THE GENERAL GEOLOGY OF THE FRANKLIN MOUNTAINS, EL PASO COUNTY, TEXAS

EL PASO GEOLOGICAL SOCIETY

AND

PERMIAN BASIN SOCIETY OF

ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

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TABLE OF CONTENTS

GENERAL GEOLOGY OF THE FRANKLIN MOUNTAINS

Mileage	Total Mileage	
0.0	0.0	Point of departure: north side of Memorial Gym on the northeast side of the University of Texas at El Paso campus (approximately Baltimore Drive and Oregon Street). Align cars to the east toward the Franklin Mountains on Baltimore Drive. Discussion on the Campus "Andesite."
0.1	0.1	Continue east on Baltimore Drive to one block beyond stop light (Mesa Street and Baltimore Drive). Turn right onto Stanton Street (Stanton parallel Mesa Street one block east) . Continue south five (5) blocks to University Avenue.
0.5	0.4	Turn left onto University Avenue.
0.9	0.4	Bear right onto Ange Street at 5-way stop Continue; turn left onto Rim Road.
1.1	0.2	Good view o f Kern Place Terrace dissected by erosion.
1.3	0.2	Kern Place Terrace.
1.7	0.4	**STOP 1.** Rim Road and Scenic Drive. Park and regroup. Scenic Drive Entrance Monument. Align yourself to be parallel to the entrance monument and face middle television tower on mountain crest (12:00). Cliff below southernmost tower (1:30) is the Upham Formation of the Montoya Group. The mottled medium- and dark-grey rocks on the southern crest dip slope are assigned to the Upham Formation. Below the "E" on the crest (1:30) the orange weathering beds are the upper-most Scenic Drive Formation and the overlying Florida Formation of the El Paso Group. Roadcut on crest of ridge (2:30) at contact between El Paso and Montoya Groups. Juárez Mountains largely composed of sediments of Cretaceous age are between 5:00 and 7:30. Complex structural features (thrusting, recumbent folds , etc.) of the range can be best observed from the American side in the early morning hours. the low range of hills (7:00 to 8:00 – smelter stack) are composed of the Campus "Andesite." Crazy Cat Mountain is a complex structure involving rocks ranging from Ordovician to Cretaceous in age (8:00 to10:00). It has been mapped and interpreted to be a dip-slip, gravity slide unit. White outcrops of Cretaceous (Comanchean) (Bed 9-Buda) in West Crazy Cat Canyon (just north of water reservoir) are observed to be topographically beneath the Lower Paleozoics (Montoya and Fusselman) that form the crest of the south ridge. W.S. Strain also noted presence of Comanchean Beds 7 (Main Street) and 8 (Del Rio) in canyon. White outcrop on nearby hill (11:30) is Aleman Formation of the Montoya Group.
1.8	0.1	Folded chert of Aleman Formation.
1.9	0.1	Upper El Paso (Florida Formation) and Montoya (Upham Formation) contact.
2.2	0.3	Scenic Point Murchison Park on right is faulted down to the south.
2.8	0.6	Police Academy Quarry (Victorio and Cook Formation s of the El Paso Group).
2.9	0.1	On left note contact between the underlying reddish brown Bliss Sandstone and the overlying El Paso Group.
3.1	0.2	Wheeling and Scenic Drive note lacustrine basin fill at left. Continue on Scenic Drive. Note lacustrine basin fill on left. Continue on Scenic Drive.

3.5	0.4	Stoplight . Turn left (Richmond Avenue and Alabama Street).
3.6	0.1	“A” on mountain to left at the Red Bluff Granite-Bliss Sandstone nonconformity.
3.8	0.2	Stoplight (Alabama Street and Nashville Avenue) . Guadalupe Catholic Church on the northwest corner.
4.0	0.2	Lacustrine basin fill t o the left .
4.2	0.2	Stoplight (Fort Boulevard and Alabama Street) .
4.5	0.3	At 10:00 note outcrop in McMillan Quarry of the Canadian El Paso Group. Good view of Precambrian to Montoya Group (in the main ridge) . White felsite sill of probable Tertiary age visible at about the Bliss Sandstone-El Paso Group contact .
5.0	0.5	Sugar Loaf Peak straight ahead. Fusselman Formation on top. This unit is a down-dropped block (McKilligan *[sic]* block of Richardson, 1909). Green transmitter tower just to the right of the Upham Formation Cliff. Continue on Alabama Street.
5.8	0.8	Alabama Street and Fred Wilson Road; bear left. Beaumont Hospital on right.
6.3	6.5	To east excellent view of Hueco Bolson and Hueco Mountains. Large peak is Cerro Alto, a Tertiary intrusive.
6.5	0.2	El Maida Shrine Temple. South Franklin Peak straight ahead.
6.8	0.3	Good exposure of fanglomeratic gravels inter-mixed with lacustrine basin fill.
7.2	0.4	Silver water tower on left. Fort Bliss annex on right.
7.7	0.5	Trinity Presbyterian Church on left. Continue three blocks and turn left at Edgar Park Avenue and Magnetic Street (name changes from Alabama Street to Magnetic Street).
7.9	0.2	Entrance to Edgar Park Quarry, excellent view of South Franklin Peak directly ahead (west). We are the guests of H. and H. Materials, Inc.
8.3	0.4	Bear right at fork.
8.4	0.1	Excellent exposure of gravels (valley fill fanglomerate).
8.5	0.1	Bear left and drive up hill.
8.7	0.2	Quartzite exposure on right.
8.75	0.05	Bear right. Note on right the weathered exposures of the Lanoria Quartzite. These Younger Precambrian units are in Richardson's (1909) Taylor Block. (The underling Bundy Breccia and Castner Limestone are not exposed here. The best section is on the north side of Fusselman Canyon to the north). The Lanoria Ouartzite is not related to the Llanorian landmass. It was named by Richardson (1909) for an old settlement 8 mi northeast of El Paso.
8.9	0.15	**STOP 2A.** Examine specimens of Lanoria Ouartzite. Make an abrupt left turn.
8.95	0.05	Turn right and continue up road. Note unweathered and weathered surfaces of quartzite.
9.2	0.25	**STOP 2B.** End of quarry. Altered diabase on south side. Argillites, altered in part, on north side of quarry. Note proximity of granite rocks to the southwest. Numerous boulders (largely Paleozoic). Turn around, head back down slope.
9.3	0.1	**STOP 2C**. "Granite Quarry" on right.
9.4	0.1	**STOP 2D**. White quartzite at intersection on right, continue downhill.
9.6	0.2	“Y” intersection

