The Geology of the Lancaster Quadrangle of Dallas and Ellis counties, Texas

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Introduction

Location.—The Lancaster Quadrangle is in southwestern Dallas County and northwestern Ellis County. It is bounded on the north by parallel 32° 37' 30"; and on the south by parallel 32° 30' 00"; on the west and east by meridians 96° 52' 30" and 96° 45' 00", respectively.

Methods of Study.—The field work was done during the summer and fall months of 1956. A state highway map of Dallas and Ellis counties was used as the base map for this study. The geology was plotted on aerial photographs and later transferred to the base map with the aid of a vertical sketchmaster. Contacts between various stratigraphic units exposed in the area were designated on the basis of the following criteria. Difference and abundance of vegetation, though unreliable alone, was used for distinguishing different types of lithology when used in conjunction with other factors. In some cases, soil color played a minor role as the distinguishing factor. In some instances relative resistance to erosion provides a tentative criterion for correlation in the Austin Chalk.

Seven stratigraphic sections were measured in detail by the author and Thomas E. Williams, along a line approximately normal to the regional
strike of the beds. These sections were measured with a steel tape, and each recognizable lithic unit was sampled. Samples later were crushed and one hundred grams of each were treated with dilute HCl until all carbonates were digested. The insoluble residue was filtered and washed to remove the calcium chloride, and then dried and weighed.

Accessibility.—The Lancaster Quadrangle is accessible from north and south by U.S. Highway 77 and State Highway 342, and from the east by Farm Road 1381. The quadrangle is also transected by a series of hard-surfaced, gravel and dirt roads; but only that part of the quadrangle in Dallas County has all-weather roads.

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Physiography

The topography is gently rolling for the most part; there are also areas of relatively flat surfaces that seem to be due to a combination of factors, such as slight dip of resistant beds and terracing. Interesting features of the area are low northwest-facing cuestas, which are due to the truncation of beds having a slight regional dip to the southeast. The maximum relief of the area is approximately 150 feet; the most abrupt relief being along the streams.

The drainage system of the quadrangle consists of four main streams; Ten Mile Creek, Bear Creek, Little Creek, and Red Oak Creek, all of which drain into the Trinity River to the east.

Stratigraphy

Introduction.—The rocks exposed at the surface in the Lancaster Quadrangle range from Upper Cretaceous to Quaternary in age. Quaternary sediments are principally flood-plain alluvium and terraces. The Cretaceous rocks are represented by the chalk and marl of the Austin which crop out in the quadrangle except where covered by Quaternary sediments.

Cretaceous System

Austin Chalk.—Dr. B. F. Shumard in 1860 first applied the name “Austin limestone” to the limestone exposed at Austin, Texas (Adkins, 1932). This formation has subsequently been known by several names. After the continuity of the formation between Dallas and Austin was
demonstrated, later names were dropped and Shumard’s designation permanently adopted.

As exposed in the Lancaster Quadrangle, the lithology of the formation designated as the “Austin Chalk” is not predominantly chalk. It is a heterogeneous mixture of marls and marly limestones. Therefore, following the recommendation of the American Committee on Stratigraphic Nomenclature (1956), it is suggested that the name Austin Chalk, be replaced by Austin Formation.

Stephenson (1937) states that in Dallas County the Austin Chalk has a minimum thickness of approximately six hundred feet. Until further studies warrant assigning formal names to the members of the Austin Chalk, the divisions informally recognized by the Dallas Petroleum Geologists (1941) will be used in this paper; namely, the upper chalk, 280 feet thick; the middle marl, 220 feet thick; the lower chalk, 200 feet thick.

**Lower Chalk.**—The lower chalk member consists of nearly pure white, massive chalky limestone beds alternating with thinner beds of gray to white marl and tan shale. The chalk beds are from eight inches to four feet thick and average about two feet in thickness. There are many good exposures of the lower chalk along streams within the area. On fresh exposures the rock is soft and gray; upon weathering, it becomes white and much more highly indurated.

**Middle Marl.**—The middle marl consists of a gray to buff marl or calcareous shale sometimes containing thick, well-indurated, marly limestone beds. Upon exposure this member weathers to finely laminated debris. The middle marl contains many beds which consist largely of fossils and fossil fragments, especially species of *Inoceramus* and *Gryphaea*.

**Insoluble Residue Analysis.**—Seven field sections of the middle marl were measured across the regional strike of the member. Bed-by-bed insoluble-residue studies were made of each section in the hope of detecting significant variations in lithology of possible use in correlation.

Unfortunately no such consistent characteristics were noted from these studies. Laboratory study and field observations demonstrate no single representative lithology for the middle marl. It is, rather, characterized by heterogeneity, and may be distinguished from the overlying and underlying members on this basis. Contacts between the middle marl and lower and upper chalk seem to be gradational except where channelling has produced local distinct contacts.

**Upper Chalk.**—The upper chalk appears to be quite similar lithologically to the lower chalk. According to Smith (1955), the uppermost
portion is distinctly marly; but this part is not exposed in the quadrangle.

*Channel and Fill Structures.*—Several linear troughs of more or less symmetrical cross-section, similar to those discussed by Bryan (1953), Hall (1953), and Overmeyer (1953), were observed in the lower chalk member. All of the channels noted cut across the massive limestone beds of the lower member. At some localities, there is a well cemented fossil fragmental limestone bed, from one to six inches thick, lining the bottom of these channels.

