THURSDAY, APRIL 24, 1879

SCIENTIFIC WORTHIES

XIV.—Jean Louis Rodolphe Agassiz, Born May 28, 1807; Died December 14, 1873

LOUIS AGASSIZ, by which names he was everywhere known, was born at Motier, in the canton of Freiberg, Switzerland, on May 28, 1807. He belonged to an old French Protestant family, who had been compelled to quit their native country by the revocation of the Edict of Nantes, we are told by Dr. Steindachner, in his paper on Agassiz, contributed to the Vienna Academy, to which we are largely indebted for what follows. His father was pastor at Motier, where his forefathers for six generations had filled the same office. Agassiz received his earliest education at home under the care of his mother, a woman of high endowments and rare culture. At the age of eleven years he betook himself with his younger brothers to the Gymnasium at Biel, in the canton of Bern, where he was mainly occupied with the study of ancient and modern languages, the knowledge of which proved of important service to him in his later biological investigations. His play-hours he devoted to fishing and the collecting of insects. Thus early did his leaning towards ichthyological researches show itself, and his knowledge of the habits of fish often astonished even experienced fishermen.

In the meantime Agassiz's father was transferred from Motier to the little town of Orbe at the foot of the Jura, and here young Agassiz became intimate during the holidays with a young clergyman named Fivaz, who first introduced him to the study of natural history, and especially botany. After four years' stay at Biel he entered the Academy of Lausanne, and in 1824 betook himself to Zurich to study medicine, in accordance with the earnest desire of his parents. Soon after, Agassiz left Switzerland to continue his medical studies at Heidelberg, where, at that time, the celebrated anatomist, Tiedemann, carried on his work. After a year's stay Agassiz exchanged Heidelberg for Munich, where Schelling, Oken, Martius, Döllinger, Wagler, Zuccarini, Fuchs, von Kobell, &c., were lecturing; and these soon became not only the kind teachers, but also the friends of young Agassiz. Döllinger, especially, the great master in physiology and embryology soon recognised the high talent of his pupil, and ripened in Agassiz a long-cherished plan of devoting himself to zoology in the widest sense of the term.

It was here in Munich that the young Agassiz, who occupied a small room in Döllinger's house, soon gathered around him a circle of young and talented students, to talk over and discuss matters of scientific interest. Agassiz's room was the meeting-place of this club, which soon assumed the title of the Little Academy, and of which Agassiz acted as president. Before this society did Michaelis lay the results of his researches in the Adriatic Sea, Born exhibited his beautiful preparations of the anatomy of the lamprey, Rudolphi lectured to the students on the Bavarian Alps and the coasts of the Baltic, and Schimper and Braun here first expounded the laws of phyllotaxis. Döllinger himself did not disdain to initiate his disciples and friends of this Little Academy in his newest discoveries and ideas, ere he made them known to the scientific world, and here he taught them the use of the microscope in embryological research.

Meantime the Bavarian members of a great scientific expedition to Brazil, under the leadership of Spix and Martius, returned to Munich, bringing with them rich collections; and after the death of Spix, the celebrated botanist, Martius entrusted Agassiz with the working out of the ichthyological material. Agassiz had scarcely reached his twenty-first year when he concluded this task in so brilliant a fashion that with this, his first-born work, on the Fishes of Brazil, he gained a reputation as one of the first ichthyologists. This work was published in Latin at Munich in the year 1829, and was dedicated to Cuvier. About the same time Agassiz began his investigations on fossil fishes. The immediate occasion of this step was a short notice by Prof. Rud. Wagner on the fossils of the Munich Museum, in which he praised the number and beauty of the unnoticed fossil fishes. Agassiz immediately applied to Prof. Fuchs, who had the care of the palæontological collection, for permission to investigate the ichthyolites in detail; Professors Wagler and Schubert placed freely at his disposal the collection of recent fishes and their skeletons, and Döllinger, Oken, and Martius in various ways encouraged him in this difficult undertaking.

From this time Agassiz devoted all the spare time left him by his medical studies to the investigation of fossil fishes, which naturally implied an adequate knowledge of the most nearly related living forms; in the holiday months he made short visits to the museums of the larger towns of Central Germany, to examine their palæontological treasures. In 1830 Agassiz went to Vienna, where he stayed a year, attending at the hospitals, and studying in the Imperial Museum the splendid collection of sturgeons of the Danube region, as well as the fossil fishes of Monte Balca. Moreover, he was so interested in the Cyprinoids of the Danube, which were already partly known to him from those of the Isar, that he concluded a work on the Freshwater Fishes of Central Europe; on account of the revolution of July, 1830, this work was not published.

The years 1831 and 1832 Agassiz spent in France, and in Paris had much pleasant intercourse with Cuvier and Alex. von Humboldt. Cuvier was then giving a course of lectures on the history of natural science, and combated with all the power of his science and his detailed knowledge of the organic structure of the whole animal world the development theory of Geoffroy based on the variability of species, which the latter defended in the sittings of the Paris Academy. From this time Agassiz adhered to Cuvier's ideas on the classification of the animal kingdom and on creation catastrophes especially, and with but little modification, defended them in his teaching and writing to the end of his life.

In Humboldt, again, Agassiz found an attached and powerful patron, whose support at a later time essentially facilitated the publication of many of his costly works, and to whose recommendation he in part owed the brilliant reception he met with in America, which he chose as his second home.

The Paris Museum was then in the zenith of its reputation; its zoological, palæontological, and anatomical collections were then the richest and most celebrated of

Europe, and Cuvier granted to the young Agassiz with genuine disinterestedness and liberality the complete use of its rich material. With untiring diligence and rare perseverance, Agassiz here continued his researches on fossil fishes, and anew worked thoroughly through the rich palæontological collection of Conte Gazzola, which contained the originals of Volta's celebrated treatise "L' Ittiologia Veronese."

In 1833 Agassiz again visited the great museums of Germany and Switzerland, and had already distinguished 500 species of fossil fishes, when, in August, 1834, he sailed for England, in order to study there the exceptionally rich public and private collections, in which he found 300 new species. In the year 1835 and 1840, he extended his journeys into Wales, Scotland, and Ireland, visiting London again and again, in order there to test the notes collected for many years for the completion of his work, and to make himself acquainted with the newest discoveries in the department of palæontology.

In 1844 Agassiz concluded the publication of his gigantic work on the Fossil Fishes, which appeared at Neuchâtel in five quarto volumes, with 311 folio plates. Eighty of the greatest museums of Europe had furnished the material for it, and the number of described species amounted to 1,700 in about 20,000 examples. The "Recherches sur les Poissons Fossiles" is undoubtedly Agassiz's most important work, and forms, with Cuvier's and Valenciennes' "Histoire Naturelle des Poissons" and Johann Müller's treatises, the foundation of our present knowledge of fishes, while it does not confine itself to the region of ichthyolites, but extends over the entire wide field of the anatomy and classification of fishes, essentially modifying the latter. Agassiz considered, and with justice, that the separation of the ganoids from the other fishes into the rank of a special order, as the greatest step towards progress for which science was indebted to him; and, on the basis of the comparison of the fossil fishes of all formations with living forms, he enunciated several generally valid laws, which have had an important bearing on the development theory of the whole organic world.

As a special fruit of Agassiz's stay in England appeared in 1844 and 1845, a monograph on the Fossil Fishes of the Devonian System and a smaller treatise on the Fishes of the London Clay.

As early as 1832 was Agassiz called to be professor at Neuchâtel, and in a short time raised the little town to be a chief seat of science in Switzerland. He created a Natural History Museum, and was the chief founder of the Scientific Society, which issued the first volume of its *Memoirs* in 1835. From all parts of Switzerland came young and talented pupils and friends of nature thither, and gathered round Agassiz, who understood how to inspire them with his great ideas. They followed him in his frequent zoological and geological excursions in the Jura and the Alps, and assisted him in procuring scientific material and helping him in the time-consuming preliminaries of those numerous works which date mainly from the years 1835 to 1845. Along with his friends Desor and Valentin, Agassiz published the great monograph on living and fossil Echinoderms.

The rich collection of fossil conchifera of Switzerland, which a young and able geologist of the name of Gressly had brought back from his travels, led Agassiz to work out the fossil conchifera of the Jura and the chalk, the result being published under the title of "Études Critiques sur les Mollusques fossiles du Jura et de la Craie," in four parts with 100 plates. This was followed by several similar supplementary publications on fossil conchifera, of which the "Iconographie des Coquilles tertiares, reputées identiques avec les espèces vivantes ou dans différens Terrains de l'Époque tertiaire," and "Mémoire sur les Moules de Mollusques vivans et fossiles," are the most important.

In spite of these numerous and comprehensive works, Agassiz found time to devote to the study of living fishes. Thus may be mentioned his treatise on the cyprinoids (1834); the great work brought out in conjunction with Carl Vogt between 1839 and 1845, on the freshwater fishes of Central Europe; in 1842 he brought out his most important "Nomenclator Zoologicus," the result of many years' gatherings, and which contained an alphabetical arrangement of the specific names of the entire animal kingdom, their etymology, information as to the authors who had proposed these names, as well as the year of their appearance. The "Nomenclator" found a magnificent conclusion in the "Bibliographie générale d' Histoire Naturelle," printed at the cost of the Ray Society, unfortunately not without some ugly mutilations on the part of the editor.

While Agassiz no doubt exercised a considerable influence on geology by means of his palæontological researches, still it is as a glacealist that his name will always be prominently associated with that science. Venetz', Schimper's, and especially Charpentier's observations and theories on the greater extension of glaciers, and their relations to erratic blocks attracted the attention of Agassiz in 1836 to the glacial phenomena of Switzerland. Charpentier's theories on the former extension of glaciers and other points especially interested Agassiz, who gave himself with his peculiar energy and fertility of idea to the study of glaciers. With Gyot, Desor, Studer, and other young friends, did Agassiz during several years visit most of the glaciers of Switzerland, and examined them in their entire extent, from their origin to their lowest margins. In 1841 was the ascent of the Jungfrau undertaken. In the middle of the Aar glacier, at a height of 8,000 feet above the sea, twelve miles from any human habitation, protected by a huge block, was a station erected, which latterly obtained a European celebrity, under the name of "Hôtel des Neuchâtelois." Here for fully eight years were researches carried out on the origin of glaciers, the forward and backward oscillations, the structure and thickness of the ice, as well as its formation, the origin of moraines, &c. In 1840 appeared Agassiz's first great work, "Études sur les Glaciers," in which he thoroughly discussed the chief phenomena of glaciers, and developed his views on their earlier extension. In a second work, "Système glacial," he gave a satisfactory account of the observations made in the years 1841–45, especially on the progress of glaciers in various years and under the influence of conditions of temperature. The adoption of a special glacial period was the final result of Agassiz's research among the glaciers of Switzerland, as well as those of Scotland and Wales. An immense ice-bed, the

result of a depression of temperature toward the end of the tertiary covered North and Central Europe, Asia, and North America, and a similar phenomenon was also found to have occurred in South America, from the South Pole to Monte Video and Chile, as Agassiz ascertained during the *Hassler* Expedition of 1872. The immense importance of this theory, both in geology and biology, was soon recognised, and its discussion has engaged the earnest attention of the ablest men in all departments of science. In the autumn of 1846 Agassiz went to America, partly on a commission from the Prussian Government and partly to fulfil an engagement to give a series of lectures on Comparative Embryology at the Sewell Institute of Boston. This course of lectures led to important results; it aroused an enthusiasm for the study of nature in the widest circles, and Agassiz understood how to make the scientific development of North America in this direction a matter of honour for the whole nation. The offer of the use of the steamers of the Coast Survey led to a scientific cruise in the summer of 1847 along the coast of Massachusetts, followed a few years later by a second larger cruise to the coral reefs of Florida.

After Agassiz had been released from his scientific mission by the Prussian Government, he accepted with pleasure the Chair of Zoology and Geology in the Lawrence Scientific School of Harvard College, Cambridge, created specially for Agassiz by the founder of the school, Mr. Abbot Lawrence. Agassiz thus gave up all thought of returning to Europe; he placed his activity, his science, and his talents, at the disposal of the nation that showed itself so anxious to keep him, and where he would enjoy a social power and a liberty which were hardly possible to the *savans* of the Old World.

As in Neuchâtel, so in Cambridge, Agassiz in a very short time attracted around him a circle of young men, enterprising lovers of natural science. With these, in June, 1848, he undertook a journey to the then little-known region of Lake Superior. In 1850 appeared his well-known work, "Lake Superior: its Physical Character, Vegetation, and Animals," in which Agassiz discussed in detail the erratic phenomena of the lake, its future form and extent, the character of its ichthyological and reptilian fauna, while Cabot, Harris, Gould, and J. Leconte worked out the rest of the collections. In succeeding years he made similar expeditions with his pupils into the interior of the United States, and with the collections brought back laid the foundation of a natural history museum, which, until then, had no existence at Harvard University.

In 1852 Agassiz went to Charleston as Professor of Zoology and Comparative Anatomy, but returned to Cambridge after two years, the warmer climate of the south not agreeing with him. Soon after he visited all the great towns of North America, lecturing in all departments of zoology and geology. Everywhere he was received with enthusiasm, for his expositions were remarkably clear and full of suggestive thought, his language noble and fluent, his knowledge of human science of the widest, his manner so charming and his conversation so full of the highest instruction, that every one felt it a privilege to be near him. From that time Agassiz became the declared pet of the Americans; he was the most popular man in the whole broad land, and in intellectual matters became its greatest benefactor, exercising his influence in improving education and increasing educational establishments.

In 1855 Agassiz began to prepare for the publication of a magnificent work, "Contributions to the Natural History of the United States," he having already published several papers on the subject in American journals. In a short time the necessary means were obtained by subscription, and in 1857 the first volume appeared, dedicated to Döllinger and his generous friend Francis Calley Gray. Unfortunately this work only reached the fourth volume. The first volume contained as introduction the universally-known and much-discussed "Essay on Classification," which latter, as a separate work, was published in London in 1859, and in an enlarged French translation in Paris, 1869. Agassiz treated in this work the questions of the origin, development, and systematic arrangement of the organic world, and developed from these his philosophical views which he had obtained from his own studies and observations, and which stand in direct opposition to the Theory of Descent.

Agassiz's collections had grown so enormously that the accommodation at his disposal was quite inadequate. By the liberality of Mr. F. C. Gray and the State of Massachusetts, as well as Cambridge University, a great Natural History Museum was begun in June 1859, and by December was so far advanced, that the greater part of Agassiz's collections could be transferred to it. From this time the improvement and completion of this museum became the chief object of Agassiz's activity. He aimed at making it in comprehensiveness and suitability for its purpose, a pattern institution for the whole world, and fitted to give the friends of natural history all possible help in their researches. The Museum of Zoology and Comparative Anatomy is much better known to the public of Cambridge and Boston as "Agassiz's Museum."

In 1864-65, Agassiz somewhat broke down from his continued labours, and he was advised to travel. He decided to visit Brazil, the fish of which furnished him with the subject of his first work. With six assistants he left New York in April, 1865, for Rio Janeiro. The party divided to work in various directions, Agassiz, himself, selecting the Amazon as his sphere, sailed up the river to Manaos, at the Mouth of the Rio Negro, and thence to Tabatinga. During the journey from Pará to Manaos 300 species of fish were collected, of which one half were drawn from life by Burkhardt. His headquarters were at Teffe and Manaos, where he studied the habits of the fish in their migrations in the main stream, and several of its tributaries. While he stayed here, his assistants explored some of the other tributaries of the Amazon, while others explored the regions on the Rio Francisco, Rio Doce, Paranahyba, &c. In July of the following year Agassiz returned to the United States with such a collection of booty as would have filled another Museum. With the co-operation of Agassiz, his wife, the true companion of her husband, and full of sympathy for his ideas, brought out the journal of these remarkable travels, which in a short time reached a sixth edition in America, and was translated into French in 1869.

Again, in the end of 1871, Agassiz left for South America, on board the war-ship *Hassler*. Count Pour-

tales, in this well-known expedition, had charge of the deep-sea researches, while Dr. Steindachner with Agassiz, was responsible for the other zoological collections. The results of this expedition are well known to naturalists. The leisurely cruise along the coast of Patagonia and Chili gave Agassiz an opportunity of studying the glacial phenomena of South America. His stay in San Francisco and Sacramento gave an impulse of the greatest importance to education and science in these towns, and in the latter led to the creation of a Natural History Society, which was named after him, the Agassiz Institute.

The history of the Penikese School of Natural History must be so fresh in the memory of our readers that we need not here repeat the details. The success of the school, modelled somewhat after that of Dohrn, at Naples, exceeded all expectation, the accommodation being quite inadequate for the number of students who appeared. At the end of the first summer his pupils bade him a long good-bye in the hope of meeting their much-loved master next year. But the additional burden seems to have been too great for the strength of the never-resting devotee of science. After scarcely eight days' illness, he died at Cambridge, December 14, 1873, in his sixty-third year, in the height of his fame. He has been justly named by his fellow-citizens of the States the "Humboldt of America." Ever amiable and open in intercourse, stimulating and instructive, clear and concise in exposition, was Agassiz; and his numerous pupils, of whom several have developed into important workers in science, as Alex. Agassiz, Stimpson, Putnam, Shaler, Wilder, Morse, &c., clung to him with truly child-like love and respect. The news of his unexpectedly sudden death shocked the whole population deeply, for America had lost in him one of her citizens of whom she had the best right to be proud.

Besides Dr. Steindachner's paper, we would refer the reader who desires further details to a paper in the *Revue des Deux Mondes* for July and August, 1875.

WATERTON'S LIFE AND TRAVELS

Wanderings in South America, the North-West of the United States, and the Antilles, in the Years 1812, 1816, 1820, *and* 1824. With Original Instructions for the Perfect Preservation of Birds, &c., for Cabinets of Natural History. By Charles Waterton. New Edition. Edited, with Biographical Introduction and Explanatory Index, by the Rev. J. G. Wood. With 100 Illustrations. (London: Macmillan and Co., 1879.)

THE reading world will feel grateful to both author and publisher for this handsome edition of one of our classical books of travel and natural history; while those who are already familiar with the work will read with interest and pleasure the excellent biographical notice of Waterton here given. We have first a sketch of his school and college life, when his taste for natural history got him into many scrapes; but we learn that the Jesuit fathers at Stonyhurst wisely utilised his irrepressible love of animals by making him rat-catcher and general vermin-killer to the establishment. We next find him travelling on the Continent, where he had a narrow escape of dying of the plague at Malaga. He visited Gibraltar, and saw a whole colony of the well-known apes which were then far more abundant than now. He speculates on the "tremendous convulsion of nature" which had opened the channel of the Straits, observing that—"if apes had been on Gibraltar when the sudden shock occurred, these unlucky mimickers of man would have seen their late intercourse with Africa quite at an end"—a passage which recalls to us those extreme catastrophist doctrines in geology which are now happily extinct.

