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NEW FOSSIL LOCALITIES IN THE VERDE FORMATION, VERDE VALLEY, ARIZONA*

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INTRODUCTION

Very few fossils and fossil localities were known in the Verde Formation until a recent study of the Verde Valley by the United States Geological Survey. During this study, many new localities (Figs. 1, 2), some containing numerous and excellently preserved fossils (Fig. 3), were discovered. The purpose of this paper is to identify and generally describe some of the areas from which fossils have been collected or noted. A more complete collection and a thorough study of the fossils in the Verde Formation probably will reveal new evidence as to the age of the formation. At the time of this writing, identification of the fossils collected by the author was not complete.

PREVIOUS INVESTIGATIONS

The first mention of fossils in the Verde Formation was by Jenkins (1923, p. 76-77) who found a "... few badly preserved gastropods having the appearance of some fresh-water types . . ." in the limestone north of Clarkdale (loc. 1).^{1/} Examination of Jenkins' fossil locality revealed a sequence of limestones that contain an abundance of plant hash (term used to designate rocks that are chiefly macerated plant material) and a few external molds of gastropods. In the same area (loc. 2), several thin beds of shale contain numerous gastropods and pelecypods.

Nininger (1941, p. 25) collected fossil mammal tracks in Bee Canyon (loc. 25) and found "... at least twenty of the ancient footprints; in one case a series of seven in regular order . . ." He noted that some of the tracks were made by a cat, a camel and "... a little split-hoofed creature the size of a goat . . ." Apparently Nininger removed all visible tracks from the locality; only the excavation site remains and no tracks are evident.

Mahard (1949, p. 119-120) found external molds of some small mollusks and the incrusted stems of some reedlike plants near the top of his measured section north of Clarkdale (loc. 15). The mollusks were identified by Teng-Chien Yen (1949, p. 119) as: *Sphaerium* sp., *Lymnaea* sp., *Physa* sp., *Gyraulus* sp., ?*Pupilla* sp. Mahard stated that "the scarcity of fossils in the lake sediments may be cited as additional evidence that the Verde Lake was shallow and saline throughout its existence . . ." Examination of Mahard's section revealed that most of it is barren of fossils. However, in the same area, a 10-foot thick zone of calcareous shale at a point about 450 feet above the Verde River contains numerous gastropods, some ostracods, charophyte oogonia, and pelecypods, and some plant material that is partially altered to carbon.

Anderson and Creasey (1958, p. 61) found some "... gastropod-like tests . . ." in the limestones south of

Clarkdale. Their assumption that the tests are those of gastropods is correct. The fossils are poorly preserved and appear to be the only ones in that locality.

Brady and Seff (1959, p. 80-82) described fossil tracks near Montezuma Castle (loc. 33) and wrote the tracks "... appear to be those of a small group of elephants . . ." The length of stride is 82 inches; the diameter of the prints is about 17 inches (Fig. 4). A note published in "Plateau" (1960, p. 88) indicates that the tracks "... were thoroughly checked and the general consensus is that there are elephant tracks as well as the tracks of a three-toed tapir at the site." Just north of Montezuma Castle (loc. 32), Brady and Seff (1959, p. 82) found "a number of freshwater gastropods and small pelecypods" and stated that "... with the exception of gastropods collected near Tuzigoot, these seem to be the only fossils known from the Verde formation." The material in which the invertebrate fossils occur does not conform to the general lithology of the Verde Formation at that locality. It appears to be younger than the Verde Formation and is probably a part of a high-level terrace deposit or cavern deposit.

Figure 4. A track that may be that of an elephant (Brady and Seff, 1959) in the Verde Formation near Montezuma Castle (loc. 33).

FOSSILS AND FOSSIL LOCALITIES

Most fossils occur in the upper beds of the Verde Formation, and, at several localities, these beds are extremely fossiliferous. The fossiliferous beds are not limited to any stratigraphic horizon or particular lithology. Fossils have been found throughout the upper part of the formation in sandstone, siltstone, mudstone, limestone, and, at Sacred Mountain (loc. 29), in conglomerate. Except for a few poorly preserved gastropods and plant remains, the lower beds of the Verde Formation are generally barren of fossils. Where fossils are present in the lower part of the formation, they are usually silicified or in siliceous lenses and nodules.