9.9	0.3	**STOP 2E.** "Structure Quarry." Note faulting and drag folds in metasediments. Continue out quarry.
10.5	0.6	Entrance to quarry. Continue straight ahead.
10.6	0.1	Magnetic Street and Edgar Park Avenue. Turn right, continue south on Magnetic Street.
10.9	0.3	Trinity Presbyterian Church on right. (Volcanic Avenue and Magnetic Street).
11.2	0.3	Good view of Hueco Mountains to the east.
11.5	0.3	Sugar Loaf Peak straight ahead. Peak capped with Fusselman Formation, large cliff above microwave station is Upham (Montoya Group).
12.7	1.2	Rear right on Alabama Street. Sugar Loaf Peak on right. Beaumont Hospital on left. SLOW!. Turn in 0.5 miles.
13.2	0.5	Turn right onto McKelligon Canyon Road.
13.4	0.2	Note contact between Upham Formation (Montoya Group) and Florida Formation (El Paso Group) 100 ft up slope on right.
13.8	0.4	Entrance to McKelligon Canyon.
14.1	0.3	Drainage dam on right. Light outcrop across arroyo badly dolomitized Fusselman Formation.
14.6	0.5	Outcrops on right are McKelligon Canyon Formation (El Paso Group). On left Precambrian (Red Bluff Granite).
15.2	0.6	Dance pavilion on left. Continue ahead.
15.3	0.1	Bear right around loop and continue around loop.
15.6	0.3	**STOP 3A**: Picnic area. Pull off as far as possible on right. Walk up canyon to examine the Precambrian Red Bluff Granite and Cambro-Ordovician Bliss Sandstone nonconformity.
15.9	0.3	**STOP 3B**. Dance Pavilion. Precambrian on right (South Franklin Block; Richardson (1909)), upper El Paso Group on left (McKilligan *[sic]* Block; Richardson (1909)). Sugar Loaf Peak ahead.
16.1	0.2	Excellent exposure of Red Bluff Granite on right.
16.7	0.6	Fault at north end of Sugar Loaf. Faulted down on south side.
17.2	0.5	Entrance to McKelligon Canyon Park.
17.6	0.4	Bear right at fork.
17.8	0.2	Turn right onto Alabama Street.
18.0	0.2	Note on right the excellent view of felsite sill.
18.5	0.5	McKinley Avenue and Alabama Street. Entrance to Tramway. Continue ahead
18.7	0.2	Stoplight (Fort Boulevard and Alabama Street). Continue ahead.
19.1	0.4	Stoplight (Nashville Avenue and Alabama Street). Continue for five (5) blocks to Richmond Avenue.
19.3	0.2	Turn right onto Richmond Avenue for Scenic Drive. Good view of Paleozoic straight ahead.
19.7	0.4	Excellent exposure of lacustrine basin fill on right.
20.0	0.3	Entrance to Scenic Drive. Bliss Sandstone on right.
20.2	0.2	Police Academy (Victorio and underlying Cooks Formations).

