; but if natural systems, showing the relationships which actually existed when they were respectively formed, then they would possess immense value, because they concerned and demonstrated a condition of ancient society of which previously we had no definite conception. From each system, in such a case, can be deduced, with almost unerring certainty, the form of marriage and of the family in which it originated. It was by this course of reasoning that I discovered the necessary antecedent existence of the intermarriage of brothers and sisters in a group to account for the existence of the Malayan system of consanguinity. This fact gives us the starting-point in which ancient society commences, with the proof that it did so commence. Hence the second member of the sequence above-named. This sequence on its face, and these solutions in express terms, treat these systems as natural in every respect.

In an address before the London Anthropological Institute in 1871 upon the contents of the same volume on Consanguinity, Sir John Lubbock places me in the same position, and leaves me there. He remarks in that address (Journal of A. I., 1871, p. 6), which I presume forms the basis of "the new chapter," that "Mr. Morgan, from several passages, appears to regard the system as arbitrary, artificial, and intentional;" from which he takes occasion to dissent. I find in that somewhat elaborate address no reference whatever to the solutions named, and none whatever to the sequence. I am persuaded they must have escaped his notice. LEWIS H. MORGAN

Rochester, New York, April 19

The Migration of Species

IT has probably been the experience of most who have undertaken a voyage to sea, to have observed land-birds and insects far from the nearest coast, either in course of transit or resting on the vessel. Many travellers have observed these visitants, and their records have proved valuable biological facts bearing on the occasional migrations of species and their consequences as has been pointed out by Mr. Darwin. But it is more than probable that this dispersal of land species over extremely wide areas of sea is far more constant and less occasional than we are at present justified in affirming from the facts as yet collected. Unfortunately, however, we glean very little biological information from the great mercantile marine service of this country, an assemblage of which we are so justly proud, and it is only by costly Government expeditions that we become acquainted with facts that remained and would have remained unnoticed by the immense number of sailors who leave our shores. Nor can we feel surprised at the result when we recollect that biology is scarcely a subject thought necessary to form part of a mariner's education. A good instance is afforded by the results of the voyage of the *Beagle*. An impalpable powder fell upon the ship off the Cape de Verd Islands. This powder must have fallen upon many ships before; but Mr. Darwin being on board the

Beagle, it was collected and sent for inspection to Ehrenberg, and results of great scientific value accrued. Had our great philosophic naturalist not been there, this dust might still have fallen on ships to the present day, been swept away as a nuisance, and unrecognised as of any possible interest. That errant species must frequently visit vessels was shown me on a voyage to the East a few years ago. Thus, in the early part of September, in about lat. 12° N. and long. 26° W., a dove flew on board, which, after resting for a short time, again pursued its journey. In about lat. 9° N. and long. 25° W. a moth, apparently *S. convolvuli*, reached the vessel just before the arrival of a squall. In reply to my inquiries, both the officers and crew stated that these were simply very common occurrences.

I think we may feel confident that most vessels sailing this course meet frequently with like objects, and the interest would be increased by finding whether the same were observed by vessels still further from the nearest land. Could some means be devised for obtaining records of these migratory species, or could some large shipowner be induced to have the same carefully recorded in the log-books kept on board his vessels, I feel little doubt that we should be astonished by the number and constancy of these wanderers from other lands. The entry in the log-book would ensure the date and approximate latitude and longitude which would be necessary factors in dealing with this biological question, and would doubtless bear further proof to Mr. Darwin's view of colonisation by chance or occasional visitants.

So much might be done by some of our present means of unendowed research that it seems weary waiting for the day when a broader education will tend to induce our sailors to reap that abundant harvest of scientific information which they so constantly have the means of acquiring. There is surely some branch of science which might be indebted to every vessel that sails from this country on a foreign voyage, could the preliminary information and impetus for inquiry be given to the officers or crew. I believe the "Religious Tract," or some kindred society, provides many of our vessels with devotional literature; could not our learned societies also compile and provide some scientific works and questions for solution which might be placed in the hands of our sailors, thus affording a pleasure for a long voyage, and producing effects to be appreciated by science at home?

We should not expect the results of a "*Challenger* Expedition," but then Government outlays for that purpose are sometimes few and far between. W. L. DISTANT

Streatham Cottage, Buccleuch Road, West Dulwich

Murænopsis tridactyla

WITH reference to Mr. Kent's letter in your last number (p. 69), I beg leave to point out to you that it is very doubtful, according to the best authorities, whether the so-called *Murænopsis tridactyla* is even *specifically* different from *Amphiuma means* (*i.e.* the two-toed form of the same animal). Of the latter this Society have had several living specimens in their collection. One of them (purchased December 6, 1870) is still living in the Society's Gardens. P. L. SCLATER

Zoological Society of London

Hardened Glass

THE account of hardened and malleable glass given in NATURE, vol. xi. p. 474, interested me greatly.

It seems hardly possible that a change in the molecular constitution of glass can take place without affecting its optical properties. May not this glass, therefore, possess refractive and dispersive powers unlike those of the kind usually employed in lenses? If it can be made of sufficient purity and is found to have a higher refractive power, it will enable us to make thinner lenses with smaller curves, thus contributing to the further improvement of optical instruments. JAMES H. LOGAN

Jacksonville, Illinois, U.S.A., May 6

Yorkshire Exhibition "Guide"

WILL you kindly allow me, as a member of the Science Committee of the Yorkshire Exhibition of Arts and Manufactures, held at Leeds, to point out that the Yorkshire "Guide" referred in NATURE, vol. xii. p. 76, is entirely an unofficial publication. No competent member of the Committee was applied to for information respecting palladium or any other exhibit. The first intimation the Committee had of the wild statements contained in the "Guide" was received from a member who purchased a copy in the usual way, and immediate steps were taken to secure that more trustworthy information should be contained in future editions of the "Guide," unofficial though it be. You will, I think, see that it is rather hard that the Committee should, as by inference they may be, be made responsible for the statements you indicate, and will, I hope, give me space for this repudiation of them.

H. POCKLINGTON

Primroses and Cowslips

IN answer to Mr. J. J. Murphy's inquiry in NATURE of May 13 (vol. xii. p. 34) I beg to state that the locality in which, as far as I am aware, no primroses are found, is formed by the outcrop of the chalk in the south of Cambridgeshire and north of Hertfordshire, and is bounded on the north and south by the outcrop of the chalk marl and the edge of the London Basin, and east and west by the Great Eastern and Great Northern main lines; it is, from the nature of the underlying beds, very dry. I have always thought, but perhaps without foundation, that primroses are not generally found in the districts in which cowslips are common, and *vice versâ*, and Mr. Murphy's remark seems to bear out this.

I have not noticed any instance of the removal of the ovules of cowslips by birds; and even primroses, in other parts of the garden than those first attacked, have been left untouched.

Odsey, near Royston, Herts H. GEORGE FORDHAM

OUR ASTRONOMICAL COLUMN

THE MELBOURNE CATALOGUE.—We have received the "First Melbourne General Catalogue" of stars, which is founded upon the observations taken with the Transit Circle under the direction of Mr. Ellery, the Government Astronomer, at the New Observatory of Melbourne, between the middle of the year 1863 and the end of 1870. It has been reduced and prepared for publication by Mr. E. J. White, the first assistant, from the materials printed in vols. ii. iii. and iv. of the Melbourne Observations. Vol. i. contained a catalogue of 546 stars resulting from the meridian observations taken previous to the removal of the Observatory to its present site, and called the "Williamstown Catalogue:" in the new publication we have the positions for the beginning of 1870, of 1227 stars, with few exceptions observed at least three times, and accompanied by the terms of precession to the third order, proper motions, and Bessel's reduction-constants (as in the British Association Catalogue), with the synonyms in Lacaille, Piazzi, Brisbane, and Johnson. Great care appears to have been taken in calculating the precessions from the mean year of observation to the epoch of the catalogue, and a detailed account of the process employed is given in the introduction. The proper motions of the stars have also been discussed where the means were available, the more uncertain results being distinguished from those possessing greater claim to acceptance by enclosure in parentheses.

Many of the most interesting stars of the southern heavens are included in this Catalogue, and we note that the remarkable one ϵ Indi has not been overlooked. In this case the recent Melbourne observations, as compared with Jacobs' at Madras in 1852, assign an annual proper motion of 4″·58 in arc of great circle, thus quite confirming values previously obtained from less reliable data. We hope that at no distant period an attempt will be made to determine the parallax of this star. Large proper motion is indicated for the stars B. A. C. 5719, Aræ, and 7816, Indi; but on comparing the Melbourne positions with those in Gilliss's Santiago Catalogue, in the Washington volume of observations for 1868, not mentioned by Mr. White amongst the authorities he had consulted, it is not confirmed in either case.

The "First Melbourne Catalogue" is a handsome specimen of typography from the Government Printing Office. It must form an essential work of reference for every southern astronomer, who has now, with the "Cape

General Catalogue," two authorities supplying him with excellent positions of a large number of stars.

THE COMET OF 1533.—In the catalogues of the orbits of comets we find two sets of elements for this comet, both deduced from the observations of Apian between July 18 and 25, which are contained in his rare work, *Astronomicum Cæsareum*. The first orbit is by Douwes, who assigned *retrograde* motion, but in the *Berliner Jahrbuch* for 1800, Olbers gives another orbit, equally satisfactory as regards representing Apian's observations, in which the heliocentric motion is *direct*, and he appeared to think it was not possible to decide which of the two is to be preferred. In addition to Apian's account of this comet we have a brief one by Gemma Frisius, who states that after having been seen about the beginning of July in 5° (or rather, as Pingré corrects him, in 15°) of the sign Gemini, near the star Capella, with 24° of latitude and 48° north declination, it passed by a westerly motion, or contrary to the order of the signs, to the constellation Cassiopea, which it traversed, finally disappearing in Cygnus. Fracastor has also left us an account of the comet's track, though there is some ambiguity about it. Since Olbers calculated the orbit the Chinese observations have been published, in the first instance by M. Edouard Biot, in the additions to the *Connaissance des Temps* for 1846, and more recently in Mr. Williams' work upon Cometary Observations in China, and it would appear that the comet moved to the vicinity of π Cygni, and was last seen on Sept. 16. If we compare the elements of Douwes and Olbers with the track thus roughly defined, we see that the retrograde orbit of Douwes is hardly probable, and that possibly a modification of the direct orbit of Olbers would be found to sufficiently represent the path of the comet, according to Apian, Gemma, and the Chinese Annals.

OCCULTATION OF VENUS.—Mr. R. Meldola, of the Royal Society Eclipse Expedition, writes that the occultation of May 2 was partially observed by Prof. Tacchini and himself from the P. and O. steamer *Peshawur* in the Arabian Sea. The moon was obscured by clouds at the time of immersion; the last contact took place at 16h. 15m. 6s. local mean time. Ship's position furnished by Capt. White—long. 77° 3′ E., lat. 6° 48′ 18″ N.

OUR BOTANICAL COLUMN

PHENOMENA OF PLANT-LIFE.—The expansive power of growing vegetable tissue is something marvellous, if the experiments undertaken by Mr. Clark, president of the State Agricultural College of Massachusetts, are perfectly trustworthy. If his appliance for measuring the force exerted by a growing pumpkin was not at fault, the greatest weight lifted by the pumpkin in the course of its development was nearly two-and-a-half tons. Apparently the greatest care was taken to arrive at the truth, and we have no reason to doubt the accuracy of the statements contained in Mr. Clark's paper which was presented to the Massachusetts Board of Agriculture. But in our ignorance of the phenomena of plant life we should like to see the observations repeated. At the end of the experiment alluded to the soil was carefully washed from the roots of the pumpkin vine, and the entire system of roots spread out upon the floor of a large room and carefully measured. In addition to the main root, roots were formed at each joint or node. The total length of root developed was calculated to be over fifteen miles; and the time the plant was growing, four months. During the greater part of the time, of course, the rate of growth was relatively slow, but the maximum rate was computed at not less than one thousand feet of root per day.

