BUREAU OF ECONOMIC GEOLOGY
The University of Texas
Austin 12, Texas

JOHN T. LONSDALE, Director

Report of Investigations — No. 2

Ouachita Facies in Central Texas

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VIRGIL E. BARNES

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OUACHITA FACIES IN CENTRAL TEXAS

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ABSTRACT[1]

Steeply dipping shales and interbedded sandstones presumably of the Ouachita facies have been discovered along the Colorado River in Burnet and Travis counties, Texas. Previously the Ouachita facies was known in Texas only from bore-hole samples. The outcropping rocks are not metamorphosed, whereas many of the bore-hole samples described in the literature are metamorphosed. A re-examination shows that the bore-hole samples nearest the outcrop lack metamorphism, except for slight changes along slickensides, whereas away from the outcrop the rocks are progressively more metamorphosed, until in Caldwell County, the farthest point reached, the rocks are schist. Lithologies and grade of metamorphism suggest that the Caldwell County bore holes enter the Ouachita facies rather than rocks of pre-Cambrian age.

INTRODUCTION

On March 17, 1948, a persistent series of steeply dipping Carboniferous rocks was found in a branch of Cypress Creek (part of Lake Travis) in southeastern Burnet County, Texas. Hill (1901, p. 142; fig. 9, p. 134) may have noted these steeply dipping Carboniferous beds in the vicinity of the Travis-Burnet County line, but his statements and figure are not clear in this respect. Additional outcrops (fig. 1), some of which are beneath the normal level of Lake Travis, subsequently were mapped along both banks of the Colorado River and side drains of the river downstream into Travis County. Mr. A. R. Palmer assisted in mapping the area shown in figure 1.

SURFACE GEOLOGY

STRATIGRAPHY

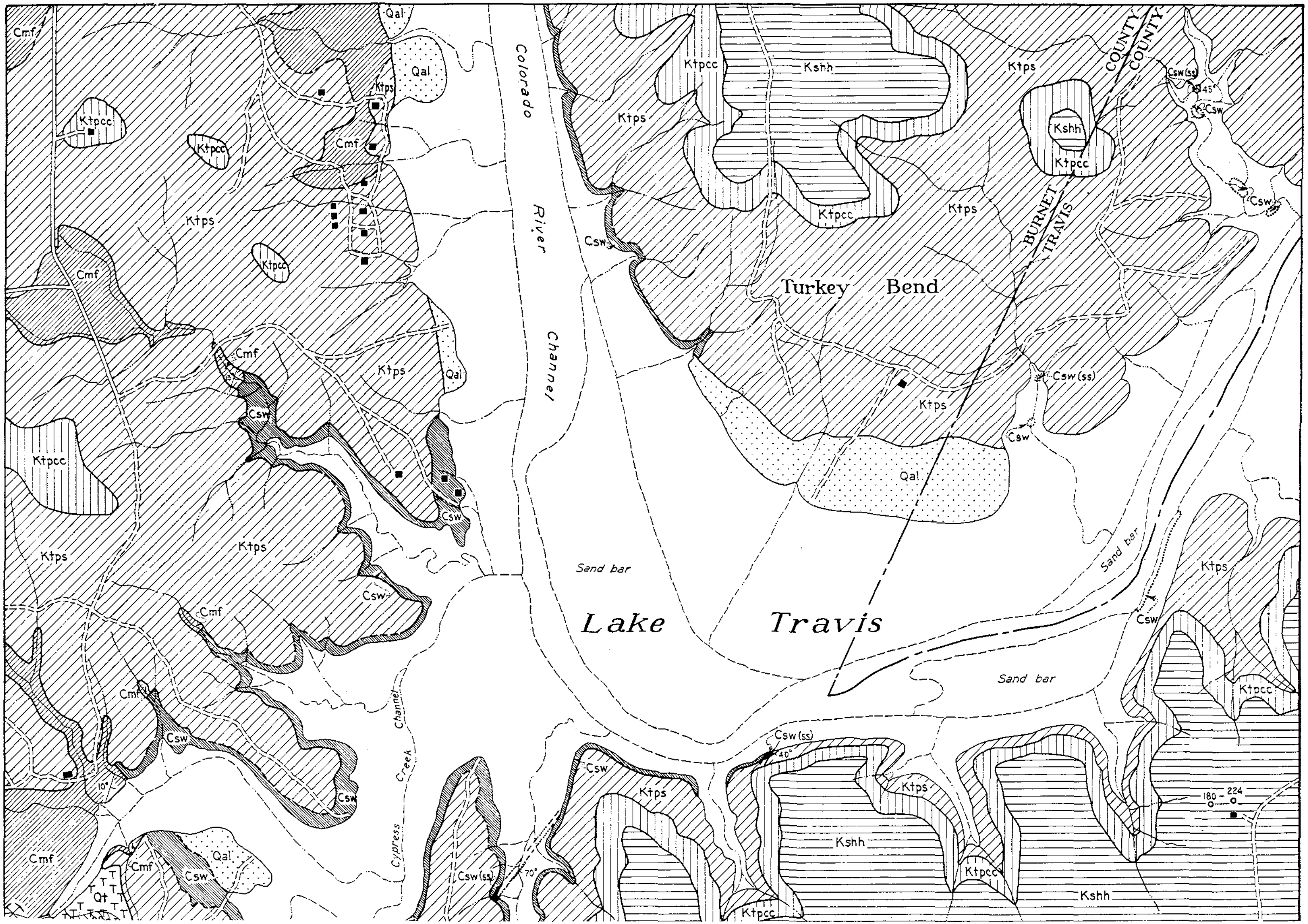
The rocks exposed within the map area (fig. 1) are as follows:

- Lower Cretaceous
  - Shingle Hills formation (new)
    - Glen Rose limestone member
    - Hensell sand member
  - Travis Peak formation (restricted)
    - Cow Creek limestone member
    - Sycamore sand member
- Lower Pennsylvanian
  - Smithwick shale
  - Marble Falls limestone (unrestricted)

The Marble Falls limestone (upper portion) falling within the map area ranges from a light-brown, massive, fossiliferous limestone to a somewhat darker siliceous well-bedded, blocky limestone. It is in sharp contact with the overlying Smithwick shale. Most of the Smithwick shale outcrops are somewhat weathered and are of a greenish to yellowish-green color, and in only a few fresh outcrops is shale of a dark grayish-black color exposed. Sandstone and siltstone are rare in the lower part of the Smithwick but become increasingly common upward. A clue to the Smithwick shale in many areas where the outcrop is poor is furnished by the presence in the soil of thin platy calcite joint fillings and thin indurated siltstone laminae. All outcrops were scanned for fossils without success, except for numerous plant markings in much of the sandstone. The thickness of the Smithwick in the eastern part of the Llano uplift is unknown since it passes directly beneath Cretaceous rocks without any intervening beds. Paige (1912, p. 8) estimates that the exposed beds within the Burnet quadrangle do not exceed 400 feet in thickness.

The Marble Falls limestone and the Smithwick shale are truncated, and deposited across them is a massive conglomerate of Cretaceous age belonging to the Sycamore sand member of the Travis Peak formation. The conglomerate is thinner above the Marble Falls limestone than over the Smithwick shale, above which it varies in thickness from about 40 feet in the northeastern part of the map area to about 15 to 20 feet in the southern part of the area. The channels that carried the gravel appear to have followed Smithwick outcrop areas (Paige,

[1]This paper was read at the annual meeting of the Geological Society of America, New York, N.Y., November 12, 1948; abstract published on p. 16 of official program.



Colorado River Channel
Turkey Bend
Lake Travis
Sand bar
Cypress Creek Channel
BURNET COUNTY
TRAVIS COUNTY
Ktps
Ktpcc
Kshh
Cmf
Csw
Csw (ss)
Qal
Qt
45°
40°
70°
10°
180
224

