# REVISION OF COMANCHE CRETACEOUS STRATIGRAPHIC NOMENCLATURE, SOUTHERN EDWARDS PLATEAU, SOUTHWEST TEXAS

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## ABSTRACT

The Devils River Formation and correlative Lower Cretaceous rock units in the southern Edwards Plateau of Texas are divisible into three geologically distinct areas on the basis of different facies developments. These are referred to as northern, central, and southern areas, and the stratigraphic nomenclature is revised accordingly.

The northern area sequence, regionally characterized by ammonite-bearing marly mudstones changing facies southward into rudist-miliolid limestones, is divisible by a disconformity into two formations. New names are under consideration pending additional fieldwork.

The central area sequence, assigned to the Devils River Formation proper and confined to a narrow band encircling the southern or Maverick basin area, is represented by the combined and undivided rudist-miliolid limestones of the northern units. Udden's concept of the stratigraphic interval is retained, but the area of application is restricted.

The southern area sequence is marked by the abrupt southward facies change of the undivided Devils River carbonate section into the three units distinctive of the Maverick basin: a lower wackestone unit, the so-called "Edwards Formation;" the evaporitic "Kiamichi Formation" (also called McKnight); and an upper lime mudstone unit previously identified as the "Georgetown Formation." Suppression of the older names is advocated, and replacement nomenclature is proposed.

## INTRODUCTION

In the years since Adkins (1933) summarized the Mesozoic stratigraphy of Texas, data on the Cretaceous of southwest Texas have increased enormously. Most of the information has come from progressively deeper downdip drilling for oil and gas, and the basic relationships comprising the regional stratigraphic framework in the subsurface have become generally known. The adjoining outcrop, on the contrary, has but recently received comparable attention, and the tie between the surface and subsurface has long remained obscure, at least in detail.

Outcrop geologic studies of recent date in the southern Edwards Plateau region (Figure 1) have been principally for two purposes: (a) hydrologic investigations programmed as a result of the 1947-1957 drought, and (b) structural mapping for surface anomalies coincident with deep gravity, magnetic or other geophysical prospects. In both cases, the areal extent of individual studies was generally local (county-size or less), and the stratigraphic nomenclature of the outcrop units was of little concern — usage consistent with earlier works was acceptable. Neither of these types of investigation automatically resolves regional stratigraphic relationships, and in neither type is the local propriety of formation names a matter of question.

A regional synthesis of the Edwards Plateau Cretaceous requires a regional approach plus a system of nomenclature that reflects significant geographic and geologic distinctions. This contribution is based on such a study, in the course of which the impropriety and ambiguity of the older terminology have been thoroughly explored. In view of the plans of The University of Texas Bureau of Economic Geology cooperative project for the 1:250,000 geologic atlas of Texas, it is timely that proposals pertinent to mappable units be submitted.

Previously used formation names, evaluated in the light of present information, are recommended for replacement, emendation, or formal acceptance, and the rock unit names selected are defined in accordance with the Code of Stratigraphic Nomenclature. The initial section treating the basis for revision is the responsibility of F. E. Lozo[1]. The section on descriptive stratigraphy is to be credited to C. I. Smith, who did the field work, certified the stratigraphic relationships, and selected the names. The geologic map (Figure 15, in color) was printed and donated by Shell Development Company, Exploration and Production Research Division, Houston, Texas.

## BASIS FOR REVISION

### Historical Background of Cretaceous Studies

The Comanche Cretaceous of southwest Texas has been studied much less than that of northeast Texas, principally because of the differences in geologic setting. The southeastward-flowing Colorado River

[1]Shell Development Company (A Division of Shell Oil Company), Exploration and Production Research Division, Houston, Texas. Publication No. 383.

[1]This paper is coauthored, and no seniority is to be implied in the order of names. F. E. Lozo.

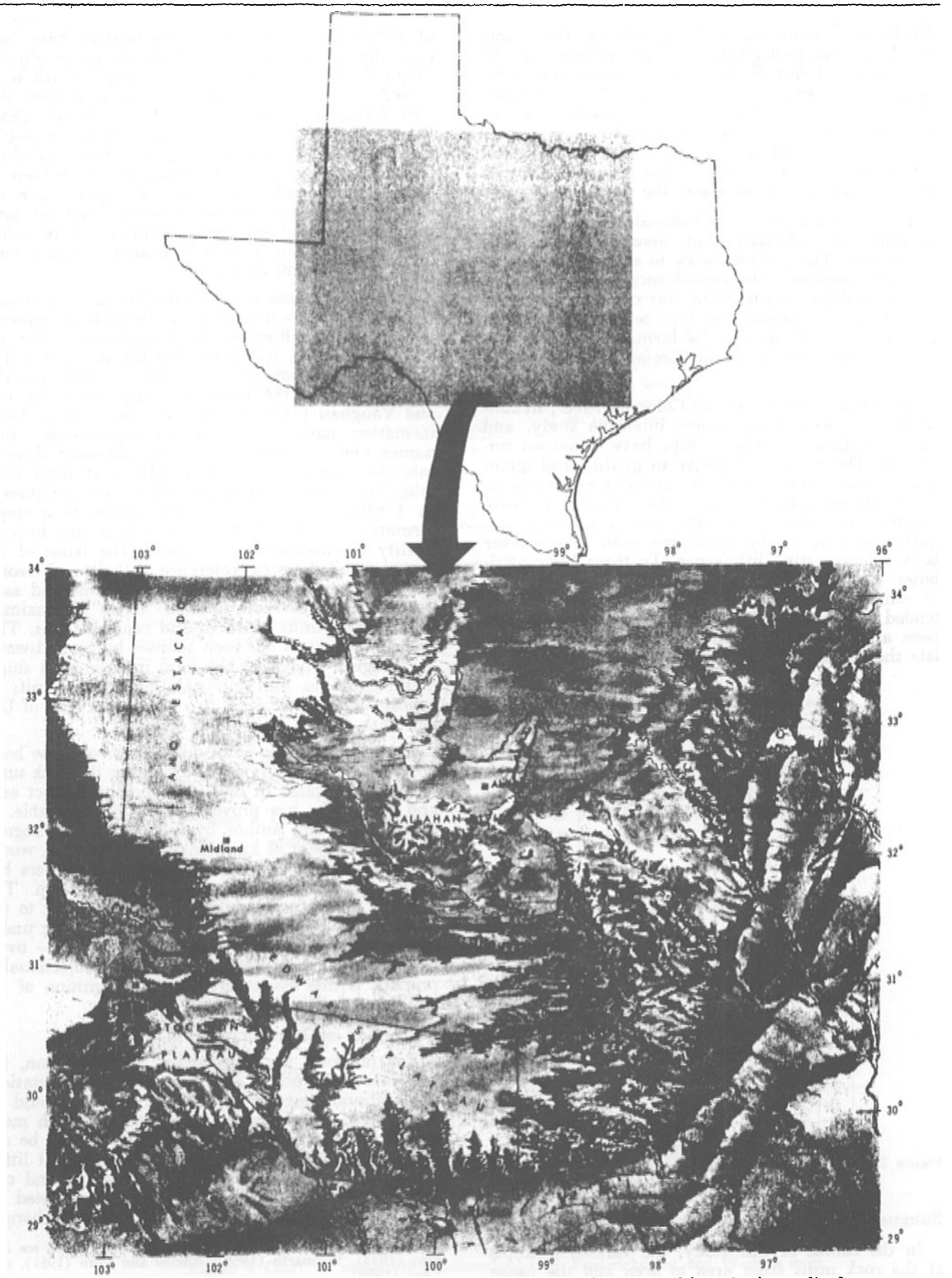


Figure 1. Physiographic diagram of Edwards Plateau and adjoining regions; area of investigation outlined.

divides the continuous outcrop belt in Texas into two large and geologically distinct regions: (a) To the north and east of the river are cuesta-type prairies and timbered terrains underlain by limestones, marls, and sands, with terrigenous clastics increasing northward. (b) To the south and west is a more extensive, elevated, marginally dissected tableland dominated by limestones — the Edwards Plateau and its trans-Pecos extension, the Stockton Plateau.

The outcrop north of the Colorado is the historically significant and classic study area of the Comanche Cretaceous. The pioneer work to elucidate the stratigraphic sequence, the faunal succession, and other salient geologic relationships was concentrated here, and, as a consequence, the type sections and namesake localities of most of the formations of the provincial lower series of the Cretaceous are within this area.

The area southwest of the Colorado River, in contrast, has received much less intensive study, and basic stratigraphic relationships have remained uncertain. The relative disparity in quality and quantity of data is due to lack of favorable exposures on the extensive upland areas of the Edwards Plateau, greater structural complexity, and a lithologic sequence dominated by limestone with few marker beds or contrasting lithologies. To these basic attributes or complications have been added problems of nomenclature; the names applied (Figure 2) extended largely from the northeastern area, have long been ambiguous and misleading in attempts to relate the stratigraphy properly.

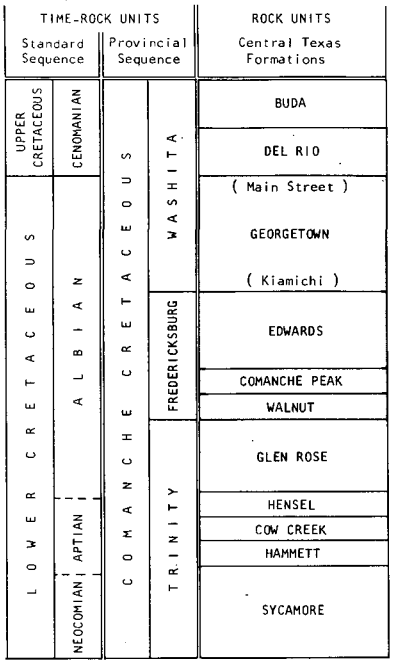


Figure 2. Sequences of stratigraphic units, central Texas; interval and names concerned within the outlined portion.

## *Summary of Previous Investigations*

In the course of this study, the various concepts of the rock units from area to area and the usage of names by all previous investigators have been critically examined and tabulated geographically (Figures. 3, 4, and 5) by areas now known to be geologically distinct (Figure 6). It is evident that local formation names from southwest Texas (Devils River, Del Rio), from central Texas (Edwards, Georgetown, Buda), and from north Texas (Walnut, Comanche Peak, Kiamichi, Grayson) have been inconsistently applied and mixed as convenience and personal judgment dictated. The fact that the same inconsistency and ambiguity occur, not only within each area but also from area to area, supports some effort toward uniformity.

