feet of thin- to thick-bedded quartz-peb-

ble conglomerate and fine- to medium-

grained sandstone with silty marl inter-

beds. The upper half of the Cox typically

forms prominent escarpments, and in

many of the outcrops the rocks are

colored dark brown or black by desert

varnish. The lower part weathers to a

terrain of low relief overlain by red-

brown residual soil. Cox-derived soil

typically supports a profuse growth of

lechuguilla, the nemesis of west Texas

geologists. Cox Sandstone blocks occur

also in collapse structures along with

imestones of younger Comanchean for-

The age of the Cox Sandstone in the

Kent quadrangle is uncertain. At the

type locality, near Sierra Blanca, the

upper part has been correlated with the

Fredericksburg Group of central Texas.

ence of Exogyra and Engonoceras in a

fairly persistent limestone about 100 feet

below the top of the formation. This

limestone, and its contained fossils, is not

present in the Kent quadrangle. In north-

eastern Chihuahua, Mexico, the basal

part is correlated with the Trinity Group.

Between these geographic extremes, the

age of the basal part of the Cox is un-

certain, but tongues of a Cox-like sand-

stone occur within the zone of Orbitolina

SIXSHOOTER GROUP

Boracho Limestone, and the Buda Lime-

Finlay Limestone (Kf)

The Finlay Limestone (Richardson,

(Drake) ranch headquarters.

blocks in collapse features.

Gryphaea mucronata Gabb

Ostrea crenulimargo Roemer

Lunatia pedernales (Roemer)

Enallaster texanus (Roemer)

Holectypus planatus (Roemer)

(Marcou)

Oxytropidoceras aff. O. belknopi

The Boracho Limestone (Brand and

abandoned) on the Texas and Pacific

Point, 2 miles west of Boracho Station.

Levinson Limestone Member (Kbl) .-

The name Levinson (Brand and DeFord,

1958, p. 379), derived from Lake Levin-

map area, crops out in the base of the

escarpment south of U. S. Highway 80 New Mexico.

Exogyra texana Roemer

east of Sierra Blanca.

This correlation is based upon the occur-

1 Professor of Geology, Texas Technological Col-

² Professor of Geology, The University of Texas, INTRODUCTION Study of Permian, Cretaceous, and Cenozoic rocks in the 30' Kent quadrangle is important to an understanding of the geology of Trans-Pecos Texas. Most of the Cretaceous rock units of central Texas lose their lithostratigraphic identity when traced into west Texas. The Kent quadrangle, astride the Diablo Platform, is one of the critical areas of intervening stratigraphy between central Texas to the east and the geosyncline

in Mexico to the west and southwest.

Permian units have been studied exten-

sively in areas of outcrop in west Texas and stratigraphic relationships of the Permian beds are fairly well known. Likewise, subsurface Paleozoic units within the Delaware basin are well known. To the southwest, beyond the margin of the Diablo Platform, surface and subsurface Permian rocks are incompletely known. It is hoped that a study of the younger rocks in the latter area might reveal characteristics which will possibly reflect late Paleozoic tectonic elements. The accompanying map, covering the area bounded by 104°00' and 104°15' west and 31°00' and 31°30' north, is the first of a series of areal geologic maps of the region. Adjoining areas are currently under investi-

gation by several workers. The Kent region is arid; numerous intermittent streams, the largest of which are Cottonwood Draw, China Draw, Salt Draw, San Martine Draw, and Hurd Draw, drain the area, Cottonwood Draw (King, 1949) rises west of the Kent quadrangle and flows eastward across the Gypsum Plain (Richardson, 1904, p. 22); its course lies mostly outside the map area. Salt Draw and China Draw also rise in a gypsum terrain and trend eastwardly through the central part of the quadrangle. Hurd Draw and San Martine Draw rise in the Davis Mountains. Cottonwood Draw discharges into the Toyah basin but does not reach the Pecos River. The others ultimately discharge into Toyah Lake southeast of Pecos, about 45 miles northeast of Kent, and the overflow from the lake enters the Pecos River. Thus the Toyah basin

Most of the annual rainfall of 13 inches occurs as thunder-showers during the summer months; immediately following heavy rains, stream channels flood to a

depth of several feet. In the central part

the hills on the west and south, and

of the area, Salt Draw debouches from

is a "semi-bolson" (Tolman, 1909, p.

runoff from a heavy rain crosses the flatthe area. Much of the pasture land has suffered extreme erosion mainly because of improper range management. Except in well-managed areas, where range grasses abound, vegetation typical of Trans-Pecos Texas prevails. It is characterized by Acacia and Mimosa including catclaws and straight-spined species, by Opuntia including prickly pears and chollas, by several species of Yucca, and by lechuguilla (Agave). These are associated with jointfirs (Ephedra), ocotillo (Fouquieria splendens), allthorn (Koeberlinia spinosa), creosote bush (Larrea tridentata), and other plants. Some of these are gypsum tolerant and manage to survive on the gypsite. Gyp weed (Coldenia hispidissima) and the four-oclock (Anulocaulis gypsogenus) thrive on the gypsite.