When his wanderings in South America were at an end he settled down in his ancestral Yorkshire home, Walton Hall, devoting himself to the management of his estate and the study of nature, and living a life of the most Spartan simplicity. His single room had neither bed nor carpet. He always lay on the bare boards with a blanket wrapped round him, and with an oaken block by way of pillow. He went to bed at eight, and was up, dressed and clean shaven every morning at four, having himself lit a fire and boiled water to shave with. His devotions and reading occupied him till six; his bailiff's report, writing and business till eight, his breakfast hour; so that he had done a fair day's work before most people are out of bed. His room was at the very top of the house; he never touched fermented liquors, and took very little meat.

His great delight was in studying the habits of birds and other wild animals; and he devoted his park of over 250 acres to this purpose. He had moats, and ponds, and swamps, woods and trees of all kinds; and he spent 10,000*l.* in surrounding the whole with a wall nowhere less than eight feet high, in order to keep out poachers and animal intruders. In this domain no gun was ever fired or anything done to disturb the feathered inhabitants. The very year after the wall was finished the herons came and established themselves in the park, where they had never bred before; and, as Mr. Wood remarks, it is strange that they should have known that the wall, which they themselves could so easily pass, would be any protection to them. He constructed a yew fortress for pheasants, built a cat-proof tower for starlings, and a lofty dovecot to secure his pigeons from poachers. Owls and titmice and many other birds had special haunts constructed for them, while rats and other bird-enemies were carefully trapped or poisoned.

Waterton was one of the kindest and most humane of men. He studied the comforts of his horses, his dogs, and even of his pigs, as if they had been human beings. He had his gates specially constructed so that his horses and cows could lean over them and converse together, without inconvenience to themselves or injury to the gates. When he took possession of a deserted country house in Demerara, tenanted by frogs and snakes, owls and vampires, he tells us in his quaint language,—"The frogs, and here and there a snake, received that attention which the weak in this world generally experience from the strong, and which the law commonly denominates an ejectment. But here neither the frogs nor serpents were ill-treated; they sallied forth, without buffet or rebuke, to choose their place of residence; the world was all before them. The owls went away of their own accord, preferring to retire to a hollow tree rather than to associate with their new landlord. The bats and vampires stayed with me, and went in and out as usual." Even when, going down the St. Lawrence, he caught, crawling on his neck, the only bug he saw in North America, he "thought of my uncle Toby and the fly;" and so, instead of killing it, he "quietly chucked it among some baggage that was

close by, and recommended it to get ashore by the first opportunity."

Any wild animals that he does not actually want for specimens he treats in the same way, and it is therefore not surprising that he looks favourably on the Indian and his mode of life. Ignorant travellers and colonists call the Indians a lazy race; "but," he remarks, "man in general will not be active without an object. When an Indian has got plenty to eat, what need has he to work? He has no idea of making pleasure-grounds. Money is of no use to him as there are no markets for him to go to, nor milliners' shops for his wife and daughters. He has no taxes to pay, no highways to keep up, no poor to maintain, no army nor navy to supply. He lies in his hammock both night and day (for he has no chair nor bed, neither does he want them), and in it he forms his bow, and makes his arrows, and repairs his fishing-tackle. But when his provisions are gone he rouses himself, and scours the forest in quest of food. He plunges into the river after the deer and tapir, or passes through swamps and quagmires, and never fails to obtain food. Should the approach of night check him while hunting, he lays him down in the forest and continues the chase the next morning till he is successful. With us the poor or needy man has to work every day and all day long for a maintenance, but should this man acquire a fortune he usually changes his habits." Waterton then amusingly sketches for us the life of an idle man for a single day, and concludes:—"Now, could the Indian in his turn see this, he would call the white men a lazy, indolent set. Perhaps, then, upon due reflection, you would draw this conclusion: that men will always be indolent when there is no object to rouse them."

Not even Gilbert White was a closer or more accurate observer of the habits of animals than was Waterton, and had he recorded all his observations during the forty years he lived at Walton Hall we should have had a work in no way inferior to White's "Selborne." There is one curious observation of his which throws some light on the origin of one of the superstitions of natural history, but which seems to have been entirely overlooked. The name *Caprimulgus*, or "goat-sucker," has its equivalent in many European languages; and the belief that this bird sucked goats or cows has been prevalent since the time of Aristotle. The only foundation for this widespread belief, suggested in any ornithological book to which I have access, is, that the goat-sucker is often found near sheep-folds and cattle-pens on account of the abundance of insects in such places. Pliny however says that they enter the folds and fly to the udders of the goats in order to suck the milk. This is a much more definite statement, and, strange to say, Waterton supports the *fact* thus stated by his own observation, and at the same time shows how the erroneous *inference* arose from this fact. At p. 233 of this volume we find the following:—"I am fully persuaded that these innocent little birds never suck the herds; for when they approach them, *and jump up at their udders*, it is to catch the flies and insects there. When the moon shone bright I would frequently go and stand within three yards of a cow, *and distinctly see the caprimulgus catch the flies on its udder.*" The passages marked in italics are most remarkable, since they directly confirm Pliny's statement that the birds "fly to the udders of the goats." It is not quite clear by the context whether Waterton made this observation in Demerara or in England. He is describing the habits of the Demerara goat-suckers at the time, but as he has said nothing about there being any cows on the deserted estate where he was staying, he may in this passage be referring to his observations at home.

In another passage at p. 198 this is certainly the case. He says (according to his custom addressing his reader as if speaking to him):—

"When the moon shines bright you may have a fair opportunity of examining the goat-sucker. You will see it close by the cows, goats, and sheep, jumping up every now and then under their bellies. Approach a little nearer,—see how the nocturnal flies are tormenting the herd, and with what dexterity he springs up and catches them, as fast as they alight on the belly, legs, and udder of the animals. Observe how quiet they stand, and how sensible they seem of his good offices, for they neither strike him, nor hit him with their tail, nor tread on him, nor try to drive him away as an uncivil intruder."

There can be no doubt that these are Waterton's own observations at home, though expressed rather generally; but the other passage, at all events, written in the first person, is far too definite a statement to be doubted, coming from such an observer; and it is curious that no modern writer on the subject appears to have referred to it.

As a capturer of snakes Waterton was pre-eminent, his fight with the great boa constrictor, and his capture single-handed of a smaller one, which he allowed to coil round his body while he held its neck in his two hands, are well-known incidents in his "Wanderings;" but Mr. Wood tells us how he coolly manipulated live rattlesnakes in the presence of a number of friends at Leeds, transferring them from one box to another with his bare hands. His secret was, simply, that if a snake is not frightened by noise or sudden movements, its natural sluggishness prevents it from resenting cautious handling.

We quite agree with the editor that few books have ever been written so thoroughly truthful and accurate, and so entirely free from exaggeration as those of Waterton; yet his veracity was often doubted by his reviewers, and he was classed among travellers of the Munchausen type. This however he little cared for, but he did not like to be called eccentric. He thought himself the most ordinary of human beings, though he climbed trees barefoot and never in his life wore a black coat. "Yet," as Mr. Wood well says of him, "had he not been eccentric he would not have been the Charles Waterton so long known and loved. . . . It was eccentric to come into a large estate as a young man, and to have lived to extreme old age without having wasted an hour or a shilling. It was eccentric to give bountifully and never allow his name to appear in a subscription list. It was eccentric to be saturated with the love of nature. It might be eccentric never to give dinner-parties, preferring to keep an always open house for his friends; but it was a very agreeable kind of eccentricity. It was eccentric to be ever childlike but never childish. We might multiply instances of his eccentricity to any extent, and may safely say that the world would be much better than it is if such eccentricity were more common."

So far we have had only praise for this book, and

though we have said nothing yet about the illustrations, they are also worthy of commendation as really illustrating the matter in hand, and being for the most part of excellent quality. But now we have the less pleasant duty of finding fault. Waterton had a strong prejudice against the use of scientific names. He tells us that the Salempenta is excellent eating; that you hear the voice of the Hannaquoi at early dawn; while such words as Conanacouchi, Labarri, and Karabimiti are continually used without any explanation of their meaning. In pursuance of his duty as editor Mr. Wood undertakes to clear up all these points, and to make the path easy both for the general reader and the scientific naturalist; and he does this by means of an "Explanatory Index," which occupies nearly one-third of the volume, and of which he says in his preface that he believes "there is not a single living creature or tree mentioned by Waterton concerning which more or less information cannot be found in this Index."

The index referred to does undoubtedly contain a great deal of useful and interesting information, but it is also full of the most extraordinary and misleading errors, which seem to show that Mr. Wood participates in his old friend's contempt for scientific names, since he evidently thinks accuracy in these names of little importance. First we have several completely obsolete names given, which the reader would in vain look for in any modern book on natural history; such as Champsa for Alligator, and Arapunga instead of Chasmorhynchus as the name of the bell-bird. Then we find misspelt or misplaced names; as *Derotypus coronatus* instead of *Deroptyus accipitrinus* for the name of the sun-parrot, and *Helias eurypyga* instead of *Eurypyga helias* for the sun-bittern. More important are the completely wrong identifications of species, or the mixing together of two quite different animals. The ant-thrushes are said to belong to the genus Pitta, which is eastern, whereas they form a peculiar American family, Formicariidæ. The feathers of the "wild turkey," a bird which does not exist in South America, are said to be used by the Indians of Demerara. The "hannaquoi," or motmot, is said to be named *Ortalida motmot*, and the description mixes up the real motmot (Momotus) and the gallinaceous Ortalida, saying that the eggs are blue and that the bird can be easily tamed and feeds with the poultry; which is certainly not true of the motmot, of which a figure is given, and which is a solitary forest bird whose eggs are white and which never walks on the ground. The "kurumanni" wax is said to be produced by a wild bee named *Ceroxylon audicola*, which is the name of the wax-palm of the Andes. The name of the "coral-snake" is given as *Tortrix scytale*, whereas the species belongs to a quite distinct family, being either an *Elaps* or a *Pliocerus*; while the deadly "labarri" snake is named *Elaps lemniscatus*, though, from the description Waterton gives, it is almost certainly a Craspedocephalus. The red grosbeak, which Waterton mentions as a rarity he was long in search for and gives a recognisable description of, is called *Cardinalis virginianus*, a bird not found in Demerara; whereas it is almost certainly the *Pitylus erythromelas*. The little tiger-bird is said to be a Tigrisoma or tiger-bittern; but Waterton's description shows it to be *Capito cayanensis*, a fruit-eating bird of a totally distinct family. The "yawaraciris" are said to be manakins of the genus Pipra; but the description in the text clearly points to the well-known "blue creepers" of the genus Cœreba. The jay of Guiana described by Waterton, and which Mr. Wood could not determine, is the *Cyanocorax cayanus*, while the "grand gobe-mouche," which is omitted from the index, is easily recognisable as the *Querula rubricollis*. Of the plant identifications I am not prepared to speak, except to remark that the cultivated pineapple is certainly not a species of *Pitcairnea*.

It is to be hoped that this delightful work will come to a second edition, and admit of these blemishes being removed. It would also be a great convenience if references were added to the explanatory index, to avoid the trouble of first going to the index proper and then back to the body of the work. These, however, are matters which, though important to the student who keeps the book for reference, will not much affect the enjoyment of the general reader; and I can therefore cordially recommend all who have not made the acquaintance of the "Wanderer" to do so in the pages of the present volume. A. R. W.

OUR BOOK SHELF

Ueber ehemalige Strandlinien in anstehendem Fels in Norwegen. Dr. R. Lehmann. (Halle, 1879.)

PROBABLY no feature of Scandinavian geology has been more frequently discussed than the remarkable lines of terrace which have been traced along the slopes of the coast, even up into the far northern fjords. Certainly no stranger, even if ignorant of geology, can visit these regions without being impressed by the freshness and persistence of these "parallel roads," which wind in and out among the intricate navigation of strait and sound, islet and archipelago. From the time of Celsius downwards a continually increasing literature has been devoted to this subject, and now Dr. Lehmann, of the Realschule, in Halle, adds another essay to the pile. He discusses at length and rejects the theories of erosion by glaciers and by floating ice, and adopts that of breaker-action. But probably no exclusive theory is correct. Unquestionably Norway has been overridden by land-ice, scarped and notched by coast-ice, as well as cut into by tides and breakers. That the terraces mark lines of former sea-level seems so self-evident that it hardly deserves more than a simple mention of the fact. But when these lines were cut out of the rock and the land was a hundred feet or more lower than it is now, the coasts were doubtless cumbered with ice, and while the breakers were grinding out a platform from the solid rock, their work was probably expedited by drifting masses of floe-ice. Dr. Lehmann's pamphlet is useful for the collected references it contains to recent literature on the subject. But it is needlessly voluminous.

Die Lust an der Musik. Erklärt von H. Berg. B. Behr's Buchhandlung. (Berlin, 1879.)

THIS is a little pamphlet which we have perused with no small amount of disappointment. After a short chapter treating of the origin of music, in which the author merely recapitulates the theory expounded by Darwin long ago, we come to Chapter II., on the development of music, in which the author states very little that has not before been stated by Darwin, and particularly by Helmholtz, in his "Lehre von den Tonempfindungen." The principal chapter, viz., that on the effects of music, in which we expected to find the explanation promised in the title of the pamphlet, or at least the expression of some new ideas on the subject, occupies but four small

pages, and contains merely a few illustrations of the capacity inherent in music of modulating the pleasant sensation it produces in the mind of man in a number of various ways. An appendix treats of the pleasure man derives from the aspect of colours, certain forms, and the beauty of the human body.

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 Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

On the Spectrum of Brorsen's Comet

THE observations of Prof. Young on the present appearance of the spectrum of Brorsen's comet are of great interest, from the circumstance to which he refers in his letter in NATURE, vol. xix. p. 559, namely, that in 1868 I found the positions of the three bright bands of this comet not to agree with those of other comets which I showed to be coincident with the bright bands in the spectrum of flames containing carbon.

The care I bestowed upon the determination of the apparently anomalous character of the spectrum of Brorsen's comet in 1868 gives me great confidence in its approximate accuracy. I wish now to call attention to the fact that a spectrum apparently essentially similar to the peculiar one exhibited by Brorsen's comet in 1868, was observed at Dunecht by Lord Lindsay in the case of Comet C 1877 (Borelly's). It is remarkable that another comet, Comet B (Winnecke's) 1877, observed by Lord Lindsay on the same evening (May 6) presented the ordinary cometary spectrum.

Lord Lindsay's diagram in the *Monthly Notices* R.A.S. (vol. xxxvii. p. 431) of these two spectra agrees as nearly as can be expected in such observations with my diagram in the *Phil. Trans.*, 1868 (Pl. xxxiii.), contrasting the spectrum of Comet B, 1868, with that of Brorsen's comet.

It may be accepted, therefore, as beyond doubt that the unusual form of spectrum of Brorsen's comet in 1868 is occasionally presented by comets. The great interest of Prof. Young's observation lies in the information which it gives us that the *same comet* may present on one occasion one spectrum, and on another the other spectrum.

I regret that the special arrangement of my telescope for photographic work does not permit me to observe the spectrum of Brorsen's comet at its present appearance.

Upper Tulse Hill WILLIAM HUGGINS

The Migration of Birds

IN NATURE, vol. xix. p. 433, there is a notice of my paper "Ueber das Wandern der Vögel," to which I have somewhat to reply.

However agreeable it is to me that my views should be communicated to your readers, and however little I object to their being submitted to rigorous criticism, I must still also desire that this criticism be fair.

I believe it is due to differences of national customs that your reviewer has not quite satisfied this desire. We make, perhaps, in Germany a sharper distinction between a *scientific* treatise and a *popular* work than in England. Of the latter we do not require that it bring forth what is *new*, but only that it should give what it has to give in a clear and easily intelligible manner. Nor do we require completeness of such a work, or even a criticism of the scientific works on which it is based; indeed, it is generally left to the author how far to cite his sources of information and how far not. In the *scientific* treatise it is quite otherwise; here only that is of value which is new; the theme must be treated *exhaustively;* the sources must always be named and dealt with critically, &c.

Now my publication is a lecture, which was delivered *before a company of educated ladies and gentlemen, and so before mere laics*, and a year and a half afterwards was printed in Virchow and Holtzendorff's Collection of Popular Lectures. *It thus belongs unquestionably to the category of popular writings.*

For this reason your severe critic had no occasion to point out that in my lecture there is much that had been long known, that sources are named but rarely, and that no scientific criticism is exercised. That is quite a matter of course in a popular work, at least in Germany. Mr. Newton would have had much better right to feel surprised *that even any new ideas were contained in it.*

My original aim in this lecture was merely to make my hearers acquainted with the new facts and views on the migration of birds, as they have been established by Wallace, Middendorff, and especially by Palmén. As I followed the new facts theoretically to their consequences, there arose perhaps some new ideas, which I should be glad to find verified in the future.

It is further a matter of course that, notwithstanding the *popular* form of my work, I stand by all that I have said; but I must protest against being made responsible *for what I have not said!*

Thus, *e.g.*, I have nowhere said that I hold Palmén's routes of flight for "absolute truths." I am rather quite of Mr. Newton's opinion, that these routes are merely *inferred*, not *directly* observed, and therefore that they are to a certain extent "conjectural." In this sense, however, the routes of birds must ever remain comparatively "conjectural," unless one were to follow the birds in a balloon. But while "conjectural," Palmén's routes are yet inferred by a purely scientific method, and I doubt not that most of them will in the main be confirmed by further observations. Precisely in the application of this method lies Palmén's great merit, and it is only to be hoped that ornithologists will follow further in his footsteps, and correct his mistakes by accumulation of new facts. That Palmén's routes contain some errors I do not doubt; I should rather wonder if it were not so.

Little, however, comes of this with reference to the questions which are treated with special fulness in my lecture, *the origination of the instinct of migration, and the powers by which the bird reaches its distant goal.*

I have, further, nowhere said that birds fly over the sea at a height of 20,000 feet, but have merely cited the fact that birds have been seen at such height; with reference, of course, to explanation of their flight over the sea. I believe that birds, in flight over the sea, do not close their eyes, but exercise their keen eyesight as far as possible. Therewith, however, it is not said (as Mr. Newton imputes to me) that in *all* flights over the sea they always keep the land in sight.

I desist from adducing further misunderstandings by Mr. Newton, and come to what *I have actually said* and am minded to maintain.

In agreement with Palmén, I have expressed the opinion, *that migratory birds have no special sixth sense*, as Middendorff has assumed, but that *they find their way only with the help of their ordinary five senses.*

Mr. Newton seems to be of a different opinion. He does not say, indeed, whether he agrees with Middendorff, but he brings forward observations which appear incapable of harmony with my view.

First, there appear in New Zealand two species of cuckoo (*Chrysococcyx lucidus* and *Eudynamis taitensis*) which regularly fly some 1,000 miles' distance over the ocean. I believe with Mr. Newton that the birds cannot fly so high as to see at once New Zealand and the Norfolk or Kermadec Islands, though on the former is a hill of 1,000 feet. Likewise I will accept the case of *Charadrius pluvialis* as a regular guest of the Bermuda Islands, and a doubtful *Charadrius* species as regular guest of the Sandwich Islands. *All these observations are, indeed, still very imperfect*, inasmuch as it is not known whence the birds come nor whither they go; but so much seems certain, that they do *regularly* fly over large stretches of ocean in which are almost no islands or rocks, and which are so great that they must of course also fly by night.

