Preliminary Notes on Plant Fossils from Late Paleozoic and Early Mesozoic Rocks in the Cordillera Oriental of Colombia

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Paleozoic and Early Mesozoic rocks form the core of many of the ranges of the Cordillera Oriental as well as in other portions of the Andes in Colombia, Venezuela and Ecuador. In general these rocks have not been studied in detail because they have been considered of little economic importance. Recently, however, with the rise of interest in possible oil of Cretaceous age in Colombia, attention has been directed to the older rocks. Prominent among these, and of special importance because it generally occurs immediately beneath the Cretaceous sequence, are the redbeds and continental sediments broadly referred to as the Girón formation. This formation, and some of the older rocks associated with it, is poorly fossiliferous and very few of the non-marine invertebrate and plant fossils occurring in it have yet been described. Thus the age of the Giron rocks has been subject to prolonged controversy. Most ideas on the subject have been based on a very few collections from the Girón formation itself, stratigraphic relationships with older and younger sedimentary rocks and broad regional relationships to rocks of similar character elsewhere in Colombia and Venezuela. Therefore information derived from plant fossils obtained at a few localities in the Giron formation and associated rocks in Santander and Boyacá is of considerable interest, even though the plants are not abundant and are generally poorly preserved.

Collections were obtained from four localities in the Girón formation and one locality in the Bocas formation. The state of preservation and lack of available information concerning plant fossils of the Late Paleozoic and Early Mesozoic in northern South America make correct determinations difficult. This preliminary report is intended to present only tentative conclusions regarding constituents of the flora and consequent age determination of the Girón formation. Subsequent more detailed study will probably produce refinements. Thanks are due to Prof. J. Wyatt Durham and Prof. W. L. Fry for advice and aid in preparing this report.

The only fossil plants obtained from rocks older than the Girón formation are those collected from the Bocas formation at Las Bocas. The Bocas formation rests on rocks containing earliest Pennsylvanian or youngest Mississippian fossils and is unconformably succeeded by the Girón formation. Here plants occur in a black shale and muddy

sandstone. The collection was obtained from road level to 10 M above the road at the east end of the bridge across the Río Lebrija at Las Bocas. This locality is near the top of the Bocas formation. Only two genera were found: *Mesocalamites* and *Cordaites*. *Cordaites* occurs from Mississippian to Early Permian, and may occur in the Triassic. *Mesocalamites*, however, is usually refered to the Mississippian but occurs in the Pennsylvanian. Although neither genus is an exceptionally good time index, both are known to occur in Pennsylvanian rocks and such an age assignment seems reasonable considering the stratigraphic position of the Bocas formation.

Fossils were obtained from the middle shaly member of the Girón formation at Quebrada Honda (Quebrada Las Palmas of Bruckner, 1954). A reasonably extensive suite of specimens was collected in well indurated, black, micaceous clay siltstone exposed in the bottom of Quebrada Honda, approximately 1.400 m. upstream from the railway bridge. Here the fossils are moderately deformed but are essentially unweathered.

Fern foliage is abundant at this locality. Most of the ferns are sterile and, it appears that *Pecopteris* is the most abundant genus. Differences seem to indicate that there are several species of this genus. In addition other specimens have been tentatively identified as *Callipteridium*. Some fertile fronds were found and probably represent species of *Asterotheca*. Specimens of *Rhodea* sp. also are fairly abundant. Poorly preserved remains of *Calamites*, and fructifications, referred to *Carpolithus*, occur sparingly.

The age of this assemblage is probably Late Pennsylvanian. *Rhodea* is most commonly found in the Mississipian but has been reported from the Late Pennsylvanian. *Calamites* ranges from the Mississippian through the Upper Permian. *Callipteridium*, on the other hand, is characteristic of the Lower Permian although it does occur in the Upper Pennsylvanian (Stephanian). The determination of *Callipteridium* in this collection is less definite than that of *Rhodea*. Bruckner (1954) however, reports *Callipteridium* (determined by Krausel and Jongman) from what is assumed to be this same locality. *Pecopteris* ranges Lower Pennsylvanian (Westphalian) to the Triassic and *Asterotheca* ranges from Westphalian to Lower Permian. Perhaps detailed study of what appears to be several species of *Pecopteris* and *Asterotheca* will yield more restricted ranges.

