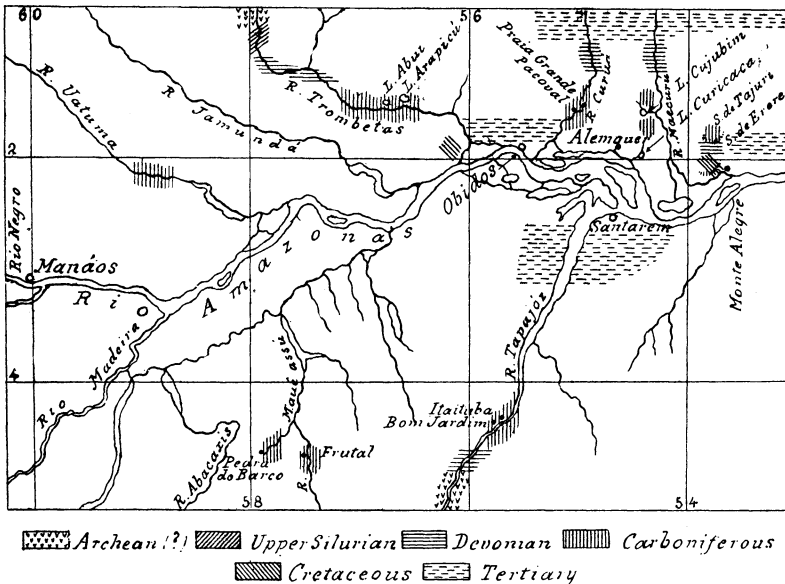


THE AMAZONIAN UPPER CARBONIFEROUS FAUNA.

As, from recent discussions of correlation and geographical distribution, the Upper Carboniferous fauna of the lower Amazonian region seems to be considered a somewhat important element, it appears desirable to make it known more completely than it is at present. A description of the brachiopods was published in 1874 (Bulletin of the Cornell University, Science, No. 2), and a revision of that group with some new material and a complete study of all the material known from Amazonian localities was made shortly afterward, but withheld from publication from lack of means for preparing the necessary plates. This study is now out of date as regards nomenclature, and many of the species then regarded as new have very likely been since described from other regions. As, however, from various circumstances the probability of being able to revise it in view of the recent literature, and to publish it with proper illustrations, is now extremely remote, it is thought best to give the following resumé. Palæontologists will find much to criticise in the identifications, notes, and comparisons made a dozen years ago and only very incompletely revised since, but it is hoped that they will be able to recognize the most characteristic types and that they will find enough of interest in a more complete presentation of this interesting fauna to overlook the shortcomings of the present note.

The region in which this fauna is definitely known is represented in the annexed sketch map, taken in great part from Steiler's Atlas, but with some modifications introduced from the map given by Mr. H. H. Smith in his work, *Brazil, the Amazons and the Coast*, New York, 1879. This map represents the upper part of what is locally known as the lower Amazonas, that is to say the section below the mouths of the Rio Negro and the Madeira, where the valley is narrowed by the approach of the

highlands from either side to, or near, the banks of the great river. The supposed Archean, which appears in the rapid section of the Tapajos on the south and of the Trombetas on the north, consists on the former river of metamorphosed quartzites and porphyritic eruptives, and on the latter of syenite and similar porphyritic eruptives. The latter prove on microscopic examination to be much altered plagioclase rocks, presumably



augite-porphyrates. Resting on these are, on the Trombetas, slightly disturbed sandstone beds with Upper Silurian fossils. Below them comes a zone of sandstone and shales with *Spirophyton*, which has been better explored on the Curuá and Maecurú and at the foot of the small Serra de Erere near Monte Alegre, where an abundant Devonian fauna has been found. Beds with *Spirophyton* have also been observed on the Tapajos below the falls, and these, originally supposed to be Carboniferous, are now referred to the Devonian. The best explored Carboniferous locality is on the Tapajos at the village of Itaituba and the neighboring limestone cavern of Bom Jardim, where five fossil-bear-

ing members have been recognized, the faunas of which are discriminated in the annexed table. The characteristic feature is a blue amorphous limestone containing beautifully preserved silicified fossils which, by the decay of the limestone where washed by the river, become dissolved out of the rock and accumulated on the beach. Similar limestone cavern and beach specimens are reported by Mr. Chandless and the late Major João Martins da Silva Coutinho, the companion of Agassiz and first discoverer of fossils on the Amazonas, at Pedra do Barco and Frutal on the Mauéassu, a small river between the Tapajos and Madeira.

The localities on the northern side have been examined by the writer at the Serra de Tajaurí near Monte Alegre, and on two small lakes, Araptoú and Abui, in the flood plain of the Trombetas at the margin of the highlands; by Mr. H. H. Smith on the Curuá and in the district about Alemquer between that river and the Maecurú, while the occurrence of beach-worn fossils similar to those of the Tapajos has been reported by the Brazilian botanist Barbosa Rodrigues on the Uatumá, a small river between the Trombetas and the Rio Negro. At the Serra de Tajaurí, at Lake Cujubim (bed No. 3 of Mr. Smith's section) in the Alemquer district and Lake Abui on the Trombetas, limestone with silicified fossils occurs; at Praia Grande on the Curuá, beach specimens similar to those at Itaituba; at Lake Curucaca and Cujubim (Nos. 5, 8, and 9) in the Alemquer district, Pacoval on the Curuá and Lakes Arapicú and Abui on the Trombetas, shales with fossils. Those from the Trombetas are apparently decomposed limestones and are associated with flints like those of Itaituba, which are also represented with chance specimens from one or two other Trombetas localities.