What then? Are we therefore compelled to make the assumption, with Middendorff, of a sixth sense, which informs the bird which direction is north? Is there no simpler explanation of the fact? Obviously, we should only be warranted in accepting such a purely hypothetical sense, if it were clearly proved, that we could never get to understand the facts without it.

The question had already occupied me, before I knew of Mr. Newton's examples. I omitted it in my lecture, because it seemed to lead me further into the region of hypotheses than I considered I could answer for before my audience.

I do not believe that we are necessitated by the far sea flight of birds, to assume a sixth sense. Is it not conceivable that birds are capable of keeping exactly the same direction of flight for many hours together, and so to fly somewhat like a shot ball or a steamship with rudder bound fast? From the physiological side, it might of course be objected that a very slight difference in the strength of the right and left wing-beats must cause a deflection from the original course, just as in the case of rowing without a steersman, a constant control by sight is necessary, if the right direction is not to be lost. To this might be replied, however, that birds are so accomplished in flight, and that we may assume they have *an extremely fine muscular sense.* Besides, they migrate mostly in company, and an error in flight of one bird will be easily corrected by the others.

But how do they hit the direction in flying away from the coast? They must be able to exactly measure the angle at which they ought to leave the land. Therein, of course, a quite small error would involve great deflections from the proper course, *but do we know that this does not actually occur often enough? and may it not be supposed that in many cases corrections are made in the flight, as soon as any point of orientation again emerges in the circle of vision? So* much we at least know, that even on land birds wander not infrequently. And it is at least not demonstrated *in any one of the cases cited by Mr. Newton*, that the birds referred to appeared on those islands *every year*, nearly *at the same time and in the same number.*

Mr. Newton adduces a second series of "facts" which seem to be against the sufficiency of the five senses; *but are these really facts?*

The young, scarcely three months old, of many of our birds, are said to pursue their flight southwards in autumn *alone.* Is that certain? and have we not here, perhaps, a too ready deduction of general rules from a few well-observed cases? Mr. Newton even says: "This seems to happen with nearly all the accipitres," &c. He quotes a letter from M. Gätke, stating that in July "Young starlings pass over Heligoland by hundreds of thousands *without a single old bird* accompanying them." I confess that I cannot regard this as a *fact*, but as a more or less probable *conjecture;* for M. Gätke, though an excellent ornithologist, could not possibly have inspected a hundredth part of these "hundreds of thousands" of starlings flying about.

I do not mean to assert that these or the other data are false; they may well be correct. I merely hold that we must guard against building far-reaching theoretical inferences on observations the general validity of which is not in the least demonstrated.

But even supposing that all these data are correct; further, supposing it certain, that these young birds, which go forth alone, also actually find the route of the species with the same certainty as if they had known it long before, would these facts be explained by the supposition of a magnetic sense? I think not. For in that case, what must have been born with the young bird? Merely this magnetic sense? *i.e.*, the power of directly perceiving external direction in its own body? By no means. There must also be born with the young bird the consciousness of what angle to the magnetic meridian it must shape its flight at.

But much more than this. It has been long known that birds, so long as they are migrating over land, frequently alter their direction; hence, supposing the young bird to be guided by a magnetic sense, there must be born with it the tendency to fly (say) twenty miles at an angle of 45° to the magnetic meridian, then 100 miles at an angle of 27°, and so on. That this is a physiological absurdity, no one would deny.

For these reasons I hold that *a special sense for direction does not exist in birds*, and that the phenomena of migration, however wonderful they appear, yet cannot ultimately depend on magic (*Zauberei*), and in this Mr. Newton no doubt agrees with me. Hence, nothing remains but to try to explain these phenomena by the known physical and mental properties of birds; *for there is no third course.*

I shall be rejoiced if Mr. Newton succeed with this better than I.

AUGUST WEISMANN

Freiburg im Breisgau, March 31

THE editor having afforded me the opportunity of seeing the foregoing remarks, it will, perhaps, be convenient to the readers of NATURE that I should here add the comments I have to make upon them.

I deeply regret if my criticism of Dr. Weismann's treatise or lecture be open to the charge of unfairness. I had no wish to misrepresent him, and I cannot see that I have been guilty of such an act—indeed, the wide publication of his theory would render any attempt to do so futile. As to his acceptance of Dr. Palmén's conjecture for "absolute truths," I must urge that he took no exception to any of them, while, in the case of his Bernacle or Brent Goose, he especially adopted (p. 27) that route X which I had particular reason to consider unfounded. I did not assert that Dr. Weismann spoke of birds flying over the sea at the height of 20,000 feet, though there seems no reason why some might not, if they can do so over the land; nor did I impute to him that they always keep land in sight. I had no need to declare my disbelief in Dr. von Middendorff's magnetic hypothesis, for I never met with any man that held it. I had spoken of it already elsewhere (*Encycl. Brit.* Ed. 9, iii., p. 769), and I considered it had been set at rest for ever by Prof. Baird in the article I cited. In like manner it seemed useless to disclaim any belief in the possession by birds of a "sixth sense" which is not common to ourselves and other animals. My only object was to show that Dr. Weismann's theory was inconsistent with certain facts, and nothing he has since adduced makes me think it otherwise. As to some of these "facts" he is incredulous, and I have no fault to find with his caution in this respect, but I am sure that the more he investigates them, the less he will be inclined to demur to them. I shall leave to the ornithologists of New Zealand the defence of those that relate to their cuckoos. Dr. Weismann will find in Mr. Jones's "Naturalist in Bermuda" (London, 1859) more than enough to justify my allegations in regard to the passage of *Charadrius virginicus* (not *fluvialis*) over those islands; indeed it has long been notorious; and as to the plovers of the Sandwich group, I have not only to thank Capt. Long, R.N., for his confirmation (*suprà*, p. 460) of my statements, but also Prof. George Forbes, who kindly informs me that when there, on the occasion of the transit of Venus, he shot scores of these birds, and that his friend Capt. Cator, R.N., of H.M.S. *Scout*, having sailed thence, was overtaken in mid-ocean by them, flying in a direct line for Vancouver's Island, on arriving at which he found they had already reached it. Concerning the "facts" relating to some young birds preceding their parents in migration, the more inquiries I make of well-placed observers the more satisfactory are the answers. For want of space I cannot here give the details, but I may just say that Mr. Cordeaux, who has been for many years a watchful observer of migratory birds on the Lincolnshire coast, has named to me nine species of *Limicolæ*, of which he has personally assured himself that the young migrate apart from, and invariably arrive earlier than, the old—thus fully bearing out Temminck's assertion, made nearly forty years ago. The case of our cuckoos, which I cited, is incontestable, and M. Gätke, I doubt not, will satisfy any scruples about his starlings in that book which we are expecting from his hands.

I will also take this opportunity of replying to Mr. Pringle's note (*suprà*, p. 481). My chief reason for not referring to the matter of temperature was that we know too little of the power of birds to resist extreme cold to depend much upon it, and I thought I would not take up room by bringing in that question. Doubtless there is something in what he says touching the loom of land, but I fail to see how it will help very far, and especially in nocturnal flights.

ALFRED NEWTON

Magdalene College, Cambridge, April 20

Colour in Nature

I WISH to offer a few remarks upon Mr. Wallace's kind and appreciative review of my work on the "Colour-Sense" in NATURE, vol. xix. p. 501. Mr. Wallace attributes to me "many errors" and inaccuracy as to matters of fact; but I do not think the instances he alleges are sufficient to justify the statement. Had I said in every case what Mr. Wallace makes me say, I should, doubtless, have been misrepresenting facts; but it seems to me that in most of the passages to which he refers he has slightly misconceived my meaning. I should not attempt to oppose so distinguished a naturalist on points of biological inference, but I venture to defend the accuracy of my statements of fact.

1. "*Scissirostrum Pagei* does not 'belong to a family generally dull,' while it is itself decidedly dull-coloured." The first statement will be correct if we place *Scissirostrum* among the brilliant starlings; but Mr. Wallace himself, following Prince

Lucien Bonaparte, puts it next to the West African *Buphagæ*. Now the *Buphagæ* are certainly dull birds, while *Scissirostrum* is described in the "Malay Archipelago" as "almost entirely of a slaty colour, with yellow bill and feet, but the feathers of the rump and upper tail-coverts each terminate in a rigid glossy pencil or tuft of a vivid crimson" (i. 430). I wrote with this passage of Mr. Wallace's under my eyes, and refer in a footnote to his volume for the vivid crimson. I did not say the bird was brilliant, I merely noticed the colour of its tail and beak. The case really stands thus: If *Scissirostrum* was differentiated from a generic ancestor generally resembling *Buphaga*, we have to inquire, why did it develop these ornamental adjuncts? and my answer is, because while *Buphaga* pecks the parasites of the backs of mammals, *Scissirostrum* feeds off "grains and fruits."

2. "Santarem, of which it is said 'the pastures are destitute of flowers, and also of animal life, with the exception of a few small plain-coloured birds,' is one of the richest localities for flowering shrubs in South America." Now, this passage to which Mr. Wallace takes exception is not mine, but is a textual quotation from Mr. Bates ("Naturalist on the Amazons," p. 183). It is given in inverted commas in my text, with reference to the original in a footnote. I was, of course, aware that the Brazilian woods generally were full of brilliant birds, and that "the butterflies in the adjacent forests were gorgeous in the extreme." What I wished to point out was that in particular spots like these meadows, where the general aspect of the flora was not bright, the purely local fauna was likewise dull. We may find great varieties in this respect nearer home in a meadow, an adjacent warren, and a moor or swamp behind it. Moreover, the passage was professedly quoted, simply as showing the general impression left upon my mind by reading various books of travel. May I add a sentence from a private letter of Mr. Darwin's, which helps out the same view on a larger scale? "The contrast," he says, "in the colour of the birds in Patagonia" (where he had just noticed "the sombre aspect of nature"), "and on the bright green flower-decked plains of La Plata is very striking."

3. About a certain squirrel, described in the "Malay Archipelago" as having a tail "ringed with gray, yellow, and brown," and as looking "exceedingly pretty," Mr. Wallace now says it "is one of the dullest of the group," while he did not "say a word about its feeding on 'bright-coloured fruits.'" But he *did* say that it would eat "any fruit" (i. 192), and I presume, therefore, that it sometimes eats "bright-coloured food."

4. "So far from the colours of caterpillars being 'mostly protective,' every entomologist knows that a large number of caterpillars in every part of the world are conspicuously coloured." True; but Mr. Wallace himself was the first to suggest that these conspicuous colours were themselves protective by giving warning of inedibility; and I am at a loss to understand what he means by thus going back upon his own words. I took my statement from Sir John Lubbock's lecture "On Certain Relations between Plants and Insects," pp. 23–24, where this fact of universal protective colouring in larvæ is very clearly brought out.

5. "Again, the ground-feeding pheasant family are passed over as containing only one brilliant bird, the peacock, whereas it abounds in species of the most gorgeous colour." But my words are very different from this—"Even among the pheasants themselves," I say on p. 176, "many species are far from brilliant; and when we come to compare the whole family with that of the parrots or the humming-birds, we shall find that the peacock alone can fairly come into competition with the typical fruit-eaters and flower-feeders." Mr. Wallace goes on to mention (amongst others) the "Impeyan pheasant of the Himalayas," and "the intensely-brilliant fire-backed pheasants of the Malay countries," as among the most brightly-coloured species. Any one would suppose from his review that I had totally overlooked these cases; but in the very same paragraph with the sentence which Mr. Wallace blames the following passage occurs:—"The forests of the Himalayas and the Malay Archipelago, with their great brilliant fruits and flowers, and their exquisite insects, form the haunts of the most beautiful species of pheasants" (p. 177). As a matter of fact, before writing that paragraph I had carefully compared all the living *phasianidæ* in the Zoological Gardens, and all the preserved specimens in the British and Oxford Muesums; and I feel sure that any one who does the same will agree with me that the peacock alone can be placed in the very first rank of brilliant colouration.

6. How much the subjective element enters into these questions may be seen from the following remark of Mr. Wallace:—"The tigers, the zebras, the beautifully-marked antelopes, and the spotted deer and giraffes, *which are really among the most brightly-coloured of all mammals*, are passed over as less beautifully coloured than the squirrels and monkeys." Now I confess myself simply astounded at the statement that the zebra, of all animals in the world, is brightly coloured—a creature without a tinge of anything but creamy white and black about its body. Quite apart from the nature of food or surroundings, I call a panda a brightly-coloured mammal; or a mandrill; or a Rhesus monkey; or a Canadian chipmonk; but certainly not a tiger, a zebra, or a giraffe, none of which has a single tinge of scarlet, blue, green, or bright yellow.

No one who knows anything of Mr. Wallace could for one moment imagine him capable of intentionally misrepresenting the humblest opponent in the smallest particular; and I owe him many thanks for much kind and appreciative criticism both on this and several previous occasions. Yet I cannot help thinking that in these instances, and others with which I will not burden your space, he has unconsciously permitted mere differences of opinion unduly to assume the appearance of positive errors in fact.

GRANT ALLEN

Remarks by the Reviewer

1. *Scissirostrum Pagei* is universally placed in the starling family. Its affinity to *Buphaga* is very doubtful, while its *crimson-tipped tail-coverts* are very different from "*a tail of vivid crimson*" which Mr. Allen gives it (p. 184).

2. I object altogether to founding theories on chance expressions of travellers. It is curious, that in my "Travels on the Amazon" (p. 157) I refer to these same Santarem pastures as follows:—"There were some boggy meadows here, more like those of Europe than one often sees so near the equator, on which were growing pretty, small *Melastomas* and other flowers. The paths and campos were covered with flowering myrtles, tall *Melastomas*, and numbers of passion-flowers, convolvuluses, and bignonias." These open meadows and campos really exhibited more conspicuous flowers than the woods and forests which swarmed with brilliant butterflies and birds.

3. I referred to the squirrel, because it was the only example given by Mr. Allen which I could at the moment test.

4. My argument is, that the colours of caterpillars are often as varied, as vivid, and as beautifully arranged as in birds and winged insects. This is not necessary for protection by *conspicuousness*, for which purpose any tint contrasted with foliage, such as black, or white, or ringed with black-and-white, would have sufficed.

5. The "pheasant" question I leave, as Mr. Allen has placed it, for the consideration of naturalists.

6. Here it seems to me Mr. Allen is himself changing his ground. His main argument is that the æsthetic tastes of the higher animals are the same as ours, yet he objects to the elegantly-marked and intensely-contrasted zebra and tiger being called "brightly-coloured." Surely they are more beautiful than the mandrill or the Rhesus; while among animals *white* is as much a colour as among flowers.

ALFRED R. WALLACE

Nitric Acid Batteries

I INCLOSE the results of some experiments I have lately made to ascertain if the cost of working the nitric acid batteries of Grove and Bunsen could be reduced. I find that the nitric acid can be replaced by a mixture of half nitric and half dilute sulphuric. And the latter gives a higher force for nearly three hours. The experiments were made with a large-surface voltameter, and the gases were collected during one minute every half-hour; four pint-size cells were used. The experiments were repeated, and every care taken to avoid any error. I have also used the mixed acids very successfully with twenty-eight cells for the electric light. I presume the increased power is due to the internal resistance of the battery being slightly lowered by the addition of the dilute sulphuric acid in the porous cell. I may add that the fumes were much less than when nitric acid alone is used.

JOHN HENRY KNIGHT

Farnham, April 19

The Black Rat

IN regard to the distribubution of the black rat (*Mus rattus*), your correspondent may be glad to know that this animal, spread

over the States in early days, but has since been supplanted, as in England, by the brown rat (*M. decumanus*). Forty years ago the black rat was the only rat in South-west Ohio. About thirty years ago the brown rat drove him out. Some years later the same occurred in Illinois. I have been informed by one of my students living in Minnesota, that neither rat is known in and about the town of St. Cloud in that state, only one having ever been seen there, and that was killed on landing from a steamer. I have seen it stated that the black rat is still to be found in some localities in England, among them the Whitechapel Docks.

E. W. CLAYPOLE

Antioch College, Ohio, April 7

Did Flowers Exist during the Carboniferous Epoch?

I CANNOT accept Mr. McLachlan's reference of the interesting *Breyeria borinensis* to the Ephemeridæ, even though he has "examined the fossil," and "has no doubt" about it. The photograph which I possess is so beautifully sharp that it brings out the minutest details, and a careful examination and comparison of it with specimens and drawings leads me to the conclusion, that in the general character of the wing-neuration it is strictly lepidopterous and of the Bombycine type, having the costal, subcostal, and median nervures, with their branches and bifurcations, arranged precisely as in that group, but differing in the much greater length of the wing and the increased number of the branches of the subcostal vein—seven instead of four. In some of the Chalcosiidæ, however, there are often six branches to this vein, but crowded together and sometimes anastomosing, owing to the much shorter apical portion of the wing. In this family also we often have an intermediate false vein, which is distinctly visible in the fossil. Until, therefore, I am referred to some group of insects with which it more nearly agrees, I must believe it to be an ancestral moth, even though, according to Prof. Haeckel and Mr. Scudder, moths ought not to have existed in the carboniferous epoch.

After a careful comparison of the photograph with specimens and figures of Ephemeridæ, I can see *no resemblance whatever* to the neuration of the family with which Mr. McLachlan so confidently associates it; while the "dense transverse reticulation" to which he refers seems to me to be merely due to crumpling of the membrane, and certainly bears no close resemblance to the strong reticulation of the veining of the Ephemeridæ, and it is, moreover, only visible at all at the base of the wing. The general form of the wing and arrangement of the veins are, however, so different, as, to me, to be conclusive against this view.

ALFRED R. WALLACE

Blue Flame from Common Salt

At the present time any spectroscopic observations of coloured flames are peculiarly interesting, and I am glad to see the origin of the blue or violet flame produced by common salt and other chlorides again discussed in your pages.

In the letter of Mr. Percy Smith (NATURE, vol. xix. p. 483), he considers the only feasible explanation to be "that it is due simply to hydrochloric acid," but he gives no proof, and admits that a spark between carbon points in a bottle of this gas does not give the violet bands. In a short paper on the subject in the *Philosophical Magazine* of December, 1862, I considered "this supposition is negatived by the fact that anhydrous chloride of copper emits these rays equally whether it be placed in a flame of hydrogen or of pure bisulphide of carbon." Neither does this characteristic flame seem due to any carbon compound, inasmuch as several chlorides will give it in a hydrogen flame. I also found that "a stream of chlorine or hydrochloric acid passed into a flame never gives the violet light, nor does Dutch liquid, muriatic ether, or chloroform mixed with alcohol and burnt in a spirit lamp," though chloride of platinum or gold give a flash of it at that temperature.

Would Mr. Smith favour us with any details of his experiments which may support his conclusion?

