TERRACES OF THE TRINITY RIVER, DALLAS COUNTY, TEXAS

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This introductory paper presents the larger facts concerning the terraces of the Trinity River in Dallas County, and points out some of the more important problems to be solved in future studies. Individual problems will be assigned to advanced students of Geology in the department. Mr. Lewis Kelsey presents the first of such studies in this issue.

Some General Considerations

Despite the fact of constant change, river valleys and stream patterns are the most permanent of all geomorphic forms. The physiographic importance of the study of rivers and river valleys cannot be overestimated, for the key to the understanding of the topography of any area is to be found in the study of the slopes, terraces, and flood plains of its streams. This fundamental fact needs to be revalued in this period of over-emphasis of peneplain and peneplain remnant.

The outstanding feature of Texas streams is their low gradient. The elevation of the Trinity River, for example, at Dallas is but 367 feet, 510.2 miles from its mouth in Galveston Bay. The average fall for the last 400 miles of the river is 8 inches per mile. From Trinidad, Henderson County, westward to Bridgeport in Wise County, 216 miles, the Trinity River climbs across the Lower Cretaceous into the Central Denuded area at the rate of one foot per mile. The total relief of the Trinity valley at Dallas is about 200 feet with a profile width of 6 miles where the Trinity crosses the gap of the Austin chalk.

Hill[1] classifies the streams of Texas prairies as (1) through flowing rivers—the Red, Brazos, and Colorado, which enter the region from the west and cross it, and (2) a system of less copious locally developed autogenous streams.

[1] Hill, R. T., 1901 U. S. G. S., 21st An. Report, Pt. VII, p. 64.

The Trinity River is placed by Hill in the second class. It was developed as a consequent stream upon the upland plain of Cretaceous rocks between the Brazos on the west, the Red on the north and the east flowing streams of East Texas.

If the Trinity is the product of erosion in a single cycle, a study of the fossils of its terraces may give definite dates to the periods of terrace deposition and a study of the terrace materials should show the progressive headward erosion and extension of the Trinity valley. The Trinity has grown at its mouth as it stretched out over newly made coastal plains; it has grown headward until finally it cut across the Cretaceous uplands into the great central denuded area of North Central Texas underlain by Pennsylvanian rocks.

Texas streams with their low gradient should also present critical data as to eustatic changes of level of the ocean during the Pleistocene. Daly[2] places the maximum contraction of the ocean volume during the Pleistocene at 225 feet. This new gradient should be evidenced by overdeepening of the Pleistocene stream valleys. If there were an increased rainfall in the southwest during this period it should also show itself in the size and character of the materials of the flood plains of the rivers.

Terrace Deposition and Headward Erosion

The paradoxical process of terrace deposition with downward cutting of a stream is now fully recognized. It is also established that valley flare is not necessarily an indication that a stream was formerly larger in volume than when it cuts on its narrow flood plain at the bottom of the notch. If these two principles are established then a still further postulate becomes tenable. Down stream terraces should show successive stations of the stream in its march of headward erosion. If these stations are marked by characteristic features such as might be exhibited across a belted coastal plain, then these stations should be recognized in

[2] Daly, R. H., "The Changing World of the Ice Age", Yale University Press, 1934.

the terrace materials. Thus physiographic forms and terrace deposits might be dated and correlated.

From Trinidad, in Henderson County, westward about 350 miles the Trinity crosses the broad belts of Cretaceous rock varying widely in hardness, fossil content, and resistence to weathering. At Bridgeport it cuts into and across the Strawn and Canyon beds of Pennsylvanian age.

Following upstream from Trinidad where the river leaves the Tertiary formations, the stream meanders widely across the soft shales and clays of the Taylor; at Dallas the Trinity is confined to a six-miles wide notch where the river passes across the Austin chalk. Beyond the gap subsequent streams flare along the base of the chalk scarp until all evidences of a valley disappears on the soft Eagle Ford shales. The West Fork of the Trinity on leaving Dallas County cuts across the Woodbine sands in a wide valley, but as it crosses the limestones of the lower Cretaceous it is again confined to flat bottom but step-walled valleys from formation to formation.

Each formation contributes terrace materials to its own area but equally to the downstream deposits. The lower terraces at Dallas, for example, carry many fossil fragments from the lower Cretaceous beds west of Fort Worth.

