Geology of the Cedar Hill Quadrangle, Dallas and Ellis Counties, Texas

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ABSTRACT

In the Cedar Hill Quadrangle, bedrock consists of the Eagle Ford shale and Austin chalk, both of Upper Cretaceous age. The shale averages about 400 feet in thickness, with only the upper 140 feet exposed. This is predominantly a dark gray, fissile mudstone with limestone concretions and several thin limestone beds in the upper part of the section. A stratum of cherty limestone six inches thick lies 107 feet below the top and serves as a marker bed in areal mapping.

The shale is disconformably overlain by the Austin chalk, at the base of which is a bed of conglomerate a foot or less thick. The Austin is characterized by massive beds of chalk separated by thin layers of calcareous shale. Joins are common throughout, and numerous small faults may be due to differential compaction within the underlying shale. Local unconformities within the formation probably represent scour-and-fill structures.

Terrace remnants in the quadrangle are largely correlated with the Love Field terrace along the Trinity River to the north. This terrace stands 30 to 40 feet above the present floodplains and consists of gray clay with lenses of gravel and, locally, of foraminiferous sand.

Introduction

The Cedar Hill Quadrangle is in the southern and northern portions of Dallas and Ellis counties, respectively; and is bounded by the parallels 32° 30' 00" and 32° 37' 30" N, and by the meridians 96° 52' 30" and 97° 00' 00" W (Fig. 1). The area measures slightly more than 64 square miles. U.S. Highway 67 crosses it, and in addition there is a network of secondary roads. Cedar Hill and Ovilla are the only towns.

Bedrock consists of the Austin chalk and the Eagle Ford shale, both of Upper Cretaceous age. The beds strike north-northeast and dip toward the east at about 60 feet to the mile (Dallas Petroleum Geologists, 1941, p. 67). The Austin chalk crops out over most of the area, but near the western boundary of the quadrangle, 140 feet of Eagle Ford is exposed. A prominent asymmetrical ridge, known as the White Rock cuesta, has developed by differential erosion of the harder chalk and weaker shale. Terraces composed of alluvium cap some of the hills to the west of the cuesta and form benches locally bordering Red Oak and Ten Mile Creeks.

A mature topography of low relief is developed on the relatively gentle eastern slope of White Rock cuesta. By contrast the west face of the cuesta is comparatively steep and in most places is marked by a cliff about 20 feet high.

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2With hearty thanks to Professors Claude C. Albritton, Arthur Richards, and John W. Harrington; and Messrs. James E. Brooks and Bob F. Perkins, for direction and aid, and criticism of the manuscript.

3Publications referred to are listed in the bibliography at the end of the paper.
Slopes below the cliff are irregular and hummocky as a result of minor landsliding within the Eagle Ford shale. Total relief in the area is approximately 300 feet, and the local relief along the cuesta is about 200 feet.

The principal contribution of this study is the map (Pl. 1), which is to be part of the larger map showing the geology of Dallas County and surrounding areas. Field work was begun during the spring and completed in the summer of 1953. Areal geology was plotted directly on aerial photographs and then transferred to a controlled mosaic with a scale of one inch to a thousand feet.

**Eagle Ford Shale**

The shale is typically dark gray to grayish black, weathering light to medium olive gray. Drillers’ logs indicate that the shale has an average thickness of 432 feet. A detailed description of the upper 122 feet of the shale is given in the following stratigraphic section:

**Stratigraphic Section of Eagle Ford Shale West of Mansfield Road at White Rock Cuesta**

(Pl. 1, station 9).

**Austin chalk**

<table>
<thead>
<tr>
<th>11. Chalk; massive.</th>
<th>2.00</th>
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<tbody>
<tr>
<td>10. Conglomerate of chalk and phosphatic pebbles and granules; fish teeth common toward bottom.</td>
<td>0.75</td>
</tr>
</tbody>
</table>

**Disconformity**

**Eagle Ford shale**

9. Shale; dark gray to grayish black, very finely laminated; weathers light olive gray with hues of grayish yellow and light brown locally; limestone concretions rare in upper part but more numerous toward bottom; selenite crystals on weathered surface associated with weathering of concretions; poorly exposed. | 63.00 |

8. Shale; arenaceous, dark gray, weathering light olive gray; characterized by large limestone concretions up to 3 feet long, commonly coated with gypsum crystals; molds of ammonites on surface of some concretions. | 1.50 |

7. Shale; dark gray to grayish black, weathering light greenish gray to olive gray with hues of grayish yellow and light brown locally; ornamented ammonites occur near top; limestone concretions scattered throughout but less than 5 inches long. | 43.50 |

6. Limestone; detrital, yellowish gray, weathering lighter; contains considerable sand and silt; fossiliferous, locally coquinitic. Contains *Prionotropis aff. woolgari* Mantell, *Inoceramus*, fish teeth, echinoids, and fuscioids. Forms bench. | 0.50 |

5. Shale; dark gray, weathering olive gray; limestone concretions few and small; poorly exposed. | 10.83 |

4. Limestone; detrital, yellowish gray, weathering lighter; not as well cemented as unit 6; locally very fossiliferous, containing *Inoceramus, Prionotropis aff. woolgari* Mantell, fish teeth and vertebrae, and fuscioids. | 0.25 |

3. Shale, similar to unit 5. | 0.38 |
2. Limestone, similar to unit 4. ........................................... 0.10
1. Shale, similar to unit 5; base not exposed. ...................... 0.25

Of the three limestone beds, only the one numbered 6 in the measured section is an important stratigraphic marker. This is a yellowish-gray flaggy rock with the consistency of sandstone and is obviously of detrital origin. Probably it is the same bed described in some detail by Reid (1952).

