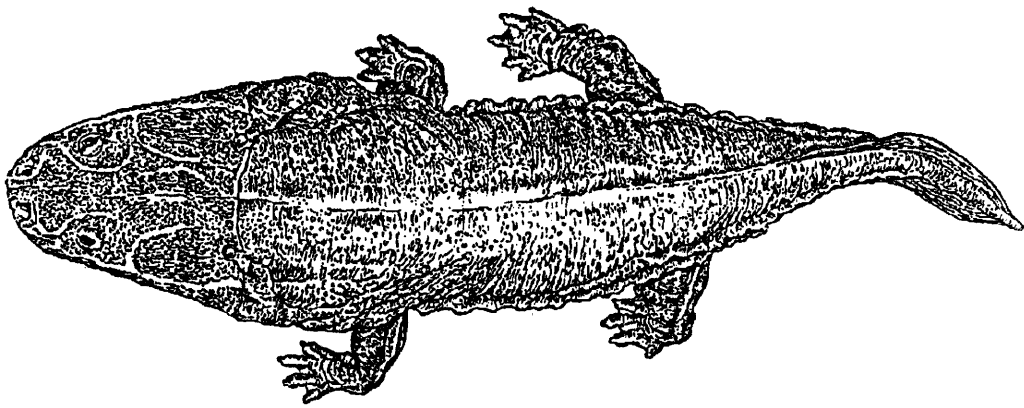


PALEONTOLOGY



A CATALOG OF UPPER TRIASSIC PLANT MEGAFOSSILS OF THE WESTERN
UNITED STATES THROUGH 1988

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Abstract-A catalog of the Upper Triassic genera and species of plant megafossils that have been described from the western United States through 1988 is presented together with a list of the pertinent references. The fossils, which were first reported nearly 140 years ago, occur at many localities west of the Mississippi River in the United States. They are particularly abundant in the Chinle Formation and Dockum Group in Utah, Arizona, New Mexico and Texas; a few additional fossils are found in the Dolores Formation in Colorado, the Popo Agie Formation in Wyoming, the Gold Range Formation in Nevada and in the Eagle Mills Formation and Arkansas. As the catalog, shows the Upper Triassic flora of the western United States includes about 70 well characterized species based on megafossils. The fossils represent nearly all major plant groups and include several of uncertain classification. The ferns and cycadophytes are especially well represented in terms of both numbers and diversity, and the conifers also are rather common. On the other hand, the ginkgophytes and lycopods are very scarce. It is evident from these fossils that a large diverse land-flora was present in the western United States during Late Triassic time.

INTRODUCTION

This catalog contains an alphabetically arranged list of all of the genera and species of plant megafossils that have been described or reported from the Upper Triassic rocks in the western United States from 1850 through 1988. Cited references are listed in the bibliography. A systematic list of all the valid taxa in the flora is provided at the end of the bibliography.

Nearly all of the fossils listed here were obtained from the Chinle Formation in Utah, Arizona and New Mexico. Much smaller numbers were collected from the Popo Agie Formation in Wyoming, the Dolores Formation in Colorado, the Dockum Group in New Mexico and Texas and the Gold Range Formation in Nevada. Although petrified wood commonly occurs in the Upper Triassic formations of the southwestern United States most of the plant fossils described from these units are impressions and compressions of leaves and reproductive structures. Abundant palynomorphs also occur in these same units, but they are not indexed here, although the principal references are included in the bibliography.

ACKNOWLEDGMENTS

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HISTORICAL BACKGROUND

Humans have known of the plant fossils which occur in the Upper Triassic strata in the western United States for thousands of years, as artifacts made from typical Upper Triassic petrified wood have been found in many ancient Indian ruins in the Southwest (Ash, 1970a). However, their presence apparently was not noted in print until a report of the explorations of Lt. J. H. Simpson of the U.S. Army in northeastern Arizona was published in 1850. In that report, he (Simpson, 1850) described the occurrence of petrified wood in the basal part of the Chinle Formation in the vicinity of Canyon de Chelly. During the following decade, petrified wood was observed at a number of additional localities in the Chinle Formation in the Southwest by members of other U.S. Army Exploring Expeditions, but none of it was described by a paleobotanist until 1858 when H.R. Goepfert reported on some specimens collected from what is now Petrified Forest National Park in eastern Arizona. He concluded (Goepfert, in Mollhausen, 1858), on the basis of his microscopic studies, that the wood had the structure of the living conifer Araucaria.