Terraces of Texas Rivers

The terraces of the Colorado River have been studied more carefully than for any other Texas stream. Hill in 1890 wrote a careful description of the terraces at Austin and gave specific names to four terrace levels.[3]

While recognizing that the Uvalde Formation, largely of flint pebbles was the result of stream deposition, Hill notes that at that horizon, 300 feet above the present floodplain, the ancient Colorado River had not yet sunk its channel into the Paleozoic and granitic beds of the Central Mineral region.

The highest river terrace at Austin, a mile or two back from the river, Hill designates as the Asylum terrace. Its elevation is about 150 feet above the floodplain and 625 feet

[3] Hill, R. T., U. S. G. S., Austin Folio No. 76, 1902, p. 6.

above sea level. The terrace materials are of granitic debris from the granitic masses of Burnet County. They contain fragments of feldspar, quartz, and pieces of Paleozoic limestone. Outstanding below is the Capitol terrace built of materials similar to the Asylum terrace. Its height is 525 feet above sea level.

Successive terrace levels at Austin are as follows: Asylum, 625; University of Texas, 615; State Capitol, 525; Fourth Street terrace, 500; Bottom terraces, 430; flood plain, 420.

T. L. Bailey,[4] 1923, describes the topography of the Colorado River terraces in Colorado County about 150 miles below Austin and gives three sections across the river valley. Seven terrace levels are recognized.

In the cross section at Lorine, Mr. Bailey recognized five paired terraces; in the Columbus section, four paired terraces; at Altair three paired terraces. The Colorado County terraces are about 90 miles distant from the Gulf. The county is underlain by the Pleistocene, Lissie formation. Bailey correlates the higher terraces, 7, 6, and 5 with the lower Lissie; terraces 4 and 3 with the upper Lissie; terrace No. 2 grades into the "seaward facing Beaumont terrace" (p. 113). Bailey thus classifies the terraces as middle or upper Pleistocene age.

The total relief in the county is the difference between the 125 feet elevation of the Colorado River as it leaves the county and the highest hill, 425 feet. The terraces range in elevation from 150 to 400 feet.

The many paired terraces, recognized by Bailey, is the most significant feature of the Colorado County area.

Terraces of the Trinity River at Dallas, Texas

Dallas owes its location to the fact that the Trinity River here cuts a broad gap across the Austin chalk cuesta. Just west of the gap is the juncture of West Fork, the south flowing Elm Fork of the Trinity, and the small subsequent north flowing Mountain Creek. The broad gap and the hard rock bottom of the Austin chalk was early used by the pioneer and later by the railroads for ford and crossing.

[4] Bailey, T. L., The Geology and Natural Resources of Colorado County, Univ. Tex. Bull. 2333, 1923.

The chalk being relatively much harder than the Eagle Ford shales outcropping to the west and the Taylor Marls on the east has held in the cuesta gap facets and terraces of the Trinity River which have been entirely obliterated or dimmed to the east and west. This fact must be remembered in any attempt to correlate its terraces with those of other areas and to date individual terraces.

The terraces of the Trinity River at Dallas are broadly divisible into three great steps, each of which may be subdivided from point to point with no great regularity. The uppermost step has been named the Love Field terrace horizon from its excellent exhibit at the Dallas air port.

The second division is a broad platform well exhibited from the Travis school on McKinney avenue to the crossing of Harwood and McKinney and which is designated as the Travis School terrace horizon.

The third great step begins at Orange Street and swings by the courthouse, the Union Terminal, Sears-Roebuck, and a large part of East Dallas, including the City Park. It has been called the Union Terminal terrace horizon.

Below the Union Terminal are the "second bottoms" leading down to the present flood plain of the river.

The areas assigned to the various terraces within the city of Dallas are shown on the map (Fig. 1) which was compiled by Lewis Kelsey. Other students who worked on the map are Billie Bramlette and Mac L. Coker. In many areas the divisions are arbitrary since the grading of streets, railroad fills and the building of homes have greatly modified the surface. Streams such as Turtle Creek, Bachman Creek, and Cedar Creek have cut numerous gorges below the terrace levels.

The highest terrace material in the county is north of Irving. This was mapped by the writer in 1917.[5] This

[5] Shuler, Ellis W., The Geology of Dallas County, Univ. Tex. Bull. 1818.

area is several miles away from the present stream bed. It is probably related to the Uvalde horizon.