PHYSIOGRAPHY AND STRUCTURE

The physiographic features of the area are related to major structural features which cojoin within and extend far beyond its borders. The five major physiographic features are: (1) the Davis Mountains front, (2) the southeastern end of the Apache Mountains, (3) a part of the Toyah basin, and (4) the

Within the area are several smaller structural features which, although of considerable magnitude locally, are areally smaller than those that control the major physiographic features; these include (1) the Rounsaville syncline, (2) the San Martine dome, (3) the Stocks fault, and (4) the collapse fea-

DAVIS MOUNTAINS The northern part of the Davis Mountains is composed of tuff and lava and forms a large broad mesa with a southerly dip. The northern front of this cliff. Like both the Seven Rivers and the range is an escarpment bounded on the Yates, the Tansill exhibits pronounced north by a broad pediment, which is lo-reef and backreef facies. The Tansill, cally veneered by thin beds of Quater- however, contains less sand in the backnary gravel. The northeastern front is a reef than the Seven Rivers and Yates, fault-line scarp. The mountains are and the conspicuous difference in the reef capped by thick layers of Tertiary rhyo- and backreef facies is in thickness of lite, and the lower slopes are underlain individual beds. In the backreef, beds by relatively non-resistant beds of Tertiare 1 to 2 feet thick; in the reef they ary tuff and Cretaceous (Gulfian) marl. are 20 or more feet thick. A complete Considerable talus has accumulated on section of 75 feet of backreef facies is a characteristic ridge-and-gully topograthe lower slopes, and large toreva blocks occur in several areas along the northern Rounsaville syncline in the prominent front. The highlands of the Davis Mountains extend only into the southeastern corner of the map area, where Newman the reef facies are lacking because of is concealed beneath colluvium or Qua-Peak (6,400 feet) and Gomez Peak (6,325 feet) are prominent features. Gomez Peak is a north-projecting salient

APACHE MOUNTAINS Only the southern end of the Apache

form the lower slopes.

of the Davis Mountains front. Viewed

from the north, it presents a conical pro-

file; the apex is formed by 1.100 feet of

rhyolite. Below the cap, landslide ma-

terials, slide rock, and gravel deposits

Mountains is included in the map area; part of the western half of the Kent quadrangle. The Apache Mountains, like the Guadalupe Mountains 50 miles farther north, consist mainly of Permian reef limestone, and the fronts of both ranges face the Delaware basin. The orderly transition from reef facies, few small sinkholes and in small soluthrough forereef facies, and thence into tion valleys. Elsewhere the presence of basin facies, so conspicuously evident in the Castile in the subsurface is indicated the Guadalupe Mountains, is not seen in the Apaches. The Apache front, frequently called the "reef front," is a scarp on the upthrown side of the Stocks fault. Most of the Apache forereef and all of the basin equivalents are concealed in the subsurface on the downthrown side The southern slope of the Apache

Mountains, topographically less conspicuous than the northern or "reef front," is formed by southerly dipping beds of the Tansill Formation which pass beneath Cretaceous strata in the flat area south of the mountains.

DELAWARE BASIN AND The Delaware basin lies northeast of the Apache Mountains. The present basin margin is nearly coincident with the Diablo Platform-Delaware basin margin of Permian time. The basin and platform are of contemporaneous origin: subsurface findings indicate that the

Diablo Platform is bounded on the northeast by reverse faults of late Pennsylvanian or early Permian age. All the northern half of the 30' Kent quadrangle is within the Delaware basin. The Toyah basin, which is a physiographic feature, coincides with the southern part of the Delaware basin, which is a tectonic feature. The Toyah basin is bounded on the west by the Rustler Hills, whereas the Delaware basin extends much farther west.

RUSTLER HILLS The Rustler Hills (Richardson, 1904, p. 22 and Pl. 1) extend southward from New Mexico as a belt about 5 miles wide and 50 miles long into the northern half of the Kent quadrangle, where the southern end of the hills has the shape of a horseshoe open to the east. The two heels of the horseshoe are shown on the map, but the closed end or toe is off the map to the west. The southern prong of the horseshoe is an anticline whose southwestern limb is the northeastern limb of the Rounsaville syncline. Well data indicate that an east-trend-

ing anticline plunges eastward through the northern part of the map area, but it has no topographic expression, unless it is obscurely related to the trend of Cottonwood Draw and to the horseshoe shape of the Rustler Hills. ROUNSAVILLE SYNCLINE AND

The name Rounsaville syncline has

never been formally proposed, but use of

the name has been commonplace by

geologists of The University of Texas for

nearly fifteen years. The name is for the Rounsaville family, the present owners of The syncline parallels the northeastern mouth of Limpia Canvon to near the southeastern margin of the map area. It continues northwestward into the Kent quadrangle where it parallels the north front of the Apache Mountains. The southwestern limb of the syncline terminates against the Stocks fault. In the east-central part of the map area, northeast of and probably genetically related to the Rounsaville syncline, lies the San Martine dome. The long axis of the dome passes through "Flat

pletely known, but recent exploratory wells indicate that closure in the subsurface, below the top of the Delaware Mountain Group, is less than the surface The northwestern extension of the San Martine dome is problematic inasmuch as blocks in the collapse features are inconclusive.

randomly oriented and the evidence is The Rounsaville syncline, San Martine dome, and Stocks fault are probably related in origin, Laramide folding, block faulting, and gravitational sliding of Permian (Ochoan) anhydrite down the steep slope at the margin of the Delaware basin possibly combined to produce the structure.

STOCKS FAULT The name Stocks fault is proposed for the fault which parallels the northeast front of the Davis Mountains and continues into the Kent quadrangle where it has produced the scarp of the Apache Mountains front. The southern limit of the fault is not yet established, but it is known to extend northwestward along the Apache Mountains front to near Seven Heart Gap at the northwestern extremity of the Apache Mountains, Maximum throw along this fault is not known, but the greatest displacement is probably adjacent to the Apache front just west of the map area. Near Lake Levinson, in the south-central part of the area, the throw is in excess of 1,100 feet. Farther southeast, off the map area, preliminary studies indicate a displacement of approximately 500 feet.