In general, three basic approaches have been used to classify the southwest Texas Cretaceous sequence above the Glen Rose, or basal sand, and below the Del Rio or Buda, where the Del Rio is missing. The oldest, most commonly used, and most objectionable method follows the premature application by Hill and Vaughan (1898a,b) of north and central Texas formation names to presumed equivalents; these *names and misconceptions* were extended directly into the subsurface sections. The next most common, but opposite, approach follows the assignment by Udden (1907) of the total section to a single formation, the Devils River Limestone; the impracticality of subdivision is implied. The latest of the approaches follows the reference of Petitt and George (1956) to the entire section as "Edwards and associated limestones" with lettered "zones" approximating the rock units of north and central Texas. This nonformal system has been adopted by ground-water hydrologists who treat the total interval as a single aquifer and as an indivisible hydrologic unit; in concept the classification is a mixture of that of Udden with that of Hill and Vaughan.

It is significant to point out that *all* of these basic approaches to classifying and naming the rock units have been applied in *each* geologically distinct area and that *none* has proved generally acceptable. A detailed account, author by author, of the progressive development of knowledge, area by area, would bring out the discrepancies of previous workers but would be extraneous to the immediate aim. The patterns of confusion, in no manner peculiar to the stratigraphic sequence or the geologic setting under consideration, have one result in common — overextension of rock unit names. This objectionable practice is due essentially to nonrecognition of facies relationships, locally and regionally.

## Evaluation of Nomenclature

For purposes of cartographic representation, intelligible description, and historical interpretation, the unsound usage of certain old names[1] should be suppressed, other names can be retained with more precise definition, and some new units must be defined and named. It is to be remembered that lithic units and names are in no sense absolute and can be abandoned, redefined, revived, or accepted as utility indicates. The bases for the proposed changes

[1]For synopsis or digests of the previously named units, see Adkins (1933), Wilmarth (1938), Adkins and Lozo (1951), and Lozo (1959).

A. Drainage Basins of Pecos River and Devils River

| | | | | References |
|---|---|---|---|---|
| Calcareous Group ( = Upper Cretaceous ) | | | | Shumard [1855-56], 1886 |
| DEVILS RIVER LIMESTONE | | DEL RIO | BUDA | Udden, 1907 |
| DEVILS RIVER LIMESTONE | | DEL RIO | BUDA | Udden, Baker and Bose, 1916 |
| DEVILS RIVER LIMESTONE | | DEL RIO | BUDA | Roberts and Nash, 1918 |
| WAL-NUT | DEVILS RIVER LIMESTONE \| GEORGETOWN | DEL RIO | BUDA | Christner and Wheeler, 1918 |
| WALNUT and COMANCHE PEAK | EDWARDS LIMESTONE: Division 1 \| Division 2 \| Division 3 | | | Liddle and Prettyman, 1920 |
| DEVILS RIVER LIMESTONE Key bed → | | DEL RIO | BUDA | Calvert, 1928 |
| WAL-NUT | COMANCHE PEAK \| EDWARDS \| GEORGETOWN | ? DEL RIO ? | | Fritts, 1933 |
| EDWARDS | GEORGETOWN | DEL RIO | BUDA | Darton, 1933 |
| DEVILS RIVER ( = Georgetown age ) | | DEL RIO | BUDA | Stanton, 1947 (also 1928) |
| [ numbered beds - no formation names applied ] Cap Rocks: 1 → 2 → 3 → 4 → | | | | Edson, 1951 |
| DEVILS RIVER LIMESTONE: Member 1 \| Member 2 \| Member 3 | | DEL RIO | BUDA | Spice, 1954 |
| *Unnamed Lower Formation* | *Unnamed Upper Formation* | *DEL RIO* | *BUDA* | *Lozo and Smith, 1964 this report* |

B. Edwards Plateau Divide: Latitude of Rocksprings - Fredericksburg

| | | | | References |
|---|---|---|---|---|
| Kreide des Hochlandes ( = Turonian - Senonian ) | | | | Roemer, 1849, 1852 |
| COMANCHE PEAK | EDWARDS \| FORT WORTH | DEL RIO | | Hill and Vaughan, 1898 a-b |
| COMANCHE PEAK | EDWARDS \| GEORGETOWN | DEL RIO | BUDA | Curry, 1933, 1934 |
| WALNUT and COMANCHE PEAK | EDWARDS Kirschberg evaporite → | | | Barnes, 1944, 1952-56 |
| EDWARDS and Associated Limestones: Zone A \| Zones B and C \| Zone D | | GRAYSON | BUDA | Long, 1962 |
| *Unnamed Lower Formation* | *Unnamed Upper Formation* | *DEL RIO* | *BUDA* | *Lozo and Smith, 1964 this report* |

**Figure 3. Chart of comparative nomenclature of Fredericksburg and Washita units applied in northern area of Figure 6, 1849-1964.**

Central Val Verde County East to Southern Real County

| | | | | References |
|---|---|---|---|---|
| COMANCHE PEAK | EDWARDS LIMESTONE \| FORT WORTH | | | Hill and Vaughan, 1898 a-b |
| DEVILS RIVER LIMESTONE | | DEL RIO | BUDA | Udden, 1907 |
| COMANCHE PEAK | EDWARDS LIMESTONE \| GEORGETOWN LIMESTONE | DEL RIO | BUDA | Curry, 1933, 1934 |
| COMANCHE PEAK Zone A | EDWARDS and Associated Limestones: EDWARDS Zone B \| Zone C ? GEORGETOWN Zone D | | | Long, 1958 |
| FREDERICKSBURG GROUP ? WASHITA GROUP COMANCHE PEAK | [ beds indicated by footage above base ] | | | Park, 1959 |
| COMANCHE PEAK | EDWARDS and Associated Limestones: EDWARDS ? Kki ? GEORGETOWN | | | Gulf Coast Association Geological Societies, 1961 |
| DEVILS RIVER LIMESTONE | | | | Rodda and Fisher, 1961 |
| COMANCHE PEAK Zone A | EDWARDS and Associated Limestones: EDWARDS and GEORGETOWN Zone B \| Zone C \| Zone D | | | Long, 1962 |
| *DEVILS RIVER LIMESTONE* | | *DEL RIO* | *BUDA* | *Lozo and Smith, 1964 this report* |

**Figure 4. Chart of comparative nomenclature of Fredericksburg and Washita units applied in central area of Figure 6, 1898-1964.**

A. Val Verde County

| | | | | | | References |
|---|---|---|---|---|---|---|
| Exogyra texana and Com. Pk. beds | Caprina limestones | Washita limestone | | Arietina clays | Vola limestone | Dumble, 1895 |
| | | EDWARDS Caprina ls. | FORT WORTH | DEL RIO | BUDA | Vaughan, 1900 b |
| DEVILS RIVER LIMESTONE | | | [ = Kgt ] | DEL RIO | BUDA | Udden, 1907 |
| DEVILS RIVER LIMESTONE | | | | DEL RIO | BUDA | Udden, Baker and Bose, 1916 |
| DEVILS RIVER LIMESTONE | | | | DEL RIO | BUDA | Roberts and Nash, 1918 |
| DEVILS RIVER LIMESTONE | | | | DEL RIO | BUDA | Calvert, 1928 |
| | | DEVILS RIVER LIMESTONE | | DEL RIO | BUDA | Stanton, 1928 |
| EDWARDS LIMESTONE | | ? | GEORGETOWN | DEL RIO | BUDA | Darton, 1933 |
| | | DEVILS RIVER LS. [ = Kgt ] | | GRAYSON | BUDA | Stanton, 1947 |
| DEVILS RIVER LIMESTONE | | | | DEL RIO | BUDA | Cheetham, 1949 |
| WALNUT and COMANCHE PEAK | EDWARDS LS. | KIAMICHI FM. | GEORGETOWN LIMESTONE | DEL RIO | BUDA | International Boundary and Water Commission, 1955 |
| | | GEORGETOWN LIMESTONE | | DEL RIO | BUDA | Hazzard, 1956, 1959 |
| *WEST NUECES FORMATION* | | *McKNIGHT FM.* | *SALMON PEAK FORMATION* | *DEL RIO* | *BUDA* | *Lozo and Smith, 1964 this report* |

B. Uvalde and Kinney Counties

| | | | | | | | References |
|---|---|---|---|---|---|---|---|
| COMANCHE PEAK | EDWARDS LIMESTONE | | FORT WORTH | DEL RIO | SHOAL CREEK LS. | | Hill and Vaughan, 1898 a-b |
| COMANCHE PEAK | EDWARDS LIMESTONE | | FORT WORTH | DEL RIO | | | Vaughan, 1900 a |
| DEVILS RIVER LIMESTONE | | | | DEL RIO | BUDA | | Udden, 1907 |
| COMANCHE PEAK | EDWARDS LIMESTONE | | GEORGETOWN | DEL RIO | BUDA | | Getzendaner, 1931 |
| WALNUT and COMANCHE PEAK | EDWARDS LIMESTONE | | GEORGETOWN | DEL RIO | BUDA | | Sayre, 1936 |
| EDWARDS FORMATION | | KIAMICHI FM. [="McKnight"] | GEORGETOWN LIMESTONE | GRAYSON | BUDA | | Imlay, 1945 [subsurface] |
| COMANCHE PEAK | EDWARDS | [unknown at surface] | DEVILS RIVER LIMESTONE | GRAYSON | BUDA | | Stanton, 1947 [outcrop] |
| | | | GEORGETOWN | GRAYSON | BUDA | | Greenwood, 1956 |
| EDWARDS and Associated Limestones | | | | GRAYSON | BUDA | | Petitt and George, 1956 |
| EDWARDS and Associated Limestones: Zone A nodular ls. | Zone B lower massive ls. | Zone C flaggy ls. | Zone D [= "Whitecap" ls.] upper massive ls. | GRAYSON (DEL RIO) | BUDA | | Welder and Reeves [1955-57] (preliminary field terms) |
| FREDERICKSBURG GROUP: nodular ls. and clay. (Kwa) | lower massive ls. | flaggy ls. | GEORGETOWN LIMESTONE | GRAYSON | BUDA | | Park, 1959 |
| COMANCHE PEAK | EDWARDS | KIAMICHI or "McKNIGHT" | GEORGETOWN | GRAYSON or DEL RIO | BUDA | | Gulf Coast Association Geological Societies, 1961 |
| COMANCHE PEAK | EDWARDS | KIAMICHI | GEORGETOWN | GRAYSON | BUDA | | Welder and Reeves, 1962 |
| COMANCHE PEAK | EDWARDS FORMATION: Zone 1 | Zone 2 | Zone 3 / Zone 4 / Zone 5 | GEORGE-TOWN | GRAYSON | BUDA | Bennett and Sayre, 1962 |
| *WEST NUECES FORMATION* | | *McKNIGHT FM.* | *SALMON PEAK FORMATION* | | *DEL RIO* | *BUDA* | *Lozo and Smith, 1964 this report* |

**Figure 5. Chart of comparative nomenclature of Fredericksburg and Washita units applied in southern area of Figure 6, 1895-1964.**

are summarized below; the formation units herein recognized have been tested and have proved to be adequate for the purposes stated.

