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PREVIEW

STRATIGRAPHY OF THE "UPPER SILURIAN" AND "LOWER DEVONIAN",  
PERMIAN BASIN, WEST TEXAS

by

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THESIS

Presented to the Faculty of the Graduate School of  
The University of Texas at El Paso  
in Partial Fulfillment  
of the Requirements  
for the Degree of  
Master of Science  
in Geology

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PERMIAN BASIN, WEST TEXAS

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## ABSTRACT

It is recommended that the name Wristen Formation be proposed for the formation in the Permian basin, presently known as the "Silurian Shale" or "Green Silurian"; with a type section in Ward County, Texas. Two members are designated in the Wristen Formation--the Wink and the Wilshire Members. The lower Wink Member consists of grey limestone, and the upper Wilshire Member consists of greenish grey shale and limestone. These members grade into a thick carbonate facies in Andrews County, Texas. The Wristen Formation is probably of Late Middle and Late Silurian age, and correlative with the Hunton Group of Oklahoma and the Caballos Novaculite in the Marathon region, though fossil evidence is not presently available.

The name Champlin Formation is suggested for the unit known as the "Lower Devonian Chert", in the subsurface of the Permian basin. The type section is in east-central Crane County, Texas. The three lithofacies of the Champlin are as follows: a chert facies in the southwest; a carbonate facies in the north; and a siliceous limestone facies in the center of the study area. The Champlin is of Early and Middle Devonian age, and is correlative with the Hunton Group of Oklahoma and the Caballos Novaculite of the Marathon region.

These two formations were deposited in the Early Paleozoic Tobosa basin, which gradually deepened until the Late Middle Devonian, when the seas withdrew temporarily from the area.

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## INTRODUCTION

### Purpose of this Investigation

The lithology, thickness, paleontology and geographic distribution of Upper Silurian and Lower Devonian rocks in the Permian basin were investigated with the following objectives:

1. To recommend formal names and designate subsurface type sections for two new Devonian and Silurian formations in the Permian basin,
2. To determine, within the study area, the lateral and vertical stratigraphic relationships of these formations,
3. To interpret the environment of deposition and geologic history represented by these formations,
4. To correlate the Upper Silurian and Lower Devonian rocks in the Permian basin with those of the surrounding regions.

### Location of the Study Area

The area of investigation is within the Permian basin of West Texas and southeastern New Mexico (Fig. 1). The bulk of the wells included in this study are in Andrews, Pecos and Winkler counties, Texas. Wells in Upton, Ward, Crane and Ector counties, Texas were also included. These wells are on the southern half of the Central Basin uplift and the eastern half of the Delaware basin (Fig. 1). Figure 2 shows the wells from which electric and sample logs were used.