A bed of arenaceous limestone nine inches thick occurs above the 6-inch limestone bed, but was never found in place. It is probably lenticular, as its float was found at three localities only. The rock is massive and of sandy texture, with 53% calcium carbonate distributed both as calcitic grains and cement.

Although small limestone concretions are scattered through the shale, concretions as much as three feet across appear to be confined to one horizon 64 feet from the top

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Fig. 1. Map showing location of the Cedar Hill Quadrangle (in heavy lines.)

of the formation. At this level the large concretions are very abundant. Most are septarian, containing seams of limonite and gypsum formed by oxidation of marcasite. In some of the septaria the marcasite veinlets remain unaltered.

Lentils of fine-textured limestone, 4 inches thick, were found at two different horizons, one about 74 feet and the other about 120 feet from the top of the formation. Ferruginous and calcareous claystone concretions were found 5200 feet north of the Mansfield Road section (Pl. 1, station 10), but their stratigraphic position could not be determined. Many of these concretions contain abundant fossils, principally gastropods and ammonites.
Ammonites retaining portions of the original shell are common, especially within an interval 64 to 75 feet below the top of the formation. The vertebrae of fishes occur infrequently throughout the upper 50 feet of the shale.

A lentil of lignite half an inch thick and 6 inches wide was found in Little Creek 500 feet south of Bear Creek Road; it probably represents the compressed limb of a tree.

Fig. 2. Small scour-and-fill structures in northern bank of Little Creek, 1000 feet west of Cockrell Hill Road (Pl. I, station 6.)

The lower chalk contains abundant Foraminifera, ostracods, and echinoid spines. The large and thick-shelled pelecypod *Inoceramus undulato-plicatus* Roemer, which measures as much as 18 inches in diameter, is abundant on Little Creek west of Duncanville Road, and its fragments are numerous throughout the chalk. The casts of two ammonites were found. Along a creek, crossing Belt Line Road 4200 feet east of Cockrell Road (Pl. 1, station 3), there is a bed about 3 inches thick composed almost entirely of shells of *Gryphaea*. The bed is underlain by massive chalk and overlain by alluvium. It crops out for only 8 feet.

The middle marl was not observed in the field. Using the
U.S.G.S. 30' Dallas Quadrangle with a contour interval of 50 feet, and assuming a uniform dip of 60 feet per mile toward the east, the middle marl should crop out in the eastern part of the quadrangle if the lower chalk is 200 feet thick, as indicated by the Dallas Petroleum Geologists (1941). Along the divides in this part of the area the topography is similar to that farther to the east where the middle marl is well exposed.

Structure

Two small scour-and-fill structures, similar to those described by Bryan (1953), Hall (1953), and Overmyer (1953), were observed in the lower chalk. One is located along Little Creek 1000 feet west of Cockrell Hill Road (Pl. 1, station 6: Fig. 2). The buried channel is exposed in both banks and appears to trend N 30° E; it is between 6 and 11 feet wide and one to three feet deep. The basal quarter-inch of the fill is composed of fossil fragments; the remainder is calcareous shale and massive chalk. A small seam of lignite three inches long and an eighth of an inch thick was found in the center of the fill.

The other scour-and-fill structure is 5400 feet downstream from the first (Pl. 1, station 7). It is 30 feet wide and two feet deep and appears to trend N 60° E. Possibly it is a continuation of the first structure.

Cross-bedded limestone is exposed on Little Creek 2300 feet upstream from Duncanville Road (Pl. 1, station 8). The cross-bedding is in a marly limestone with laminations averaging about a half-inch thick. This rock is underlain by three feet of calcareous shale and overlain by a more massive marly limestone. Local dips up to 13° are probably related to drag along a fault about 40 feet downstream. The presence of cross-bedding indicated that the limestone is at least in part a clastic sediment deposited on current-swept bottoms.

The lower Austin chalk is intricately jointed, especially in the vicinity of faults. On Little Creek, 500 feet west of the eastern margin of the map, joints trending N 25° E are spaced at intervals of about 18 inches over a distance of 2000 feet. Near faults the joints are even more closely spaced. Joints in the massive chalk commonly terminate against shaly partings both above and below.

Fifty faults were mapped in the lower chalk. The strike
and dip of 46 of these was recorded and plotted on a stereograph. Only four have dips less than 45°, and all appear to be normal. Most of the apparent displacements range from a few inches to several feet.