20.7	0.5	Scenic Point. Note contact between thin bedded Florida Formation of El. Paso and Upham Formation cliff of the Montoya on the right near the "20 Miles An Hour" sign.
21.1	0.4	Coles Reservoir Road.
21.3	0.2	Rear right at road fork.
21.4	0.1	Dirt tracks to Crazy Cat Canyon microwave installation and TV tower access road.
21.5	0.1	Jackson Reservoir on right. **SLOW**.
21.7	0.2	Take a very sharp right to Jackson Reservoir.
21.8	0.1	**STOP 4.** Loop cars. Discussion on slide tectonics. Excellent view of Juarez and southern Franklin Mountains.
22.0	0.2	Turn right onto paved road. Note Kern Place Terrace and the "Andesite" hills at the University of Texas at El Paso.
22.5	0.5	Road forks. Bear left onto Robinson Avenue (Piedmont Drive arid Robinson Avenue).
22.75	0.25	El Paso Tennis Club on left in wide arroyo that dissects Kern Place Terrace. Continue on Robinson Avenue.
23.2	0.45	Turn right onto Stanton Street. Continue north two blocks to Baltimore Drive.
23.3	0.1	Turn left onto Baltimore Drive.
23.35	0.05	Stoplight (Mesa Street and Baltimore Drive). Turn right (north) onto Mesa Street.
23.75	0.4	Look left (west). Note Campus "Andesite" hills. Cristo Rey in distance and the ASARCO stack.
23.85	0.1	Stoplight (Mesita Drive and Mesa Street, Luby's Cafeteria).
23.95	0.1	"Andesite" outcrop on right
24.85	0.9	Sahara Motel on right
24.9	0.05	Turn right into Lomas Del Rey onto Castellano Drive. Go one block, turn left onto Cuartel Drive.
		STOP 5. Discussion of Pleistocene. Cristo Rey-(6:00) interpreted to be a laccolithic-like intrusion. The skyline of the Southern Franklin mountains (essentially Montoya) is visible from 10:00 to 2:00. The highest visible peak, Mount Franklin, lies at 11:30. At 1:30 is the TV tower on Ranger Peak (top of Aerial Tramway). Crazy Cat Peak is at 2:00, the microwave tower is at 3:00, and the ASARCO stack is at 5:00. Note Quaternary basin fill in low hills at 12:30 to 2:00, 6:00 to 6:30, and from 7:00 to 10:00. The La Mesa Surface lies from 6:30 to 7:30. Note "Andesite" hills and related intrusions at 4:00 and Mexico at 5:00.
25.15	0.25	Turn left onto Argonaut Drive, return to Mesa Street. Turn right onto Mesa Street. View of Cristo Rey at turn. Excellent Pleistocene exposures next 1.5 mi of road cuts.
25.7	0.55	Fiesta Theater.
26.7	1.0	Excellent outcrop of caliche on right (Crown Point Drive and Mesa Street).
26.8	0.1	Stoplight. (Shadow Mountain Road and Mesa Street).
26.9	0.1	Fortune-Coronado Tower on right.
27.0	0.1	Stoplight (Balboa Road and Mesa Street).

27.2	0.2	At 2:00 outcrop of Pleistocene basin fill in hillside cut in distance.
27.9	0.7	Entrance to Coronado High School. Directly ahead (12:00) is a good view of La Mesa Surface and the Potrillo Mountains. A view of Cristo Rey and Juarez Mountains to the left.
29.1	1.2	Turn right at TexaGo Station onto Interstate 10 access road.
29.5	0.4	On right Pleistocene exposure (one of A. Metcalf's Pleistocene gastropod locations).
29.6	0.1	Interstate 10 north.
30.1	0.5	Overpass, view of Three Sisters, interpreted to be andesite intrusions (possib1y 1acco1ithic) developing in association with Cretaceous sediments, mostly Comanchean Bed 4 (Duck Creek) identified by W.S. Strain. Note erosion surfaces.
31.1	1.0	Cross bridge. North Franklin Peak 2:30; north peak of the Three Sisters on right; Anthony's Nose 1:30; 3:30 South Franklin Peak (with aircraft guidance system towers); 6:00 Cristo Rey; 9:00 Potrillo Mountains.
32.1	1.0	Overpass.
32.2	0.1	8 mile marker
32.3	0.1	3:30 Smuggler's Pass where intermountain road will pass. It will show the best Precambrian section locally. 3:00 North Franklin Mountain (part of Richardson's (1909) Central Franklin Block)
32.9	0.6	Intermountain Road overpass. 12:00 Organ Mountains, 9:00 Potrillo Mountains.
35.7	2.8	Turn right into Vinton Turnoff.
36.1	0.4	Stop at Stuckey’s for lunch. Continue from Stuckey’s toward the Franklin Mountains.
36.3	0.2	Leave pavement at De Alva Drive. Bear right onto dirt road.
36.5	0.2	Anthony's Nose 2:00.
37.2	0.7	Cross El Paso Natural Gas pipeline road. Continue toward the mountains.
37.4	0.2	Cattle guard in fence.
38.0	0.6	Yokum's Place.
38.3	0.3	Note from just north of Anthony's Nose down to road good view of Silurian through mid-Pennsylvanian. At 10:00 low hills, Wolfcamp (Permian) sediments dipping to the west.
39.0	0.7	Permian section to left in quarries. Low center cars park on main road. Turn left. CAUTION. Watch arroyo.
39.1	0.1	**STOP 6.** End of dirt track. Turn cars around. Examination of the Wolfcamp exposure in quarries. Discussion concerning Permian Hueco Group (Wolfcamp), Pennsylvanian Panther Seep Equivalent (Missouri-Virgi1), and Richardson's (1909) Anthony and North Franklin Blocks.
39.2	0.1	Return to main road. Turn left toward the mountains.
39.7	0.5	**STOP 7.** Examine Des Moines, Bishop's Cap Formation (Magdalena Group) sections in quarries. Follow the dirt track.up into the canyon. Low center cars remain behind.
40.0	0.3	**STOP 8.** Examine Morrow La Tuna Formation and Atokan Bernino Formation. Note contact between Mississippian (Helms Formation-Chester) and Pennsylvanian (La Tuna Formation-Morrow) to be seen by looking up Vinton Canyon at the base of the flatirons. Orange slopes largely Meramec Rancheria Formation.

