



## *Notes on the upper Paleozoic plants of central New Mexico*

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# NOTES ON THE UPPER PALEOZOIC PLANTS OF CENTRAL NEW MEXICO

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## INTRODUCTION

Remains of fossil land plants occur at a number of localities in the Upper Paleozoic strata of central New Mexico. These fossils represent a series of floras that succeeded one another in the area from Mississippian through Early Permian time. A study of these fossils has the potential of giving insight into the environments of deposition of these strata. Unfortunately, none of the fossils have ever been described in any detail, and most of the data on them is limited to identifications that are scattered in a number of reports and unpublished theses. In this report we bring together the published and unpublished data we have on these floras to document some of the changing aspects of the land flora in the central New Mexico area during 50 million years in the Late Paleozoic.

The floras are discussed in sequence from oldest to youngest, and where possible, they are correlated with the floral zones proposed by Read and Mamay (1964).

## MISSISSIPPIAN FLORAS

Mississippian plant fossils apparently are rather rare in central New Mexico. The only reported occurrence of such fossils in this area is that of an ancestor of the Articulata or horsetail, *Archaeocalamites radiatus* (= *Asterocalamites scrobiculatus*), from Mississippian strata in the Magdalena mining district near Socorro (Northrop, 1962).

## PENNSYLVANIAN FLORAS

### Sandia Formation

Several authors have noted the occurrence of fossil land plants in the Sandia Formation near Placitas at the northern end of the Sandia Mountains (Kelley and Northrop, 1975). These fossils apparently were identified by C. B. Read. The following forms have been reported from the formation:

Lycopods Fernlike foliage Conifers  
*Lepidodendron* sp. *Neuropteris* sp. *Cardiocarpus* spp.  
*Cordaites* sp.

C. L. Herrick (former President of the University of New Mexico) reported (1900, 1904) on four new species of the lycopod *Lepidodendron* from the fire-bed clays in the Sandia Formation east of Socorro. He briefly described the fossils, but he did not compare them with any known species of *Lepidodendron*. A study of his illustrations suggests that the fossils most probably represent either *Lepidodendron aculeatum* or *L. mannabachense*. In the same report Herrick also mentioned a specimen of *Lepidodendron* sp. from the lower part of the Sandia Formation on the western side of the Ladron Mountains.

Pfefferkorn (1979) has briefly reported on some floras in the Lower Pennsylvanian strata in the Sandia Mountains, but it is unclear where they occur. Presumably, some are in the Sandia Formation.

Although none of the floras in the Sandia Formation have been described, Read and Mamay (1964) placed the floras in the lower part of the formation into zone 6, the zone of *Neuropteris tennesseana* and

*Mariopteris pygmaea*. Also, they placed the upper part of the formation into zone 8, the zone of *Neuropteris tenuifolia*.

## Madera Formation

The best-known fossil-plant locality in the lower part of the Madera Formation occurs in Tijeras Canyon in a road cut on the northern side of I-40 across from Carlito Springs. The locality was discovered in 1954 by University of New Mexico students (C. Bamberg, W. Atkinson, and S. Marsh) who collected a large suite of fossils for the Geology Museum at their institution. Later, one of the authors of this manuscript recovered the locality and collected additional material there. At this locality the fossils are found in the lower part of the Madera Limestone in a bed of highly fractured green mudstone. The fossils are preserved as brown-stained impressions. Illustrations of a few of them are given in Figures 1-5. The following forms have been recognized at this locality:

This flora is dominated by the foliage of the presumed seed fern

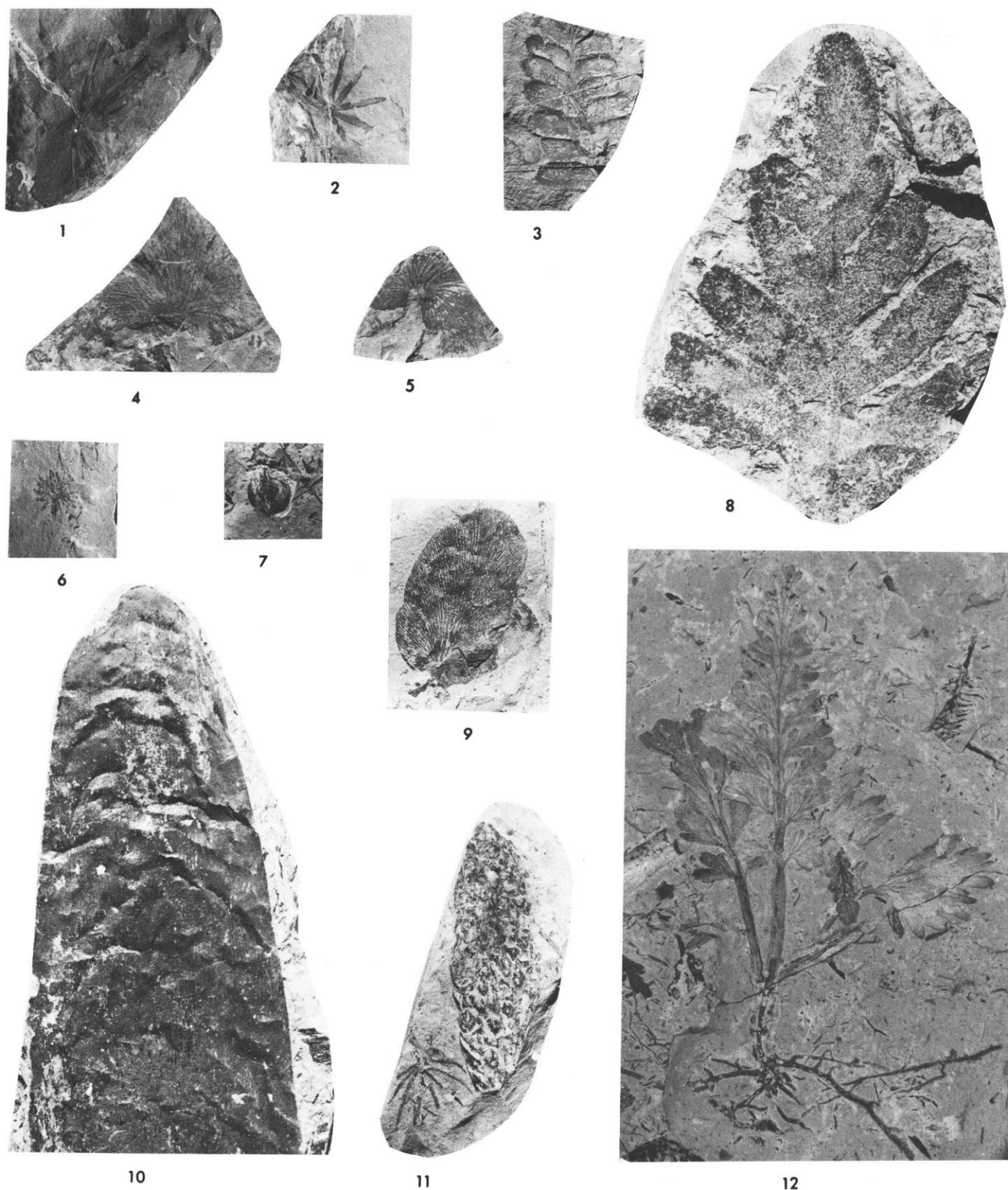
Lycopods	Articulates	Fern-like foliage
<i>Sigilaria</i> sp.	<i>Sphenophyllum</i> <i>cuneifolium</i>	<i>Neuropteris</i> sp.
	<i>Calamites</i> sp.	<i>Cyclopteris</i> sp.
	<i>Asterophyllites</i> sp.	
	<i>Annularia radiata</i>	

*Neuropteris* sp. Each of the other taxa in the flora are represented by only a few specimens. The flora seems to be of Middle Pennsylvanian age and to be representative of floral zone 9, the zone of *Neuropteris rarinervis*, of Read and Mamay (1964).

Middle Pennsylvanian floras have been reported from the Sandia and Sangre de Cristo mountains by Pfefferkorn (1979). Presumably, they are in the Madera Formation.

