The Geology of the Palmer Quadrangle, Ellis County, Texas

James Alfred Pitkin

Introduction

Location of Palmer Quadrangle.—This quadrangle lies in northeastern Ellis County. It is bounded by the meridians 96° 37' 30'' and 96° 45' 00'', and by the parallels 32° 22' 30'' and 32° 30' 00'', and includes an area of some 61 square miles. U.S. Highway 75 crosses the quadrangle, and there is a complementary network of secondary roads. Palmer, Trumbull, and Boyce are the only towns within the area.

General Stratigraphy.—Bedrock consists of the upper chalk member of the Austin chalk and two members of the Taylor marl, the Lower Taylor marl member and the Wolfe City sandstone member. All units are of Upper Cretaceous age. Quaternary terrace deposits cover most of the bedrock surface. Recent alluvium is found on stream floodplains.

![Fig. 1. Index-Map, showing location of the Palmer Quadrangle.](image)

Physiographic Setting.—The Palmer Quadrangle lies on the northwestern margin of the Gulf Coastal Plain. It is characterized by the level plains, low-rolling hills, and low-gradient streams found throughout this physiographic province. Noticeable throughout most of the quadrangle are the broad, flat interstream plains, mantled by Quaternary terrace deposits. To the south most of the terrace material has been eroded off, leaving the gently-rolling hills of the Taylor marl. In the southeast part of the quadrangle, east of Grove Creek, the Wolfe City sandstone member forms a low but distinct cuesta since the sandstone is more resistant
to erosion than the underlying marl. Most of the quadrangle is drained by the east flowing intermittent tributaries of the Trinity River, Red Oak and Grove Creeks.

**Purpose and Method of Study.**—The study of this area is a portion of a regional mapping program in north central Texas by the Department of Geology of Southern Methodist University. The principal contribution of the study is the geologic map (Pl. I).

Field work was done in the spring and summer of 1957. Areal geology was plotted directly on aerial photographs and then transferred to a controlled mosaic with a scale of one inch to one thousand feet. A tracing of the mosaic was then reduced to provide the final geologic map, on the scale of about two inches to the mile.

**Acknowledgments.**—Thanks are due to Professors Arthur Richards, James E. Brooks, and David L. Clark for direction and aid in the study, and in criticism of the manuscript. Donald F. Reaser and Ewing Snyder Jr. helped in the field work. Tobin Aerial Surveys of San Antonio, Texas, provided the controlled mosaic.

**Stratigraphy**

**Upper Chalk Member of the Austin Chalk.**—The Austin chalk in north central Texas has been divided into four units (Dallas Petroleum Geologists, 1941, p. 43). The youngest of these units, the upper chalk member, is the oldest bedrock in the Palmer Quadrangle. A maximum of 40 feet is exposed along stream channels in the northwestern portion of the quadrangle. The upper chalk consists of thick whitish-gray chalk beds alternating with thin bluish-gray marl and calcareous shales. The chalk beds are from 1 to 4 feet thick, averaging 3 feet. The marl and calcareous shale beds range from ½ to 2 feet thick, averaging 1 foot.

*Inoceramus* sp. is the dominant fossil found in the upper chalk in this area. It occurs as molds and in fragments throughout outcrops of the upper chalk.

A fragment of a mold of the large ammonite *Parapusozia* sp. was found as float on an unnamed branch of Bushy Creek (Loc. 4, Pl. I). From its position in the stream bottom, it must have weathered from the uppermost ten feet of the Upper Austin, as seen at this locality. Due to the disconformable relationship of the Austin and Taylor, an unknown thickness of the upper chalk is missing here.

The *Parapusozia* mold contained one complete and several incomplete specimens of "brittle-stars" or ophiuroids. Only eighteen species of ophiuroids have been described from the Cretaceous System, including three from Texas (Berry, 1941, p. 61). These are the first reported ophiuroids from the Austin chalk. Other specimens of *Parapusozia* sp.
were found in situ about 3 feet below the Austin-Taylor contact (Loc. 4, Pl. 1).