COLLAPSE STRUCTURE

Solution of Castile Gypsum has produced several large collapse features in the central and northern parts of the map area. These are probably local elements of the regional depression beneath the Pecos Valley (Maley and Huffington, 1953). Within the area of collapse, stratigraphic differentiation is difficult as all post-Castile units occur in random association. Failure to recognize the collapse leads to erroneous structural interpretations. The exact date of the major collapse is not known. The silt, gravel, and gypsite of the Gatuña Formation have of the map area. The Cox rests on the filled some of the initial depressions, and siltstone member of the Rustler, but post-Gatuña Quaternary beds overlie northward beyond the map, it rests on Young (1958) has described an inter- the Davis Mountains has been used as

truncated collapsed units. Probably the age of the major collapse is pre-Gatuña; perhaps the dissolving of the gypsum began late in the Tertiary Period after the regional uplift that accompanied the block faulting farther west. The profusion of faults of low displace ment in the vicinity of Davis Mountain Station can probably be attributed to solution of the Castile Gypsum. Undoubt-

central portion of the area.

edly, many similar faults are concealed

beneath the alluvium in the flat in the

STRATIGRAPHY King's (1949) regional geologic map includes the Kent quadrangle. DeFord's students (DeFord, 1956; Hay-Roe, 1957) have divided the Guadalupian rocks into three formations, introducing the names Seven Rivers, Yates, and Tansill from the Permian basin of west Texas and southeastern New Mexico. The Ochoan rocks are also divided into three formations, bearing the standard Delaware basin names Castile, Rustler, and Pierce Canyon. Brand and DeFord (1958) divided the Comanchean rocks into formations and members. The Gulfian beds and the Tertiary volcanic rocks have not yet been completely classified. The post-volcanic basin fill is called Gatuña, a name introduced from southeastern New Mexico, and two of the widespread pediment

gravels are called Bigtank and Gozar. PERMIAN SYSTEM GUADALUPIAN SERIES

Seven Rivers Limestone (Psr) The Seven Rivers Limestone (Lang, 1937, pp. 860-863) crops out in the Guadalupe Mountains and in the Wylie Mountains (Hay-Roe, 1957). The proximity of the Apache Mountains to the Wylie Mountains and the similarity of facies relationships between the Apache and the Guadalupe Mountains provide the basis for the use of the term Seven Rivers in the Kent quadrangle. The base of the Seven Rivers Lime stone is not exposed within the map area. The uppermost 200 feet crop out in the upthrown blocks of several of the northwest-trending faults northeast and north of Kent. The upper 500 feet of the formation (DeFord, 1956, pp. 16-18) is

1904, p. 47) in the Kent quadrangle consists of a maximum of approximately 40 feet of sandstone, arenaceous limestone, exposed in the canyon of Hurd Draw and coarse-grained massive limestone. Outcrops of the Finlay parallel the outjust west of the map area. Three distinct facies occur within the crops of the Cox Sandstone, on which it lies unconformably. The best exposures Seven Rivers: (1) a forereef facies, consisting of reef talus; (2) a reef facies, of the Finlay are in the low escarpment approximately a mile north of U. S. consisting of massive beds of limestone and dolomite: and (3) a backreef facies. Highway 80. In all exposures, the basal

consisting of thin- to thick-bedded limefew feet contain several thick-bedded stone. Only the reef facies is well ex- fossiliferous sandstone beds which conposed. Most of the forereef is on the tain a profusion of Ostrea crenulimargo downthrown side of the Stocks fault and Roemer and Gryphaea mucronata Gabb. ter terrain on the east and inundates the the backreef beds pass beneath the Yates The upper part contains thin to McCutcheon units, but detailed correlaflood plain with water several feet deep. Formation to the south. Within the reef, thick-bedded coarse-grained, fossiliferous tion with the various formations of the White) and Pecten (Neithea) duplicifossils, but several thin beds of wellpreserved individuals and, in places, relimestone, whereas Oxytropidoceras aff. mains of sponges practically make up the rock. Several strata contain a pro-O. belknapi (Marcou) is abundant near fusion of the fusuline Polydiexodina. The Finlay Limestone thins to the Yates Formation (Py)

> Yates oil pool, Pecos County, Texas, extends through the subsurface of the Permian basin and, like the Seven Rivers, crops out in the Guadalupe Mountains. In the Apache Mountains exposures of the Yates are nearly colinear with those of the Seven Rivers, which it conformably overlies. The Yates, like the Seven Rivers, is poorly exposed within the map area. West of Hurd Draw, and approximately 3 miles west of the map area, the Yates Formation is 260 feet thick. There, the formation contains the maximum observed quantity of sandstone in the area. Northward, sandstone is less abundant and the total thickness is about 140 feet. In the canyon of Hurd Draw, the reef facies of the Yates is 200 feet thick. The backreef facies of the Yates crops out in the southern part of the Apache Mountains and the reef facies, near the north front of the range. The backreef consists of thin- to thick-bedded

sandy limestone and thin to massive sand-

stone layers. Within the reef facies the

The Yates Formation, named for the

limestone beds are massive and sand-Tansill Limestone (Pt) The Tansill Limestone (DeFord and Riggs, 1941, pp. 1713-1728) is widely distributed in the southern slope of the Apache Mountains, where it caps the south-dipping back slope of the range. The relatively flat summit of the mountains is capped by the Tansill Limestone. The most prominent exposures are in the north front of the Apache Mountains, where the Tansill forms the high, steep exposed in the southwest limb of the

escarpment a mile and a half northnorthwest of Kent. Complete sections of OCHOAN SERIES Rocks of late Permian (Ochoan) age are restricted to the Delaware basin. The Castile Gypsum, the Rustler Limestone,

and the Pierce Canyon Formation are exposed in the map area; the Salado Salt is not present.