The type of preservation differs. Some fossils are composed of original material, some are replaced with calcareous or siliceous material, some are evidenced only by external or internal molds, and some plant material has been altered to carbon and peat.

The invertebrate fossils, most of which are lacustrine or terrestrial, are gastropods, pelecypods, ostracods, and charophyte oogonia. The plant fossils are chiefly stems, rootlets, hollow spheres which may be seeds, and pollen.

The vertebrate fossils include teeth, various bones, and a few tusks. They represent the remains of such animals as rodents, bats, and probably mastodons. Dr. C. W. Hibbard, University of Michigan, identified some of the small vertebrate teeth (1959, personal communication). He found two teeth to be upper M^2 's of the cotton rat *Sigmodon*. Also, he identified the tooth of a kangaroo rat *Dipodomys*.

^{1/} Fossil localities are numbered; the numbers refer to the locations shown on figures 1 and 2, and to the description of the localities given at the end of this report.



Figure 1. Index of map of fossil localities 1 through 25.

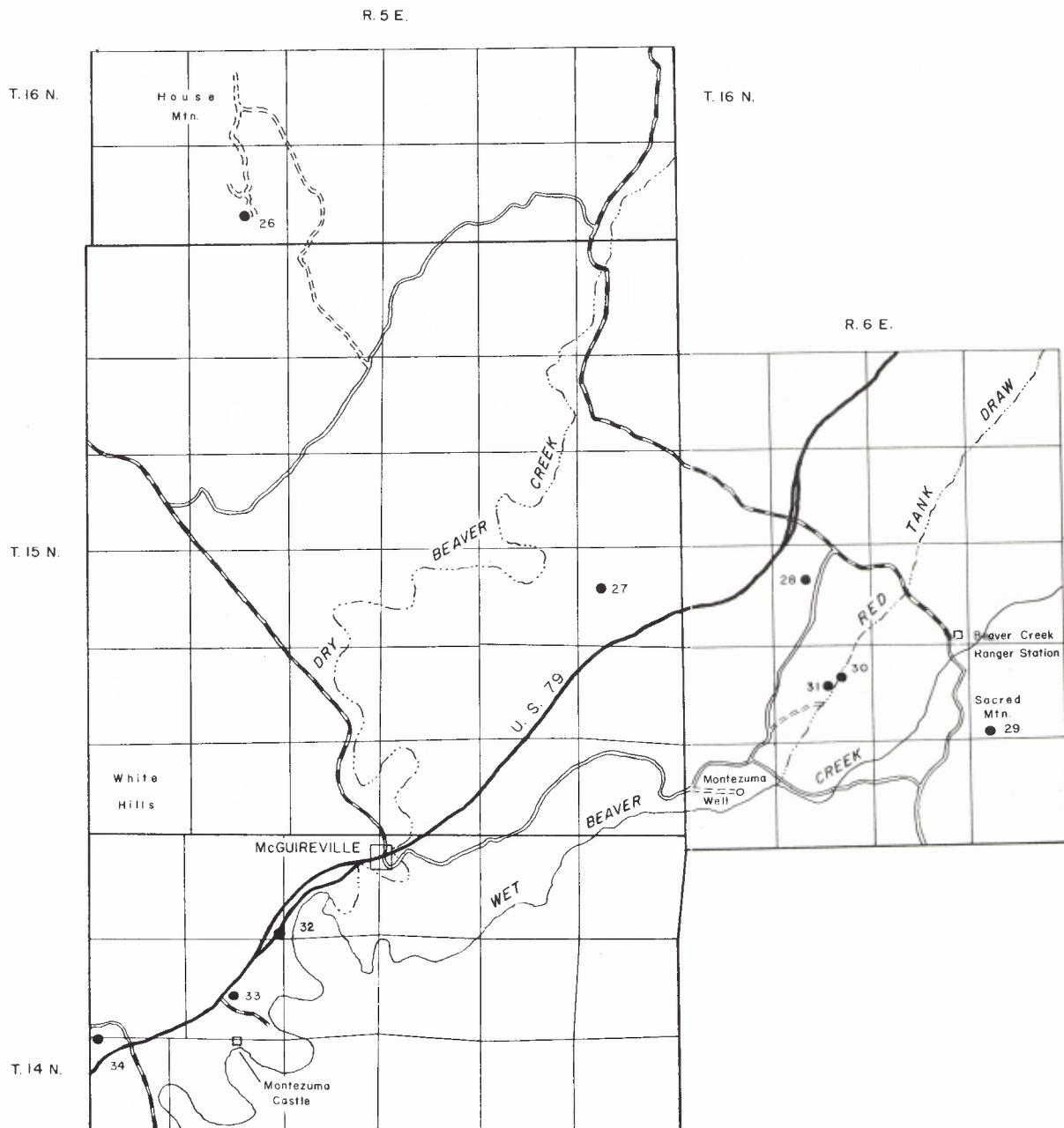


Figure 2. Index of map of fossil localities 26 through 34.

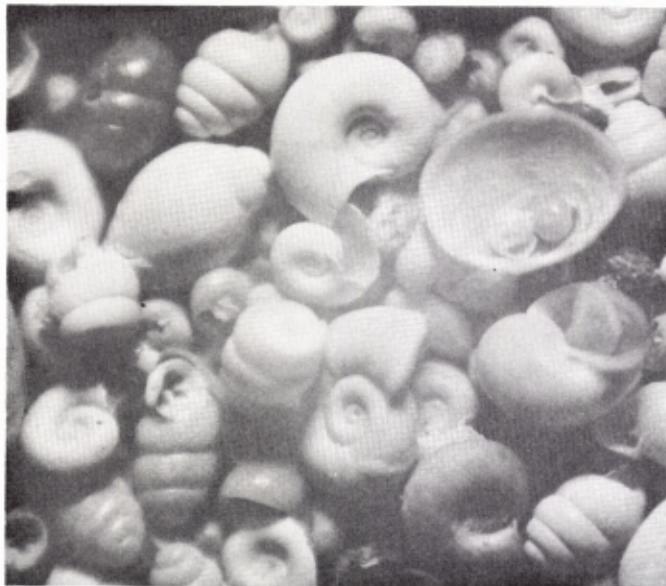


Figure 3. Some well preserved fossils from Verde Formation (loc. 26).

DESCRIPTION OF FOSSIL LOCALITIES IN THE VERDE FORMATION

The locality number refers to the location of the fossil localities shown on Figures 1 and 2.

Locality No. Description of Locality