Marcasite concretions are seen occasionally in the chalk beds. They are not as abundant in the Upper Austin as in the middle Austin to the northwest, where they are locally larger and very common (Ingels, 1957, p. 11; Reed, 1957, p. 108).

**Austin-Taylor Contact.**—Earlier workers (Stephenson, 1929, 1937; Reaser, 1957; Peabody, 1957) have indicated a disconformable relationship for the Austin chalk and the overlying Taylor marl in Ellis County and central Texas. Their criteria have included stratigraphic thinning and variation in stratigraphic position of fossil zones in the Austin. The presence of a thin but persistent phosphatic-pebble bed between the two formations is also cited.

The only usable criterion in the Palmer Quadrangle is the phosphatic pebble bed. The other two could not be used, since so small a portion of the Upper Austin is exposed in the quadrangle that accurate thickness variations cannot be recognized. The contact zone is clearly exposed near the western edge of the quadrangle along Bushy and Red Oak Creeks (Localities 1, 4, 5, 6, 7, Pl. 1).

The phosphatic pebble bed is seen as a zone of reddish iron-stained clay or marl, containing numerous phosphate pebbles, phosphatized fossil molds and fragments, shark's teeth, and prisms of *Inoceramus* sp. The zone is typically 1/4 to 1 inch thick, but may be as much as 1 1/2 inches thick.

An excellent exposure of the contact zone may be seen on an unnamed tributary of Bushy Creek 3/4 mile southwest of the Farm Road 983 crossing of Bushy Creek (Loc. 4, Pl. 1). Fifteen to 20 feet of Upper Austin is overlain by 15 feet of Taylor, with the reddish marl zone marking the contact. At one isolated area on this stream channel, a mat of crystalline calcite is seen within the contact zone. The calcite contains *Inoceramus* prisms and phosphate pebbles. The calcite was possibly deposited by circulating ground water that dissolved the original marl matrix, and then precipitated the calcite around the pebbles and prisms.

The phosphatized fossils include sharks' teeth, corals, pelecypods, gastropods, and numerous fragments of cephalopods.

A petrified vertebra and several specimens which were tentatively identified as either petrified wood or bone were found adjacent to the contact zone at the exposure southwest of the Bushy Creek bridge (Loc. 4, Pl. 1). The specimens were not in place, and could have weathered from the Quaternary terrace.

Limestone fragments showing cone-in-cone structure were collected
from the weathered part of the contact zone at two exposures, one immediately north of the Bushy Creek bridge (Loc. 1, Pl. 1), the other along an unnamed tributary of Red Oak Creek 300 feet west of Farm Road 813 in the west central portion of the quadrangle (Loc. 6, Pl. 1). They are dominantly composed of dense calcite, with coatings of yellowish iron oxide.

Taylor Marl.—The Taylor marl in north-central Texas has been divided into four members: (a) the lower marl member of the Taylor, (b) the Wolfe City sand member, (c) the Pecan Gap chalk member, and (d) the upper marl member. The first two units are present in the Palmer Quadrangle.

There is a notable amount of confusion in the literature concerning the Taylor marl. This is primarily due to changes in lithology in this unit as seen along its outcrop pattern in north-central and northeast Texas. The author believes the first step in clarification would be as suggested in Richards & Albritton (1948, p. 67):

... since the Taylor contains rocks of such varied lithology as chalk, sand, and shale, as well as marl, it would more properly be called the "Taylor formation," or as Adkins called it (1932, p. 455), the "Taylor group."

The lower marl member underlies approximately 75 percent of the Palmer Quadrangle, and is the only unit of bedrock here for which a complete section is found.

