# FIELD & LABORATORY

Volume XXV October, 1957 Number 4


## Geology of the Ferris Quadrangle, Dallas and Ellis counties, Texas


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ABSTRACT

The Ferris Quadrangle in southern Dallas and northern Ellis counties, Texas, is underlain by the Austin Chalk and Taylor Marl, both of Upper Cretaceous age. Two members of the Austin, the middle marl and the upper chalk, along with the lower blue-gray unit of the Taylor Marl, crop out within the area.

The Austin-Taylor contact, within the area in Dallas County, is transitional and consists of chalk and marl sequences intermediate in lithology between the two formations. The contact in Ellis County is marked by a reddish-brown clay zone containing phosphate nodules, indicating an unconformity.

Approximately one-half of the area is covered by two Quaternary terraces and recent alluvium.

A large, northeast-trending, normal fault with a minimum displacement of 150 feet is exposed on Bear Creek in the southwest corner of the quadrangle. Taylor Marl has been downfaulted on the northwest against Austin Chalk on the southeast. It is probably a part of the Balcones Fault System.


The Ferris Quadrangle is in the southeastern part of Dallas County and in the adjacent northeastern part of Ellis County (Fig. 1). It is bounded by parallels 32° 30′ 00″ and 32° 37′ 30″ north and meridians 96° 37′ 30″ and 96° 45′ 00″ west and includes approximately 58 square miles. Ferris, the largest community in the area, is in the southeastern part of the quadrangle in Ellis County. Wilmer, Patrick and the eastern edge of Lancaster are the only other towns in the quadrangle.

U.S. Highway 75, which crosses the quadrangle from north to south, is the most heavily traveled road. Of importance also is Belt Line Road, which crosses the area from Lancaster on the west to the Trinity River on the east.

The area is dissected by Cottonwood, Ten Mile and Bear creeks, which flow from west to east across the quadrangle and empty into the Trinity River. All creeks are intermittent and flow for only a short period after rains. The Trinity River crosses the extreme northeast corner of the quadrangle and is the only perennial stream. Drainage is largely dendritic but in some areas of Austin Chalk the streams are fault-controlled.

Topographically, the area rises from the low Trinity River floodplain to a broad flat terrace which covers a large part of the Dallas County portion of the quadrangle. The terrace lies largely between Cottonwood and Ten Mile creeks and extends westward across the quadrangle to Lancaster. Below Ten Mile Creek the topography changes to rolling, grass-covered hills of Taylor Marl with highly dissected slopes. The area underlain by the Austin Chalk consists of smooth broad hills whose crests are usually held up by resistant strata.

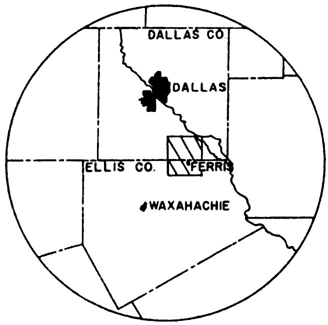


FIG. 1. Index Map, showing location of the Ferris Quadrangle.

Field work was done during the summer and early fall of 1956. Geology was plotted on aerial photographs and transferred by means of a vertical sketchmaster to a base map having a scale of four inches to the mile. The map thus obtained was reduced by one-half to produce the geologic map included with this report (Pl. 1).

I desire to express my sincere appreciation of Arthur Richards, James E. Brooks and David L. Clark, Department of Geology, Southern Methodist University, for suggestions and criticisms in the field and in the preparation of the manuscript; as well as of Jerome J. C. Ingels, Thomas E. Williams and James A. Pitkin for help in field work. I am also indebted to Edgar Tobin Aerial Surveys, San Antonio, Texas, for photo-mosaics of the quadrangle.

## Stratigraphy

*Middle Marl Member of the Austin Chalk.*—The Austin Chalk was designated "Austin limestone" as early as 1860 by B. F. Shumard in describing the limestone exposed in the vicinity of Austin, Texas. White (1887, p. 40) and Taff (1893, p. 305) also refer to the chalk as Austin limestone. In early papers R. T. Hill referred to it as Rotten limestone

(1887a, p. 297, 300; 1887b, p. 292), Dallas limestone (1887a, p. 298), and Austin-Dallas chalk (1889a, p. XIII; 1889b, p. 112; 1892, p. 71). When it became apparent that the strata could be traced from Dallas to Austin, Shumard's name was adopted and all others discarded. The chalk is approximately 600 feet thick in Dallas County and has been subdivided into four parts by the Dallas Petroleum Geologists (1941, p. 43).

