[From the American Journal of Science and Arts, Vol. XVII, June, 1879.]

Notice of Recent Scientific Publications in Brazil.—O. A. Derby on the Geology of the Lower Amazonas; by Richard Rathbun.

The Archivos of the National Museum of Rio de Janeiro, which were started in 1876, and of which only a single volume was published regularly, have again made their appearance. The numbers recently received, and issued only in the early part of this year, comprise volume II complete, for 1877, and the first half of volume III, for 1878. They are accompanied by numerous plates, some of which seem to have been carefully executed. The cause of the delay in the publication of this annual, the only one devoted to natural history memoirs in Brazil, is not given, but the high character of several of the articles contained in the present volumes, partially compensates for their late issue.

Dr. Fritz Müller, of Santa Catharina, contributes to both volumes interesting papers on certain structural points among insects, principally on the scent-bearing organs of several species of Lepidoptera, and, in volume II, treats of the correlation of the versicolored flowers of a species of *Latana*, of Santa Catharina, and the insects which fertilize them. Dr. Lacerda, of the Museum, gives the results of his experiments with the poison of *Bothrops jararaca* and *Bufo ictericus* on several domestic animals. The second volume also contains "Notes on the Localities of Antiquities (Ceramios) of Pará," by S. Ferreira Penna, and an extended memoir, entitled "Notes on the Stone Lip-ornaments of the Archæological Collection of the National Museum," by Dr. Ladislau Netto, the director of that institution. In the third volume are two short geological and mineralogical studies of small sections in the province of Minas Geraes, by members of the School of Mines of Ouro Preto.

The paper of greatest interest to North Americans, however, is "A Contribution to the Geology of the Lower Amazonas,"* by Mr. Orville A. Derby, formerly of the Geological Commission of Brazil, but recently appointed geologist in the National Museum at Rio de Janeiro. This memoir, which occupies considerable space in volume II, is a résumé of the principal results of the explorations of the late Prof. Ch. Fred. Hartt, Mr. Derby and others, in the Amazonian valley, and adds many important facts and generalizations to those hitherto published.

The first portion of the paper is devoted to a discussion of the topography and hydrography of the basin of the Amazonas, and of the relations of the great river and its many large tributaries

* The English version of this paper was published in the Proceedings of the American Philosophical Society of Philadelphia, for February, 1879.

to the surrounding table-lands and mountain chains, which direct their courses. Mr. Derby endeavors to show that between the three sections of the Rio Amazonas, popularly called the Maranon, Solimões and Baixo Amazonas, or upper, median and lower courses, there exist not only topographical differences, but also very marked differences in geological structure. After briefly describing the general geological history of the Amazonian region, as brought out by Prof. Hartt, the author enters into a detailed account of the several formations, that have been discovered in the lower valley, the immediate subject of his article. The most important conclusions recorded by him are the following:

The metamorphic deposits composing the plateau and mountain range between Guayana and Brazil, and the central Brazilian plateau, and thus bordering the Lower Amazonian basin on the north, and forming its higher lands on the south, may be divided into two series—a lower one, consisting of highly crystalline rocks, and an upper one, of generally non-crystalline rocks. The former, which constitutes the most of the Guayanian plateau, and forms the base of that of Brazil, consists of gneiss, gneiss-granite and syenite, and has been referred by Prof. Hartt to the Laurentian. The Serra do Mar and the Serra do Mantiqueira, farther south in Brazil, are made up of the same formation.

The second or upper series, composed mostly of quartzites, metamorphic schists and crystalline limestones, probably represents both the Huronian and Lower Silurian, as an apparent difference in age is exhibited in the exposures of these rocks. To the Lower Silurian are referred, as before, the itacolumites and talcose schists of Minas Geraes. The metamorphic rocks are generally well exposed in the falls and rapids of the several tributaries of the Amazonas, the upper, or non-crystalline series being usually the first reached in ascending these rivers.

The southern edge of the metamorphic deposits of the Guayanian plateau, beginning near the Atlantic, in about 1° north, extends a little south of west to near the confluence of the Rios Negro and Branco, between latitudes 1° and 2° south; the northern edge of the same rocks in the plateau of Brazil presents a line of exposures, which pass the Tocantins, between 3° and 4° S., the Tapajos, between 4° and 5° S., and the Madeira, between 8° and 9° S. The edges of the metamorphic regions, thus defined, mark approximately the borders of the ancient channel, which existed between the primitive islands of Brazil, and in which were laid down, without great changes of level, or disturbances, the newer formations from the Upper Silurian to the Cretaceous inclusive.

There is a certain concordance in stratification between the

beds of the two series of the metamorphic deposits, but the evidence goes to prove that the older, or Laurentian, had been more or less disturbed and metamorphosed, before the deposition of the newer, although the great general movement of upheaval, that affected, and gave character to, the entire metamorphic region of Brazil, was posterior to both.