Best exposures of the Castile Gypsum where the lower, shaly part is well formed the northeastern front of the (Richardson, 1904, pp. 43-45) are in the western half of the Kent quadrangle and the upper, limestone part is exposed within the "gypsum plain" and in the in the lower slope of the hill. The princiescarpment at the western extremity of the Rustler Hills. Few if any measurable outcrops are covered by slump or alluvium. Outcrops may be found only in a posits along Cottonwood Draw in the northwestern portion of the area were formed by erosion, transportation, and redeposition of the gypsum. An accurate

thickness of the Castile Gypsum can be obtained only from deep wells. Rustler Limestone (Pr) The Rustler Limestone (Richardson, 1904, p. 44) is well exposed east of Rustler Springs, about 10 miles north of the northwestern corner of the map. There the Rustler is composed of, in descending order, a gypsum member, the Culebra Limestone member, and a 100foot siltstone member containing beds of dolomitic limestone and gypsum (De-Ford, 1956), Walter (1953) described Permian fossils from the Culebra and the siltstone members. Southward, the two upper members are replaced by a thick dolomitic limestone that caps the Rustler Hills where they assume the shape of a shoe within the map area are composed of this dolomitic limestone. The under-

lying siltstone member is not exposed here, but it crops out in the northwestern quarter of the map area. The Pierce Canyon Formation (Lang, 1935, pp. 262-270) crops out only at Red Point, a prominent north-facing escarpment 10 miles north-northeast of Kent. The base of the formation is not exposed; in the subsurface it rests on the Rustler Limestone, A small exposure near the Yearwood (Drake) ranch headquarters, assigned to the Rustler, contains interbeds of red-orange siltstone which

are similar to the typical Pierce Canyon At Red Point the Pierce Canyon consists of about 140 feet of reddish-orange to reddish-brown siltstone and quartzose sandstone. Interbedded with the typical red strata are numerous thin beds of silty clay which contain gray-green reduction spots. These, along with fairly continuous thin gray-green silty clay beds, have been described by Miller (1957, p. 177). Other aspects of the Pierce Canyon have been studied by Miller (1955a, 1955b) and Miller and Folk (1955).

> CRETACEOUS SYSTEM COMANCHEAN SERIES

Spectacular exposures of Comanchean beds in a homocline that dips about 21/2° southward extend from east to west across the southern part of the Kent quadrangle roughly parallel to U. S. Highway 80. The cuestas of Cretaceous rock are between the Davis Mountains front on the south and the Apache Moun-

the flanks of the Rounsaville syncline

Tearwood Formation (Kyl) and (Kye)

to the southern part of the map area,

carpment a mile and a half north-

northeast of Kent and in the flat area

adjacent to the south slope of the

Apache Mountains. The Yearwood con-

with a sporadically distributed basal

The upper or limestone part of the

Yearwood, up to 110 feet thick, consists

of thin- to thick-bedded light gray lime-

stone with calcareous shale interbeds. It

conglomeratic part. The limestone is

sparsely fossiliferous; only poorly pre-

served algal remains, sporadic Chara

oogonia, and several poorly preserved

In the vicinity of the type locality

(Drake) ranch headquarters, the basal

1.2 miles southwest of the Yearwood

conglomerate, up to 55 feet thick, con-

tains rounded to subangular quartz

pebbles and cobbles in a matrix of fine-

characteristic is the scattered limestone

pebbles and cobbles that contain species

of the late Guadalupian fusuline genus

Polydiexodina. Fragments of petrified

wood attest the proximity of land dur-

ing time of deposition. In areas away

from the type locality the basal con-

glomerate is thin, absent, or represented

Cox Sandstone (Ke)

p. 47) unconformably overlies the Year-

wood in the southern part of the area.

Northward it overlaps the Yearwood and

oversteps the Pierce Canyon Formation

and the Rustler Limestone. The over-

stepping is a surface reflection of the

subsurface anticline in the northern part

The Cox Sandstone (Richardson, 1904,

to medium-grained sandstone and cal-

gastropods have been found in it.

is more widely distributed than the lower

sists of as much as 160 feet of limestone

where it crops out in the prominent es-

The Yearwood Formation is restricted

and to areas of collapse.

the slopes of the inface are formed by grained quartizitic sandstone containing the Boracho Limestone, A lower escarpand quartz pebbles. Above the basal sand ment north of U.S. Highway 80 is capped layers of the lower part, the limestone is similar to the upper part of the under-Cox Sandstone forms its inface. lying San Martine Limestone Member. The Buda, Boracho, and Finlay make In areas where the sandstone is absent, up the Sixshooter Group; the basal the base of the Buda is established with unit of the Cretaceous in the area is difficulty. The middle part of the Buda called the Yearwood Formation. consists of about 60 feet of thin- to thick-South of the high escarpment capped bedded argillaceous limestone. The upper by the Buda Limestone is a broad pedipart contains about 40 feet of thin- to clay and marl. ment that records the retreat of the Davis thick-bedded limestone; fragments ring Mountains front; the many linguiform when struck by a hammer. terraces mark the presence of Gulfian surface and subsurface expressions of the clay or marl beneath the gravel-covered fossiliferous. Numerous samples of the contains a considerable amount of gypgastropod Nerinea volana Cragin and Cretaceous exposures north of the the pelecypod Pecten (Neithea) roemeri Texas and Pacific Railroad are limited to (Hill) may be obtained from bedding