17, Pembridge Square, April 10 J. H. GLADSTONE

Cape Diamonds

AT the Croydon County Court a lady sought to recover 36*l.* 15*s.* paid for a ring, the stone in which had been represented to be *a diamond*, and which was indeed admitted to be a Cape diamond.

Judgment was given for the plaintiff, because several diamond *dealers* gave evidence which, the judge stated, clearly showed that what were described as "Cape diamonds" were not at all *to be regarded as* ordinary diamonds, and the receipt showed that the ring was sold *as a diamond* ring. The "several diamond dealers" stated that so-called Cape diamonds were comparatively valueless and lacked the essential qualities of the Brazilian stones, viz., lustre, hardness, and colour.

Now all this is beside the question, which was not as to the value of Cape diamonds, nor yet what they lacked of the qualities of the Brazilian stone, but simply whether this stone was a diamond or not, not even whether it was or was not an ordinary diamond, and I am surprised that any judge could be thus led away from the legal point.

I see that notice of appeal has been given, and it is to be hoped for the credit of elementary science that the court above will require some *scientific* evidence, such as specific gravity or chemical composition, about Cape diamonds. If, for instance, it can be shown that they are a form of carbon, the point is settled.

It would be just as absurd for a person to object to Derby coal as not coal because it lacked the good qualities of Wallsend. The ring was sold as a diamond ring; the question is: Is the stone a diamond?

I have no personal interest whatever in the matter. I know nothing of the case except as it appears in the report. I possess no diamonds, not even a "Cape"; but I am interested in seeing justice administered with some regard to the scientific knowledge of the day.

B. G. JENKINS

April 14

Sense of Temperature

YOUR correspondent J. T. B. asks for further instances of the cultivation of the sense of temperature. None can be more striking than that of the caste of egg-hatchers in Egypt, who determine the temperature in their ovens entirely without the aid of instruments, and maintain it at 100° to 103° Fahr. during the requisite three weeks. How successful they are is shown by the official return for 1831, given by Lane ("Modern Egyptians," London, 1842, vol. 2, p. 5, *et seq.*) from whom I take these particulars. Out of a total of 26,204,500 eggs artificially incubated, 17,418,973 were successfully hatched.

April 19 ALFRED H. HUTH

Tides at Chepstow

THE highest tides in the Wye and in the Severn for the present year were on Tuesday, April 8. On that day, up the Wye, at Llandogo, the tidal rise was 13 feet; at Tintern Abbey, 21 feet 5 inches; at Chepstow Railway Bridge, 44 feet. Up the Severn, at Newnham, the tidal rise was 20 feet; at Portskewitt, 46 feet 6 inches; at Cardiff, 44 feet; at Clevedon Pier, 52 feet.

Reference to Coxe's "Historical Tour in Monmouthshire," 4to Edition, 1801, p. 358, containing his own *soundings* at high tide, on September 4, proves that there has been no perceptible change in the depth of the Wye at high tide this century.

The Severn has been confined within narrower limits by the South Wales Railway embankment, on the Monmouthshire side, since 1850, and by Lord Fitzhardinge's breast-works on the Gloucestershire side, from about same date, but the height of the tide and the depth of the river have not been sensibly affected by these slight alterations. One fact further may be worth mention, however: a gun-boat or armed sloop, commanded by Capt. White, came up the "Pill," below St. Pierre, in 1827, on a surveying expedition, remained at anchor some days, and re-entered the Severn without difficulty, piloted by W. Wheeler, a thing that would now be impossible on account of the embankments. The Pill is a mere creek—the "anchorage," dry ground.

JOHN YEATS

OUR ASTRONOMICAL COLUMN

BRORSEN'S COMET.—The following ephemeris of this comet for May is deduced from Dr. Schulze's elements, with the time of perihelion passage corrected so as to accord better with the observations in March at Florence and Kremsmunster. The heliocentric co-ordinates, referred to apparent equinox of May 1, for combination

with the X, Y, Z of the *Nautical Almanac*, have been found from—

$$x = r\,[9{\cdot}94281],\ \sin.\,(v + 207\ 51'8),$$
$$y = r\,[9{\cdot}98498],\ \sin.\,(v + 126\ 18{\cdot}6),$$
$$z = r\,[9{\cdot}73737],\ \sin.\,(v + 60\ 32{\cdot}2).$$

Ephemeris for Greenwich Midnight

1879.	Right Ascension. h. m. s.	North Declination. ° ′	Log. distance from Earth.	Log. distance from Sun.
May 1 ...	5 45 30 ...	59 42·0		
2 ...	5 57 36 ...	60 38·4 ...	9·8459 ...	9·9366
3 ...	6 10 31 ...	61 30·5		
4 ...	6 24 10 ...	62 17·8 ...	9·8422 ...	9·9494
5 ...	6 38 31 ...	63 0·1		
6 ...	6 53 37 ...	63 36·4 ...	9·8395 ...	9·9621
7 ...	7 9 19 ...	64 6·7		
8 ...	7 25 30 ...	64 30·5 ...	9·8381 ...	9·9745
9 ...	7 42 5 ...	64 47·3		
10 ...	7 58 55 ...	64 57·1 ...	9·8379 ...	9·9866
11 ...	8 15 50 ...	64 59·5		
12 ...	8 32 41 ...	64 54·9 ...	9·8388 ...	9·9984
13 ...	8 49 16 ...	64 43·3		
14 ...	9 5 28 ...	64 24·9 ...	9·8409 ...	0·0100
15 ...	9 21 11 ..	64 0·2		
16 ...	9 36 19 ...	63 29·6 ...	9·8441 ...	0·0213
17 ...	9 50 46 ...	62 53·5		
18 ...	10 4 30 ..	62 12·4 ...	9·8484 ...	0·0323
19 ...	10 17 28 ...	61 27·0		
20 ...	10 29 39 ...	60 37·8 ...	9·8538 ...	0·0430
21 ...	10 41 5 ...	59 45·2		
22 ...	10 51 49 ...	58 49·7 ...	9·8602 ...	0·0535
23 ...	11 1 52 ...	57 51·9		
24 ...	11 11 16 ...	56 52·1 ...	9·8675 ...	0·0637
25 ...	11 20 5 ...	55 50·6		
26 ...	11 28 20 ...	54 48·1 ...	9·8757 ...	0·0736
27 ...	11 36 4 ...	53 44·9		
28 ...	11 43 18 ...	52 40·6 ...	9·8848 ...	0·0833
29 ...	11 50 5 ...	51 36·2		
30 ...	11 56 28 ...	50 31·8 ...	9·8942 ...	0·0927
31 ...	12 2 28 ...	49 27·6		

THE DOUBLE-STAR, SOUTH 190.—Interest attaches to this object for more than one reason. The principal star possesses a large proper motion in which the companion participates, while there is a much slower change of relative position in the same way that we observe in 61 Cygni. Further, there would appear to be some evidence of variability of light in the principal star. Argelander in his memoir on the proper motions of 250 stars, assigns +0·0691s. in right ascension, and −1″·766 in declination, or 2″·015 annually in arc of great circle, in the direction 151° 14′. If we compare Lalande's observation on May 22, 1798, with the observations made at Bonn in 1864, and at Washington 1867–69, almost identical values with those given by Argelander will result. The following figures will sufficiently indicate the variation in relative position that has occurred since Piazzi observed the star early in he present century:—

		°	′
Piazzi	1806·7	Position 251·4	Distance 9·40
Herschel and South ...	1823·32	,, 270·1	,, 10·82
Herschel (Cape Obs.).	1836·46	,, 277·4	,, 12·08
Jacob	1856·37	,, 284·0	,, 13·35
Stone (Cincinnati) ...	1877·37	,, 290·3	,, 14·92

The star forms one of Sir W. Herschel's catalogue of 145 new double stars, where the duplicity is stated to have been discovered in 1785; at the epoch 1791·39 the angle was estimated 270° —, distance IV.; an observation not easily reconciled with more recent ones.

As regards variability the principal star was rated 4m. in Argelander's zone No. 295, on May 20, 1850; it is 5·9m. in the second Radcliffe catalogue, while the Washington observers call it 6·6m.; Lalande and Piazzi estimated it 6m. Argelander calls the companion 8·4. The position of South 190 for 1880 is in R.A. 14h. 50m. 27s., N.P.D. 110° 52′·3. It is No. 1186 in the Greenwich catalogue for 1860.

THE MINOR PLANET HILDA.—This small planet, the most distant member of the group, which approaches the orbit of Jupiter within 0·85 of the earth's mean distance from the sun, has been sought for unsuccessfully at Berlin, near the calculated position; there may now probably be a difficulty in recovering it.

GEOGRAPHICAL NOTES

WE hear that Sir Walter C. Trevelyan, who died lately at Wallington, Northumberland, has bequeathed to the Royal Geographical Society, of which he had been for many years a trustee in conjunction with Lord Houghton, the sum of 500*l.*, in addition to a valuable collection of books relating to the Faroe Islands, maps, &c.

THE geographical haze in which some of our daily contemporaries persist in enveloping themselves, appears to be growing denser. The "War at the *Cape*" is bad enough, but the telegram received last week from a special correspondent at Baku, informing a wondering public that "Krasnovodsk has returned with General Lazareff, and Lomakine's reconnaissance to the confluence of the Attrek and Sumbir [*sic*], &c.," fills the cup to overflowing. Krasnovodsk, we thought, was the name of a town and bay on the eastern shore of the Caspian, but the tangle is above our powers to unravel.

THE new part of the *Transactions* of the Asiatic Society of Japan is wholly occupied with Mr. John Milne's narrative of his journey across Europe and Asia to the Land of the Rising Sun. From some singular statements which he makes, we suspect that Mr. Milne was not sufficiently careful in making himself acquainted with the literature of Chinese travel before leaving; otherwise he would hardly venture to assert that the journey from Peking to Tientsin and overland to Shanghai has but seldom been made by Europeans. Mr. Milne's views on the subject of the rendering Chinese sounds are very remarkable.

THE Paris Society of Geography held its annual meeting for the election of officials on Friday, April 18. Admiral Laroncière le Nourry was returned president almost without opposition. The great gold medallist is Lieut. de Brazza, the Ogowé explorer. A gold medal was also awarded to Lieut. Wyse, of the French Navy, for his exploration of the Isthmus of Darien, for the construction of an inter-oceanic canal. The gold medal for Polar exploration was awarded to Sir George Nares, Commander of the last English Arctic Expedition. The Cross of the Legion of Honour was also given to M. Brazza and his fellow-explorer, Dr. Ballay. Lieut. Wyse and Lieut. Reeks received a similar honour for the Darien explorations. An address was given by Commander Perrier on the determination of longitudes by electricity. A map was distributed amongst members showing all the European and African towns whose longitudes have been determined by that process. They number about one hundred, extending from Oural to Valentia, and from Lapland to Sahara.

NO. 3 of this year's *Mittheilungen* of the Vienna Geographical Society contains an important paper, with map, on the sources of the Dniester and the valley-structure of the region of the Upper Dniester and Strwcaz. The first number of this year's *Boletin* of the Madrid Geographical Society contains, among other things, the first part of an account of an excursion in the La Plata Republics, by Capt. Carrasco y Guisasola.

THE just published *Bulletin* of the Antwerp Geographical Society contains, amidst a considerable variety of matter, a paper by Mme. Dumas de Baiglie, entitled "Les Voyageuses illustres." The Society about a year ago resolved to admit ladies, and the author of this paper is a *membre associé*, who seems very grateful for this recognition of the rights of women.

AMONG the new bills introduced into the first session of the Forty-sixth U.S. Congress is one authorising the president to establish a temporary colony at some point north

of the eighty-first degree of north latitude, on or near the shore of Lady Franklin Bay, for the purpose of scientific observation and exploration, and to develop or discover new whaling grounds; such officers as may be necessary to be detailed to take part in the same, and with permission to use any public vessel or vessels in connection therewith. This is essentially Capt. Howgate's plan, and probably introduced by his request.

THE last number of the *Indian Antiquary* contains a note by Major J. S. F. Mackenzie on some curious customs current among the Komti caste in regard to marriage, &c. "A Folklore Parallel," by Prof. C. H. Tawney, of Calcutta, is also worthy of notice.

MGR. LAVIGERIE, Archbishop of Algiers, communicates to *Les Missions Catholiques* intelligence respecting the portion of the French missionary expedition in East Africa, which, under the leadership of Père Livinhac, was gradually making its way towards Lake Victoria. At the date of the letter (December) the five Europeans were all in good health, and were then in Mirambo's country, on the way to Uganda. Père Livinhac writes that they had been three months in Unyanyembe, and that they were then twenty or thirty days' march from the lake. In the same number of *Les Missions Catholiques* Mgr. Ridel continues the account of his recent captivity in Corea, in which he gives a terrible picture of the prisons of the country.

A TELEGRAM from Malmö states that the steamer *Nordenskjöld*, built for M. Sibiriakoff, to go to the assistance of Prof. Nordenskjöld's expedition, was launched on the 17th inst.

A VERY interesting narrative of travel has just been commenced in the *Tour du Monde*, entitled "Voyage en Nouvelle Guinée," by M. Achille Raffray. The first instalment deals with the Moluccas, which M. Raffray visited *en route*, but in the second he commences his work in New Guinea. The illustrations are unusually good.

BIOLOGICAL NOTES

THE EARLY TYPES OF INSECTS.—Samuel H. Scudder has published a memoir on the early types of insects (*Memoirs* of the Boston Society of Natural History, vol. iii. Part i. No. 11, March, 1879). He concludes that the hexapods, arachnids, and myriapods appeared together in the carboniferous strata. That the hexapod insects may be divided into a higher group (Metabola), and a lower group (Heterometabola), that the latter are Devonian and carboniferous, the former just appearing in the Jurassic period. The Devonian forms were in the early stages of their life, undoubtedly aquatic. Nearly all the palæozoic orthoptera belong to the lower Saltatorial families. It would seem that the earlier types were of inferior organisation, and that the general type of wing structure in insects has remained unaltered from the earliest times.

HALOSPHÆRA, A NEW GENUS OF UNICELLULAR ALGÆ.—Under this name Dr. F. Schmitz describes, in the first "Heft" of the first volume of the *Mittheilungen aus der zoologischen Station zu Neapel*, an organism which is found abundantly between the middle of January and the middle of April, floating on the surface of the water in the Bay of Naples. Hitherto known to collectors simply as *punti verdi*, Dr. Schmitz gives it the name *Halosphæra viridis*. It presents to the naked eye the appearance of minute just visible pale green globules, the largest having a diameter of from 0·5 to 0·6 mm., but with no independent power of motion like that of *Volvox*. Each globule consists of a tolerably thick perfectly smooth and colourless cell-wall, coated on the inside with a thin layer of pale green protoplasm, which incloses a single very large central vacuole filled with a colourless cell-sap. The green colour of the protoplasm is due to its being interspersed with a small number of minute grains of chlorophyll; and there is also, at an early stage, a single globular nucleus with a somewhat darker nucleolus. As the cell increases somewhat slowly in size, the process of cell-division commences. The single nucleus divides into two nuclei, which gradually separate from one another; and this process is repeated time after time, until a very large number of nuclei, which the author reckons to average from 200 to 300, come to be tolerably regularly distributed through the parietal protoplasm of the mother-cell, which has by this time attained its full size. The layer of protoplasm then breaks up into a number of primordial daughter-cells, each surrounding one of the nuclei, and having the form of a hemispherical ball, the flat surface of which is in contact with the cell-wall of the mother-cell. They are of a uniform bright green colour, without apparently containing any distinct grains of chlorophyll. The external cell-wall of the mother-cell has now become differentiated into two distinct layers, the outer one of which bursts into two nearly equal halves, and becomes completely detached from the inner one, which now itself consists distinctly of two layers. The hemispherical green daughter-cells then become transformed into zoospores of a very peculiar shape. They begin gradually to detach themselves from the outer cell-wall, and to take up positions in the interior of the cell. In most cases each of them contracts in the centre into somewhat the shape of an hour-glass, but pointed at the two ends, ultimately dividing in the middle into two zoospores of conical shape, with a nearly flat base, but toothed at the edges, and a pointed apex. To a colourless protuberance in the centre of the nearly flat base are attached two very long vibratile cilia. Sometimes only a single zoospore is formed from each of the primordial cells, and occasionally more than two. The remaining cell-wall of the mother-cell has, in the meantime, been gradually swelling up and deliquescing, and has now become completely converted into mucilage, so that the zoospores escape free into the surrounding water. After moving about for some time with a rather slow swarming motion, they fall to the bottom; but their further development has not been followed up. Until its complete life-history is known, it is impossible to assign a systematic position to *Halosphæra*. It may possibly come near *Eremosphæra*, a genus of Conjugatæ; its resemblance to *Volvox* is clearly only superficial.

A NEW ALGA.—In the first Heft of the 1st vol. of the *Mittheilungen aus der zool. Station zu Neapel*, Dr. Falkenberg describes a new genus of Phæosporeæ under the name *Discosporangium*, with the following characters:—Thallus, an irregularly branched filament, consisting of a single row of cells, and growing by an apical cell. Reproduction by zoospores, which are formed singly in the compartments of multilocular zoosporangia. The zoosporangia are placed singly near the middle of the cells of the thallus, forming a square unilamellar plate, the compartments of which open separately when ripe on the upper side of the sporangium.

IN the second Heft of the same publication Dr. Falkenberg gives a complete list of the marine Algæ of the Bay of Naples.

MARINE FLOWERING PLANTS.—Dr. I. B. Balfour has just published (*Transactions* Bot. Soc. Edinburgh, Session 1877-78) a most valuable and interesting memoir on two species of the genus Halophila, found very abundantly in widely extended patches on the reefs surrounding the island of Rodriguez. The island was visited in 1874 by Dr. I. Balfour as naturalist accompanying the "Transit of Venus" expedition. Of the two species one, *H. ovalis*, grows on spots which are just uncovered at low tides. The other, *H. stipulacea*, grows in places where it is always submerged. Specimens

collected both in flower and fruit were preserved in alcohol, and were most painstakingly investigated at Prof. de Bary's botanical laboratory at Strassburg. The only portion of the life-history of these plants left for future investigators is the germination of their seeds, which, probably, does not take place until the first quarter of the year. The stem structure is simple. Of the presence of sieve-tubes in the bundles there appears to be no doubt. The mode of the tissue formation at the tips of the roots is peculiar; from an initial group of cells underneath the root-cap, there issues three distinct tissues. This corresponds to the third type of Janczewski, who, among the monocotyledons, found it only in Elodea. The scale and foliage leaves are described in detail. The epidermal layer is peculiar; stomates are to be found in neither of the species. The floral axis is short and axillary; there is a double-leaved spathe. The author is inclined with Ascherson to consider the plants dicœcious. The anther cavities are filled with a mass of confervoid pollen. These pollen cells are found to be united in long strings, each string apparently continuous through the greater part of the length of the cylinder. The partition walls between adjacent cells in a string are transverse. The ovary is inferior and contains many ovules. The author suggests the morphological identity of the stamens and carpels, "the same phyllomes (or the phyllomes from the same nodal regions), which, in the male form stamens, in the female form carpels." A technical and emended character to the genus and of the two species concludes this paper.