### Suppressed (Restricted) Names

These names, (Figure 5), quite valid for central and (or) north Texas rock units, are considered inappropriate for usage in southwest Texas.

WALNUT (Hill, 1891) and (or) COMANCHE PEAK (Hill, 1891). Either or both of these names have been applied to the nodular limestone at the base of the section under discussion. Usually associated with *Exogyra texana* Roemer and other mollusks, and widespread and persistent as a basal transgressive lithofacies, the unit has not been securely mapped or traced as a continuous body into the type Walnut or Comanche Peak units of north-central Texas.

EDWARDS (Hill and Vaughan, 1898) and GEORGETOWN (Hill, 1901). Although derived in name from the Edwards Plateau, the Edwards Formation was thoroughly misconceived in the namesake area at the time of substitution of the name "Edwards" for the paleontologically designated "Caprina limestone." Hill and Vaughan's generalized section from the Nueces and Uvalde quadrangles is a composite section based on observations from parts of all three of the geologically distinct areas of this report. The so-called "Edwards" of the southern Edwards Plateau is misleading as to lithic character and grossly inaccurate as a tabular rock unit correlative of the type Edwards of central Texas. Projection of the term Edwards (as with the Comanche Peak and Walnut), solely on a homotaxial basis, through an intermediate area of complex structure and stratigraphy was questionable in principle originally and has proved unsound in practice ever since. The basic objections to the Edwards as a valid unit in southwest Texas also apply to the so-called "Georgetown." Even more atypical with respect to the physical attributes of the type section, the name has been retained mostly by association with the name Edwards.

KIAMICHI (Hill, 1891). The unwarranted substitution (Imlay, 1945) of the name Kiamichi for the then-informal "McKnight" evaporite-bearing, dark "shale" section in the subsurface was erroneously predicated on lateral continuity of the Kiamichi from north Texas into southwest Texas; the name was subsequently extended to the outcrop in Uvalde County by the U. S. Geological Survey (Welder and Reeves, 1962). The southwest Texas unit is now known to be completely separate from, and geologically unrelated to, the type Kiamichi (southeastern Oklahoma); neither facts nor logic supports retention of usage in the Rio Grande embayment area.

### Retained Names

DEVILS RIVER (Udden, 1907). As in the case of Hill and Vaughan's studies to the east, Udden's observations to the west were from all three of the distinct areas of the present report. Unlike the area to the east, the exposures along the Devils River are limited to the upper portion of the section between the Glen Rose and Del Rio formations. Although indicating a general correlation with the (erroneous) Georgetown and Edwards of Hill and Vaughan, Udden stressed the uncertainty of his correlations and the impracticality of subdividing the section at this stage of reconnaissance, and he introduced the term Devils River. The name has been generally used since, in all areas, to refer to the entire and undivided section below the Del Rio and above the Glen Rose. This concept is useful in a much narrower area than previously applied and, as restricted in this report (to the central area only), is both meaningful and appropriate.

DEL RIO (Hill and Vaughan, 1898) and BUDA (Vaughan, 1900). Normally overlying the Devils River or equivalent strata are dark clays with thin, flaggy, shelly, or arenaceous beds, the type Del Rio. The Geologic Names Committee of the U. S. Geological Survey have favored the usage of Grayson (Cragin, 1894) over Del Rio, but the facies differences and other distinctions between the marly north Texas formation and the type Del Rio are considered more valid than priority in retaining the name Del Rio (cf. Adkins and Lozo, 1951, pp. 114, 153). With respect to the Buda, the name has been consistently applied in southwest Texas by all workers.

### Provisional and New Names

These names, defined in accordance with the Code of Stratigraphic Nomenclature, are the WEST NUECES, McKNIGHT (Winter, 1961), and SALMON PEAK formations in the southern area. No type section or type well of the McKnight has yet been designated; an outcrop reference section is presented. The regional relationship of these units and the Devils River Formation is diagrammed in Figure 7.

## DESCRIPTIVE STRATIGRAPHY

### Geologic Setting and General Relationships

The standard section of the outcrop Comanche Cretaceous in central Texas is shown in Figure 5. This report is concerned with that portion of the column within the shaded border. None of the formation names shown in this interval is currently considered applicable in the Edwards Plateau region because of facies changes and considerations of stratigraphic propriety. However, the bounding formations — Glen Rose and Del Rio — have the same facies here as in central Texas, and the contacts between them and the interval studied are considered to be time-stratigraphic horizons as well as lithologic boundaries.

Interpretations of physical features of upper Glen Rose beds in the southeastern part of the study area indicate that during this time lime muds, now represented as dolomitized mudstone[1], were deposited in the littoral zone and immediately offshore while lime wackestones with normal marine fauna were

[1]Carbonate rock classification in this report follows Dunham (1962).

being deposited farther offshore. At the end of Trinity (Glen Rose) time the shoreline had withdrawn to a position parallel to and slightly north of the Balcones fault trend. The shore area and an expanse some distance inland was an exposed mud flat undergoing consolidation, cementation, and weathering. Farther inland and westward fluvial sands, silts, and redbeds were being deposited.

As the sea readvanced to the north, offshore lime wackestones with normal marine faunas were deposited in the following sequence: (1) transitionally on dolomite and dolomitic marls; (2) disconformably on bored, oyster-encrusted, and weathered dolomite; and (3) transitionally to locally disconformably on sands and silts. These initial transgressive sediments, a nodular lime wackestone varying from 10 to 60 feet thick, form a basal rock unit common to most of the study area. It may be desirable to designate the unit formally in the future, but for the present this seems unnecessary[1].

These basal beds and the overlying 500-700 feet of limestones can be divided geographically into three geologically distinct areas — northern, central, and southern (Figure 6) — and the rocks in each area are divisible into distinct formations (Figure 7). The northern area sequence, divisible by a disconformity into two formations, is characterized by ease of subdivision, by distinctive faunal assemblages, and by a north-south facies change from marly mudstones to predominantly rudist-miliolid wackestones. The southward facies change culminates in a narrow band of undivided rudist-miliolid lime wackestones, mudstones, and minor grainstones which constitute the central area. The boundary between the central and southern areas is a line of abrupt facies change from the single mass of indivisible limestones to three formations of variable limestone facies (Figure 8). This line of facies change marks the northeastern boundary of the Maverick basin (Winter, 1961a-c), and the three formations are characteristic of this basin.

The upper contact of this group of closely interrelated formations is a major unconformity exhibiting both truncation of the underlying beds and two separate onlaps of the overlying formations, the Del Rio and the Buda. In the southern area, 80-90 feet of Del Rio clays plus a basal 30 feet of inter-bedded clay and limestone overlies the unconformity. Northward these beds thin by onlap and truncation. Beyond the onlap-plus-truncation limit of the Del Rio, the Buda Limestone rests on the unconformity, and this relationship is present over most of the northern area investigated.

[1]This unit has been mapped by previous workers as the "Comanche Peak" or "Walnut-Comanche Peak" formation. For reasons stated in the Revision of Nomenclature section, it is not desirable to use either of these names in this area. Furthermore, as the basal transgressive beds of several formations, the unit is an integral part of these formations, and designation as a separate stratigraphic unit serves to obscure rather than clarify this relationship.

[2]Proposals treating the northern area are withheld pending additional field work.

## Definition of Rock Units

On the bases for revision summarized in the initial section of this report, a revised system of nomenclature appropriate for the central and southern areas is submitted below[2]. The formation units recognized are of tested utility for descriptive and cartographic purposes (Figures 9-15);[3] the names proposed and the usages advocated should suppress certain ambiguities and thus advance sounder interpretations of the geologic history of the region concerned.

### Devils River Formation (Udden, 1907)

Udden introduced the name Devils River Limestone in these words:

> "This name is here applied to the limestones which are found exposed on Devil's River (Val Verde County). They include what is known in central Texas as the Edwards and Georgetown limestones. The upper hundred feet, or less, correspond to the latter, and the lower four hundred feet are the equivalent of the greater part of the former. They are not separated by any well-marked horizon of change, but merge gradually into each other."

The errors of the conjectured footage equivalents of this date (extended directly from the assumptions of Hill and Vaughan (1898) on the Edwards Plateau section to the east); the fact that essentially all of the exposed section observed by Udden is of Washita age (noted earlier by Dumble (1895) and stressed subsequently by Stanton (1928); and the observation that Udden applied the name to exposures from old Camp Hudson (Figure 6), north of the outcrop trend as now restricted, downstream to the Rio Grande, quite some distance south of the restricted trend, have not affected the basic concept of the Devils River Limestone. The concept of an undivided formation predominantly of Edwards facies but representing all of the Fredericksburg formations plus the overlying Georgetown Washita of central Texas has remained useful, has been consistently so applied, and can be retained with slight modification.

The data pertinent to redefinition of the Devils River Formation are given below:

*Formal reference.* Udden, J. A. (1907), Report on a Geological Survey of the Lands Belonging to the New York and Texas Land Company (Ltd.) in the Upper Rio Grande Embayment in Texas, *Augustana Library* Pub. No. 6, p. 56.

*Name and geographic feature.* Devils River Limestone, after exposures along Devils River, Val Verde County, Texas.

[3]Figure 15 is based on the works of Hill and Vaughan (1898a-b,), Vaughan (1900a), Long (1958, 1962), Welder and Reeves (1962), and Bennett and Sayre (1962) with additional mapping by the writers.