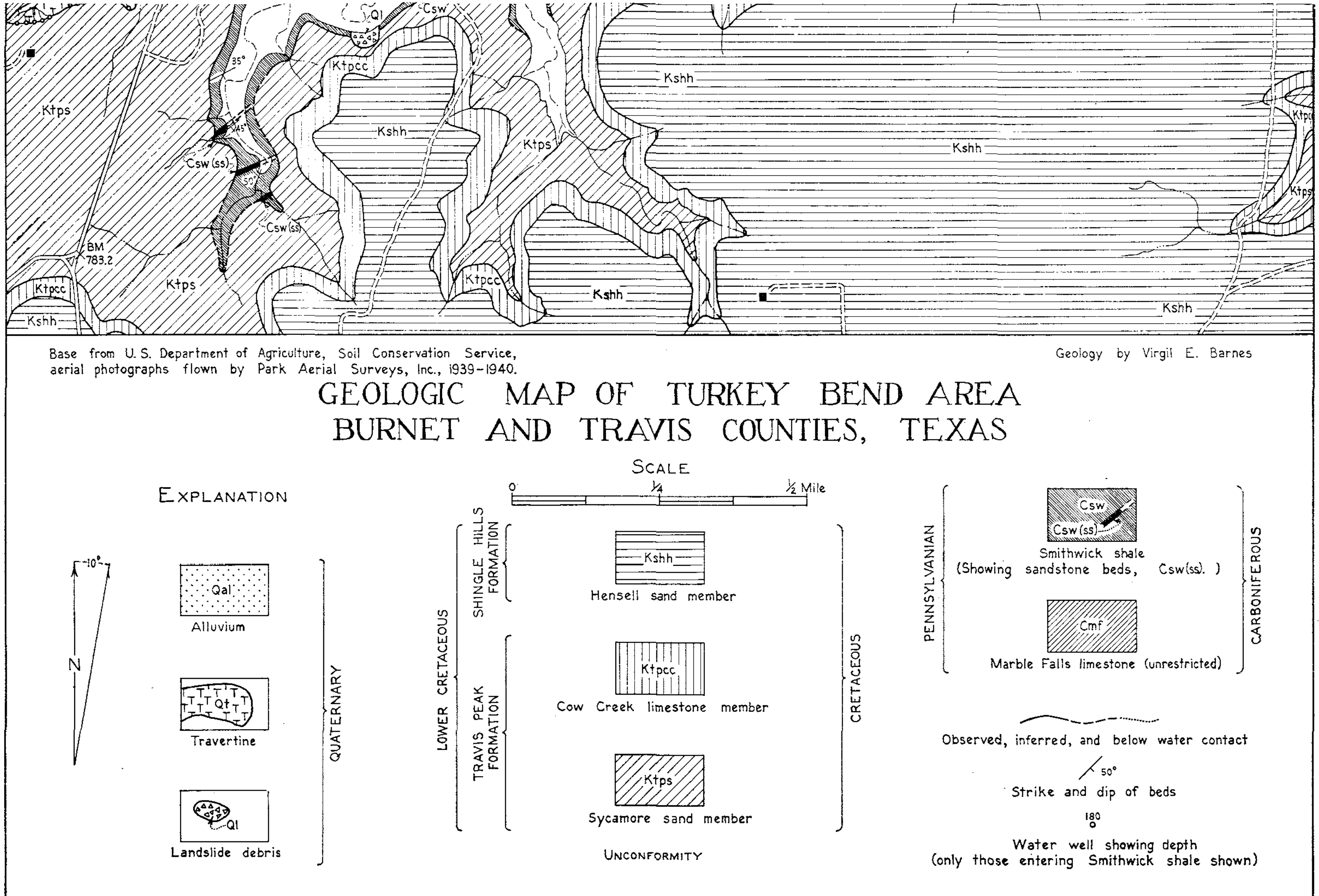


Fig. 1. Geologic map of Turkey Bend area, Burnet and Travis counties, Texas.

1912, geologic map of Burnet quadrangle), thus accounting for the greater thickness of conglomerate in the northern part of the map area. The conglomerate is a mixture of the rocks of the pre-Cretaceous stratigraphic column of central Texas, and many boulders, especially those of Hickory sandstone, are more than a foot in size. The conglomerate is well cemented, and great blocks of it have ridden downward on the yielding Smithwick shale. The portion of the Sycamore sand overlying the conglomerate is mostly reddish, poorly sorted clastics consisting of pebbles, sand, silt, and clay ranging from about 40 to 100 feet thick. Above this is about 20 feet of greenish-weathering, highly sandy and silty clay, at the base of which is a thin conglomerate composed predominantly of Ellenburger pebbles up to 6 inches in size, most of which have been bored by mollusks.

The Sycamore sand is overlain by the Cow Creek limestone member which varies in thickness within the map area (fig. 1) from about 10 to 30 feet, thinning westward. Above the Cow Creek limestone is the Hensell sand, about 100 feet thick, which is followed outside of the map area by the Glen Rose limestone.