AMERICAN APHIDES.—Dr. Riley gives a detailed account of the life-history of some species of gall-making Pemphiginæ (Art. 1, vol. v. *Bulletin* of the United States Geological and Geographical Survey of the Territories, 1879). The facts concerning these Aphides have a special interest on account of the close relationship between the insects of this group and the now notorious grape vine Phylloxera. The special history of *Schizoneura americana*, n. sp., is given. It is to be found curling and gnarling the leaves of the White Elm (*Ulmus americana*), and passes from the egg state through no less than seven stages, in some winged, in some wingless, but in all agamic until the seventh, when, as the result of fertilisation, the true egg state is again reached. Another very common gall described is that formed by *Colopha ulmicola*, and the diagnoses of five new species of Pemphigus are given. In a second part of this paper Mr. Monell describes several new species, and gives detailed synonymy of several already described. Two excellent plates accompany Dr. Riley's notes on the gall-making forms.

NEW BIRDS FROM THE PORTUGUESE POSSESSIONS IN WESTERN AFRICA.—Prof. Barboza du Bocage publishes (*Journ. de Scien. Math. Phys. Natur.*, Nos. xxiii. and xxiv., Lisboa, 1878) his sixteenth and seventeenth lists of birds from Angola. A new genus and species (*Hylypsornis salvadori*) is established for a creeper, and a pretty sun-bird is called after M. d'Anchieta, who has added so much to our knowledge of the birds of Angola (*Nectarinia anchietæ*). Several other new species are described in the sixteenth list. In the seventeenth list a new genus and many additional new species are also established, the more remarkable being a sun-bird (*Nectarinia oustaleti*) and a unique bird from Caconda (*Sharpia angolensis*), called after Mr. Sharpe, of the British Museum, and having affinities with Hyphantornis.

A UNIVERSAL CATALOGUE

THE Council of the Society of Arts, probably the most practically useful body in the kingdom, has taken a positive step towards the accomplishment of a task which certainly deserves to be called gigantic. We need not moralise once more on the extent to which the making of books has been carried; many a modern Solomon has no doubt been appalled into silence in the effort even to realise, far less to express, the extent of this manufacture. To attempt to begin *ab initio* to catalogue the works published during the past century, or even since the beginning of the present century, would be a task which to us would seem to be hopelessly endless. Any one whose business it is to work with books, and even the most thorough-going scientific worker must refer to them occasionally, must recognise the immense advantage, however, of having in one properly arranged catalogue, as complete a list as possible of printed books, and the farther back it went, the more valuable it would be. It is, then, certainly a fortunate thing that there exists ready to hand, though unprinted, a catalogue which for all practical purposes may be regarded as a universal catalogue of printed books, and that not only for the past century, but the past four centuries and more; for the British Museum Catalogue begins as far back as 1450. Some time ago the Society of Arts considered the advisability and practicability of constructing a catalogue coming down to the year 1600. The Council addressed a series of questions to them likely to give useful answers, and afterwards met to hear evidence on the subject. Mr. Bullen and other authorities were thus examined, and it seems to have been Mr. Bullen who happily suggested that the best and only sure method of laying a solid foundation for the Universal Catalogue of English printed literature would be to print the Catalogue of the Printed Books in the British Museum, from A.D. 1450 to the present time, say, the end of the year 1878, representing about 1,250,000 vols., and comprising between 2,000,000 and 3,000,000 entries, *i.e.*, main titles and cross references. He considered the work might be ready for printing, "in a rough and ready way," in two years, and in less time if more force were employed, and that it would take five years to print. All the witnesses agreed that the printing of the British Museum Catalogue would be highly desirable, and the Committee are of the same opinion.

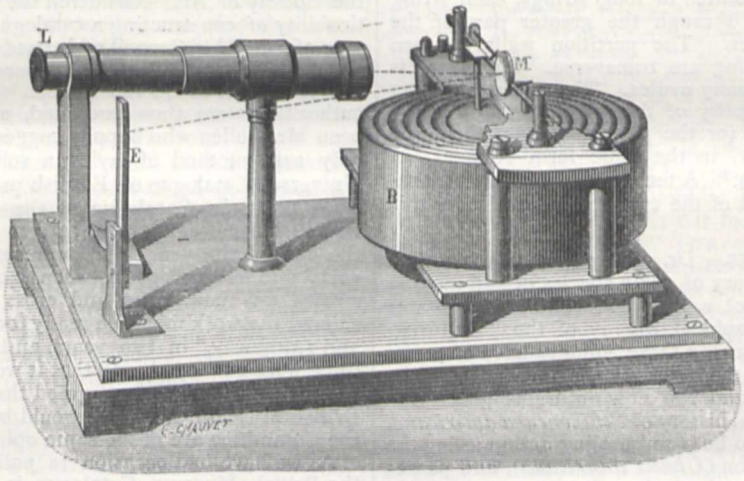
As we have had occasion to point out in these pages, the British Museum Catalogue is by no means perfect, and it is specially difficult for a man in search of a scientific serial or paper to get at it without much roundabout hunting from one cross reference to another, much waste of time, and loss of temper. Still considering all the difficulties in the way of constructing a perfectly new catalogue, we do not think a better course could be followed than that suggested by the Society of Arts' Council. It might be possible to introduce some improvement in arrangement during the process of printing, and especially with reference to the arrangement of the publications of scientific societies, which at present is so completely unscientific. It must also be borne in mind that the Catalogue is only one of authors, and that for many purposes of research such a catalogue is of little use without an equally complete one of subjects. Still the want of the latter is no argument against the publication of the former, though we should hope that the one would be followed by the other.

Of course such a stupendous, and, at its cheapest, costly undertaking could hardly be accomplished by any private body, and it is natural that the Society of Arts should look to government for help in the matter. As the scheme has the approval of the President of the Society, the Prince of Wales, we should think that the Government is not likely to hesitate in granting such aid as might be required. Of course the printing and paper need not be luxurious nor expensive, and the specimen-page issued by the Society seems to us satisfactory. It is calculated that the British Museum Catalogue would thus occupy about forty-five volumes of 1,000 pages each, and could be issued through the Stationery Office at about 16*s.* per vol., and even less if the edition were of 2,000 copies. No doubt a fair sale would be obtained for such a publica-

tion both at home and abroad, for take it all in all, as Mr. Bullen says, "no catalogue in the world, whether in print or in manuscript, is equal to that of the British Museum." We hope, therefore, that the proposal of the Society will speedily meet with a favourable response from Government, and that should it be decided to print the British Museum Catalogue, some plan will be formed by which proofs may be revised not only by qualified bibliographers, but that the various departments of literature, science, and art will be represented on the staff of revisers.

A MIRROR BAROMETER

M. LÉON TEISSERENC DE BORT has invented an aneroid mirror barometer, which is described in a recent number of *La Nature*. It is based on a method analogous to that well-known since the researches of Gauss for the reading of small rotations. M. Teisserenc de Bort has sought to obtain an aneroid barometer which will give precise observations at sea, especially in rough weather, when it is impossible to read the mercury barometer. The principle of this barometer is very simple. The elastic tub or box B carries, as in most aneroids, a metallic point, which follows its movements. In the ordinary aneroid the transformation of the vertical movement into a rotating movement necessitates either a chain or a curb, or a sort of fork which works in a spiral furrow cut in the axis which supports the needle. These various systems have the inconvenience of producing frictions; some of them are liable to dust and rust. In the mirror barometer, the transformation of the movement is obtained by the simple contact of a small palette supported on the axis of the mirror and of the point spoken of above. As the angle which the plane of the mirror may describe does not exceed 12° on each side of the vertical, it follows that the contact of the point in the palette is always precise.



Teisserenc de Bort's mirror barometer.

As to the amplification of the movements necessary to enable us to appreciate millimetres and their fractions, this is obtained by reading with the aid of a small reticled telescope, L, the image of a graduated scale E which is reflected in the mirror M. By combining the enlargement of the telescope with the distance of the scale from the mirror, we succeed in giving to the apparatus a length of less than 20 cm. by 12, which renders it quite portable. It is important to remark that the amplification of the movements of the box, which, in ordinary barometers, is obtained by means of several levers, is obtained here by an optical process; it follows that the numerous frictions and the time lost in contacts are mostly eliminated. There remains only a single movement, that of the axis which bears the mirror; in the barometer figured the pivots are of steel and the cap of platinum, and in order to avoid rust, the whole is nickel-plated.

M. Teisserenc de Bort proposes to construct others, in which the axis will be mounted on rubies. This garniture will not sensibly increase the price of the apparatus. This instrument is too new to allow us to appreciate the full degree of precision which it can attain. In a trial in a captive balloon by Capt. Perrier of several aneroids as compared with the mirror, the latter showed a great sensibility, and it quickly resumed its original position on landing.

BUTTERFLIES WITH DISSIMILAR SEXES

NATURALISTS have long been familiar with the fact that the two sexes of certain species of lepidoptera often differed from each other in colour and marking, and sometimes in form and size to a very considerable extent. For this phenomenon the convenient term "Antigeny" has been proposed by Mr. S. H. Scudder.[1] In accordance with Darwin's theory of sexual selection we find that when the sexes of a butterfly differ to any marked extent in colour, it is generally the male which is the more gaudily coloured, although there are certain genera in which the reverse obtains; but, as I pointed out in NATURE (vol. iii. p. 508), there is reason to believe that in these exceptional cases the males may be the selecting sex. Mr. Charles Darwin having recently called my attention to a paper on this subject in *Kosmos*,[1] by that most philosophical entomologist, Fritz Müller, I have thought that an abstract might interest readers of NATURE.

The species of which the author treats, *Epicalia acontius*, has such very dissimilar sexes that Fabricius described them as distinct species, calling the male *Antiochus* and the female *Medea*, while in Doubleday and Westwood's "Genera of Diurnal Lepidoptera" the two sexes are placed in different genera, the male in *Epicalia* and the female in *Myscelia*. It is not known with certainty who first pointed out that *Antiochus* and *Medea* were the sexes of the same species; but this fact is now

[1] *Proc.* Amer. Acad., xii. 150.

[1] "Epicalia acontius. Ein ungleiches Ehepaar," *Kosmos*, January, 1879, p. 285.

established beyond doubt. Were this not the case *Antiochus* would be without a female and *Medea* without a male. Indeed Fritz Müller has reared from larvæ both sexes of an allied species, *Epicalia numilia*, which differ from one another to the same extent as do the sexes of *E. acontius*. In both sexes of this latter species the general ground colour of the wings is black, the male having a broad oblique bar of a bright orange colour extending from about the middle of the inner margin to about the middle of the fore-wing in the direction of the apex. There is a corresponding blotch near the middle of the hind-wing, so that when the wings are extended the bar on the fore-wing is continuous with the blotch on the hind-wing, the whole forming one oblique orange bar. The female (*Medea*) has two oblique rows of pale yellow spots across the fore-wings running nearly parallel with the costal margin, and two similar rows across the hind-wings; when the insect rests with outstretched wings, the fore- and hind-wings overlap so that the spots of all four wings form three straight parallel rows which are continued on the body by spots of the same colour. The sexes of *E. numilia* differ in a similar manner.

Further, in the female of *E. acontius* (as in both sexes of *E. numilia*), the inner margin of the fore-wing is nearly straight, while it is markedly curved in the male. Both wings in this latter sex are also much broader in proportion to their length than is the case with the female, and in consequence of this, the wings of *Antiochus* overlap each other to such an extent that nearly half the hind-wing is hidden beneath the fore-wing, the space thus concealed being fully twice as broad as in *Medea*. The curvature of the inner margin of the fore-wing of a butterfly when exaggerated on the over-lapping portions of the two wings, is, according to the author, a never-failing indication of the presence of a scent-secreting organ at this spot. Thus, having read in Doubleday and Westwood's "Genera" that in the fore-wing of *Ageronia* "the inner margin in the male is occasionally dilated," Fritz Müller caught a male specimen of *A. arethusa*, and found a strong odour to be emitted by a scent organ concealed between the wings. Now in *Antiochus* a similar organ exists, while it is absent in the male of *E. numilia*, and in this latter the fore and hind wings overlap only to the same extent as in the female.

When in lepidoptera the sexes of a species differ from one another to any great extent in colour and marking, the female is generally inconspicuous or is coloured gaudily in imitation of some other species (mimicry). Thus in *Thecla hemon* the male is bright blue, while the female is dull brown, while in *Dyschema amphissa* the male is white, and the female is one of the numerous mimickers of *Acræa thalia*. This explanation, however, does not apply to the female of *E. acontius*, since there is no species marked in a similar manner which might serve as a model for mimicry. On the other hand, the *Medea* type of marking is to be found in a large number of species of the same and of allied genera (the female of *Myscelia orsis*, for example). Neither can the coloration of Medea be considered protective, since it is very conspicuous, and the insect has a habit of sitting with wings fully expanded.

According to Darwin's theory of sexual selection,[1] the ancestor of the present genus *Epicalia* was probably of the *Medea* type—the present form of the male having resulted from selection by the female. The author then asks whether *Medea* has preserved the form of marking common to both sexes of the progenitor, and whether this marking has any present significance; also: "Is the colour ornamental, or for offensive or defensive purposes, or both?—for the one does not exclude the other." In reply to the latter part of this question, dissent is expressed from Prof. Gustav Jaeger's view, that yellow is as a rule an offensive or defensive colour. It is next pointed out that in the female of *E. numilia*, the row of spots is replaced by a broad oblique yellow bar, this alteration of pattern being attributed to sexual selection by the males, which must have thus preserved but at the same time slightly modified, the taste of the common ancestor of the genera *Epicalia* and *Myscelia*, the females of a few species of which have been made to depart to a much greater extent from their congeners by a greater divergence of taste on the part of their mates. The females of most of the species of these genera had, however, "set the fashion" in a completely new direction, and thus brought about the dissimilarity of the males.

In support of this view the author remarks, that although sexual selection is generally regarded as being exerted by the females, yet, as Haeckel has maintained,[1] the selection by the males must have an equal influence on the opposite sex. That such a choice is exerted by butterflies the author has already pointed out.[2] In the present case we must believe that the two sexes manifested completely different tastes,[3] just in the same manner as much that we consider physically or intellectually superior in woman would be considered unfitting for men.

The acquisition and modification of the *Medea* type of marking may have occurred at a time when both sexes of the ancestral form were alike. Such peculiar marking could not have been produced by the direct action of external conditions nor by any innate "laws of growth," neither can it be considered as a protective colouring produced by natural selection. Sexual selection is thus the only explanation left open.

It has been shown by Weismann that the colour and marking of butterflies' wings are undoubtedly affected by external conditions, and in the case of larvæ markings, which, through such conditions, make their appearance on one segment, not unfrequently extend to other segments (by correlation of growth?). The same appears to hold good for the wings of butterflies: markings which through any cause appear in any one wing-cell tend to be repeated on corresponding places in the other wing-cells. When such markings serve as signs of distastefulness or for other protective purposes, they would be preserved, and even increased in brilliancy and size by the action of natural selection. Thus a striped butterfly might be produced from a simple grey or brown one, and the markings regularly repeated on the corresponding places of the wing-cells would not fail to give us a pleasing impression, although no selection with special regard to beauty had taken place. In such cases, however, it is obviously immaterial whether the markings of the fore- and hind-wings harmonise or not. When, however, we have an unbroken bar across both fore- and hind-wings so arranged that the pattern is only complete when the insect sits with outstretched wings, or is in an attitude of flight, while in every other position the bar is broken, it may be safely assumed that the ever-vigilant eye of selection had brought about this result.

The markings of *Medea* are then considered from this point of view. The two rows of yellow spots on each wing, as already described, form three straight rows when the wings are spread out as in flight; in any other position—if, for instance, the fore-wings are pushed too forward or too far backwards—the symmetry is broken. Special attention is called to the fact that the hindmost rows of spots on the hind-wings have been distorted so as to form a straight bar parallel with the other rows; this results from the displacement of the spots, each of which, although situated in one wing-cell, does not appear on the *corresponding place* in each cell; were this the case, the row would be curved instead of straight. That it was the sense of beauty of a critical eye which straight-

[1] "Descent of Man," i. 388.

[1] "Generelle Morphologie," 1866, ii. 244. [2] *Kosmos*, ii. 42

[3] The term "reciprocal sexual selection" might be advantageously applied to such classes of cases.—R. M.

ened the original curved row of spots to a straight bar, is most strikingly shown by the two foremost spots of the row which are unsymmetrical with regard to the corresponding row on the front wings, and which really form the commencement of a curved bar, *but these are hidden by the overlapping of the front wings.*

Thus it was perhaps the selection of males by the females that first perfected the *Medea* type among the progenitors of the genus. Later on the males of some of the species may have been completely modified (as with *E. acontius*), while the females retained their peculiar pattern (by reciprocal selection or by sexually limited inheritance?) down to the present time.

In conclusion, attention is directed to the scent-secreting organ of *Epicalia acontius* as compared with that of another butterfly belonging to a quite different group, viz., *Antirrhæa archæa*, the organ being almost identical in these two widely-separated species, and thus affording a striking instance of what is well known to evolutionists as "analogy," in contradistinction to "homology."

R. MELDOLA

SUN-SPOTS AND COMMERCIAL CRISES

I HAVE been repeatedly told by men who have good opportunity of hearing current opinions, that they who theorise about the relations of sun-spots, rainfall, famines, and commercial crises are supposed to be jesting, or at the best romancing. I am, of course, responsible only for a small part of what has been put forth on this subject, but so far as I am concerned in the matter, I beg leave to affirm that I never was more in earnest, and that after some further careful inquiry, I am perfectly convinced that these decennial crises do depend upon meteorological variations of like period, which again depend, in all probability, upon cosmical variations of which we have evidence in the frequency of sun-spots, auroras, and magnetic perturbations. I believe that I have, in fact, found the missing link required to complete the first outline of the evidence.

About ten years ago it was carefully explained by Mr. J. C. Ollerenshaw, in a communication to the Manchester Statistical Society (*Transactions*, 1869-70, p. 109), that the secret of good trade in Lancashire is the low price of rice and other grain in India.[1] Here again some may jest at the folly of those who theorise about such incongruous things as the cotton-mills of Manchester and the paddy-fields of Hindostan. But to those who look a little below the surface the connection is obvious. Cheapness of food leaves the poor Hindoo ryot a small margin of earnings, which he can spend on new clothes; and a small margin multiplied by the vast population of British India, not to mention China, produces a marked change in the demand for Lancashire goods. Now, it has been lately argued by Dr. Hunter, the Government statist of India, that the famines of India do recur at intervals of about ten or eleven years. The idea of the periodicity of Indian famines is far from being a new one; it is discussed in various previous publications, as, for instance, "The Companion to the British Almanack for 1857," p. 76. The principal scarcities in the North-Western and Upper Provinces of Bengal are there assigned to the years 1782-3, 1792-3, 1802-3, 1812-13, 1819-20, 1826, 1832-3. Here we notice precise periodicity up to 1812-13, which, after being broken for a time, seems to recur in 1832-3.