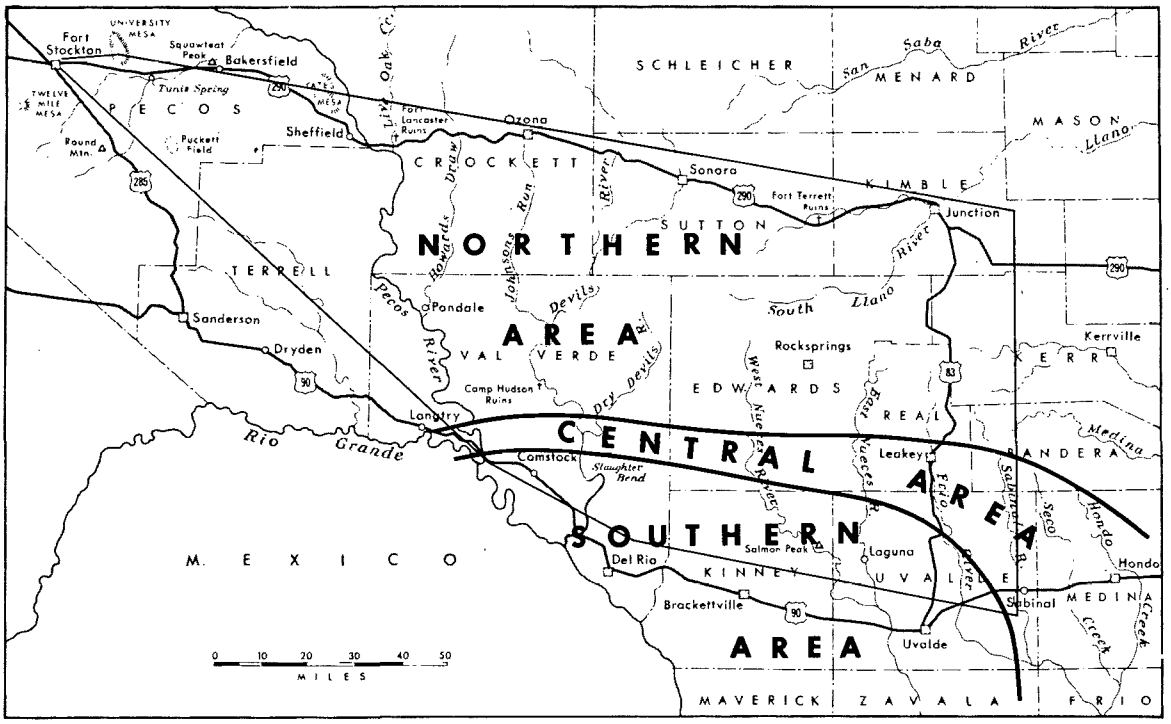


Figure 6. Map of geologically distinct areas in the Edwards Plateau; area of study outlined.

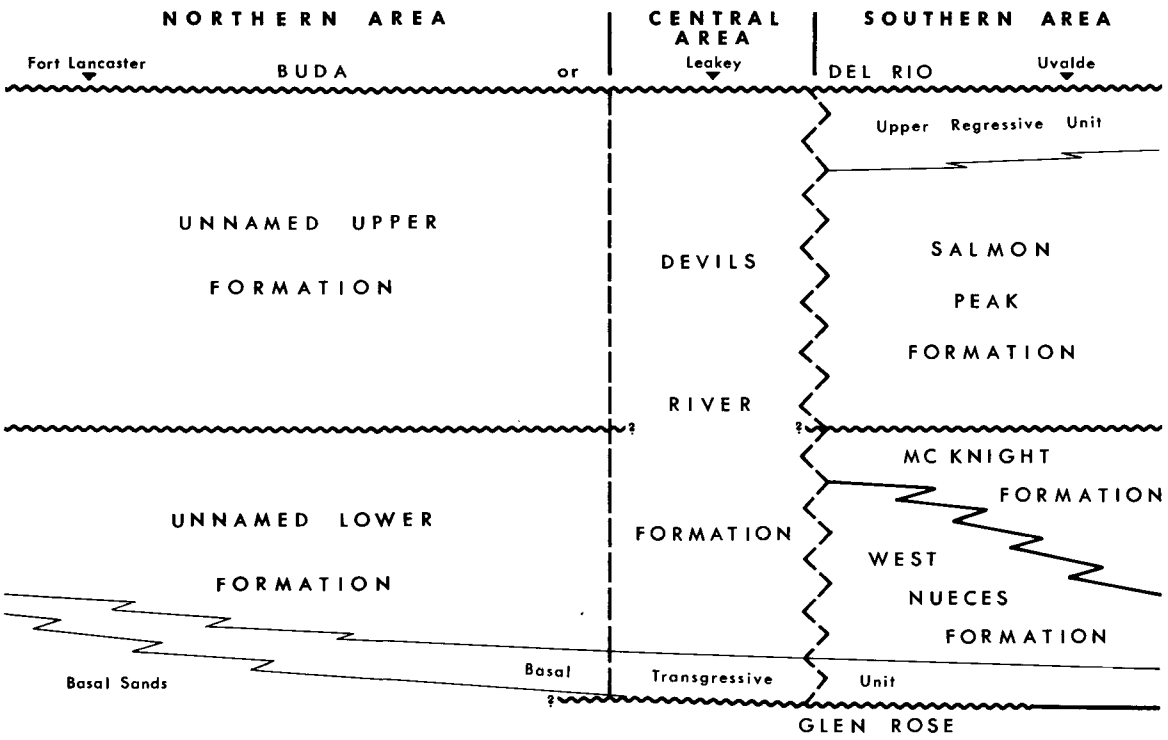


Figure 7. Generalized northwest-southeast stratigraphic section of Devils River Formation and equivalents, Edwards Plateau.

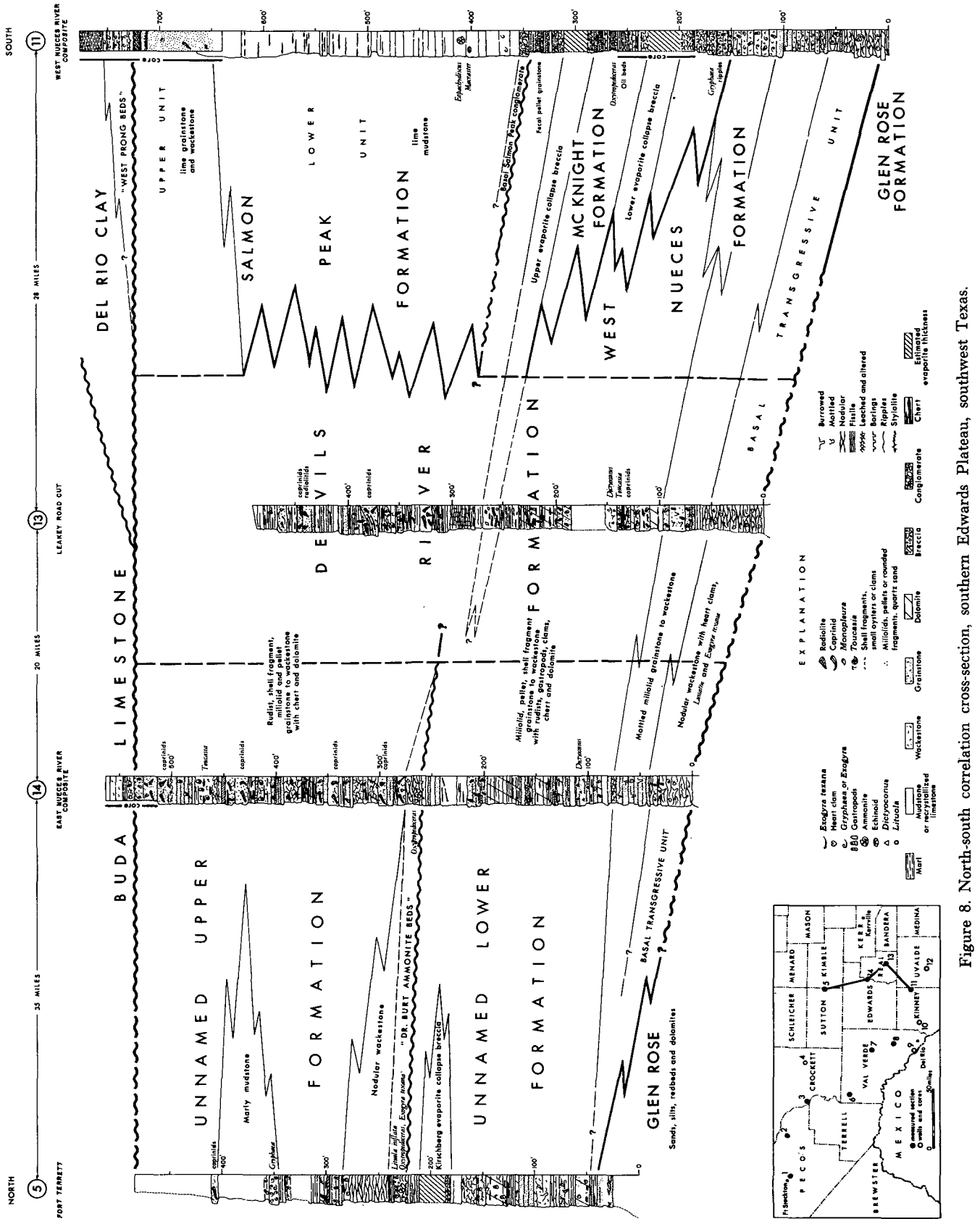


Figure 8. North-south correlation cross-section, southern Edwards Plateau, southwest Texas.