> cuestas, and species of the ammonite Budaiceras are characteristic through-Differentiation of Buda and San Martine blocks in areas of collapse is extremely difficult because of similar appearance, random orientation, absence of the basal conglomerate, and Quaternary cover. The symbol Kbus designates collapse blocks, the position of which is not necessarily indicative of regional structural or stratigraphic re-

GULFIAN SERIES Rocks of Gulfian age are mostly limited to the southern half of the map area. They crop out at several places in the slopes of Gomez Peak, in the trough of the Rounsaville syncline, and in the walls of stream channels south of the cuestas near U. S. Highway 80. Several small outcrops have been found in areas of collapse in the central and northern parts of the map area. Only the basal formation of the Gulfian Series, the Boquillas Limestone, is sufficiently homogeneous and well enough exposed to be a practical cartographic unit in the area. The overlying Gulfian units, consisting mainly of clay and marl, are not differentiated and are designated Kg on

Flaggy beds assigned to the Boquillas Limestone (Udden, 1907, pp. 17, 19-23) crop out in several places south of U.S. Highway 80 and in the slopes of Gomez by sporadic quartz pebbles. Brand and Peak. Because of low resistance to DeFord (1958, pp. 373-376) named the erosion, most outcrops are poor and formation and discussed its age and cor- covered with rubble. The best exposure in the area is in Gold Hill 31/2 miles south of Davis Mountain Station (junction of U.S. Highways 80 and 290). There, nearly 200 feet of the formation is exposed. In the Gold Hill section, the basal 100 feet contains the typical flaggy, dark grayish-orange, silty limestone beds. The upper 100 feet contains thinto thick-bedded flags of sandy limestone interbedded with marl and calcareous shale beds up to 6 feet thick. The Boquillas is fossiliferous, but most of the fossils are poorly preserved. from the Tertiary of the north front of

Boquillas Limestone (Kbo)

esting group of ammonites from the vounger Rustler and on Pierce Canyon, as shown by Wilson, Tunnell, and Hall base of the Boquillas Limestone 5 miles southeast of the southeast corner of the map area. These are: The Cox consists of as much as 170

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occur above the following: Metoicoceras cf. M. bösei Jones Probable Turonian ammonite, which *Utaticeras? n. sp. (?) *Watinoceras n. sp. Typoturrilites n. sp.

**O. davisense Young
**Neopulchellia brundretti Young All seven species occur together at base of Boquillas resting on Buda. *Slightly silicified, Late Cenomanian ammonites. **Thoroughly silicified, somewhat abraded, late Early Cenomanian

In the map area, a smaller assemblage of the same basal Boquillas faunule was collected from a slump block of Buda-Boquillas east of the Nevill ranch headquarters near the Culberson-Reeves County line about 2 miles north of the county road to Toyah. This block is in the southern part of the large area of collapse shown on the northern part of

texana in several areas south and south-Above the Boquillas Limestone are approximately 300 feet of marl, shale, and argillaceous limestone. This Gulfian unit has about the same age as the central The Sixshooter Group (Brand and Texas sequence that includes the upper DeFord, 1958, p. 378) consists of, in aspart of the Eagle Ford, the Austin, and cending order, the Finlay Limestone, the the Taylor, Most exposures of this unit are outside the map area, and, except stone. The Boracho Limestone is subor several small outcrops in the slopes divided into two members, the Levinson of Gomez Peak, the area contains few Limestone Member and the San Martine that have been precisely placed within Limestone Member. The name Sixshooter the unit. The large, linguiform areas of is derived from Sixshooter Draw, 31/2 Quaternary gravels are underlain by miles northeast of the Yearwood pediments cut upon Gulfian marl, but

the bedrock is concealed in most areas. TERTIARY ROCKS Rocks of Tertiary age in the map area include the volcanic rocks of the Davis Mountains, the Spring Hills, and the Rounsaville syncline; the basin fill of

McCutcheon Group The McCutcheon Group (Eifler, 1951)

the Toyah basin; the landslide debris on

ncludes lava, tuff, nonmarine lime-

stone, and conglomerate of the Barrilla within the map area are probably closely correlative and laterally continuous with limestone Toucasia patagiata (C. A. group has not been completed, Consequently, the Tertiary volcanic rocks of the map area are designated by the Eifler's McCutcheon Group consists,

in ascending order, of the Jeff Conglomerate, the Huelster Tuff with the north. In the north bank of Crow Draw, distinctive nonmarine limestone member, 11/4 miles east-southeast of the Nevill the Star Mountain Rhyolite, and the ranch headquarters, the Finlay is 15 feet Seven Springs Formation. The basal thick. Elsewhere in the central and Jeff Conglomerate has been traced northnorthern part of the map area, the ward along the northeastern front of the Finlay occurs only as randomly oriented Davis Mountains and thence westward along the northern front. No doubt it is Fossils are locally abundant in the present beneath the talus and landslide Finlay. The most characteristic megamaterial on the slopes of Gomez Peak and is overlain there by the Huelster Tuff. The Jeff crops out west of the map area in the slopes of Black Peak, a prominent landmark near the south western corner of the Kent quadrangle, Pecten (Neithea) duplicicosta Roemer and the nonmarine limestone of the Toucasia aff. T. patagiata (C. A. Huelster is well exposed there. The 1,100 feet of rhyolite that caps Gomez Peak and the rhyolite in the Spring Hills and in the other outcrops in the Rounsaville