With another plant of the same species, *Cucurbita maxima*, an experiment was instituted to ascertain the pressure exerted by the rising sap. For this purpose the plant was cut off near the ground, after it had attained a length of twelve feet, and a mercurial gauge attached to the part left in the ground. The maximum force with which the root of the pumpkin exuded the water absorbed by it was equal to a column of water 48·51 feet in height.

Some experiments to determine the channels through which the crude sap rises, and on the diffusion of the elaborated sap, gave interesting results. Mr. Clark says: "We find that the crude sap imbibed by the root-hairs from the surface of the particles of the soil seems to be taken up in a dry state; that is, it appears to be absorbed molecule by molecule, no fluid water being visible, and carried in this form through all the cellulose membranes between the earth and leaf, by which it is to be digested or exhaled. We do not say this is literally true, but it accords very nearly with what is constantly to be seen in some species of plants. The circulation of the sap in a poplar tree is very dry compared with that of the blood of any animal. Not a drop of moisture will ever flow from the wood of an aspen, so far as we have observed." It was found that an exceedingly small proportion of sapwood sufficed to convey the necessary supply of crude sap to the foliage, but none would ascend through the bark.

The quantity of sap that flowed from different trees during the season varied greatly in diverse species. Thus the entire flow from the bitter-nut was less than the product of the sugar-maple for a single day; but the iron-wood and the birches surpass the maple in the rapidity and amount of their flowing. A paper-birch, fifteen inches in diameter, bled in less than two months over one thousand four hundred and eighty-six pounds of sap; the maximum flow, on the 5th of May, amounting to sixty-three pounds and four ounces. The grape bleeds comparatively little as compared with many other things. A very large proportion of the trees experimented upon did not show any tendency to bleed in spring. We might extract many other interesting details from Mr. Clark's paper, had we sufficient space for them.

PHYSICS IN GERMANY

(*From a German Correspondent.*)

HERR STEFAN, of Vienna, has published a paper on a series of researches on adhesion. It is well known that two plane plates which are placed upon one another adhere together so firmly that they can only be separated by a certain amount of force. This phenomenon has hitherto been considered as caused by adhesion (*i.e.* by the action of molecular forces between the particles in contact between the two plates), and it was tried to determine the magnitude of this adhesion statically.

The improbability of this conception already follows from the fact that in the case in question no immediate contact of the two plates takes place, but that between them there is a layer of air of considerable thickness. If two glass plates are employed for this experiment, they do not show Newton's coloured rings; these can only be produced with plates that are perfectly plane and with the application of considerable pressure. If, therefore, molecular forces were active in this case between the particles of the two plates, then the molecular sphere of action would have to be very much larger than is generally adopted according to other experiments. The phenomenon becomes still more striking if the experiment is made under water. In that case an attraction in the two plates can still be perceived, even if they are a millimetre apart. Herr Stefan used for his experiments two plates of glass, of which one was suspended from a balance in such a manner that its inferior plane was horizontal. The balance was then brought to equilibrium. The second plate was also placed horizontally under the other one. Three little pieces of wire were then placed upon it, and the upper plate was then let down so far as to rest upon these pieces of wire. By varying the thicknesses of the wires the distance of the two plates could be brought to any desired magnitude. To tear away the upper plate

from the under one, it was necessary to place a certain over-weight into the other scale of the balance.

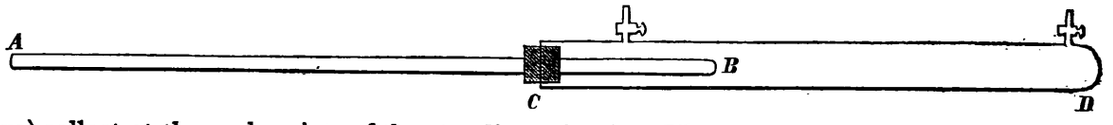
It was found that the separation of the two plates can be accomplished by any force, however small, only the time in which the distance of the plates is increased by a certain fraction through the action of such a force, is all the greater, the smaller this force is. This time is still greater if the two plates are in water or in another liquid, instead of in air. To give an idea of this we may mention that the distance of two plates, of 155 millimetres diameter, under water, which originally was 0·1 mm., was increased in consequence of the continuous pull of 1 gramme by 0·01 mm. only in 1½ minutes, by 0·1 mm. only in 7 minutes.

Herr Stefan in his experiments measured the time that passed while the original distance of the plates increased by a certain fraction. First, the law was established for the motion of the plates in liquids as well as in air, that the times stand in the reverse proportion to the separating force. With the same overweight they are the longer, the smaller the original distance of the plates, but this in a far greater than a simple proportion; they increase nearly in square proportion if the distance of plates decreases in a simple one. For different sized plates the times in question stand in the proportion of the fourth powers of the semi-diameters of the plates; for different liquids in the same proportions as the times which elapse, while equal volumes of these liquids flow through a capillary tube, under equal pressure.

It results clearly that with this phenomenon there rests a problem of hydrodynamics and not of molecular forces. The phenomenon can be explained in the following manner:—When the separating force begins to act, the distance of the plates is increased by an infinitely small part. The space contained between the plates is thus enlarged, the liquid therein contained is dilated, and consequently its hydrostatic pressure decreased. The over-pressure of the exterior liquid acts against the separating force. No equilibrium is, however, attained, because the decrease of hydrostatic pressure between the plates causes an inflow of the exterior liquid and thus a decrease of the difference of pressure. The distance of plates may be again increased by the separating force, and then the same process is repeated in a continuous manner.

Herr Stefan has therefore given the name of *apparent adhesion* to this phenomenon. He has tried to deduce theoretically all the different laws to which the different experiments have led him; he has succeeded in finding an equation which expresses these laws, and which at the same time permits the deduction of the co-efficients of interior friction of the liquids experimented with, directly from the experiments. The values of the coefficients obtained in this manner correspond almost exactly with those obtained by the experiments of Poisseville, Maxwell, and O. E. Meyer. But as Herr Stefan thinks the theoretical solution of the problem only an approximate one, we reserve further details on the subject.

If we rub a wet cloth quickly over a glass tube, closed at both ends, it is caused to vibrate longitudinally. If at the same time it gives its lowest longitudinal note (as we will suppose for the sake of simplicity), then the end planes of the tube strike quite periodically against the air enclosed in it, and cause the same to vibrate. These vibrations are isochronous with those of the tube itself. They proceed from both ends of the tube towards one another, and, as a consequence, standing waves are formed in the enclosed air column. If into such a tube lycopodium or silicic acid has been placed, these powders (as also Herr Kundt has discovered



a few years ago) collect at the node points of the standing waves and form figures of a very peculiar kind. As the length of these standing waves depends solely on the height of the generating sound and of the velocity of the waves in the gas, with which the tube is filled, the proportion of this wave-length to the wave-length in the glass gives the relative velocity of sound in air, with that in the glass as unity. Herren Kundt and Lehmann at Strasburg have lately tried to produce longitudinal vibrations and the figures just mentioned in a liquid, enclosed in a cylindrical tube, in a similar manner. It was found that in a column of water standing waves and figures can be produced almost as easily as in a column of air. The apparatus which was used for this purpose consisted of a glass tube, A B, closed at one end, B, which was placed firmly into a wider glass tube, C D, by means of an india-rubber stopper. The latter glass tube was closed at end D, and had two lateral outlets with stopcocks, so as to be easily filled with water. The powder which is placed in the tube C D must be sufficiently heavy and of a certain degree of fineness; it is best to use for this purpose finely divided iron (*Ferrum limatum*). The column of liquid must be free of even the smallest air-bubble. If the liquid used, for instance water, contains a gas absorbed, it must be first freed from it by continual boiling. In order to make the apparatus sound it is necessary only to rub a wet cloth quickly over the protruding part of the tube A B.

The figures in this column of liquid may serve for the determination of the velocity of sound in the liquid. If the end A of the sounding tube is closed by a cork, and if then over this end another tube is attached, which contains lycopodium, then, by the figures which occur in the liquid, and by those which occur in the tube with air, the wave-length of the same sound is obtained both in liquid and in air. The proportion of both gives the relative velocity of sound in the liquid with reference to that in air as unity. This relative velocity multiplied by the absolute velocity in air at the same temperature, gives the absolute velocity of sound in the liquid at the temperature in question. It was interesting to compare the results of this method of determining the velocity of sound in water, with the values required by the ordinary theory of the velocity of sound. According to the theory based on the experimentally determined elasticity of water, the velocity of sound at 8° Celsius is 1,437 metres. Colladon and Sturm, by their experiments in the Lake of Geneva, found the same to be 1,435 metres at 8° C. Although the remarkable coincidence of these values is only accidental, it is nevertheless proved that experiments such as those of Colladon and Sturm do not give figures that are very far from the theoretical values. The experiments of Kundt and Lehmann show that the diameter and thickness of the glass of the tube, which is used for the determination of the velocity of sound according to the method above described, greatly affect the value of the velocity of sound in water. In a tube of 2·2 mm. thickness of side, and 28·7 mm. diameter, the velocity at 18° C. was 1040·4 metres (the mean of two experiments which coincided very closely); in another one of 5 mm. thickness of side and 14 mm. diameter, the velocity was found 1382·2 metres at 22·2° C. As it would be very difficult to avoid unevenness in the sides of the tube, it does not seem probable that when using tubes the above value of 1,435 metres could be completely reached. These experiments, proving the influence of the thickness of the sides and diameter of a tube upon the velocity of sound in water, contradict the hypothesis of Wertheim, according to which a column of liquid, which is sounding or conducting sound, behaves like a firm rod. S.W

MAGNETO-ELECTRIC MACHINES*

FEW discoveries in physical science have been more important in themselves, or richer in practical results, than Faraday's discovery of the induction of electrical currents; and with the exception of the immortal work of Newton on the properties of Light, it would be difficult to mention any other experimental investigation, as it first issued from the hands of the author, so complete in all its details, or so full of new and original facts. Œrsted's grand discovery, which linked together electricity and magnetism, had already yielded a scientific harvest of uncommon richness. It led immediately to the construction of electro-magnets vastly exceeding in power any permanent magnets which were then known or have since been made. The multiplier or galvanometer of Schweigger supplied a new and important instrument for measuring electrical currents, which, with a little modification, became the electric telegraph. Faraday discovered the rotatory character of

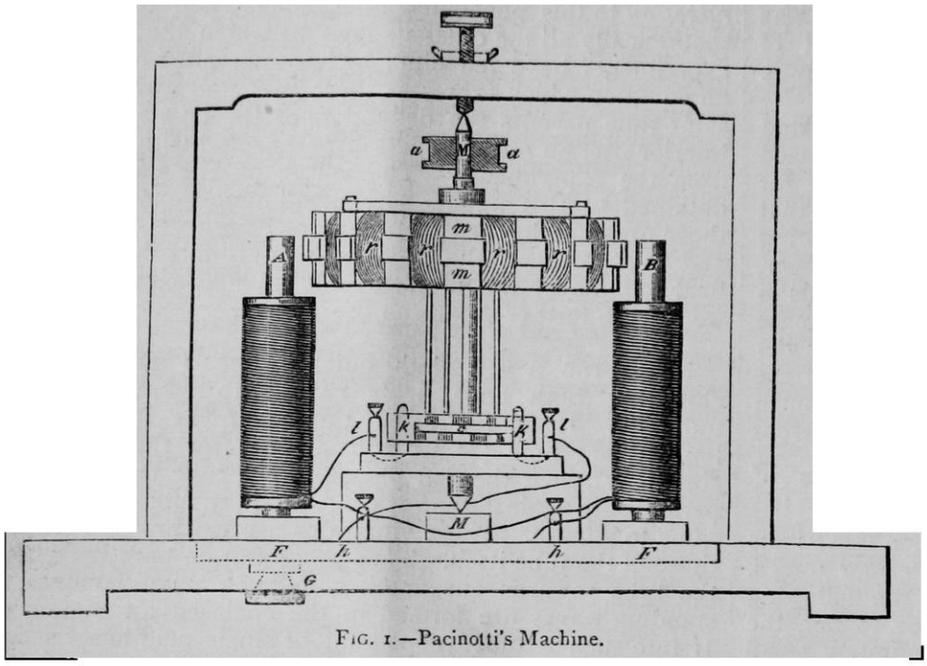


FIG. 1.—Pacinotti's Machine.

