GEOLOGY OF THE DOSS-HORTH AREA, WASON AND GILLESPIE COUNTIES, TRAAS

A Thesis

By-

THEODORE COUCERAN

Submitted to the Graduate School of the Agricultural and Mechanical College of Turns in partial fulfillment of the requirements for the degree of MASTER OF SOTUMER

August, 1959

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Head of Department of Geology and Geophysics

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The cooperation and friendliness of the ranchers of the area are greatly appreciated.

The writer is especially grateful to his wife, Barbara Coughran, for her continual help and encouragement throughout the project.



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ABSTRACT

The Doss-North area is located on the southwest flank of the Liano uplift of central Texas. Rocks exposed in the area are of Upper Cambrian, Lower Ordovician, possible pre-Cretaceous Neoszoic (?), Lower Cretaceous, and Tertiary to Recent ages. All seven members of the two Upper Cambrian formations, the Biloy and Wilberns, of the Liano region are represented in this area. The Ordovician system (Ellenburger group) is represented by the Threadgill limestone member. Arkosic conglomerate of possible pre-Cretaceous Neoszoic or Early Cretaceous age occurs in a small outerop. The Lange's Will conglomerate, and sandstone, siltstone, and limestone units represent the Cretaceous system; terrace gravel and alluvium represent the Tertiary to Quaternary.

In this area the Cambrian - Ordevician contact is conformable. The contact of the nearly horizontal Cretaceous beds with older rocks is unconformable.

The Paleozoic rocks have a strike of N. 40° to 50° E. and a regional dip of 6° - 8° S.E. Three steeply-dipping major faults, downthrown toward the northwest, trend northeast - southwest across the area. Eulerous minor faults occur throughout the area, commonly forming small horsts and grabens.

The geologic history of the thesis area, with several small variations, is essentially the same as that of the larger Llane region.

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GEOLOGY OF THE DOSS-NORTH AREA, MASON AND GILLESPIE COUNTIES, TEXAS

INTRODUCTION

LOCATION AND ACCESSIBILITY

Located on the southwest flank of the Llano uplift in central Texas, the Doss-North area is approximately bisected by the Mason-Gillespie County line (Figure 1). The rectangular area contains roughly 18 square miles and is 6 miles long in a north-south direction and 3 miles wide in an east-west direction. The west boundary coincides with longitude 99°10' west. The south boundary lies one mile north of Doss, Texas, for which the area is named. Doss is about 23 miles northwest of Fredericksburg, Texas, by way of U. S. Highway 87 and Farm-to-Market Road 648.

The area is accessible from either Mason or Fredericksburg. Ranch-to-Market Road 783 crosses the eastern half of the area in a north-south direction. The Onion Creek and Lange's Mill roads, both of which are metal-surfaced, join to cross the southern half of the area in an approximate east-west direction. Two improved dirt roads join to cross in an approximate east-west direction. Two improved dirt roads join to cross in an approximate east-west direction the northern half of the area. An improved dirt road roughly coincides with the upper two-thirds of the west boundary. A network of unimproved ranch roads provides access to most parts of the area.

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FIGURE 1. LOCATION MAP OF THE DOSS NORTH AREA, MASON AND GILLESPIE COUNTIES, TEXAS

Adapted from Texas State Highway Department highway maps of Muson and Gillespie Counties, Texas.

PLATE II



Figure 1. MASSIVE QUARTS SAUDSTOYT RED IN BASE OF CAP MOUNTAIN LIMESTONE On Cow Valley Creek, 330 yards east of Ranch-to-Market Road 783. Sandstone bed about 25 feet above base of Cap Mountain.



Pigure 2. MASSIVE BUDS OF UPPER CAP NOU WIN LIMESTONE

On Mircadgill Grock, 350 yards west of where Onion Creek joins Threadgill. Note relative size of harmer leaning against bottom ledge.



FIRLD TROHNIQUES

The field work was done during the period from June 15, 1958, to August 20, 1958. Empping was done on accetate overlays of United States Department of Agriculture aerial photographs, series DFZ, numbers 40, 42, 43, 101, 103, and 105, dated November 28, 1955. The scale of the photographs is approximately 1920,000 or 1 inch equals 1667 feet.

Stratigraphic contacts and faults were located on the ground and plotted on the sociate overlays. Easy contacts and faults were first detected by vegetational changes and lineations on the photographs, and then checked by ground observation. The stereoscope was used to help assortain the stratigraphio-topographic relationships.

Strikes and dips were taken with a Brunton compass. A makeshift Jacob's staff and a Brunton compass were used to measure stratigraphic sections.

Elevations within the thesis area were obtained by the simultaneous use of an aircraft altimeter and an amercial barcester. Readings from both instruments together were taken at oritical points along the main reads, each instrument being used to shock the other. A gravity station (alidade elevation) made by Farnes (1952) at Dess, Texas, was used as the base points. All readings were taken botween 4:00 and 6:00 A.T. of the mane day.

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PREVIOUS INVESTIGATIONS

There has been much bread and general study of the geology of the Llano region in the past, with some detailed work done in specific areas. However, except for an overlap on the southeast corner, no detailed geologic study of the thesis area has been published.

Roemer (1846) made the first published observations of the Llano region in an account of his travels with an exploring party of German colonists. He briefly described some Cretaceous deposits and fossils, and also some granites.

E. F. Shumard (1861) confirmed the work of Roemer, and made the first tentative correlation of strata in the Llano area with that of the Fotsdam group (Upper Cambrian) of the northern United States. In 1884, Walcott definitely established Shumard's "Potsdam group" as Upper Cambrian.

The results of a systematic geological survey of the Llano area in 1889, made under the auspices of the then newly formed Texas Geological Survey, were reported by individual authors. Comstook (1890) introduced the terms Hickory series, Riley series, and San Saba series for Cambrian and Ordovician strata exposed in the uplift. Tarr (1890) described the topography and drainage pattern of central Texas; and concluded that the principal streams of the region were initially developed on Cretaceous strata during Tertiary time and later superimposed upon Paleozoic rocks.

SECTION LANGUAGE

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Fidelity Omon Skin

Paigo (1911) named and briefly described the Cap Nountain, Wilberns, and Ellenburger formations, and used the name Hickory sandstone formation in place of Constock's "Hickory series". Faige (1912), in a comprohensive geologic folio on the Llano and Burnet quadrangles, further described the Hickory sandstone, Cap Hountain, Wilberns, and Ellenburger formations.

Sollards, Adkins, and Plummer (1932) reviewed and discussed the Procembrian, Paleozoic, and Ecocoic stratigraphy and paleogeography of the Llanc area. In 1934, Sollards dosoribed the major structural features of the Llanc region, and mentioned the general northeast-southwest trends of faults.

Bridge (1937) named the Lion Hountain sandstone member of the Cap Hountain formation.

Barnes (1944) made the first montion of the Welgo sandstone of the Wilberns formation, and described the stratigraphy of the Cretaccous rocks exposed in Gillespie County.

In a progress report on the stratigraphy of the Ellonburger group of central Texas, Cloud, Barnes, and Bridge (1945) revised the term Ellenburger limestone to Ellenburger group, and restricted it to beds of early Ordevician age. They also proposed the reduction of the Elley series to the rank of a formation which included as members the Hickory sandstone, Cap Mountain limestone, and Lion Nountain sandstone.

Barnes, Dawnon, and Parkinson (1947) compiled a reconnaissance type geologic map of the Lange's Mill area which over5

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laps the southeast corner of the thosis area in Gillespie County. With the exception of the Welge sandstone, the Wilberns formation was not differentiated into members on this map.

Bridge, Barnes, and Cloud (1947) described and redefined the two formations and eight members of the Upper Cambrian strata of central Texas. This publication has since become a standard reference to these rocks.

Cloud and Barnes (1948) published an extensive report on the Ellenburger group of central Toxas. This report also included general descriptions of pre-and post-Ellenburger beds, and description of the geologic structure and history of the Llano region.

In 1950, Plummer's comprehensive description of the Carboniferous rocks of the Llano region was published posthumously. Included in this report was a dotailed description of the Lower Crotaceous rocks and fossils of the Llano area.

Barnes, (1952) described the Upper Cambrian, Ordovician, Cretaceous, and Quaternary rooks exposed in the Squaw Greek quadrangle in Gillespie and Tason counties, and propared a detailed geologic map of that area. The Squaw Greek quadrangle overlaps the southeast corner of the thesis area.

Barnes and Bell (1954) described the stratigraphy of the Cambrian rocks of the Llane area, and included within this description five graphic stratigraphic spectrums and three dotailed measured sections. ere the subbler surver as to be to be the faile of the fillence former. Somethe

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PHYSIOGRAPHY

CLIEGATE AND VOGSTATION

The Dess-North area lies within the semiarid Llane region. The average rainfall is approximately 22 inches per year, varying from a few inches to over 45 inches a year. Nost of the rain usually falls during the winter and spring, leaving the summers hot and dry. The mean average temperature of Nason County is about 64° 7., ranging from extrames of 110° F. in the summer to below zero in the winter.

The vegetation of the area belongs to a type adapted to a semiarid environment and thin rocky topsoil. The most prevalent trees are live oak, mesquite, and codar. Common shrubs include agarita, Nexican persimmon, and catesolaw. Tucca plants and various species of cacti are also common. Orasses such as buffalo, orowfoot, and curly mesquite occur throughout the area.

Since the distribution and relative abundance of vegetation is to a large degree dependent upon the character of rock outcrop and associated soil, vegetation characteristic of unit outcrops will be discussed with stratigraphy.

TUPOGRAPHY

The major part of the Dess-North area lies within the topographic basin of the Llano uplicity however a small southwest portion is within the Edwards Flateau province. Presenbrian and some Paleonoic rocks are exposed in the center of the Llano erosional basin, and more resistant Paleonoic and Cretaceous rocks Y I TA DE CARA

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form the higher surrounding flanks and rim. Long fingers or remnants of the Edwards Plateau extend into the basin from the east, south and west sides. According to Plummer (1950), the maximum and minimum elevations of the Llano area are 2,000+ feet and 650 feet respectively, giving an approximate total relief of 1550 feet.

The maximum elevation of the Doss-North area, estimated to be about 1980 feet, is on a Cretaceous hill in the extreme southwest portion. The lowest elevation, approximately 1495 feet, is where Cow Valley Creek flows out of the northeast corner of the area. Therefore, the total relief of the area is about 485 feet.

In the northern part of the area north of Gow Valley Creek the lowermost bods of the Cap Nountain member form a low, gently sloping terrain. Just south of the creek more resistant beds of the upper part of the Cap Nountain limestone form a steep ouesta.

To the south and southeast of the cuesta formed by Cap Mountain limestone, hills composed of Point Peak shale and capped by bioherms form a high ridge trending southwest. These hills are the highest Paleczeic hills in the area, the highest being approximately 1800 feet in elevation.

The Cap Mountain limestone (repeated by faulting) and the Lion Mountain sandstone exposures in the east central portion of the area just south of the ridge of Point Peak shale and bioherms form a gently sloping, northeast-trending valley. To the There the algebra more under liance and the real field for the der to a soremember of the interacts liabetur expects the the test the the errors would use more either. However, or Plogues (17.6), the maximum and addition either and the liast or the sowould be the more retrained and the second and or the liabet and to the test of the

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east and south of the valley, exposures ranging from Welge sandstone to Ellenburger limestone and basal Cretaceous sand form a rolling terrain, rugged only where it is broken by the deeply entremched Threadgill and Onion creeks.