To the Cretaceous is referred the disturbed sandstone mass with fossil leaves of the Serra de Eréré, and a similar mass, in which, however, no fossils have been found, near Obydos, and to the Tertiary, the low plateau (100 meters more or less) of horizontal sands and clays back of Santarem on the Tapajos, the denuded ridges of Monte Alegre and Obydos and the high plateaus (300 meters more or less) on the Curuá and Maecurú, which

are evidently the prolongation of the table-topped hills of Parauaquara and Almeirim to the eastward of the limits of the map. Presumably the Tertiary beds cover, or have covered, a large part of the areas left blank on the map.

A full list of the fauna, so far as known, is given in the following table with the distribution of the species in the different localities. Out of the total number of 122 species 62 have been found in the limestone of Bom Jardim near Itaituba, which, being the formation from which the most complete collections have been made, and apparently also the richest in species, may be taken as the standard with which the others may be compared. The silicified specimens found free on the beach at Itaituba are evidently washed out of a decayed limestone, and the character of the specimens as well as the numerical comparison indicates its complete identity with that of Bom Jardim, since of the 33 species recognized on the beach, only five rare forms of Bryozoa, Echinoderms, and Eusulina have not as yet been found in the limestone.

The peculiar siliceous boulders have every appearance of being weathered out of a limestone bed and their position on the beach at Itaituba indicates that this bed was intimately associated with that furnishing the loose beach specimens, if not identical with it. Of the 32 species recognized in the boulders, 13 have not been found in the limestone, and of these 10 (six being gasteropods) have not been found in the other Itaituba rocks though two of these occur in the shale of Pacoval on the Curuá. The fauna of the boulders is characterized by the abundance of lamellibranchs and gasteropods, making up two-thirds of the species, and the differences between its fauna and that of the limestone are presumably of habitat rather than of horizon. Large coarse forms predominate and are for the most part so rare that no certain conclusion regarding them can be drawn. The exceptions are *Streptorhynchus correianus* and *Productus cora*, which are abundant and characteristic. The former has not been found in the other rocks at Itaituba, though it occurs elsewhere, and the absence from the limestone of the latter, one of

the most abundant and widespread of the Amazonian species, is remarkable.

Of the 38 species of the white decomposed cherts, also found loose on the beach of Itaituba in small fragments, 17 have not been found elsewhere at that place though four of them occur at one or another of the other localities. The leading characteristic of the chert fauna is the abundance of small lamellibranchs, 14 species, of which six have not been found in the other rocks of Itaituba though three of them occur elsewhere, and of gastropods, 13 species, of which seven occur also in the limestone and one in the siliceous boulders. It is to be noted, however, that the greater part of the fossils of these two groups found in the limestone are from cherty nodules in the upper part, which leads to the hypothesis that the white decomposed cherts may have weathered out of the limestone or of some layer in immediate connection with it. The two brachiopods, *Spiriferina spinosa* and *Chonetes amazonica*, peculiar to the cherts, are exceedingly rare forms.

Stronger indications of a possibly independent fauna are found in the few loose fragments of an impure argillaceous limestone, from which five species are known, none of which have been found in the purer limestone of Bom Jardim, though two occur in the boulders and one, probably two, in the cherts. These fragments possibly represent the rock from which the boulders and cherts have weathered out, and presumably come from above the limestone with a continuation of its fauna with differences due to habitat. In short, all of the Itaituba material indicates essentially the same horizon.

The Mauéassu limestone at Pedra do Barco and Frutal is identical in aspect and character of the fossils with that of the Tapajos at Itaituba. Of the 18 species known from Pedra do Barco, two species of *Productus*, a *Pleurotomaria*, and an *Euomphalus* have not been found at Itaituba. The limestone No. 3 at Lake Cujubim has only one species, *Productus cora*, out of 11 not found in that of Itaituba, although it occurs in the boulders and cherts. This same *Productus* and another of the *P. nebrascensis* type

(occurring also at Pedra do Barco) are the only distinct forms among the 10 in the limestone at the Serra de Tajauri. The beach specimens from Praia Grande on the Curuá are exactly similar to those from Itaituba, and of the 12 species known from that place only an undetermined *Athyris* has not appeared at Itaituba. The yellow shale, probably a decomposed limestone from Lake Arapicú with 11 species and the limestone and shale of Lake Abui with five, show the same close relationship and indicate that the limestone extends westward to the Trombetas. None of the fossils from the Rio Uatumá, still farther to the westward, have been seen by me, but according to the note of Sr. Barbosa Rodrigues they agree in character and mode of occurrence with those of Itaituba.