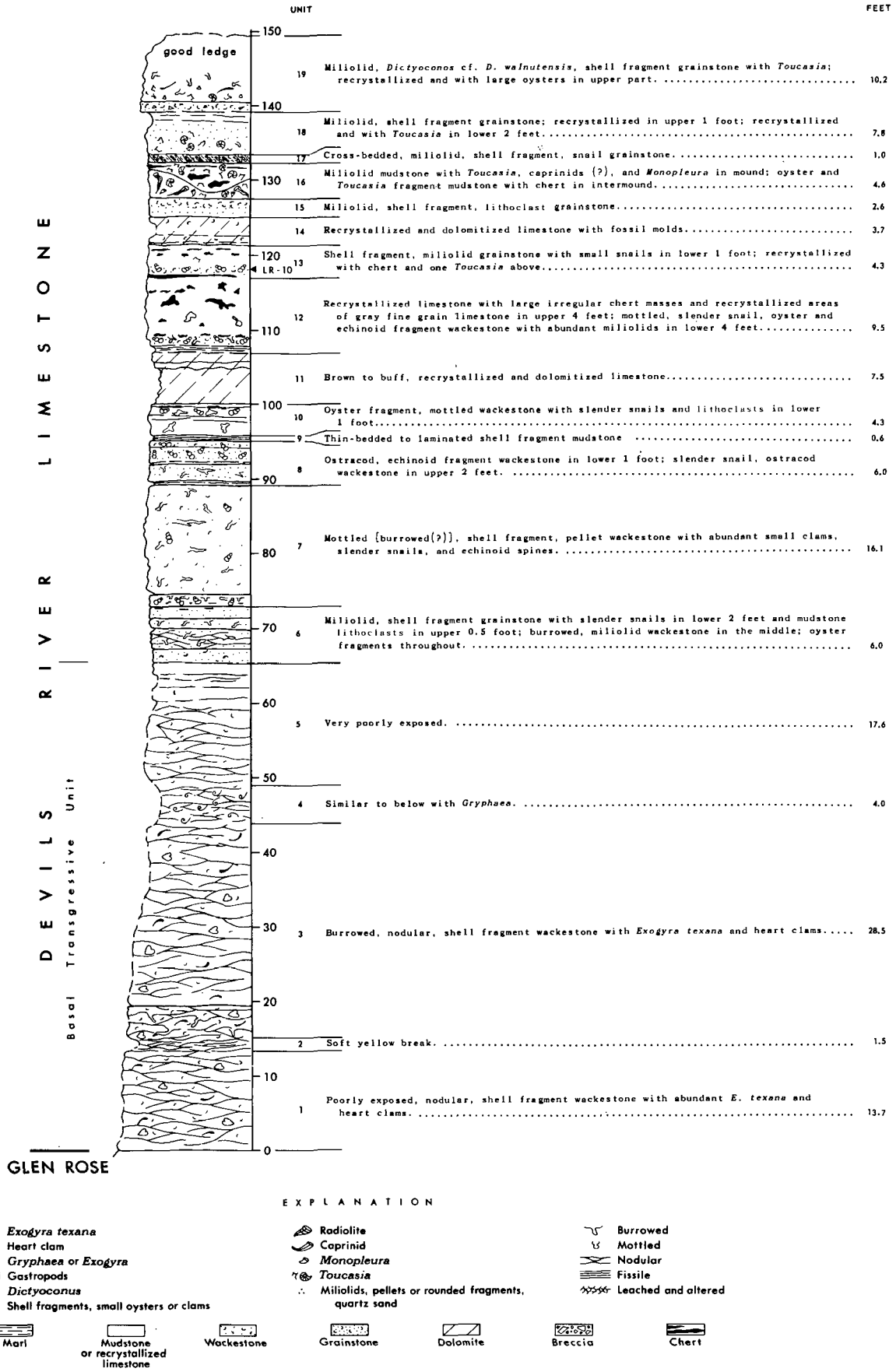


Figure 9a Graphic section of the Devils River Formation at the type locality; 4 miles west of Leakey on State Highway 337, Real County, Texas.

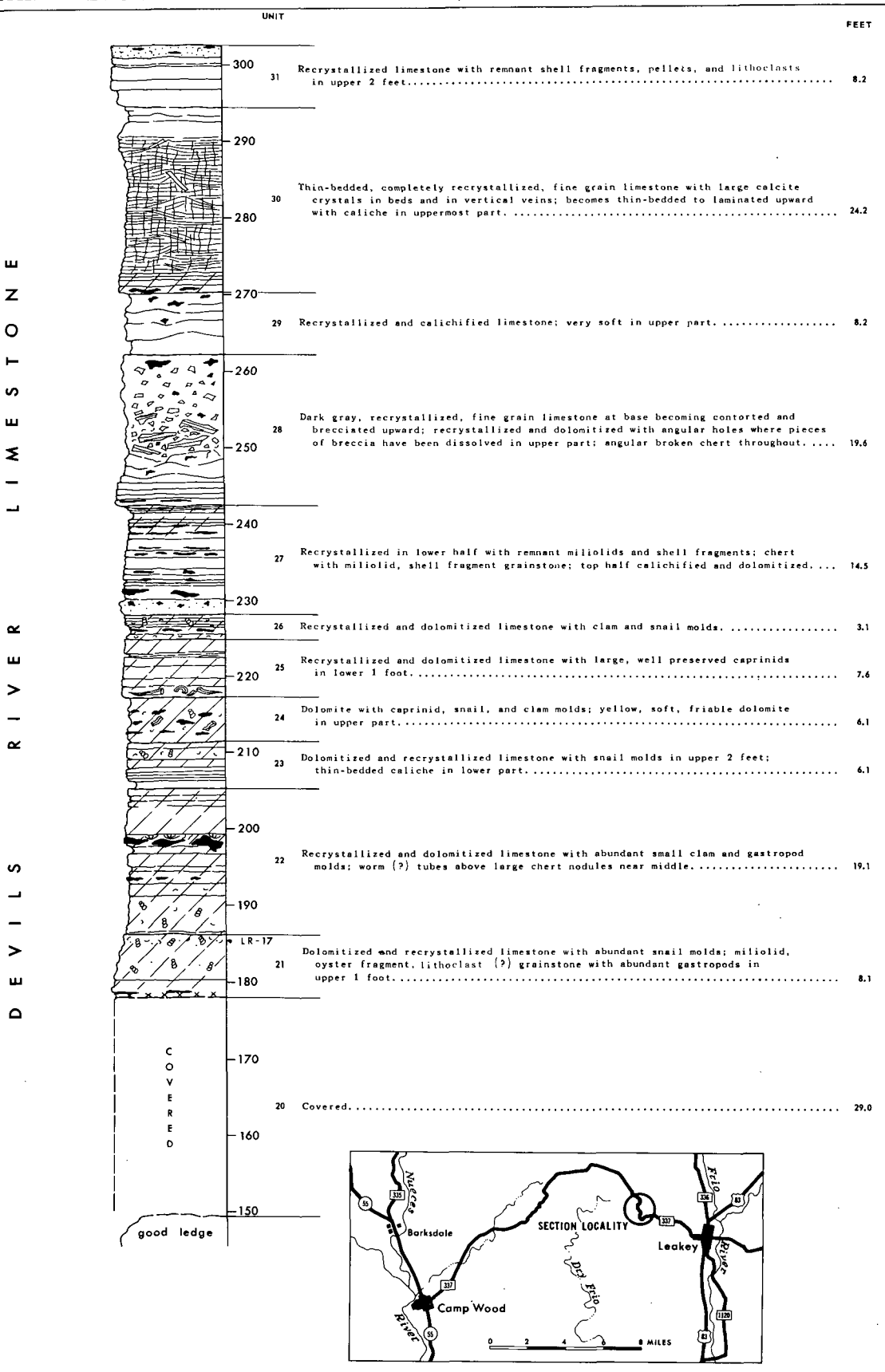


Figure 9b Graphic section of the Devils River Formation at the type locality; 4 miles west of Leakey on State Highway 337, Real County, Texas.

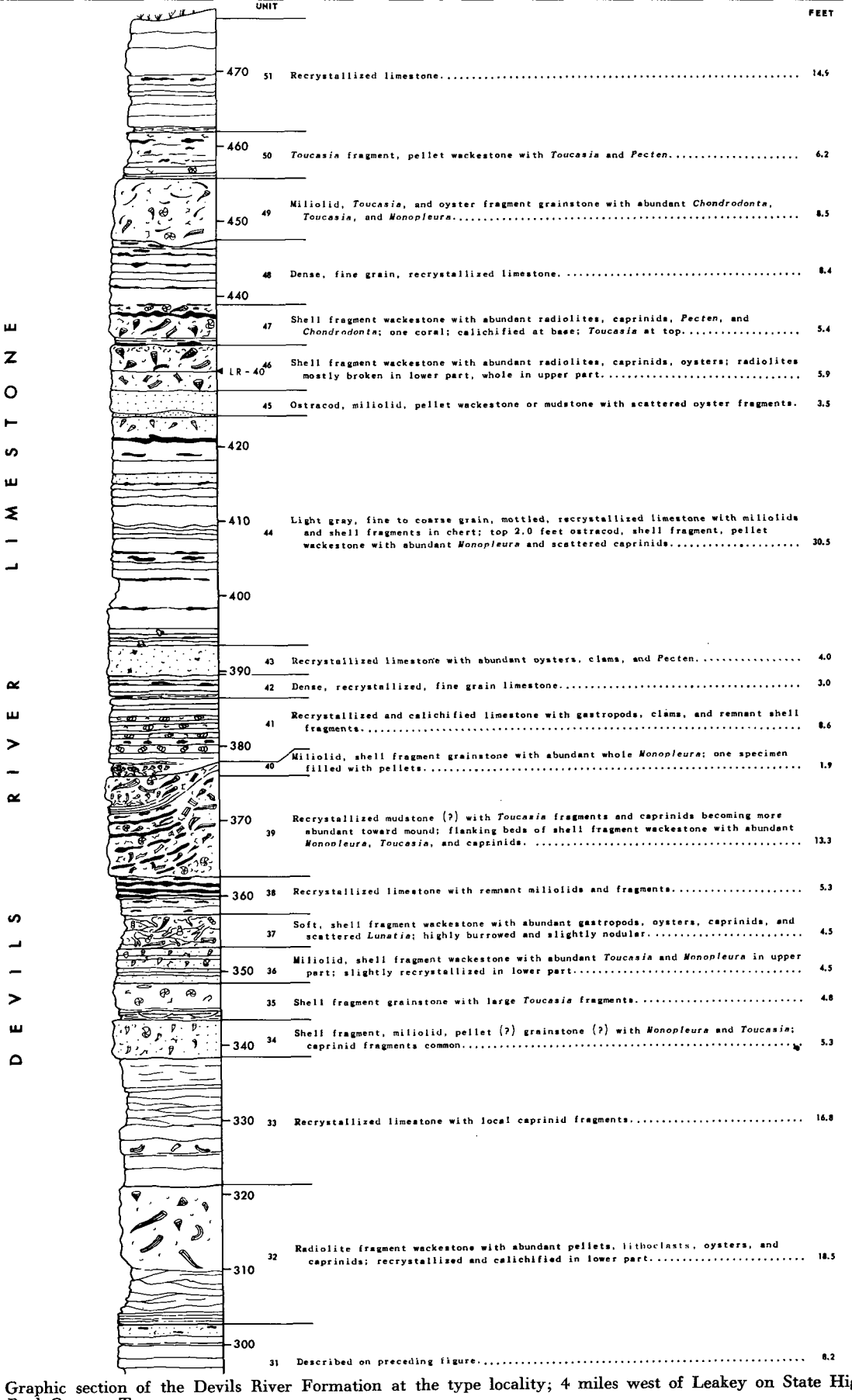


Figure 9a-c. Graphic section of the Devils River Formation at the type locality; 4 miles west of Leakey on State Highway 337, Real County, Texas.