Partly through the kind assistance of Mr. Garnett, the Superintendent of the British Museum Reading Room, I have now succeeded in finding the data so much wanted to confirm these views—namely, a long series of prices of grain in Bengal (Delhi). These data are found in a publication so accessible as the *Journal* of the London Statistical Society for 1843, vol. 6, pp. 246-8, where is printed a very brief but important paper by the Rev. Robert Everest, chaplain to the East India Company, "On the Famines that have devastated India, and on the Probability of their being Periodical."

Efforts have, I believe, been made by Dr. Hunter, Mr. J. H. Twigg, and probably others, to obtain facts of this kind, which would confirm or controvert prevailing theories; but this little paper, which seems to contain almost the only available table of prices, has hitherto escaped the notice of all inquirers, except, indeed, Mr. Cornelius Walford. The last number of the *Journal* of the London Statistical Society contains the second portion of Mr. Walford's marvellously complete account of "The Famines of the World, Past and Present," a kind of digest of the facts and literature of the subject. At pp. 260-1 we find Everest's paper duly noticed. In this latter paper we have a list of prices of wheat at Delhi for seventy-three years, ending with 1835, stated in terms of the numbers of seers of wheat—a seer is equal to about 2lb. avoirdupois—to be purchased with one rupee. As this mode of quotation is confusing, I have calculated the prices in rupees per 1,000 seers of wheat, and have thus obtained the following remarkable table:—

Price of Wheat at Delhi

1763	... ...	50 M.C.	1800	... ...	22
1764	... ...	35	1801	... ...	23
1765	... ...	27	1802	... ...	25
1766	... ...	24	1803	... ...	65 M.
1767	... ...	23	1804	... ...	48 C.
1768	... ...	21	1805	... ...	33
1769	... ...	24	1806	... ...	31
1770	... ...	28	1807	... ...	28
1771	... ...	33	1808	... ...	36
1772	... ...	38 C.	1809	... ...	40
1773	... ...	100 M.C.	1810	... ...	25 C.
1774	... ...	53	1811	... ...	28
1775	... ...	40	1812	... ...	44
1776	... ...	25	1813	... ...	43
1777	... ...	17	1814	... ...	30
1778	... ...	25	1815	... ...	23 C
1779	... ...	33	1816	... ...	28
1780	... ...	45	1817	... ...	41
1781	... ...	55	1818	... ...	39
1782	... ...	91	1819	... ...	42
1783	... ...	167 M.C.	1820	... ...	46
1784	... ...	40	1821	... ...	38
1785	... ...	25	1822	... ...	35
1786	... ...	23	1823	... ...	33
1787	... ...	22	1824	... ...	39
1788	... ...	23	1825	... ...	39 C.
1789	... ...	24	1826	... ...	48 M.C
1790	... ...	26	1827	... ...	30
1791	... ...	33	1828	... ...	22
1792	... ...	81 M.	1829	... ...	21
1793	... ...	54 C.	1830	... ...	21
1794	... ...	32	1831	... ...	26
1795	... ...	14	1832	... ...	22
1796	... ...	14	1833	... ...	33
1797	... ...	15	1834	... ...	40 M.
1798	... ...	8	1835	... ...	25
1799	... ...	17	1836	... ...	— C.

The letter M indicates the maxima attained by the price, and we see that up to 1803, at least, the maxima occur with great regularity at intervals of ten years. Referring to Mr. Macleod's "Dictionary of Political Economy," pp. 627-8, we learn that commercial crises occurred in the years 1763, 1772-3, 1783, and 1793, in almost perfect coincidence with scarcity at Delhi. M. Clément Juglar, in his work, "Des Crises commerciales, et de leur Retour périodique," also assigns one to the year 1804. After this date the variation of prices becomes for a time much less marked and regular, and there also occurs a serious crisis about the year 1810, which appears to be exceptional; but in 1825 and 1836 the decennial periodicity again manifests itself, both in the prices of wheat at Delhi and in the state of English trade. The years of crisis are marked with the letter C.

[1] This view is confirmed by the opinion of Mr. E. Helm, as given in the *Transactions* of the same society for 1868-9, p. 76.

When the above numbers are plotted out in the form of a curve, the earlier part of the series presents the appearance of a saw, with four or five high, sharp-pointed teeth at almost exactly equal distances of ten years. The first maximum, that of 1763, is perhaps imperfectly represented, and were the table extended backwards, the true maximum might fall in 1762. It is remarkable that after about the year 1807 the character of the curve suddenly and entirely changes, the oscillations becoming comparatively small, irregular, and rounded, although the periodicity, as already remarked, seems to recur in a less intense degree after 1823. This change in the curve may be due to some local causes, such as the opening of new roads and markets, and it is obviously important that we should learn whether this is the case, or whether some important meteorological variation is here manifested. This is not the only instance in which a well-marked decennial oscillation appears to be for a time suddenly arrested or thrown into confusion.

One difficulty which presents itself in connection with the above table is that the commercial crises in England occur *simultaneously* with the high prices in Delhi, or even in anticipation of the latter; now the effect cannot precede its cause, and in commercial matters we should expect an interval of a year or two to elapse before bad seasons in India make their effects felt here. The fact, however, is that the famines in Bengal appear to follow similar events in Madras. Thus it is well known that the great famine occurred in the year 1770, or even began in 1769, though it seems not to have made its mark at Delhi until 1773. This quite explains the fact that the English crisis was in 1772-3. Mr. F. C. Danvers, of the India Office (*Journal of Science*, N.S., vol. viii. p. 436), assigns famines in the Madras Presidency to the years 1781-3 and 1790-2. In fact Mr. Danvers explicitly points out this tendency of famines to travel northward, saying (p. 441): "It is a point worthy of remark that severe droughts in Northern India have, on several occasions, followed closely upon distress similarly caused in the Peninsula of India; thus the Madras famine of 1781 to 1783 was followed by one which affected Bengal, the north-western provinces, and the Punjab in 1783-4; the failure of rains which resulted in scarcity in many of the provinces of the Madras Presidency in 1824-5, was followed by a similar calamity in the North-western Provinces in the succeeding years. The "Guntoor" famine of 1833 preceded only by a few years one which affected the north-western and lower provinces of Bengal in 1837-8, and the Madras famine of 1866 was very closely followed by one in the North-western Provinces and the Punjab in 1868 to 1870." We see, then, that in looking for periodicity, we must confine each comparison to events of the same locality. It must also be allowed that the *commencement* of famine in India precedes by about two years the occurrence of commercial collapse in England.

It ought to be added that Everest refers to a journal published at Calcutta, called *Gleanings of Science*, which contains (vol. i. p. 368) a table of the prices of various kinds of grain at Chinsurah in Bengal, from 1700 to 1813. The volume is to be found in the British Museum; but on referring to it and plotting out the curve for the price of rice, it was very disappointing to find the series broken by gaps of several years every here and there, which renders it impossible to draw any safe inference, affirmative or negative. The table is said to have been drawn up by G. Herklots, the fiscal of Chinsurah, from authentic documents. Now, if such documents existed half a century ago, it is indispensable that minute inquiry should be made for any local records of the kind which may still exist.

Returning to the prices at Delhi, and taking the above table in connection with a mass of considerations of which I have given a mere outline at the last meeting of the British Association (see *Journal* of the Statistical and Social Inquiry Society of Ireland, August, 1878, pp 334-42; NATURE, vol. xix. pp. 33-37). I hold it to be established with a high degree of probability that the recurrence of manias and crises among the principal trading nations depends upon commerce with the east. This conclusion is confirmed by the fact that these fluctuations are but slightly felt by the non-trading nations, and that what these nations do feel is easily accounted for as an indirect effect.

It has been objected by the *Economist* that this explanation cannot be applied to the earlier crises in the years 1711,1721, and 1732, because trade with India was then of insignificant dimensions. But the reading of many old books and tracts of the seventeenth and eighteenth centuries has convinced me that trade with India was always looked upon as of the highest importance. A large part of the political literature of the time was devoted to the subject, and under the Mercantile Theory the financial system of the country was framed mainly with an eye to Indian trade. The published returns of exports and imports probably give us little idea of the real amount of trade, as smuggling was very common in those days, and much of the Indian trade went on secretly in private ships or indirectly through Holland.

Dr. George Birdwood has lately been studying the records of the India Office, and he gives as the result of his extensive reading "that the history of modern Europe, and emphatically of England, has been the quest of the aromatic gum-resins, and balsams and condiments, and spices of India and the Indian Archipelago" (*Journal* of the Society of Arts, February 7, 1879, vol. xxvii. p. 192). This closely corresponds with the view which I have been gradually led to adopt of the cause of decennial crises.

While India is, no doubt, together with China, the principal source of disturbance, there is no reason to suppose that it is the only source. A nearly exhaustive analysis which I have made of the trade of England with various parts of the world during the last century, as given in Whitworth's valuable tables, fails to disclose any clear periodicity as regards European trade. The investigation of various long series of prices of agricultural produce in Europe also leads me to believe that the decennial periodicity, if felt in Europe at all, is over-borne by disturbing causes, or involved in too great complication to admit of discovery. On the other hand, I have fallen upon the very interesting and significant fact that the export trade from Maryland and Virginia exhibits what seems to me an unquestionable periodicity, with maxima in the years 1701, 1711-13, 1720, 1742, 1753, 1764, and 1774. The same tendency is not apparent in the trade of New England. Thus it is likely that crises may have an independent meteorological origin in the semi-tropical States of the Union; and, if so, it is probable that there are other tropical parts of the world where the meteorological conditions allow the cycle to manifest itself. This subject, so far as it has yet been studied, is full of important and mysterious facts, which stimulate the interest of the inquirer in a high degree. At the same time it is plain that sound conclusions can be reached only by most extensive analyses and comparisons of large series of facts. The search for the facts, too, among the records of the last two centuries, the suitable part of which has in too many cases probably perished, is so tedious and disappointing that it taxes the patience of the inquirer very severely. It is no jest at all.

But whatever be the area of the tropical and semi-tropical regions from which the decennial impulse comes, mainly India and China, no doubt, it does not follow that the extent of the commercial mania or crisis here is bounded by the variation of the foreign trade. The impulse from abroad is like the match which fires the inflammable spirits of the speculative classes. The history of many bubbles shows that there is no proportion be-

tween the stimulating cause and the height of folly to which the inflation of credit and prices may be carried. A mania is, in short, a kind of explosion of commercial folly followed by the natural collapse. The difficulty is to explain why this collapse so often comes at intervals of ten or eleven years, and I feel sure the explanation will be found in the cessation of demand from India and China occasioned by the failure of harvests there, ultimately due to changes of solar activity. Certainly the events of the last few years, as too well known to many sufferers, entirely coincide with this view, which is, nevertheless, made the subject of inconsiderate ridicule.

Hampstead, April 23 W. STANLEY JEVONS

JAMES NICOL, F.R.S.E., F.G.S.

ANOTHER of the links connecting us with the early days of geology has been severed by the death of the Professor of Natural History in the University of Aberdeen. For some years past Prof. Nicol's failing health prevented him from undertaking more work than his college duties required, so that he had somewhat fallen behind the crowd of younger aspirants to scientific reputation. It is a pleasant duty to recall his early services to geology. As far back as the year 1843 we find him contributing to the series of prize essays of the Highland Society a memoir on the geology of his native county, Peebleshire. Devoting himself with energy to the prosecution of his favourite pursuits, he prepared a useful little Guide to the Geology of Scotland, illustrated with maps and sections, and giving, from his own observations and the researches of previous writers, a compendious account of Scottish geognosy, so far as then known. Many years afterwards he published another compilation of Scottish geology in the form of a Geological Map of that country. He specially took up the mineralogical and petrographical department of geology, and showed his capacity for these subjects by publishing a text-book of mineralogy, which has kept its place as a work of reference. Appointed Assistant Secretary of the Geological Society, he in that capacity edited the Society's Journal, and had an opportunity of coming personally in contact with the foremost geologists of his time. Among those whose friendship he formed, one of the kindest and most serviceable was Murchison. Through the assistance of that active and powerful friend Nicol was appointed to the Chair of Geology at Cork, and a few years afterwards to the more lucrative post at Aberdeen, which he resigned only last year. During these years of official work he found time for a number of original papers chiefly on the geology of different parts of Scotland. Thus he returned once more to the study of the rocks of his own Tweed Valley to which he had been the first definitely to apply the term silurian. In company with his friend and benefactor Murchison, he extended these observations into Ayrshire and the west of Scotland. With the same companion he visited the north-west of Scotland, and after a long journey through these regions produced an independent memoir, in which he suggested that much of the metamorphic rocks of the north-west Highlands consisted of altered Carboniferous formations. When the fossils found in the Assynt limestones proved to be unquestionably Lower Silurian he was of course compelled to retract his published suggestion. He then adopted a completely opposite view and endeavoured to prove that the rocks which he had thought might be altered Carboniferous were really the most ancient or fundamental masses of the west coast brought up everywhere to the surface again by a vast dislocation and inversion. In this view, no less than in that for which it was substituted, he was opposed by Murchison, who proved by many sections that the rocks in question really lay upon the fossiliferous limestones and could not therefore be older than the Lower Silurian period. From the time of this dispute the late professor devoted himself chiefly to his duties at Mareschal College, where his capacity for business made him a most useful colleague. From summer to summer, however, he could resume the hammer and renew his acquaintance with old haunts or make himself familiar with new ones. In these excursions he was sometimes accompanied by an old geological friend to whom he could communicate the views he no longer cared to publish. With a kindly nature he united a certain timidity which made him shrink from publicity and led to his being less widely known than his personal qualities deserved that he should be.

NOTES

THE International Meteorological Congress was opened at Rome on Tuesday last week, nearly all the Countries of Europe being represented, as well as the United States. Prof. H. P. S. Smith and Mr. Scott represented this country. Prof. Cantoni was elected president, M. Wild, of St. Petersburg, vice-president, Dr. Hoffmeyer, of Copenhagen, and Mr. Scott, secretaries. The introductory address was given by M. Depretis, who spoke of the great influence exercised by the physical sciences on the progress of the other sciences, and consequently on the moral and economical development of nations. He referred to the important place of meteorology among the physical sciences, and concluded by welcoming the strangers to Italy. Dr. Buys Ballot was unable to be present, but Prof. Mascart read an address sent by him, full of scientific data and statistics, passing in review all the discoveries recently made in America and Europe in meteorological science. The report on the work of the permanent committee was read by the secretary of the committee, Mr. Scott. The congress then divided into sections for work.

THE annual meeting of the French Sociétés Savantes commenced on April 16 at the Sorbonne. The general sessions of the Section of Sciences were held under the presidency of M. Milne Edwards, on April 16, 17, and 18. MM. Faye and Wurtz were vice-presidents, and M. Blanchard the secretary. M. Faye delivered a lecture on the 18th in the large hall, on the Great Movements of the Atmosphere. General Nansouty, the Director of the Pic du Midi Obsevatory, gave an address, in which he complained of the interruptions in the telegraphic communications with Toulouse, caused by the snows during winter, and insisted upon the necessity of placing the wire under ground. M. Ferry, the Minister of Public Instruction, who is president, said that he should take the measures which were asked for by the gallant observer, whose devotion to science was so widely admired in France and abroad. M. Alluard, Director of Puy de Dôme Observatory, presented a series of maps tabulating the readings taken at Clermont Ferrand and on the top of the mountain. An intermediate station has been established. The final meeting of the Congress took place in the large hall of the Sorbonne, under the presidency of M. Ferry, who was assisted by a large number of officials. Five reports were read on the works of the Sociétés Savantes. The Minister, as usual, delivered a speech stating the projects of his administration. The number of learned societies in France is now 360. He stated that the Government spent 11,000,000 frs. in 1870 for the Faculties; the sum was now 30,000,000 frs. The list of rewards granted was then read over. The four gold medalists in science are M. Combercure, of Montpellier, for mathematical disquisitions, M. Dieulafait, of Marseilles, for geology, M. Coquillon, for determining the quantity of inflammable gas contained in the air of coal-mines, and M. Schrader, for explorations in the Pyrenees.

THE French Physical Society held its annual meeting the other day at the Hotel of the Societé d'Encouragement, rue Bonaparte. The *façade* of the hotel was illuminated by a series of twenty-four lamps of the Reynier system fed by three large gramme machines, each of them consuming from three to four horse-power. The effect was regular for several hours, but the illuminating power was very low as compared with ordinary regulators. Among the apparatus exhibited we noticed a rotation machine exhibited by M. Antoine Breguet, to demonstrate that the Gramme machine may be considered as a form of the Barlow rotating wheel. M. Nodot, *preparateur* of the Dijon Faculty of Sciences, exhibited a Barlow apparatus, in which the rotating part is formed by a series of copper wires radially implanted in the centre. M. Deprez exhibited a new motor worked by six Bunsen elements, and which gives about five kilogrammetres per second. This apparatus is analogous to a Wilde electro-magnetic machine. All the principal opticians of Paris, Breguet, Ducretet, Carpentier (formerly Ruhmkorff), Dubosc, Dumontin, Froment, Deleuil, Sauter and Lemonnier, sent in an improved or enlarged form the instruments which have attracted the attention of physicists in recent years. The Faber speaking-machine, which has been attacked by one of the French scientific papers as being worked by a ventriloquist, was exhibited and explained by M. Garrel. The display was considered as one of the most successful that has been offered to the public since the Society was established. The large halls of the hotel were crowded up to a late hour.

SINCE the commencement of the present year, the well-known weekly German botanical journal, the *Botanische Zeitung*, has passed into the sole editorship of Prof. De Bary, of Strassburg.

THOSE interested in British botany will be glad to hear that the threatened extinction of the Botanical Exchange Club, to which we recently alluded, has been averted. Mr. Charles Bailey, of Manchester, has offered to undertake the main responsibility of the curatorship, although the scope of the Club will in future be somewhat restricted. There is a proposal for issuing, in connection with the Exchange Club, a small number of copies of a reference herbarium of British plants, the difficult and critical species being especially kept in view, on the plan of Reichenbach's "Flora Germanica Exsicata."

THE *Times* Paris correspondent telegraphs that at the sitting of the Academy of Sciences on Monday, it was announced that Lavoisier's chemical apparatus, still preserved by his heirs, but hitherto left unnoticed, had been minutely inspected by Prof. Truchot, of Claremont Ferrand. It is in excellent preservation, and the accompanying documents show that Lavoisier was the author of the work on sea-water distillation published anonymously in England.

AN exhibition of an interesting kind is to be held in Dresden in the summer of this year. This is a general exhibition of objects of art, science, and industry, connected with the education and training of youth. The following are the various classes into which the exhibition will be divided:—1. Teaching material for schools, home, Kindergärten, &c. 2. Printed works, as schoolbooks, children's books, illustrations. 3. Gymnastic and similar apparatus. 4. Musical instruments. 5. Toys. 6. Articles required for children in all departments of industry, as furniture, linen, clothes, orthopædic instruments, &c. A systematic exhibition of the development of various school materials will be connected with the above, and historical objects connected with training and education are therefore desired. A similar exhibition on a small scale in 1877 had a great success. The Committee of the Exhibition consists of one merchant and three teachers. Inquiries should be addressed to Herr Kaufmann C. Heinze, Dresden. The Exhibition will be open from July 1 to August 31.