The oldest rocks exposed in the quadrangle are those belonging to the middle member of the Upper Cretaceous Austin Chalk. Outcrops of this unit are confined to the northwest corner of the area in the vicinity of Lancaster. The best exposures are found along the banks of Ten Mile Creek and an unnamed branch of the creek which flows behind Edgewood Cemetery.

The member consists of gray marl and calcareous shale interbedded with layers of chalk. The weak marly beds are from two to four feet thick and weather to a flaky clay. The resistant chalk layers are from one to three feet thick and weather white to cream color.

*Gryphaea* sp. and *Inoceramus* sp. are the most common fossils found in place; occasionally *Exogyra ponderosa* is found as float. Pearly-white, fibrous fragments of the prismatic shell layer of *Inoceramus* are especially abundant.

Marcasite nodules are abundant in the middle marl. They weather to a powdery limonite, which stains the enclosing rock yellowish-brown.

The contact between the middle marl and upper chalk appears to be gradational, and at no outcrop was the transition clearly shown. Within the transition zone are hard, dense clastic limestone beds 6–8 inches thick containing *Gryphaea* sp. and *Inoceramus* prisms.

*Upper Chalk Member of the Austin Chalk.*—The upper member crops out primarily in the western half of the quadrangle. It is exposed in all creeks and in several abandoned chalk quarries. The upper Austin differs from the middle Austin primarily in being more massive in its lower portion. These massive chalk beds vary in thickness from one to five feet and are separated by thin beds of marl and calcareous shale. On fresh exposure the chalk is light bluish-gray but weathers almost pure white.

Fractures in the massive chalk units are subconchoidal to conchoidal. By differential erosion of hard chalk and soft marly layers, the upper Austin develops into prominent, resistant ledges separated by deeply indented recesses. The resistant beds spall into thin sheets or plates, producing rounded ledges.

*Inoceramus* sp. is the dominant fossil in the upper Austin, and occurs chiefly as molds and isolated fragments or prisms in the chalky layers. Specimens 12 to 18 inches in diameter are common.

Smith (1955, p. 15), studying the Austin Chalk regionally, found that the uppermost strata of the upper chalk member consist of impure chalk beds interbedded with marly units. The marly beds attain a thickness of four feet. He noted that this lithologic sequence of chalk and marl is similar to the upper part of the middle marl member.

The present writer found that the uppermost strata of the upper chalk contain the curved fossil annelid *Hamulus* sp., the pachydont *Durania* sp. and the large ammonite *Parapusozia* sp. The ammonites are 35 to 40 inches in diameter and lie parallel to the bedding. One specimen measuring 35 inches in diameter was found along Cottonwood Creek (Loc. 1, Pl. 1). Smith (1955, p. 16) found that *Parapusozia americana* Scott ranged through the upper 40 feet of upper chalk into the base of the Taylor Marl. Pachyodont fragments are common on weathered outcrops of the uppermost Austin Chalk. One large complete specimen was found in a marly bed near the Austin-Taylor contact at the intersection of Hash road and a branch of Ten Mile Creek (Loc. 4, Pl. 1).

Marcasite concretions, similar to those in the middle marl, are also found in the upper chalk. Numerous examples of branching, twiglike forms were noted in the uppermost chalky layers.

Clastic limestones occur in the upper chalk and appear to be more frequent in the uppermost strata. In Bear Creek near the western edge of the quadrangle a black clastic limestone one foot thick is exposed for approximately 180 feet (Loc. 7, Pl. 1).

*Austin-Taylor Contact.*—The Austin-Taylor contact, within the area studied in Dallas County, is transitional and is distinctly different from the abrupt Eagle Ford-Austin contact to the west. The contact zone consists of a sequence of interbedded layers of chalk and marl which is not characteristic of either formation.