In the extreme southwest and western portions, high mesa-like hills of Crotaceous rock extend into the area. Sandstone and siltstone form the steep bacal portion of the mesas, and limestone forms the sories of flat topographic benches of the upper portion.

DRAINAGE

The entire Llano region is within the watershed of the Colorado River and its tributaries, the San Saba, Llano, and Pedermales Rivers. According to Tarr (1890), these streams were superimposed upon the Falcozoic rocks and have been little modified by Falcozoic structure and rock character.

The Doss-North area is entiroly within the Beaver Creek watershed and therefore within the larger Llane River drainage basin. Drainage of the area is generally eastward. Cow Valley Creek drains the northern third of the area, while Threadgill Greek and its tributaries, formen and Onion Greeks, drain the southern two-thirds of the area. All but Threadgill Creek are intermittent streams.

Generally the overall drainage pattern of the area is dendritic and without regard to local structure. However, some of the smaller streams such as Cow Valley Creek follow the

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existing structure through much of their courses, and are subsequent. Short lengths of some of the larger streams such as Onion and Threadgill creeks are also partially adjusted to local structure.

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STRATIGRAPHY

GENERAL STATEMENT

Rocks exposed in the Doss-North area range in age from Cambrian to Recent, and include sandstones, siltstones, limestones, shales, conglomerates, and alluvium. Mississippian and Pennsylvanian strata that are occuron in other areas of the Llano uplift are absent in the thesis area. The oldest rock cropping out is the uppermost Hickory sandstone. The coologic column for the area is as follows:

Cenogoic era Quaternary Tertiary (?) terrace gravel Mesozoic era Cretaceous system Lower Cretaceous Limestone unit Siltstone unit Sandstone unit Lange's Mill conglomerate Mesozoic (?) arkosic conglomerate Paleozoic era Ordovician system Lower Ordovician Ellenburger group Tanyard formation Threadgill member Cambrian system Upper Cambrian Wilberns formation San Saba limestone member Point Peak shale member Norgan Creek limestone member Welge sandstone member Riley formation Lion Mountain sandstone member Cap Mountain linestone momber Hickory sandstone member

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CAMBRIAN SYSTEL

The Cambrian period is represented in central Texas solely by Upper Cambrian strata - the Hiloy and Wilberns formations. All eight members of the two formations are exposed or partly exposed in the Doss-North area.

Riley Formation

The name Riley was first used as a series name by Comstock (1890) for Cambrian rocks exposed in the Riley Mountains in Llano County. This nomenolature was subsequently rejected by the United States Geological Survey, and in 1945, Cloud, Barnes, and Bridge (p. 154) named and defined the Riley formation to designate part of the same rocks. As defined, the formation includes all of the Cambrian strate in contral Texas beneath the Wilberns formation. The formation is divided, from base to top, into Hickory sandstone, the Cap Mountain limestone and the Lion nountain sandstone members.

Hickory sandstone member

The term "Hickory series" was introduced by Constock (1890) for Cambrian strata exposed near Hickory Creek in Llano County. Faige (1912) changed the name to Hickory sandstone formation. This was subsequently redefined by Cloud, Barnes, and Bridge (1945, p. 154) to Hickory sandstone member of the Hiley formation.

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The outcrop, in the form of dark-red, residual soil, barely extends into the northern edge of the area. Just north of the area the Hickory crops out as well consolidated rock, and there the gradational contact with the overlying Cap Mountain limestone was placed at a distinct vegetational change at the base of a steep cuesta.

The ontire outcrop of the Hickory sandstone is included within gontly sloping to flat, cultivated fields.

Cap Mountain limestone member

Definition and thickness

The original Cap Mountain formation named by Faige (1911, p. 23) for Cap Mountain in Llano County was redefined by Cloud, Barnes, and Bridge (1945, p. 154) as the Cap Mountain limestone member of the Riley formation.

According to Bridge, Barnes, and Cloud (1947, p. 113), the Cap Hountain limestone in the Llano region ranges from about 135 to 455 feet thick, with an average thickness of 280 feet. Because of faulting and alluvial cover, a complete section of , in a course to a my manhager man and the second at . This ? . whe

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enade were anythe filler first and an another arms in the of the general the to be a source and the state of the of the The maline source and an anythe source of the of the Cap Hountain limestone was not exposed in the Doss-North area; however the member was estimated to be about 430 feet thick. Barnes (1952) measured 418 feet of Cap Fountain in the Threadgill Greek composite section, part of which lies within the thesis area.

Lower Boundary

The Hickory - Cap Mountain contact is transitional, with the noncalcareous sandstone of the Hickory grading upward into the alternating inpure limostones and calcareous sandstones of the Cap Mountain. A distinct change in vogetation and slope between the two members can usually be seen both in the field and on aerial photographs. The contact occurs at the base of a cuesta of Cap Mountain limestone. Although this type of change was not observed in the thesis area, it was noted just north of the area.

Lithology

The lower beds of the Cap fountain member are predotinantly dark-fred, medium-grained, in part highly hematitic, calcareous sandstone, with an increasing arount of brown, arenaceous linestone toward the top. In the northwest part of the area, approximately 25 feet above the base of the member, a massive 3to 4-foot bed of light-tan, fine- to modium-grained, well-sorted, essentially nonceleareous, quartz sandstone forms a prominent ledge similar to that formed by the Welge sandstone member of the Wilberns formation (Pl. II, fig. 1).

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The lower beds grade upward into light brown to olivogray, fine- to medium-grained, silty, slightly glauconitic limestones. Higher in the section the limestones are fine to medium grained, occasionally silty and sandy, and commonly glauconitic. Thick to massive bedding predominates (Pl. II, fig. 2). Generally the color is medium-gray mottled by browns and yellows.

In the upper part of the member, the limestones become dark greenish-gray and greenish-brown, coarse grained, and highly glauconitic. Except for cocasional zones or lenses of trilobite fragments, this interval is generally sparsely fossiliferous. The upper contact with the Lion Mountain sandstone member is transitional.

Topography and Vegetation

The Cap Nountain outcoop forms a prominent cuesta in the north part of the area, with the dip slope toward the southeast. In the northwest portion of the area a partially dissected plateau has been formed from the gentle dip slope of the cuesta.

In the northern part of the area the outcrop is characterized by acrub eak, Spanish dagger, persimmen, and, in places, by extremely thick growths of cataclaw. Thickets of cedar are characteristic of the outcrop in the southeast part of the area.

Lion Nountain sandstone member

Definition and Thickness

The Lion Nountain sandstone member was named by Bridge (1937) for Lion Mountain in northwestern Burnet County, Texas.

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Bridge originally defined this sandstone as the top member of the former "Cap Mountain formation". However Cloud, Barnes, and Bridge (1945, p. 154) made the Lion Mountain sandstone the top member of their newly defined Riley formation. They retained the original boundaries of the sandstone.

The Lion Mountain sandstone in the Llano region ranges from about 20 to 69 feet in thickness. In the Doss-North area the member was estimated to be approximately 69 feet thick.

Lower Boundary

The Cap Mountain - Lion Mountain contact is transitional, with the greenish-brown, relatively massive limestones of the Cap Mountain grading upward into the highly glauconitic sandstones, siltstones, and thin-bedded limestones of the Lion Mountain. The contact was placed at the lower edge of the characteristic, sparsely vegetated, topographic bench of the Lion Mountain, which roughly coincides with the first appearance of green, glauconitic, quartz sandstone and siltstone.

Lithology

The Lion Hountain saidstone member is composed chiefly of medium- to coarse-grained, highly glauconitic, commonly calcareous sandstone with minor portions of glauconitic limestones, and lesser amounts of silty shale. The limestones are greenishgray, cross bedded, coarse grained, and highly fossiliferous. Limestone predominates in the lower part of the member, with the 32. So midness are as a completened life ferried without the optical sources on the sources of the sources o

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sandstone becoming more abundant upward and composing the bulk of the upper half of the member.

Each of the limostone is in the form of relatively flat lenses of trilobite fragments and phosphatic brachiopods. The sandstone is composed roughly of equal amounts of glauconite and quartz grains, with a minor amount of calcite. T. D. Daugherty (personal communication, 1959) found that, in about the uppermost foot of Lion Mountain sandstone, the sand and silt grains become coarser and less well sorted than those below.

Blackish-red, hard, silicoous, hematite nodules litter the woathered slopes of the Lion Countain outcrops (Fl. III). Because these nodules are found only on the surface of the outcrop, they are believed to be a weathering product of the concentrated glauconite. The glauconite apparently weathers relatively easily and the soluble forrous iron and colloidal silica are dissolved by ground-water. By capillary action and subsequent dehydration the ferrous iron and colloidal silica are concentrated in the soil profile as insoluble forric oxide (hematite, Fe_2O_3) and quartz respectively. Fettijohn (1952, p. 138) stated that hematite may represent a progressive dohydration and hardening of a gel, analcgous to that shown by silica.

The top of the Lion Countain member is marked by a disconformity.

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WEATHERED SLOPE OF LION MOUNTAIN SANDSTONE LITTERED WITH BLACK HETATITE NODULES

About 2/3 mile east of Ranch-to-Market Road 783 near center of area. Weathered out! lenses of trilobite coquina near right edge of picture.

PLATE III

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Topography and Vegetation

The Lion Nountain characteristically forms a relatively narrow, sparsely vegetated, topographic bench between the outcrops of the Cap Nountain linestons and the Welge sandstons.

Vegetation on the nutcrop is typically sparse and scattered; on aerial photographs the nearly bare bench is quite distinct.

Wilberns Formation

The Wilberns formation was named by Faige (1911, p. 45) for Wilberns Glen, on Little Llano River, in northeastern Llano County. Barnes (1944, p. 37) very briefly redefined the Wilberns formation and mentioned the four included members - the Welge sandstone, Lorgan Creek limostone, Point Peak shale, and San Saba limestone, in ascending order. Finally the Wilberns was more completely described by Bridge, Barnes, and Cloud (1947).

Welge sandstone member

Definition and Thickness

The Welge sandstone member was named by Bridge and Barnes (Barnes, 1944, p. 37) for the Welge land surveys in Gillespie County. According to Bridge, Barnes, and Cloud (1947, p. 115), the Welge sandstone in the Llano region varies in thickness from 9 to 35 feet, with an average thickness of 18 feet. In the type section along Squaw Creek, half a mile north of the Gillespie County

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Lower Boundary

The Lion Mountain sandstone - Welge sandstone contact is disconformable, with the orange-brown, resistant sandstone of the Welge resting on the more unconsolidated sandstone and siltstone of the Lion Mountain member.

Lithology

The Welge member is a yellowish- to orange-brown, massively bedded, fine- to medium-grainod, generally nonglauconitic, quartz sandstone. The lowormost foot of section is slightly glauconitic in places. The quartz grains are well sorted and rounded, and many have secondary recomposed faces (Barnes, 1947, p. 114) which glitter in the sunlight. In normal outcrop within the report area the sandstone is somewhat friable; but where it is adjacent to or included within the fault zones it has become well indurated by a hard siliceous cement.

