

# Geology and Vertebrate Fauna of a New Site in the Wellington Formation (Lower Permian) of Northern Oklahoma

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**ABSTRACT.**—Remains of terrestrial vertebrates have been discovered in the Wellington Formation (Lower Permian) in Noble County, Oklahoma. The site, designated “The Kirby Quarry,” is named for the owner of the fossiliferous exposure. It has yielded a diverse vertebrate assemblage of three-dimensional remains of fish, amphibians, and reptiles. The Kirby Quarry is the first reported site from the Wellington Formation, Oklahoma, in which the hybodont shark *Hybodus* is known to occur; it is also only the third known site for the araeosceloid reptile *Dictyobolus tener*.

## INTRODUCTION

The Kirby Quarry—site OMNH 1220, Oklahoma Museum of Natural History—is in Noble County, north-central Oklahoma. The quarry opens into a west-facing road cut with rock exposures extending east into a pasture. Site data, on file in the Museum’s Department of Vertebrate Paleontology, are available to qualified investigators.

Several vertebrate-bearing sites are known in the Wellington Formation of northern Oklahoma. Among them, the Kirby Quarry is remarkable because its vertebrate material occurs in highly packed, concentrated pockets within curved depressions in the gray shales. Masses of bones and scales are cemented together by reddish siltstone. The majority of the vertebrate fossils consist of scales, skull pieces, and rib fragments of small palaeoniscoids and the larger platysomid fish. Remains of several different amphibians and reptiles also have been recovered there. The site has yielded specimens of a new araeosceloid reptile whose description awaits recovery of additional material.

Two seasons have been devoted to field studies at the site, resulting in a modest collection of fossils now deposited in the OMNH vertebrate paleontology collection. All the bones are three-dimensional with very little crushing. They are disarticulated and fragmentary, so that most are inadequate for species-level identification. All the fossil elements are small, although a few larger bones are represented as fragments. Plant fossils occur in the uppermost meter of Unit 9 and in Unit 10, but the remains are either carbonized film or barite replacement; identification is impossible.

## GEOLOGY AND ENVIRONMENTAL INTERPRETATION

The area around the quarry has been mapped by Shelton (1979). The basal sandstone is easily recognized as his Pwu (upper key bed of the Wellington Formation). The capping sandstone is about 6 m (~20 ft) above the basal sandstone and therefore likely Pwu-620—in the Billings Pool Member of the Wellington Formation.

### Stratigraphic Column (see Fig. 1)

Unit 10 (Pwu-620) consists of a fine-grained subarkosic sandstone (Shelton, 1979), reddish brown (10R 4/6), cross bedded with climbing ripples and de-watering structures. It includes rare, moderately well-preserved fossil plant trunks ranging from 2.5 to 5 cm in thickness, and cuts sharply into Unit 9.

Unit 9 is a blocky to fissile shale, pale olive (10Y 6/2) with reddish brown intervals. It contains vertebrate and plant fossils, most of which are rare and are concentrated in the uppermost 114 cm. Malachite, cuprite, hematite, and limonite weather from the unit in the form of lenticular concentrations about 2–3 mm across.

Unit 8 is a reddish brown sandstone. Its lithology and thickness vary within the locality; to the north, it is a fine-grained siltstone about 8 cm thick; to the south it grades into a dense, cross-bedded, heavily burrowed sandstone about 61 cm thick. Farther south the unit thins to about 12 cm,

with casts of vertebrate tracks on the underside of the unit and pelecypod fossils on the top surface. Overlying this sandstone is a lens of carbonate about 3.5 m wide and 15 cm thick in the middle; it does not persist laterally.

Unit 7 is a pale olive, blocky shale and claystone about 46 cm thick; it grades into a reddish brown, well-laminated siltstone in the uppermost 7 cm.

Unit 6 is a pale olive dolomitized carbonate mudstone that varies in thickness from 14 to 30 cm. To the north it pinches out into a claystone; to the south the unit approaches 30 cm in thickness.