The change in nomenclature for some of the Cretaceous units (Trinity group), mentioned above and shown on figure 1, was found to be necessary during the mapping of Gillespie and Blanco counties, but since none of this work has been published, the reason for the change in nomenclature will be briefly stated.

The basement sands of Hill (1901, pp. 132-140) are not distributed entirely as he supposed, that is, as a continuous sheet climbing higher stratigraphically westward. Instead the basement sands are interrupted by the Cow Creek limestone in most of the area mapped during the past few years and the Cow Creek limestone actually overlaps directly on to Paleozoic rocks (Cloud and Barnes, 1948, Pl. 3). The Hensell sand mapped westward (MS. maps) gradually climbs higher stratigraphically until in northern Gillespie County it is equivalent in age to the Glen Rose limestone (Barnes, 1940, p. 52). Much of the Hensell sand is, therefore, a clastic shoreward facies of the Glen Rose limestone. Conglomerate and coarse sand of the Hensell sand rest on the massive coquina of the Cow Creek limestone, furnishing a sharp boundary for mapping, whereas other contacts in the Trinity group are gradational.

The Hensell sand is much more closely allied to the Glen Rose limestone than it is to the Cow Creek limestone. It is proposed, therefore, to remove the Hensell sand from the Travis Peak formation and place it in a new formation composed of two members, the Hensell sand member and the Glen Rose limestone member. It is proposed that the new formation be named the Shingle Hills formation, after the Shingle Hills in western Travis County where the entire sequence of the Hensell sand and the Glen Rose limestone is traversed by road between Hamilton Pool and the Shingle Hills.

The Trinity group as revised for central Texas is tabulated as follows:

- Trinity group
  - Shingle Hills formation
    - Glen Rose limestone member
    - Hensell sand member
  - Travis Peak formation
    - Cow Creek limestone member
    - Sycamore sand member

STRUCTURE

The Marble Falls limestone strikes between N. 20° and N. 30° E. and dips between 10° and 15° eastward. The overlying Smithwick shale appears to be conformable with the Marble Falls limestone, having the same dip, but eastward progressively develops a steeper dip, the maximum recorded being 70°. In the vicinity of the steepest recorded dip, some of the less well-defined beds may be overturned. Dips within the shaly portion of the Smithwick were largely discounted because of the prevalence of slumping. Observations were confined mostly to sandstone beds in positions suggesting the absence of slump. Much of the outcrop mapped is poorly exposed. However, wave action by Lake Travis is rapidly uncovering fresh rock and outcrops should improve.

The steeply dipping sandstone beds (fig. 1) are aligned about N. 45° E., which is at variance to the strike of the Marble Falls limestone and might suggest that the steep dips are caused by normal faulting. Dips as steep as these are not uncommon in the Llano uplift in the immediate vicinity of normal faults, but in no example seen are the steep dips exposed over such a wide area transverse to the direction of faulting. Faulting to produce such a large drag should be of fairly large magnitude, and any outcrops to the eastward (the direction of the downdropped side in case of normal faulting) should be of rocks higher in the section. The few poor outcrops seen, however, are Smithwick shale; and two drilled water wells, three-fourths of a mile to the southeast of the belt of steeply dipping sandstone, encountered Smithwick shale beneath rocks of Cretaceous age.

A cross section was prepared using the structural data in the southwestern corner of figure 1. The minimum thickness for the Smithwick shale between the 35° dip and the top sandstone bed, providing, of course, that duplication is not present, is 700 feet. There is room for another 300 feet of beds beneath the 35° dip sign of the map, giving a total indicated thickness of about 1,000 feet, without any provision for beds overlying the top sandstone bed. Estimates by Sellards (1933, p. 101) of the thickness of the Smithwick shale are between 300 feet at the surface and 600 feet in the subsurface to the north. The Smithwick shale in the Turkey Bend area might be thicker than normal. It is thought, however, that the excessive thickness may be due in part to duplication caused either by thrusting or by folding. However, if the beds mapped are Strawn, as suggested by Sellards (1933, p. 101), the thickness indicated is not excessive.