The best exposure of this transition zone is along Cottonwood Creek in the northern outskirts of Wilmer, where the Taylor outcrop consists of 15 to 20 feet of bedded, blue-gray

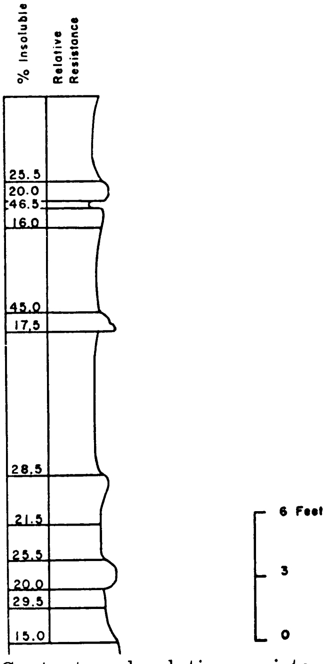


FIG. 2. Insoluble Content and relative resistance of Austin-Taylor transition zone exposed along Cottonwood Creek (Loc. 2, Plate 1).

marl (Loc. 1, Pl. 1). Upper Austin Chalk appears in the stream bottom 300 yards upstream (Loc. 2, Pl. 1). Between these outcrops of typical Taylor Marl and typical Austin Chalk are 30 feet of transitional beds. Insoluble residue analyses of strata exposed here show the lithology, using Pettijohn's (1957, p. 410) classification, to vary from marly limestone to marl (Fig. 2). This outcrop is the one measured by Shuler (1918, p. 20) and by Smith (1955, Sec. No. 23, Fig. 2, p. 18). Shuler designates the locality as the Austin-Taylor contact but the exact position vertically is not clear. Smith arbitrarily includes the transitional strata in the uppermost Austin Chalk and places the contact at the base of the marl sequence.

Stephenson (1937, p. 139) found the Austin-Taylor contact in Dallas County to be marked by a granular limestone bed varying in thickness from less than one to six inches and containing scattered shells of *Diploschiza* sp., shell fragments of *Inoceramus* sp. and ostreids. He interpreted the limestone bed as lying at the base of the Taylor. Along Prairie Creek, approximately eight miles north of the quadrangle, Stephenson found an angular discordance between the limestone bed and underlying chalk and postulated an unconformity. However, no criteria for an unconformity were seen within the area of the Ferris quadrangle in Dallas County.

The Dallas Petroleum Geologists (1921, p. 60) investigated the exposure at locality 2 and found that:

> The upper beds of the Austin are of gray calcareous shale and impure chalk weathering light gray to nearly white. These grade with no apparent break into softer buff and brownish calcareous clay-shale of the lower Taylor. At one place a limestone concretion two feet across was found in the lower Taylor beds directly above the contact, but aside from this there is nothing to mark the boundary between the two formations aside from the lithological differences just noted.

This section was mapped as uppermost Austin Chalk by the present writer.

In Ellis County the Austin-Taylor contact is marked by a reddish-brown clay zone one to three inches thick, containing reworked *Inoceramus* prisms and phosphatic nodules. Some nodules are identifiable as ammonite fragments which have been replaced by phosphate. This distinctive zone is best shown along a small branch of Bear Creek north of locality 9. According to Krumbein (1912, p. 60) and Stephenson (1929, p. 1325), the presence of phosphate nodules is evidence for an unconformity. Stephenson (1929, p. 1330) found that a phosphatic conglomerate at the base of the Taylor could be traced northward through Ellis County nearly to the Ellis-Dallas county line, where it is pinched out.

*Taylor Marl.*—The Taylor Marl was first called the Blue Bluff divisions and Exogyra Ponderosa Marls by R. T. Hill in his papers of 1887 and 1889 (1887a p,. 298; 1889a, p. XIII; 1889b, p. 114) and later renamed the Taylor Marl by him in 1891 (1892, p. 73). The type locality of the Taylor is at Blue Bluff on the Colorado River, six miles east of Austin, Travis County, Texas (Adkins, 1932, p. 455). According to reported well borings and estimates of the normal dip, the marl is approximately 1200 feet thick (Hill, 1889b, p. 115).

The only unit cropping out within the study area is the lower member of the Taylor. At the base it consists of light gray to buff marl, which weathers into small flakes. The lowermost marls are relatively high in calcium carbonate but are overlain by darker, medium gray to blue-gray marls which have a lower carbonate content.