Topography and Vegetation

The outcorp of the Welge forms a preminent lodge or low cuests between the Yorgan Creek and Lion Mountain members. Weathered fragments of the Welge sandstone litter the slope of the Lion Mountain sandstone near the Welge - Lion Mountain contact (P1. IV).

PLATE IV



Figure 1. LEDGS OF WELCE SANDSTORE RESTING ON LION MOUNTAIN SANDSTORE BENCH Located 160 feet east of Ranch-to-Carket Read 783 just north of pipeline crossing.



Figure 2. DISCONFORMABLE LIGH MOUNTAIN-WELCH CONTACT (RILEY-WILBERNS CONTACT) About 2/3 mile east of Ranch-to-Tarket Road 783 near center of area. Litter on Lion Mountain bench is mostly from overlying Welge sandstone.

The Welge outcorp is marked by dense vegetation which characteristically includes scrub oak and mesquite. This dense growth shows up as a distinctly dark band on acrial photographs.

Morgan Creek limestone member

Definition and Thickness

The Horgan Greek limestone number was named by Bridge (1937) for Horgan Greek in Burnet County, Texas. According to Bridgo, Barnes, and Cloud (1947, p. 115) the Morgan Greek member varies in thickness from about 70 feet to about 160 feet, averaging about 120 feet. In the Doss-North area the measured thickness of the member was 138 feet.

Lower Boundary

The Welge sandstone - Morgan Greek limestone contact is gradational, with the yellowish-orange, noncalcareous sandstone of the Welge grading upward into the dark-red or marcon, coarsegrained, sandy limestone of the Morgan Greek. The boundary was placed at the lowernest marcon, arenaceous limestone. A slight topographic change is present - the gentle slope of the cuesta formed by the Welge reverses to the steeper stairstep slope of the Morgan Greek. Also the Welge outcrop is marked by a dense belt of vegetation in contrast to the more sparsely vegetated Morgan Greek outcrop.

Lithology

The lower part of the Lorgan Grock consists of marcol, coarse-grained, sandy likestones which grads upward into grayichpink to graenich-gray, finer-grained, gla consisting likestones. The boddlay varies from massive near the base to updime in the upper part of this interval.

The upper half of the number is composed chiefly of dark- may to procession, and un-bodded, medium-grained, normally glauconitic linestones, alternating with thin-bodded, fine-grained, silty linestones, siltstones and silty balancous shales. Beds of stromatolitic bioherns from 6 inches to 3 feet in discotor occur throughout this upper interval. Some of these stromatolitic limestones are quite persistent, and form ledges that can be traced laterally apress the entire outprop. Four the top of the upper, just below the uppermost hedge. Four the top of the solver, just below the uppermost hedge. This much like the everyping Point feak shale.

Fost of the lorgan Greek is highly fossiliferous, with conven occurrences of writebite fragments or "hash" and corners brachie eds. At most dates a characteristic zone containing an abundance of the brachie of <u>Boorthis texama</u> occurs about 50 fact above the base of the number.

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Lithology

The Foint Fock shale is composed of grayish-green to light brown, thin-and well-bedded, calcareous shales and siltstones, with subordinate amounts of fine-grained limestones, intraformational limestone conglomerates, and thin-bedded dolomites (FL. ∇ , fig. 1). Stromatolitic biohorm zones generally occur throughout the lower middle portion of the member, with shale found above, below, and between these sones. The shales and siltatones occur in beds from 1/2 to 6 inches thick, and both are slightly to moderately micaceous. The limestones are usually gray to brown, thin-bedded and commonly glausonitie. The intraformational conglementes or "edgewise" conglementes consist of angular, flattened pebbles of variously colored limestones, arranged haphazardly in a silty, calcareous matrix, and occur in beds from 1 inch to 1 foot thick (FL. ∇ , fig. 2).

The stromatolitic bickers sones, comprising nearly onequarter of the Point Peak member, vary both in thickness and in stratigraphic position. Although the thickest zones occur in the lower part of the middle of the member, 1- to 2-foot beds of small bickerns, similar to those in the Morgan Greek limestone, are found locally throughout the Point Peak shale. In the measured section along Threadgill Greek, a bickern zone about 37 feet thick occurs 73 feet below the Point Peak - San Saba contact (PL. VI, fig. 1). This stratigraphically low occurrence contrasts markedly to other areas of the Llane uplift, where the top of the bickerns was selected as the Point Peak - San Saba boundary, or where the A C L Construction of the basis of the basis

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PLATE V



Figure 1. POINT PEAK THIN-BEDDED SHALE AND SILTSTONE On north bank of Threadgill Creek about 1/2 mile northeast of C. Heard's house.



Figure 2. WEATHERED BOULDER OF POINT FEAK INTRAFORMATIONAL CONGLOMERATE In extreme northeast part of area.



PLATU VI



Figure 1. POINT FDAX BIOHERY ZONE On east bank of Threadgill Crock about 1/2 mile northeast of Lange's Will. Note shale interbedded with biohorms.



Figure 2. "CABBAGE HEAD" STRUCTURE OF POINT PEAK BIOHER'S In northeast part of the area.



biohorms were included completely within the San Saba limestone. In the northern part of the thesis area generally two or three biohern zones, each 10 to 20 feet thick, are found in the upper middle part of the Point Foak. Locally any one of these zones may grade laterally into bedded limestone or shale, but usually at least one zone is always present. In the Dose-North area, the bioherm zones 10 or more feet thick were mapped as separate units of the Point Feak member.

The stronatolitic bioherm zones are composed of greenishgray and mottled, microgranular to sublithographic limestone, which is thought to be algal in origin. Intraformational conglomerate occurs locally between individual bioherms. Concentric or "oabbaye head" structures form on the weathered surface of the bioherms (71. VI. fig. 2).

Overall the Point Poal: shale is not highly fossiliferous; however brachiereds are locally common throughout the member. A persistent, thick bed of brown limestone containing silicified brachiereds occurs about 45 feet below the top of the shale.

Topography and Vegetation

The outcorp of the Foint Teak shale forms a steep to gentle slope between the underlying Torgan Greek limestone and the more resistant biohoms zenes. Where two biohem zenes are present, the shale forms a moderate slope between them. The biohem zenes usually cap the high hills of Toint Teak shale in the northeast

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The shale outcrop is characterized by mesquite, some live oak, and much persimmon and agarita. A particularly heavy (growth of live oak, which appears as a dark band on aerial photographs occurs on the lower part of the bioherms and on the shale immediately below. Locally the bioherms are bare of vegetation, except for some cateolaw and persimmon.

San Saba limestone member

Definition and Thickness

The San Saba limestone member was named by Bridge (Bridge, Barnes, and Cloud, 1947, p. 117) for exposures at and near the Mason - Brady highway bridge over the San Saba River, northwest of Camp San Saba, McGullooh County, Texas. Somstock (1890, p. 301) originally used the term "San Saba Series" for these same bods or for some part of them. According to definition by Bridge, Barnes, and Cloud (1947, p. 117), the member is composed of the "more or less glauconitic limestone" occurring between the underlying Foint Peak shale member of the Wilberns formation and the overlying Threadgill member of the Tanyard formation. It is the uppermost member of the Wilberns formation and of the Cambrian system.

The San Saba member is 230 foot thick at the type section and averages about the same throughout the Llane uplift.

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In the Doss-North area, the measured thickness of the member is 271 feet.

Lower Boundary

The Foint-Feak - San Saba contact is gradational, with the gray-brown clacareous siltstones, shales, and gray- to greenishbrown, fine-grained, slightly glauconitic limestone of the Foint Feak grading upward into light-gray to oream, thin-bedded, sublithographic limestones of the San Saba. Insemuch as stromatolitic bioherms do not occur at the top of the Foint Peak in this area, the boundary was placed at the bottom of the first beds of hard limestones. The boundary has no topographic expression.

Lithology

The lower third of the San Saba linestone member is composed of light-gray (mottled yellow) to light-oream, generally thin-bedded, sublithographic to fine-grained, nodular limestone. The yellow color of the beds, which is characteristic elsewhere in the Llano region, is not as pronounced in this area. Bods are usually 1/4 to 1 1/2 inches thick, but occasionally are up to 8 inches thick, and are interbodded with thin siltstones and shale. This portion of the member contains thin beds of intraformational conglomerate, thin beds of extremely glauconitic limestone, and coarse-grained, highly fossiliferous, occasionally cross-bedded limestone. The intraformational conglomerates in the lower third of the San Saba are of two typess (1) those lithologically similar
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to the Point Poak shale member, and (2) those in which the linestone pebbles are in a limestone matrix and the conglomoritic character is revealed only by weathering. A 5-foot zone of small bioherms cocurs near the top of this portion of the member.

The upper two-thirds of the member is composed chiefly of light-gray to greenish-gray and brown, medium- to coarse-grained, thin- to thick-bedded, glauconitic limestones, with occasional intorbedded siltstones. This portion of the member is highly fossiliferous and, as in the lower third of the member, contains thin beds of intraformational conglomerate, formed by limestone pobbles in a limestone matrix.

In the northeastern quarter of the area a bicherm gone of considerable thickness (over 15 feet) occurs about 15 feet above the base of the San Saba member. Bridge, Barnes, and Cloud (1947) considered the thick bicherm zone occurring in the Camp San Saba area, McCulloch Sounty, as belonging to the Point Peak member. However in 1954, Barnes and Bell (p. 15, 20) placed the thick bicherm zones of that area within the lowermost portion of the San Uaba limestone member. It appears that the occurrence of bicherm zones within the lower part of the San Saba member is fairly common in the western part of the Llane uplift. In the thesis area these bicherms appear to be of the same strenatelitic character as the Toint Feak bicherms, except that they are greenish-brown to brown in color and, in places, considerably dolomitized. Although no thick bicherm zones are present in the measured section of San Saba along Threaddill Creek, Barnes (1952) mapped large zones

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1 3/4 miles farther northeast on strike with this section. Apparently the San Saba biohern zones grade laterally into other facies as do the Point Peak biohern zones.

In the measured section in Threadgill Creek, the San Saba as a whole is highly fossiliferous, containing an abundance of trilobites, brachiopods and some gastropods. Small subspherical structures about penny- to pea-sized and called <u>Girvanellas</u> are visible on bedding surfaces of some limestones. Cloud and Barnes (1948, p. 30) refer to these structures as stromatolites and therefore they are of algal origin.

Topography and Vegetation

In the southern half of the area where Onion and Threadgill creeks have cut deeply into the linestone, the San Saba member forms high bluffs (Pl. VII). On the nearly flat hilltops in the northeastorn quarter of the area, the weathered surface of the San Saba is littered with thin, platy slabs of linestone.

The San Saba outcrop is usually somewhat sparsely vegetated with live oak, Nexican persimmon, and cedar.

ORDOVICIAN SYSTEL

The Ordovician system is represented in the Llano uplift by rocks of Early and Late Ordovician age. The lower Ordovician rocks of the Ellenburger group, according to Cloud and Barnes (1948), are essentially equivalent to the lower half of the Lower Ordovician of the Ozark uplift in Missouri and Arkansas. : 1/4 artes furning an ended an arrite at the art 2 artes / arriverst - the function of the art artes (and a factor for a the artes) include an artes in the mark and bounded armon

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BLUFF OF SAN SABA LINESTONE MEMBER

Just downstream from Lange's Mill on the north bank of Threadgill Greek. Earnes (1948, p. 411) reported that the bluff is about 60 feet high and formed by limestones of the lower part of the member.