- 1 NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 14, T. 17 N., R. 3 E. Locality described by Jenkins (1923). Some beds are moderately fossiliferous. External molds of gastropods are common. Many beds contain plant hash. Fair preservation.
- 2 NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 14, T. 17 N., R. 3 E. Limestones containing plant hash are abundant; several contain external molds of gastropods. Some thin ($\frac{1}{2}$ to 2 inches thick) shales contain numerous pelecypods. Fair preservation.
- 3 NW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 26, T. 17 N., R. 3 E. From green shale in small wash about 50 feet south of road. Ostracods and gastropods are common. Fair preservation.
- 4 SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 17 N., R. 3 E. From south-facing cliff. Limestone, shale, and peatlike material are all fossiliferous. One limestone bed is so fossiliferous that it might be called a gastropod coquina. Excellent preservation.
- 5 SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 17 N., R. 3 E. From north-facing cliff. Sandstone, siltstone, mudstone and claystone are all very fossiliferous containing many types of invertebrates. A carbonaceous shale at the bottom of a sinkhole-type structure contains vertebrate teeth and bone fragments. Excellent preservation.
- 6 SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 17 N., R. 3 E. Argillaceous peatlike material in the bottom of the wash is extremely fossiliferous and contains most types of invertebrates. Numerous bone fragments and several rodent teeth have been found. Excellent preservation.



Figure 4. A track that may be that of an elephant (Brady and Seff, 1959) in the Verde Formation near Montezuma Castle (loc. 33).

Locality No.