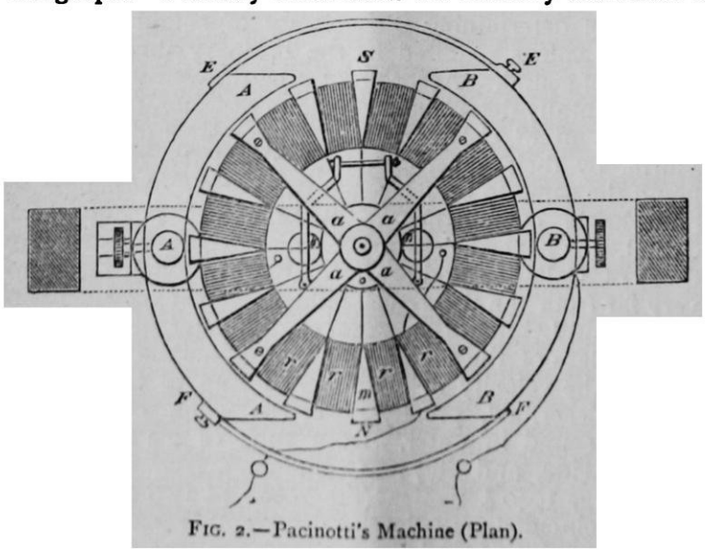


FIG. 2.—Pacinotti's Machine (Plan).

the reciprocal action of magnets and electrical currents; and Ampère showed that all the properties of a permanent magnet could be explained on the hypothesis of electrical currents in a fixed direction circulating around the magnet. A problem which proved to be one of surpassing difficulty, and long baffled many of the most distinguished physicists of Europe—to obtain electrical currents by means of a steel magnet—was in 1831 completely solved in the exhaustive memoir by Faraday, in which he announced the discovery of the induction of electrical currents. It may be interesting to describe, nearly in his own words, Faraday's original experiments.

Two helices of insulated copper wire were passed round a wooden block, the ends of the wire of one helix being connected with a voltaic battery, and those of the other with a galvanometer. So long as the current from the battery passed through the first helix the needle of the galvanometer remained motionless, but on breaking the connection with the battery, a momentary current, as indicated by the galvanometer, traversed the wire of the second helix. The direction of this current was the same as that of the primary current of the battery. When the first helix was connected with the battery, another momentary current traversed the second helix, but in this case it was in the opposite direction to the primary current. Substituting for the first helix and the voltaic battery a permanent steel magnet or an electro-magnet, Faraday found that on introducing one end of the magnet into a hollow helix a temporary current was produced in the wire of the helix in one direction, and on withdrawing it another temporary current occurred in the opposite direction. For artificial magnets the magnetism of the earth may be substituted, and thus electrical currents can be obtained by induction from the magnetic conditions which everywhere prevail on the surface of this globe. The singular phenomenon first described by Arago, and afterwards elaborately investigated by Babbage and Herschel, that when a copper plate is rotated below a freely suspended magnet the latter tends to follow the motion of the plate, was shown by Faraday to arise from electrical currents induced by the magnet in the rotating metallic disc.

Soon after the announcement of these important results, Pixii constructed in Paris the first magneto-electric machine. I have still a vivid recollection of this machine as I saw it in Pixii's workshop. The currents were obtained by the rotation of a powerful horse-shoe magnet in front of an armature composed of two short

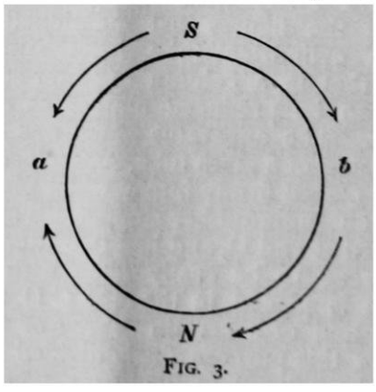


FIG. 3.

bars of soft iron with a connecting crossbar, the latter being surrounded by a long coil of copper wire covered with silk. The armature had, in short, nearly the form of a horse-shoe electro-magnet. With this machine electrical sparks were obtained, and water was freely decomposed. In the rotation of the magnet the faces of the armature or electro-magnet became successively north and south poles with intermediate conditions of neutrality, and the direction of the current changed at every semi-revolution of the magnet. Hence, in the decomposition of water and other electrolytes, the ele-

* The substance of a Lecture, with additions, delivered at the Belfast Philosophical Society, March 17, by Dr. Andrews, F.R.S., L. & E.

ments or radicles produced by the electrolysis could not be obtained separately. Pixii is said to have applied a commutator to his machine in order to obviate this defect. An important modification of Pixii's machine was soon after made by Paxton, who caused the armature to revolve instead of the permanent magnet. According to the character of the current required, armatures with longer or shorter wires were employed. A large machine of this construction, exhibited some years ago at the Polytechnic Institution in London, was capable of igniting a short platinum wire. In Clarke's machine the position of the armature was altered and an improved commutator applied. Siemens afterwards, by giving the armature a cylindrical form, rendered it more compact and better fitted for rapid rotation.

Siemens' armature was happily applied by Wilde, in 1866, to the construction of a machine of extraordinary power. Starting from a small magneto-electric machine provided with six steel magnets, each weighing one pound, and capable of carrying about ten times their weight, Wilde transmitted the direct current from this machine through the coils of an electro-magnet provided like the former with a Siemens' armature, and the direct current from the latter he in like manner transmitted through the coils of another large electro-magnet—so large, indeed, that its armature alone weighed above one third of a ton. This was also provided with a Siemens' armature. When the machine was in full action it melted a rod of iron 15 inches in length and a quarter of an inch in diameter, and gave the most brilliant illuminating effects when the discharge took place between carbon points. As nearly as could be estimated, the mechanical force absorbed in producing these results was from eight to ten-horse power. Wilde's machines have been successfully employed by Messrs. Elkington for the precipitation of copper and other metals, and he has lately proposed some important modifications to adapt them to the production of the electric light.

Some years before Wilde's experiments were published, Holmes had constructed on the Saxton principle a powerful magneto-electric machine, which has been successfully used at Dungeness and other lighthouses, and machines differing little from Holmes's are employed in some of the French lighthouses. In Holmes's original machine forty-eight pairs of compound bar-magnets were arranged for the armatures (160 in number) to revolve between the poles of the magnets, and by a system of commutators the current was obtained always in the same direction. Its amount, however, varied at almost indefinitely short intervals from a maximum to one-half of that amount. In practice these variations were wholly inappreciable.

The first suggestion of a magneto-electric machine capable of giving a continuous current always in the same direction is due to Dr. A. Pacinotti, of Florence. In the nineteenth volume of "Il Nuovo Cimento," which was published in 1865,* Pacinotti describes the model of an electro-magnetic machine constructed, some time before, under his direction, for the Cabinet of Technological Physics in the University of Pisa, whose essential feature was a novel form of armature to which he gave the name of "transversal electro-magnet." This armature was formed of a toothed iron ring, *m m* (Fig. 1), capable of rotating on a vertical axis, M M, and having the spaces between the teeth occupied by helices of copper wire covered with silk. The wire of the helices was always wound in the same direction round the ring, and the terminal end of each helix was brought into metallic connection with the adjoining end of the wire of the succeeding helix. From these junctions connecting wires were carried down parallel to the axis of the machine, and united to insulated plates of brass, of which a double row, as shown in Fig. 1, were inserted in a wooden cylinder, *c*, which was itself firmly attached to the lower part of the axis. The current entered through the successive brass plates as they came into contact with a small metallic roller, *k*, which was in communication with one pole of a voltaic battery. At the point of junction with the wires of the helices, the current from the battery divided into two parts, which respectively traversed in opposite directions the connected helices, each through a semi-diameter of the ring, and finally left the machine on the opposite side by a second roller, *k*, which was in connection with the other pole of the battery. When the connections were made, the iron ring began to rotate round its axis with considerable force. In a trial in which the current was supplied by four small elements of Bunsen, a weight of several kilogrammes was raised. In the apparatus as actually constructed, the poles of the electro-magnet were enlarged by the addition of two segments of soft iron, A A, B B (Fig. 2), which extended over the greater part of the iron ring. The details of the construction of the transversal electro-magnet will be easily understood from the plan given in Fig. 2.

Towards the end of the paper to which I have already referred, Pacinotti shows that the iron ring armature, or transversal electro-magnet, may be applied to reverse the conditions just described, and to obtain continuous electrical currents, always in the same direction, from a magnet, whether a permanent one, or an electro-magnet. As the original paper has not, as far as I know, been translated into English, and the scientific journal in which it was published is little known in this country, I will not make any apology for giving the following extract without abridgment.

"If we substitute for the electro-magnet A B (Fig. 1) a permanent magnet, and make the transversal electro-magnet revolve, we shall have a magneto-electric machine which will give an induced continuous current always in the same direction. To find the most suitable positions on the commutator from which to collect the induced current, let us observe that in presence of the poles of the fixed magnet, there are formed, by influence, at the extremities of a diameter, opposite poles on the moveable electro-magnet. These poles, N S (Fig. 2), maintain a fixed position when the transversal electro-magnet rotates upon its axis; and therefore, in respect to the magnetism and consequently to the induced currents, we may consider, or suppose, that the helices of copper wire move round on the ring magnet while the ring itself remains at rest. To study the induced currents which are developed in these helices, let us take one of them in the various positions it can assume. From the pole N (Fig. 3) advancing towards the pole S, there will be developed a direct current in one direction till the middle point *a* is reached; on passing this point the current will assume an opposite direction. Proceeding from S towards N, the current will maintain the same direction which it had from *a* to S, till the middle point *b* is reached; after passing *b* the direction will be again changed, and will now be the same which it had from N to *a*. Now, since all the helices communicate with one another, the electro-motive forces will be collected in one given direction, and will give to the entire current the course indicated by the arrows in Fig. 3;* and for collecting it, the most suitable positions will be *a b*; that is to say, the rollers on the commutator should be placed at right angles with the line of magnetism of the electro-magnet."

Pacinotti does not appear to have constructed specially a magneto-electric machine on the above principle, but he states that he verified the correctness of his views by turning the iron ring in the electro-magnetic machine, and observing the direction of the currents when a galvanometer was introduced into the circuit.

* The date on the title-page of the volume is 1863, but it contains a letter dated Rome, Jan. 19, 1865

* Fig. 3, as given in the text, is an exact fac-simile of the corresponding figure in the original. It is obvious from the figure itself, as well as from the text, that there is an error in the engraving, and that the arrow between S and *b* should point towards S and not towards *b*.

The results he obtained were not great, but were sufficient to enable him to announce that a magneto-electric machine could be constructed which would have the advantage of giving the induced currents all in the same direction, without the help of mechanical arrangements to separate opposed currents or to make them conspire with one another.

From the foregoing analysis of Pacinotti's memoir, there can be no doubt that it contains a description of the ring armature which in the hands of Gramme has recently led to the construction of magneto-electric machines giving continuous currents of great intensity. I cannot, however, pass over without notice an extraordinary blunder into which Pacinotti has fallen, and which would render any machine constructed after his model altogether valueless. By a reference to Fig. 2, which, as well as Figs. 1 and 3, has been engraved from a photograph of the plate appended to the original memoir, it will be seen that the letters N and S are placed at the end of the diameter of the ring which is at right angles to the line A B joining the poles of the fixed magnet. That Pacinotti intended these letters to designate north and south magnetic poles is manifest from the following passage among others in his memoir :—"Osserviamo che per influenza sulla elettro-calamita mobile si formano i poli opposti alle estremità di un diametro in presenza ai poli della calamita fissa. *Questi poli* N S mantengono una posizione fissa anche quando la elettro-calamita trasversale ruota sul suo asse." It is hardly necessary to say that the positions assigned by Pacinotti for the poles in an iron ring under the influence of a fixed magnet are in reality those of the neutral points, or points of no magnetism, and that the magnetic poles of the ring are at a distance of 90° from the positions stated by him. This mistake has led to a serious blunder in the construction of his machine, the metallic rollers which carry off the induced currents being placed, not at the neutral points (as Pacinotti has himself clearly showed that they ought to be), but at the poles of the ring. That any effects at all were obtained from the model at Pisa, we must attribute to the slight shifting of the poles of the ring due to its rotation. Apart, however, from this unaccountable error, it can scarcely be disputed that to Pacinotti is due the merit not only of having devised the ring armature or transversal electro-magnet, but of having also accurately analysed its mode of action.