(a) Lower Taylor Marl Member: The lower marl is a medium-gray to bluish-black marl, in beds from 1 to 4 inches thick. The marl weathers to yellowish-brown flakes, giving a "cracked" appearance on the sides of gullies, as noted by Hill (1901, p. 336). It has a sub-conchoidal fracture and distintegrates rapidly on exposure. Slopes formed on the marl thence show a greater number of gullies than those formed on the more resistant Austin and Wolfe City.

Due to flatness of terrain and bedrock, dip determinations were not possible. Using, however, a dip of $0^\circ 40'$ to the east, as compiled by the Dallas Petroleum Geologists (1941, p. 67) for neighboring Dallas County, the Lower Taylor is here about 430 feet thick.

Seams of caliche nodules are quite abundant in outcrops of the lower marl. Commonly the seams are thin and discontinuous, following bedding planes. The caliche is particularly abundant in the "B" and "C" soil zones, as seen at any outcrop of the member. It is derived from the concentration of CaCO$_3$ leached from the soil and the bedrock marl.

The carbonate content of 25 samples of the lower marl varies from 10 to 35 percent, with 17 percent as the average determined by dissolving the carbonate with dilute HCl. According to Pettijohn (1949, p. 286), "normally marls contain 25 to 75 percent. clay. Rocks richer in
clay may better be called calcareous clay or shale..." The lower marl is thus best described as a calcareous clay. For simplicity's sake, it is called a marl throughout this report.

Secondary gypsum is found on occasion in outcrops of the lower marl. It is seen as thin plates of crystals along bedding planes and joints.

Several structures believed to be either fuscoes or iron oxide concretions were found upstream from locality 4 (Pl. I). None was found in place. The largest is 12 by 3½ inches. They are tubular, commonly branching on one end. The outer rims are a hard limonitic layer, containing scattered grains of red iron oxide with a discontinuous mat of crystalline gypsum on the outer surfaces. The interiors are hard, calcareous, and sandy-textured, with discontinuous seams of iron oxide throughout. Possibly these structures were formed from iron sulfide concretions in the zone of oxidation.

Whitish-brown to buff limestone concretions are found in the uppermost part of the lower marl member (Localities 13, 14, 15, 18, 20, Pl. I). They are of ellipsoidal to roughly-tubular form, ranging up to 1½ feet in length and 1 foot thick in the larger masses. Wherever observed, the long dimension lies parallel to the bedding. The interiors are a hard, dense, bluish-gray calcite, with coarse crystalline calcite along internal fractures.

Inoceramus sp. and Ostrea sp. occur sporadically throughout the member.

At the Barron Brick Company clay pits at Palmer (Loc. 12, Pl. I), a 50-foot section of the Lower Taylor is exposed. The Lower Taylor is also well exposed at recent roadcuts of portions of the new route of U.S. Highway 75, in gullies draining into Red Oak, Grove, and Bushy Creeks in the western part of the quadrangle (Localities 8–10, Pl. I), and in a gully near U.S. 75 in the southeast part of the area (Loc. 19, Pl. I).

Lower Taylor-Wolfe City Contact: The contact of the lower marl member with the overlying Wolfe City is not seen at the type locality at Wolfe City, Hunt County, nor at any point further eastward (Dane & Stephenson, 1928, p. 44).

This writer has arbitrarily picked the Lower Taylor-Wolfe City contact in the Palmer Quadrangle on the criterion of the appearance of appreciable quantities of sand in the stratigraphic section. The hillside section two miles southeast of Palmer (Loc. 16, Pl. I) shows what is believed to be a transition zone from the Lower Taylor to the Wolfe City. The section is as follows:
4. Interbedded slabby calcareous sandstone and sandy marl.  
   Thickness (feet)  
   15.0  
3. Bluish-black marl, with laminae of unindurated calcareous sand.  
   40.0  
2. Hard fine-grained tan to gray calcareous sandstone (possibly lenticular)  
   0.5  
1. Bluish-black marl.  
   5.0  

Total thickness . . . . . . . 60.5

Bed 1 is interpreted as Lower Taylor marl. Beginning with Bed 2, sand appears in the section. Bed 4 represents a typical Wolfe City section for the Palmer Quadrangle. Thus the arbitrary contact is placed between Beds 1 and 2. Nowhere else in the quadrangle is this section exposed.