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Ellenburger Group

The "Ellenburger limestone" was named by Paige (1911, p.24) for the Ellenburger Hills in the Burnet quadrangle. Paige considered the included limestones and dolomites to be "Cambro-Ordovician" in age. Cloud, Barnes, and Bridge (1945) revised the term "Ellenburger limestone" to Ellenburger group, which they restricted to beds of early Ordovician age. They also divided the group into three formations, which are, in ascending order, the Tanyard, Gorman, and Honeycut formations. Of these, only the Tanyard formation is present in the Done-North area.

Tanyard Formation

The Tanyard formation was named for rocks exposed at the Tanyard locality, on the east bank of Buchanan Lake in northwestern Burnet County, Texas. The formation is divided into the Threadgill and Staendebach members, lower and upper respectively. Averaging 505 feet thick, this formation is composed chiefly of limestone and dolomite. Only the Threadgill member is present in the thesis area.

Threadgill member

Definition and Thickness

Originally defined as the "Threadgill limestone" by Bridge and Barnes (Barnes, 1944, p. 37), the Threadgill unit was revised to member status by Cloud, Barnes, and Bridge (1945, p. 143) to include

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dolomite equivalent to the original linestens. The member was named after exposures on Threadgill and Formen Greeks, south of Lenge's Mill, Gillespie County. These exposures are within the thesis area.

According to Cloud, Barnes, and Bridge (1945, p. 143) the Threadgill monber ranges in thickness from 91 feet in the castern part of the Llane region to 313 feet in the vestern part. In the type soction within the thesis area, the measured thickness of the member is 200 feet (Barnes, 1952).

Lower Boundary

Although the Cambrian - Ordevieian contact is disconformable in the eastern part of the Mane uplift (Cloud and Darnes, 1948, p. 31) in the western part the contact appears to be transitional (PL. VIII, Cig. 1). In the Dess-North area the mediumgray and preenish-gray, granular, intermittently glauconitic licestones of the San Saba member (Vilborns formation) grade uptard into the wood-ash gray and buff, menglauconitic, sublithegraphic linestones of the Threadgill member (Janyard formation). The boundary was placed between the last occurrence of clausonite in the San Saba and first appearance of the generopods <u>Onbilets</u> and <u>Letespirs</u> in the Threadgill. Cloud and Darnes (1948, p. 61) stated that <u>Orbilets</u> and <u>Letespirs</u> first appear at the base of the Lower Ordevician, the <u>Orbilets</u> having a long range within the Lower Ordevieian, and <u>Letespirs</u> having a long range within the Ordevician. In this area there are nearly as many fault contacts between the

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PLATE VIII



Figure 1. CONFORMANES CALTERIAN-ORDOVICIAN CONTACT (TRANSITIONAL SAN SAMA-THREADOILL CONTACT) On west bank of Threadgill Greek about 1/2 mile upstream from Lange's Mill. Contact indicated by white line.



Figure 2. BLUFF OF THREADGILL LIMESTONE MEETBER On south bank of Threadgill Creek about 200 yards east of Ranch-to-Markot Road 783 bridge. Bluff about 30 feet high.

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San Saba and Threadgill members as there are sedimentary contacts. The presence of <u>dirvanellas</u> in San Saba limestones in contrast to their apparent absence in the Threadgill limestones was used cautiously to differentiate between the two members. The San Saba -Threadgill contact has no topographic expression.

Lithology

The Threadgill member is predominantly a wood-ash-gray to beige, thin-bedded, almost totally nonglauconitic, sublithographic limestone. Limestone intraformational brecoias and conglomerates, and yellowish-brown, dolomitized burrows and trails are common throughout the member. Some fine-grained limestones and siltstones are also present, and dolomite zones occur near the top of the member.

The Threadgill member is considered highly fessiliferous by Barnes (1952). Most of the fessils are readily visible only on the bedding surfaces. Gastropods such as <u>Ophileta</u> and <u>Lytospira</u> predominate, with some brachicopods and trilobites present.

Where covered, the Threadgill member is overlain by either Cretaceous sand and conglomerate, or by Tertiary - Quaternary terrace gravel and alluvium.

Topography and Vegetation

Along the courses of Onion and Threadgill Creeks the Threadgill limestone has formed bluffs 15 to 30 feet high (Pl. VIII, fig. 2). In other parts of the area the momber is topographically expressed as an upland flat or as gently rolling hills. the taken in a second to a start and material part and a second to a se

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ROCKS OF UNCERTAIN MESOZOIC AGE

Arkosic conglomerate

Definition

In 1954 Grote (p. 30) described an exposure of arkosic conglomerate in the Contral Bluff Creek Area. Grote gave the age as questionably Mesozoic. Rogers (1955) described, in detail, arkosic conglomerate from fourteen outcrops located in Mason, Menard, and Kimble counties, and concluded that the conglomerate was of Early Cretaceous age. Woolsey (1958) briefly described arkosic conglomerate in the Squaw Creek - Marshal Creek area, but reached no definite conclusions as to age.

Only one small outcrop of arkosic conglomerate is present in the Doss-North area. This particular rook appears to have been deposited sometime during the Mosozoic era, either as alluvium on the Paleczoic erosion surface before the advance of early Cretaceocus seas, or as the lower part of the earliest sand deposited by the encroaching seas. anda sources **beath to trates in seneral de seneral boundain** boundain al deservicie the seneral strip discontained and a line the test iteradeservice line and statistic touring powers and a line . An tage of threadgain the near birdig termination addes argost a tak in invite an

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Character

The arkosic conglomerate is composed essentially of poorly sorted, quartz and pink microoline pebbles, commented by a siliceous, hematitic matrix. The pebbles range from medium sand size to 1/2 inch in diameter. Overall color of the conglomerate ranges from dark marcon to dark gray. As a result of the siliceous coment the conglomerate is a very hard, resistant rock.

The conglomerate orops out in only one locality, where it unconformably ovorlies the glauconitic sandstone of the Lion Mountain member. Possibly the cement for the conglomerate was derived from the underlying glauconite. The unit is estimated to be about 3 feet thick in this area.

Stratigraphic Relationships

The true stratigraphic position of the arkosic conglomerate is not apparent in the thesis area. The only definitely known stratigraphic relationship is that the conglomerate directly overlies the Lion Hountain sandstone member of the Hiley formation.

Rogers (1955, p. 15) reported that in northeast Kimble County undisturbed arkosic conglowerate overlies faulted and folded middle Pennsylvanian rocks, thereby indicating an age at least younger than middle Pennsylvanian and probably post-Pennsylvanian for that particular conglowerate. He also stated (p. 16) that the superposition of Lower Cretaceous beds upon three separate outcrops of arkosic conglowerate procluded the possibility of the conglowerate being younger than Early Cretaceous. For lack of evidence to the

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contrary, the arkosic conglomerate of the thesis area is also considered to have been deposited after Pennsylvanian time.

Inasuch as outcrops of arkosic conglomerate in other areas of the Llano uplift are directly overlain by Lower Cretaceous rooks and the arkosic conglomerate of the Doss-North area contains no fragments of Cretaceous rooks, the arkosic conglomerate of this area is considered to be not younger than Early Cretaceous. The Lange's Mill conglomerate also does not contain any fragments of Cretaceous rooks but is composed chiefly of pebbles of Paleozoic limestones and is therefore considered to be no younger than Early Cretaceous.

Several physical relations of the arkosic conglomerate are evident in the thesis area. The conglomerate occurs in an intensely faulted, relatively high, flat portion of the area. It is 45 feet higher in elevation than the highest and nearest outerop of the Lange's Hill conglomerate, and is both higher and lower than outerops of the Cretaceous sandstone. The arkosic conglomerate and the basal part of the sandstone unit are similar in that they both are composed chiefly of poorly sorted, subangular quartz grains, and are in some degree forruginous. They are dissimilar in that the arkosic conglomerate contains an appreciable amount of feldspar, is totally noncalearcous, and is highly indurated; whereas the sandstone unit contains no observed feldspar, is calcareous, and is unindurated to slightly indurated.

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In the Doss-North area, two possible stratigraphic positions for the arkosic conglomerate are considered; (1) as a deposit between the Lange's Mill conglomerate and the overlying sandstone unit, either as an alluvial apron or as the basal portion of the sandstone; and therefore younger than the Lange's Mill conglomerate, and (2) as an alluvial doposit upon the pre-Cretaceous erosion surface, and elder than the Lange's Mill conglomerate.

There are several indications that the arkosic conglomerate might belong stratigraphically between the Lange's Mill conglomerate and the Cretaceous sandstone unit. The higher elevation of the arkosic conglomerate compared to that of the Lange's Mill conglomerate indicates a possible stratigraphic position above the Lange's Mill unit. Also, the similarity of quartz grains, sorting, and forruginous nature of the arkosic conglomerate and sandstone unit suggest that the conglomerate is possibly a well-cemented portion of the lower part of the sandstone unit. The total lack of particles of Faleogoic linestones in the arkosic conglomerate is in marked contrast to their con-

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spicuous predominance in the Lange's Eill conclomerate. This would imply that deposition of the Lange's Mill conglomerate occurred during the erosion of the Paleozoic limestones, and that the deposition of the arkosic conclomerate occurred only after the Paleozoic rocks had been stripped away to expose Precambrian granite. Possibly the encroaching Early Cretaceous seas first deposited the basal Lange's Mill conglomerate in the lowest areas of the pre-Cretaceous erosion surface and then deposited the sandstone unit. Or perhaps both the Lange's Mill and arkosic conclomerates were alluvial deposits laid down before the advance of the Cretaceous seast the Lange's Mill conclomerate was first deposited in stream channels and valleys, and after exposure of the Precambrian granite, the arkosic conglomerate was deposited upon a somewhat higher erosion surface. Where the basal portion of the sandstone unit or alluvial arkosic material was deposited in the vicinity of Paleozoic faults or fault zones, it was subsequently cemented into a very hard, siliceous arkosic conglomerate and preserved from later erosion that completely removed the other uncomented material.

Physical relations that could be considered unfavorable to the immediately preceeding interpretation are also present. First, there is evidence suggesting that the arkosic conglomerate is not the basal portion of the Cretaccous sandstone: that the outcrop of arkosic conglomerate is both higher and lower than outcrops of the Cretaceous sandstone implies that it night not be the first

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deposit of the advancing Cretaceous seas; and if the conglomerate belongs between the Cretaceous sands, its different lithology is difficult to explain. Also, if there is a relation between the outcrop of arkosic conglomerate and the adjacent faults, remnants of the conglomerate might be expected near faults or fault zones in the vicinity of the single observed outcrop, even if cementation was erratic. There appears to be a total absence of arkosic conglomerate in these portions of the area. Also, no feldspar has been observed by the writer in the lower part of the sandstone unit in the thesis area; however, this may be due to feldspar occurring only locally in the sandstone.