Description of Locality

- 7 SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 35, T. 17 N., R. 3 E. Gastropods and ostracods are common from argillaceous, carbonaceous material under first limestone ledge in wash just west and about 200 feet south of windmill. Excellent preservation.
- 8 SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 35, T. 17 N., R. 3 E. From uranium prospect pit. An arenaceous white limestone contains some large, dark yellowish orange, internal and external molds and casts of gastropods, many of which have calcite crystals lining the interior. A carbonaceous peatlike material is also fossiliferous. Most types of invertebrate forms are represented. Excellent preservation.
- 9 SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 36, T. 17 N., R. 3 E. From south-facing slope. Ostracods collected from shale are excellently preserved. In many cases both valves are attached; one valve on some forms has a winglike projection (alae). Good preservation.
- 10 SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 36, T. 17 N., R. 3 E. Large gastropods and pelecypods in peatlike material in bottom of wash. Some original shell material. Poor preservation.
- 11 SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 19, T. 17 N., R. 4 E. From uranium prospect pit. Fossils in 6-inch shale between two limestones. Mostly original shell material. Gastropod plates are abundant. Some gastropods and calcareous plant seeds (?) are excellently preserved.
- 12 NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 30, T. 17 N., R. 4 E. Limestone in deep wash on south side of road contains internal and external molds of gastropods and plant hash. Fair preservation.
- 13 SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T. 17 N., R. 4 E. From bulldozer cut on east side of trail. Peatlike claystone contains invertebrate fossils. Poor preservation.

Locality No.	Description of Locality	Locality No.	Description of Locality
14	SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 32, T. 17 N., R. 4 E. From southwest bank of creek. Limestone at top of ridge contains external molds of invertebrate fossils, especially gastropods. Limestone at level of wash contains numerous algae like structures. Fair preservation.	23	NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 33, T. 16 N., R. 4 E. From westernmost tributary of Sheepshead Canyon. Well preserved invertebrate material is abundant throughout thick sandstone section. Lenses of black carbonized plant material contain some plant debris that is practically unaltered. These rocks may be younger than the Verde Formation.
15	SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 7, T. 16 N., R. 3 E. Section measured by Mahard (1959). From peatlike calcareous claystone in limestone unit just above end of fence. Fossil zone about 10 feet thick. Invertebrate fossils very abundant; many are poorly preserved but some are excellently preserved. Some carbonaceous material shows excellently preserved plant structure.	24	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 16 N., R. 4 E. From just under uppermost ledge-forming limestone along Oak Creek and several hundred feet north of Oak Creek school. Material is a highly calcareous, arenaceous claystone. Invertebrate fossils, especially gastropods, pelecypods, and ostracods, are very abundant. Original shell material. Excellent preservation. Calcified plant debris scattered throughout. These rocks may be younger than the Verde Formation.
16	SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 10, T. 16 N., R. 3 E. Peatlike, calcareous claystone in bottom of wash and south-facing cliff is abundantly fossiliferous. Much of the shell material is original but crushed. An argillaceous limestone contains some excellently preserved gastropod molds.	25	NW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 22, T. 15 N., R. 4 E. Fossil track locality described by Nininger (1941). No tracks evident.
17	SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 12, T. 16 N., R. 3 E. From uranium prospect pit. Carbonaceous peatlike claystone and arenaceous limestone is very fossiliferous. Much of the shell material is original and most invertebrate fossil types are represented. Many shells are crushed; some gastropods and most ostracods are well preserved.	26	SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 32, T. 16 N., R. 5 E. From near head of small wash. A highly calcareous peatlike claystone contains invertebrate and vertebrate fossils. Numerous teeth and bone fragments have been found — most were identified as rodents, bats, or some type of insectivores. Fossils are very abundant, and many are well preserved (Fig. 3).
18	NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 12, T. 16 N., R. 3 E. Carbonaceous peatlike material in bottom of wash contains many invertebrate fossils. Most shells are crushed, but some gastropods and ostracods are well preserved.	27	SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 24, T. 15 N., R. 5 E. A zone of nodular limestone and claystone about 110 feet below top of mesa contains invertebrate fossils, especially gastropods and pelecypods, and plant material. Some fossils are well preserved.
19	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 12, T. 16 N., R. 3 E. From south-facing slope along old road. Argillaceous limestone contains some well preserved internal and external molds of invertebrate fossils, especially gastropods.	28	NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 20, T. 15 N., R. 6 E. From top of small, limestone-capped butte. Ostracods, gastropods, and charophyte oogonia are abundant in a highly calcareous, argillaceous, plant-hash material under uppermost limestone ledge. Several thin beds are composed entirely of charophyte branchlets. Excellent preservation.
20	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 16 N., R. 4 E. Limestone, siltstone, and chert in upper 80 feet of steep, south-facing cliff along Oak Creek are very fossiliferous. Gastropods and ostracods are common. Plant hash is abundant in several beds and one zone contains some hollow plant impressions as much as one foot in diameter and 8 feet in length. Good preservation.	29	SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 27, T. 15 N., R. 6 E. From Sacred Mountain. A conglomerate and calcareous mudstone contain bone fragments, tusks, and teeth of a large animal, possibly from a mammal such as a mastodon. Invertebrate fossils also are present. Fair to excellent preservation.
21	NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 23, T. 16 N., R. 4 E. From southeast-facing cliff just west of Page Springs. Two-foot thick limestone at top of cliff is very fossiliferous containing gastropods, pelecypods, and ostracods.	30	NE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 29, T. 15 N., R. 6 E. From a highly calcareous, nodular, mudstone under limestone ledge on east side of Red Tank Draw and just north of ranch. Calcareous plant hash is abundant. Invertebrate fossils are not abundant but are excellently preserved. Some pelecypods have both valves intact. These rocks may be younger than the Verde Formation.
22	SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 33, T. 16 N., R. 4 E. From bed of old road in Sheepshead Canyon. Mudstone or argillaceous sandstone contains several species of gastropods and ostracods. Original shell material. Excellent preservation. These rocks may be younger than the Verde Formation.		