(*To be continued.*)

*LECTURES AT THE ZOOLOGICAL GARDENS**

V.

Mr. Garrod on Camels and Llamas

THE Tylopoda form a group which includes the Camels together with the Llamas ; the name indicating that their feet are covered with callous skin instead of with hoofs as in the typical Ruminants, from which group they also differ considerably in many other characters, to be considered seriatim.

Horns are not developed in either sex. The upper lip is hairy and partly cleft. False hoofs are wanting. The general body-proportions are not so symmetrical as in any of the Cavicornia or Deer. Osteologically several special features present themselves. In the vertebræ of the neck the canals which are developed in the transverse processes, for the vertebral arteries to run in on their way to the brain, are excavated in the sides of the spinal canal of the cervical region. In the ankle two of the bones—the naviculare, or scaphoid, and the cuboid—which are anchylosed in the true Ruminants, are independent of one another. In the upper jaw there are two teeth developed, one on the side of each premaxilla; they are therefore lateral incisors. The canines in the lower jaw are of a different shape, and are separated by an interval from the incisors. The molars form a series of five above and four below ; in the Camels, but not in the Llamas, an additional small premolar, isolated in position and following the canine, is to be found in both jaws, increasing the grinder series to six above and five below on each side.

The abnormal conformation of the gastric section of the alimentary canal in the Camels has attracted the attention of many naturalists. In the Llamas the same structure maintains. As in the typical Ruminants the stomach is composed of several cavities communicating one with the other, but there is some difficulty in deciding which are the exact homologues of the *rumen*, *reticulum*, *psalterium*, and *abomasum*. The first cavity is a capacious globose sac into which the œsophagus opens. A longitudinal band of muscular fibre partly constricts it, in its course from the right side of the cardiac orifice backwards along the ventral surface, opposite the middle of which a narrow and long aggregation of "water cells" starts to continue tranversely towards the left side of the organ. This longitudinal muscular band forms one of the boundaries—the left one—of a much larger collection of deeper water cells, which embrace the posterior portion of the right side of the paunch in the concavity of their crescentic mass. From the right of this first main compartment a second smaller one is cut off by a constriction which leaves a considerable opening between the two. Its position is that of the reticulum ; it is deeply honeycombed, the lining membrane of the cells being covered with villi much like those on the surface of the folds of the psalterium of the deer, &c. The cell-walls are thin and but slightly muscular. In the paunch the mucous membrane is smooth and not at all thick. The water-cells are formed on a framework of many intersecting muscular sheets arranged in layers with intervals of less than an inch between them, one half being at right angles to the other, so as to form rows of quadrilateral cavities. These are again incompletely divided up by secondary septa. The orifices of the cells are partly closed by diaphragm-like membranes at their mouths. Most probably the contraction of the aggregated muscular fibres in the same situations is capable of closing the cells completely when necessary. That the camel can store fluid in these water-cells is borne out by the experience of so many authors that doubt is scarcely possible. For instance, in his "Travels to discover the Source of the Nile," Bruce (vol. iv. p. 596) tells us on one occasion that "finding the camels would not rise, we killed two of them . and from the stomach of each got about four gallons of water, which the Bischareen Arab managed with great dexterity." As John Hunter remarks, there is no physiological reason why this should not be the case. A specialised structure is observed by zoologists ; a special power is attributed by travellers ; the function and the structure may be reasonably correlated : why should they not be so, as no other explanation suggests itself? There is no arrangement for closing the cells of the reticulum similar to that found in those of the rumen.

A muscular fold runs from the termination of the œsophagus along the superior or vertebral side of the lesser curvature of the stomach to the third compartment, which evidently directs the products of rumination into it, just as the two folds of the same region do which traverse the reticulum in the typical Peccora. Following the honeycomb-bag is a single elongate cylindrical cavity, which dilates slightly and becomes bent at its pyloric extremity. This compartment is thin-walled and longitudinally ribbed internally for its proximal five-sixths, beyond which the mucous membrane is much thickened and evidently digestive in character, especially in the neighbourhood of the angle of the inflection in that region. This section of the stomach apparently corresponds to

* Continued from p. 69.

the abomasum, the psalterium being absent. In the Bactrian Camel there is a partial constriction in it, which separates off a small proximal cavity, which may be its homologue.

In the corpuscles of the blood the Tylopoda are unique among Mammalia, these minute discs being oval instead of, as in all other members of the class, circular.

Of the Camels there are two species, both domesticated, the Bactrian and the Arabian; the one possessing two humps and the other one. A swift variety of the latter is called the Dromedary. The former inhabits Turkestan, Persia, Thibet, and Mongolia; the latter Arabia and Northern Africa. Of the Llamas there are two wild species which have each of them domesticated representatives; the feral Guanaco and Vicuna finding their tame representatives in the Llama and Alpaca. They are all found in the Cordilleras of the Andes, down as far as Terra del Fuego. Taking the Tylopoda as a whole, their geographic range is extremely exceptional. Closely allied animals, as the Ostrich and the Rhea, are found in South Africa and South America respectively. North Africa and Arabia, in some respects, resemble India, as far as their fauna is concerned. No similar ties bind Northern Africa with South America, and it is this which makes the distribution of the Camels and Llamas so abnormal and so inexplicable, on the assumption that they sprang from a common ancestor as far back as the Miocene age, when we take as our basis the assumption that the existing zoological regions are the remains of a very different distribution of land.

(*To be continued.*)

THE LINE BETWEEN HIGHLANDS AND LOWLANDS

THE usual ten days' excursion which terminates the work of the Geological Class at the University of Edinburgh, has this year been devoted to an experiment in the practical teaching of Geology which bids fair to be often and profitably repeated—viz., the working out of a definite problem in the field, teacher and students together. In the Class excursion to Arran in 1872, it was observed that the Old Red Sandstone appeared to be brought against the Highland schists by a fault. Last year the fault was actually seen by the Class on the other side of the island in the cliffs of Stonehaven. Accordingly, the task proposed to be accomplished this year was to trace this dislocation across the country, if possible, from sea to sea. Such a traverse would at least bring the pedestrians face to face with some of the finest and least visited river scenery in Scotland, while it would probably also impress some geological lessons on their memory in a way not likely ever to be forgotten. At the same time it might be successful in discovering some new points in British geology.

The party mustered at Edinburgh, and proceeded at once to Stonehaven, where the first day's work consisted in following the magnificent coast-section which rises above the sea in the picturesque cliffs of Kincardineshire. The fault by which the slates and greywackes of the Highlands have been brought side by side with the red sandstones and shales of the Lowlands was again found. The rocks have there been so greatly squeezed against each other that their line of separation is by no means so abrupt as it might be expected to be. Instead of the mass of débris which so often fills up the space between the cheeks of a large dislocation, there was in this case a somewhat tortuous line of junction along which, without any broken materials intervening, the two series of Highland and Lowland rocks seemed to be, as it were, welded together. One might pass this part of the section and fail to notice the fault, though at the distance of a few yards he would find himself in a totally different set of rocks, and would then turn back to discover the actual line of separation. That this fault must be an important one was first shown by the fact that the strata of the Old Red Sandstone have here been thrown on end for more than two miles back from their junction with the Highland rocks. Along the noble coast cliffs the beds of sandstone and conglomerate stand on edge like books on the shelves of a library. The portion of them so placed considerably exceeds 10,000 feet in thickness, and yet by no means includes all the Old Red Sandstone of this part of Scotland.

From Stonehaven the party worked its way across the country for more than 100 miles to the Aberfoyle district. The line of junction between the slates and the Old Red Conglomerates and Sandstones was traced at many points, and sometimes followed for miles across the moors. In no case was the actual fault again seen, but its position could be in most cases drawn firmly on the map by help of the numerous sections laid open by the rivers which descend from the south-eastern slopes of the Grampians. As the journey advanced, however, it was discovered that the fault did not always lie between the Highland rocks and the Old Red Sandstone, but that it sometimes left bays of the latter formation on its north side. This was a new and interesting fact, for it showed the base of the Old Red Sandstone of these regions lying undisturbed and unconformably upon the upturned edges of the slates. In these bays were found enormous beds of coarse volcanic conglomerate and sheets of porphyrite, precisely agreeing with those which form the chains of the Ochil and Sidlaw Hills on the south side of the great valley which here flanks the Highlands. It was, therefore, apparent that the lavas, ashes, and gravels originally extended quite up to and enveloped the base of the Highland mountains that bounded on the north the inland sea or lake in which the Old Red Sandstone was deposited.

But perhaps the question of most general interest elucidated by this excursion was the relation between lines of dislocation and lines of valley. The fault which begins on the east coast at Stonehaven and runs in a straight line across the country to Arran—a distance of 170 miles—is probably one of the greatest, if indeed it is not absolutely the greatest, in Britain. We do not yet know the amount of displacement which it has caused. But that it was accompanied by enormous movement of the earth's crust is sufficiently proved by the band of vertical strata, sometimes more than two miles broad, which runs along its southern border. Surely if the valleys and gorges of this country, as many writers still contend, have been caused by or are coincident with lines of subterranean fracture, such a grand line of fracture as this ought to be strikingly characterised by such surface features. Particular attention was devoted to this point during the excursion, and the result may be briefly given. Not a single main valley was found to run along the fault, while all the valleys and some of the deep gorges emerging from the Highlands run directly across it without deflection. In one case only was there an approach to a coincidence between the line of the fault and a glen, viz., in that of Glen Artney. But there the dislocation, instead of keeping the centre of the valley, was found to run far up on the northern side, the stream in the centre winding to and fro across the vertical strata of Old Red Sandstone. Along its whole course the fault is not more marked than on other lines where two series of rocks of different characters and modes of weathering come together. But not only does no long and broad valley or series of valleys mark the line of this fracture in its passage across the island; it passes athwart the channels of the North and South Esk, the Prosen, the Isla, the Ericht, the Tay, and the Forth, without in the least degree producing any waterfalls or transverse gorges. Moreover, it cuts across two of the best known lakes of

the Southern Highlands, Lochs Vennachar and Lomond, without revealing its presence by any abrupt surface features. These transverse valleys can be admirably studied in some of the river ravines. The gorges of the Ericht, Isla, and North Esk, indeed, are true cañons, their precipitous walls range from 80 to sometimes 200 feet in height, between which the rivers toil in narrow tortuous chasms. It is easy to examine the strata in these natural sections, and to find conclusive proof that in spite of their fissure-like character the ravines have been cut out of the solid and unbroken Old Red Sandstone, the strata of which can be traced from side to side in undisturbed continuity. The pot-holes marking old levels of water-grinding can be traced at various heights above the present streams, which are still at work deepening their channels in the same way. The contribution therefore which this geological ramble makes to the discussion of an interesting question in the physiography of Great Britain may be put thus :—An enormous dislocation crosses the island along the southern margin of the Highlands. It has not given rise to any marked line of glens or valleys. It is crossed by all the rivers and some of the lakes which emerge from the southern side of the Grampians, and some of these rivers flow in deep narrow gorges across the line of fracture. Yet in none of these gorges could any trace be found of transverse fracture; on the contrary, they everywhere bore evidence only of long-continued aqueous erosion.