		White slope in distance is Fusselman Formation (Silurian). Time permitting, a walking trip will be taken up the canyon to examine the Mississippian, Devonian, and Silurian. To the west is an excellent view of the Potrillos and the Rio Grande Valley. Discussion of the Upper and Middle Paleozoic.
40.2	0.2	Back to main track. Return to I-10.
41.8	1.6	Yokum''s Place.
42.4	0.6	Cattle guard in fence.
43.5	1.1	Pavement begins. Continue west across overpass.
43.9	0.4	Turn left to Interstate 10 (across overpass).
44.3	0.4	Interstate 10.
47.2	2.9	Good view of Smuggler's Gap (Intermountain overpass).
51.3	4.1	I-10 and Mesa Street.
51.5	0.2	Overpass. 9:00 note terrace at Country Club, also at 9:00 the Thunderbird which has been interpreted to be a Precambrian high area influencing sedimentation in the lower part of the El Paso Group. Both features are on the west flank and slope of South Franklin Peak. Cristo Rey is at 2:00.
53.4	1.9	Sunland Park Drive and I-10.
54.2	0.8	Racetrack Drive and I-0.
54.3	0.1	Left on road. Outcrops of the lower Cretaceous Bed 1 (Edwards equivalent).
55.0	0.7	Southwest Portland Cement Company. (SLOW- Right turn ahead).
55.1	0.1	Leave road. Turn under second railway bridge, take sharp right at Paisano Drive onto Ewald Kipp Way, cross Rio Grande into New Mexico. Good view of Cristo Rey. Turn right. Outcrops between railroad bridges include beds 1 through 4 (Comanchean Edwards and Duck Creek equivalents) [n. b. the approximate Big Bend equivalents to the Böse number: are: Beds 1-3 = Del Carmen Limestone; Beds 4 and Lower 5 = Sue Peaks Formation; Beds Upper 5-7 = Santa Elena Limestone; Bed 8 = Del Rio Clay; Bed 9 = Buda Limestone; and Bed 10 = Lower Boquillas Formation).
55.4	0.3	White Bed 1 (Edwards) under bridge.
55.8	0.4	Cross old railroad tracks. Bed 1 (Edwards) faulted against Bed 4 (Duck Creek) and 5 (Fort Worth-Denton) along road to Anapra.
56.0	0.2	Abandoned Dixie Ethyl Plant. Outcrops on left dark brown to black shales (Bed 6, Weno-Powpow) overlain with sandstone (Bed 7, Main Street). Good view of Bed 1 (Edwards) across river.
50.3	0.3	Outcrops of dark shales of Bed 6 (Keno-Paw Paw).
56.6	0.3	Outcrops in quarry on left of Bed 7 (Plain Street).
56.7	0.1	Intersection with paved road (New Mexico 273). Carousel Club on right. White outcrop left is Bed 9 (Buda). Turn left toward Club Morocco.
56.3	0.2	Turn left up dirt track to Cristo Rey.
57.1	0.2	SLOW. CAUTION. Railroad tracks. Yellow marly sand across tracks on left Upper Cretaceous Bed 10 (Eagle Ford).

57.2	0.1	Outcrops of white Bed 3 (Buda) to left. Some Bed 8 (Del Rio) in gully.
57.3	0.1	Outcrops of Bed 6 shale (Weno-Powpow) overlain by Bed 7 (Main Street) on right in road cut.
57.35	0.05	Road forks, turn right.
57.4	0.05	CAUTION. Cross railroad tracks and note darkened slightly metamorphosed rocks in contact with laccolithic (?) Tertiary intrusion. Continue to Cristo Rey.
57.7	0.3	Path to top of Cristo Rey. Continue to flat area ahead and park cars. Examine complex structure of contact with intrusion. Collect fauna from folded beds 5 (Fort Worth-Denton) and 6 (Weno-Paw Paw). The shales of Bed 6 (Weno-PowPow) are exposed across the railway tracks. Bed 7 (Main Street) is sandstone cliff at top. Isoclinal folds may be seen by walking down road towards the track and looking up the side canyons.
57.85	0.15	Cristo Rey path.
58.0	0.15	Railroad crossing.
58.15	0.15	Cristo Rey Road and New Mexico 273 (turn right). Continue straight across Rio Grande, turn right onto freeway.
53.6	0.45	Reenter Paisano, continue south.
59.6	1.0	Southern Pacific Railway Bridge.
59.8	0.2	ASARCO slag pile on left. Smeltertown on right.
60.2	0.4	ASARCO stack.
61.4	1.2	SLOW. Bear right off Paisano Drive onto Yandell Drive exit. Orange and green building on right is part of an old Fort Bliss installation.
61.9	0.5	SLOW. Sharp turn left at the end of the bridge.
62.2	0.3	Road forks. Continue straight ahead.
62.3	0.1	Note weathered and fresh surfaces of the Campus "Andesite"
62.7	0.4	Sun Bowl on right. Take right fork through parking lot, cross lot, and continue to Memorial Gym.
63.0	0.3	END OF TRIP. *Hasta que nos veamos otra vez*