Small specimens of *Inoceramus* sp. and *Ostrea* sp. were found preserved in the basal Taylor. At some localities partings of yellowish-brown, fine-grained standstone were seen. Yellow to buff limestone concretions also occur in the Taylor and are abundant along a gully about two miles east of Ferris (Loc. 6, Pl. 1). The concretions vary in shape but are commonly egg-shaped masses *ca.* 8–10 inches in diameter. The interiors are usually light gray limestone containing fractures filled with crystalline calcite.

The best exposures of Taylor are those found in clay pits near Ferris. As seen in the Acme Brick Company's pits, approximately 75 feet of Taylor is exposed and consists of bedded, blue-gray marl which weathers to a yellowish-brown clay. It has a blocky, subconchoidal fracture. On dry outcrops the weathered marl has a "crackled" appearance as noted by Hill (1901, p. 336). The clay used in brick making is obtained primarily from a zone 70 to 80 feet thick, which is located approximately 100 feet above the Austin-Taylor contact (Shuler, 1918, p. 38). This particular zone is especially suitable for brick clay due to its low lime content (Ries, 1908, p. 62).

Secondary gypsum is found in weathered outcrops of marl. It occurs mainly as clusters of crystals on the weathered surface. In the Acme clay pits veins up to one inch thick are seen along joints and bedding surfaces.

*Quaternary Deposits.*—The Quaternary is represented by the Love Field and Carrollton terraces (Taggart, 1953) and the recent alluvium. The Love Field terrace is the most extensive. From Wilmer south to Ten Mile Creek it is a broad well-defined surface about 60 feet above the Trinity floodplain. These deposits consist primarily of yellowish to light brown sand and sandy clay with gravel at the base containing quartzite pebbles, petrified wood, and fossil fragments. Locally this basal gravel is tightly cemented with calcium carbonate. This terrace overlies Taylor Marl throughout most of the area. Indentification of the Taylor in poor exposures is difficult due to the similarity of the weathered marl and terrace clay. However, it was found that the terrace clay in drying develops closely spaced vertical cracks while the Taylor has a bedded appearance.

Caliche occurs in the terrace and may develop into three-inch nodules. Commonly, the nodules are less than one-quarter inch in diameter and are widely scattered on weathered outcrops.

The best exposure of the terrace is along Bear Creek, where approximately 20 feet of terrace overlies Taylor Marl (Loc. 10, Pl. 1). Good exposures may also be seen near Wilmer (Loc. 2, Pl. 1) and at the intersection of Cottonwood Creek and Pleasant Run road.

The Carrollton terrace is found as remnants about 10 feet above the Trinity floodplain. Deposits consist of red to light brown clay, sand and gravel. Commercial gravel pits in the northeast corner of the quadrangle offer the best exposures.

Alluvial deposits in the present Trinity River floodplain consist of dark-gray to black silty clay, rich in organic matter, underlain by several feet of clay, sand and gravel. Locally, along Bear Creek, the alluvium contains chalky gravel which is used for road construction.

## Structure

The Cretaceous strata in Dallas County strike north-northeast and dip approximately 60 feet per mile to the east (Dallas Petroleum Geologists, 1941, p. 67).

Normal faults are common in the Austin Chalk but most have small displacement. Calcite veins usually fill the openings along faults, and slickensides on the fault surface are preserved on the outer surfaces of the calcite.

*Bear Creek Fault.*—A large northeast trending fault in the southwest part of the quadrangle crossing Bear Creek (Loc. 8, Pl. 1) has here been named the Bear Creek Fault. It is exposed in a 40-foot cliff on a meander scar, and is the largest fault found, thus far, in the near vicinity of Dallas. Taylor Marl on the northwest is downfaulted against upper Austin Chalk on the southeast.

The fault strikes north 47° east and dips 63° to the northwest. Slickensides and mullion structures are conspicuous on the face of the cliff. Downstream from Bear Creek Fault, beds of upper Austin Chalk dip 30° to 35° to the west. This reversal of dip can be traced for approximately 100 feet, at which point the beds once again return to their normal, gentle eastward dip. The apparent throw as seen in the cliff is a minimum of 40 feet, but the relationship of the Taylor to the dragged Austin downstream indicates a minimum throw of 150 feet.

Crystalline calcite fillings up to 8 inches thick occur in the fault zone. These slickensided fillings were probably deposited by solutions circulating along open cracks. Brecciated chalk along the fault plane shows evidence of healing by thin veinlets of calcite.