One of the largest faults is exposed along Ten Mile Creek in the northeastern corner of the area, just south of Pleasant Run Road (Pl. 1, station 4). The displacement is at least 15 feet, and possibly much more. There is a brecciated zone one foot thick on either side of the fault surface. As seen in Figure 3, the beds in the downthrown side appear to thin toward the fault, but this is an optical illusion due to minor associated faults not all of which show in the photograph.

Some of the minor faults which were not mapped are very irregular, making abrupt turns of 90° in their strike. Curved faults are common, especially in the northern part of the area along a tributary of Ten Mile Creek east of Duncan-
ville Road. Adjacent to the larger faults are minor flexures which have been produced by drag. Openings along frac-
tures have been filled with veins of crystalline calcite that range upward to a foot in thickness. In a few cases the streams locally follow joints and small faults, but usually the course of the streams is not affected by fractures.

If these faults are related to the Balcones system their prevailing strike should be toward the northeast. However, fewer than 5% of them are so oriented (Fig. 4). Differential compaction within the underlying Eagle Ford shale is probably responsible for most of the faults in the area.

Contact between Eagle Ford and Austin Formations

This contact can be observed at two places: on Mansfield Road, and in the southwestern corner of the quadrangle at station 5 (Pl. 1). At both localities the typical dark gray Eagle Ford shale is overlain disconformably by a 10-inch layer of conglomerate composed of reworked Austin chalk with numerous fish teeth (Fig. 8) and phosphatic pebbles. The conglomeratic bed in turn is overlain by a stratum of typical white Austin chalk.

The disconformity evidently follows the surface of an ancient sea floor in which pebbles and phosphatized materials collected during an interval of non-deposition. Even after the first layers of the Austin chalk began to be formed, currents locally eroded these sediments and redistributed their fragments as pebbles and cobbles. There is nothing to indicate that the Eagle Ford was subaerially eroded prior to deposition of the chalk; the disconformity must therefore have developed beneath the waters of the ancient Gulf of Mexico.
Terraces

Terraces along Red Oak and Ten Mile creeks stand 30 to 40 feet above the present floodplains. Their surfaces connect to the north with the Love Field terrace as mapped by Cheatham (1950) and Taggart (1953). West of the cuesta the terrace is 45 to 60 feet above present floodplains of the tributaries leading into Mountain Creek, but this also appears to be part of the Love Field bench. The terrace shown in the lower-left corner of the map (Pl. 1, station 9) is about 30 feet above the Love Field level and may belong to the Marsalis terrace.

With the exception of the Marsalis (?) terrace (which is a chalk gravel) the alluvium in the terraces is of gray clay with lenses of chalk gravel and locally of foraminiferal sand. Usually the deposits are stratified and cross-bedded. A few quartzite pebbles of unknown origin were found in the terrace along Red Oak Creek.

Recent alluvium consists of clay and chalk gravel generally overlain by several feet of dark brown to black humic clay.

Geologic History

During Upper Cretaceous time the entire area was submerged and mud was deposited in quiet waters. The presence of sulphurous material and disseminated organic matter suggests that the bottoms were poorly aerated or that deposition was relatively rapid. At intervals detrital calcite and sand were swept in by currents to form beds of clastic limestone. Mud was deposited up until the end of Eagle Ford time, after which there was an interval of non-deposition. Fish teeth accumulated on the sea bottom, and phosphatic nodules developed. Thin layers of chalk were deposited and intermittently reworked by bottom currents.

Deposition began anew when layers of limy mud commenced to accumulate on the scoured surface of the disconformity. The fact that layers of chalk alternate with partings of calcareous shale suggests rhythmic deposition, but the period of the rhythm remains unknown. During at least two different periods volcanic ash fell in the area and formed the bentonite beds.

In post-Cretaceous time the area was uplifted and eroded. During the Pleistocene, successive floodplains were left behind as terraces as the rivers cut downward.
The Levator anguli scapulae in Necturus

Joseph P. Harris, Jr.

Professor St.-George Jackson Mivart first described the M. levator anguli scapulae in *Necturus* in 1869. He noted an origin of the long, slender muscle on the occiput, and an insertion on "the inner side of the dorsum of the scapula." Mivart, earlier in the same year, had used the same name for a homologous muscle in the hell-bender; in this, he apparently adapted Funk's (1827) and Rüdinger's (1868) earlier name. Kingsley (1907) used the name M. levator scapulae for the same muscle, following an earlier pattern set by Carus (1828), Schmidt, Goddard, & van der Hoeven (1864), Humphry (1871) and Osawa (1902).

Kingsbury & Reed (1908, 1909a, 1909b), and Reed (1914, 1920) studied the sound-transmitting apparatus in urodele amphibia. They described in *Ambystoma* a muscle extending from the opercular cartilage of the otic capsule to the dorsum of the scapula, and named it "M. opercularis", following Gaupp (1898). They stated that this muscle was absent in most larval urodeles, but that it developed in most Caudata at the time of their transformation. Specifically, they said the M. opercularis was absent in larval *Ambystoma* and in *Necturus*, among others. As a result of their investigations, Kingsbury and Reed concluded that there is a difference in the method by which aquatic and terrestrial salamanders transmit sounds to the otic capsule. Terrestrial salamanders, with the body raised from the ground, believed to receive vibrations through the foreleg to the