Table 1. General Stratigraphy of the Franklin Mountains

Mine Units	Time-Rock Units	Group	Böse Equiv.	Rock Units
Neogene	Pleistocene			Bolson Deposits Camp Rice Fort Hancock
			Böse Equiv.	Central Texas Equiv.
Cretaceous	Gulfian	Washita Group	10	Eagle Ford
	Comanchean		9	Buda
			8	Del Rio
			7	Main Street
			6	Weno-Paw Paw
			5	Fort Worth-Denton
			4	Duck creek
		Fredericksburg Group	1-3	Edwards
Permian	Leonard (?) Wolfcamp			Alcran Mtn. Formation Cerro Alto Limestone Hueco Canyon Formation
Pennsylvanian	Virgil	Magdalena Group		
	Missouri			Panther Seep Equiv. (with gypsym)
	Des Moines			Bishop's Cap Formation
	Atokan			Bernino Formation
	Morrow			La Tuna Formation
Mississippian	Chester			Helms Formation
	Meramec			Rancheria Formation Las Cruces Formation
Devonian	Upper			Percha Shale
	Middle			Canutillo Formation
Silurian	Miagaran (Middle)			Fusselman Formation
	Alexandrian (Lower)			

Mine Units	Time-Rock Units			Rock Units
Ordovician	Cincinnatian (Upper)	Montoya Group		Cutter Formation Aleman Formation Upham Formation
	Canadian (Lower)	El Paso Group		Flordia Formation Scenic DriveFormation McKelligon Canyon Formation Jose Formation Victorio Formation Cooks Formation SierriteFormation
Cambro-Ordovician	Croixan and/or Canadian			Bliss Sandstone
Younger Precambrian			Red Bluff Granite	Rhyolite Porphyry Lanoria Quartzite Mundy Breccia Castner Limestone

PRECAMBRIAN ROCKS OF THE FUSSELMAN CANYON AREA

W. N. McAnulty, Jr.
University of New Mexico

INTRODUCTION

Fusselman Canyon is cut into the eastern slope of the Franklin Mountains about 7.5 mi north of the southern end of the range. It is just east of North Franklin Mountain, the highest point in the range and also the highest structural point in Texas. The Fusselman canyon area is important because exposed in the area is the most complete and least metamorphosed section of Precambrian rocks in west Texas and southern New Mexico. The sequence of Precambrian rocks exposed in the canyon area is more than 4500 ft thick and includes, from oldest to youngest, the Castner Limestone (1300 ft thick), the Mundy Breccia (200 ft thick), the Lanoria Quartzite (2000 ft thick), and an unnamed extrusive rhyolite porphyry unit (1000 ft thick). Two Precambrian silic intrusions – porphyritic microgranite and granite – and numerous diabase dikes and sills intruded the sedimentary and extru-sive rocks. The Castner Limestone, the Mundy Breccia, and the Lanoria Quartzite have low-grade metamorphic effects. The Bliss Sandstone (Cambrian and Ordovician age) uncomformably overlies the Precambrian rocks.

Castner Limestone:

The Castner Limestone was named and described by Harbour (1960). Although named the Castner Limestone, the original rock before metamorphism was very siliceous and dolomitic. Some beds contained more than one third dolomite; thin chert beds were abundant, especially in the upper part of the section. Marl or shale partings were common between beds, and many beds were argillaceous. The Castner was intruded by Precambrian porphyriric microgranite and by granite. Several diabase dikes and sills also intruded the sequence.

The Castner Limestone consists of thin to massive beds of partly recrystallized limestone, and layers of morphosed, sedimentary features such as bedding, stromatolites, and sedimentary breccias are well preserved. Near the base of the section is a zone 4 to 6 ft thick containing abundant stromatolites that have been identified as the algae *Collenia frequens* (Harbour, 1960). Stromatolites are found scattered throughout limestone beds in the lower part of the section. Sedimentary breccias composed of thin, tabular limestone clasts are especially common in the upper one third of the Castner section. The breccias are similar to edgewise conglomerates. The clasts are inclined to bedding from 10° to 70°. In the bottom and top few inches of the breccia zones the clasts are more nearly parallel to bedding. Intraformational breccias make up about 60% of the upper 100 ft of the limestone. Numerous small recumbent folds and thrust faults, which are probably the result of soft sediment slumping, are also found in the upper part of the Castner section. The deformational complexity increases noticeably in the upper 30 ft of the section. The upper surface of the Castner is erosional. In several places isolated blocks of limestone are resting on bedded limestone beneath.

Metamorphic minerals and textures are easily discernable in hand specimens of the Castner Limestone. Metamorphic banding is parallel to bedding even near discordant contacts. Euhedral garnet crystals (1 to 3 mm) are common on bedding planes. The metamorphic minerals easily identifiable megascropically in the Castner are re-crystallized calcite, garnet, mica, and tremolite. Hornfelsic textures are distinctive.