Two collections were obtained west of Montebel along the road across the Arcabuco Range between Duitama and Charalá. Both localities are in the middle shaly member of the Girón formation. One is a road cut 1/4 km. west of Montebel. Here fossils occur in black shale which weathers buff to white and is associated with siltstone. Six genera have been tentatively identified: *Sagenopteris* cf. *S. Nilssoniana*, *Elatocladus* sp., *Elatocladus* (*Brachyophyllum*) sp., *Zamites* sp., *Ginkgo* sp., and *Cladophlebis* (*Coniopteris*) sp. The second collection is from a raod metal quarry approximately 2½ km. west of Montebel just east of Infiernito. Here the fossils are in black, silty, micaceous shale weathering buff to white, associated with siltstone and mudstone. Seven genera from this locality have been tentatively identified: *Elatocladus* (*Pagiophyllum*) sp., *Asterotheca* sp., *Otozamites* sp., *Podozamites* sp., *Sagenopteris* cf. *S. Nilssonians*, *Elatocladus* sp.

and *Elatocladus* (*Brachyophyllum*) sp. It will be noted that *Sagenopteris, Elatocladus* (*Brachyophyllum*) and *Elatocladus* occur in both Arcabuco localities.

In general, the plants from these two localities indicate an age range of Rhaetic to Jurassic. Probably the most significant constituent of the flora is *Sagenopteris* cf. *S. Nilssoniana. Sagenppteris* is known to occur with a wide distribution from the Rhaetic to the Cretaceous. *Sagenotpteris*, however, had not been reported from South America until the study of Frenguelli (1941). He describes specimens of *Sagenopteris Nilssoniana* in the Liassic of Piedra Pintada, Argentina. Leaves from the Arcabuco Locality closely resemble those reported by Frenguelli. *Elatocladus* (*Brachyophyllum*) and *Elatocladus* (*Pagiophyllum*) occur from the Rhaetic to the Cretaceous, but reach their optimum development in the Jurassic. *Podozamites* and *Cladophlebis* (*Coniopteris*) range from the Rhaetic through the Early Jurassic, again being more characteristic during the Jurassic. *Otozamites* has a slightly more extensive range, occurring from the lower Triassic into the Cretaceous. *Ginkgo* appears in the Lower Triassic and is still living. The only genus from the Arcabuco collections which does not occur in the Jurassic is *Asterotheca*, which is generally assumed to drop out in the Rhaetic. Thus the assemblage as a whole, is at present best assigned a possible age of Rhaetic trough Jurassic.

The fifth collection was obtained from a lense of micaceous mudstone in a conglomerate ledge immediately east of the highway bridge over Quebrada Mensuli, just south of Floridablanca. The fossil bed is probably stratigraphically about 50 M below the lowest rocks measured in the Mesa de Ruitoque section (Langenheim, 1959). The rocks here are thoroughly fractured and deeply weathered. Thus fossils, though abundant, are largely fragmentary and oxidized. Unfortunately maceration techniques and preparation of balsam transfers did not yield cuticlar material, which would permit definite determinations. Attempts to recover spores were also unsuccessful. Several nearly complete fronds were salvaged, however, and tentatively are considered as *Ptilophyllum* sp. *Elatocladus* (*Pagiophyllum*) also is present. Fragments of other cycadeoid leaves and several types of seeds are as yet undetermined. *Ptilophyllum* is considered by most workers to be restricted to the Jurassic and *Elatocladus* (*Pagiophyllum* ranges from the Rhaetic to the Cretaceous. Thus the rocks at Floridablanca are probably Jurassic in age.

References cited

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