Another point of interest noted in the course of the excursion was the fact that Comrie—a locality so long and widely celebrated for its frequent and sometimes sharp earthquake shocks—lies almost directly over the line of the great fault. This fact seems to be the first of any consequence which has been ascertained in the attempt to connect the abundance of tremors at that place with any geological structure of the ground underneath. From this brief notice it will be seen that there was plenty of geological interest and novelty to keep up the enthusiasm of the party from the beginning to the close of the excursion. Glorious weather and an endless variety of scenery added fresh charms to each day's work, while over the whole came the glee and hearty exuberance which the free open face of nature could not but evoke in men who had been working hard together in town all the winter and spring.

THE U.S. GOVERNMENT BOARD FOR TESTING IRON AND STEEL

IN accordance with "An Act making Appropriations for Sundry Civil Expenses of the Government, for the fiscal year ending June 30, 1876, and for other purposes," approved March 3, 1875, and in reply to a memorial presented to Congress in January last by the American Society of Civil Engineers, the President of the United States has appointed a Board with instructions to determine by actual tests the strength and value of all kinds of iron, steel, and other metals which may be submitted to or procured by it, and to prepare tables which will exhibit the strength and value of these materials for constructive purposes.

The object of this Board is so admirable, and in this, as already in some other similar respects, the U.S. has set an example so worthy of imitation by European Governments, that we shall be doing a service in publishing the details of the organisation of the Board. Congress, we may state, has voted 50,000 dollars to defray the expenses of the Board.

The following are the names of its members :—President, Lieut.-Col. T. T. S. Laidley, U.S.A.; Commander L. A. Beardslee, U. S. N.; Lieut.-Col. Q. A. Gillmore, U. S. A.; Chief Engineer David Smith, U. S. N.; W. Sooy Smith, C.E.; A. L. Holley, C.E.; R. H. Thurston, C.E., Secretary

The work of the Board is divided into sections, each section being entrusted to a standing committee from the members of the Board. The following are the Sections :—

(A) *On Abrasion and Wear.*—Instructions: To examine and report upon the abrasion and wear of railway wheels, axles, rails, and other materials, under the conditions of actual use.

(B) *On Armour Plate.*—Instructions: To make tests of armour plate, and to collect data derived from experiments already made to determine the characteristics of metal suitable for such use.

(C) *On Chemical Research.*—Instructions: To plan and conduct investigations of the mutual relations of the chemical and mechanical properties of metals.

(D) *On Chains and Wire Ropes.*—Instructions: To determine the character of iron best adapted for chain cables, the best form and proportions of link, and the qualities of metal used in the manufacture of iron and steel wire rope.

(E) *On Corrosion of Metals.*—Instructions: To investigate the subject of the corrosion of metals under the conditions of actual use.

(F) *On the Effects of Temperature.*—Instructions: To investigate the effects of variations of temperature upon the strength and other qualities of iron, steel, and other metals.

(G) *On Girders and Columns.*—Instructions: To arrange and conduct experiments to determine the laws of resistance of beams, girders, and columns to change of form and to fracture.

(H) *On Iron, Malleable.*—Instructions: To examine and report upon the mechanical and physical proportions of wrought iron.

(I) *On Iron, Cast.*—Instructions: To consider and report upon the mechanical and physical properties of cast iron.

(J) *On Metallic Alloys.*—Instructions: To assume charge of a series of experiments on the characteristics of alloys, and an investigation of the laws of combination.

(K) *On Orthogonal Simultaneous Strains.*—Instructions: To plan and conduct a series of experiments on simultaneous orthogonal strains, with a view to the determination of laws.

(L) *On Physical Phenomena.*—Instructions: To make a special investigation of the physical phenomena accompanying the distortion and rupture of materials.

(M) *On Re-heating and Re-rolling.*—Instructions: To observe and to experiment upon the effects of re-heating, re-rolling, or otherwise re-working; of hammering, as compared with rolling, and of annealing the metals.

(N) *On Steels produced by Modern Processes.*—Instructions: To investigate the constitution and characteristics of steels made by the Bessemer, open hearth, and other modern methods.

(O) *On Steels for Tools.*—Instructions: To determine the constitution and characteristics, and the special adaptations of steels used for tools.

The Sectional Committees of the Board, we learn from the official circular sent us, are appointed to conduct the several investigations, and the special researches assigned them in the interval during which the regular work of the Board is delayed by the preparation of the necessary testing machinery, and during such periods of leisure as may afterward occur.

These investigations are expected to be made with critical and scientific accuracy, and will, therefore, consist in the minute analysis of a somewhat limited number of specimens and the precise determination of mechanical and physical properties, with a view to the detection and enunciation of the laws connecting them with the phenomena of resistance to flexure, distortion, and rupture.

The Board will be prepared to enter upon a more general investigation, testing such specimens as may be

forwarded to the President of the Board, or such as it may be determined to purchase in open market, immediately upon the completion of the apparatus ordered, at which time circulars will be published giving detailed instructions relative to the preparation of specimens for test, and stating minutely the information which will be demanded previous to their acceptance.

GUSTAVE THURET

ON the 10th of May France lost one of her most distinguished naturalists. M. Thuret left his home at Antibes in perfect health, and expired at Nice a few hours afterwards from an attack of angina pectoris.

Unlike many of his contemporaries, Thuret was not a voluminous writer. But his papers, though not numerous, are all extremely admirable, and his work has laid the foundation of our modern knowledge of the biological phenomena of the Algæ. Probably his earliest paper was an account of the antherozoids of *Chara* (1840). He was the first to detect the cilia upon these structures in any plant. In 1844 he published an account of the peculiar mode of asexual reproduction in *Nostoc*. In 1845, in conjunction with Decaisne, he described for the first time the antheridia and antherozoids of *Fucus*. In 1850 and succeeding years he published his admirable papers upon the zoospores of different groups of Algæ. In 1853 he established for the first time by actual observation, in the case of *Fucus*, the existence amongst Algæ of the phenomenon of fertilisation. In 1866, in conjunction with Bornet, he described the extremely remarkable phenomena of sexual reproduction amongst the *Florideæ*. They found not merely that the process of fertilisation was accomplished in a very peculiar and remote way, but also that, besides the effect produced on the germ-cell, a series of developments were induced in the parent plant as the result of it. In every group of Algæ the results which he achieved were of the most fundamental kind.

A man of independent wealth, he passed a great part of the year on his property at Antibes, on the shore of the Mediterranean. Bornet, his distinguished *collaborateur*, lived with him. In the gardens which surrounded his house he had assembled one of the most remarkable collections of plants to be found growing in the open air in any part of the world. W. T. T. D.

NOTES

PUNCTUALLY at the time arranged, four o'clock in the afternoon of last Saturday, the *Alert* and the *Discovery*, accompanied by the *Valorous*, left Portsmouth for their work in the Arctic regions. No better equipped expedition, it may again be said, has ever left any country, and no previous British expedition has ever been so universally popular. Every available point on land was occupied by spectators who had come to see the departure of the expedition. The vessels in the harbour and the yachts and boats along the beach were dressed with flags, and as the two ships stood out to sea their course lay through a perfect flotilla of craft of all kinds, whose occupants cheered Capt. Nares and his companions on their way. Among the last messages received by Capt. Nares was a telegram from the Queen "wishing you and your gallant companions every success;" the telegram was accompanied by a packet, the contents of which did not transpire. In the morning the Lords of the Admiralty inspected the ships, and wished the expedition "God speed." Mr. Clements R. Markham accompanies his cousin, Commander Markham, as far as Disco. The sbips arrived at Queenstown on Tuesday, the *Alert* and *Discovery* going on to Bantry Bay. The *Valorous* joined them yesterday, when the three proceeded on their way.

MR. GEORGE BENTHAM, F.R.S., has been elected a corresponding member of the French Academy of Sciences.

MR. CHARLES DARWIN has been appointed foreign honorary member of the Imperial Academy of Science, Vienna.

THE Hebdomadal Council of Oxford University have agreed to propose that in the Convocation to be held at the Encœnia, or Commemoration, the honorary degree of D.C.L. be conferred on the following persons:—Sir W. R. Grove, F.R.S., Sir J. Lubbock, F.R.S., Mr. E. B. Tylor, F.R.S., Captain Douglas Galton, C.E., F.R.S., and Mr. C. T. Newton.

THE reception at the Royal Society on Wednesday week was a great success; there was a very large attendance of Fellows. There was plenty of opportunity for quiet talk, which was taken ample advantage of. Mr. Crookes repeated his interesting experiments.

GOVERNMENT have refused to send or pay the expenses of a commissioner to the forthcoming International Geographical Congress at Paris. One would have thought that, as much from a practically commercial as from a scientific point of view, this Congress, judging from its programme, is likely to be of the highest importance; and who more likely to reap benefit from such a Conference than the greatest naval and commercial power in the world? Government, however, have the excuse that the French Government simply approve of the Congress, and have refrained from stamping it with an official character.

INVITATION circulars have been issued for the Bristol Meeting by the British Association, whose sittings commence on August 25, under the presidency of Sir John Hawkshaw, C.E., F.R.S. The local secretaries are Messrs. W. Lant Carpenter and John H. Clarke.

M. EDOUARD COLLOMB, who for many years has been the Treasurer of the Geological Society of Paris, has just passed away at the age of seventy-four years. M. Collomb accompanied Agassiz in his Alpine travels. He also travelled during many years in Spain with M. de Verneuil, studying the mineralogical resources of the Iberian Peninsula. The result of these protracted explorations was the publication of the first geological map of Spain.

MR. HENRY WILLETT again appeals for funds to carry on the work of the Sub-Wealden Exploration to a depth of 2,000 feet. A week ago the boring had reached 1,080 feet. It has been decided to continue the boring to 1,500 feet, by which time all the available funds will be exhausted; to do this, 1,200*l.* are wanted, and we cannot think that for the want of so comparatively small a sum the first scientific boring in this country will be brought to a premature conclusion. The latest cones and fossils indicate that the boring is still in the Kimmeridge Clay, to the fauna of which *Ammonites Jason* must now be added.

THE acclimatisation of trout in Tasmania is certified by an official report, which states that in 1873 a total distribution of 4050 trout ova was made from the rivers of that country to the neighbouring colonies; 800 of these ova were sea trout, and the rest brown trout.

THE motion for diminishing the size of the type used in printing the *Comptes Rendus* was lost, because a number of members declared in the private sitting of the Academy that it was impossible for them to read the papers printed with the characters which had been proposed. Consequently it has been resolved that the number of pages given to each paper shall be diminished by one-third part of the number originally allotted.

THE Municipal Council of Paris have voted a sum of 500*l.* to pay the professors of a superior school of Anthropology, which will be opened next November in a building lent gratuitously

by the École de Médecine; no fees are to be charged from pupils. M. Wallon has granted a sum of 300*l.* yearly for laboratory expenses. Anthropological societies and private individuals have subscribed a fund; the shares are said to be worth 40*l.* Five courses of lectures are to be delivered, including a series by M. Broca on Craniology, by M. Dailly on Human Races, M. G. de Mortillet on Prehistoric Times. The number of lectures is to be increased as the resources of the association multiply.

ACTIVE preparations are being made for the exhibition of the French Geographical Society at the Pavillon des Flores. The large hall is almost finished, and is said to be of superior taste and magnificence.

FOR the first time in recent years the French Minister of Public Instruction is one of the leading members of the Cabinet. It is said that in the discussion on the new electoral law, M. Wallon intends to ask the Versailles Assembly to vote that ignorance be considered a disqualification, and that any elector be disfranchised who cannot read and write.

M. GEOFFROY SAINT-HILAIRE, the Director of the Jardin d'Acclimatation, Paris, has just instituted a new intermediate station for tropical plants at the Iles d'Hyères. Delicate plants will consequently not be taken at once from a hot to a cold atmosphere.

A MEMORIAL tablet, bearing an appropriate inscription, now marks the spot in Westminster Abbey where the remains of Dr. Livingstone are deposited.