In the Castner Limestone, mineral assemblages indicate that the metamorphic grade is the hornblende-hornfels facies of contact metamorphism. Notable variety exists between rock samples. Some samples have only three mineral phases, while others have as many as ten phases. A total of 27 different minerals were identified in thin sections of the Castner. The most commonly occurring minerals are carbonate (mostly calcite, but also some dolomite), tremolite-actinolite, garnet (probably grossular-andradite), diopside, pyrite, plagioclase, epidote, and quartz. The variety of minerals and the presence of such minerals as scapolite, tourmaline, and fluorite indicate metasomatism through halogen-rich emanations. However, metasomatism is generally restricted to zones near pegmatites; most metamorphism of the Castner was probably essentially isochemical. Mineralogical banding is well developed in the Castner. Bands that weather out to resistant ribs are composed dominantly of calc-silicate minerals but probably were originally chert. Dolomite is not present where abundant calc-silicate minerals are found, and the mineral assemblages indicate that dedolomitization reactions have occurred. The impure beds in the Castner rich in aluminum, iron, magnesium, and silica are now hornfels. Other beds that were composed of relatively pure limestone and dolomite were metamorphosed to marble that contains minor amounts of chron-drodite, talc, and secondary serpentine.

Mundy Breccia:

The Mundy Breccia rests uncomformably on the Castner Limestone and is overlain uncomformably by the Lanoria Quartzite. The Mundy is a basalt flow breccia; the fragments and matrix are the same rock type-basalt. No breccia fragments of other than basalt composition were seen. The breccia fragments and matrix consist of plagioclase laths in an ophitic groundmass altered to chlorite, amphiboles, and biotite. Metamorphic minerals, especially tremolite, obscure much of the original igneous texture.

Lanoria Quartzite

The Lanoria Quartzite was named and described by Richardson (1909). Harbour (1960) suggested division of the Lanoria into three members. A massive cliff-forming unit separates the lower and upper members. The Lanoria is composed of thin to thick-bedded sericitic-chloritic metasandstone and metasiltstone, and smaller amounts of massive quartzite. The formation name is misleading in that only the middle member is composed of quartzite; the lower and upper members are metasandstone and metasiltstone. The metasandstone of the lower member contains 40% to 60% sand sized quartz grains in a sericite matrix. Minor amounts (less than 10%) of the plagioclase similar in size and shape to the quartz grains are also present as detrital grains. The matrix of the sandstone was originally clay but has been recrystallized to sericite and chlorite. Some anhedral grains of musco-vite and biotite grade into patches of sericite. A tabular body of porphyritic microgranite about 1000 ft thick intruded the lower member about 300 ft above its base. Diabase sills up to 30 ft thick are present near the top of the lower member. The upper member consists of thin-bedded chloritic-sericitic metasandstone. Thin-bedded units in the upper member are similar to the sericitic beds in the lower member, but contain finer grained quartzite sand and no large grains of mica in the matrix.

The middle member is a massively bedded cliff-forming unit about 1200 ft thick. It is composed of several massive units of quartzite 100 to 300 ft thick, separated by thinner bedded units similar to the metasand-stone of the lower member. The quartzite contains rounded quartz grains and minor amounts of rounded plagioclase grains in what was originally a silica matrix. The quartz has been recrystallized to form an interlock-ing mass of angular grains with optical continuity. At place near the top of the upper member are exposures of well-developed ripple marks, some having an amplitude as large as 12 inches. Fucoid marks are also present on many of the bedding planes.

Rhyolite Porphyry

Precambrian rhyolite porphyry uncomformably overlies the Lanoria Quartzite. At the base of the rhyolite is a quartzite conglomerate from 5 to 20 ft thick. Approximately 95% of the conglomerate clasts are quartz and chert; the remaining 5% is composed of rhyolite fragments. The rhyolite contains distinctive pink, subhedral phenocrysts of orthoclase and smaller quartz phenocrysts in a black to dark reddish-brown aphanitic groundmass. The groundmass contains very fine-grained (less than 0.02 mm) feldspar laths and abundant fine-grained opaque minerals. An isotopic age determination made on the rhyolite yielded an apparent age of 99 m.y. (Muehlberger, 1966).

Porphyritic Microgranite:

Porphyritic is the older of the two silicic intrusions in the canyon area and makes up the largest volume of intrusive rock exposed in the area. Phenocrysts comprise from 10% to 70% of the rock and are dominantly microcline; but quartz, untwinned plagioclase and small amounts of biotite, hornblende, and magnetite are also present. Microcline occurs both as single subhedral phenocrysts and as glomeroporphyritic masses up to 8 mm across. Perthitic intergrowths are well developed in the microcline and obscure most of the microcline twinning.

Quartz phenocrysts are smaller than microcline and occur as embayed, euhedral bipyramidal grains, but quartz is not evident on the outcrop. Strongly developed granophyric texture in the groundmass is the most striking feature of the microgranite in thin section. Granophyric texture makes up from 5% to 75% of the groundmass.

The porphyric microgranite intruded the Castner Limestone and the lower member of the Lanoria Quartzite. Xenoliths of quartzite from a few ft to more than 800 ft across are present in the intrusion.

Granite

Pegmatitic granite intrudes the Castner Limestone and the Porphyritic microgranite. The granite is characterized by large exsolved patches of untwinned plagioclase, and by the scarcity of mafic minerals. Large subhedral grains of microcline, with strong perthite development, interlocking with anhedral grains of quartz and plagioclase make up most of the rock. Numerous aplite-pegmatite dikes cut the granite. Some dikes extend beyond the granite contact into the porphyritic microgranite. Three pegmatite dikes that intrude limestone have altered margins containing tourmaline, fluorite, biotite, and some beryl. Elongate protrusions of limestone into the granite and limestone xenoliths near the granite contact are common. The contact between the microgranite and granite is also irregular and sinuous.