The second stratigraphic position considered for the arkosic conglomerate is that it is older than the Lange's Mill conglomerate. Because of its distribution and extremely poor sorting, it appears that the arkosic conglomerate might possibly have been an alluvial appendence. Inasmuch as glauconite contains both silicate and iron, the hard, siliceous and homatitic cement that preserves the arkosic conglomerate from erosion could have been derived from the underlying, highly glauconitic Lion Mountain sandstone. That the outcrop of arkosic conglomerate is at a higher elevation than the Lange's "ill conglomerate and portions of the Cretaceous sandstone unit can be explained by progressive onlap of Cretaceous sees. Also there is the possibility that the Lange's Mill conglomerate is a younger terrace deposit within a valley out through the arkosic conglomerate and other rocks. Ferhaps the arkosic conglomerate was deposited on the pre-Cretaceous surface as

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a terrace or an alluvial agron, cemented locally, partially eroded, and finally covered by the enerosching Cretaceons sea. The Lange's "ill conglomerate was possibly deposited in the valleys and channels either as the basal deposit of the advancing seas, or as an alluvial deposit before the sea covered the area. The sandstone unit was deposited next, covering the Lange's "ill conglomerate and all other areas lower than the arkesic unit, and finally overlapping the arkesic conglomerate. Later erosion stripped the sandstone unit from much of the Paleozoic surface, exposing the remnants of the arkesic conglomerate.

The interpretation that the arkosic conglomerate is older than the Lange's Hill conglomerate also has several weak points. If the arkosic conglomerate was deposited before the Lange's Hill conglomerate, then it too should possibly contain fragments of the Paleozoic limestones. However this would depend largely on the climate at that time. The outcrops of similar highly indurated arkosic conglomerates in other areas do not always overlie Lion Mountain sandstone, indicating that the hard siliceous and hematitic cenent is not necessarily derived from that unit.

After due consideration the writer's only conclusion is that the arkosic conglomerate is probably of Nesozoic age; even Permian age cannot be precluded. The Dess-North area does not appear to be the critical area for determining the true stratigraphic relations between the arkosic and Lange's Mill conglomerates.

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CRETACEOUS SYSTEM

The Cretaceous system is represented in the Llano region by rooks of Early Cretaceous age (Comanche Series), which, except for the northwest side, are distributed around the flanks of the uplift. The contact of the nearly horisontal Cretaceous beds with older rooks is everywhere unconformable.

In describing the Squaw Creek quadrangle, Barnes (1952) recognized the following Cretaceous units:

> Fredericksburg group Edwards limestone Comanche Peak limestone Walnut clay

Trinity group Shingle Hills formation Glen Rose limestone member Hensell sand member

The above sequence differs from previously recognized nomenolature in that the term Travis Peak formation has been dropped and the term Shingle Hills formation added, to include the Glen Rose limestone and Hencell sand members. In the Doss-North area the Cretaceous units previously recognized by Barnes were not differentiated, but were simply mapped, in ascending order, as the Lange's Mill conglowerate, sandstone, siltstone, and limestone units. The total thickness of Cretaceous rocks in this area is about 330 feet.

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Lange's Mill conglomerate

Definition and Thickness

The Lange's Mill conglowerate was named by Barnes, Dawson, and Parkinson (1947) for exposures near Lange's Mill in northwestern Gillespie County. Although Barnes dropped the n^Ame Lange's Mill in his subsequent publications and referred to this unit merely as basal conglomerate of the Hensell sand, the name has been retained for use in the Doss-North area.

Although Barnes (1952) described this unit as the basal portion of the Hensell sand, there may be some question as to whether the Lange's Mill conglomerate is the basal portion of the sandstone unit. The Lange's Mill conglomerate and the sandstone unit are not exposed together in the thesis area. However soil or "wash" believed to have been derived from the sandstone is in contact with the conglomerate. Only one restricted outcrop of the conglomerate shows any apparent gradation upward. The grain or particle size of the uppermost portion of this outcrop, however, is not nearly as small as the grain size of the lowermost portions of the sandstone unit exposed at other localities. If there were originally gradational strate between the Lange's Mill conglomerate area, or they have been weathered to the pebbly red soil or "wash" that commonly overlies the Lange's Mill conglomerate in this area.

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The possibility that the Lange's Will conglemerate is post-Cretaceous cannot be absolutely procluded. However the apparent total lack of fragments of Cretaceous linestone and chort in the conglemerate strongly indicates that it is not post-Cretaceous in age. Tertiary or Recent terrace gravel exposed near outcrops of the Lange's Will conglemerate is composed essentially of Cretaceous limestone particles and chort, particularly Edwards chert.

Barnes (1952) described the conglements in the vicinity of Lange's Fill as possibly being 40 feet thick. At other outcrops in the thesis area the conglements was estimated to range in thickness from 10 feet to a feather ed~o.

Lithology

The Lange's 'ill conglomerate, wherever observed, unconformably overlies either the San Saba or Threadgill limestones (F1. LX, fig. 1). The indurated conglomerate is composed chiefly

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PLATE IX



Figure 1. UNCONFORMABLE ORDOVICIAN-ORETACEOUS CONTACT

On Onion Creek about 250 yards upstream (west) of Ranch-to-Karket Road 783 bridge. Threadgill member ovorlain by Lange's Mill conglomerate.



Figure 2. LANCE'S MILL CONCLONERATE In Drainage ditch on west side of Ranch-to-Market Road 783 just north of Mason-Gillespie County line.


of variously sized and colored linestone publies, cobbles, and bouldors derived from the Riley, Wilborns, and Threadgill formations and bound together with a carbonate coment. Quartite, chert, and white, massive quartz publies occur occasionally in the conglemerate. The individual publies and boulders range in size from very small publies to boulders 4 fost in length, and are well-rounded to sharply angular ([1. IN, fig. 2]). Locally the conglemerate is friable near the top and has the appearance of locasely consolidated gravel.

Topography and Vegetation

The Lange's "ill conglemenate is generally found in creek bottoms or adjacent slopes and does not influence the topography.

Vegetation is abundant where the conglowerate has weathered to a pebbly soil, and is characteristically live oak, some codar and mesquite, and various forms of thick brushes. V my little vegetation is present on the bare exposed surface of the indurated conglomerate.

Sandstone Unit

Definition and Thickness

The Cretacoous sandstone unit mapped in the Doss-North area is probably equivalent to, in whole or in part, the Honsell saud nombor of Barnes (1952), and possibly to part of the Glon Rose linestone member. In the thesis area the sandstone unit ranges from a feather edge to an estimated 150 feet thick.

Lower Boundary

Within the Doss-North area the Cretaceous sandstone unit or soil derived from it rests unconformably upon all members of Cambrian age except the Hickory sandstone, and upon the Threadgill member of Ordovician age. Soil derived from the sandstone also rests upon the Lange's Hill conglemente of Darly Cretaceous age. The sand covers over fifty percent of the southern half of the area.

Lithology

The sandstone unit varies widely in color and composition, and is generally poorly sorted. It is a predominantly red to gray, massive, fine- to coarse-grained, unindurated to slightly indurated, calcareous sand (Pl. X). The sand generally grades from red, coarse-grained and ferruginous in the lower portion, to gray and buff, silty in the upper portion. It is also more calcareous in the upper part than the lower.

Topography and Vegetation

In most of the southern half of the area where the sandstone unit is present as cover over Paleozoic rocks, it forms upland flats, gently rolling hills, and flat lowland fields. Where the sand is immediately overlain by the siltatone unit, as in the extreme southwost and eastern portions of the area, it maintains a steep slope.

PLATE X



MASSIVE CRETACEOUS SANDSTONE UNIT

On south bank of an Onion Creek tributary at west border of area. Sand is dull red and medium grained. Vegetation is usually abundant on the sand outcrop.

except for the steep portions at the base of the high Cretaceous hills. There is no particularly characteristic vegetation present on the outcrop; locally it may consist of the trees, shrubs, and grasses found on any member of the Cambrian and Ordovician formations.

Siltstone Unit

Definition and Thickness

The Cretaceous siltstone unit mapped in the thesis area is probably equivalent, in whole or in part, to the Glen Rose limestone member of the Shingle Hills formation, the Walnut clay, and the Comanche Peak limestone; all mapped by Earnes (1952) in the Aquaw Creek aqudrangle, Gillespie and Eason counties, Texas.

In the Doss-North area, the siltstone unit is about 80 feet thick.

Lower Boundary

The siltstone unit occurs only in the Cretaceous hills in the southwestern and extreme western parts of the area. There the contact was placed at the horizon where the silt-sized material first becomes predominant.

Lithology

The siltstone unit is composed of gray- to light-buff, massively bedded and in places nodular, argillaceous, calcareous siltstone and cream- to very light-buff, silty marl.

The unit is abundantly fossiliferous at several horizons. Unidentified gastropods and brachiopods were found in place, and <u>Exercyra</u> <u>texama</u> was found on the weathered slope a few feet above the base of the unit.

Topography and Vegetation

The siltstone unit forms the stoepest slope of the high Cretacoous hills in the thesis area. Near the top of the unit, well-comented siltstones form vertical, white cliffs (N. XI, fig. 1).

A dense growth of vegetation, prodominantly on the northern slopes, is distinctive of the siltatone outcrop, and consists chiefly of Spanish cak. This dense growth shows on acrial photographs as a black band.

Limestone Unit

Definition and Thickness

The Cretaceous limestone unit capped in the Doss-North area is probably equivalent in part to the lower part of the Edwards limestone.

In this area the limestone unit is about 60 foet thick.

Lowar Boundary

The siltstone unit - limestone unit contact is gradational. The contact was placed at the base of the first thin-bedded, hard limestone. About 3 feet above this first limestone, there is a characteristically flat, chort-littered bench.





Figure 1. CRITACTONS SILESJOWN BLUFF (UFTER FORTION OF HILL) Viewed from cast, at dirt road junction at the west border of area about 1 mile north of Mason-Gillespic County line.



Figure 2. FROFILE OF LIESTONU-CAPTED CRETACIOUS ENSA Same hill as in Figure 1 viewed from another hill to the south. Contacts of sandstone, siltstone, and limestone units are indicated by white lines.

Lithology

The limition unit is composed of gray to light-buff, microgramular to medium-grained, soft to hard limestone. Fuch of the limestone contains black or gray chert modules. Locally caliche has formed on the weathered surface of some of the softer limestone.

Topography and Vegetation

In the southwestern part of this area the resistant limestone unit forms a more or less flat, commonly ohert-littered surface that comprises the upper portion of the steep-sloped Cretaccous hills or mosas (F1, XI, fig. 2).

Sorubby live oak, cedar, and some Spanish oak form vogetational banding on the various topographic benches.

TURFIARY AND QUATURNARY SYSTEMS

Torrace gravel of Tertiary or Quaternary age and Recent alluvium are present in the Dess-North area.

The terrace gravel or "high gravel" of Barnes (1952) occurs in the extreme southeastern part of the area and is composed essentially of granules, pebbles, cobbles, and caliche. Nost of the material was derived from Cretaceous linestone and chert and possibly from the coarser constituents of the Cretaceous sandstone unit. The characteristic Edwards chert content distinguishes the terrace gravel from the more friable pertion of the Lange's "ill conglemerate. The gravel is over 10 feet thick in places.

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The alluvium is composed of silts, sands, gravels and conglomerates that occur principally along the major streams. Locally this alluvium is at least 10 foot thick, and in the northeastern and southeastern parts of this area some of it is cultivated. Bas Alevery , Shine instite in her some sides interiored?