Unit 5 is a blocky reddish brown and pale olive mottled shale approximately 45.7 cm thick with two distinctive carbonate intervals, each 1–2 cm thick.

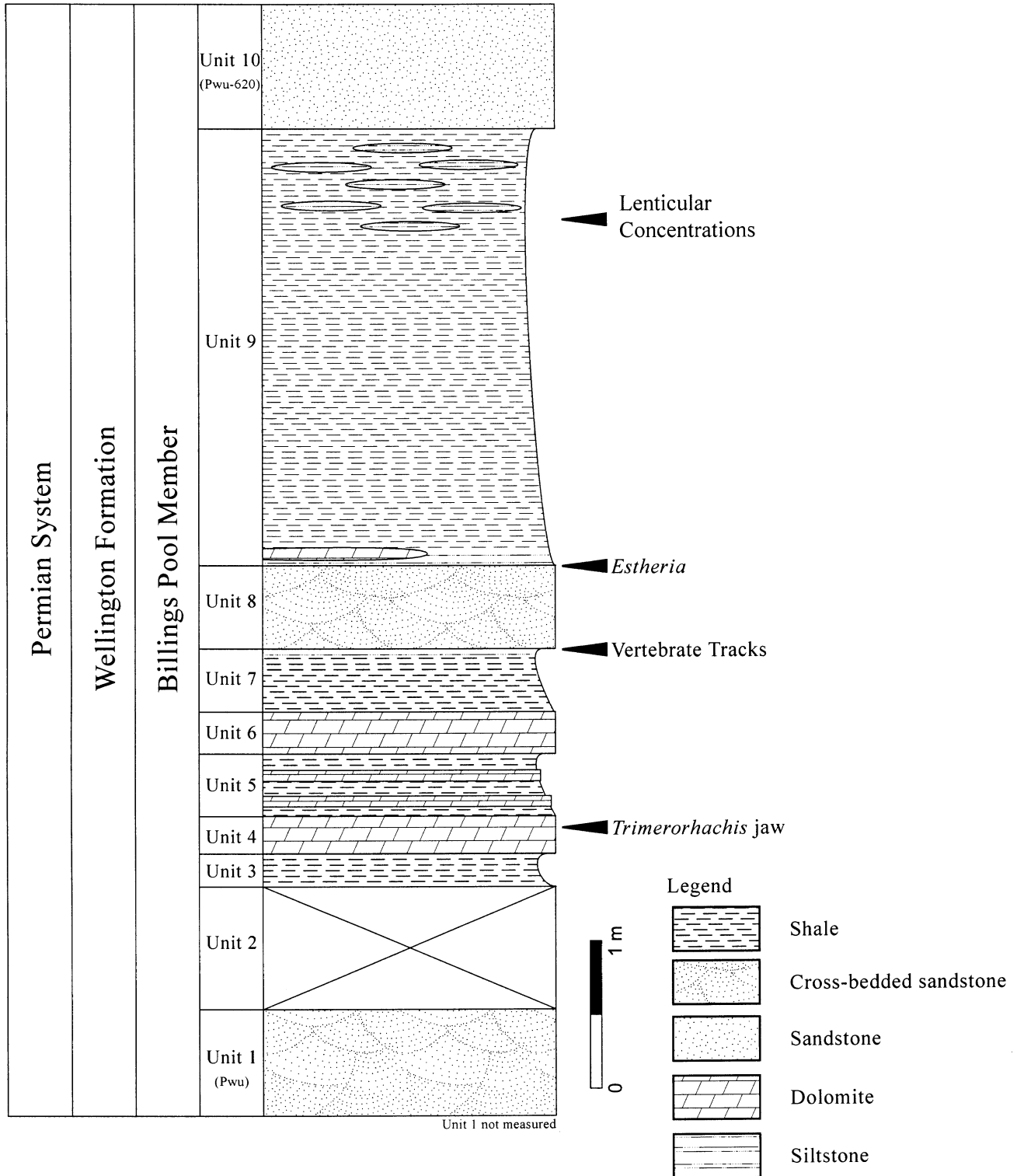


Figure 1. This stratigraphic column for the Kirby Quarry shows the geology and the fossil-producing layers.