### Previous Investigations

Harlton (1930) and Lowman (1930 and 1930a) first publicly

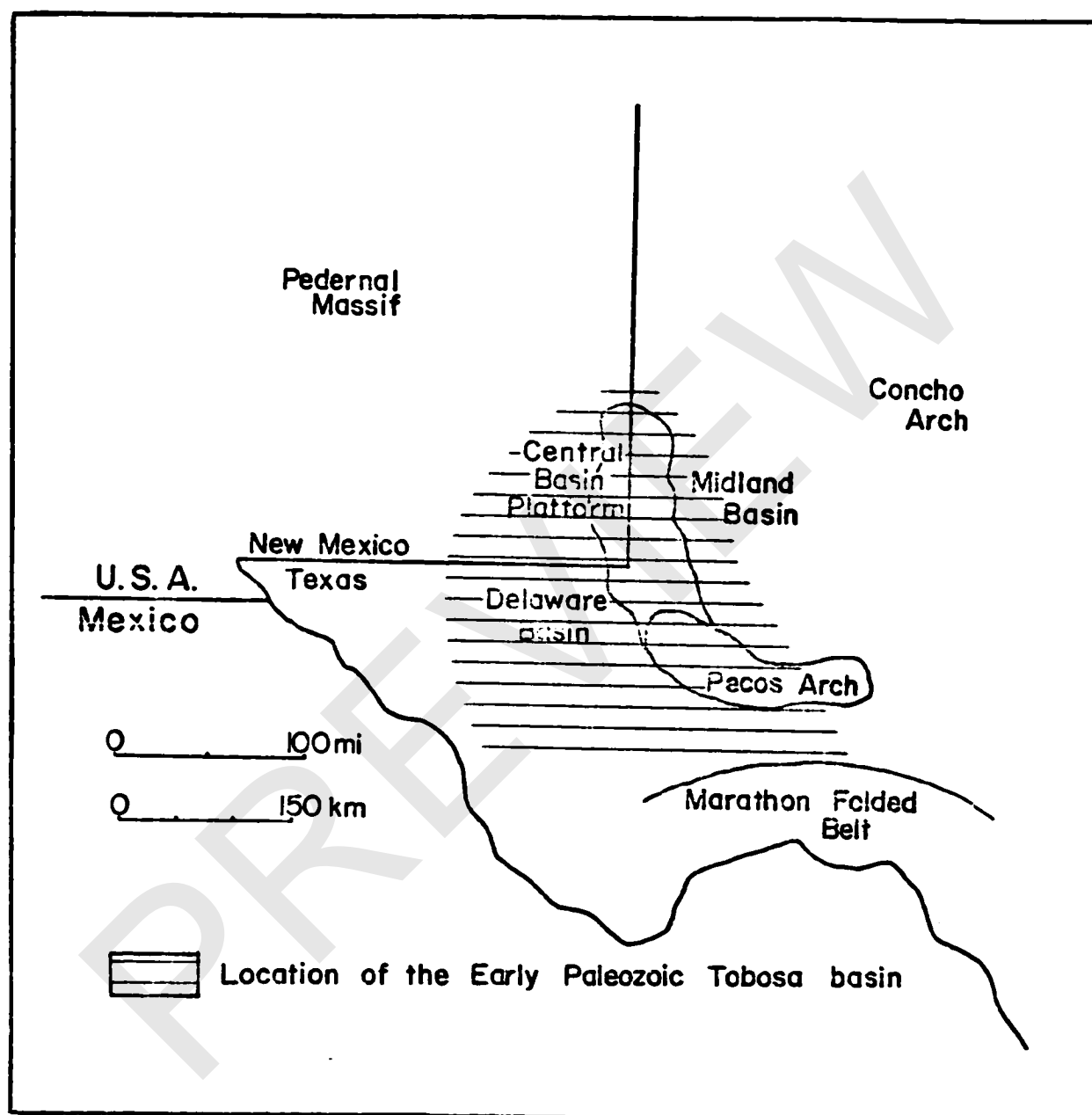


Figure 1: Structure of the Permian basin, West Texas and south-eastern New Mexico. The Central Basin platform, Pecos arch, Delaware basin and Midland basin are late Paleozoic features (modified from Galley, 1958).