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STRUCTURAL CHOLOGY

REGIONAL STRUCTURS

The Llane uplift of central Texas is structurally a large dome in which, according to Sollards (1932, p. 30), the Precambrian basement rocks have been uplifted 5,000 or 6,000 feet. Within the uplift region Precambrian and Talcosoic rocks of pre-Canyon age have been disturbed by an extensive fault system in which the major faults generally trend mortheast - southwest. These are normal faults, having steep or vortical dips and often forming extensive graben and horst structures.

Regional folding of Taleozoic rocks has been recognized in the Llane region, and Grote (1954) reported the presence of a gentle fold trending northeast in the Central Bluff Grock area of Tasen County. Intense structural deformation occurred during Frecambrian time, but the resulting structures were beyeled by erosion before Upper Cambrian deposition and are not reflected in Falcozoic or later rocks.

To facilitate the discussion of time of coourrence, the geologic divisions of the Carboniferous strats now recognized in the Llane region (flummer, 1950, p. 16) are given as follows:

> Formsylvanian system Canyon group Strawn group Smithwick formation Farble Falls group

Dississippian system Barnett formation Chappel formation

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According to Sellards (1934, p. 84) the Llano uplift was a positive area as early as mid-Mississippian time. This is indicated by the thinning of the Barnett formation as it approaches the Llano region. Sellards (1934, p. 97) stated that a strong angular unconformity between Bend and post-Bend (post-Smithwick) rooks suggests that the major uplift occurred after Bend time.

The major late Paleozoic faulting, occurring with or immediately following the principal uplift, is dated by Cloud and Barnes (1948, p. 121) as inter-Strawn and pre-Canyon, or as post-Strawn and pre-Canyon in age. This designation is based upon the evidence that the faults cut all pre-Canyon beds of the region while apparently not disturbing Canyon and later beds.

STRUCTURE OF THE DOSS NORTH AREA

General Statement

The principal structural features of the Doss-North area are normal, stooply-dipping faults, which generally trend northeastsouthwest and range in throw from a few feet to an estimated 785 feet. The faults essentially control the outerop pattern. Three major faults, or fault zenes, and numerous minor faults disturb all but the Cretaceous and later rocks.

Except in fault zones or small fault blocks, the Paleozoic strata have an average strike of $2.40^{\circ} - 50^{\circ}$ 2. and an apparent regional dip of about $6^{\circ} - 8^{\circ}$ 3. 2. The Cretaceous strata have little or no dip.

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The only occurrence of folding in this area is that of minor folding within the Point Peak shale member of the Wilberns formation.

Faulting

Cajor Faults

Three major faults, trending northeast - southwest, cross or partially cross the Dess-North area: the Monsola fault in the extreme northwestern part, the Law fault in the upper middle part, and the Squaw Creek fault zone in the lower middle part. All major faults are downthrown to the northwest.

The Monsola fault, named by Ammer (1959) crosses the northwest corner of the thesis area and disappears beneath Cretaceous cover immediately west of the area. This fault changes from a strike of N. 70° L. in the northerly adjacent Hilda-Southwest area, and increases in threw from over 200 feet in the former area to an estimated 650 feet in the latter. The fault is downthrown to the northwest, and near the western edge of the area where Cap Mountain limestone is faulted against Morgan Creek and San Saba limestones, a small but sharply defined resequent searp has formed.

The Law fault extends into the thesis area about 0.8 miles south of the northeast corner. In conjunction with Peterson (1959), this fault was named by the writer for the G. Law land survey. The fault changes from a strike of N. 70° E. at the east border to a strike of N. 45° E. near the west contral part of this area, where

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it disappears beneath Cretaceous cover. The Law fault, which has a maximum throw of 785 feet, is the largest fault in the area. Differential erosion has formed an obsequent scarp along the mortheast portion of the fault, and here also occur two horsts or blocks of rock surrounded by branches of the main fault. At many places a narrow ridge or dike of hard, silicified Welge-like sandstone occurs along the fault.

The Squaw Grock fault, named by Woolcey (1958), extends into the middle eastern part of the area as a wide zone of faulting. Nost of the faults of this zone strike about 3.45° T., but a few strike N. 10° to 15° T. The largest fault has at least 660 feet of threw (Car Nountain against Ellenburger). One short cross fault (extending obliquely between two parallel faults) less than one half mile long, has an estimated threw of 380 feet. Threws of 300 to 400 feet, steep dips, and horst blocks are common. Normal drag occurs along one fault extending across Threadgill Greek.

The Daffan fault, named by Antor (1959), lies just west of the extreme northwestorn portion of the area and approximately parallels the border (PL. XIII). Although this fault is not within the thesis area, it influences the structure in the northwest portion, and apparently merges with the Consola fault just west of the area beneath the Contaceous cover.

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PLATE XII



BRANCH OF SQUAW CREEK PAULT

On Threadgill Greek 1/2 mile northeast of C. Heard's house. Cap Countain limestone (rock lodges on right side) faulted against Point Poak shale.



Minor Faults

Eugerous normal and steeply dipping minor faults occur throughout the thesis area. The strikes of these faults are usually more northerly than those of the major faults, and the average throw is less than 100 feet. The majority of these minor faults are, or appear to be, branches of the major faults. Direction of displacement or downthrow is variable, with the result that small horsts and grabons are common. Faults that extend obliquely between and connect two larger parallel faults are rare, and occur only in the zone between the Daffan and Fonsola faults in the northwestern portion of the area, and in the Squaw Creek fault zone in the eastern central portion.

Ridges of highly inducated (nearly quartitic) Welge-like sandstone often occurs along the faults, and facilitate the tracing of the faults over relatively long distances. There these dikes occur near faulted Welge sandstone, it is likely that they are actually composed of well-comented Welge sandstone. However where they occur along faults far removed from any Welge outcrop, their relation to the Welge is uncertain. The sandstone dikes are resistant to weathering because of their hard silicoous element.

Wherever the resistant Welge candstone has been displaced, extremely small faults may be easily detected, but displacement within the Cap Fountain limestone is not nearly so obvious, and even the larger faults usually cannot be traced through it for any great distance with much containty. Faulting contained wholly within



the Cap Fountain limestone was often detected by wegetational lineations, although these also occur along joints in this member. There are no key beds within the Cap Fountain limestone that can be utilized in the detection of faults.

In the extreme northwestern part of the thesis area, much small-scale block faulting has occurred in the V-shaped zone outlined by the apparently merging Daffan and Mensela faults. The faults increase in number and in displacement toward the apex of this zone. An enlarged map of this intensely fractured zone is shown on Plate XIII: the map extends a short distance past the west border of the thesis area so as to include the Daffan fault.

Age and Origin of Faulting

All the Paloozoic strata in the Dess-North area have been cut by faulting, while the overlying Cretaceous strata have been undisturbed. The youngest rock unit cut by faulting is the Threadgill linestone of the Ellenburger group; the faulting in this area can therefore be positively dated as post-Ellenburger and pro-Cretaceous. However, evidence for the Llane region as a whole, as previously discussed under regional structure, indicates the age of faulting as pro-Canyon.

Evidence for cause of faulting in the Llane region is both meager and inconclusive, and any proposed theory of origin is therefore necessarily speculation. However, several facts are evident: (1) general northeast-southwest trend for most major and a managed and a traditionary and a telepade for any telepade for any angle and and and a second and a second a second constance, at the second at a second at any term and a second any term and a second at a second at a s the any term of terms and terms and a second at any term at a second at a second at a second at a second at a s the any term of terms and second at any term is any term of term at a second at a second at a second at a second

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It would appear that since Procembrian time intense compression has never occurred throughout the Llano region, and that the faulting was not a result of tension due to relaxation of compressional stresses. The broad folds that trend northeastsouthwest could be due to axes of more positive uplift that also trend northeast-southwest. A northeast-southwest fault system would then be expected along those broad folds.

Earnes (1956, p. 9) stated that the faulting of rocks in the Llane uplift was related to the Quachita orogony. It is difficult to see any definite relation of this nature unless the actual uplift of the region is related in some way to the orogony. Differential uplift of the area does provide one possible explanation for the Llano fault system.

Attitude of Beds

The regional dip of the strata in the Doss-North area - 6° to 8° S.E. - is not that which would be expected on the southwest flank of a structural dome. Anomalous regional dips have been reported from other areas flanking the uplift.

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Southeast regional dips have been reported throughout a region extending from the thesis area northwestward to a point east of Streeter, Eason County, Toxas. West of Streeter dips are generally toward the west. An extension of the Richland Springs axis of relatively higher uplift of basement rock (Grote, 1954, p. 42) through the Streeter area may be the cause of the opposing dips. This axis has the apparent effect of a broad fold trending northeast-southwest. The southeast dip in the thesis area could then be due to position on the southeast flank of a more positive or higher uplift of the basement rock.

Another possible explanation for the southeast dip is that the area from Streeter to the thesis area is part of a large fault block which dips to the southeast. However, the known existence of not one, but a large number of fault blocks within this area would preclude this explanation. Of course all or most of these many fault blocks could be tilted toward the southeast.

Folding

Folding in the Doss-North area is confined to small local folds in the Point Peak shale (Pl. XIV). These folds are a result of the incompetency and relative plasticity of the shale with respect to overlying and underlying beds. Three possible modes of origin are considered: (1) tectonic folding, (2) folding due to overload or differential compaction, and (3) folding related to faulting.

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PLATE XIV



Figure 1. RELATIVELY LARGE FOLD IN POINT PEAK SHALE

Roadside exposure on east side of Ranch-to-'arkot Road 783 near crest of hill, about 0.3 mile south of pipeline crossing. Foint Feak bioherns overlying shale in loft of picture.



Figure 2. SMALL TIGHT FOLD IN POINT PEAK SHALE A few feet north of fold shown in Figure 1.



Very little, if any, regional compression and tectonic folding have occurred in the Llano region since the end of Precambrian time. However, the regional uplift and consequent doming of the area could have caused possible slippage along beds, resulting in minor folding within the somewhat plastic Point Peak shale.

Overload or compression beneath overlying bioherms could possibly explain the folding in the Point Peak shale. A thick zone of bioherms does overlie the observed folds, and the small folds could have resulted from compaction by the weight of the bioherms. The presence of the bioherms over the flank of one particular fold (Pl. XIV, fig. 1) and the absence of bioherms over the crest indicate compression due to the bioherms. Or perhaps there is a bioherm beneath the crest of this fold and the fold was due merely to differential compaction of the beds above and around the bioherm. The crests of the smaller folds are nearly always pointing vertically upward (Pl. XIV, fig. 2). There are clearcut examples of differential compaction over and around bioherms in other parts of the Llano region (Cloud and Barnes, 1048, p. 408).

Folding related to faulting is a possibility in the thesis area. The small folds observed in the Point Peak shale were only a few feet from a fault bringing Norgan Creek limestone up against Point Peak shale. One small drag fold is present just at the fault. The folds farther away from the fault could have resulted from stresses set up by the faulting.

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It appears to the writer that the evidence favors overload and differential compaction as the cause of most of the minor folding in the Point Foak shale of the Dess-North area.