The fauna from the shale at Pacoval on the Curuá is thought by Mr. Smith to come near the top of about 600 feet of shale above the limestone furnishing the beach specimens of Praia Grande. The rock is decomposed and of a marly aspect, indicating a high original proportion of calcareous matter. Of its 37 species, 10, all lamellibranchs, have not been found at Itaituba, the others occurring at that place mainly in the cherts and boulders in which also occur the three (*Productus cora*, *P. nebrascensis* and *Streptorhynchus correianus*) out of its 13 brachiopod species that have not been found in the Bom Jardim limestone. The shaly beds at Lake Cujubim and Lake Curucaca in the Alemquer district, also placed above the limestone by Mr. Smith, agree, so far as their fossils can be made out, with the Pacoval fauna.

Thus, although there is on the Lower Amazonas a considerable thickness, probably from 1,000 to 2,000 feet, of supposed Upper Carboniferous rocks, all the known fossils are marine and from a single, or two closely related horizons. As stated in my paper on the brachiopods and afterwards confirmed by an examination of a collection brought from Lake Titicaca by Prof. Alex. Agassiz (Bull. Mus. Comp. Zool., No. 12) the Andean Carboniferous fauna is of about the same horizon. In southern Brazil, where there is an extensive Carboniferous area, fresh-water conditions seem to have prevailed and marine fossils have

thus far proved to be rare and unsatisfactory. So far as their characters have been made out they agree with the prevailing vegetable and reptilian types in presenting a decided Permian, or perhaps early Secondary, facies. Both in its physical and palæontological characteristics this formation of southern Brazil offers considerable analogies with those of South Africa, India, and Australia, containing the *Glossopteris* flora (see Waagen, Neues Jahrbuch, 1888, II., pp. 172-177). If on further study this analogy is found to hold good, we shall have at, or near, the close of the Palæozoic two strongly contrasted chains of similar formations extending from east to west across the whole present land area of the globe. The one with an abundant and characteristic marine fauna reaches from China to Bolivia with the Salt Range and the Lower Amazonas (also the Pichis river locality in Peru) as intermediate links; the other, with predominant fresh-water and terrestrial conditions, reaches from Australia through India and Africa to southern central South America.

Terebratula itaitubense.—Dr. Waagen who distinguishes the group of *Terebratulas*, to which this species belongs by King's name *Dielasma* identifies this species on the limit between the middle and lower division of the *Productus* limestone in the Salt Range, India.

Terebratula sp.—The forms represented by fig. 24, pl. III. of my paper and referred with doubt to the young of the preceding species, prove to belong to a distinct type of short louped *Terebratuloids* without or with only rudimentary septal plates in the dorsal valve. This character, combined with dental plates in the ventral valve, would perhaps place it in Waagen's genus *Zugmeyeria*, which thus far is only known in the Rhaetic.

Athyris subtilita.—Dr. Waagen, who makes a new genus *Spirigerella*, for types similar to this, considers the Indian and Brazilian forms as identical and distinct from the North American *A. subtilita*, proposing to distinguish them by the name *S. derbyi*. His doubt as to whether I may not in my description have somewhat exaggerated the importance of the foramen may be well founded,

AMAZONIAN UPPER CARBONIFEROUS FOSSILS.

	ITAITUBA.				RIO MAUESSU.		ALEMQUER DISTRICT.				RIO CURUA.		RIO TROMBETAS.			
	White Cherts.	Siliceous Boulders.	Beach.	Argillaceous Limestone.	Limestone Bom Jardim.	Pedra do Barco.	Frutal.	Cujubim No. 3.	Cujubim No. 5.	Cujubim No. 8 & 9.	Curuca.	Tajauri.	Pacoval.	Praia Grande.	L. Atrapicu.	L. Abui.
<i>Terebratula itaitubense</i> , Derby.....					x											
<i>T</i> sp.....		x														
<i>Waltheimia coutinhoana</i> , Derby.....					x											
<i>Eumetria mormoni</i> , Marcou.....	x	x			x											
<i>Athyris subtilita</i> , Hall.....		x			x											
<i>A</i> sublamellosa, Hall.....		x			x											
<i>A</i> (?) sp.....			x		x											
<i>Spirifer camarata</i> , Morton.....			x		x											
<i>S</i> rockymontana, Marcou.....			x		x											
<i>S</i> (Martina) perplexa, McChesney.....			x		x											
<i>S</i> (Martina) planoconvexa, Shumard.....			x		x											
<i>Spiriferina transversa</i> , McChesney.....			x		x											
<i>S</i> spinosa, Norwood and Pratten.....	x				x											
<i>Rhynchonella pipira</i> , Derby.....	x				x											
<i>Camaraphoria</i> sp.....					x											
<i>Orthis penniana</i> , Derby.....			x		x											
<i>O</i> morganiana, Derby.....			x		x											
<i>Streptorhynchus correaanus</i> , Derby.....		x			x											
<i>S</i> hallianus, Derby.....		x			x											
<i>S</i> tapajotensis, Derby.....			x		x											
<i>Chonetes amazonica</i> , Derby.....	x				x											
<i>C</i> glabra, Geinitz.....			x		x											
<i>Strophalosia cornelliana</i> , Derby.....			x		x											
<i>Productus semireticulatus</i> , Martin.....			x		x											
<i>P</i> cora, d'Orbigny.....	x				x											
<i>P</i> chandlessi, Derby.....		x			x											
<i>P</i> batesianus, Derby.....			x		x											
<i>P</i> rhomeanus, Derby.....			x		x											
<i>P</i> wallacianus, Derby.....			x		x											
<i>P</i> clarkianus, Derby.....			x		x											
<i>P</i> nebrascensis, Owen.....			x		x											
<i>P</i> punctatus, Martin (?).			x		x											
<i>Discina</i> sp.....	x				x											