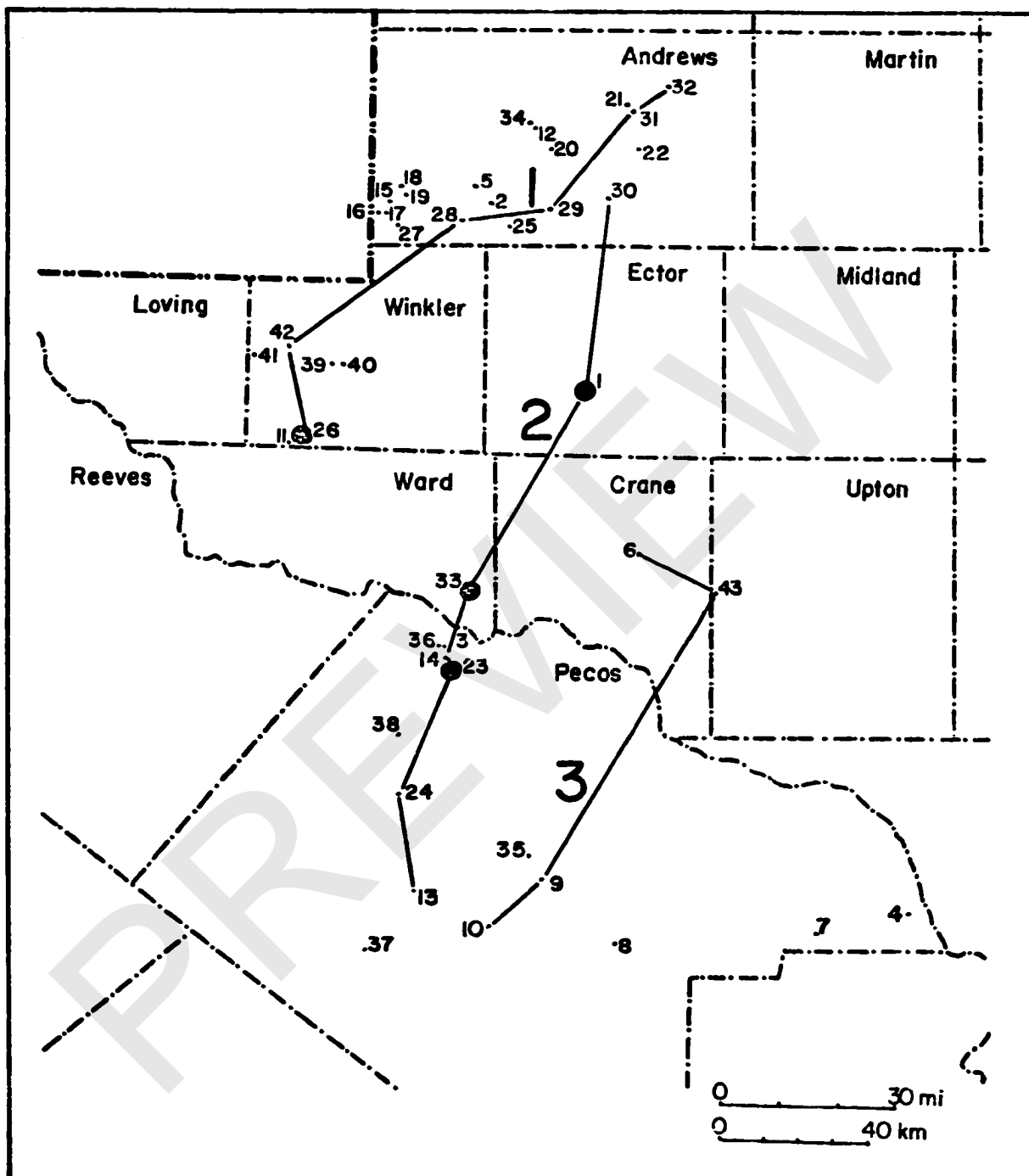


Figure 2: Index Map of the study area, showing location of wells included in the study and lines of cross section (see Appendix A for well names). Large dots indicate wells used as type sections for new units named in this paper.

recognized that there are strata of Silurian age in the subsurface of the West Texas Permian basin. Both authors correlated cuttings from the early deep wells of the Big Lake field with the Silurian portion of the Hunton Group of Oklahoma. Cordry and Upson (1941) published a detailed description of subsurface Silurian rocks in West Texas, and were the first to mention rocks of Early Devonian age in the subsurface of the Permian basin. These units were encountered during the drilling, in 1940, of Gulf's J. T. McElroy #103, in Upton County, and of Gulf's Wristen Brothers #5, in Ward County.

Thousands of other wells have penetrated the Devonian and Silurian Systems of the Permian basin. Consequently, many geologists writing about the general geology of the area have discussed these strata; in particular: Jones, 1953; Galley, 1958; Jones and Smith 1965. Wilson and Majewski (1960) wrote about the geologic history of the Middle Paleozoic in the Permian basin. In 1967, McGlasson made a detailed study of the stratigraphy and geologic history of the Silurian and Devonian of the Permian basin.

#### METHODS OF STUDY

Samples of cuttings from 27 wells were examined under a low-power binocular microscope and strip logs made of the percentage lithologies. These samples were loaned by the Midland Sample Library, Midland, Texas. Sample logs for six additional wells were made available by Penn, Hills and Turner, Midland, Texas. Electric logs were used in conjunction with all but one sample log.

Eight additional wells were also included in the study though only electric or radioactivity logs were available for them. Appendix A lists all the wells used in this study, and Figure 2 shows their locations. Only four thin sections were made owing to the unavailability of cores and fineness of samples.

## GEOLOGIC SETTING

### Physical Setting

During most of the Early and Middle Paleozoic, West Texas and southeastern New Mexico were covered by a shallow continental sea. The area of thickest sediments has been called the Tobosa basin by Galley (1958) (Fig. 1). This basin was bordered on the east and northeast by the Concho Arch, and on the northwest by the Pedernal massif. Only a small amount of clastic material was deposited in the basin during the Silurian and Devonian period, indicating that the adjacent land areas were probably of low relief.

To the south of the Tobosa basin was the Marathon-Ouachita geosyncline. The depth of the water during Middle Paleozoic time, in the geosyncline, is uncertain. Some geologists believe that it was very deep (Thomson, 1964), and others believe it was shallow (Folk, 1973).

Today there is no surface expression in West Texas of either the Tobosa basin or later structures because of at least four unconformities since latest Permian time, and overlying Mesozoic and Cenozoic beds.

### Stratigraphic Setting

The Montoya Formation of Upper Ordovician age (Fig. 3) was used as a lower limit of the cuttings study. The Montoya consists of brownish grey, cherty carbonates, and is most easily recognized in cuttings by the presence of brown chert. Silurian rocks rest unconformably on the Montoya Formation. In the subsurface (Fig. 3), the Fusselman Formation, of Early and Middle Silurian age, consists of light-colored cherty limestone, grading northward into dolomite. One of the most diagnostic features of the Fusselman in cuttings is the presence of white chert.