GROLOGIC HISTCRY

GUNERAL STATUIENT

The geologic history of the Doss-North area is a part of the history of the larger area of the Llano region. The overall regional history of the uplift will be discussed first; then any unusual or anomalous events indicated by the depositional record of the thesis area will be described.

General review of the geologic history or depositional record of the Llano region has been given by Paige (1912), Sellards (1934), Cloud and Barnes (1948), Cheney and Goss (1952), and Barnes (1956).

REGIONAL HISTORY

Precambrian

During Precembrian time a thick sequence of sedimentary rocks similar to those of the later Paleozoic deposition was deposited, deeply buried, and subsequently deformed, intruded, and metamorphosod. Notamorphism of the series resulted in the formation of schist, gnelss and marble. Granite intrusions were common. Uplift followed, and long-continued denudation resulted in an irregular topography of local rolief as great as 800 feet (Barnes, 1956, p. 8). It was upon this surface that the Late Cambrian seas advanced. PRETERAL MARKING

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Cambrian

The absence or Lower and Fiddle Cambrian rocks in the Llane region suggests that ercesion of the Precambrian surface continued until encreachment of the Late Cambrian seas. The eldest Falcozeic deposit, the Hickory Sandstone, contains dreikanters in its bacal portions. Goolsby (1957) reported that although the lithelogic character of the Lower Hickory sandstones suggests they are residual acclian sediments, the cross-bedding present indicates subaqueous deposition. He also stated that orons-bedding studice suggest that there sandstones were deposited at the mouths of fast, possibly temperary, streams where they entered the quiet sea. The middle and upper portions of the Hickory sandstone were apparently deposited in shallow seas. Cross-bedding, sub-rounded grains, and ripple marks are characteristic.

The Hickory sandstone grades vertically and laterally into Cap Nountain granular limestones, indicating either a rise in sea level and depletion of quartzess detritus, or a decrease in capacity of the streams to carry the detrital lead. The lack of an intermediate shale facies suggests that either the rise in sea level was rather rapid, or that there was a deficiency of shale-size material from the source area, allowing the early deposition of carbonates.

The occurrence of glaucomite, trilobites, and brachiopods suggests a shallow moritic environment during the deposition

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The Cap Fountain likestone grades upward into the highly fossiliferous and glauconitic sandstone of the Lion Hountain. Cloud and Barnes (1948, p. 112) suggested that the Lion Fountain sandstone, along with the Welge sandstone, was deposited in a regressive - transgressive zone. The return to predominance of sand in the Lion Fountain member points to an uplift of a quartzdetritus source. Barnes (1956, p. 8) stated that the thinning of the Lion Fountain and Welge sandstones southeastward indicates that the sand source was in the northwest direction. The writer believes that, although rock units may thin away from their source, this is certainly no definite criterion for direction of source; for example, the Earroo sediments in southern Africa become cearser toward their northward source but thicken southward. However, increase in cearseness is a valid indication of direction of sources.

Barnes, Dawson, and Parkinson (1947) and Cloud and Barnes (1948, p. 343) refer to the Lion Wountain - Velge contact as disconformable, but do not discuss or give details for such reference. In the discussion of local history the writer gives reasons for designating this contact as a disconformity.

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The Welge sandstone represents an environment of agitated or turbulent water that was unfavorable to the formation of glauconite. The Welge is only slightly glauconitic locally in the lowermost part and is totally nonglauconitic upward. The end of Welge time marks the decrease of clastic influx, and a greater transgression of the sea.

A return to an environment somewhat similar to that of Cap Mountain time is implied by the granular Morgan Creek linestone and its included abundance of glauconite and remains of shallowwater marine life. Ripple marks are also present. Near the top of the Morgan Creek limestone, small bioherms make their first appearance in Upper Cambrian rocks, indicating an intermittent shallowing or shealing of the sea.

At the end of Morgan Greek time, the influx of argillaceous material exceeded carbonate deposition and the Point Peak shale was deposited. A general shallowing of the sea is evidenced by the common occurrence of intraformational conglomerates. Faige (1912, p. 79) stated that intraformational conglomerates along with other features such as inderacks suggest tidal flat environment. Cloud and Barnes (1948, p. 112) reported that the Point Peak shale gives place to carbonate rocks to the east in the Llano region, indicating warm sheal waters in that direction, far from an effective source of clastics.

During San Saba time, apparent continuation of shoaling in the eastern part of the region is inferred by the lateral

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transition of San Saba limestone into Vedermales dolomito eastward (Cloud and Barnes, 1948, p. 112). In the wostern part of the region, sandy sediments became only intermittently introduced, and the glauconitic and fossiliferous limestones and interbedded siltstones were deposited. Except for brief local shealing, the rost of the San Saba in the western part of the uplift was deposited in a shallow, relatively calm moritic environment. Barnes (1956, p. 9) reported that in the westernmost portion of the region the San Saba contains thick beds of sand, and the source was probably to the west.

In the western part of the Llano region, sedimentation was apparently continuous across the Cambrian - Ordovician boundary (Pl. VIII, fig. 1). However, Cloud and Barnes (1948, p. 112) reported that the southeastern part of the region became emergent at the end of Cambrian time, with resulting truncation of highest Cambrian strata.

Ordovician

According to Cloud and Earnes (1948, p. 100-105), in Ellenburger time, warm, intermittently turbulent, shallow seas persisted throughout the Llano region, and were probably less than 100 fathoms deep. Land lay to the cast and south of the region, and was either distant, worn vory low, or separated from the Llano region by a channel. The limestones of the Ellenburger group probably originated as chemically precipitated aragonite

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muds in an environment not unlike that found today in the Bahama Bank region. Barnes (1956, p. 9) stated that Lower Ordovician rocks are as much as 1,826 feet thick in the southeastern part of the uplift and as little as 830 feet thick in the northwestern part. This variation in thickness is caused by truncation in the west, representing a marked eastward tilting of the region either before or during the advancement of Devonian seas. That the truncation was pre-Devonian is evidenced, according to Cloud and Barnes (1948, p. 113), by the occurrence of the oldest known Devonian strata in the eastern part of the region, and the youngest in the west where maximum Ellenburger truncation occurred.

Eiddle Ordovician rocks are not represented in the Llano region. Either these rocks were never deposited or they were completely eroded prior to Late Ordovician deposition. Upper Ordovician rocks recognized in the Llano uplift are preserved mostly in collapsed areas in the Ellenburger. Known Upper Ordovician rocks are not present in the thesis area.

Devonian

Lower, Hiddle, and probably Upper Devenian rocks are present in the Llano uplift. Most of these occurrences are fillings in solution structures of various sorts (Barnes, Cloud, and Warren, 1947). The marked unconformity between the Devenian and underlying rocks indicates that the Devenian rocks must have been deposited upon an extensively eroded surface.

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Marco Marco Marco Marco Marco Marco Deventer generation and in the Marco Marco Marco Marco Marco Marco Manuela Marco Net marco Net Marco Net Marco Net Marco Marc Rocks of Devonian age are not present in the Docs-North area.

Carboniferous

Earine invasions cocurred during Eississippian and Pennsylvanian times, and laid down a series of fossiliforous limestones, shales, and lesser amounts of sand and conglomerate. The high organic content in the darkly colored limestones and shales suggests that the land area during Carboniferous time was possibly low and swampy. Thinning of the Barnett shale (Late Eississippian) as it approaches the Llano region indicates that uplift of the region had begun by that time. Sollards (1934, p. 97) stated that the principal uplift was post-Bend and pre-Canyon in age. Evidence for such dating is that, where the Bend is present, the Ellenburger has retained nearly its full thickness, indicating that the greatest erosion of Ellenburger was of post-Bend age. During Fennsylvanian time the region was highly faulted. Unfaulted Canyon and younger beds overlying older faulted Falcosoic strata date the faulting as pre-Canyon.

Carboniferous strata do not occur in the thesis area.

Termian, Triassic, and Jurassic

Sometime during the Permian, Triassic, and Jurassic periods the Llano region was emergent and was eroded to expose, in some places, the Procambrian rooks. Either sediments were never deposited during most of this time, or they were deposited and

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totally removed by subsequent erosion. The arkosic conflomerates present in the region might possibly represent deposition during this time, although, with the present state of knowledge, this is highly speculative.

Cretaceous

At the beginning of Cretaceous time, seas advanced over the croded Paleozoic surface and possibly deposited basal conglomerate in the valleys and other relatively low areas. By progressive overlap the Cretaccous sands, siltstones, and limestones were deposited on the Paleozcic and Precambrian surface. Plummer (1950. p. 101) stated that starting from near Marble Falls in Burnet County, and extending westward toward the interior of the region, and to topographically higher elevations, younger and stratigraphically higher members of the Lower Crotaccous sequence coue in contact with the Ellenburger and older rocks. This clearly indicates that the Llano region was a peninsula, a point, or perhaps an island during Travis Peak (Hensell) and Walnut time, which became smaller and smaller due to progressive overlap, and finally was totally submerged near Edwards time. According to Barnes (1944, p. 37). the Travis Peak sand is the shoreward sandy facies of the Cretaceous system of Texas and, at different places is equivalent to the Glen Rose limestone, Walnut clay, Comanche Feak limestone, and possibly other units.

் நேர் நிலையுக்கு பிரையாக குறையில் நிலையில் பிருந்து குறையில் பிருந்து குறையில் கொண்ணியில் கொண்ணியில் குற்கு முறையில் குறையில் குறைய குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறையில் கேறையில் குறையில் கேறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் கேறியில் கேறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் கேறியில் கேறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் கேறியில் கேறியில் கேறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் கேறியில் கேறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் கேறியில் கேறியில் கேறியில் குற குற்குக்கு குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் குறியில் கேறியில் கேறியில் கேறியில் க

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Fost-Cretaceous

Since the final withdrawal of the Cretaceous seas, the Llano region has remained emergent until the present time. Erosion has stripped the Cretaceous rocks from the center of the region, exposing Faleozoic and Precambrian rocks. A large topographic basin has resulted from this extensive erosion. Tortiary or Recent terrace gravels were deposited along the former courses of the streams and rivers of this area. Recent alluvium has also been deposited along the streams and rivers.

LOCAL VARIATIONS

Cap Yountain deposition

In the Doss-North area a massive, fine- to medium-grained, quartz sandstone occurs about 25 feet above the base of the Cap Mountain limestone. The lateral extent of this sandstone is not known, due to faulting and alluvial cover. Bryant (1959, p. 20) reported that a similar massive but very fine-grained sandstone occurs in the lower limenitic part of the Cap Mountain limestone in the Schep-Panther Creek area, about 4 miles northwest of the Doss-North area. He stated that this massive sandstones in the Schep-Panther Creek and the Doss-North area are actually the same unit or occur at the same interval, and the grain size in each area has been correctly ascertained, then an increase in coarseness toward the southeast is indicated. The apparently limited

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distribution of the massive sandstone and increase of coarseness toward the southeast suggest a brief reappearance of local sources of quartz material possibly to the southeast in early Cap Hountain time due to either climatic changes or minor tectonic activity in the source area.

Lion Mountain deposition

The combination of alternating linestones and sandstones, trilobite "hash" lenses, and high concentration of glauconite indicates intermittently varying environments during deposition of the Lion Mountain member. However, in that most of the limestone is sandy and most of the sandstone is liny, the variation does not appear to be very great. The glauconite and fossiliferous limestones represent quiet, moderate to shallow neritic water. The "hash" lenses and relatively coarse detritus of the sandstone suggest turbid or agitated conditions.