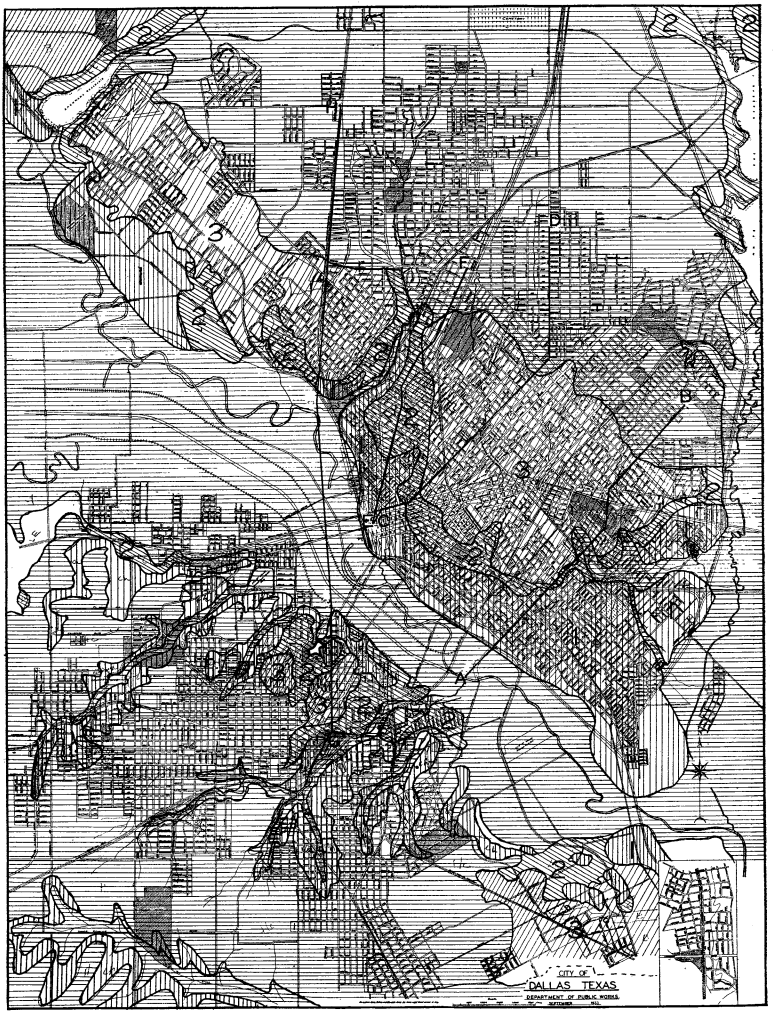

Fig. 1. Trinity River Terraces within the city of Dallas. (1) Union Terminal Terrace. (2) Travis School Terrace. (3) Love Field Terrace.

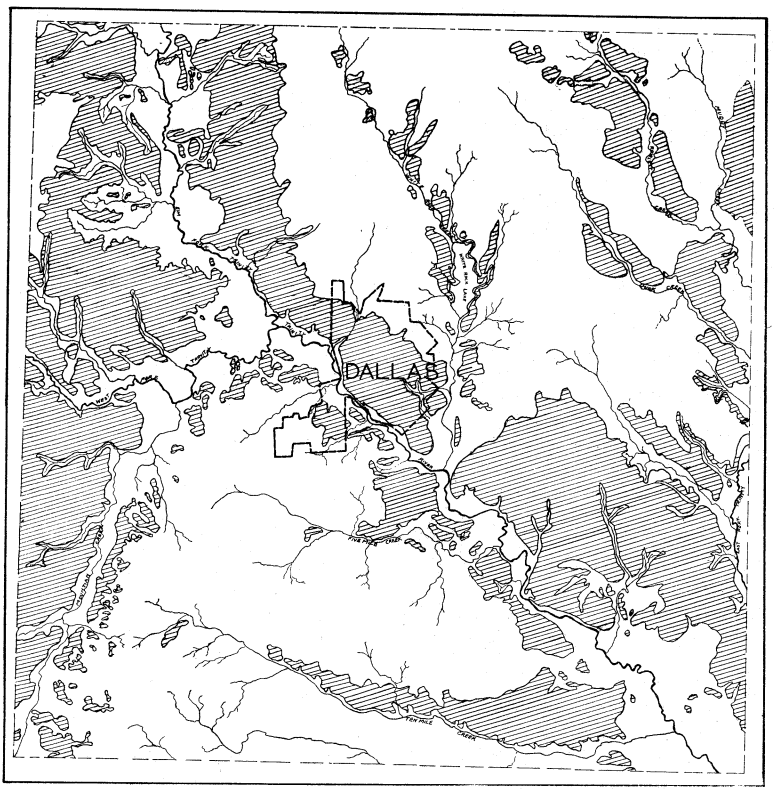

Fig. 2. Terrace Soils of Dallas County, after William T. Carter, Jr.