	ITAITUBA.				RIO MAUEASSU.		ALEMQUER DISTRICT.				RIO CURUA.		RIO TROMBETAS.			
	White Cherts.	Siliceous Boulders.	Beach.	Argillaceous Limestone.	Limestone Bom Jardim.	Pedra do Barco.	Frutal.	Cujubim No. 3.	Cujubim No. 5.	Cujubim No. 8 & 9.	Curuca.	Tajauri.	Pacoval.	Praia Grande.	L. Arapicu.	L. Abui.
<i>Entolium aviculatum</i> , Swallow (?)	x												x			
<i>Lima retifera</i> , Shumard	x															
<i>Aviculapecten occidentalis</i> , Shumard	x				x											
A— carboniferous, Stevens	x															
A— neglectus, Geinitz																
A— coxanus, Meek and Worthen																
A— sp.		x														
A— (Streblopteria?) hertzeri, Meek	x															
<i>Avicula</i> , cf. <i>A. longa</i> , Geinitz																
A— sp.																
A—, cf. <i>Bakewellibicarinata</i> , King	x															
A—, cf. B— parva, Meek and W.	x															
A—, cf. B— sedgwickiana, King	x															
<i>Pseudomonotis</i> sp.																
<i>Posidonomya</i> (?) sp.	x				x											
<i>Pinna peracuta</i> , Shumard	x				x											
<i>Myalina kansasensis</i> , Shumard	x				x											
M— sp.	x															
<i>Modiola</i> (?) sp.	x															
M— (?) sp.	x															
<i>Yoldia</i> (?) sp.	x															
<i>Nucula</i> sp.																
<i>Macrodon tenuilineatus</i> , M. and W. (?)																
M— sp.																
M— sp.																
<i>Solenomya</i> sp.	x															
<i>Solenopsis</i> (?) sp.																
<i>Schizodus wheeleri</i> , Swallow (?)	?															
S— rossicus, de Verneuil (?)	x															
S— sp.																
S— sp.																
<i>Conocardium</i> sp.																
<i>Astartella</i> (?) sp.	x				x											

	ITAITUBA.				RIO MAUEASSU.		ALEMQUER DISTRICT.				RIO CURUA.		RIO TROMBETAS.			
	White Cherts.	Siliceous Boulders.	Beach.	Argillaceous Limestone.	Limestone Bom Jardim.	Pedra do Barco.	Frutal.	Cujubim No. 3.	Cujubim No. 5.	Cujubim No. 8 & 9.	Curucaca.	Tajauri.	Pacoval.	Praia Grande.	L. Arapicu.	L. Abui.
Pleurophorus tropidophorus, Meek (?)	..	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..
P. sp.	..	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..
Allorisma subcuneata, M. and W.	..	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..
A. sp.	..	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..
A (?) sp.	..	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..
A (Sedgwickia) sp.	..	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..
Chaenomya (?) sp.	..	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..
Pleurotomaria speciosa, M. and W.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P. marcouana, Geinitz (?)	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P. conoides, M. and W. (?)	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P., cf. P. subdeccata, Geinitz..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P., cf. P. depressa, Cox.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P. (?) sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Murchisonia sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
M. sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
M. sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Loxonema sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Aclis sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Naticopsis nana, Meek and Worthen.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
N. (?) sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polyphenopsis sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P. sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P. (?) sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euomphalus sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
E. (?) sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Platyceras nebrascensis, Meek.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dentalium sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bellerophon carbonarius, Cox.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B. crassus, Meek and Worthen (?)	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B. sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