Cloud (1955) concluded that the formation of glauconite if favored by moderately cool marine waters, moderate to shallow neritic dopths, and slightly reducing conditions. High organic content of bottom sediments, lack of continued turbulence, and slow or negative sedimentation also aid in the formation of glauconite. Nearly half of the Lion Hountain sanstone is glauconite.

Inasmuch as the deposition of quartz detritus usually requires turbulent or agitated water, the relatively quiet reducing conditions favorable for clauconite formation occurred only intermittently during Lion Hountain deposition. The presence of

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limestones interbedded with the sandstones also suggests varying conditions. The numerous trilobite lenses and "hash" imply that during the deposition of the limestones, organic material or deceying organic matter was plentiful on the sea floor, resulting in reducing conditions.

The nature of the occurrence of glauconite in the Lion "countain sandstone suggests that the glauconite was concentrated in some manner after its original formation. Concentration might have been brought about by short movement or transportation on the sea floor, aided possibly by subelevation and removal of the finer sediment.

Lion 'ountain - Welge contact

Cloud and Barnos (1948, p. 343) refer to the Lion "ountain - Welge contact as a disconformity. This apparently sharp stratigraphic contact can be observed in the Dess-Jorth area. The nature of the contact indicates a possible interruption of deposition, or a rapid change in rate and type of deposition. Although the smooth, even nature of the contact does not suggest an erosion surface, a fairly long time interval may be represented. At the end of Lion Jountain time, a temporary base level of aggradation was probably either reached or closely approached, resulting in nondeposition or very slow deposition.

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Point Peak deposition

In the thosis area and in the adjoining Squaw Creek quadrangle, a shallowing and warming of the seas occurred in Point Peak time earlier than in most of the other areas of the Llano region. This is indicated by the early appearance of the thick bicherm zone in this area. The zone or zones vary considerably in stratigraphic position, thickness, and number, suggesting local control of shealing.

The amount of terrigenous material present in the water appears to be a major factor controlling growth of bioherms: a reduction in the terrigenous supply results in clearer water and in maximum growth; an increase in supply results in deposition of shale and siltatone. Of course the amount of terrigenous material is itself controlled by various factors such as distance from source area, height of source area, carrying capacity of streams at source area, and marine currents.

Cloud (1952, p. 2146) stated that the filamentous structure of the Upper Cambrian bioherms in central Texas is strongly suggestive of the calcium-precipitating and sedimentbinding blue-green algae which do not form large structures below about 30 meters of sea water. Because the very large bioherms in the Camp San Saba area of "coulloch County rest in most places upon intraformational conglements, water considerably shallower than 30 meters is indicated for maximum bioherm growth. However, in the Dess-North area the observed bioherms apparently rest upon

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chale in most places, and shale deposition does not particularly indicate shallow water conditions.

San Saba deposition

The stratigraphic position of a thick bioherm zone in the lower part of the San Saba linestone of the Doss-North area indicates a general shallowing of sees in that area during early San Saba time. Barnes and Bell (1954) reported the occurrence of thick bioherm zones in the lower portion of the San Saba member in the Camp San Saba and Calf Greek areas in the northwestern part of the Llane uplift. Apparently the water was too deep and cool in the eastern part of the uplift for the formation of bioherms during San Saba deposition.

Arkosic conglomerate deposition

In the Doss-North area, arkosic conglomerate was deposited upon the pre-Cretaceous erosion surface either before or after the Lange's Will conglomerate. Subsequent erosion removed all but the most indurated parts of the arkosic conglomerate. The microcline content of the conglomerate indicates the source of sedimonts as uncovered Precambrian igneous rocks. The presence of basal Crotaceous rocks resting directly on Precambrian rocks in this region verifies the fact that Precambrian rocks were exposed sometime during post-Pennsylvanian and pre-Cretaceous time. und a far and share in the second state and a second state and a second state of the second second second second

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TOOTOTEC STOLOGY

Ground-water is the nest imperiant geologic resource of the Dess-North area. In the southern portion of the area the main easily available source of water is the Pretaceous conditions unit (Hensell sand). The Lion Nountain sandatone and possibly the Weige sandatone provide the main water aquifers in the middle part of the area, and the Hickory conditions provides water in the extreme northern part. The Lange's 'ill spring, which is reported to flow 300 gpm, issues from the Lange's 'ill conglementate. At Dess, the town well is reported to be 740 feet deep (Barnes, 1952) and undenbtedly produces water from Taleconic rocks.

A caliche pit located in the north-contral portion of the area has provided large amounts of secondary-road surfacing material.

Soils are used mostly for grazing and limited cultivation of crops. Nost of those that are cultivated are derived from basal Cap Nountain limestone, Lion Nountain sandstone and Cretaceons sandstone.

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APPENDIX



MEASURED SECTION

Section of the Wilberns formation measured along the east bank of Threadgill Creek and a small tributary, from a point about 0.3 miles due east of Cyrus Heard's ranch house to a point about 0.6 miles due east of Lange's Mill, Gillespie County, Texas

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Thickness Feet above
in feet base
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Wilberns formation

San Saba limestone member

- 25. Limestone: Light brown weathering to yellow mottled surface, thin-bedded, wery fine grained to sublithographic, and sparsely glauconitic. Occasionally there are thin beds of intraformational conglomerate; one is at 570.3 to 570.5 feet. The top of this interval marks the contact with the Threadgill limestone, the contact was picked between the last occurrence of glauconite and the first appearance of <u>Lytoppira</u> and <u>Ophileta</u>.....17 554-571
- 24. Limestone: White to light brown, thinbedded coarsely granular to sublithographic, and very glauconitic to

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and greensih-gray, medium- to massive-bedded, slightly glauconitic, fossiliferous to nonfossiliferous limestones, and thinner beds of green, glauconitic siltutones, from 462
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to 455 feet occur brown, dense, nonfossiliferous limestones and greenish-gray to brown, "hashy", glauconitic limestones; at 445.5 feet to 447 feet, greenish-gray to greenish-tan, crossbedded, coarsely-crystalline, fossiliferous and very glauconitic limestone; at 459 to 455 feet, green siltstone. From 455 to 459 fest occurs brown, massive, crystalline, very slightly fossiliferous limestone, and from 459 to 460 feet, green, glauconitic siltstone. From 460 to 469 feet. occurs greenish-brown to purplish-gray, finely crystalline. slightly glauconitic limestone with occasional inter-layered beds of green. 442-469

monallinger and moral size fag. At or "dealer lines of your labour our denstants. belows thread is some mate as second -more different as an and the trail acordin (received and Line of the Jug vaca . An algor The fort that to see wheel dispagadely the tont the or all with , mathing moves , tool all an estimate to present and anote soil and one topic thereast to crat without is rain station to the test, arony around the HERDON . FORT THE OR ON PRICE . ADDITING provider applaule to ethicate applateration when the second interest interest ber of many · • tory-detabling induration has been weet

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19. Limestona: Greenish-brown to cream, thinto thick-bedded, sometimes cross-bedded, fine to coarse, granular, componly glauconitic. The beds vary considerably in thickness and beds 3 to 4 inches thick sometimes comprise layers 1 foot thick. In places there are extremely glauconitic beds 1 inch thick. Cream-colored, fairly thick "hash" beds commonly show much cross bedding. An intraformational conglomerate 6 inches thick occurs just below 402 feet. From 402 to 408 feet surface of beds shows rather prominent cross-hedding. Above 408 feet there occasionally occur thin beds of coarsely-granular, glauconite "hash" 30 388-418 18. Limestone: Yellowish-green gray to light cream, thin bedded, finely crystalline

to sublithographic and slightly glauconitic. Beds generally range from 1/4 to 1 1/4 inches thick, with z few beds ranging up to 6 inches thick. From 356 to 379 feet beds weather to a knobby.

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- 16. Limestone: Grayish-white to buff or cream, thin bedded, hard, solid, and sublithographic. Some thin beds of limestone intraformational conglomerate occur between 312 and 332 feet. A few beds of white, crystalline limostone are present. The contact with the Point Peak shale was placed at the first predominance of hard tan, sublithographic limestone. . . . <u>32</u> 300-332 Total thickness of San Gaba measured 271

Point Peak shale member

 Limestone and siltstone: Gray-brown, thinbedded, crystalling limestone with interbouded,

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stones, and light-gray shale. Deds of silt-

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- 11. Limestone and siltstone: Light-gray to light-brown, fine-grained limestone, and gray-green calcareous siltstone. The limestones are thinly bedded and argillaceous. An intraformational conglomerate occurs in the middle of this interval. 7.5 160.5-188

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Morgan Creek limestone memoer

9. Limestone and siltstone: Light-tan to greenish-gray, fine- to medium-grained. generally "hashy", glauconitic, limestones, and grayish-green, micaceous siltstones. Beds of Loorthis "hash" 1 to 2 inches thick and interbedded with siltstone occur from 142 to 147 feet. A light-tan, gedium-bedded, crystalline. "hashy", glauconitic limestone is present 140-148 8. Limestone and bioherms: Whitish-gray to greenish-gray, brown stained on surface, fine- to medium-grained, occasionally silty, glauconitic limestone, and small bioherms about 1 to 3 feet in diameter. Limestones have a platy appearance on weathered surface. Bioherms occur from 118.5 to 120 feet, 130 to 132 feet, 134 to 135.5 feet and 138.1 to 138.5 feet, and weather as gray, rounded knobs on limestone

PRIME CONTRACT COMPANY of main of the constantion and sectampile of 「おおおまたはいーあい」と呼ば、スターー語語語を「「なおもと・ほど」でいってい woodil indifferentiate Predently Classifier all a caster anazy-entrent one beserer interesting the second to make the training ditty tonnastant the dout bet at 1 of A lines to be SHE Bers when anotherits Antikitaravya, ashanjendinat, raffatat (main in particular to the second process in the second - THE ME DE CONTRACT 44000 ST THE . rotation of the state and the the second grate risks and the second anti tin o arradoid · jorabio, reselimes ar was some and he with some and an Art LAL . 1901 L. LOS OF L. SOF ONE LOOK A. THE weerconst is break falladere. fart is siderar

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- 7. Limestone and siltstone: Alternating beds of greenish-gray, up to 1 foot thick limestones, and gray siltstones. 10 97-107
- 5. Limestone: Whitish-gray to gray, fine- to coarse-grained, thinly-bedded limestone.
 Beds alternate from 1 to 6 inches thick.
 Weathered limestone gives platy appearance.
 There is much trilobite "hash" in the highly glauconitic limestone near top. Also near the top there are concentrations of calcite crystals, some 1/4 inch across. Possible
 <u>Ecorthis</u> fragments from 58 to 60 feet. . . . 16 46-62
 4. Limestone: Gray to grayish-white, yellow stains on surface, some thin purplish beds,

medium- to coarse-grained, highly glauconitic

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Welge sandstone member

1. Sandstone: Orange to tan, massive and

partly cross-bedded, fairly evenly sorted,

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GEOLOGIC MAP AND CROSS SECTION OF THE DOSS-NORTH AREA, MASON AND GILLESPIE COUNTIES, TEXAS