*Type region (namesake area).* No type section or locality originally specified. By the Code (Art. 13i), the type area contains the type locality, and the type locality contains the type section. Without these, the original reference area — from Camp Hudson downstream to the Rio Grande — is actually a namesake area only[1].

*Type section and type locality.* Here designated as the section exposed in roadcuts along the Camp Wood-Leakey road (State Highway 337), Real County, Texas, from about 4 miles west of Leakey to the top of the divide. This is the maximum exposed interval — 447 feet of the 500- to 600-foot outcrop total thickness — and the most accessible section in the trend.

*Type area.* Extends from northern Uvalde County through the type locality in southern Real County, and west through southern Edwards into the namesake Devils River drainage near the mouth of Dry Devils River (Figure 6). Outcrop belt is 10-15 miles wide, as defined by the limits of the subdivided sequences to the north and south.

*Summary lithologic description and contacts.* The Leakey roadcut section (Figure 9a-c) has been described by Long (1958), Park (1959), Rodda and Fisher (1961), Welder and Reeves (1962) and is treated in the field trip guidebooks of the South Texas Geological Society, 1960, and the Gulf Coast Association of Geological Societies, 1961. The entire section is dominated by miliolid, pellet, rudist, shell fragment lime grainstones and wackestones locally dolomitized, brecciated, and chert-bearing; rudist mounds and layers are more common in the upper portion. The basal nodular, fossiliferous wackestone is disconformable on the Glen Rose; the uppermost beds (absent here) are in disconformable contact with the Del Rio to the west.

*Area of application.* In southwest Texas, the outcrop area of application extends from northwestern Medina County west through the type area to the Rio Grande near the mouth of the Pecos River. In Mexico, the outcrop belt has been mapped by Petroleos Mexicanos across the Serrania del Burro (near Cerro El Colorado) and extended south through the Sierra del Carmen and Sierra de San Geronimo toward Musquiz (Smith, manuscript in preparation).

## West Nueces Formation (New Name)

*Name proposal.* The West Nueces Formation is here proposed as a replacement name for the so-called "Edwards" and "Comanche Peak" plus "Walnut" formations as applied in the Maverick basin area of the Rio Grande embayment. The name is taken from exposures in the type area along the West Nueces River, eastern Kinney and western Uvalde counties, Texas.

*Type section and type locality.* The type section (Figure 10) is exposed in bluffs on the left bank of the West Nueces River, about 3½ miles northwest of the Laguna-Brackettville road crossing (State Highway 334), immediately upstream from the confluence with Chalk Creek, Chapman Ranch, northeastern Kinney County. The locality (WN I & II, Figure 15) is about 8 miles north of Turkey Mountain and is two miles West 22° North of Salmon Peak on the U.S.G.S. Turkey Mountain quadrangle, 15-minute series, 1:62,500 scale.

*Summary lithologic description.* The type section is about 145 feet thick and is in sharp concordant contact with the underlying Glen Rose. The lower 60 feet is the regional basal transgressive unit — nodular, shell fragment wackestone with common oysters and other molluscan fossils — generally called Comanche Peak (cf. Bennett and Sayre, 1962, p. 19). The overlying 80-85 feet of massive bedded, miliolid, pellet, shell fragment wackestones to mudstones with some grainstones is the so-called Edwards where the overlying flaggy unit is referred to the Kiamichi (Welder and Reeves, 1962) Others have referred informally to the upper West Nueces unit as the "first zone of the Edwards," to the flaggy unit as the "second zone," etc. (Bennett and Sayre, 1962).

*Area of application.* Southerly from the type area, the West Nueces can be defined objectively over most of southern Uvalde and Kinney counties by recognition of the basal nodular wackestone beds. Beyond this limit in the subsurface the basal contact is indefinite within a transitional interval, and the projected position of the West Nueces-Glen Rose contact over most of the Maverick basin is conjectural. In practice, the area of application is coincident with the limits of the overlying McKnight Formation.

## McKnight Formation (Winter, 1961)

The name McKnight, first used informally by Hedwig T. Kniker in reference to the dark limestone with evaporites in the Paul Teas and Producers of Maryland Oil Co. No. 1 S. E. McKnight well, Dimmit County, Texas (Sandidge, 1946, and personal communication 10/28/61), was discarded as a synonym of Kiamichi by Imlay (1945). Later data are in disagreement with Imlay's conviction of equivalency and of continuity of the Kiamichi from the East Texas embayment into the Rio Grande embayment. The bases for his conclusions have since been rejected by many workers, and the name McKnight has been revived (Winter, 1961a-c, 1962) for subsurface usage west of the San Marcos platform. The unit has been securely extended to the outcrop, and the name McKnight is herewith applied to the surface exposures.

*Provisional status of name.* Although the intent of Winter (1961c, p. 19) is implicit, and many of the specific requirements of the Code (Art. 13) have been met, Winter designated no interval (type section) in any specified well (type locality), and the name thus lacks critical elements of definition for

[1]This is the situation in many early definitions of stratigraphic units, for example the Edwards Limestone (Lozo, 1959, p. 4).

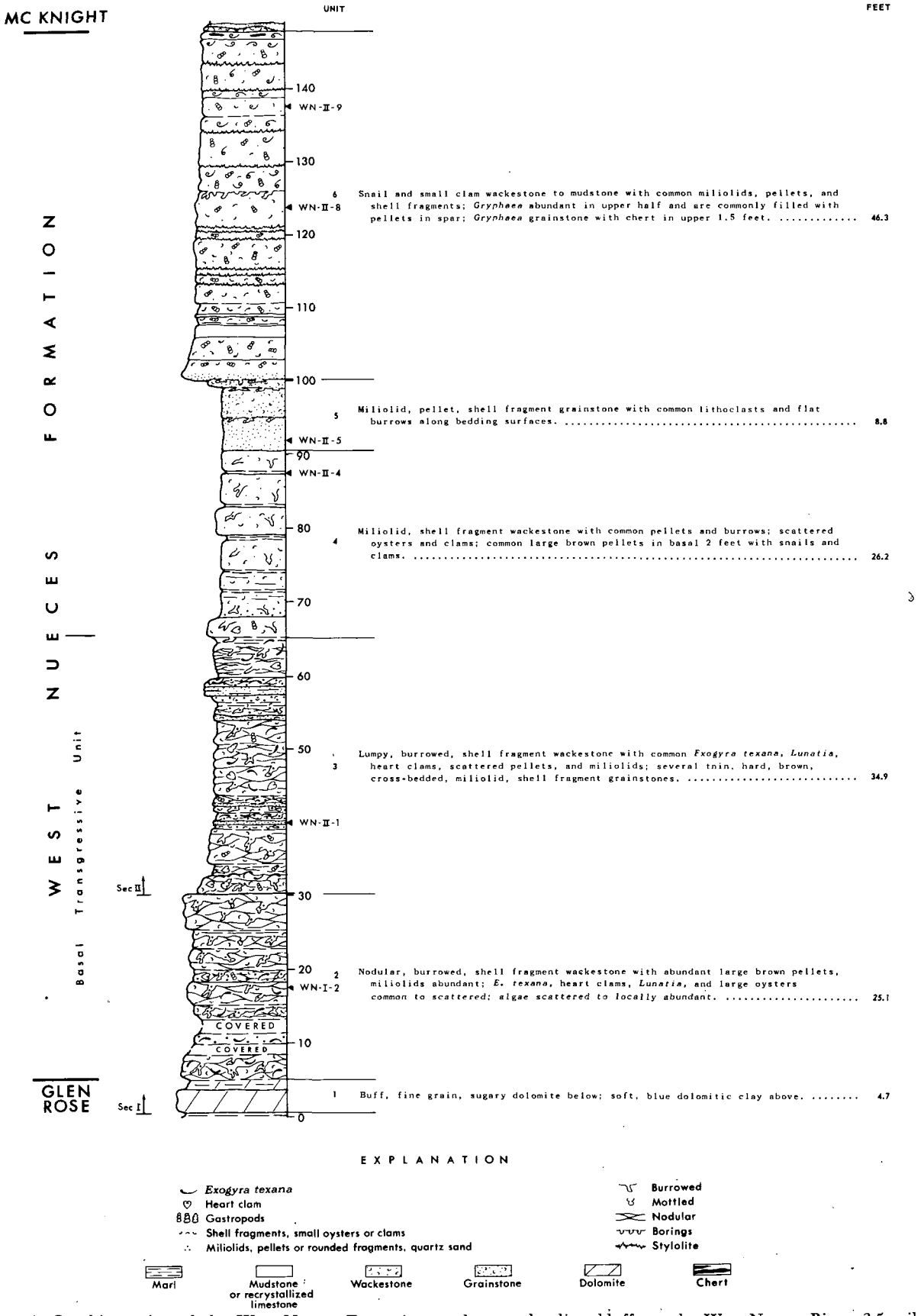


Figure 10. Graphic section of the West Nueces Formation at the type locality; bluffs on the West Nueces River, 3.5 miles northwest of State Highway 334 road crossing, Kinney County, Texas.