	ITAITUBA.				RIO MAUEASSU.		ALEMQUER DISTRICT.					RIO CURUA.		RIO TROMBETAS.		
	White Cherts.	Siliceous Boulders.	Beach.	Argillaceous Limestone.	Limestone Bom Jardim.	Pedra do Barco.	Frutal.	Cujubim No. 3.	Cujubim No. 5.	Cujubim No. 8 & 9.	Curucaca.	Tajauri.	Pacoval.	Praia Grande.	L. Arapicu.	L. Abui.
<i>Syncladia biserialis</i> , Swallow (?)
<i>Fenestrella shumardi</i> , Prout (?)
F— intermedia, Prout (?)	x	..	x	..	..	..	..	..	..	..	..	..	..	..
F— sp.	x	..	..	..	..	..	..	..	..	..	..	..
<i>Glauconome trilineata</i> , Meek (?)	x	..	..	..	..	..	..	..	..	..	..	..
<i>Polypora submarginata</i> , Meek (?)	..	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..
P— sp.	x	..	..	..	..	..	..	..	..	..	..	..
<i>Ptilodicta carbonaria</i> , Meek (?)
P— sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..
Gen. et sp. indet.
<i>Campophyllum</i> sp.	x	..	x	..	..	..	..	..	..	..	..	..	..	..
<i>Lophophyllum</i> sp.	x	..	..	..	..	..	..	..	..	..	..	..
<i>Stenopora</i> sp.	x	..	x	..	..	..	..	..	..	..	..	..	..	..
<i>Michelina</i> sp.	x	..	..	..	..	..	..	..	..	..	..	..
<i>Fistulipora nodulipora</i> , Meek (?)	x	..	x	..	..	..	..	..	..	..	..	..	..	..
<i>Rhombipora lepidodendroides</i> , Meek	x	..	x	..	..	..	..	..	..	..	..	..	..	..
<i>Aulopora</i> sp.	x	..	x	..	..	..	..	..	..	..	..	..	..	..
<i>Monticulipora</i> sp.	x	..	x	..	..	..	..	..	..	..	..	..	..	..
<i>Polycella</i> sp.	x	..	..	..	..	..	..	..	..	..	..	..
<i>Eocidaris hallianus</i> , Geinitz (?)	x	..	x	..	..	..	..	..	..	..	..	..	..	..
<i>Archæocidaris</i> sp.	x	..	x	..	..	..	..	..	..	..	..	..	..	..
<i>Erisocrinus</i> (?) sp.	x	..	..	..	..	..	..	..	..	..	..	..
Gen. et sp. indet.	x	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Phillipsia</i> sp.	x	x	x	..	x	..	..	..	..	..	..	..	..	..	..	..
P— (<i>Griffithides</i>) sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Fusulina</i> sp.	x	..	..	..	..	..	..	..	..	..	..	..	..	..
TOTAL, 122 species	38	32	33	5	61	18	11	11	2	8	..	10	37	12	11	5

a point that can only be cleared up by a reëxamination of the material. At all events it seems to me more probable than his suggestion that the two forms may occur in Brazil. As stated in my paper, the Brazilian specimens differ somewhat from the generality of those seen from North America, while their correspondence, especially in internal characters, with those from the Salt Range, fully justifies Dr. Waagen's opinion of their identity.

Athyris sublamellosa.—Some years ago I saw in the National Museum, at Washington, shells from various western localities variously referred to *A. royssil*, Eveille, *A. hirsuta*, Hall, and *A. orbicularis*, McChesney, that I could not, from the external characters seen, distinguish from the Brazilian and that occurred in the same association, which is not the case with the original *A. sublamellosa*.

Athyris? *sp.*—A thick shell from Praia Grande, Rio Curuá, with acute umbonal ridges, giving it something of a *Centronella* aspect, is here referred, on account of its resemblance to a form from Spergen Hill, which is clearly an *Athyris* (*Spirigerella* of Waagen).

Spirifer camaratus.—An examination of specimens from Lake Titicaca (Bull. Mus. Comp. Zoöl. No. 12, p. 279) establishes the identity of the Bolivian form (*S. condor*, d'Orbigny) with the Brazilian. Dr. Waagen separates *S. condor* and *S. musakheylensis* from the Salt Range, India from the North American form principally on account of the prominence of the concentric lamellæ. On well preserved Brazilian specimens these are as strong as on the Bolivian shells, and if they prove to be absent from equally well preserved specimens of the North American form, the Brazilian shells may have to be referred to the Bolivian or Indian type.

Spirifer rockymontanus.—*S. opimus* in my paper. Dr. White has shown that Marcou's name has precedence over that of Hall.

Spirifer (Martinia) perplexa.—Dr. Waagen, who adopts McCoy's name *Reticularia* for shells of this type, is also of the opin-

ion that the North American and Brazilian form is distinct from the European *S. lineatus*, Martin.

Rhynchonella pipira.—The distinct truncation of the beak of this species would appear to place it in Waagen's genus *Terebratuloidea*. The internal characters are unknown.

Camaraphoria sp.—A small smooth species of this genus is quite abundant in white decomposed chert from Lake Arapicú, Rio Trombetas, and rare in the Itaituba limestone, being at both places too imperfect for determination.

Orthis morganiana.—Specimens from New Mexico referred with doubt to *O. resupinoides*, Cox, by Dr. White, are possibly identical, in which case that name will take precedence. They are smaller and casts do not show the prominent dental lamellæ and septum of the Brazilian form, but the material is too poor for a satisfactory comparison. Specimens from Old Baldy near Virginia City, Montana, in the National Museum at Washington, labeled *O. resupinata*, Martin, by Mr. MEEK, are almost certainly identical. Dr. Waagen describes a closely allied form from the Salt Range under the name of *O. derbyi*.