After deposition of the Lower Devonian rocks, the seas withdrew for a time from much of the Tobosa basin, readvancing in Late Devonian time to deposit the Woodford black shale unconformably on the Lower Devonian cherty carbonates.

### Structural Setting

During the Late Paleozoic era, the Tobosa basin was divided into the Delaware and Midland basins by the creation of the Central Basin uplift (Fig. 1). This deformation is not directly related to the lithologies of Upper Silurian and Lower Devonian beds, though it may possibly have caused epigenetic dolomitization of the Fusselman and/or Montoya Formations (Galley, 1958). The top of the Lower Devonian unit varies in elevation by over 17,000 feet—from -21,326 feet in Ralph Lowe's University #17-1 (Pl. 3) to -3575 feet in Wilshire's Atlantic-Frame #1 (Pl. 2). This relief may be due to the boundary faults, postulated by Hills (1970) and

		South Central Oklahoma	Permian Basin	Franklin Mountains and Vicinity	Marathon Region
Mississippian	Lower	"Mississippi lime"		Lake Valley Fm	Tesnus Fm.
				Caballero Fm	
Devonian	Upper	Woodford Shale	Woodford Shale	Percha Shale	
	Middle			Canutillo Fm	
		Frisco Fm	<u>Champlin Fm.</u>		
		Bois d'Arc			
	Lower	Haragan Fm			
Silurian	Upper	Henry- house Fm	Wristen Fm		
			Wink		
	Middle	Chimney Hill Fm	Fusselman Fm	Fusselman Fm	
	Lower				
Ordovician	Upper	Sylvan Sh	Montoya Fm	Montoya Fm	Maravillas Fm
		Viola Fm			

names underlined indicate new formation names proposed in this paper

Figure 3: Correlation Chart for the Permian basin and surrounding areas (modified from McGlasson, 1967; Shannon, 1962; and Lettione, personal commun., 1975).

other authors, along the edge of the Central Basin uplift. Faults have affected the measured thickness of the Lower Devonian unit in some localities as a few wells (Phillips's University EE #1, for example) have repetitions of Lower Devonian beds. Other wells may have strata omitted by faulting though there is no clear evidence of this.

### STRATIGRAPHY

#### Wristen Formation (Nom. Nov.)

The Wristen Formation has been known as the "Silurian Shale", "Upper Silurian" and "Green Silurian". These names are not acceptable as the unit is less than half shale, nor is it only Upper Silurian in age. As this unit does not crop out anywhere in the region, a subsurface type section is necessary. It is recommended that the name Wristen, from the type well, be applied to this formation.

The type section of the Wristen Formation is in the Gulf Oil Corporation's Wristen Brothers #5-SI well, in the Wickett field, Pecos County, Texas (well No. 33, Fig. 2). Table I contains information about the type well for the new formation. Gamma Ray, Neutron and sample logs for this well are shown in Plate 2, and Appendix B includes detailed descriptions of cuttings from 6350 to 7160 feet.

Two members are designated in the Wristen Formation because of their wide areal extent and their usefulness in describing the Wristen. These two members, the Wink and the Wilshire, are

TABLE I

## Type Section of the Wristen Formation

Operator: Gulf Oil Corporation

Well name: Wristen Brothers #5-SI

Location: 2332 feet from the northwest line, 2322 feet from the southwest line, Section 8, Block 5, H & TC Survey, Ward County, Texas

Field: Wickett

Date drilled: 1948

Total depth: 7704 feet

Ground elevation: 2492 feet

Rotary table elevation: 2502 feet

Top of Wristen: 6730 feet

Elevation of top of Wristen: -4228 feet

Base of Wristen: 6956 feet

Elevation of base of Wristen: -4454 feet

Thickness of Wristen: 226 feet (69 meters)

Logs run: Gamma Ray, Neutron

Cuttings are presently stored at the Midland Sample Library

Figure 2 shows the location of this well

Appendix B has detailed descriptions of cuttings from the type section

(continued)

TABLE I (CONTINUED)

Brief description of lithology of drill cuttings from the type section. Colors are from the "GSA Rock Color Chart" Geological Society of America (1963).

<u>Depth in the Well</u>	<u>Member</u>	<u>Lithology</u>
6730 - 6870'	Wilshire	About 60% light grey, green grey and medium blue grey, shaly limestone; about 40% dark grey, green grey and blue grey limy shale; traces of olive grey chert
6870 - 6956'	Wink	About 90% white to light olive grey, soft limestone; about 10% dark grey limy shale