SCIENCE.

FRIDAY, DECEMBER 7, 1883.

JOACHIM BARRANDE.

II., HIS SCIENTIFIC WORK.

THE influence of Barrande upon science in this country and throughout Europe has been of the first importance; and he has done much for the reputation of many of our investigators by his careful attention to their works, and his respectful quotations. He recognized the work especially of Dr. E. Emmons, and gave him the credit of being the discoverer of the primordial fauna, which Emmons had previously published as being in the Taconic system. Barrande thus ranged himself, during the celebrated Taconic controversy, on the side of Dr. Emmons, and his principal supporter in this country, Professor Jules Marcou. One of M. Barrande's most remarkable discoveries related to what he has called 'colonies.' According to him, certain characteristic fossils appeared sporadically in the faunas preceding those to which they properly belonged; and he deduced from this the result that two faunas having some identical species, but existing in different parts of the world, were not necessarily contemporaneous because of this fact, but might, indeed, be very distinct in age. These views are strongly supported by Professor Jules Marcou in this country, who states that he has discovered similar colonies in the rocks of the Taconic, underlying the Potsdam at Swanton and Phillipsburg; and is opposed principally by English authors upon the grounds that the evidence was stratigraphically defective. Barrande's reply to this, which he was preparing at the time of his death, has not yet been published. The theory has the support of the geologists of Vienna, especially Haidinger, director of the Imperial museum, whom Barrande quotes upon the titlepage of each of his books upon the 'colonies.'

From 1846 to the present time, the smaller publications of this voluminous and accurate writer must have reached nearly a hundred. Of these, between seventy and eighty were made to learned bodies, and from sixteen to twenty were pamphlets and books of octavo size: some of these were abridgments of his larger volumes. In the latter series, his *études*, extracts, etc., he published over three thousand pages and twenty-nine plates. Of these, his 'Cephalopodes, études générales,' was the most important to the general student. His grand work, the publication of which was begun in 1852, and is not yet finished, has already reached, as we have said, the number of twenty-two quarto volumes. These treat of the Trilobites and Crustacea, 1,582 pages, 84 plates; Cephalopoda, 3,600 pages, 544 plates; Brachiopoda, 226 pages, 153 plates; Acephala, 342 pages, 361 plates; and he announces as having already completed over 100 plates of the Gasteropoda, which have not yet appeared. This makes the enormous number of 5,750 pages of text in quarto, and 1,148 plates already issued, which we estimate as containing about eighteen thousand figures of fossils of the finest execution.

Barrande published large editions of his smaller works, which he distributed with a free hand to many institutions and scientific men; but of his larger works, the edition, probably on account of the expense, was limited to two hundred and fifty copies. The larger number of these he also gave away to scientific institutions and to individual geologists, and it is estimated that he did not receive in return as much as the actual cost of three of the large volumes.

The Gasteropoda, Echinodermata, Bryozoa, and miscellaneous fossils still remain unpublished; though over a hundred plates of the Gasteropoda were completed, and the text was being printed, at the time of his death.

The number of species described amount to thirty-six hundred. When we reflect that each

of these had to be studied, and handled over and over again many times, before reaching the final stages of classification, description, and illustration, we are amazed at the industry and capacity required to do all this scientific work single-handed. Barrande, unlike other voluminous authors, had no collaborators. With the exception of an amanuensis, draughtsmen, mechanical preparators, and mere collectors, he did all of this vast work. A careful and comprehensive system was followed in every volume, and in the descriptions of each species; so that, when one has mastered the intricacies of this, he can at once find every thing relating to the history, literature, structure, relations in time, and geographical distribution, of any species or group.

Finally, in the cephalopods, the parts and internal structures for which this fossil type is remarkable, as well as the embryo shells and their characteristics, are followed out in the same way. We will speak more at length of this type, partly because it was the favorite and most fruitful field of research of this eminent author, and was selected by him as the stronghold from which to attack the theory of evolution, and partly because we have no space to do justice to other departments, where he, however, made important discoveries; as, for example, among the trilobites. With infinite labor he succeeded in getting series showing the stages of growth of some species among these ancient Crustacea, and taught us that it was possible to study their development even in the Silurian period. Barrande's efforts have been frequently referred to as if he were one of what we might call the numismatic school of geologists, who study animal fossils as if they were medals, useful principally to verify the date and place of formations. On the contrary, his technical labors had a distinctly ideal purpose, — the investigation of the evidences for and against the theory of evolution. His education and consequent psychological condition placed him in opposition, and, in spite of his honest efforts to treat the subject fairly, controlled his classifications, and warped his judgment. The Cuvierian form of anthropomorphology was his faith; and he failed, as have most great executive men, in realizing the dangers of his own mental training, and the need of correcting the personal equation.