A large diverse flora occurs in the upper part of the Madera Formation (= Pine Shadow Member of the Wild Cow Formation of the Madera Group of Myers, 1973) in the Manzanita Mountains at the Kinney Brick Company clay pit. The flora was discovered by one of the authors on October 9, 1961, and later, a small collection of the fossils was obtained there. Subsequently, a much larger collection of plant fossils was made from the locality by Mamay of the U.S. Geological Survey. The flora is of particular interest because it is associated with a large invertebrate fauna that includes insects and eurypterids and a variety of fishes and amphibians (see Kelley and Northrop, 1975 for a summary). The most noteworthy plant fossil in the flora is a large leaf that Mamay (in preparation) describes as a new species of the ginkgophyte *Dichophyllum*. That leaf has long narrow segments which are nearly a meter in length.

Plant fossils have been reported from several additional localities in the upper part of the Madera Limestone by several authors. Kelley and Northrop (1975) summarized these occurrences, noting that the identifications were originally made by C. B. Read. The following forms were recognized by Read:

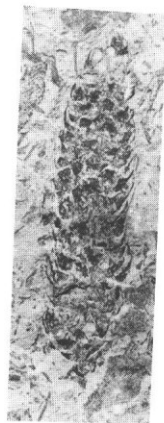


Figures 1-5. Fossil plants from the lower part of the Madera Formation near Carlito Springs, Sandia Mountains: 1—*Asterophyllites* sp., 2—*Annularia radiata*, 3—*Neuropteris* sp., 4 and 5—*Cyclopteris* sp.; all figures natural size.

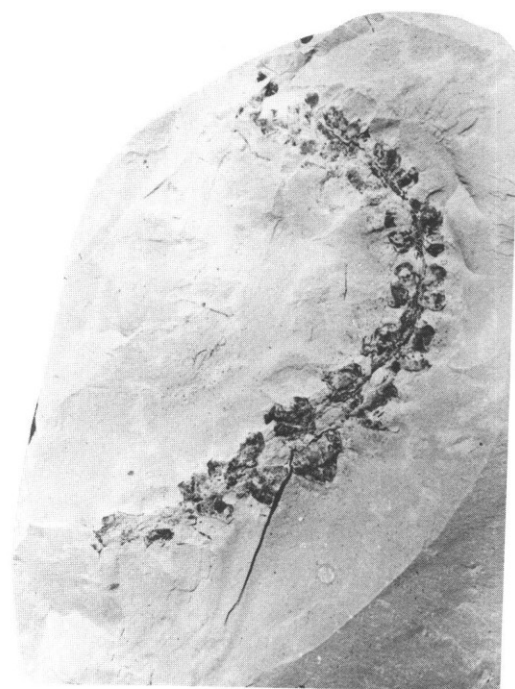
Figures 6-12. Fossil plants from the Red Tanks Member of the Madera Formation in Carrizo Arroyo, Lucero uplift: 6—*Annularia* sp., 7—*Samaropsis* sp., 8—*Odontopteris* sp., 9—*Neuropteris* sp., 10—*Cordaites principalis*, 11—*Lebachia cone* and *Asterophyllites* sp., 12—*Sphenopteris* plant; all figures natural size.