Radiometric age determinations made on the silicic intrusive rocks of the Fusselman Canyon establish the age of these rocks at about 1000 m.y. (Wasserburg, 1962).

Diabase

Diabase dikes and sills intrude every Precambrian formation in the Fusselman Canyon sequence. At least two periods of diabase intrusion are represented in the canyon. The diabase dikes are weathered to topographic depressions that form conspicuous trench features 10 to 30 ft wide and several hundred ft long. The diabase contains 30% to 70% plagioclase subophitically enclosed in olivine and clinopyroxene (pigeonite).

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PALEOECOLOGY OF A CANADIAN (LOWER ORDOVICIAN) ALGAL COMPLEX

David V. LeMone
Department of Geology
University of Texas at El Paso

A series of detailed paleoecological studies of the Canadian (lower Ordivician) El Paso Group are in progress in the southern Franklin Mountain, El Paso County, Texas. Seventy ft above the base of the McKelligon Canyon Formation (Flower, 1964) an algal complex of particular interest crops out.

In 2 ft of vertical exposure five distinct depositional phases with four subaerial and/or subaqueous disconformities are recorded. Two periods of algal growth (cf. *Collenia*) with associated surge channels are observed. The last period of algal growth displays differential erosion between the algal heads and surge channels. The lithofacies suggests a very shallow near shore to supratidal environment developing two phases of algal mats in a similar manner to the algal flats of the Khor Al Bazam, Trucial Coast, Southwestern Persian Gulf (Kendall and Skipworth, 1967).

The described algal mats are interpreted to have developed in a different sedimentary and environmental framework than the overlying marine, shallow water "typical" archaeoscyphid-*Pulchrilaminae spinosa* mounds of the middle and upper McKelligon Canyon Formation. The Jefferson City (Arenig) McKelligon Canyon Formation complex or sabkha is Unit B 1, Bed 16, Honeycut equivalent of Cloud and Barnes (1948). It is the G-1 *Protopliomerops celsaora* and G-2 *Protopliomerops contracta* zones of Hintze and Ross (1951).

This study was supported in part by a grant from the University Research Institute, University of Texas at El Paso.

LATE PALEOZOIC IN EL PASO BORDER REGION

Frank E. Kottlowski
New Mexico Bureau of Mines and Mineral Resources
Socorro, NM

Basal Mississippian strata overlie the Late Devonian black shales in southern New Mexico and west Texas, but older cherty Devonian limestone near Chihuahua. Mississippian rocks, mainly crinoidal limestones, thicken southwestward to more than 1200 ft in the Pedregosa Basin and southeast to about 800 ft in the Delaware Basin. The Chesterian nearshore beds are concentrated south of the 33^{rd} parallel.

Total thickness of Pennsylvanian is more than 3000 ft in Delaware Basin at southeast, perhaps 4500 ft in Orogrande Basin northeast of El Paso, and more than 2400 ft in the Pedregosa Basin to southwest. Wolfcampian strata, Abo red beds to the north, Hueco Formation to the south and southeast, and Harp to the southwest, are 3000 to 4000 ft thick in the Delaware and Orogrande Basins. The marine limestone and shale of Hueco grade laterally northward into terrestrial Abo red beds. Leonardian strata, as much as 4000 ft thick in the southeast, thin northward and westward, being removed by erosion during late Mesozoic time over Burro uplift to the southwest.

Guadalupian strata, as much as 5500 ft thicken Delaware Basin, thin to an eroded edge westward. Ochoan rocks, mainly anhydrite and halite, are concentrated in Permian Basin area with about 5000 ft present in Delaware Basin part.

LATE CENOZOIC STRATA OF THE EL PASO AREA

William S. Strain
Department of Geology
University of Texas at El Paso

Late Cenozoic strata in the El Paso area are mostly of lacustrine and fluvial origin. They are principally claystone, siltstone, sand, and gravel, overlain by caliche and dune sand. The strata are best exposed in the Rio Grande Valley. The Fort Hancock and the Camp Rico, two formations which have been described, are included in the Santa Fe Group. The deposits are at least 4,920 ft thick and vertebrate fossils show that the upper 600 ft are Pleistocene and recent in age.

A PRELIMINARY NOTE ON THE GEOLOGY OF THE CAMPUS "ANDESITE"

Jerry M. Hoffer
Department of Geology
The University of Texas at El Paso

The Campus "Andesite" occupies an area of approximately one square mile in the Rio Grande Valley southwest of the Franklin Mountains in El Paso, Texas. Most of the intrusion is bounded on the east by Mesa Avenue, on the south by Main Street, and on the west by the Rio Grande. (Fig. 1).

The intrusion has been forcibly implaced into sediments of Cretaceous age, producing generally deep dips and minor silicification in the surrounding limestones and shales. Exposures showing the sediment-igneous contact zone are not abundant as in most areas the igneous rock is in contact with late Quaternary alluvium and lake sediments. The best sediment-igneous contacts are zones found at the northwest and south edges (in the new road cuts for the Interstate highway) of the intrusion.