In 1859, members of the Ives Expedition made a small collection of poorly preserved leaves from the lower part of the Chinle Formation in northern New Mexico. The collection was turned over to J. S. Newberry to study just before the American Civil War, but it was not described until many years later (Newberry, 1876). As summarized elsewhere (Ash, 1970a, 1972b), only a few additional Upper Triassic plant fossils were described from the western United States until 1941 when L. H. Daugherty of San Jose State College published a comprehensive study of those that occur in the Chinle Formation in Arizona and New Mexico and in the Dockum Group in West Texas. In that report, which was the turning point in the study of Upper Triassic plant fossils of the western United States, Daugherty described a total of 34 species based on megafossils, principally leaves, including several that have been described earlier and four new species of palynomorphs. Since 1941, many additional plant megafossils and palynomorphs have been described from the Upper Triassic rocks in the western United States, especially from the

Chinle Formation and the Dockum Group, and several of the older taxa have been redescribed as summarized below.

STRATIGRAPHIC BACKGROUND

Chinle Formation

The Chinle Formation is widely exposed in northern Arizona and southern Utah, and is much less widely exposed in northwestern New Mexico, southwestern Colorado and southeastern Nevada. Throughout this region it rests unconformably on older strata. The formation consists of a variety of clastic sedimentary rocks. At the base is a thin persistent bed of conglomerate that often includes small amounts of sandstone and shale. It is overlain by a thick sequence of mainly greenish and brownish mudrock which grades upward into reddish mudrock. Numerous, thin, discontinuous beds of sandstone also occur throughout this part of the Chinle. The uppermost part of the formation consists of reddish sandstone and pinkish-purple silty limestone. The Chinle has a maximum thickness of about 550 m in northwestern New Mexico and apparently correlates with the late Carnian and early Norian Stages of the Upper Triassic (Ash et al., 1986).

Plant fossils are quite abundant in the Chinle Formation at many places, particularly in the lower part. Although this flora has been studied for many years, new localities with new forms are found nearly every field season. There seems to be a general change in the flora from the bottom to the top of the formation, and three floral zones have been recognized in it (Ash, 1988). In the basal beds the flora is fairly large and is dominated by conifers and cycadophytes. Higher up the flora is quite large and varied and is dominated by ferns, cycadophytes and several unclassified gymnosperms. The known flora in the upper beds of the Chinle is very small, consisting of only a few identifiable forms.

The plant fossils in the lower part of the Chinle are often well preserved with the cuticle or epidermis intact, but the fossils usually are somewhat fragmentary. In contrast, those in the highest beds are merely impressions but at two localities entire plants are preserved. The principal references for the plant megafossils in the Chinle are Daugherty (1941), Ash (1970a, 1972a, 1972e, 1975a, 1978b, 1980, 1986a, 1987c), Gould (1971), Knowlton (1888) and Litwin (1984). Numerous palynomorphs also have been described from these strata since the pioneering work of Daugherty (e.g., Dunay and Traverse, 1971, Gottesfeld, 1972, Stone, 1978, Litwin, 1984, 1986).

Dockum Group

The Dockum Group is exposed principally in the panhandle of Texas and adjacent areas in eastern New Mexico. It consists mainly of variegated and red claystone and mudstone

and a small amount of somber colored sandstone and conglomerate. The unit is subdivided into several formations which are discontinuous and generally cannot be traced any great distance. The Dockum has a maximum thickness of about 650 m, but most exposures usually show only 100 m or less. It appears to correlate with the late Carnian and early Norian Stages.