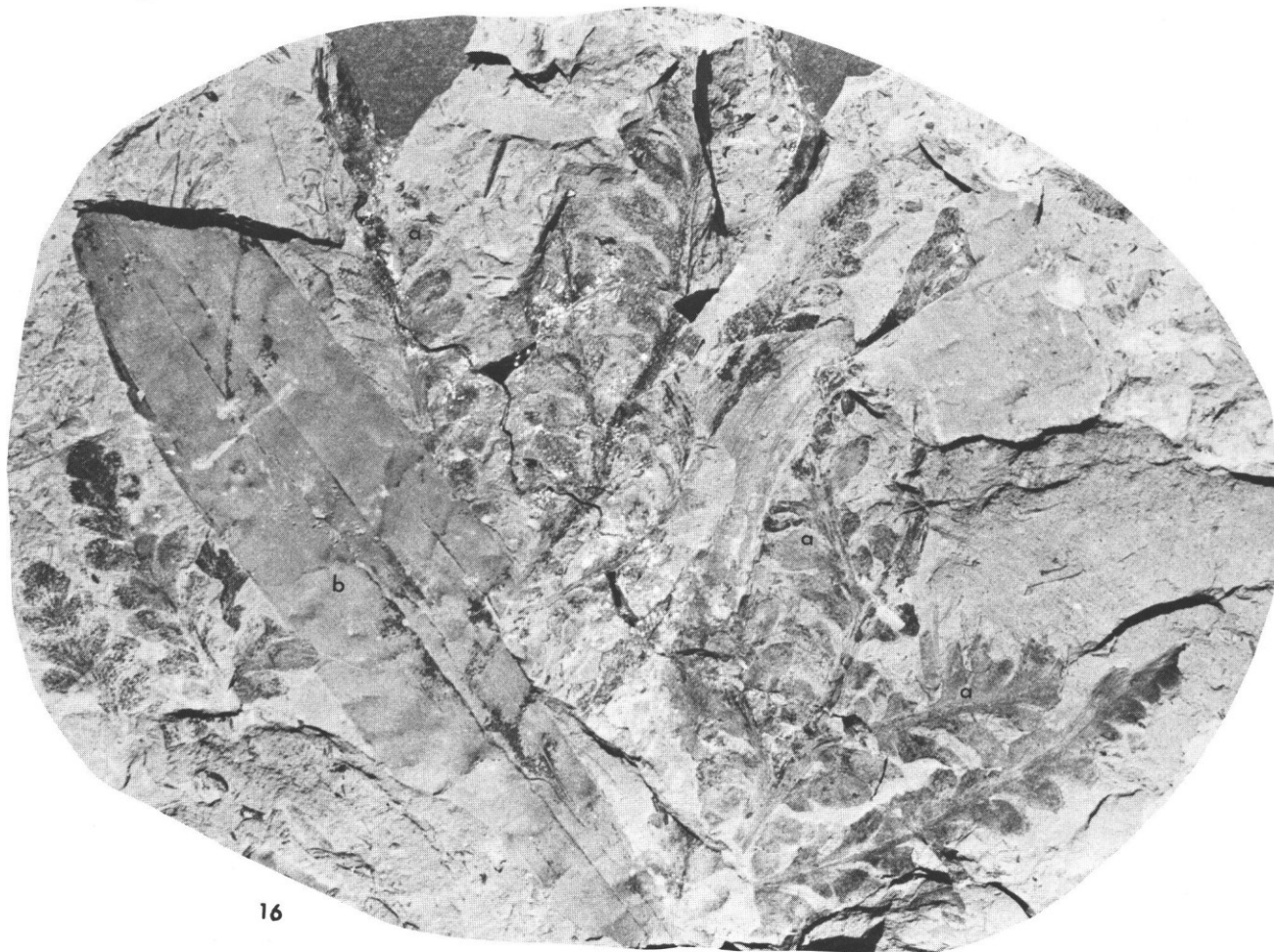
13



14



15



16

Figures 13-16. Fossil plants from the Red Tanks Member of the Madera Formation in Carrizo Arroyo, Lucero uplift: 13—*Ernestiodendron filiciforme*, 14—*Phasmatocycas* sp., 15—*Lebachia* cone, 16—slab of rock showing callipterid foliage (a) and *Cordaites principalis* (b); all figures natural size.

Articulates	Fern-like foliage	Conifers
<i>Asterophyllites</i> sp.	<i>Neuropteris</i> spp.	<i>Walchia</i> spp.
<i>Calamites</i> sp.	<i>Pecopteris</i> sp.	
	<i>Plagiozamites</i> sp.	

It appears likely that flora from the Kinney Clay pit correlates with floral zones 11 and 12 (locally combined), the zone of *Odontopteris* spp. of Read and Mamay (1964). Correlation of the other floras with their zones is much less certain and will not be attempted at this time.