Unit 4 is a pale olive dolomitized carbonate mudstone about 23 cm thick in which a jaw section of a *Trimerorhachis* was found. To the north, the unit forms large disconnected nodules; to the south it pinches out.

Unit 3 is a pale olive to reddish brown mottled blocky shale about 60 cm thick.

Unit 2 is covered, but may be a red shale.

Unit 1 is a fine-grained, subarkosic reddish brown (10R 4/6), cross-bedded sandstone. (This is the Pwu of Shelton, 1979.) The base of the sandstone is not exposed here.

Given the occurrence of freshwater fauna, carbonized plant material, and de-watering structures in the upper sandstone, these sediments appear to represent a lacustrine environment. Concentrations of bone and plant material can be found in lenticular concentrations, possibly formed by oscillating current directions. The dolomitized carbonate mudstones may have resulted from dolomitization within the vadose zone post-depositionally—or they could be dolomitized freshwater carbonate lenses that formed in lacustrine water. Further study of these dolomitized carbonates could lead to a better understanding of the environment and timing of dolomitization of these lenses, which are horizontally inconsistent.

## FAUNA

The fauna at this site are mainly aquatic. Most of the identifiable remains are palaeoniscoid fish, represented by scales and skull fragments, and four types of freshwater sharks. The most important of the sharks, *Hybodus*, is represented by fin spines. In Oklahoma, *Hybodus* remains have been recovered in younger strata at three sites (Simpson, 1974, 1976, 1979; Zidek, 1976)—all in the upper Garber Formation of southwestern Oklahoma. At the Kirby Quarry, all the recovered

TABLE 1. — Faunal List from Unit 9, the Kirby Quarry

Invertebrata
Conchostraca
<i>Estheria</i>
Vertebrata
Chondrichthyes
<i>Hybodus</i> sp.
<i>Orthacanthus platypternus</i>
<i>Orthacanthus texensis</i>
<i>Xenacanthus luederensis</i>
Osteichthyes
<i>Sphaerolepis arctata</i>
<i>Platysomus parvus</i>
<i>Palaeoniscoidea</i> , spp. indet.
Amphibia
<i>Archeria</i> sp.
<i>Diplocaulus</i> sp.
<i>Trimerorhachis</i> sp.
Reptilia
<i>Dimetrodon</i> sp.
<i>Dictyobolus tener</i>
<i>Ophiacodon</i> sp.
? <i>Captorhinus</i> sp.
<i>Araeosceloidea</i> , indet.

*Hybodus* fin spines (OMNH 58220, 58221, and 58444 through 58448) are small fragments, about 3 mm to 5.5 mm long. No *Hybodus* teeth have yet been found in the Wellington Formation of Oklahoma.

Two distinct types of *Hybodus* spines have been found at this site (Fig. 2). Type “A” (OMNH 58220, 58445 through 58448) is represented by fragments of five fin spines. Morphology of two fragments indicates that they are almost complete distal ends; the three others represent more proximal ends.

On fin spines referred to as *Hybodus* type “A”, the entire surface is ornamented, with seven parallel longitudinal ridges running the entire length, one of which forms the anterior keel of the spine. Ridges and grooves are smooth, and approximately equal in width. The ridge walls are slightly rounded proximally and extremely rounded distally. The grooves narrow toward the distal end to about one-half the width of the ridges. The height of the ridges also decreases toward the distal end. The shape of the denticles changes from a sharp edge with a downward pointed tip toward the proximal end, to a gently arch-shaped denticle ridge with a center high apex distally. The three ridges and grooves on each side are almost centered with a flat surface, both anterior and posterior to the ridges and grooves series. The anterior flat surface is approximately the width of four to five ridges, and the posterior flat surface is about two ridges wide. On both of the flat surfaces are three longitudinal lines of pits. In OMNH 58220 are four denticles along the posterior face; they are in a single series. The distal tip is slightly displaced, alternating from right to left of the base of the pre-