The formations above the metamorphic, so far observed in the Lower Amazonian valley, are the Upper Silurian, Devonian, Carboniferous, Cretaceous and Tertiary. The Upper Silurian immediately follows the metamorphic series, on the north side of the valley, but has not yet been recognized to the south of the Amazonas. On the Rios Trombetas, Curuá and Maecurú, where they were examined by Mr. Derby and his party, the rocks of this formation are exposed over an area of only a few miles in width, have an estimated thickness of about 1,000 feet, and rest upon felsite and syenite; they are very gently inclined, and consist mostly of thin-bedded, argillaceous and micaceous sandstones, with some massive beds of pure sandstone. In the lower part of the series, on the Trombetas, are fossiliferous beds, containing in addition to other species, *Arthrophycus Harlani* Hall, *Lingula cuneata* Con., *Orthis hybrida* Sow. and *Bucania trilobata* Con., which indicate an horizon corresponding to the Medina Sandstone of the Niagara group of North America.

The Devonian rocks occupy a broader superficial area than the Upper Silurian, but, so far as studied, are of less thickness,—about 530 feet. They have been traced northward from Ereré, where they were first discovered by Prof. Hartt, in 1870, a distance of about seventy-five miles, on the Rios Maecurú and Curuá. Three sections or groups were readily distinguished, differing from one another, both in lithological characters and in fossils. The lower, or Maecurú group, having a thickness of about thirty feet, consists entirely of coarse sandstones, and is very fossiliferous. The only fossils of this section that have been determined are the Brachiopods, which prove that the section is closely related to the Upper Helderberg of North America, but has also many characters in common with the Hamilton group.

The second or Ereré group has an estimated thickness of about 200 feet, is made up mostly of fine-grained micaceous sandstones, with some beds of black shale, and is underlaid by beds of cherts. The fossils, which are mostly Brachiopods, are in part identical with those of the Maecurú, in part, with those of the Hamilton group of North America. The upper group, called the Curuá, is about 300 feet thick, and consists almost entirely of black and yellowish shales, passing at times into shaly sandstones. The only recognizable fossils discovered

were *Spirophytons*, apparently belonging to the same species as those described from the Hamilton group of New York.

The Devonian rocks in the Ereré region have suffered greatly by denudation, and are much dislocated and divided by trap dykes, making their study very difficult. Beds apparently of Devonian age have been found as far west as the Rio Uatumá, and, to the south of the Amazonas, on the Tapajos and Xingú.

Of all the Paleozoic deposits of the Amazonian valley, the Carboniferous is exposed over the largest area, but, at the same time, presents the greatest difficulties to study. Being composed for the most part of soft rocks, it has been much denuded only widely-separated exposures remaining, of which it is difficult to determine the correlation of the several beds. It is, therefore, also impossible to estimate with certainty the thickness of the series, which probably exceeds 1,800 feet. The rocks are soft sandstones, shales and limestones, of which the latter, though having the least thickness, are the most important, from their being the best preserved and the richest in fossil remains. The fossiliferous beds, originally studied by Prof. Hartt and Mr. Derby on the Tapajos, were traced to the north of the Amazonas, on the Rios Maecurú, Curuá, etc. The different exposures, however, appear to represent about the same limited horizon, characterized by identical fossils.

The region over which the Carboniferous has been actually observed, is defined by Mr. Derby as follows: On the south side of the valley, it reaches up the Tapajos, to near the base of the rapids; westward it extends to, or beyond, the Rio Mauhéassú, situated midway between the Tapajos and Madeira, and eastward to, or beyond, the Xingú. To the north of the Amazonas, it stretches some distance northward of the region of Alenquer, partially covering up the Devonian between Ereré and the Maecurú locality, and has been found to the west, on the Rio Uatumá, and to the east, on the Rio Jauary near Prainha. There can be no doubt but that the Carboniferous really extends much farther west, and eastward, to near the Atlantic. From what has been said before, however, it will be understood that this formation is not exposed over the entire region above defined, although at one time it must have been continuous there. It was observed on the principal rivers mentioned, generally in the vicinity of the lower falls or rapids, and also at many intermediate localities, but is mostly covered up by more recent formations, or by dense forest growths, and over large tracts has been completely swept away. Notwithstanding the fact that the fossils of this group indicate an horizon, equivalent to the Coal Measures of North America, no seams of coal have yet been found on the Amazonas. The beds lie as a rule nearly horizontal.

Mr. Derby refers the sandstone hills of the Ereré series, which surround the Devonian plain of the same name, to the Cretaceous, from a study of the leaves of dicotyledonous plants, contained in some of the beds. These hills, which are composed of inclined strata, were elevated during, or at the close of, the Cretaceous age, as a broad anticlinal ridge, afterwards denuded away in the central portion, so as to uncover the Devonian plain, and leave the present series of monoclinal ridges, disposed in the shape of an ellipse.

Much of Mr. Derby's paper is also devoted to the extensive Tertiary deposits and the *varzea* of the Amazonian valley, subjects already treated of at some length by Prof. Hartt.