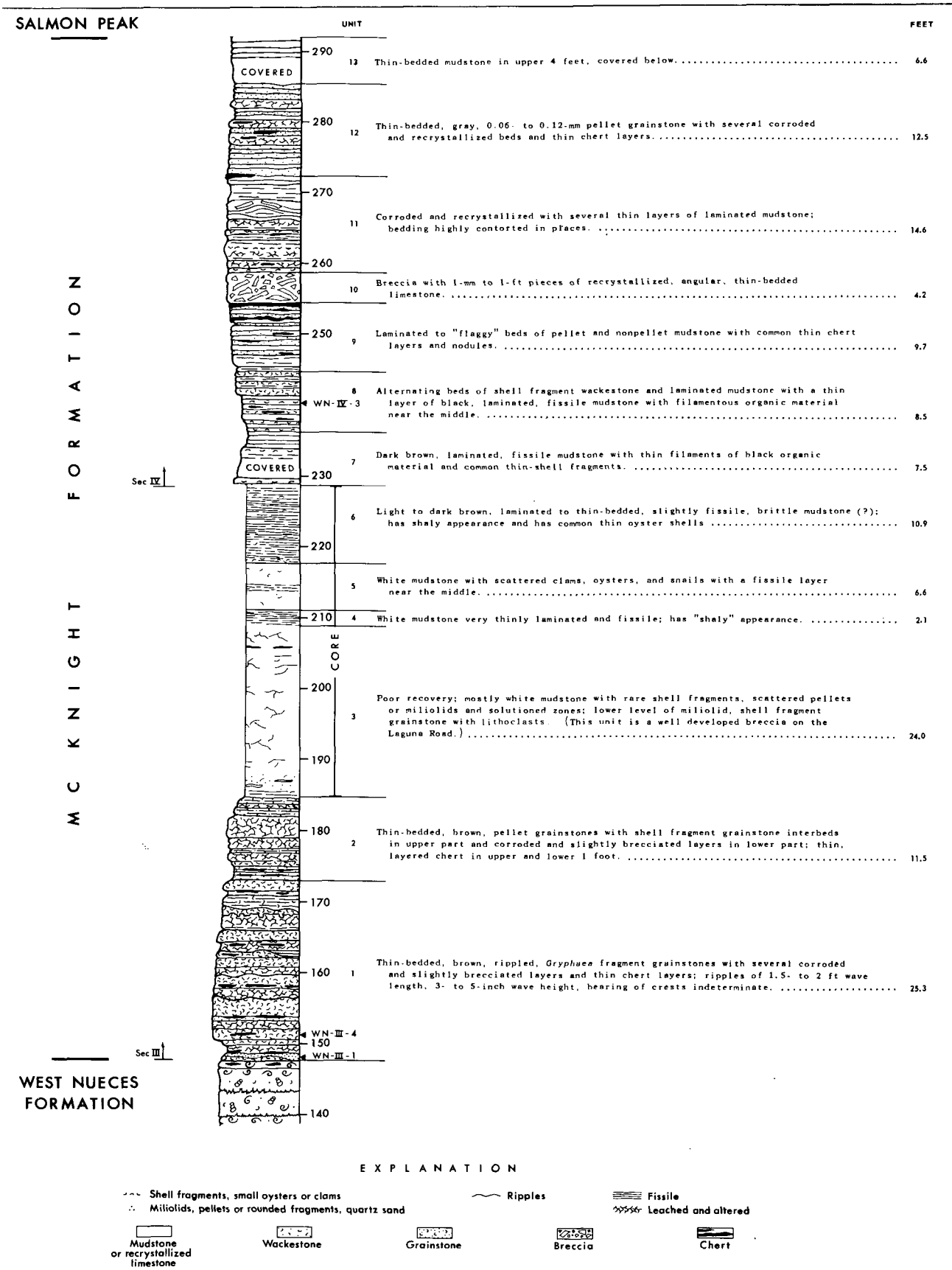


Figure 11. Graphic section of the McKnight Formation. Composite outcrop reference section: lower 37 feet from the Bitter Ranch section, Kinney County; remainder from Chalk Bluff section and core, Uvalde County.

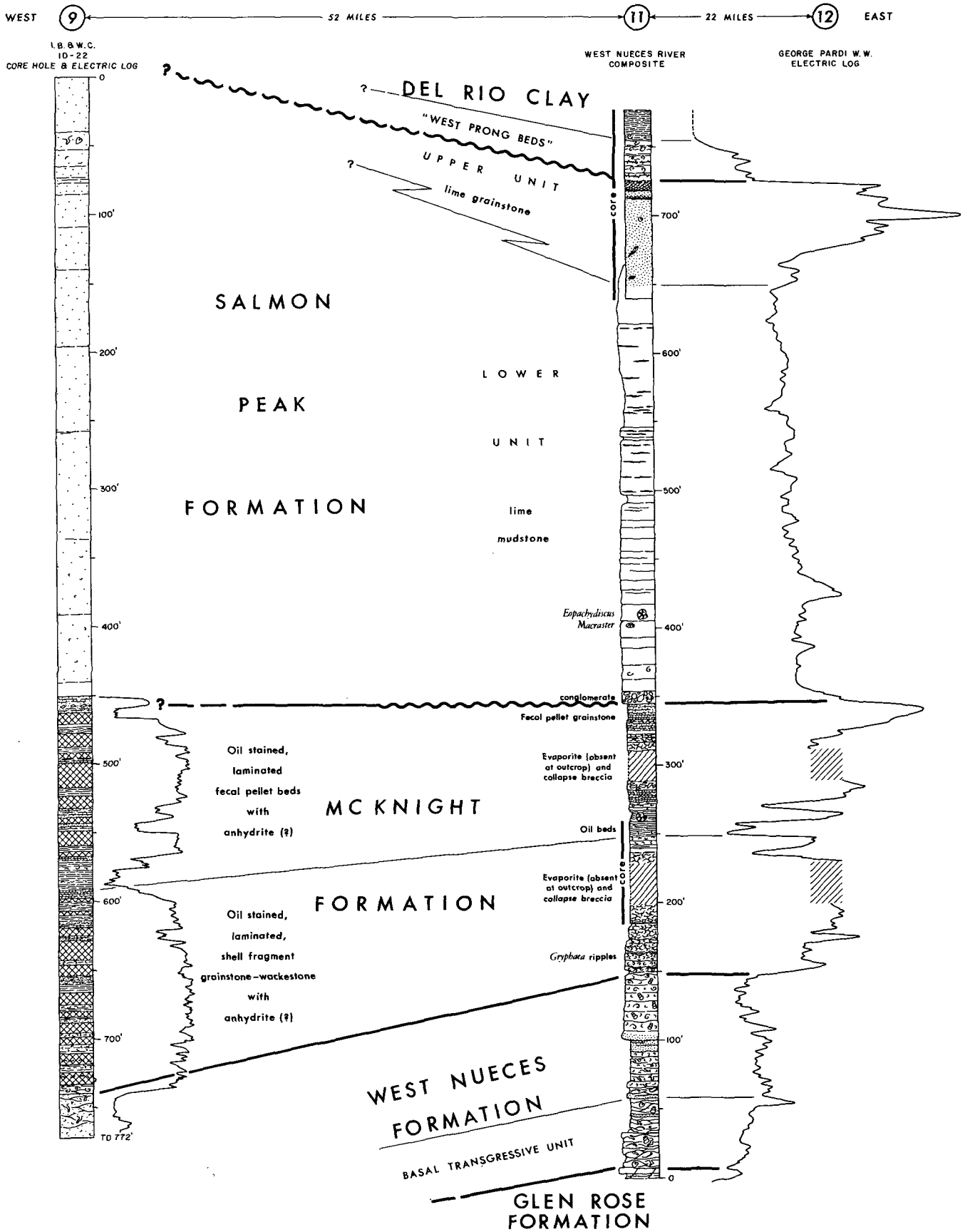


Figure 12. Correlation diagram of the West Nueces composite section, Kinney and Uvalde counties, and the International Boundary and Water Commission ID-22 core test, Val Verde County, Texas.

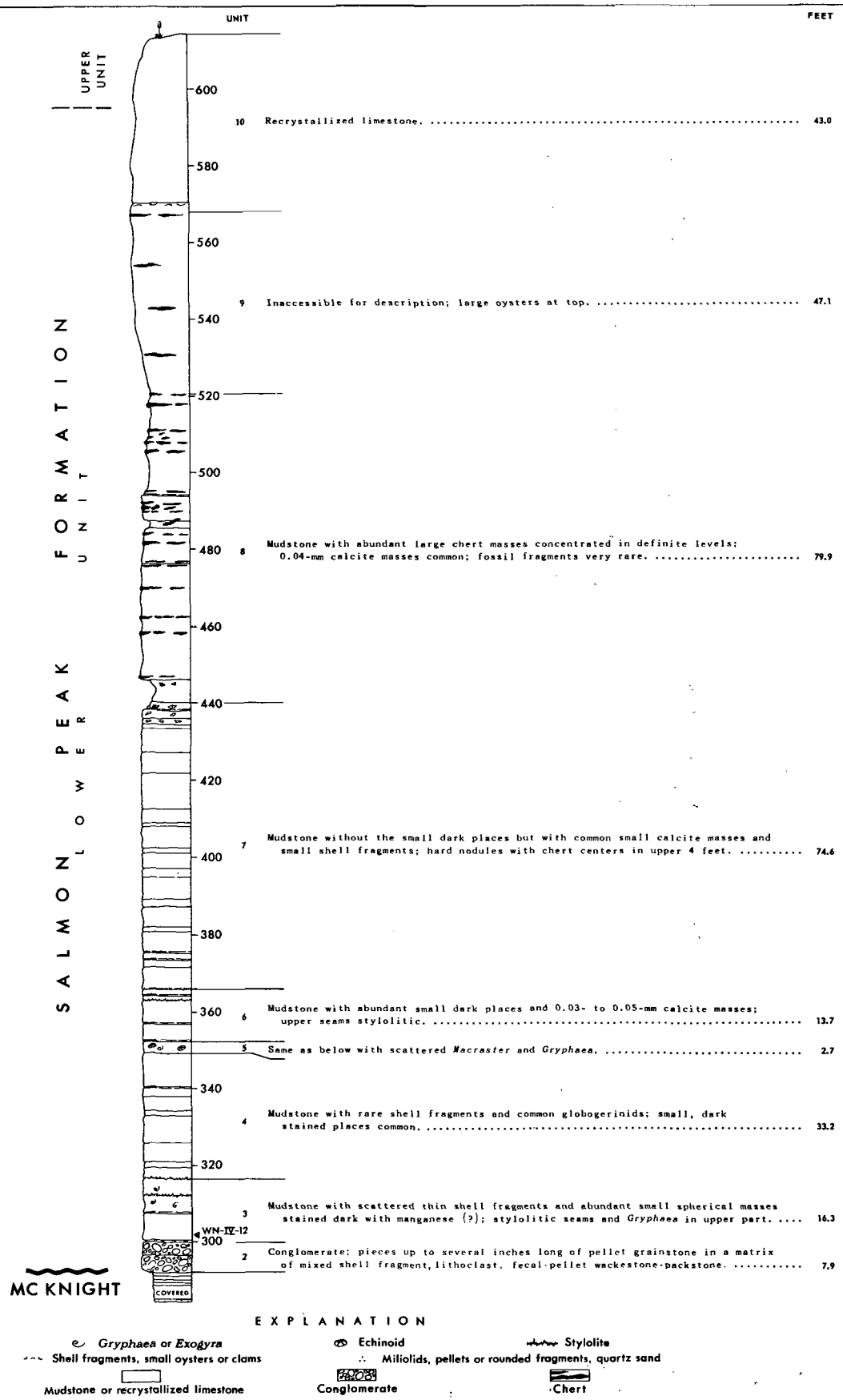


Figure 13. Graphic section of the Salmon Peak Formation (lower unit) at the type locality; Chalk Bluff on the Nueces River, 17 miles northwest of Uvalde, Uvalde County, Texas.