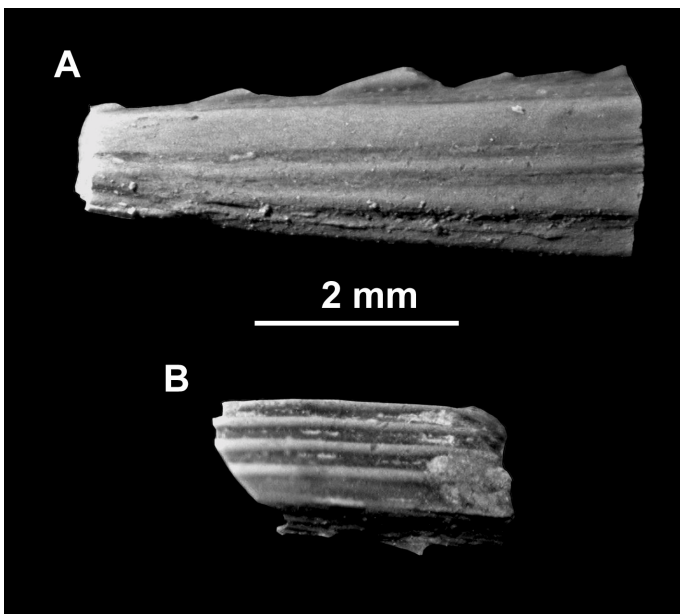


Figure 2. *Hybodus* shark fin spines at the Kirby Quarry occur as two different types. A—OMNH 58220 is type “A”; B—OMNH 58221 is type “B”.

ceding denticle. The denticles are smooth, and longer than wide. There is very little space between denticles; they almost touch. OMNH 58220 is 5.63 mm long, 1.22 mm wide distally, and 1.98 mm proximally. The widest spine fragment measures 2.76 mm.

Type "B" is represented by two fragments (OMNH 58221 and 58444) that show characteristics of a distal position on the spine. The entire surface of the spine is ornamented with 11 parallel longitudinal ridges, running the entire length. One ridge forms the keel of the spine. Ridges and grooves are smooth and approximately equal in width. The ridge walls are slightly rounded, and the grooves are deep. On either side of the single row of denticles are three rows of longitudinal pits. On OMNH 58221 are two partial denticles. The lower denticle shows that the surface was smooth. The distal tip is slightly offset to the right. The distal tip of the second denticle is missing, so it is unknown if the distal tips alternate from right to left as in the type "A" spines. The denticles are longer than wide and between them is a space approximately three-fourths the length of a denticle. OMNH 58221 is 2.86 mm long and 1.24 mm wide.

The type "A" and "B" fin spines above were compared with the three types described by Simpson (1974, 1976, 1979) and Zidek (1976), all in the collection of the OMNH and from the upper Garber Formation of southwestern Oklahoma; they differ morphologically. Because these specimens are fragmented and small, we believe that type "A" and "B" are both from immature sharks.

The Kirby Quarry is only the third recorded site for the araeosceloid reptile *Dictyobolus tener*; the others are Perry 6 (Olson, 1967, 1970) and Perry 7 (Burkhalter, 1987)—both 2 mi west of the Kirby Quarry. *Dictyobolus tener* has been described by Olson (1970), who suggested that it was piscivorous. Such a dietary preference would explain the presence of *Dictyobolus tener* in the highly aquatic fauna of this site.

A new araeosceloid reptile was also found. Two vertebrae, one caudal (OMNH 58183) and one dorsal (OMNH 58183), have the same general structure and size as *Dictyobolus tener*, but they lack the heavy pitting on the surface. These new vertebrae are similar to specimens being studied by

Keith Carlson (personal communication, 1993) of Gustavus Adolphus College (Saint Peter, Minnesota) from a site about 4 mi northwest of the Kirby Quarry; he has recovered multiple coiled strings of articulated vertebrae. A complete faunal list for the site is given in Table 1.

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