The predominant forms noted have smooth concave floors and are filled with limestone very similar in lithology to the bedrock in which the channel is cut. There was one channel observed different from the others, in that the filling consists of stratified sediments of the middle marl, and also in the fact that the channel is flat-bottomed with sides sloping at about 30 degrees.

These various channels would seem to indicate that the deposition of the Austin Chalk was not a continuous process. Deposition was probably broken occasionally by periods of turbulence, during which the bottoms of the seas were channelled by submarine turbidity currents (Kuenen, 1950, 1955), or possibly by powerful undertow currents similar to those present today along stretches of marginal deposition.

*Concretions.*—Numerous marcasite concretions were found in the Austin Chalk, varying in size and shape from spherical forms a fraction of an inch to about three inches in diameter, to elongated forms measuring three or four inches in length, and from a fraction of an inch to an inch in diameter. They have been described as being of pyritic composition in earlier literature (Shuler, 1918), but later writers state that they are actually composed of marcasite (Bryan, 1953; Hall, 1953; Overmeyer, 1953; Roberts, 1953).

*Quaternary Deposits*

*Terraces.*—Terrace deposits crop out in disconnected patches from 10 to 60 feet above the streams in many parts of the area—the largest being north of Ten Mile Creek, near the eastern edge of the quadrangle. Most of these remnants are so dissected that little or nothing of the original surface is preserved. Since the terrace record is so fragmental here, no correlation with the Trinity terraces near Dallas has been attempted.

The terrace remnants consist largely of cross-bedded sand lenses inter-tongued with lenses of chalk gravel. The pebbles are fairly well rounded and fairly resistant. These gravels are locally cemented with calcite. In the lower portion of the terrace and on the crests of hills many exotic
quartz pebbles are found. These were noted for the most part in the eastern half of the quadrangle. They consist of red to tan quartzite and white vein quartz. There are no rocks similar to the lithology of these exotic pebbles cut by the present drainage system of the area. Therefore, these exotics must be remnants of older rocks cut by a previous and more extensive drainage system.

Structure

Faults.—Throughout the Lancaster Quadrangle, many normal faults were noted. One fault was noted that has a minimum displacement of 100 feet. Two others have at least 40 feet displacement, but most have displacements of from only a few inches to a few feet. The geologic map of the Lancaster Quadrangle (Plate 1) shows in the immediate vicinity of the intersection of U.S. Highway 77 and Belt Line Road (Localities 6 & 15), some of these faults which appear to have formed a small horst and a graben.

In Ten Mile Creek, 218 yards west of U.S. Highway 77 (Locality 15, Plate 1), a normal fault striking N. 48° E. and dipping 61° southeast, has down-faulted middle marl against lower chalk dipping 31° southeast due to drag.

Farther to the northwest where Pleasant Run Road crosses Ten Mile Creek, approximately 350 yards upstream (Locality 14, Plate 1), a normal fault strikes N. 26° E. and dips 65° to the northwest. Middle marl is downfaulted with reverse drag against lower chalk.

In a minor creek (Locality 18, Plate 1), 1000 feet to the east of Locality 14, lower chalk is exposed along the west bank of the stream with middle marl being exposed along the east bank; evidently there is a fault that has down-faulted middle marl against lower chalk.

About 2000 feet east of the State Highway 342 bridge over Bear Creek (Locality 13, Plate 1), a fault with a minimum displacement of 100 feet strikes N. 40° E. and dips 60° west. Lower chalk is downfaulted against middle marl with dips as steep as 30° in the middle marl, due to drag. Near this fault there are several minor paralleling faults with offsets of up to a few feet. Due to the scale of the map (Plate 1) they are not shown.

Joints.—Joints were noted in almost every exposure of bedrock in the quadrangle. The majority of the joints seen were straight for the distance exposed, but in some cases they are slightly curved. The predominant strike trend for these joints is NE-SW with a minor trend of NW-SE (Plate 1).

It has been stated by past authors (Dallas Petroleum Geologists, 1941) that the faulting in the area is probably due to differential com-
paction of the Eagle Ford sediments underlying the Austin Chalk. This can hardly be true in view of the magnitude of the major faults in the quadrangle, although it may well be true in the case of the minor faulting father to the west.

Foley (1926) extended the Balcones Fault system of Central Texas northward into Dallas County. The faults in the Lancaster Quadrangle appear in high probability to be extensions of the Balcones system, substantiating this idea.

**Geologic History**

The fact that the Austin Chalk consists of marl layers alternating with marly limestones and chalk beds suggests that this formation was rhythmically deposited from an infraneritic depth (Scott, 1940).

Probably, during late Cretaceous or early Tertiary time, these Cretaceous rocks were broken by normal faults. Minor adjustments may have taken place as late as Pleistocene time, as evidenced by minor movements of this age (Bryan, 1936), farther to the south.

During Quaternary time the base level of the streams in the Lancaster Quadrangle was attained with resultant deposition of terrace material.

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GEOLOGIC MAP OF LANCASTER QUADRANGLE, TEXAS

GEOL OGY BY
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