Gatuña Formation (Qga) .- In the latter part of the Tertiary Period the Trans-Pecos region was uplifted. Block DeFord, 1958, p. 379) includes all strata faulting that accompanied the uplift between the underlying Finlay Limeproduced deep intermontane basins. The nearest of these, Salt Basin, is about 10 stone and the overlying Buda Limestone. The name is from Boracho Station (now miles west of the Kent quadrangle and about 25 miles west of the map area. Railroad, approximately 101/2 miles west The regional depression in the Pecos Valley on the east probably came into of Kent. The type locality is at Boracho being at about the same time, but it was ormed by solution and collapse rather than by block faulting. The deepest part is about 30 miles east of the map area. The depression is a hundred miles long son in the south-central part of the from south to north (Maley and Huffing-

syncline are probably Star Mountain

and in both flanks of the Rounsaville syncline. It also occurs in several hills in the vicinity of San Martine Station (now named the Gatuña Formation by Lang abandoned) on the Texas and Pacific Railroad and in the lower slopes of Goused as a general name for the body of mez Peak. Exposures in the northern part material that fills the vast depression. It of the area are limited to the collapse probably ranges in age from late Tertiary to early Quaternary. Escarpment exposures of the Levinson Within the map area the Gatuña is composed largely of highly weathered, coarse gravel derived from the Davis phy that reminds one of an inverted jello Mountains. The gravel grades into gypsite that was derived from the gypsum In most outcrops the boundary between outcrops on the west. Farther north, the Levinson and the underlying Finlay beyond the map area, the Gatuña consists largely of sand derived from the ternary gravel, but the contact is exposed in the north bank of Crow Draw near the farther away in the Pecos Valley de-

stones are common in the lower part of ossiliferous throughout, but the lower, Slide material (O1).-The moveshaly part contains more species than the overlying limestone. The most fossilifering of the Rounsaville syncline, which ous exposure in the map area is immedi- were probably contemporaneous with ately behind the schoolhouse at Kent, the regional uplift and block faulting,

scarp record earlier landslides, those

The slide material within the map

domly oriented masses of volcanic rock

derived from the cliffs of rhyolite above.

neath the younger terrace and pediment

QUATERNARY GRAVEL

The names Bigtank and Gozar are

Bigtank Gravel (Ob)

soluble constituents that were originally

present in the gravel. In most exposures

the thickness is only a few feet, but

slumping on the flanks of terraces gives

the illusion of greater thickness. The

Bigtank is the highest gravel in the area.

The linguiform outlines of the deposits

are prominent features on aerial photo-

Gozar Gravel (Ogg and Ogt)

The Gozar Gravel, like the Bigtank,

contains materials derived from the

ain by a caliche horizon, which attests

to removal by solution of original ma-

terials probably derived from Cretace-

ous rocks. Near the Tinnin ranch, in the

central part of the map area, the Gozar

Gravel contains the conspicuous Toy

Limestone Member (Qgt). Although the

Toy appears to underlie typical Gozar

The Toy Limestone Member is non-

marine, probably lacustrine. Megascopic

pellets with irregularly banded, more or

ically, it appears to be an algal lime

stone formed by colonies of algae which

belong to the green algae (Chlorophyta)

phyta). Insoluble residues are predomi-

or possibly to the blue green (Cyano-

Davis Mountains. It is likewise under

exposed in the walls of an artificial lake Davis Mountains. The thick rhyolite resistant to erosion than the rocks farpal guide fossils to the Levinson Member ther northwest atop the high uplift of the Apache Mountains. The more rapid retreat of this northernmost part of the Gryphaea navia Hall new escarpment, swinging around Gomez Oxytropidoceras acutocarinatum auc-Peak as a hinge point, created the torum (non Shumard) present north front of the Davis Mountains. Landslides were perhaps the most ervinquieria equidistans (Cragin) effective means of erosion and retreat. The slide remnants farthest from the

Nevill ranch headquarters. There, sand- pression, much of it consists of reworked

Other fossils including foraminifers and ostracodes are listed by Brand and area occurs on the slopes of Gomez DeFord (1958, p. 382). Peak. It consists chiefly of large, ran-San Martine Limestone Member (Kbs).—The upper of the two members of the Boracho Limestone, the San Martine Limestone Member, was named by Brand and DeFord (1958, p. 382) for exrounded hills of unassorted angula posures near San Martine Station on debris, which is up to 200 feet thick in the Texas and Pacific Railroad. The places. The oldest slide material near member forms the gentle slopes beneath the Buda Limestone cap on the high escarpment south of U.S. Highway 80. contains thin- to thick-bedded, hard, coarse-grained limestone which forms a distinct ledge sometimes called the middle cap-rock. Above the lower ledge, the upper part consists of about 230 feet of

proposed by DeFord (manuscript), and argillaceous limestone with thin calcathe name Toy is proposed herein. The San Martine Limestone Member is fossiliferous throughout. The basal 30 overlies truncated Gulfian marl. East of feet contains a profusion of echinoids; the area, the Bigtank overlies truncated on weathered surfaces there may be as many as 26 individuals in an area 18 of volcanic materials derived from the inches square. The upper part contains Davis Mountains. The presence of a several distinctive guide fossils: caliche horizon in the underlying bed-Leonites wintoni (Adkins) rock attests to removal or dissolving of

Paracymatoceras texanum (Shumard) Other fossils, including foraminifers and ostracodes, are listed by Brand and

Regionally the Del Rio Clay occurs directly beneath the Buda, but within the map area there is no outcrop of rock between the Boracho and the Buda that resembles the Del Rio. At Boracho Point in the western half of the Kent quadrangle, however, a sandstone bed that is lithically similar to the Eagle Mountain Sandstone of erosion in the Kent quadrangle.