Terrace Soils of Dallas County

The terrace soils of Dallas County were studied in detail by William T. Carter, Jr.,[6] in his soil map and bulletin on the soils of Dallas County. The map of the terrace soils of Dallas County in this article (Fig. 2) is taken from Mr. Carter's soil map and credit is hereby given for his keen observations and his foundation work for this study.

Mr. Carter recognized three major types of terrace soils in the county, the Bell, the Lewisville, and the Cahaba. He

[6] Carter, William T., Jr., Soil Survey of Dallas County, Texas, 1924, U. S. Department of Agriculture.

not only recognized certain soils as being the result of reworking and deposition by streams at both high and low levels but also that terrace materials may in part at least have been transported from the areas of the Woodbine sand underlying the Eastern cross-timbers, the Grand Prairies and perhaps the Western cross-timbers.

The formation of terrace soils is not a simple process. A section of the terrace covered by Bell clay for example at Love Field, following Carter's description, consists of a top 3-foot section of calcareous black or dark ashy gray clay beneath which layer the clay may have a greenish cast. At variable depths beneath the clay are beds of gravel predominantly of hard chalk and limestone with occasional quartz and sand. This gravel is often cemented into a hard bed locally known as "concrete".

The Bell clays overlie fairly typical local stream gravel such as is to be seen along streams draining the chalk areas, but the slope of the surface and top character of the soil indicate that much of the surface materials are the result of flood wash from the adjacent higher areas of Houston clays.

The Lewisville soils are lighter in color, have a large amount of clay, and show more definitely their stream origin.

The Cahaba and associated soils are sandy loams with light shades of brown. They are obviously of the flood plain type of soils. Significantly, too, they are non-calcareous, from which fact Mr. Carter concludes they, in part at least, have originated from Eastern and Western cross-timber belts.

In general, the identification of the terraces may be made upon its soils but there are some exceptions since the classification of the U. S. Bureau of Soils is largely physical. The Love Field and associated terrace horizons are covered by the Bell clay; the Travis School horizon by the Lewisville, and the Union Terminal by the Cahaba. On the other hand, the Bell clay, lower phase, is lower than the Lewisville. The Lewisville also has a high and low phase. In general, however, the classification stands.

Age of the Terraces

It is dangerous to rely on negative evidence. However, as neither the Love Field terrace nor the Travis School terrace has yielded identifiable fossils, they can only be dated with reference to the Union Terminal terrace. Dr. O. P. Hay in personal communications identified the rather extensive Pleistocene fauna of the Union Terminal horizon as mid-Pleistocene.

Since mid-Pleistocene the Trinity River has lowered its flood plain about 50 feet. If there is a buried channel of ten to twenty feet deeper the total deepening or rather overdeepening by the river would be 60 feet since mid-Pleistocene.

The proportion of sand and gravel in the Union Terminal terrace is much greater than in the terraces above it; on the other hand the size of the gravel in the second bottom and the flood plains is again greatly increased and fossil fragments of the lower Cretaceous formations occur in great abundance.

Compared to the materials of the Union Terminal terrace, the Love Field terrace shows a greatly lengthened period of weathering, its structure shows sluggish stream action with no material which has been identified as from farther west than the Woodbine horizon. While elephant bones were found in the white gravel of White Rock creek they were near to its present stream bed and can be referred to the Union Terminal horizon. If the Union Terminal terrace is dated mid-Pleistocene, it is possible that the Travis school horizon dates its beginning.

The large areas of the Love Field terrace horizon, not only along the West and East forks of the Trinity but even high along the smaller tributaries of White Rock and Ten Mile Creek, seem to indicate a long period of stability. Since their deposition the Trinity has cut about 120 feet. From the facts now in hand the Love Field may be and probably is as old as late Tertiary.

Problems for Future Study and Solution

Crossing as it does a series of belted zones the Trinity River offers the opportunity for quantitative studies of the volume of material contributed by each belt to floodplain debris, distance transported, erosion or wear, and the successive horizons for the entrance of new materials into the stream terraces.

Detailed studies of individual terraces will give larger fossil groups for identification and correlation.

Future studies of the river floodplain and cross-sections will throw new light on Pleistocene rainfall, denundation and stream erosion.