SUBSURFACE GEOLOGY

The rocks beneath the Cretaceous east of Turkey Bend have been described by Udden (1919), Sellards (1929, 1931a, 1933), Adkins (1924), and Adkins and Arick (1930). That these rocks belong to a fold belt extending southward from the Ouachita Mountains through central Texas and thence westward to the Marathon basin was first suggested by Cheney (1929) and developed further by Miser (1929, 1930), Sellards (1929, 1931b, 1933), Miser and Sellards (1931), and King (1931). The rocks occupying this fold belt have come to be known as the Ouachita facies.

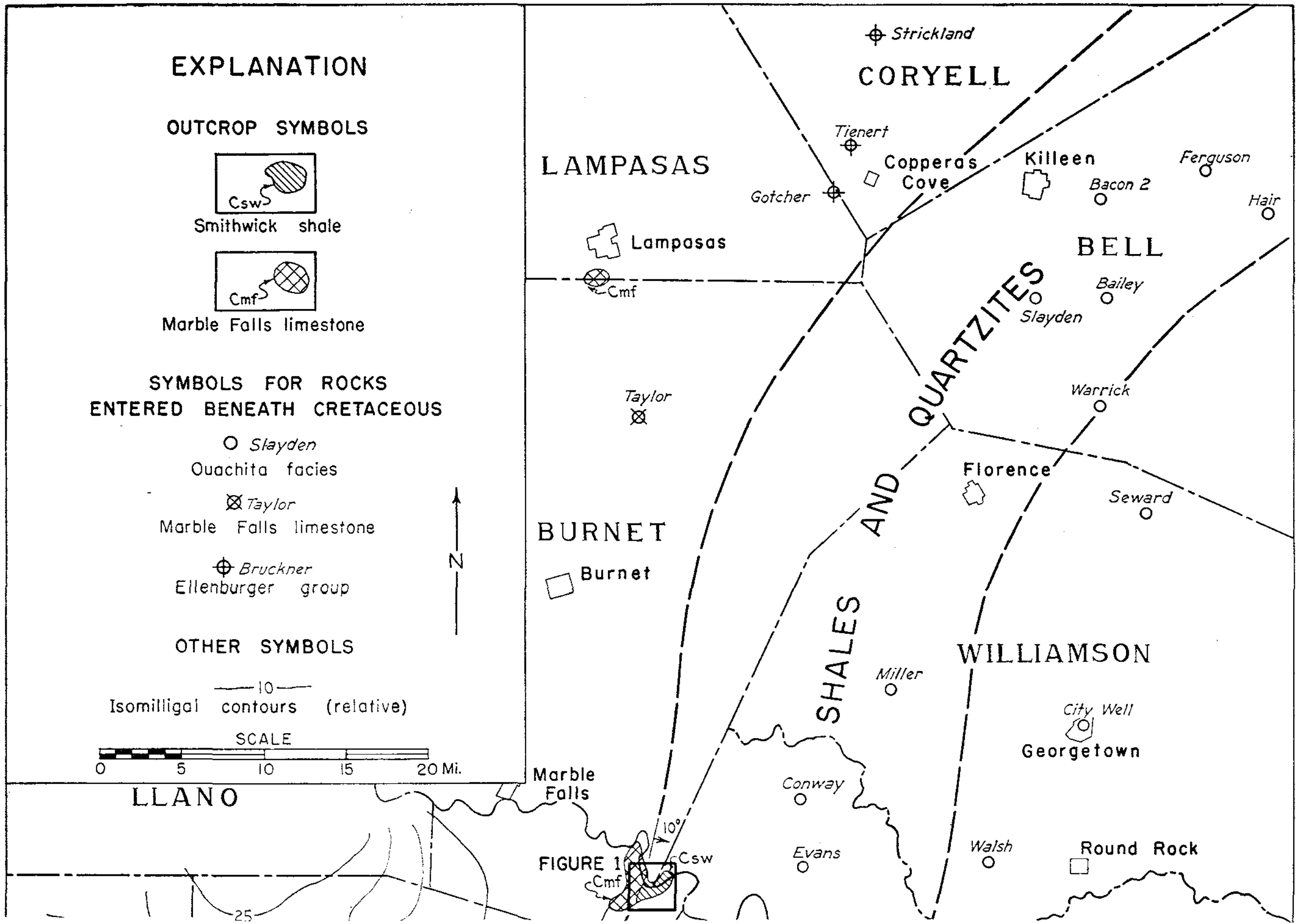
Samples from wells entering the Ouachita facies within 60 miles of the outcrop were examined under a binocular microscope; these include wells described by Udden (1919), Adkins and Arick (1930), Sellards (1931a, 1933), and a few drilled since 1932. A thin-section study would be more revealing; however, with the binocular microscope, or even with the unaided eye, it is obvious that these rocks are progressively more highly metamorphosed eastward.