To the northeast and southwest the fault is concealed for about one-half mile by Quaternary terrace deposits. The fault cannot be traced farther to the northeast, but in the southwest corner of the quadrangle it can be seen crossing two unnamed stream branches. Near this major fault there are minor parallel faults of the same trend with throws of one to five feet.

Bear Creek has formed an unusual meander within the faulted area, indicating local fault control of the stream course. It is probable that the stream abutted against the faulted, resistant Austin Chalk and was for a short distance deflected northward along the relatively soft Taylor Marl. The center of the stream meander is covered by recent alluvium, but blue-gray Taylor Marl may be seen below the alluvium during the dry season.

Other major faults trending in a northeasterely direction have been located by Jerome J. C. Ingels, Louis C. Reed and William W. Peabody (oral communications), graduate students at Southern Methodist University mapping to the west and southwest of the Ferris Quadrangle. In a personal communication to Sellards (1934, p. 49), D. C. Barton stated that he had traced a zone of fracturing and minor faulting northward from Waco passing near Italy in Ellis County and near McKinney in Collin County. The general trend of the Balcones Fault Zone is northeastward and, if the trend is projected into Ellis and Dallas counties as indicated by Fohs (1923, Pl. 12), and Foley (1926, p. 1262, Fig. 1) the projection would pass diagonally across southeast Dallas County. Due to the magnitude and orientation of the Bear Creek Fault, it is probably a part of the Balcones Fault System.

*Joints.*—Joints are numerous in both the Austin Chalk and Taylor Marl. They are fairly straight and most are nearly vertical. Curved types occur but are less common than the straight type. The predominant joint trends are N. 35° E. and N. 55°–85° W.

Downstream from Bear Creek Fault (Loc. 8, Pl. 1) the strikes of 30 joints in the upper Austin Chalk were recorded. It was found that 25 were orientated between N. 40°–80° E. and 5 were essentially E-W in alignment.

Regularly spaced vertical joints in the Austin-Taylor transition zone at locality 2 (Pl. 1) are aligned N. 20°–35° E. and stained buff by surface water moving along the fractures. The strikes of twelve relatively straight joints in the Acme clay pits near Ferris (Loc. 5, Pl. 1) have two principal trends, N. 30° E. and N. 55° W.

## Summary

The Ferris Quadrangle is underlain by the Austin Chalk and Taylor Marl, both of Upper Cretaceous age. Two members of the Austin, the middle marl and the upper chalk, along with the lower blue-gray unit of the Taylor Marl, crop out within the area.

The Austin-Taylor contact, within the area in Dallas County, is transitional and consists of chalk and marl sequences intermediate in lithology between the two formations. The contact in Ellis County is marked by a reddish-brown clay zone containing phosphate nodules, indicating an unconformity.

Approximately half of the area is covered by two Quaternary terraces and recent alluvium. The Love Field terrace, approximately 60 feet above the Trinity floodplain, is well developed near Wilmer. There are only small remnants of the low Carrollton terrace.

Northeast-and-northwest-trending vertical joints are numerous. A large northeast-trending, normal fault with a minimum displacement of 150 feet is exposed in the southwest corner of the quadrangle. It has been named the Bear Creek Fault in this paper. Taylor Marl has been downfaulted on the northwest against Austin Chalk on the southeast. It is probably a part of the Balcones Fault System.

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# Gustavus Wilhelm Wuerdemann (1817-59), Early Naturalist of the U.S. Coast Survey

*S. W. Geiser*

The recent appearance of Wraight & Roberts' sequicentennial historical account of the U.S. Coast & Geodetic Survey[1] calls to mind the splendid natural-history collections that G. W. Würdemann, tidal-observer and meteorologist, made during the years 1844 to 1859, especially in Texas, Louisiana, and Florida. As no extended biographical notice of this naturalist has appeared in the nearly one-hundred years that have passed since his death, the present note may be of interest to students of the history of scientific exploration in the early South and Southwest.

At a meeting of the Board of Regents of the Smithsonian Institution in 1859, Alexander Dallas Bache, Superintendent of the U.S. Coast Survey, made remarks on Würdemann's work, not only as it pertained to the Survey, but

[1]A. J. Wraight and E. B. Roberts, *The Coast and Geodetic Survey, 1807-1957*. Washington, Government Printing Office, 1957. (90 pp.)