### PERMIAN FLORAS

A large, diverse, well-preserved flora occurs in the Red Tanks Member of the Madera Formation in Carrizo Arroyo, Lucero uplift. Although the Red Tanks Member is usually considered to be of Late Pennsylvanian age, a study of the plant macrofossils and megafossils indicates an Early Permian age. A preliminary report on the flora has appeared (Tidwell and Ash, 1980), and a detailed study of one fossil has been submitted for publication. The flora, like the older flora found at the Kinney clay pit, is associated with a large invertebrate fauna which includes insects and eurypterids in addition to many brachiopods and molluscs (Kues and Kietzke, 1976, 1981). A selection of the fossils in the flora is shown in Figures 6-16. The flora includes:

Articulates	Fern-like foliage	Conifers
<i>Asterophyllites</i> sp.	<i>Neuropteris</i> spp.	<i>Cordaites</i> sp.
<i>Annularia</i> sp.	<i>Sphenopteris</i> spp.	<i>Samaropsis</i> sp.
		<i>Gomphostrobus</i> sp.

Several other conifers are also present, including several members of the *Walchia* complex (e.g., *Lebachia* and *Ernestiodendron*). In addition a few specimens of callipterid foliage (fig. 1 6A) and the putative early cycad *Phasmatoxycas* (fig. 15) have been noted in the flora. Several fossils in the flora appear to represent new and as yet undescribed genera and/or species. This flora probably correlates with zone 13, the zone of *Callipteris* spp. of Read and Mamay (1964).

### Abo Formation

The Abo Formation of Early Permian age contains fossil plant remains at a number of localities. Two distinct floras seem to be represented in the formation. The older flora in the basal portion of the formation includes abundant remains of the conifer *Walchia pinniformis* and less commonly, *Callipteris conferta*, *Callipteris lyratifolia*, *Gomphostrobus bifidus*, and possibly *Dichophyllum*. One of the best known localities for this flora which has been correlated with zone 13, zone of *Callipteris* spp. of Read and Mamay (1964), is at the Spanish Queen mine near

Jemez Springs.

Plant fossils known in the upper part of the Abo represent a flora which is distinct from that in the lower part of the formation. The flora from the upper part consists mainly of poorly preserved impressions of the foliage of the supposed Pteridosperm *Supaia* sp. and of the conifer *Walchia* sp. and unidentified coniferous wood. Several localities where this flora occurs are in Abo Canyon at the southern end of the Manzano Mountains. This flora is correlated with zone 14, the zone of the *Supaia* flora of Read and Mamay (1964).

### SUMMARY

The older floras in the Sandia Formation and the lower part of the Madera Limestone are small and include the articulates (horsetail relatives) *Calamites*, *Sphenophyllum*, and *Annularia*, as well as ferns, seed ferns such as *Neuropteris* and *Pecopteris*, and a few conifers such as *Cordaites*. The younger floras in the upper part of the Madera (below the Red Tanks Member) contain representatives of these same groups

in addition to large numbers of conifers, including representatives of the *Walchia* complex and *Cordaites*. Although all of these floras are similar to contemporary floras in eastern North America, they appear to be somewhat xerophytic. Read (1947) has termed these Pennsylvanian floras of the western U.S., which show this xerophytic modification, as the Cordilleran flora. This modification is thought to be due to the fact that there was widespread orogenic activity in the western United States during the Pennsylvanian, and upland habitats were expanded at this time at the expense of the lowland habitats (Read and Mamay, 1964).

The older Permian flora in the uppermost part of the Madera Formation (Red Tanks Member) in central New Mexico is rather similar in composition to the preceding Upper Pennsylvanian floras in the area. The flora consists of a few articulates, many ferns, and seed ferns including callipterids together with a large number of other types of gymnosperms, such as *Cordaites*, *Walchia*, and *Phasmatoxycas*. The large variety of plants in the flora suggests that it represents both lowland and upland environments. The younger Permian floras in the Abo Formation are more or less impoverished and include what are taken to be distinctly xerophytic forms such as the seed fern *Supaia* and the conifer *Walchia*. It is evident that the Permian floras show an increasingly xerophytic trend which had been established during the Pennsylvanian. These changes are probably a reflection of the continuing orogenic activity in the region.

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