Near the outcrop (fig. 2) the wells in a belt about 20 miles wide enter rocks which mostly have not been altered except along numerous slickensided surfaces. A few wells on the eastern side of the belt enter rocks transitional to phyllites and gray quartzites of the next belt, which is also about 20 miles wide. The phyllites in the second belt vary from those which are incipiently recrystallized to those that are entirely recrystallized but still very fine grained. The quartzites in both belts are similar with perhaps more oriented minerals developed eastward. In the first belt, evidence of folding and faulting is present in all wells, and calcite and quartz veins are common. Quartz veins are common in the second belt, and the structure is perhaps more complex.

The outermost belt of rocks is represented only by a group of wells in the Luling area, Caldwell County. The rocks penetrated are schists in which even the quartzites have a schistose structure. Sellards (1933, pp. 132, 133–134), influenced by Bailey and Barnes, suggests that these rocks may be pre-Cambrian in age. There is no incontrovertible evidence as to whether these rocks are pre-Cambrian or Paleozoic in age, but, as already shown, the degree of metamorphism increases eastward and the kind of sediments involved appears to be very similar throughout. The grade of metamorphism exhibited by the Caldwell County rocks is lower than that of the pre-Cambrian rocks of central Texas, and it seems likely that they may be Paleozoic in age.

GRAVITY DATA

The writer, in collaboration with Mr. Frederick Romberg, of Austin, has been


EXPLANATION
OUTCROP SYMBOLS
Csw
Smithwick shale
Cmf
Marble Falls limestone
SYMBOLS FOR ROCKS ENTERED BENEATH CRETACEOUS
Slayden
Ouachita facies
Taylor
Marble Falls limestone
Bruckner
Ellenburger group
OTHER SYMBOLS
10
Isomilligal contours (relative)
SCALE
0 5 10 15 20 Mi.
N
LAMPASAS
CORYELL
BELL
BURNET
WILLIAMSON
LLANO
Strickland
Tienert
Gotcher
Copperas Cove
Killeen
Ferguson
Bacon 2
Hair
Lampasas
Cmf
Slayden
Bailey
Taylor
Warrick
Florence
Seward
Burnet
SHALES AND QUARTZITES
Miller
City Well
Georgetown
Marble Falls
Conway
10°
Csw
FIGURE 1
Cmf
Evans
Walsh
Round Rock
25