A SCIENTIFIC Society has recently been established in Caius College, Cambridge, for the diffusion of scientific knowledge among the members of the College, for the reading of essays on scientific subjects, and for the holding of scientific discussions. The Society admits within the range of its discussions all sciences of observation. An interesting feature in the scheme of the Society's proceedings is that the first half-hour of each meeting is to be devoted to open discussion, to the answering of questions proposed by any member either at the time or at a previous meeting, or to the exhibition of specimens. The first president of the Society is Mr. B. Anningson, M.A., M.B., the newly-appointed Medical Officer of Health for Cambridge, and the secretary is Mr. Wm. Ewart. A number of papers have been read during the present term. The meetings have been well attended and the discussions well supported.

A SCIENTIFIC Society has been formed at Gloucester, chiefly in connection with the School of Science there, under the title of the Gloucester Philosophical Society. A programme of papers for the year has been issued. In addition to the regular monthly meetings, a course of six lectures on Structural Botany is being delivered by Mr. Allen Harker to the members of the Society. One or more excursions are to form a feature of the course. Gloucester has hitherto been rather apathetic than otherwise on science; this looks more healthy.

ON Nov. 23, at Balliol College, Oxford, there will be an examination for a Brackenbury Scholarship for the encouragement of Natural Science, worth 80*l.* a year for four years.

WE are very much surprised, and on all accounts it is greatly to be regretted, that the Legislature of Massachusetts has rejected the Bill for a new Survey of the State to which we have already referred. Massachusetts is known all the world over as being one of the most intelligent and best educated States in the Union. Evidently, however, the State schools are too strong in arithmetic; a Mr. Plunkett brought some extraordinary calculations before the House, showing that the Survey would cost nearly a million and a half of dollars and occupy nearly a hundred years! Besides an advanced and accomplished calculator, the Massachusetts Legislature is also happy in the possession of a "funny man," a Mr. Rice, who seems occasionally to relieve the severity of Mr. Plunkett's extreme calculations by bright flashes of buffoonery. Mr. Rice described the proposed Survey as "sending young men with muck-rakes to scratch the sterile soil of the State and make pictures."

THE Indian Museum at South Kensington was opened to the public on the 1st instant.

THE newly issued part of the Transactions of the Zoological Society of London contains an exhaustive memoir on the birds inhabiting the Philippine Archipelago, illustrated by twelve coloured quarto plates.

PROF. HALL GLADSTONE completed his course of lectures at the Royal Institution on chemical force on Tuesday, and exhibited a new compound he had just discovered, Zinc Ethylochloride, $Zn\begin{Bmatrix} C_2H_5. \\ Cl \end{Bmatrix}$

THE necessity of utilising the large rivers for maritime navigation is becoming one of the questions of the day in France. The Municipal Councils of Lyons and Marseilles are considering the means of connecting Marseilles with the Rhône by a canal practicable for shipping; while the Municipal Council of Paris have appointed a commission to devise means to render the Seine navigable from Rouen to Paris.

PROF. DRAKE, the eminent Berlin sculptor, has just finished a colossal statue of Alexander von Humboldt, ordered by the city of Philadelphia; it is nine feet high, and will be shipped to its destination early in June.

A TELEGRAM, dated Berlin, May 28, states that the Tashkend Government has sent an expedition to Hissar, an unknown principality east of Shahrisiabsk, and north of the Afghan frontier. The members of the expedition are mostly scientific.

BAILLIÈRE, of Paris, has published an analytical "Table des Matières" of the first ten volumes (1864-74) of the *Revue Scientifique*. The Table forms a very useful index to much of the scientific work of the last ten years.

A THICK Supplement (No. 41) to *Petermann's Mittheilungen* has just been published, containing a multitude of statistics on the population of the earth, by E. Behm and H. Wagner. They estimate the total population of the globe at 1,396,842,000, distributed as follows:—Europe, 302,973,000; Asia, 798,907,000; Africa, 206,007,000; America, 84,392,000; Australia and Polynesia, 4,563,000.

HEFT VI. of *Petermann's Mittheilungen* contains a beautiful map illustrative of Dr. Rohlfs' travels in the Libyan Desert during 1873-74. It embraces the portion of North Africa between 25° and 29° N. lat., and 26° and 32° E. long. This map, along with the explanatory letterpress by Dr. Jordan and Dr. Rohlfs which accompanies it, will be found to add in a very important degree to an accurate knowledge of this hitherto imperfectly known region. The map shows the route not only of Rohlfs' expedition, but of Schweinfurth and several other explorers, from Krump (1701) downwards.

IN a paper by Prof. J. D. Dana, in the May number of Silliman's *American Journal*, on Dr. Koch's evidence with regard to the contemporaneity of Man and the Mastodon in Missouri, the author comes to the following conclusions:—Taking all things that have been reviewed into consideration, he thinks there is sufficient reason for regarding Dr. Koch's evidence of the contemporaneity of Man and the Mastodon *very doubtful*. He hopes that the geologists of the Missouri Geological Survey now in progress will succeed in settling the question positively. The contemporaneity claimed will probably be shown to be true for North America by future discoveries, if not already so esta-

blished; for Man existed in Europe long before the extinction of the American Mastodon.

AN interesting innovation has been tried with great success at the National Library of Paris. It has been suggested by M. Belliard, one of the principal librarians, who was appointed the head of the Receiving Office a few months ago, to publish a monthly paper containing a descriptive list of the works which have been presented to the library, or purchased during the preceding months. The works sent by the Home Office for the *dépôt legal* are not registered in that paper: there is for these a special publication. The first number has been issued, and is a lithographed 12mo pamphlet of thirty-two pages, having about two hundred entries. A copy will be presented to the great libraries abroad and in France.

MR. A. J. HARVEY, known to many as the advocate of various schemes of social improvement, now propounds a scheme for a "People's Museum of Physical Astronomy, to be erected and endowed by Government." "The object and design of a Museum of Physical Astronomy," Mr. Harvey states, "should be to popularise, familiarise, enlighten, and instruct the people in whatever can be illustrated, taught, and told, through the eye alone and without the aid or necessity of books, &c., of Physical Astronomy." It should be "a museum worthy of the intelligence and wealth of this great country, in which the whole visible universe is roughly presented to us, exhibited upon a colossal yet exact scale, and wherein the actual motions of the heavenly bodies are visible to the naked eye, wherein vast space can be spanned by the hand and great epochs of time counted with ease by the mind."

WE have received from Messrs. Blackwood and Sons an interesting lecture by Dr. Page, entitled "Recreative Science; a Plea for Field Clubs and Science Associations." It ought to be circulated extensively among our field-clubs and other local scientific societies.

ONE of the most important of the many valuable U.S. Government documents published during a few months past is the Annual Report of the United States Geological and Geographical Survey of the Territories for 1873, as prepared by Dr. Hayden, being a volume of 730 pages, profusely illustrated with plates and sections, and exhibiting the physical geography, the sectional geology, the mining, and the natural history of the country. The volume consists of several sections. The first, that of Geology, Mineralogy, and Mining Industry, was prepared by Dr. Hayden, Mr. Marvine, Mr. Peale, and Dr. Endlich. The second embraces special reports on Palæontology, on the Fossil Flora, by Prof. Lesquereux, and on the Vertebrates by Mr. Cope. Part third, Zoology, contains articles on the recent Invertebrates, by Lieut. Carpenter, Dr. Packard, Baron Ostensacken, Mr. Ulke, Dr. Hagen, Mr. S. J. Smith, Prof. Verrill, and Mr. William G. Binney. Part fourth, upon the Geography and Topography, is from the pen of Mr. James T. Gardner, geographer of the expedition. There is also an appendix by Mr. A. R. Marvine.

THE Rev. G. H. Hopkins gives the following method for fixing the curves which steel filings take when under the action of a bar magnet. The filings having been prepared so as to be as nearly the same size as possible, and that size very minute, are pound into a mortar, and a small quantity of finely powdered resin is added; these are stirred together until the two substances are completely mixed, and then, considerable pressure being exerted upon the pestle, they are rubbed until the resin adheres to the filings in a very fine coating. The filings can then be sprinkled as usual, and the curves formed. It is best (after the curves are formed) to heat the plane surface, glass, paper, or wood, according to convenience, over a stove or in an oven, which easily allow it to be sufficiently as well as uniformly heated. For projecting the curves on a screen, the following, we believe, is a very effective method. Cover the glass with thin gum-water, allow it to dry perfectly; obtain the curves on the dry gummed surface; finally, breathe on the plate: the gum is thereby softened and the curve permanently fixed. Substituting corresponding shaped pieces of paper for the magnets (a pin-hole can be used to indicate the N. pole), the curves can be covered with a second plate of glass, and thus preserved as an ordinary lantern slide.

A VERY satisfactory report has been issued for the past year by the committee of the Devon and Exeter Albert Memorial Museum, &c. Several valuable additions in natural history have been made to the Museum, and in the reference library there has been an addition of eighteen per cent. in the issue of works on science and art. The institution as a whole continues to work so well that more room and better accommodation are urgently demanded.

THE additions to the Zoological Society's Gardens during the past week include a Grey-cheeked Monkey (*Cercocebus albigena*), a Marsh Ichneumon (*Herpestes paludosus*), an Angolan Vulture (*Gypohierax angolensis*) from W. Africa, presented by the late Mr. H. Ansell; a Syrian Bear (*Ursus syriacus* from Western Asia, presented by Mr. W. Kirby Green; an Australian Cassowary (*Casuarius australis*) from Australia, presented by Mr. E. P. Ramsay; a Black-necked Stork (*Xenorhynchus australis*) from Australia, presented by Mr. C. Moore; two Egyptian Geese (*Chenalopex ægyptiaca*) from W. Africa, presented by Mr. R. B. N. Walker; three Chestnut-eared Finches (*Amadina castanotis*) from Australia, presented by Mrs. G. French Angas; a Common Raccoon (*Procyon lotor*) from N. America, presented by Mr. Wesson; a Reeves's Muntjac (*Cervulus reevesi*) born in the Gardens.

SCIENTIFIC SERIALS

The American Journal of Science and Arts, May.—The first article is a continuation (No. 5) of a series of notices on recent earthquakes, by Prof. Rockwood. The second is an inquiry by Prof. J. D. Dana on Dr. Koch's evidence with regard to the contemporaneity of Man and the Mastadon in Missouri. (See Note, p. 96.)—Mr. Carey Lea communicates a short note on the influence of colour upon reduction of light, and Prof. Rowland a description of a new diamagnetic attachment to the lantern.—The geological articles are the Primordial Strata of Virginia, by W. Fontaine, and the Age of the Southern Appalachians, by F. H. Bradley.—The contributions from the Physical Laboratory of Harvard College are on the construction of Gaugain's galvanometer, on a new form of magneto-electric engine, by W. R. Morse, and some remarks by S. Newcomb on the Transit of Venus.

THE *Journal de Physique théorique et appliquée*, April 1875, contains the following original papers:—Researches on thermo-diffusion, by J. Violle.—Determination of the velocity of light and of the sun's parallax, by M. A. Cornu.—On some polarisation experiments, by M. Bertin (last paper).—On an apparatus destined to get glass penetrated by the electric spark, by MM. Terquem and Trannin.—The number contains also several abstracts from papers taken from other serials.