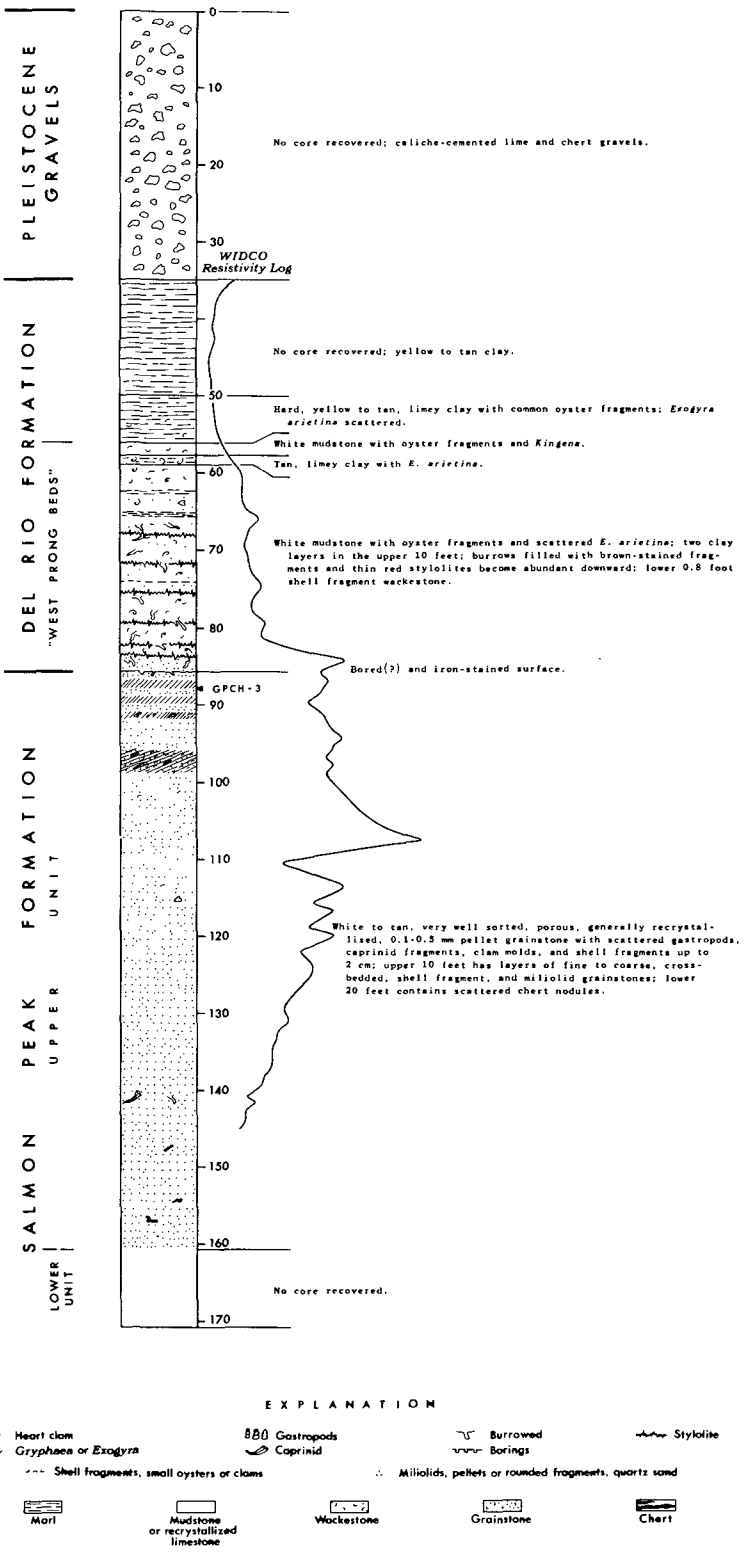


Figure 14. Graphic section of the Salmon Peak Formation (upper unit) from the Shell Development Co., George Pardi Corehole No. 1, 6 miles northwest of Uvalde, Uvalde County, Texas.

formal establishment as a subsurface unit[1]. Although the unit is now known to outcrop, and an outcrop type section could be defined (and another name proposed), informal priority and familiar usage of McKnight would seem to favor retaining the subsurface name and defining a subsurface type section.

*Outcrop reference section.* The surface reference section (Figure 11) of the McKnight is a composite of two sections: The lower part is from a bluff (WN-III, Figure 15) on the right bank of the West Nueces River on the Bitter Ranch, 1.2 miles south of the Tularosa road intersection with the "river road," northeastern Kinney County; the upper part is from the basal 75 feet of Chalk Bluff (WN-IV, Figure 15) on the Nueces River, 2 miles south of Nineteen Mile Crossing of State Highway 55 (Uvalde-Rocksprings road), western Uvalde County. On the U.S.G.S. Turkey Mountain quadrangle, 1:62,500, the Bitter Ranch bluff (opposite the mouth of Miguel Canyon) is 3.5 miles due west of Salmon Peak. Chalk Bluff, about 4 miles south-southeast of Laguna, is in the northwest corner of the Chalk Bluff topographic quadrangle, 1:24,000[2].

*Summary lithologic description.* The maximum outcrop thickness of the McKnight is about 145 feet, and the section is divisible into lower and upper thin-bedded limestone units separated by a petroliferous 25-foot section of black, laminated, fissile, clayey lime mudstone beds. The 70-foot lower section of brown shell fragment and pellet grainstones with thin chert layers is overlain by lighter mudstones with solutioned zones and collapse breccia. The 55-foot upper unit, as exposed at Chalk Bluff, is mostly thin-bedded mudstone; it also contains thin chert layers, solution zones, and another collapse breccia bed near the middle. The solution zones and breccia beds represent evaporite beds in the subsurface (Figure 12).

*Areal outcrops.* In southwest Texas the total section is exposed only in the reference area of northeastern Kinney and northwestern Uvalde counties. Exposures of the upper portion are present on the West Fork of Sycamore Creek, 9 miles southeast of Carta Valley, southwestern Edwards County, and on the Devils River in southern Val Verde County at the easternmost point of Slaughter Bend and at the mouth of Dead Mans Creek, 11 river miles upstream. In Mexico, the McKnight encircles the southeastern end of the Serrania del Burro.

### Salmon Peak Formation (New Name)

*Name Proposal.* The Salmon Peak Formation is here proposed as a replacement name for the so-called "Georgetown Limestone" as applied in the Maverick basin of the Rio Grande embayment. The formation is characteristically exposed in the vicinity of Salmon Peak, Turkey Mountain quadrangle, 19 miles northeast of Brackettville, Kinney County (Bennett and Sayre, 1962, pl. 5), after which the unit is named.

*Type section and type locality.* The type section of the Salmon Peak Formation is taken from two localities. The lower part (Figure 13) is from the 320-foot maximum exposed section at Chalk Bluff on the Nueces River, Uvalde County, about 14 miles southeast of Salmon Peak. The uppermost 75 feet (Figure 14), incompletely exposed in the type area, is described from a cored interval[3] depth 86-161 feet) on the George Pardi Diamond P Ranch (cf. Chalk Bluff quadrangle), 8 miles southeast of Chalk Bluff.

*Summary lithologic description and contacts.* The type section is about 380 feet thick and in the type area of Uvalde and Kinney counties is divisible into two distinct parts: a lower, 305-foot unit of thick-bedded, white, globigerinid lime mudstone with large, irregular masses of chert in the upper half, and an upper, 75-foot unit of worn shell fragment grainstone cross-bedded near the top and with scattered caprinid fragments throughout (Figure 12). The upper grainstone unit, a tongue of Devils River lithofacies, is replaced southward by the mudstone. At the outcrop, the Salmon Peak disconformably overlies the McKnight, and the basal bed is conglomeratic with pholad-bored pieces of the thin-bedded, fecal pellet McKnight grainstone in a lime mudstone matrix. The upper contact is likewise an emersion surface underlying the lower Del Rio (West Prong beds of Greenwood, 1956).

*Area of application.* The Salmon Peak Formation is coextensive with the McKnight on both sides of the Rio Grande and is present in similar facies over the entire Maverick basin.

## SUMMARY

In the course of a regional stratigraphic synthesis of the Edwards Plateau Cretaceous, the impropriety and ambiguity of the current outcrop nomenclature has been thoroughly examined. Evaluated in the light of present data, certain previously used formation names are recommended for replacement and new names are proposed accordingly; other named units are emended or supported for formal acceptance. The revisions are:

| | |
|---|---|
| West Nueces Formation (new) | to replace "Edwards" plus "Comanche Peak" |
| McKnight Formation (Winter, 1961) | to replace "Kiamichi" |


[1]No decision, in conjunction with subsurface workers, has been attempted to designate the namesake well as the type well or to specify the interval (compare Winter's depths of 6630 to 6950 with Imlay's 6615 or 6730 to 7038; it may be noted that Mrs. Kniker's original determination of the McKnight was from 6875-7038).

[2]These localities were field trip stops 7 and 9, respectively, of the Gulf Coast Association of Geological Societies 1961 field trip.

[3]The Shell Development Co., No. 1 George Pardi corehole is 6.15 miles northwest of the State Highway 55 overpass of the Southern Pacific railroad, 800 feet southeast of the Diamond P ranchhouse, 400 feet northeast of the highway, in Tobin grid 6S-2E. The location scales 50 feet from the south line, 2600 feet from the east line, G.C. and S.F. R.R. survey, Blk. 591. The core is to be deposited with The University of Texas, Bureau of Economic Geology, Austin.

| | |
|---|---|
| Salmon Peak Formation (new) | to replace "Georgetown" |
| Devils River Formation (Udden, 1907) | areally restricted |

In accordance with the Code of Stratigraphic Nomenclature, definitions, sections, localities, areas of applicability and other basic data are presented in support of the revision submitted. A geologic map of the critical outcrop reference area in the southern Edwards Plateau is included (Figure 15).

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