Locality No.	Description of Locality	Locality No.	Description of Locality
31	SW 1/4 SW 1/4 NE 1/4 sec. 29, T. 15 N., R. 6 E. Under limestone on west side of Red Tank Draw and just northwest of ranch. Rock has travertine appearance. Plant hash is abundant. Contains some well preserved gastropods and pelecypods. This is an excellent locality for leaf impressions; they occur in limy material and are well preserved. These rocks may be younger than the Verde Formation.	34	NW 1/4 NW 1/4 NW 1/4 sec. 18, T. 14 N., R. 5 E. Lenses and thin beds of chert along bottom of wash contain well-preserved external molds of invertebrate fossils, especially gastropods. Several hundred feet upstream and at first limestone ledge that forms small falls south of road are some fairly well-preserved, silicified plant rootlets or branchlets.
32	SE 1/4 SE 1/4 SE 1/4 sec. 5, T. 14 N., R. 5 E. One of several invertebrate fossil localities of Brady and Seff (1959). Well-preserved shells occur at south end of road cut — locality may be destroyed by new highway excavation. This fossiliferous sandstone is probably younger than the Verde Formation.		REFERENCES CITED
33	NE 1/4 NE 1/4 SW 1/4 sec. 8, T. 14 N., R. 5 E. Fossil track locality described by Brady and Seff (1959). The tracks are very distinct and well preserved.		<p>Anderson, C. A., and Creasey, S. C., 1958, Geology and ore deposits of the Jerome area, Yavapai County, Arizona: U. S. Geol. Survey Prof. Paper 308, 185 p.</p> <p>Brady, L. F., and Seff, Philip, 1959, "Elephant Hill": Plateau, v. 31, no. 4, p. 80-82.</p> <p>Jenkins, O. P., 1923, Verde River lake beds near Clarkdale, Arizona: Am. Jour. Sci., 5th ser., v. 5, no. 25, p. 65-81.</p> <p>Mahard, R. H., 1949, Late Cenozoic chronology of the Upper Verde Valley, Arizona: Denison Univ. Jour. Sci. Lab., v. 41, art. 7, p. 97-127.</p> <p>Nininger, H. H., 1941, Hunting prehistoric lion tracks in Arizona: Plateau, v. 14, no. 2, p. 21-27.</p> <p>Yen, Teng-Chien, 1949, in Mahard, R. H., 1949, Late Cenozoic chronology of the Upper Verde Valley, Arizona: Denison Univ. Sci. Lab. Bull., v. 41, p. 119.</p>