The facts, however, were strong enough even to meet his requirements in some of the groups he studied; yet he ended by admitting that evolution must, in part at least, be true. He believed that the different types were miraculously created, but that the smaller series which he had traced might have been evolved within certain well-defined limits, fixed according to the plans of an infinite intelligence, which it was hopeless to try to understand. He was also deficient in that sort of zoölogical knowledge which is acquired only by research among existing animals, and a familiarity with their modes of development, anatomy, and habits. This explains the apparent inconsistencies which show themselves in his text: — the continual admission of transition forms between different species and smaller groups, and yet the perpetual denial of the probable former existence of any such transitions between what he considered distinct types, whenever he could not actually find them; his comparisons between the Silurian and recent Nautili, which he supposed to be very similar, when in reality only their adults are similar, the young shells and their developmental stages being widely different; his singular opinion that species like these Silurian Nautili and other forms, which seemed to him out of place and also inexplicable on account of their structure, had been set in the geological record as intentional exceptions, to teach man the divine origin of this apparently modified chaos of gradations. Barrande understood, and gave a fair statement of, the ordinary views of evolutionary embryologists on p. 74 of his 'Études générales, Cephalopodes,' and represented a naturalist of this stamp investigating the embryos of the fossil Nautiloidea. After finding all the forms of the group from the Silurian to the present time with the same type of apex or young, he would then necessarily draw from this embryo a picture of the lost prototypical ancestor of all the Nautiloidea. In his next steps he would find the

adults of transition forms from Nautiloidea to Ammonoidea, and set down his convictions that the Ammonoidea must have been derived from Nautilus through these transition forms, the gradations being Nautilini, Goniatites, Ammonites. Barrande then pictures this same naturalist as attempting to verify his apparently well-founded conclusions by opening a species of Goniatite with the anticipation of discovering within, at the apex, or young shell, an identical form and structure to that which he had been accustomed to find in the Nautiloidea, and his consequent confusion, and the overthrow of his theory, upon the exposure of a different form. Barrande's argument deals fairly with every point; and his facts are crushing refutations of the usual direct, simple modes pursued by embryologists in handling the question of the evolution of types. Barrande's work had no orators or lecturers to translate it; and the hypothesis of the embryologists, and even evolution itself, escaped an attack, which, if supported by powerful influences, might have shaken the popular faith in the new school of thought.

Hyatt has denied that there were such great and essential differences between the embryos of the Nautiloidea and those of the Ammonoidea; and they certainly seem to have been more alike than was supposed by M. Barrande. The fact, however, remains, that Barrande saw clearly that the embryos of these two nearly allied groups, which are united by most authors into one order, were, even in the Silurian, more easily separable from each other than some of the adult forms. When we can add to this, his discovery and thorough demonstration of the distinctness of the different types of fossils in the Silurian, and their sudden mode of appearance, we see clearly that he succeeded in doing the work which has thrown the greatest light upon the most obscure and interesting periods of the world's history, and which has furnished a temperate and healthy opposition to the theory of evolution. His faults of logic were unavoidable, with his mathematical and Cuvierian education, and strong feelings of loyalty to his masters in science; but these are only slight scratches upon the face of the vast monument erected by his labors, his discoveries, his eighty-three years of unblemished moral and faithful life, and his personal sacrifices for the advancement of science and the truth.

WHIRLWINDS, CYCLONES, AND TORNADOES.[1] — V.

CYCLONIC circulation has thus far been described as if it were effected in radial lines in to and out from the centre; but here, as in the whirlwind, perfect radial motion is impossible. A horizontal rotary motion would soon be established near the centre by the inequality of the inblowing winds. It is found, however, that all storms yet studied turn from right to left in the northern hemisphere, and from left to right in the southern (fig. 9). Such constancy points to something more regular than the accidental strength of the winds, — to some cause that shall always turn the indraughts to the right of the centre as they run in towards it in the northern hemisphere, and to the left in the southern hemisphere; and this cause is found in the rotation of the earth on its axis.

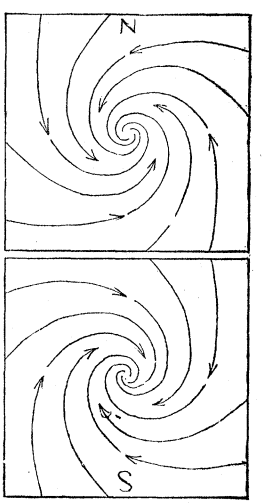

FIG. 9.

There is a force arising from the earth's rotation that tends to deflect all motions in the northern hemisphere to the right, and in the southern to the left; and this deflecting force varies with the latitude, being nothing at the equator, and greatest at the poles. It may be found that this statement differs from that generally made: namely, that moving bodies are deflected only when moving north or south, and not at all when moving east or west: for it is thus that Hadley (1735) and Dove (1835) explained the oblique motion of trade-winds, and that Herschel and others explained the rotation of storms. But this is both incorrect and incomplete; for a body moving eastward is deflected as well as when moving northward, and the actual deflective force is greater than that accounted for in Hadley's explanation.

[1] Continued from No. 43.