(Gillerman, 1953, p. 31) of the Eagle Mountains and the Van Horn Mountains unconformably overlies the Boracho and conformably underlies the Buda. Brand and DeFord (1958, p. 385) suggested that this sandstone is the basal sandstone of the Buda Limestone. The time during which Del Rio sediments were being laid down elsewhere was probably a time The Buda is the cap-rock of the numerous high buttes and south-dipping cuestas in the vicinity of U. S. Highway 80. It likewise forms high cliffs in the lower slopes of Gomez Peak. In the northern part of the map area, the Buda occurs along with other Comanchean units in randomly oriented slump blocks Lithically, the Buda consists of three nantly silt-size quartz particles with distinct parts. The lower part is a lesser quantities of fine- to mediumcoquinoid and clastic limestone approxi- grained quartz sand. The maximum The highest escarpment is capped by the mately 40 feet thick. Locally, the base is measured thickness of the Toy Limerelatively pure Buda Limestone, whereas marked by hard, fine- to medium- stone is 16.5 feet in the low north-facing

> tion. The name is taken from the U. S. Coast and Geodetic Survey's triangula-W.) which marks the type locality. The Gozar Gravel (Qgg) is wide spread in the southern part of the map area in the drainage of Hurd Draw and San Martine Creek. It veneers wide pediments developed upon Cretaceous Along Cottonwood Draw in the northwestern part of the area, the Gozar lacks Both the middle and upper parts are materials from the Davis Mountains but from the "gypsum plain" on the west. Along Salt Draw the Gozar contains plane exposures atop the buttes and many fragments derived from the

> > f all streams of the map area contain deposits of fine-grained sand and silt with lenses of gravel, which for convenience have been grouped into a single unit. Detailed examination, however, reveals the presence of two distinct units which are separated by an unconformity. The lower unit is probably equivalent to the Neville Formation and the upper to the Calamity Formation of Albritton and Bryan (1939). Within the drainage areas of Salt, China, and Cottonwood Draws, the older alluvium (Neville) includes prominent gypsite beds. Detrital caliche is also characteristic of the older alluvium: it was derived from the caliche beds beneath the Bigtank or Gozar Gravels. These caliche beds and one within the older alluvium indicate several stages of caliche forma-

Alluvium (Qal)

MINERAL RESOURCES ROAD MATERIALS Limestones from the basal and upper

tion during the Quaternary Period.

parts of the San Martine Member of the Boracho Limestone and from the Buda Limestone have been used extensively as base course and as filler in black-top mix. Cox Sandstone has also been utilized locally for surface material on ranch roads and unimproved public roads. These materials are suitable for highways, and their use could be ex- but no large deposit of sulfur has tended to the limit of economical trans-BUILDING STONE

Extrusive rocks from the Davis Moun-

tains have been utilized for commercial, ranch, and public buildings. The hard. non-argillaceous beds from the Boracho and Buda Limestones appear to meet on the potential uses of the gypsum and requirements for building stone, but local demand has not yet developed. Banded limestone from the Boquillas PETROLEUM PROSPECTS Formation is used locally for ornamental The Paleozoic rocks of the Delaware stone. In the past, tuffaceous material

platform south of the Rounsaville syncline probably has less favorable prospects than the Delaware basin, but there, also, Paleozoic formations might yield oil and gas. Commercial quantities of oil from Mesozoic or Cenozoic rocks is Castile Gypsum. Several small pits have unlikely, although the first field which been dug in the Castile and in Quaterproduced oil from Cenozoic fill and nary gypsite along Cottonwood Draw, alluvium in west Texas was just east of the northeastern part of the map area. An index to surveys and wells accompanies the geologic map.

GROUND WATER Ground water is the most important resource of the Kent quadrangle, Sparse rainfall and periodic drought make surface supplies undependable even for livestock use. The Cox Sandstone is the best aquifer of the region. Water from it is widely used for livestock. The most favorable location for development of water from the Cox for irrigation purposes is near the Yearwood (Drake) basin yield oil and gas in many places, ranch near the axis of the Rounsaville

have been made in the map area. The mately 1,100 feet deep maintain a static water level of 150 to 160 feet below the surface. Inasmuch as the Cox crops out in both flanks of the Rounsaville syncline, a considerable recharge of ground water might be expected. The proximity of arable soil overlying Quaternary alluvium establishes the possibility of considerable future agricultural activity in this

> northern parts of the map area produce small amounts of water from the Rustler Limestone, Castile Gypsum, or from alluvium. They all yield highly mineralized water usable only for live A small quantity of ground water is produced from wells in volcanic rocks near the front of the Davis Mountains Some water is reported from wells drilled within the limit of the landslide material on the slopes of Gomez Peak; the aquifer is probably the Jeff Con-

> > glomerate. Between the Davis Moun-

tains front and the backslope of the

cuesta south of U. S. Highway 80, several wells produce from a relatively deep stratum, probably Cox Sandstone. Recently, the village of Kent drilled a water well south of town, but the location and producing formation are