Der Naturforscher, March 1875.—From this part we note the following papers:—On the influence of the density of metals upon their magnetisation; new researches made by Herr Börnstein with iron, nickel, and cobalt.—On the meteorite of Roda (in the Spanish province of Huesca), by Herren Tschermak and Lang.—On the genetic classification of the flora of Australia, by C. von Ettinghausen.—On the shooting stars observed on Nov. 13 and Dec. 10, 1874, at the Toulouse Observatory, under the direction of M. Gruey.—On vegetable mucus, by Herren Kirchner and Tollens.—On the action of hydrochloric acid upon lead-antimony alloys, by Herr H. v. d. Planitz.—On the behaviour of hydrocarbons under restricted oxidation, by M. Berthelot.—On

the star system 61 Cygni; discussion of M. Flammarion's latest papers on the subject.—On the repulsive power of comets, by G. V. Schiaparelli.—On the respiration of Fungi, by Herr Müntz.—On over-saturated solutions and the dissociation of salts in solution, by A. Tscherbatschew.—On forests, the courses of rivers, and atmospheric moisture, by L. Fautrat.—On the radiation of the sun; observations made at the Observatory of Montsouris, near Paris, by Marié-Davy.—On the time of reaction of the sense of taste at the tip of the tongue, by Herren M. v. Vintschgrau and J. Hönigschmied.—On colouring matters and the sensitiveness towards light of several silver salts, by H. W. Vogel.—On the decomposition of vegetable xanthophyll by light, by J. Wiesner.—On the circulation of ammonia in the atmosphere, by Herr Al. Schloesing.—On some glacier-phenomena in the Bavarian high plateaus; a communication made to the Munich Academy, by Herr Zittel.—Researches on the process of digestion in the intestines of sheep, by Eugen Wildt.—Some researches on magnetism, by M. Bouty.—On the antiseptic properties of salicylic acid; an extract from the *Journal für praktische Chemie*, by Herr Kolbe.—On the direct observation of the atmosphere of Venus, by C. S. Lyman; results of these observations show the horizontal refraction of Venus' atmosphere to be 44″·5; in 1866 it had been determined at 45″·3, and Mädler in 1849 had found it 43″·7. Mr. Lyman measured the diameter of the planet six times on Dec. 10 (the day after the transit), and found it on the average to be 63″·1; the average of eleven measurements on Dec. 11 was 63″·75.—On the electric action of a thermal source at Baden, Switzerland, by Herren Thury and Alb. Minich.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, March 15.—On the relation between differences of atmospheric pressure and velocity of wind, according to the theories of Ferrel and Colding, by Dr. Hann. The author begins with a review of the two theories of storms, the older of which has been accepted chiefly in Germany, the other in America and the Northern States of Europe. According to the former, whirlwinds are formed mechanically by different streams of air meeting, and centrifugal force causes the central depression. The more modern theory regards a local depression as the first condition, causing an indraught resulting in a whirlwind through the earth's rotation. The primary depression is held to follow condensation of vapour. Probably there is something right in each of these views. Eddies can, doubtless, be formed by currents meeting at certain angles, but the direction of rotation would not be invariable in each hemisphere. Besides, the mechanical resistance to the progress and continuance of a whirlwind so formed would, without inconceivably favourable conditions, be far too great to be overcome. Dr. Hann recognises the part played by vapour in storms, but thinks that many meteorologists rely too much on it in their need, and points to the works of Hopkins and Laughton for instances of this partiality. He believes that the greater part of the low pressure which accompanies storms must be explained by mechanical laws, and that the local differences of pressure in a cyclone or even in a straight-blowing current (if such there be) follow from movements of the air. Condensation may cause a depression, and that depression we know may cause winds which produce a depression ten or fifteen times greater. Prof. Ferrel endeavours to show mathematically that depressions are due to centrifugal force and the earth's rotation. Colding considers tropical hurricanes as true whirlwinds, and his values for pressure from centre to edge reckoned from this hypothesis agree with observation. Now, there is no reason why centrifugal force should not act in spirally-whirling storms in relation to radius and velocity. The earth's rotation adds to the effect of this force, and the result is a diminution of pressure towards the centre on the earth's surface. The enormous extent of some minima is thus explained, which an ascending current and precipitation fail to account for. Dr. Hann proceeds to develop mathematically the theories of Ferrel and Colding, and gives the following formula (1) for finding the barometric gradient:—

$$\Delta B = \frac{l}{287{\cdot}4}\frac{B}{T}(2n \sin.\phi + u)v$$

where B is the height of the barometer at point of observation, T the absolute temperature (*i.e.* 273° + t), l = 50 geographical miles, u the angular velocity of rotation, n the angular velocity of the earth's rotation, ϕ the latitude, and v the distance traversed in unit of time. In this equation it is assumed that the circulation is simple, without friction, and not inducing new masses of air.—In the *Kleinere Mittheilungen* we have an article on Baumhauer's Meteorograph, and some extracts from a letter of Prof. Mohn, dated 21st December last, on cyclonic minima. In this letter the writer states that having called the attention of Herr Guldberg to the fact that Colding's point of view is quite different from that of the new school of meteorologists, that gentleman worked out his own formula and found as much agreement between his results and observations of an Antilles hurricane as Colding found by his method. The factors taken into consideration by Herr Guldberg were, barometric gradient, rotation of the earth, centrifugal force, and friction of the air. Prof. Mohn believes the central minimum to be a mechanical effect of rotation. He discovered lately that Prof. Ferrel had worked with similar formulæ and had derived therefrom similar results, but he intends to pursue his task, and believes it will be ascertained that relations of pressure are in great part functions of movement.

THE *Bulletin Mensuel de la Société d'Acclimatation de Paris* for February gives the customary yearly summary by M. Quihou of the principal experiments carried out in the Jardin d'Acclimatation in the Bois de Boulogne during 1874, and of the most important plants cultivated there.—M. Jeannel gives a report on various experiments conducted by him during the year in the Jardin de Luxembourg with the object of testing the value of mineral manures in horticulture.—The new kind of silkworm, *Attacus Yama-mai*, is the subject of a long paper by M. F. A. Bigot.—An attempt made by M. Victor Fleury to acclimatise the Siberian rabbit in France has not entirely succeeded, but excellent results have ensued in the crossing of this race with the common grey rabbit of the country.—The value of the *Eucalyptus globulus* in correcting the unhealthiness of marshy and other lands is proved by its effect in certain parts of Algeria, where, in the neighbourhood of Lake Fezzara, in Constantine, a large area of land hitherto noted for its insalubrity has greatly improved since the plantation of a large number of these trees.

Annali di Chimica applicata alla Medicina, Feb. and March, 1875.—These numbers contain the following papers:—On diastase and some preparations from malt, by H. Duquesnel.—On croton-chloral, by Engel.—On a carbonic solution of tribasic phosphate of lime, by Chevrier.—On a glycerine solution of iodide of potassium, by C. O. Barberis.—On the ventilation of closed localities, by G. P.—On vinic alcohol, aldehyde, and ethers: experimental researches made in the Physiological Laboratory of Padua, by Drs. P. Albertoni and F. Lussana.—On ferments and fermentations in the human organism, by A. Pavia.—On some fermentation processes by J. Macagno.—On a simple, easy, quick, and certain means to distinguish in mankind real death from apparent, by Dr. A. Monteverdi. This consists of injecting under the skin an aqueous solution of ammonia, and watching the appearance of the blister produced.—On blood fibrine and the formation of a substance analogous to ordinary albumen, by A. Gautier.—Researches on the parasite that produces whooping-cough, by Dr. Lebrerich.—On apomorphia, by G. Hirne.—A note on cremation, by the editor of the *Annals*, Dr. G. Polli.

THE *Gazzetta Chimica Italiana*, fasc. iii. 1875, contains the following papers:—On the action of acetyl chloride upon santonine and santonic acid, by F. Sestini.—On some derivatives from alphatoluic acid, by C. Colombo and P. Spica.—On the formation of sugar in fruits, by M. Mercadante.—On a new method of determining the tannic acid contained in wines, by A. Carpané.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, May 6.—Anniversary Meeting.—Dr. G. J. Allman, F.R.S., president, in the chair.—The officers of the Society were elected for the ensuing year as follows, viz.:—President, Dr. G. J. Allman, F.R.S.; Treasurer, Dr. J. Gwyn Jeffreys, F.R.S.; Secretaries: T. Currey, F.R.S., and St. George Mivart, F.R.S.; and as Members of the Council: Dr. J. D. Hooker, Pres. R.S.; Dr. J. G. Jeffreys, F.R.S.; Major-General Scott, C.B.; R. B. Sharpe, and Chas. Stewart, in the place of J. Miers, F.R.S., T. P. Pascoe, Major-General Strachey, F.R.S., Dr. H. Trimen, and the late D. Hanbury, F.R.S. The President then delivered an address on the History and Development of the Infusoria.

Anthropological Institute, May 25.—Col. A. Lane Fox, president, in the chair.—Mr. T. G. B. Lloyd read papers on

the Beothucs of Newfoundland, and on the Stone Implements of Newfoundland. The first paper was a continuation of one read the previous session, and contained the further experiences of the author in Newfoundland, which island he had recently revisited. The Beothucs possessed several of the characteristics belonging to many of the tribes inhabiting North America, whilst they differed from them in the following peculiarities:—Lightness of complexion, the use of trenches in their wigwams for sleeping places, the peculiar form of canoe, the custom of living in a state of isolation apart from the white inhabitants of the island, and their persistent refusal to submit to any attempts made to civilise them. They were also remarkable for their inability to domesticate the dog.—Prof. Busk communicated a paper on two Beothuc skulls, and described them as presenting all the characteristics of the normal brachycephalic form of the Red Indian skull.—In his second paper Mr. Lloyd described the stone implements he had brought from Newfoundland, consisting of axes, chisels, gouges, spear and arrow heads, scrapers, fish-hooks; also cores, flakes, whetstones, rubbing stones, sinkers, and stone vessels.—Mr. Park Harrison exhibited and described five photographs, from Tahiti, of Easter Island wooden tablets; and Mr. H. Taylor exhibited a series of fine photographs of people inhabiting the South Sea Islands.

Royal Horticultural Society, May 12.—Scientific Committee. A. Murray, F.L.S., in the chair.—The Chairman made a communication with respect to the acarus to which Prof. Thiselton Dyer had drawn attention as destroying the female flowers of the Yew. He believed it to be undescribed, and proposed for it the name of *Tetranychus taxi*. It was allied to the acarus which Prof. Westwood had described as very injurious to the young buds of the currant.—Mr. M'Lachlan exhibited specimens of wallflower in which the petals were virescent.—Dr. Masters showed leaves of the vine (from a nursery in the neighbourhood of London) bearing galls produced by Phylloxera.—Prof. Thiselton Dyer called attention to a paper by Dr. Franz Low, translated in the current number of the *Annals and Magazine of Natural History*. It described a nematoid worm (*Tylenchus Millefolii*), which produced the galls on the rachis of the leaves of the common Milfoil.—Prof. Thiselton Dyer exhibited three flasks which contained Pasteur's solution, all three of which had been subjected to boiling. The neck of No. 1 flask, treated on March 3, 1875, was plugged, while the contents were still boiling, with cotton-wool, and the fluid remains clear and unaffected. In flask No. 2, otherwise similarly treated, but without any plug, so that access of air and therefore of spores was allowed, there was a dense growth of mould (*Penicillium*). In No. 3, boiled on Sept. 30, 1873, but in which the plug was removed for five seconds only on Oct. 15, 1874, a dense mould had made its appearance.

General Meeting.—W. Burnley Hume in the chair.—Prof. Thiselton Dyer called attention to the principal objects exhibited.—A fine potful of the rare Irish Butterwort, *Pinguicula grandiflora*, was shown by Mr. Dean. *Senecio macroglossus*, an evergreen greenhouse climber shown by Mr. Green, had foliage identical with that of some forms of ivy; it was a native of the Cape.—A ripe fruit of *Stephanotis floribunda* was sent by R. T. Coombe, Taunton. Morels, which are abundant this year, were represented by a fine series of *Morchella crassipes*, sent by J. Barclay, The Durdans, Epsom.