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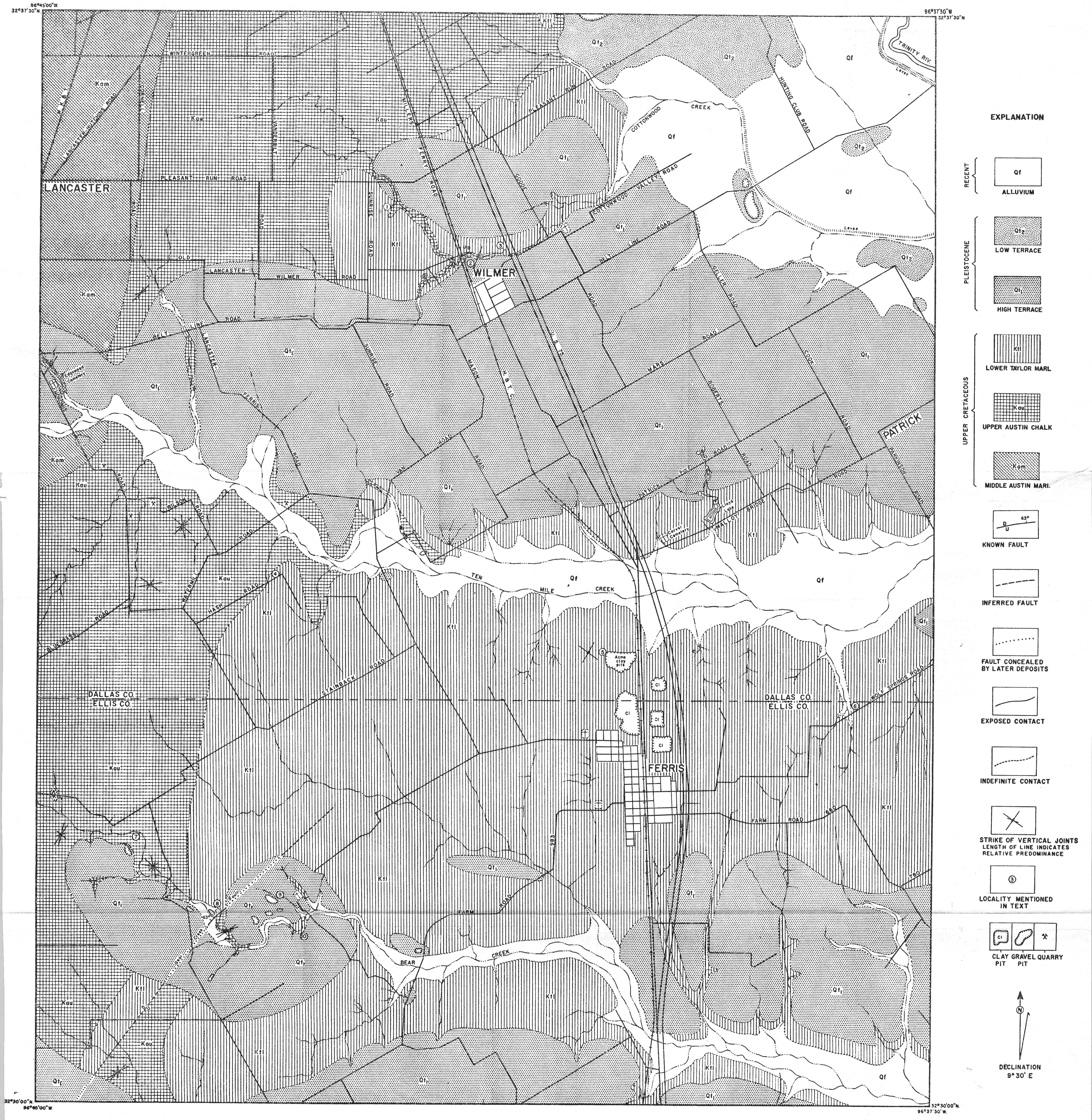
PLATE I




# GEOLOGIC MAP OF FERRIS QUADRANGLE

## DALLAS AND ELLIS COUNTIES, TEXAS

AREAL GEOLOGY BY
DONALD FREDERICK REASER
SUMMER AND FALL
1956

BASE MAP FROM
TEXAS HIGHWAY DEPARTMENT

SCALE

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MILES