The concretions in the uppermost Lower Taylor (supra) seem to occur in a discontinuous zone some 10 to 30 feet below the Wolfe City contact. At localities 14, 17, and 20 (Pl. I), the concretions are found in beds which are within this 20-foot zone. At locality 15 (Pl. I) on the north side of Grove Creek, the concretions are abundant in gullies in the Lower Taylor. Fragments of calcareous sandstone are scattered about the surface in this area, and are believed to be erosional remnants of the Wolfe City which conceivably was once present there. Thus, wherever concretions were found, the Wolfe City is usually closely adjacent, and hence were used as a guide in mapping the contact.

Numerous phosphate pebbles, including phosphatized gastropods and cephalopod fragments, were collected from a general zone 3 to 7 feet above the zone of concretions at a roadcut 2½ miles southeast of Palmer (Loc. 17, Pl. I). This is the only place along the Lower Taylor-Wolfe City contact area where phosphate pebbles were found.

(b) Wolfe City Sand Member. This unit was named by Stephenson (1918, p. 155, the type locality being near the town of Wolfe City, Hunt County) who stated: "The Wolfe City sand member of the Taylor marl consists of 75 to 100 feet of fine calcareous sand or sandy marl with a few round, oval, or irregular concretions of calcareous sandstone."

The Wolfe City in the Palmer Quadrangle is (estimated) 70 feet thick. Typical exposures in the southeast corner of the quadrangle (Localities 16, 21, 22, Pl. I) show thin beds of slubby fine-grained sandstone alternating with thicker beds of sandy marl. The calcareous sandstone is a light bluish-gray on fresh fracture, brown on weathered surfaces. These beds attain a maximum thickness of 1 foot. The sandy marl is gray to bluish-black on fresh fracture and weathers brown. These beds have a maximum thickness of 4 feet.

Four samples of the calcareous sandstone averaged 45 percent, by weight soluble in dilute hydrochloric acid. The non-calcareous residue
consists of predominantly angular to subangular grains of quartz, with lesser amounts of feldspar, mica, and glauconite. Heavy minerals constitute less than 0.1 percent. by weight of the samples examined. Magnetite was the dominant material, with a few grains of zircon. An average of 70 percent. by weight of the non-carbonates fell in the 1/8 to 1/16 millimeter size-range and 20 percent. is less than 1/16 millimeter in diameter. Clay lenses to ½ inch in length are found in the calcareous sandstone.

The sandy marl averages 78 percent. of non-calcareous material, from treatment of four samples. An average of 35 percent. of the residue lies in the 1/8 to 1/16 millimeter size-range; 58 percent. is less than 1/16 millimeter in diameter. The composition of the sand-size particles is essentially the same as in the calcareous sandstone: predominantly quartz with some feldspar, mica, and glauconite.

Fucoidal structures are found in the calcareous sandstone beds. They are tubular in form, commonly branching, and composed of calcareous sandstone.

Indistinct fossil molds are occasionally seen in the Wolfe City; but no identifiable fossils were found.

Quaternary Deposits.—Terrace clays and recent alluvium represent the Quaternary in the area. The terrace clays cover a large portion of the quadrangle. Broad flat plains extending east and west from Trumbull and Palmer are mantled by the clays. They were largely derived from the Taylor marl, are yellowish-brown, poorly bedded, and contain sand lenses, well-rounded quartz pebbles and Inoceramus prisms. Caliche pebbles and seams are very common. The terrace clays can be distinguished from the underlying Taylor marl by their lack of bedding and the presence of clastic lenses. They erode into vertical-sided gullies which are never found in the Taylor marls. A 20-foot section is exposed 1½ miles northeast of Trumbull (Loc. 11, Pl. 1). There are good exposures in roadcuts for the new route of U.S. Highway 75.