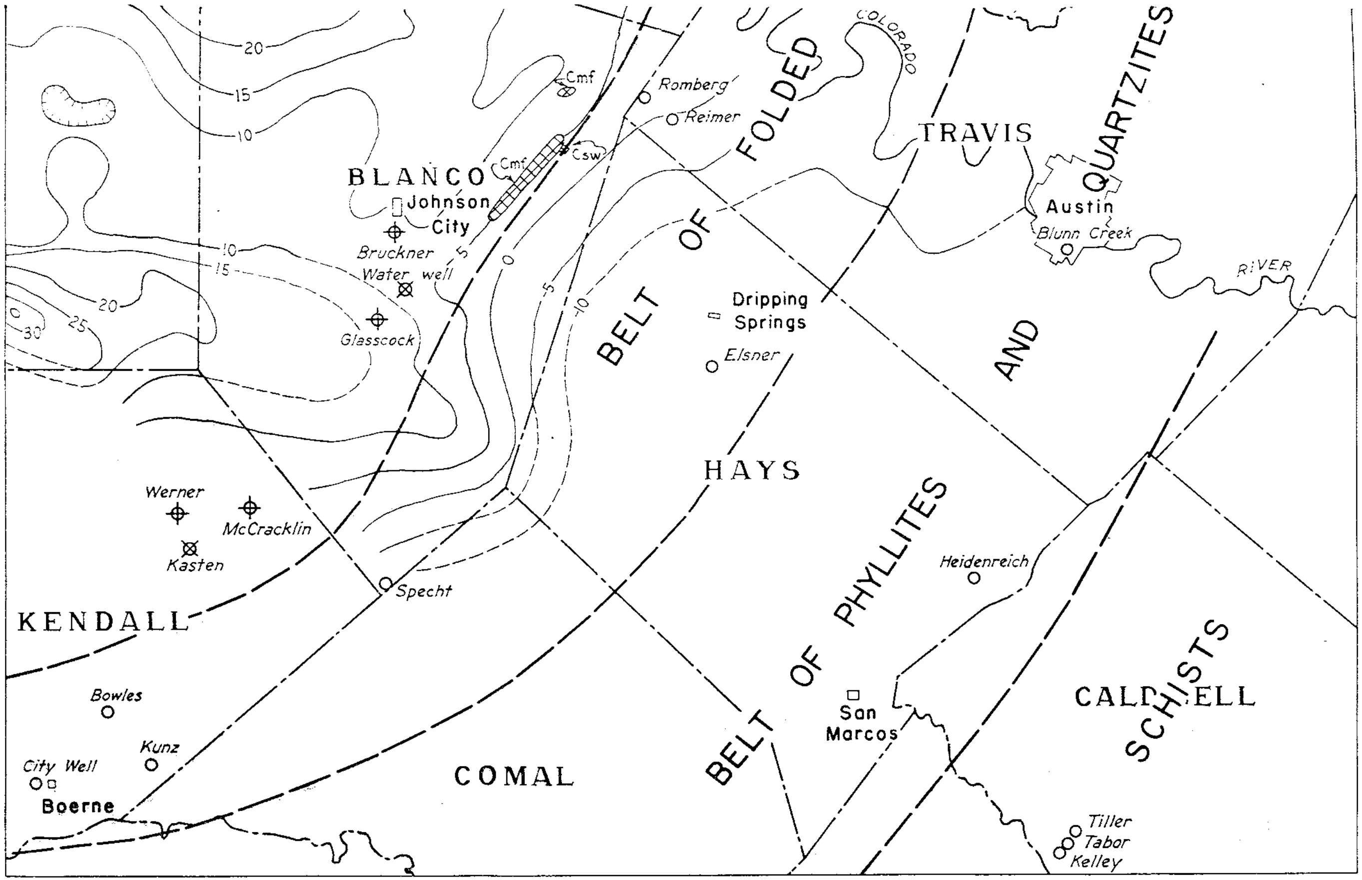


Fig. 2. Map showing variation in the degree of metamorphism of the Ouachita facies southeastward from its outcrop in central Texas.

compiling gravity data in central Texas for several years, and a part of the area covered is shown in figure 2. Not enough observations have been made above the Ouachita facies to allow conclusions to be drawn; however, generalized isomilligal contours are shown on figure 2 for a portion of the area so far covered. The recent findings of Woolard (1948, p. 316) that the thrust zone of the Appalachians is along a series of negative anomalies, may be significant, and it will be interesting to see if such negative anomalies are present along this belt.

CONCLUSIONS

Steeply dipping rocks belonging to the Ouachita facies outcrop along the Colorado River in the vicinity of the Burnet-Travis County line. Southeastward in the subsurface, similar rocks become progressively more metamorphosed. In Caldwell County, schist originally thought to be of pre-Cambrian age is probably of Paleozoic age. Examination of these rocks in the subsurface is confined to central Texas; therefore, no evidence is given for or against the continuation of these rocks as a structural unit to either the Ouachita Mountains of Oklahoma or to the Marathon basin of west Texas.

In the vicinity of the outcropping portion of the Ouachita facies the underlying predominantly carbonate rocks of Lower Pennsylvanian and Lower Ordovician age are normal in appearance and can be expected to continue eastward with little facies change. The rocks of the Ouachita facies could have overridden these rocks without seriously disturbing them. In this event petroleum accumulations might exist beneath the Ouachita facies providing suitable reservoirs are present. Additional stratigraphic units, some of which may form suitable reservoirs, may be present in the subsurface. Addition of stratigraphic units eastward is indicated by outcropping Devonian formations (Barnes, Cloud, and Warren, 1947) in the eastern part of the Llano uplift and the thickening by addition of beds at the top of the Ordovician (Cloud and Barnes, 1948, p. 32).

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