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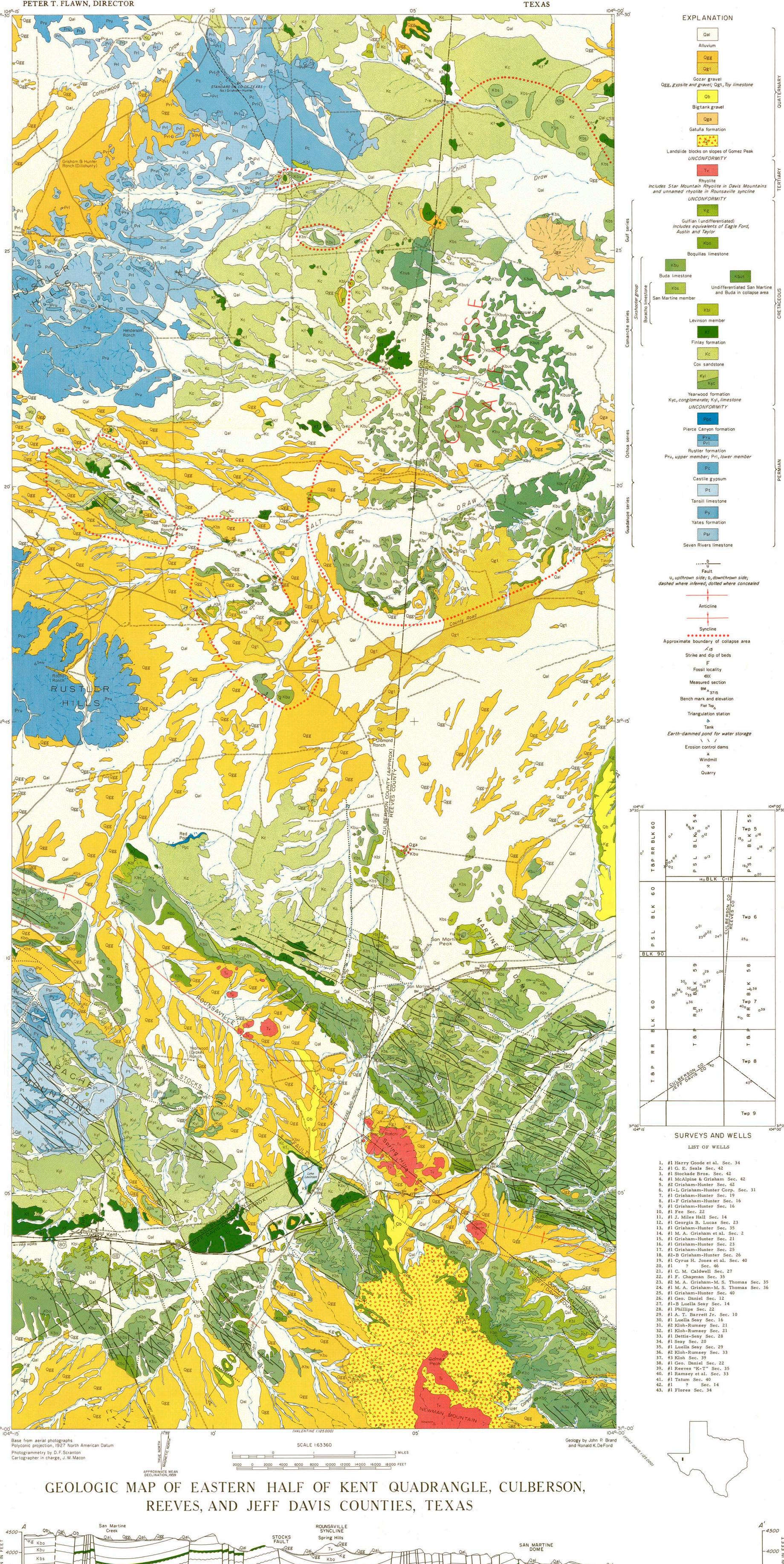
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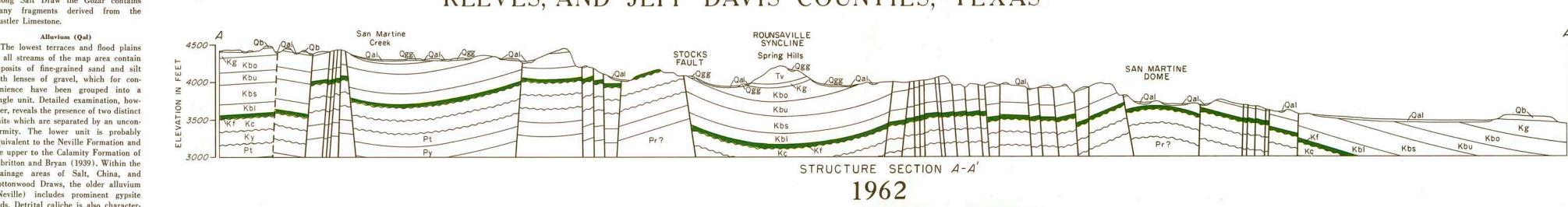
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QUADRANGLE MAP NO. 24

EASTERN HALF OF KENT QUADRANGLE



aggregate in lightweight concrete blocks. Near Rustler Springs, approximately 10 miles north of the map area, are several small sulfur prospect pits in the

been located. In recent years agricultural research has shown that gypsum, alone, is an excellent soil conditioner for highalkaline and high-saline soils. The Castile Gypsum as well as the gypsite deposits along Cottonwood Draw might be suitable as soil conditioner Evans (1946) discussed the geology of the Rustler Springs deposits and commented

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