Streptorhynchus.—According to Dr. Waagen's arrangement, based on well defined internal characters of this perplexing group, *S. correianus* takes the name of *derbya*, *S. hallianus* remains with that of *Streptorhynchus*, while *S. tapajotensis* becomes *orthotheses*. The specimens from the shale of Pacoval, Rio Curuá, referred to *S. (derbya) correianus*, are more depressed and less irregular than those from Itaituba, but for the most part attain as large a size and present the strong ventral septum of that species, though possibly some of the smaller specimens not showing internal characters may belong to *Orthotheses*.

Chonetes glabra.—Some of the specimens from Pacoval, Rio Curuá, referred here are larger than those from Itaituba and have the mesial sinus very indistinct, or lacking, thus approaching the characters of *C. amazonica*, which possibly may prove to be identical.

Productus semireticulatus.—Specimens from Lake Titicaca that

undoubtedly represent *P. inca*, d'Orbigny, prove that the Bolivian form does not belong to *P. semireticulatus*, as usually referred, but rather to the *P. costatus* group, though probably distinct from the European form.

Productus cora.—In the argillaceous strata of the Curuá and Trombetas the forms here referred become very large and take on extravagant shapes from irregular marginal expansions, but no good characters could be found for separating them from the more symmetrical forms from Itaituba. The material brought from Lake Titicaca by Prof. Alex. Agassiz, though rather unsatisfactory for this type, appears to prove the complete identity of the Brazilian shells with the original Bolivian type of *P. cora*.

Productus chandlessi.—A single specimen from Lake Titicaca shows that this form occurs also in Bolivia and thus renders it probable, notwithstanding the differences in the figures, that d'Orbigny's *P. peruvianus* is identical, in which case that name will of course take precedence.

Productus batesianus.—The specimens from the localities on the north side of the Amazonas, referred with doubt to this species, may possibly be distinct. If identical, those from Pacoval and Cujubim represent a dwarf and less distinctly sinuated variety; those from Lake Arapicú agree more nearly with the typical form from Itaituba but are larger.

Productus rhomeanus.—North American forms apparently identical with this are referred to *P. longispinus*, Sow., by Meek & White, from which, however, it seems to me to differ by important internal characters.

Productus wallacianus.—A small *Productus* extremely abundant in the shale of Pacoval, Rio Curuá, is either distinct or a dwarf variety of this species. This type, which appears to be rare or lacking in the North American beds, is represented in the Salt Range by *P. opuntia*, Waagen.

Productus clarkeanus.—This is probably identical with *P. per-tenuis*, Meek.

Productus nebrascensis.—A specimen from the limestone at the base of the Serra de Tajauri, is almost certainly identical with the North American shell; those from other localities are too imperfect for positive identification.

Productus punctatus (?).—A specimen from Pedra do Barco, is identical with the North American shells usually referred to *P. punctatus* but which have been separated by Dr. White under the name of *P. nevadensis*.

Discina.—Two or more species probably occur. One of these is very similar to *D. missouriensis*, Shumard.

Entolium aviculatum (?).—The doubt in regard to this species is due to imperfection of the material. So far as the characters can be made out the agreement with the North American type is complete.

Lima retifera.—In a direct comparison with Nebraska City specimens no difference of importance could be detected, as these show a grouping of the ribs in pairs very characteristic of the Brazilian shells but not represented on most figures of this species.

Aviculopecten occidentalis.—The material here referred shows considerable variability, but no constant characters could be found for distinguishing more than one species, or for separating this from the North American form which appears to be equally variable. The more typical forms with subequal ribs and furrows are from Itaituba, while those from the Curuá have furrows wider than the ribs, giving these an alternating appearance.

Aviculopecten carboniferous.—So far as can be made out from a comparison of left valves alone the Brazilian specimens agree perfectly with those from Nebraska City.

Aviculopecten neglectus.—The hinge line shows obscurely a row of cartilage pits such as are represented by Meek & Worthen on specimens from Illinois.

Aviculopecten coxanus.—Compared with figures of this species the Brazilian shells appeared to differ in the greater length of the posterior sinus and by the shortness of the hinge line but they

agree in these respects with authentic specimens from Nebraska City.

Aviculopecten *sp.*.—A large coarsely ribbed left valve and a smooth right valve, ribbed on the posterior ear, are presumed to belong together. A Kentucky shell described by Cox under the name of *A. providencesis* agrees in size and some other characters but no close comparison can be made.

Aviculopecten (*Streblopteria*) *hertzeri*.—The Brazilian specimens agree very well with the figures and description of the Ohio shells.

Avicula, *five* *sp.*.—The general character of the aviculoid forms of the fauna is indicated by the comparisons of the above table. All were regarded as new, though on direct comparison of authentic specimens the first, and possibly the second, may prove identical with *A. longa*, from which, however, it appears to differ in its larger size, less attenuated form, shallower sinus and smaller ear. The three last species have the general appearance of *Bakewellia* but the hinge characters are those of *Avicula*.