Identifiable plant megafossils, particularly leaves, are not common in the Dockum but do occur throughout the Group and at many localities. Petrified wood occurs in the Dockum but it is not as abundant or well preserved as in the Chinle Formation to the west. The fossil leaves in the formation are usually well preserved. The flora is not as large as the flora in the Chinle but does contain several of the same species, and it is evident that the floras are closely related. The principal references on the plant megafossils in the flora are Daugherty (1941) and Ash (1970c, 1972c, 1975a, 1976a, 1980). Dockum palynomorphs are described in Dunay and Fisher (1979) and Fisher and Traverse (1971).

Dolores Formation

The Dolores Formation is exposed principally in the walls of deep canyons in southwestern Colorado. It ranges up to about 320 m in thickness and consists principally of reddish-brown siltstone and fine-grained sandstone. The formation is generally thought to be approximately equivalent to the upper part of the Chinle Formation of the Colorado Plateau region (Stewart et al., 1972) and probably correlates with the Carnian and Norian stages also. Plant megafossils which have been reported from the Dolores are casts or impressions. The principal references for the Dolores Formation are Holt (1947), Brown (1956), Tidwell et al. (1977) and Ash (1980, 1987c).

Popo Agie Formation

The Popo Agie Formation occurs in west-central Wyoming where it is about 30 m thick. The formation consists mainly of reddish to purplish claystone and other siltstone and sandstone. Several localities in the Popo Agie have yielded poorly preserved impressions of a few typical Upper Triassic leaves and stems. The principal references for this flora are Berry (1924) and Ash (1980).

Gold Range Formation

The Gold Range Formation of southwestern Nevada consists of a sequence of argillite, limestone, volcanic flows, tuff and breccia. It has a thickness of about 900 m according to Ponsler (1977). A few impressions of typical Upper Triassic leaves have been obtained from the unit (Ash in Ponsler, 1977).

Eagle Mills Formation

The Eagle Mills Formation is known only in the subsurface in east Texas and adjacent areas in Arkansas and adjoining states. The unit consists of a sequence of nonmarine redbeds, gray and white siltstone and diabase. It ranges up to about 2600 m in thickness and rests unconformably on Paleozoic strata (Scott et al., 1961). A few impressions of a typical Upper Triassic leaf have been described from the unit in Arkansas by Dorf (in Scott et al., 1961), and Moy and Traverse (1986) have described a small Upper Triassic palynoflora from the formation in east Texas.

COMPOSITION OF THE FLORA

Presently about 70 well characterized species based on plant megafossils are known from the continental Upper Triassic rocks of the western United States. Most of the species are represented by compressions; only a few are based on impressions, petrifications or pithcasts. Nearly all of these plant megafossils occur in the lower part of the Chinle Formation or in the Dockum Group, but a few are known from the upper part of the Chinle and Dolores formations (Ash, 1980, 1987c).

Non-vascular plants are represented in the flora by small, discrete, ovoid bodies ranging from 2 to 50 mm in diameter that are found in some of the wood in the Chinle Formation. Daugherty (1941) compared these fossils with similar bodies which are formed in the wood of certain living conifers by a heart-rot fungi and assigned them to Polyporites.

In spite of their rather delicate nature, the lycopods are represented in the flora by several megafossils including the compressed leafy shoot of an extinct species of Selaginella and the petrified stems of a small lycopod called Chinlea. The horsetails are mainly represented by pithcasts of a large species of Neocalamites and Equisetites. They occur at many localities in the Upper Triassic of the western United States. At one locality the fossil attains a maximum diameter of nearly 30 cm and a length of at least 6 m (Holt, 1947). This division is also represented by the compressed stems and cones of a small Equisetites and the compressed stems and leaves of a species of the rare horsetail Schizoneura.

Fern and fern-like foliage is rather common in the Upper Triassic flora of the western United States. Some fragmentary tree-fern stems also occur in these same strata. The foliage represents a variety of ferns, including two (Phlebopteris and Clathropteris) which have palmate fronds and are probably closely related to certain living tropical ferns. Others, such as Cynepteris and Wingatea have a pinnate type of frond. The tree fern is assigned to the