In the area underlain by the Upper Austin chalk, the terrace contains numerous disseminated chalk pebbles and pebbles and fragments in lenses. Here the clays have a more whitish cast than those underlain by the Taylor marl. Recent alluvium of the floodplains is dark brown to black.

Structure

The Upper Cretaceous strata in the quadrangle dip gently to the east at about 60 feet to the mile.

Faults.—Normal faults are quite common in the Austin chalk, most having but small displacement. Calcite veins preserving slickenside and
mullion structures are commonly seen along the fault planes. Quite probably the Lower Taylor is also somewhat faulted. Outcrops, however, are scarce and no faults were observed.

On a branch of Bushy Creek in the northwest corner of the quadrangle (Loc. 3, Pl. I), a brecciated zone striking N 63° E is exposed in the creek bottom. To the northwest for 100 feet the beds dip 6° toward the brecciated zone and to the southeast the beds dip 25° northwest into the brecciated zone. There is no distinctive bed here, so no offset in the fault could be determined, and no fault plane could be found to indicate the dip of the fractured zone.

About one-fourth mile upstream (Loc. 2, Pl. I) along the same branch of Bushy Creek, an anomalous dip in the chalk of 20° to the east suggests another fault and is so shown on the map. Exposures here are so poor that no fault could be found.

![Strike-Diagram of 115 vertical joints in the Upper Austin Chalk of the Palmer Quadrangle.](image)

Because of scale, four closely spaced faults seen at the locality southwest of the Bushy Creek bridge (Loc. 4, Pl. I) could not be shown separately on the map. They are generalized as one fault striking northeast. All four of these faults are downthrown to the north with offsets of the Austin-Taylor contact of from 10 to 20 feet. These faults are clearly exposed because of the striking lithologic change across them from the white Austin to gray Taylor.

Two faults were mapped in the area west of Farm Road 813 in the west central portion of the quadrangle. At both, the Austin-Taylor contact is offset a minimum of 5 feet.

Workers to the west and north of the Palmer Quadrangle in Ellis and Dallas Counties (Ingels, 1957; Peabody, 1957; Reaser, 1957; Reed, 1957) have mapped a number of northeast-trending normal faults. In most instances, the downthrown block is to the northwest.

The Balcones fault system has been extended through Ellis and Dallas counties as far north as Rockwall County by Fohs (1923, p. 715) and
Foley (1926, p. 1261). Sellards (1934, p. 49) reports a zone of faulting from McLennan County through Collin County.

As concluded by Ingels (p. 15), Reaser (p. 91), and Reed (p. 112), in all likelihood the fault pattern in Dallas and Ellis counties, including the Palmer Quadrangle, is a northeastern extension of the Balcones fault system.

Joints.—The upper chalk member of the Austin has many joints. Most are vertical and straight, or nearly so; but a few are curved. The strikes of 115 joints were taken in the Upper Austin (Fig. 2). Eighty-two of these strike to the northeast and 33 to the northwest. The northeast joints have two dominant trends: 60 trend between N 60° and 85° E. For the northwest-trending joints, 23 trend between N 20° and 50° W and 10 N 80° W.

Fewer joints were seen in the lower marl and the Wolfe City because of the scarcity of outcrops. The strikes of 60 joints were taken in the Lower Taylor; 25 tended to the northwest, 35 to the northeast. The major groups are: 7 between N 70° and 80° E, 8 between N 50° and 60° E, 10 at N 10° E, and 23 between N 45° and 55° W. The strikes of 6 joints all trending N 65° E were taken at one small exposure of the Wolfe City.

The trends of a total of 181 joints were taken in the quadrangle. Three principal trends are notable: 80 between N 55° and 85° E, 39 at N 10° E, and 42 between N 30° and 55° W.