Pseudomonotis *sp.*.—Apparently identical with specimens from Nebraska City, referred with doubt by Meek to *P. radialis*, Phillips, but thought to be really distinct.

Posidonomya (?).—A peculiar type with the surface ornamentation of *Posidonomya* and the form of *Avicula*. *Avicula acosta*, Cox, from Kentucky, is perhaps congeneric, but differs in the character of the ears.

Pinna peracuta.—Fragments from the Curuá indicate a length of about 20 centimeters. The material is too fragmentary for satisfactory comparisons, but appears to be identical with fragments from Kansas, referred to Shumard's species.

Myalina kansasensis.—Compared with Kansas specimens the Brazilian form seems never to have attained so great a thickness in the cardinal region, but otherwise they present no differences of consequence. Small specimens with a well developed lobe have the aspect of *M. swallowi*, McChesney, but are connected by insensible gradations with the larger more typical forms.

Myalina sp.—Similar to *M. subquadrata*, Shumard, but probably distinct.

Modiola, two sp.—The two forms differ materially in aspect, but the differences are due to the character of the material in which they are preserved. That from the shale of Pacoval is similar in many respects to *M.*(?) *subelliptica*, Meek, from Nebraska, but the latter is narrower with a less inclined hinge line. The Itaituba specimens are more gibbous than any known to me from elsewhere.

Yoldia sp.—Too badly preserved for identification, but very similar to *Y. subscitula*, Meek & Hayden.

Nuculana sp.—Similar to *N. obesa*, White, but too imperfect for a satisfactory comparison.

Macrodon, two sp.—The smaller is identical with specimens from Leavenworth, Kansas, labeled *M. carbonarius* by Mr. Meek, but considered by Dr. White to be *M. tenuilineatus*. The larger one resembles somewhat *M. carbonarius*, Cox, but has coarser ribs and is apparently distinct from any described North American species.

Solenomva sp.—A single specimen occurs in chert from Barreirinha on the Tapajos above Itaituba, where it is associated with *Productus cora*. It resembles somewhat some figures of *S. biammica*, de Verneuil, but differs from the generality of figures of that species and is probably distinct.

Solenopsis sp.—Referred to this genus from a general resemblance to *S. solenoides*, Geinitz, from which it is distinguished by being wider posteriorly than anteriorly.

Schizodus, four sp.—No. 1 is referred with doubt, due principally to imperfection of the material, to *S. wheeleri*; No. 2 is apparently identical with the Nebraska shell referred by Mr. Meek with doubt to *S. roscus* but thought by him to be really distinct; No. 3 is of the type of *S. wheeleri*, but is different from any North American shell with which it has been compared; and No. 4 is possibly a dwarf variety of No. 3, but is regarded as more probably distinct.

Conocardium sp.—Too imperfect for positive identification but apparently new. The ornamentation is similar to that of *C. obliquum*, Meek & Worthen.

Astartella (?) sp.—A shell agreeing in hinge characters with Hall's type, *A. vera*, from Iowa is quite abundant at Itaituba and Pacoval. A Nebraska shell described by Geinitz as *Astarte nebrascensis*, but thought by Meek to be an *Edmondia* or *Cardiomorpha*, is similar in form and ornamentation but probably generically distinct. In the National Museum at Washington there is a shell from Lake Titicaca showing the hinge, which is identical with the Brazilian forms. This is very likely the *Trigonia antiqua* of d'Orbigny.

Pleurophorus.—Two species occur, one of which is apparently identical with *P. tropidophorus*, Meek, though no direct comparison of specimens could be made. The other and larger form is apparently new, though resembling somewhat an undetermined species figured on plate XXVI., fig. 6b, of vol. V. of the Illinois report.

Allorisma subcuneata.—Compared with authentic specimens from the western United States, the Brazilian form appears identical.

Allorisma sp.—Possibly a variety of the preceding but probably distinct.

Allorisma (?) sp.—Similar in form to *Edmondia?* *glabra*, Meek, but appearing to have a sinuated pallial line which, if not a deceptive appearance, would place it in *Allorisma*.

Sedgwickia (?) sp.—A large pyriform shell with a double umbonal ridge is here referred. Nothing like it has been seen from North America.

Chaenomya (?) sp.—A large shell of the general type of *C. cooperi*, Meek & Hayden, but probably distinct from that species.

Pleurotomaria.—The general character of the *Pleurotomarias* of this fauna is indicated by the doubtful identifications and com-

parisons of the above table. As the comparisons have only been made from figures it is quite possible that the first five forms may prove to be representatives of North American types. The sixth by the circular form of its whorls and central position of the smooth spiral band differs from any species known to me.

Murchisonia.—Two of the species belong to the section of the genus characterized by a strong angular carina represented in North America by *M. copel*, White, and *M. nebrascensis*, Geinitz, with the former of which one of the Brazilian forms may prove to be identical. The third resembles in form and ornamentation *Turetella* (?) *stevensoni*, Meek & Worthen, but has the spiral band of *Murchisonia*.

Loxonema sp.—Similar to but probably not identical with *L. scitula*, Meek.