SECONDARY Technical Education forms the subject of the address delivered before the American Institute of Mining Engineers by their president, Mr. Eckley B. Coxe, at their Baltimore meeting. Great stress is laid on the necessity of educating workmen, and the maxim, a little learning is a dangerous thing, is combated by the statement that false learning mingling with the truth causes the danger. If the truth of the maxim were admitted we fail to see that it provides a very strong argument against education. A little dynamite is a dangerous thing, but it is of great use in mining work. The author states that they have already five good schools at their works, and proposed to establish another to carry on the education of those boys who have left them to enter the works. While admitting that an average boy cannot work all day and study all the evening, and foreseeing the possibility of making Jack a dull boy, the programme of studies is sketched out "as far as we have been able to arrange it." It comprehends instruction in algebra, geometry, trigonometry, free-hand and mechanical drawing, with descriptive geometry, physics, chemistry, mineralogy, and geology, mechanics and the construction of machines, framing, mining, and mine surveying, English composition, book-keeping, and, last of all, writing. Our astonishment is that not only is arithmetic omitted but lunar and planetary theory have no place assigned to them.

The *Madras Times* writes:—The necessity of a scientific training for coffee planters is now being recognised. Men of intelligence, industry, and steady habits can alone hope to succeed as coffee planters. We would urge upon estate owners the expediency of insisting upon their superintendents and assistants possessing a knowledge of chemistry, sufficient at least for the purposes of coffee planting. They should be able to make analyses of the coffee tree, soil, manures, &c. Planters should also be able to take correct observations of the weather, gauge the rainfall, take notes of the nature and progress of the various diseases the coffee tree is subject to, and so forth. The paper of questions submitted by Mr. Harman to the various coffee planters in Coorg will put their capabilities to the test, and though we are aware that there are many educated and intelligent planters in that province, we fancy some of them will find it no easy task to answer the last of Mr. Harman's questions: Can you give analyses of your rock soil and sub-soil?

ON January 15, 1880, an International Exhibition of products of agriculture, industry, science, and fine arts will be opened at Mexico. The Exhibition will remain open for three months.

THE Anthropological Exhibition at Moscow was opened on the 16th inst. The International Anthropological Congress, connected with this exhibition, will however not meet until August 7 next.

SLIGHT shocks of earthquake were noticed at Montmarault and Chantelle, in the French Department of the Allier, on March 27th. A slight shock of earthquake, lasting about fifteen seconds, and travelling from east to west, was felt at Darjiling at 8.15 on the morning of the 11th ult.

THE death is announced of Mr. William Mudd, the curator of the Botanical Gardens, Cambridge, after a brief illness. The stipend attached to the office is about 100*l.* a year; it is in the gift of the Botanical Garden Syndicate.

MARK W. HARRINGTON, M.A., F.L.S., lately Professor of Astronomy at the Imperial University of Peking, and formerly assistant Professor of Botany at the University of Michigan, has just been appointed Professor of Astronomy and Director of the Observatory at the last-named institution, the chair rendered vacant by the resignation of Dr. James C. Watson, now Professor of Astronomy at the Wisconsin University.

A COURSE of three lectures will be delivered in the Galleries of Natural History and Antiquities, British Museum, on the 24th, 28th, and 30th inst., by Dr. Carter Blake, of Westminster Hospital. Some of the keepers of departments will also give *vivâ voce* explanations of the specimens under their care.

MR. ARTEMAS MARTIN, a well-known American mathematician, has lately commenced the publication of a serial work, entitled *The Mathematical Visitor*, appearing occasionally at intervals of several months. It is published by him at Erie, Pennsylvania, and shows a creditable spirit of enterprise in entering a field which is not generally considered remunerative.

WE have received the first number of the *American Chemical Journal*, which promises to take a high place in scientific literature. Its first object is to collect the good original papers written by American chemists, and to make them the basis of a purely chemical journal, while papers from other journals, and notes in all departments of chemistry will find a place. It is expected that six numbers will appear yearly. The principal articles in the first number are "On the Complex Inorganic Acids," by Dr. W. Gibbs, "On Nitrogen Iodide," by Mr. J. W. Mallet, a paper on Lockyer's hypothesis that the so-called elements are compound bodies, by Mr. C. S. Hastings, of Johns Hopkins University, and "On the Oxidation of Substitution Products of Aromatic Hydrocarbons," by Messrs. Remsen and Iles. There are, besides, several reviews and a number of notes.

THE scientific journals of Pennsylvania express much regret at the possibility of the failure of the Legislature of that State to make appropriations for the continuance of the work of the Geological Survey. This work has been carried on for several years past under Prof. Lesley with great success, and it is so near completion that its cessation now might be considered almost a national calamity.

THE War Department is on the point of at length adopting war balloons into the land and sea services. Movable apparatus for inflating and manipulating military balloons in the field has just been completed in the Royal Arsenal, Woolwich, and been tried with two new balloons, specially constructed for military purposes. The appliances consist of a portable tank, weighing 400 lb., containing iron shavings, together with a portable boiler and furnace. These appliances can be moved about with troops on the field or on vessels at sea. Hydrogen is generated by passing steam through the iron turnings. As soon as the necessary arrangements can be made it is in contemplation to send a few war balloons out to Zululand.

THE boring of an artesian well for the purpose of investigating the nature of the chalk layers through which the submarine tunnel between England and France is to pass was resumed on the French coast at Sandgatte on March 1 last. The depth of the well, which at the end of last year was at 34·35 metres, was extended to 38·50 m.—that is, to a depth corresponding to 8·67 m. below the low-water level. At this depth the flow into the well amounted to 1,300 litres per minute, and the exhaust machines became insufficient. They are to be replaced by more powerful ones.

WE are glad to see that Messrs. Kegan Paul and Co. have published in a handy form a complete translation of Prof. Haeckel's "Freedom in Science and Teaching," first reproduced in this country in our own columns. There is an interesting prefatory note by Prof. Huxley.

A NEW monthly electrical paper has been started in Paris, the *Lumière electrique*, intended as a general organ of electricity.

WE have received from Messrs. Cole and Sons, of Notting Hill, several specimens of pathological, physiological, and educational preparations for the microscope, which for cutting and mounting surpass anything we have seen. They are really beautiful preparations, and deserve to be widely used.

THE Report of the Marlborough College Natural History Society for the past year is an unusually satisfactory one. Several modifications in the rules have been attended with good results, and the Society seems in a fair way to become a real working one. The papers by the boys and others are highly creditable; perhaps the most generally interesting is that by Mr. Rodwell, on Iceland. The Report of the Winchester and Hampshire Scientific and Literary Society is not quite so satisfactory as could be wished; the *dilettante* and absolutely idle elements seem large, and the Report complains of the indifference to the less popular subjects. We trust that the next Report will be more satisfactory.

Apropos of electric perforation of glass, Prof Waltenhofen, of Prague, has recently described the following experiments:—A thin glass plate, having on it a small drop of stearine, is introduced into the spark-path of an electric machine. It is perforated at the part where the drop is, and more easily so when the drop-side is turned to the positive electrode. A glass plate, hung bifilarly between the electrodes of a Holtz machine, is driven by the discharge towards the negative electrode, and more strongly, if the side turned towards the positive electrode be partly covered with stearine. Prof. Waltenhofen considers that the rapidly-moving air-molecules in the spark-path are ruled by a component of velocity directed from the positive to the negative electrode.

THE following subjects in natural science have been proposed by the Society of Arts and Sciences of Utrecht, for prize competition:—1. Researches on the development of one or several species of invertebrates whose history is not yet known. 2. Researches on the influence of small variations in exterior circumstances on the evolution of the embryo of one or several species of vertebrates. 3. Exact anatomical description of the larva and nymph of the common cockchafer (*Melolontha vulgaris*). 4. By what means may the water of rivers which traverse Holland be purified so as to become potable, without any injury to health? What would be the expense of applying them on a large scale? 5. A memoir on the results of experiments made in recent times on the motion of liquids and the resistance they offer to moving bodies; with an exposition (*a*) of the general or special laws which may be deduced; (*b*) of the principal points on which some data are still wanting, and the nature of the experiments necessary to obtain them. 6. Critical and experimental study of the functions of the semicircular canals of the ear. 7. Critical and historical study of the theories of electric phenomena observed in muscles and nerves. 8. Critical *aperçu* of the methods employed to determine the place which substituted atoms and groups of atoms occupy in bodies of the aromatic series, according to the theory of the constitution of benzol given by Kekulé and Ladenburg. 9. Determine rigorously the quantities of heat liberated or absorbed in the allotropic change of two or several simple substances. Each prize consists of an honorary diploma and about 25*l*. Papers must be sent in to the Secretary before December 1, 1879.

THE additions to the Zoological Society's Gardens during the past week include three Red Brockets (*Cervus rufus*) from Brazil, presented by Mr. W. H. Lacy; a Blue-faced Green Amazon (*Chrysotis bouqueti*) from St. Lucia, West Indies, a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, presented by Mr. Neville Holland; a Black-faced Kangaroo (*Macropus melanops*) from South Australia, three White-eared Conures (*Conuras leucotis*) from Brazil, an Upland Goose (*Bernicla magellanica*) from the Falkland Islands, deposited; a Reeve's Muntjac (*Cervulus reevesi*) born in the Gardens.

ON THE DEVELOPMENT OF THE SKULL AND ITS NERVES IN THE GREEN TURTLE (CHELONE MIDAS), WITH REMARKS ON THE SEGMENTATION SEEN IN THE SKULL OF VARIOUS TYPES[1]

FOR these embryos the author is indebted to Sir Wyville Thomson and Mr. H. N. Moseley, the latter having sent him the smaller specimens, and the former the ripe and nearly ripe young. There are in all five stages.

1st Stage, ½-in. long.—The embryo is already fairly formed, for there are rudiments of all the principal organs. About fifty-two somatomes may be counted behind the head, and there are evidently seven clefts—four post-oral, two pre-oral, and one oral. The body of the embryo is tolerably distinct from the yolk-sac, the mesocephalic flexure is well marked, and the tail is coiled upon itself.

The regions of the body, viz., cervical, dorsal, and caudal, are plain. A fold lying between the fore and hind limbs shows the commencing carapace, which is at present the only mark to distinguish it from any other Sauropsidan embryo.

Half the ventral region is now taken up by the heart and its pericardium, and behind it the ventral laminæ have not closed below, thus showing the Wolffian bodies within. Posteriorly the umbilical vessels are seen emerging.

The limb-buds grow out from a continuous ridge, due to a thickening of the mesoblast at the upper part of the somato-pleure.

The body-cavity extends into the head, thus corroborating

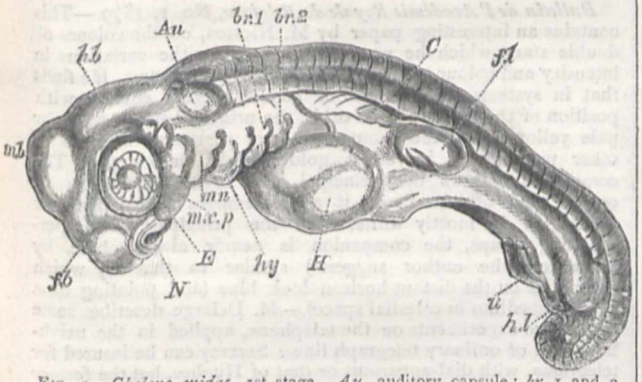


FIG. 1.—*Chelone midas*, 1st stage. *Au*, auditory capsule; *br.* 1 and 2, branchial arches; C, carapace; E, eye; *f.b*, fore-brain; *f.l*, fore-limb; H, heart; *h.b*, hind brain; *h.l*, hind limb; *hy*, hyoid; *m.b*, mid brain; *mn*, mandible; *mx.p*, maxillo-palatine; N, nostril; *u*, umbilicus.

Mr. Balfour's account of the same thing taking place in the Selachians.[2]

As far as possible, the head has formed a coil similar to that of the tail, from which it never more than partially recovers. This bending of the head, which imprisons the elements of the face, sets the dorsal region free, and the neural canal expands to form the three vesicles of the brain. Buds are already seen on the forebrain which give rise to the hemispheres.

The axial tissues, below the nervous structures, are thickening into embryonic cartilage.

A sectional view shows the mid-brain to be bent like a horse-shoe, forming the "middle trabecula" of Rathke, which is occupied by the apex of the notochord, its investing structures, and the third nerves.

Three pairs of chambers, for the organs of special sense, are built in the sides of the cranium.

The mouth is formed as in other types, by the extension of the third pair of clefts into one another; the fourth or mandibulo-hyoid cleft, being what is usually known as the first cleft.

The first post-oral visceral arch, forms most of the frame-work and machinery of the mouth, but as a rule, rudiments of pre-oral arches, supplemented by sub-cutaneous bones, finish the upper jaw.

On the whole, the series of clefts and folds along the face of the embryo are at this stage very regular, and the sense capsules are intimately connected with those which lie below them.

[1] Abstract of a paper by Prof. Parker, F.R.S., read at the Royal Society on February 13.

[2] This extension of the body-cavity is also seen in the lizard.

The slit-like opening of the nasal sac and the space between the eyeball and maxillo-palatine fold are very probably openings of the same nature as those behind them.

The tubular cartilage that forms round the external nostril is homologous with the "labial" that serves the same purpose in the Icthyopsida.

The floor of the skull is open under the fore-brain, and the double maxillo-palatine fold is sharply severed from the nasal fold. The fronto-nasal process is but little freed from the inferior cranial wall and the nasal folds.

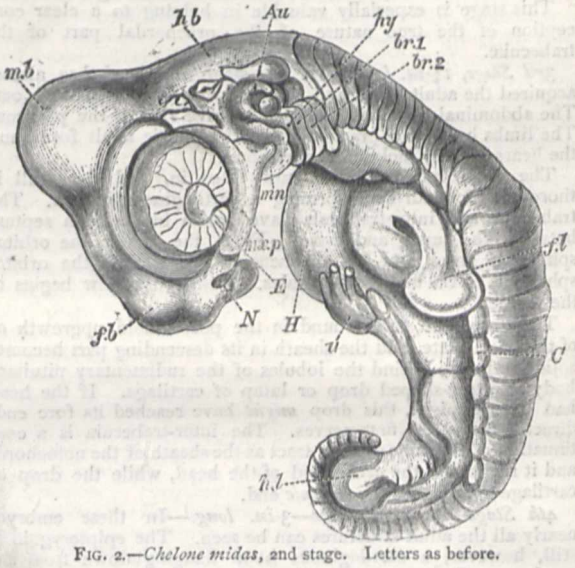


FIG. 2.—*Chelone midas*, 2nd stage. Letters as before.

2nd Stage, ¾-in. long.—The proximal part of each limb now lies adherent to the infero-lateral region of the body in a manner very similar to what is seen in the osseous fishes. The edge above the deep sulcus between the marginal row of cutaneous folds and the ingrowing abdominal part of the body-wall is ultimately somewhat bevelled down, but it shows well that the structure in which the plastron is formed is not originally flat but trough-shaped.

The upper region of the mandible is already assuming the very image of the quadrate with its tympanic cavity and its

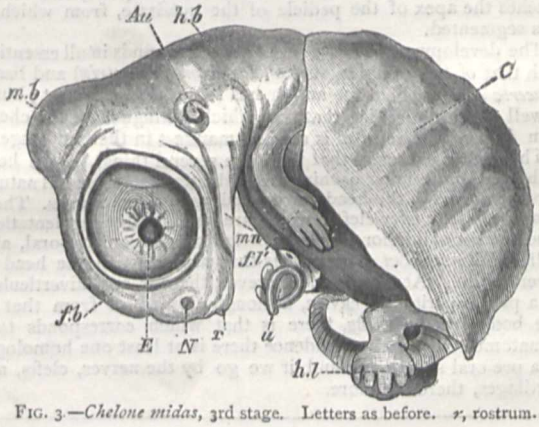


FIG. 3.—*Chelone midas*, 3rd stage. Letters as before. *r*, rostrum.

condyles. In the cavity a discoid body—the "extra-stapedial" has developed. Between the second post-oral (hyoid) fold and the hollow of the quadrate elevation, the beginning of the membrana tympani is seen.

The eyeball is now at its relatively largest size, exceeding the mid-brain in bulk.

The maxillo-palatine fold is somewhat hour-glass shaped, and has a head-cavity in its fore part.

In the middle of the palate an open space appears into which the oral lining has grown. This diverticulum is the rudiment of the pituitary body. It lies where the hypoblast and epiblast

meet, but is probably formed from the latter. The infundibulum is beginning to grow towards the pituitary body, and close in front of it are seen the optic nerves which are still hollow. Rudimentary olfactory lobes are seen where the solid olfactory nerves are given off.

Cartilage is forming in the base and sides of the skull, as well as in the ear-capsules. The notochord ascends high into the head and is slightly curved over at the end. The azygous prochordal element, or inter-trabecular bar, is of equal size to the trabeculæ, which are now articulated with the hind part of the basis cranii, in front of the base of the ascending wall.

This stage is especially valuable in helping to a clear conception of the true nature of the prochordal part of the trabeculæ.

3rd Stage, 1¼-in. long.—In this stage the head has almost acquired the adult form, and the carapace is well marked out. The abdominal region is flattened to give rise to the plastron. The limbs have also practically acquired their adult form, and the heart is fairly inclosed in the thorax.

The post-oral clefts are now filled in, and the skull is thoroughly chondrified, forming a cartilaginous trough. The trabeculæ and inter-trabecula have grown into a high septum between the eyes and nose. From the former, the orbito-sphenoids grow, and the alisphenoids extend from the orbito-sphenoids to the auditory capsules. Ossification now begins in the palate.

The notochord turns round in the post-clinoid upgrowth of the basal plate, and the sheath in its descending part becomes solid, and ends behind the lobules of the rudimentary pituitary body as a tear-shaped drop or lump of cartilage. If the head had been straight, this drop *might* have reached its fore end, directly below the first nerves. The inter-trabecula is a continuation of the same skeletal tract as the sheath of the notochord, and it reaches to the *actual* end of the head, while the drop of cartilage approaches the *organic* end.

4th Stage—two-thirds ripe—3-in. long.—In these embryos nearly all the adult structures can be seen. The epipterygoid is still, however, a cartilaginous hook hanging down from the quadrate. The columella is well developed, and its shaft is ossified.

The parietals have grown down the sides of the skull causing the alisphenoids to be absorbed to a great extent. The investing bones are now rapidly developed, but much of the endocranium is still soft.

5th Stage—ripe—4in. long.—The processes of development and ossification have now gone so far that little can be remarked upon as differing from the adult. The epipterygoid, however, which is wedged in between the descending parietal and the pterygoid, is now a distinct bone, but its apex permanently touches the apex of the pedicle of the quadrate, from which it was segmented.