Summary

The Austin chalk and the Taylor marl of Upper Cretaceous age constitute the bedrock of the Palmet Quadrangle. About 40 feet of the upper chalk member of the Austin, consisting of massive chalk beds interbedded with thin beds of marl and calcareous shale, crop out here. Several specimens of rare "brittle-stars" or ophiuroids were collected from the Upper Austin.

The Upper Austin is disconformably overlain by 430 feet of blue-black Lower Taylor marl. The disconformity is indicated by a thin but persistent reddish marl zone containing numerous phosphate pebbles and phosphatized fossils.

Some 70 feet of the calcareous sandstone and sandy marl of the Wolfe City member of the Taylor conformably overlies the Lower Taylor. The lowest sandy bed is considered to be the basal unit of the Wolfe City member. A zone of limestone concretions in the uppermost Lower Taylor was also used as a stratigraphic marker.

Quaternary terrace clays and recent alluvium cover an appreciable portion of the area. The terrace consists primarily of reworked Taylor
marl, with some chalk pebbles in marly clay where the terrace overlies the Upper Austin.

Several faults in the northwest part of the quadrangle are interpreted as belonging to the Balcones zone.

There are three dominant joint-trends in the area: N 30° to 55° W, N 55° to 85° E, and N 10° E.

REFERENCES


DALLAS PETROLEUM GEOLOGISTS, 1941, Geology of Dallas County, Texas: Field & Lab., v. 10, no. 1, 134 pp.


FOHs, F. J., 1923, Structural and stratigraphic data of northeast Texas petroleum area: Bull. Econ. Geol., v. 18, no. 8, pp. 709-731.


WEBER, L. C., 1957, Geology of the Midlothian Quadrangle, Ellis County, Texas: Field & Lab., v. 25, no. 4, pp. 105-114.


STEPHENSON, L. W., 1918, A contribution to the geology of northeastern Texas and southern Oklahoma: U.S. Geo. Survey Prof. Pap. 120, pp. 125-163.


Biological Notes

FIRST RECORDS OF FOUR EAST-EUROPEAN LINNAEAN PLANTS AT DALLAS, TEXAS.—The following species of plants were recently found by me, growing along a creek that runs through Kidd Springs Park, in the Oak Cliff section of Dallas: *Myagrum perforiatum* L. (26Apr1958), *Scandix Pecten-Veneris* L. (16Apr58), *Bupleurum roundifolium* L. (24Apr58), and *Asterella arvensis* L. (24Apr58). All of the species are native to Europe and the Near East. The first 3 species are "new" to Dallas County; the last species is new to the State of Texas. The soil in which the plants were collected contained limestone and calcareous clay. Collections are deposited in the Southern Methodist University Herbarium.

*Myagrum perforiatum* L. has been reported previously from black clay in fields and along roads in Denton County (L. H. Shinnars, *Spring Flora of the Dallas-Fort Worth Area, Texas*, 1958, 163). My plants were occasional, becoming rare in the latter part of May. *Scandix Pecten-Veneris* L. has previously been reported as adventive near Houston (L. Constante, *Flora of Texas, 5, 293, 1951*). *Bupleurum roundifolium* L. has been widely introduced in the eastern and central United States, and sporadically introduced in southern Texas (Constance, *op. cit.*, 1951, 283). It is now recorded from Dallas County. *Asterella arvensis* L. (fide Gustave Hegi, *Illustrierte Flora von Mitteleuropa, VI*, 199, 1913) is a native of middle and southern Europe, north Africa, and western Asia, "extremely widespread and often erratic in loamy and lime-containing fields..." It will be seen above, that the species with us in Dallas County was collected from limy-clay soil. The *New Britton & Brown Illustrated Flora, 3, 282, 1952* reports this species
GEOLOGIC MAP OPALMER QUADRANGLE
ELLIS COUNTY, TEXAS