Aclis sp.—Similar to but probably not identical with *A. stevensana*, Meek & Worthen.

Naticopsis nana, Meek & Worthen. The Brazilian specimens are larger than those figured in the Geology of Illinois but show no essential differences from specimens from other North American localities.

Naticopsis (?) sp.—A peculiar little shell with a form like *Ampullaria* and indistinct indications of a spiral band which, if not deceptive, would place it in *Pleurotomaria*.

Polyphemopsis sp. A medium sized shell with a deep suture and elongated volutions, giving it the aspect of certain Silurian forms for which Conrad proposed the name of *Subulites*.

Polyphemopsis sp.—An elongated form somewhat similar to *P. peracuta*, Meek & Worthen, but too imperfect for identification.

Polyphemopsis (?) sp.—A subglobose form resembling *P. inornata*, Meek & Worthen, and which may prove to be *Machrocheilus*. A small specimen in chert shows traces of color.

Euomphalus.—Two species occur. One with angular whorls is of the type of *E. pentangulatus*, Sow.; the other with elevated

spire and rounded whorls perhaps does not belong to this genus.

Platyceras nebrascensis.—A single small specimen agrees with Dr. White's figure of this species in Wheeler's report.

Dentalium sp.—Too imperfect for positive identification. Ornamentation like that of *D. meekianum*, Geinitz, but larger and more rapidly expanded.

Bellerophon.—Of the three species of this genus, one, from a direct comparison of specimens from Danville, Ill., can be positively identified with *B. carbonarius*, Cox; another is probably identical with *B. crassus*, Meek & Worthen, while the third, a beautifully cancellated, non-carinate little species, is apparently new.

Polyzoa.—All the identifications in the above table are given with doubt, because no opportunity has been had for a comparison with specimens nor, in some cases, with figures. The specimens referred to *Synocladia biserialis*, *Fenestrella shumardi*, and *Glauconeme trilineata* agree well with the figures seen; those referred to *Polypora submarginata* are probably distinct if that species is correctly figured; *Fenestrella intermedia* and *Ptilodictya carbonaria* are identified from descriptions alone, while a species of *Polypora* and of *Fenestrella* cannot be referred satisfactorily to any described form known to me. The former bears considerable resemblance to *Synocladia virgulacea* as illustrated, but appears to differ generically, while the latter is somewhat like a species from the Ohio Carboniferous (*P. gilberti*, Meek). A species of *Fenestrella* agrees well with some from Nebraska referred to, but probably not identical with, *F. plebeja*, McCoy. A peculiar ramose form closely resembling, in general appearance, *Rhombipora lepidodendroides*, but with Escarella-like cells which show it to be a *Polyzoa*, cannot be satisfactorily referred.

Campophyllum sp.—The Brazilian specimens appear to be identical with a small undetermined coral from Kansas City, Mo., and also with a Subcarboniferous form from Marion Co., Iowa, that has been referred to *Zaphrentis spinulosa*, Hall.

Lophophyllum sp.—Small specimens are somewhat similar to *L. proliferum*, McChesney, but the species cannot be satisfactorily referred to any described North American form.

Stenopora sp.—This form is apparently new.

Michelinia sp.—With smaller cells than any described form known to me except *M. concinna*, Longsdale, from Russia.

Fistulipora nodulifera (?).—Not identical if well preserved North American specimens are without spines as described. This may prove to be a *Monticulipora*.

Rhombipora lepidodendroides.—Well determined by a direct comparison with authentic specimens of the North American type.

Aulopora sp.—The long straight cells give a greater resemblance to *Syringopora* than to the usual small creeping forms of *Aulopora*, but the tabulæ and connecting tubes of the former genus are lacking.

Monticulipora sp.—Dr. White informs me that an identical form occurs in North America, where it has been referred to an European species.

Polycoelia sp.—No American form of this genus has been described, though Shumard mentions one from Texas.

Eocidaris hallianus (?), Geinitz.—Water worn spines agree with this species so far as their character can be determined.

Archæocidaris.—Three, or perhaps four, species are represented by material too imperfect for positive determination. *A. biangulatus* and *A. triserratus* are perhaps represented together with another type of spine that cannot be satisfactorily referred. A single interambulacral plate from Praia Grande, Rio Curuá, may belong with one of these three types of spines.

Erisocrinus (?) sp.—A single calyx appears to belong to this genus. It is distinguished by great concavity of the base and by ridges along the joints rising into spines at the angles. An undetermined genus of crinoid is represented by a hexagonal,

spinose radial plate with two facets for arms, and columns of at least two generic types occur.

Trilobites.—Two, or perhaps three, occur representing the genera *Phillipsia* and *Griffithides*, which appear to be distinct from any of the described species.

Fusulina.—A few water-worn specimens have been found on the beach at Itaituba.

A few fish teeth and two species of cephalopods also occur, but the notes regarding them have been lost. One of the cephalopods is mentioned by Prof. Hartt in his description of the Tapajos section, which from its position is now thought to be probably of Devonian age.

ORVILLE A. DERBY.

São Paulo, May 23, 1894.