The development of *Chelone midas* corresponds in all essentials with that of the common snake (*Tropidonotus natrix*) and lizard (*Lacerta agilis*) which the author has recently worked out; but it is well worth remarking that that which distinguishes the chelonian from other reptiles is already manifest in the first stage.

The author considers that there are several things in the head of the vertebrate embryo which are evidently of a segmental nature. Firstly, nerves in the head corresponding to spinal nerves. These constantly fork over clefts, which are also signs of segmentation. The number of inferior arches, whether pre-oral or post-oral, also indicate the number of segments that may exist in the head of a vertebrate. At any rate, wherever there is any diverticulum of a pleuro-peritoneal cavity, although divided off from that of the body by the clefts, there is that which corresponds to a somatome. By this last evidence there is at least one homologue of a pre-oral somatome, and if we go by the nerves, clefts, and cartilages, there are more.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE Council of King's College have decided to give the name "Wheatstone Laboratory" to the physical laboratory of the College, in honour of Sir Charles Wheatstone, who was for some years Professor of Experimental Philosophy in the College, to which he also bequeathed his valuable collection of physical apparatus. The report of the laboratory work shows that the physical laboratory was established in the year 1868, and that during the eleven years of its existence about 250 students have been trained in it in the various branches of practical physics. The average number of occasional students—*i.e.*, students who are engaged in research and do not attend with any special class, has been nine a year during the last five years. Among these are graduates of the older universities, who come to reside in London after they have completed their term of residence at the University. Engineering students in their third year's course have the privilege of working in the laboratory free of charge. There are also special practical classes which have been well attended, for the Bachelor of Science and the Preliminary Scientific M.B. Examinations of the University of London, and also special classes for evening class students who are engaged in business during the day-time. In all there are not less than forty students now engaged in practical work in physics in "the Wheatstone Laboratory" in King's College. The Laboratory is greatly in need of endowment, in order that an additional Demonstrator may be appointed, and the usefulness of the laboratory still further extended.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, March.—We note the following papers in this number:—Concerning $\frac{T_1 - T_0}{T_1}$, or the limit of efficacy of steam-engines, by Mr. Klein.—Gauging- and measuring-implements, by Mr. Richards.—A new engine-governor, by Prof. d'Auria.—Conical arches at South Street Bridge, Philadelphia, Pa., by Mr. Stauffer.—Graphic freight diagrams, by Mr. Dudley.

Bulletin de l'Académie Royale de Belgique, No. 1, 1879.—This contains an interesting paper by M. Niesten, on the colours of double stars, which he was led to study by the variations in intensity and colour of planets in relation to the sun. He finds that in systems which allow of connecting the colours with position of the satellite in its orbit, the principal star is white or pale yellow when the companion is at periaster, whereas in other positions it is yellow, gold yellow, or orange. The companion follows the principal star in its fluctuations of colour, and often exceeds it as it removes from periaster (where it is mostly white, like the principal). In perspective groups, the companion is nearly always blue, by an effect (the author suggests) similar to that by which mountains on the distant horizon look blue (and pointing to a gaseous medium in celestial space).—M. Delarge describes some instructive experiments on the telephone, applied in the neighbourhood of ordinary telegraph lines. Secrecy can be insured for telegrams, with dial-apparatus or that of Hughes, but the former is objectionable as leaving no trace, and the latter is very expensive and delicate. Hence recourse should generally be had to cipher.—M. Marchal contributes a revision of American Hederaceæ, describing eighteen new species and a genus.—M. Chevron is led to deny the inalterability of tricalcic phosphate by citrate of ammonia; but the use of this solvent for separation of the phosphate may give sufficiently exact results if a too great excess of the citrate solution be avoided.—We further note an analysis of, and reports on, the second part of M. Lagrange's work on the origin and establishment of astronomical movements, wherein is assumed that the material atoms were originally diffused through space in a state of rest and at the absolute zero of temperature, and endowed simply with reciprocal attraction.—M. Malaise writes on arsenopyrite, or mispickel, and on the arsenical water of Court Saint-Étienne.

No. 2. We have here a paper by M. Saltel on a mathematical paradox, and on a new character of decomposition due to the presence of multiple lines.—M. van Beneden records the receipt of some interesting fossils of cetacea from marls of the tertiary epoch in Croatia.

THE *Revue Internationale des Sciences* (January-March, 1879), contains the following papers of interest: On the cell soul and soul cells, by Ernst Haeckel.—On the nutrition of plants, by J. L. de Lanessan.—Analysis of two memoirs on *Noctilucæ*, by G. Carlet.—On a monstrous skeleton of a batrachian, by F. Lataste.—Researches on *Bacteria*, by Dr. Koch.—On vascular innervation, by MM. Grutzner and Heidenhain.—On the action of light and heat upon moving spores, by E. Strassburger and E. Stahl.—On contagious diseases and disinfecting agents, by Prof. Naegeli.—General observations on fertilisation, by E. Strassburger.—On a technical process for the study of fish embryos, by F. Henneguy.—On the retina red and its relation to vision, by

W. S. S.—On the movements of diatoms and *Oscillatoria*, by Th. W. Engelmann.—On the preparation and conservation of inferior organisms, by R. Blanchard.—On the influence of motion and rest upon life, by Dr. A. Horwath.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, April 17.—Dr. Roscoe in the chair.—The following communications were made:—On heptane, from *Pinus sabiniana*, by T. E. Thorpe. Wenzell, in 1872, described, under the name of abietene a hydrocarbon obtained by distilling the exudation of the Californian "nut pine." The author has subjected the crude oil (which occurs in commerce in San Francisco) to an exhaustive chemical and physical examination, and finds that it consists of nearly pure heptane. This discovery, that a paraffin is playing the part of oil of turpentine in a tree now living is exceedingly interesting, as our only natural sources of this hydrocarbon are petroleum and fossil fish oil.—On the determination of tartaric acid in lees and inferior argol, by B. J. Grosjean. The author suggests several improvements in the well-known oxalate process of Warington. The employment of the method of filtration suggested by Casamajor, the addition of potassium chloride to render the precipitation of the potassium bitartrate complete, precipitation of the latter salt by stirring, &c. By these improvements the author has shortened the time required for an estimation to four hours.—Conditions affecting the equilibrium of certain chemical systems, by M. M. P. Muir. The author has carefully studied the influence of time, temperature, and mass on certain reactions: 1. Bismuthous chloride, hydrochloric acid, and water. 2. Calcium chloride and potassium or sodium carbonate.—On the action of oxides on salts, Part II., by E. J. Mills and J. W. Pratt. The authors have examined the actions of aluminic, ferric, and stannic oxides on potassic carbonate at a temperature of 735°.—Examination of substances by the time method, by J. B. Hannay. The author has arrived at the following conclusion:—Two hydrated salts, in forming a double salt containing the normal amount of water, expend one-half of the affinity of the anhydrous salt for its water of crystallisation, in combining with each other, showing that the formation of double salts is comparable with other forms of chemical action.—Preliminary note on certain compounds of naphthalene and benzene with antimony chloride, &c., by Watson Smith. The author has obtained white needles, which he believes to be trinaphthylstibine or naphthyloxystibine. He has obtained other crystalline compounds, which have not yet been examined.

Anthropological Institute, April 8.—Mr. Hyde Clarke, vice-president, in the chair.—Mr. Coutts Trotter, of the Bengal Civil Service, was announced a Member.—Prof. W. H. Flower, LL.D., F.R.S., read a paper entitled "Illustrations of the Method of Preserving the Dead in Darnley Island and South Australia." A mummy from Erroob or Darnley Island, in Torres Strait, inhabited by a Papuan race, was first described. It was fastened in an extended position upon a framework made of pieces of wood, joined together with native cords, and kept in an upright position in the house of the relatives. The surface was covered with red ochre, and a piece of the large Indian volute shell (*Melo indica*), fashioned into the shape of a shield, was suspended in front of the body, as worn by the warriors in battle. The whole of the viscera had been removed through an aperture in the right flank, which had been carefully closed by an interrupted suture. Pieces of light wood filled the abdominal and thoracic cavities. The tongue, larynx, &c., had been removed through the mouth; the lips were not closed, but the jaw was kept from falling by a piece of cord passing close to the bone, through the nostril, and round the ramus of the mandible. The orbits were filled with a resinous substance, and imitation eyes of mother-of-pearl introduced. The second specimen described was a dried mummy from near Adelaide, in South Australia, presented in 1845 to the museum of the Royal College of Surgeons by Sir George Grey. In this case the limbs were bent jointly, and fixed by a band of native netting close to the side of the body, the knees being behind the shoulders, and the feet close to the hips. The internal organs had not been removed, but the mouth had been filled with emu's feathers, and carefully sewn up, a tassel of feathers hanging from one corner. Both cases showed a considerable amount of care and trouble bestowed in what was considered the decent and proper care of the body after death; but, as might be expected, a more elaborate development of art was attained in the Papuan than in the Australian.—A paper by Mr. M. J. Walhouse was read, on rag-bushes and kindred observances. The author, referring to the custom of tying pieces of rag to the bushes near springs of healing repute and by the tombs of holy men, once common in England, and still observed on the Continent, adduced evidence of its antiquity, and instances of its occurrence in Europe, Africa, throughout Asia, and all over America from the north to Patagonia. He also described some apparent varieties of custom, when other objects than rags were used, but with the same motive, and thought that they, as well as the rags, were offered as symbols of sacrifice or gifts, sometimes to deities, sometimes to ghosts, and often as thank-offerings for cures of sickness and other benefits. The worthless form of such offerings might be owing to the sacred spots being frequently in remote and desert regions, where travellers and pilgrims were not likely to have things of value to spare, and would leave trivial scraps and shreds ready at hand rather than nothing at all. Or they might be substitutes for more valuable offerings, once generally made, but which have a tendency to decrease in value, and at last exist only nominally as survivals. The Chinese custom of offering mock food and gilt-paper ornaments at tombs, where costly gifts were anciently made, was referred to in illustration of this. It was further suggested that the *ex voto* offerings, so commonly hung in Roman Catholic churches, are a form and development of the rags and shreds tied to bushes, and that may-poles and even Christmas-trees may have had a similar origin.—A number of antiquities from the United States of Colombia were exhibited by Mr. W. D. Powles.

Meteorological Society, April 16.—Mr. C. Greaves, F.G.S., president, in the chair.—The following were elected Fellows of the Society:—R. W. Abbotts, Rev. S. Allen, D.D., E. H. Banks, F. J. Bramwell, F.R.S., J. A. Caird, E. H. Cardwell, the Earl of Durham, J. Farquharson, W. Garnett, Rev. C. W. Harvey, W. Inskip, the Earl of Powis, and D. Robie. The papers read were: On the results of comparisons of Goldschmid's aneroids, by G. M. Whipple, F.R.A.S.—Observations on the temperature of the Atlantic during the month of March, by P. F. Reinsch.

Entomological Society, April 2.—J. W. Dunning, M.A., F.L.S., vice-president, in the chair.—Mr. McLachlan exhibited the cases of a number of species of Brazilian caddis-flies with the insects bred from the larvæ that manufactured some of them, sent to him by Dr. Fritz Müller from Santa Catharina, and read extracts (with notes) from Dr. Müller's letters on the subject. In reference to the habits of Mantidæ, which had been recently brought under the notice of the Society, Mr. Stainton referred to a larval form of probably *Mantis religiosa*, which had been forwarded to him in 1866 by Mr. Moggridge, jun., and which, from its saltatorial habits, that gentleman had described as a "curious grasshopper." De Geer had also drawn attention to the apparent similarity between these insects belonging to different orders, and Mr. Stainton considered that the peculiar motion of the young Mantis was an illustration of the remark of Mr. Darwin, that the relationships and affinities of animals are often more expressed in the embryonic than in the adult form.—Sir Sydney Saunders exhibited a bag-like fabrication, said to be the production of a large species of spider inhabiting the Fiji Islands.—The Secretary read a note from Mr. J. W. Sclater, on insects destroyed by flowers.—Miss E. A. Ormerod communicated a paper entitled "Observations on the Effects of Low Temperature on Larvæ." From an examination of many species belonging to different orders, during the severe frosts of the past winter, none were found materially injured by the low temperature to which they were subjected.—Mr. Distant communicated a paper containing descriptions of new species of hemiptera collected by Dr. Stoliczka during the Forsyth expedition to Kashgar in 1873-74, to form portion of the general work on the scientific results of the expedition now in course of publication at Calcutta.

Geological Society, April 9.—Henry Clifton Sorby, F.R.S., president, in the chair.—Rev. Joseph Finnemore, Thomas James Slatter, William H. Twelvetrees, Arthur Pendarves Vivian, and Ernest Westlake, were elected Fellows; Prof. Bernhard von Cotta, Freiberg, Dr. Nicolai von Kokscharow, St. Petersburg, and Dr. J. J. S. Steenstrup, Copenhagen, were elected Foreign Members; and Prof. P. J. van Beneden, Louvain, Prof. Guglielmo Guiscardi, Naples, and Prof. Gerhard von Rath, Bonn, Foreign Correspondents of the Society.—The following communications were read:—On the geological age of the rocks of the southern highlands of Ireland, generally known as "the

Dingle Beds" and "Glengariff Grits," by Prof. E. Hull, F.R.S. The author has arrived at the following results:—First, that "the Dingle Beds" are perfectly conformable to, and continuous with, the upper silurian beds of the Dingle promontory. Secondly, that they are the representatives of "the Mweelrea Beds and Salrock Slates," of West Galway and Mayo, the age of which, as shown by the fossils, is upper silurian, and that "the Dingle Beds" may therefore be regarded as of the age of the Ludlow Rocks, but unusually developed—the view adopted as far back as 1839 by Sir Richard Griffiths. Thirdly, that throughout the south of Ireland "the Dingle and Glengariff Beds" are disconnected from the succeeding conformable series, consisting of (*c*) lower carboniferous slate; (*b*) the upper old red sandstone with *Anadonta jukesii*; (*a*) the lower old red sandstones and conglomerate, as these three conformable formations are found resting upon, and against, the Glengariff beds successively in a direction either from south to north, or from south-west to north-east, owing to a conformable overlap against the flanks of an old shelving shore formed of the Glengariff beds. Fourthly, that at the close of the upper silurian period, and after the deposition of "the Dingle and Glengariff Beds," these strata were disturbed, upraised, and denuded, and were not again submerged till the commencement of the old red sandstone (*a*), when they were successively overlain by the beds of that formation with the succeeding ones of the lower carboniferous period, probably including the carboniferous limestone in some places. Lastly, that it was during this period of upheaval that, as the author believes, the marine Devonian beds (Ilfracombe and Morte series) were deposited, which accounts for their absence in the Irish area, which was either a land surface or only partially submerged. To this part of the subject the author hoped to call the attention of the Society on a future occasion.—On some three-toed footprints from the triassic conglomerate of South Wales, by W. J. Sollas, F.G.S.—On the silurian district of Rhymney and Pen-y-lan, Cardiff, by W. J. Sollas, F.G.S.

Statistical Society, April 15.—Sir R. W. Rawson, vice-president, in the chair.—Mr. E. G. Ravenstein, F.R.G.S., read a paper on the geographical distribution of the Celtic speaking population of the British Isles. He stated that four Celtic languages are at present spoken in the British Isles, three of which belonged to the northern Gaelic or Gadhelic, and one to the southern or Cymraig branch. The former are Irish Gaelic, Scotch Gaelic, and Manx; the Cymraig branch, since the extinction of Cornish, being now represented only by the Welsh. *Ireland.*—The localities where Irish Gaelic is the language of the majority, are comparatively limited and remote areas, where the population is less dense than in the more fertile and English speaking districts of the island. In 1851, 23·3 per cent. of the population spoke Irish, and in 1871 15·3 per cent. The success of the labours of the "Society for the Preservation of the Irish Language" was referred to, although it cannot be doubted that Irish is on the decrease. Opinions differ as to the agencies to which this decrease must be ascribed. The census on the whole presented a very fair picture of the linguistic condition of Ireland. *Scotland.*—Mr. Ravenstein said that not quite 9 per cent. of the population could speak Scotch Gaelic, and that there was no doubt it was dying out, although in the more remote parts of the Highlands, and in the Hebrides, it still maintains its ground. In the Isle of Man 25·6 per cent. of the population still understood Manx. *Wales* (Cymraig).—Of all the Celtic speaking races in the United Kingdom, the Welsh were the most important, and in the maintenance of their own language they showed by far the greatest amount of vitality. Including 60,000 Welsh in England, there are 1,006,100 Welsh speaking people in Great Britain. The total number of persons in the United Kingdom still speaking a Celtic tongue was:—

Irish Gaelic	867,600
Scotch ,, ...	309,250
Manx	12,500
Welsh	1,006,100
Total	2,195,450

or nearly 7 per cent. of the population of the British Isles.

PARIS

Academy of Sciences, April 14.—M. Daubrée in the chair.—The following papers were read:—Law of propagation of expressive nervous affections and phenomena, by M. Rambosson. A movement purely physical may be transformed into one physiological, and into one psychic or cerebral, being transmitted to these different media; and reciprocally, a psychical movement may be transformed with a physiological and a physical; and that without altering in nature, the same phenomena being reproduced after all these transmissions and transformations, on repassing into the same medium.—Studies on Collioure and its environs, by M. Seriziat.—On the curve-place of positions of centres of curvature of a left curve after its development on a straight line, by M. Aoust.—On various experiments with an oscillating pendulum having large amplitudes, by M. Dejean de Fonroque. The pendulum being free to oscillate in all directions, the plane of oscillation becomes rapidly oriented in a particular direction; which the author thinks is nothing but the horizontal projection of the earth's trajectory, or the resultant of the two great motions of translation of the earth, towards Hercules and round the sun. The trajectory in question does not change sensibly in direction, in the course of a day; but in this time the inclination of the horizontal plane (passing through the point of suspension) to this trajectory varies incessantly according to a law easily determined, consequently its projection on this plane must vary, also the direction of the pendulum. M. Cornu, while not accepting the causes assigned, thought the phenomena worthy of attention.—Anomaly of magnetic observations of Paris, by M. Flammarion. He does not allow M. Marié-Davy's explanation.—Fossil fauna of the environs of Castres, by M. Caraven-Cochin. He has discovered several carapaces of tortoises in the eocene sandstone of the place, also jaws and teeth of Lophiodon, scales and teeth of crocodiles (apparently three new species), remains of various mammalia, &c.—On an alteration of the cells of renal epithelium, at the commencement of Bright's disease, by M. Cornil. He describes vacuoles in the cells of the uriniferous tubes, filled with a ball or drop of granular albuminoid matter.—Researches on the Pyrenomycetes of St. Paul and Amsterdam Islands, by M. Crié.—Considerations on the Echinida of the Cenomanian formation in Algeria, by M. Cotteau. He finds remarkable relations of the system in Algeria to that in France.

GÖTTINGEN

Royal Society of Sciences, February 12.—On the constant batteries of Grove and Bunsen, by Herr Fromme.—Report on ear diseases, by Dr. Burkner.

March 1.—On the reduction of Abel integrals to elliptical and hyper-elliptical, by Herr Königsberger.

CONTENTS