Physical Society, May 22.—Prof. Gladstone, F.R.S., president, in the chair.—Mr. Spottiswoode, F.R.S., exhibited and described a revolving polariscope. A luminous beam passes from a small circular hole in a diaphragm through a polariscope, the analyser of which is a double image prism, the size of the hole being so arranged that the two luminous discs shall be clear of each other. If the prism be made to revolve rapidly, one of the discs revolves round the other and is merged into a ring of light, which is interrupted at opposite sides by a dark shaded band, the position of which depends upon the position of the original plane of polarisation. The discs may be coloured by inserting a selenite plate, and the rapid revolution of the analyser then gives alternating segments of complementary colours; or, if a quartz plate be used, the rotating disc passes successively twice in a revolution through all the colours of the spectrum, and when the revolution is rapid, merges into a prismatic ring. The effect of the interposition of a $\frac{1}{4}$-undulation plate, which converts plane into circularly polarised light, was then shown, and Mr. Spottiswoode also interposed a concave plate of quartz, and exhibited the effect of rotation on the characteristic rings of quartz.—Prof. Adams exhibited a polariscope adapted for showing the optic axes of crystals in which they are much inclined to each other, as in the case of topaz. The part of the instrument by which this is effected consists of a frame in which the crystal is supported between two hemispherical lenses, the common centre of which is at the centre of the crystal. The frame is capable of motion round an axis at right angles to that of the instrument. By this means each of the axes can be brought under the cross wires, and the space through which the frame is moved affords a means of determining the angle between the axes of the crystal. The crystal may be immersed in a liquid in cases in which its optic axes are too far apart to be seen in air.—Dr. Mills made a verbal communication on fusion-point and thermometry. His apparatus for fusion-points consisted essentially of a beaker, in which stood an inverted funnel, the shortened stem of which carried a test-tube, supported by a contraction at its base. The test-tube contains naphtha of high boiling-point, and the thermometer and capillary tube containing the substance occupy its centre; the funnel has four equidistant semicircular cuts at the end of its stem, and six on its lips; the beaker is nearly filled with strong oil of vitriol, and has a wooden cover; on the application of heat below the beaker, warm oil of vitriol ascends in the funnel, and cold oil of vitriol descending, enters at the lip; thus an automatic stirring is kept up, and the mercury in the thermometer rises so regularly as to appear perfectly continuous in course, even under considerable magnifying power. The manner of preparing and filling the capillary tubes was described. Attention was then drawn to the "zero error" of thermometers. In thermometers which have not been much used, the zero error must always be determined immediately after experiment. It is also generally necessary to correct for the projection of the thermometer beyond its bath. This correction has been experimentally determined by the author, and required from 1,500 to 2,000 observations of temperature for each of four instruments used. It was ascertained that the well-known expression—

$$C = \cdot0001545\ (T - t)N$$

given by Regnault and Kopp is not supported by actual trial. If we write the expression thus—

$$C = x(T - t)N$$

experiment shows that x depends on the length N exposed, and

$$x = \alpha + \beta N$$

For lengths of about 25°, x is about ·00013, and increases about ·0001 for every additional 25° The exact values of α and β require, however, to be ascertained for each instrument.—Mr. Bauerman, F.G.S., described and illustrated a very simple method for ascertaining the electric conductivity of various forms of carbon. The method, which was originally devised by Dr. von Kobell, consists in holding a fragment of the substance to be tested with a strip of zinc bent in a U-form, and immersing it in a solution of copper sulphate. In the case of a bad conductor a deposit of copper takes place solely on the surface of the zinc, but when a good conductor is employed a zinc-carbon couple is formed, and a deposit takes place on the surface of the carbon. Numerous specimens were exhibited which showed that the conducting power is greatest in coal which has been subjected to a great degree of heat, and the lowest temperature at which this change takes place appears, in the case of anthracite, to be between the melting points of zinc and silver. Such experiments appear to be specially important as giving a clue to the temperature at which anthracitic metamorphism has been effected by the intrusion of igneous rock.—Prof. Woodward exhibited an apparatus for building up model cones and craters. It consists of a wooden trough about 18 inches long, with sloping sides; at the bottom of the trough a bladed screw carries forward the ashes, sawdust, or other material used, to an opening through which air from a powerful bellows is forced upwards. A board 3 or 4 feet square, with a hole in the centre, is placed over the air-jet, and on this the crater is formed. Several of the peculiarities of natural cones may thus be illustrated, and their structure shown, by using sawdust of various colours.

WELLINGTON, N.Z.

Philosophical Society, Feb. 10.—Dr. Hector, F.R.S., in the chair.—The annual report by the Council (adopted as read) congratulated the Society upon its prosperous condition, not only in regard to the great increase in the number of members, but upon the growing interest taken in the work of the Society, as indicated by the large attendance at the meetings of the past session, and by the number of interesting papers read and dis-

cussed by members. There are now 161 names on the books, twenty-two new members having been elected since January 1874. Seven general meetings were held, and thirty-two papers read on the following subjects:—*Geology.*—1. Did the Great Cook River run N.W. or S.E.? Mr. Crawford. 2. On the Tertiary Series of Wanganui, Mr. Purnell. 3. On the microscopic structure of the igneous rocks of New Zealand, Richard Daintree. 4. On the Pleistocene glaciation of New Zealand, Mr. Travers. 5. Changes in the physical geography of New Zealand since the arrival of the Maoris, Mr. Hood. *Zoology.*—1. Description of fish, presented to the Museum by Prof. Wyville Thomson, Dr. Hector. 2. On new fish from Chatham Islands, Dr. Hector. 3. On certain disputed points in New Zealand Ornithology, Dr. Buller. 4 On New Zealand whales, Dr. Hector. 5. On *Piotus novæ hollandiæ*, Dr. Buller. *Botany.*—1. On a new species of *Rubus*, by Mr. Buchanan. 2. On the durability of New Zealand timber, Mr. Buchanan. 3. On *Juncus camprocarpus* and a new species of Isoetes, Mr. Kirk. 4. On new species of mosses, Dr. Knight. 5. Flowering plants and ferns of Chatham Islands, Mr. Buchanan. 6. Description of New Zealand lichens, Dr. Knight. 7. Two plants new to New Zealand, *Lepilæna preissii* and *Carex chlorantha*, Mr. Kirk. *Meteorology.*—1. On solar radiation in New Zealand, Mr. Rous Marten. 2. On the hot winds of Australia and their influence on the climate of New Zealand, Mr. Hood. 3. On the hot winds of Canterbury, Mr. M'Kay. *Chemistry.*—Five papers pointing out certain new discoveries in chemistry, Mr. Skey. *Miscellaneous.*—1. On ergot in rye, Dr. Hector. 2. On portion of a wreck found at the Haast River, Capt. Turnbull. 3. On the identity of the Moa hunters with the present Maori race, Mr. M'Kay. 4. On Maori traditions respecting the Moa, Mr. Hamilton. 5. On the longitude of Wellington Observatory, Capt. Nares, of H.M.S. *Challenger.* 6. On the Duplex system of telegraphy, Mr. Lemon. These papers will all appear in the seventh volume of the "Proceedings and Transactions of the New Zealand Institute," which is now going through the press. The balance-sheet showed a credit of 162*l.*, of which Dr. Hector was requested to expend 100*l.* in purchasing standard works of reference in England.—The Chairman announced that Prof. Wyville Thomson, Prof. Newton of Cambridge, and Robert M'Lachlan, all of whom had taken great interest in New Zealand science and added much to its literature, had been elected honorary members of the New Zealand Institute. Dr. Buller, F.C.S., F.G.S., was elected president for the ensuing two years. Mr. Travers, F.L.S., vice-president, then took the chair, and the following papers were read:—Further proofs of the former existence of the Great Cook River, by J. C. Crawford, F.G.S.—Notes on Hutton's "Catalogue of Marine Mollusca of New Zealand," by Dr. Ed. von Martens.—On some additions to the collection of birds in the Colonial Museum, by Dr. Buller.—Additional notes on New Zealand fishes, by Dr. Hector.—Further notes on New Zealand whales, by Dr. Hector.—Mr. Travers said that the visit of Dr. Hector to Europe with a valuable collection of specimens of natural history and other objects would materially advance the cause of science in New Zealand.

Philadelphia

Academy of Natural Sciences, Sept. 15, 1874.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy made some remarks on the moving power of diatomes, desmids, and other Algæ. While the cause of motion remains unknown, some of the uses are obvious. The power is considerable, and enables these minute organisms, when mingled with mud, readily to extricate themselves and rise to the surface, where they may receive the influence of light and air. In examining the surface-mud of a shallow rainwater pool, in a recent excavation in brick clay, he found little else but an abundance of minute diatomes. He was not sufficiently familar with the diatomes to name the species, but it resembled *Navicula radiosa*. The little diatomes were very active, gliding hither and thither, and knocking the quartz sand-grains about. Noticing the latter, he made some comparative measurements, and found that the Naviculæ would move grains of sand as much as twenty-five times their own superficial area, and probably fifty times their own bulk and weight, or perhaps more.—Dr. J. Gibbons Hunt remarked that in the vegetable kingdom it is exceedingly rare to meet with glands which have distinct excretory ducts. Some authors deny their existence entirely; but in *Nepenthes rafflesiana*, *N. distillatoria*, and *N. phyllamphora*, and probably in all the species, are large cylindrical glands which pour out their secretion through distinct excretory ducts.

Paris

Academy of Sciences, May 20.—M. Frémy in the chair.—The following papers were read:—Observations of the moon, made with the meridian instruments of the Paris Observatory during 1874, communicated by M. Leverrier.—Some remarks on the discussion with regard to cyclones, by M. Faye.—Researches on sun-spots and solar protuberances made during the years 1871 to 1875, by Father Secchi.—Conditions of the maximum amount of work produced by heat-engines, by M. A. Ledieu.—M. André read a paper on the scientific results obtained at Nouméa by the Transit party.—On the determination of singularities of the left curve, at the intersection of two surfaces of any order that have a certain number of multiple points in common, by M. L. Saltel.—A note by M. V. Cornil, on the dissociation of the violet of methylaniline and its separation into two colours under the influence of normal and pathological tissues, particularly by tissues inclined to amyloid degeneration.—Application of the graphical method to the study of the mechanism of swallowing, by M. S. Arloing.—On a new proceeding in the operation of the cataract (extraction by means of a peripherical piece of cloth), by M. L. de Wecker.—Sulphuration of copper and of iron by a prolonged presence in the thermal source of Bourbon-l'Archambault, by M. de Gouvenain.—On the wanderings of the oak Phylloxera, by M. Lichtenstein.—On some reactions of chromium salts, by M. A. Etard.—On Camphenes, by M. J. Riban.—A note by MM. C Saint-Pierre and G. Jeannel, on a reaction of carbon bisulphide; conversion of carbon bisulphide into hydro-sulphocyanic acid.—On the influence of the pressure in the atmosphere upon the life of man, by M. Cl. Bernard.—Researches on the respiration of birds, by the same and M. Campana.

BOOKS AND PAMPHLETS RECEIVED

British.—The Pebbles in a Bolton Brick field. A Lecture by Rooke Pennington, B.A., LL.D. (*Bolton Daily Chronicle*).—Report of the Rugby School Natural History Society for 1874.—Notes on the Fertilisation of Cereals (Botanical Society of Edinburgh).—On the Graphical representation of the movements of the Chest Wall in Respiration: A. Ransome, M.D., M.A. (Taylor and Francis).—Arctic Papers for the Expedition. A selection of Papers on Arctic Geography and Ethnology. Printed and presented to the Arctic Expedition of 1875 by the Royal Geographical Society (John Murray).—A Compendious Statement of the Nature and Cost of certain Sewage Processes: Major-General Scott, C.B.—Ornithology of the Straits of Gibraltar: Lieut.-Col. L. Howard and L. Irby, F.Z.S. (R. H. Porter).—Contributions to Natural History and Papers on other Subjects: James Simpson (Edinburgh Publishing Company).—Recreative Science: David Page, LL.D. (Wm Blackwood).—Transactions of the Norfolk and Norwich Naturalists' Society, 1874-75. Vol. ii. Part i.—The Potato Disease: Eccles Haigh (G. Philip and Son).—Chapters on Sound: C. A. Martineau (Sunday School Association).—The Zoological Record for 1873 (John Van Voorst).

Colonial.—General Report on the Operations of the Great Trigonometrical Survey of India during 1873-74: Col. J. T. Walker, R.E., F.R.S., &c., Superintendent of the Survey (Dehra Dun, M. J. O'Connor).—Proceedings of the Annual Meeting of the Members of the Agri-Horticultural Society of Madras on the 24th and 27th of March, 1875.

American.—Centrifugal Force and Gravitation. Part I.: John Harris (Lovell Printing and Publishing Company).—The Surface Geology of Ohio, U.S. (Columbus, O.; Nevins and Myers).

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