Mineralogically, the Campus "Andesite" is porphyritic with approximately 40% phenocrysts composed of plagioclase feldspar and minor biotite and hornblende. The plagioclase phenocrysts are andesine and show strong normal and oscillatory zoning. Biotite and hornblende show numerous reaction borders; biotite can be seen replacing hornblende in some crystals. The presence of numerous fractures, resorbed edges, and zoning of the plagioclase and reaction rims on the biotites and hornblende indicate that these intratelluric phenocrysts were not in equilibrium with the magma that produced the finer-grained groundmass crystals.

The aphanitic groundmass (averaging 0.06 mm) is composed of plagioclase and potash feldspar with minor quartz and magnetite.

A strongly altered, less porphyritic facies has been found near the south end of the intrusion. In addition, variations in mafic content and plagioclase content has been identified, but at present, their significance is unknown.

Research funds for this study were received through a grant-in-aid from The Society of the Sigma Xi and the University Research Institute, University of Texas at El Paso.

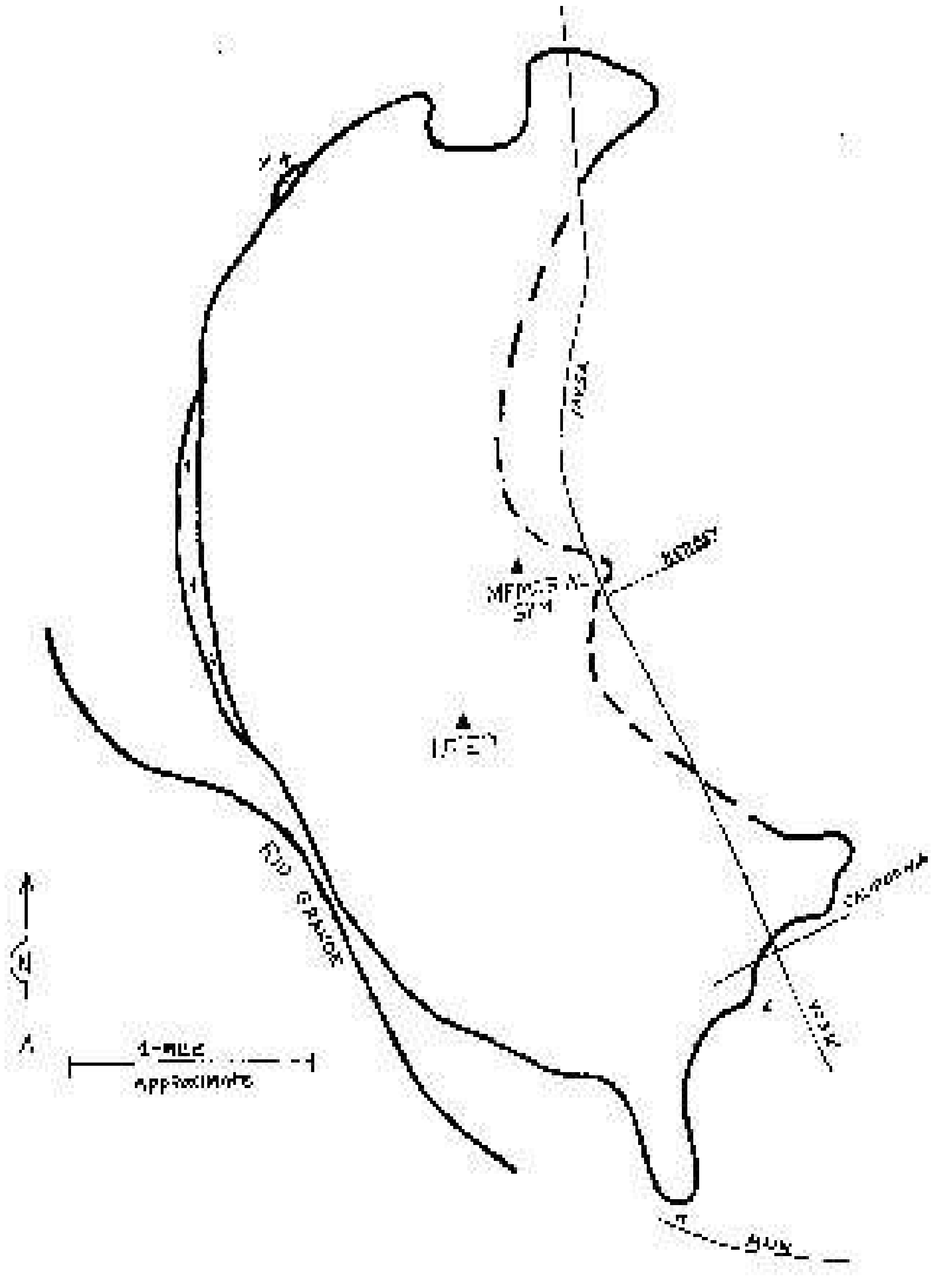

Figure 1. Campus Andesite

CONJECTURAL DATING BY MEANS OF GRAVITY SLIDE MASSES OF CENOZOIC TECTONICS OF THE SOUTHERN FRANKLIN MOUNTAINS, EL PASO COUNTY, TEXAS

Earl M. P. Lovejoy
Department of Geology
The University of Texas at El Paso

Absence of pre-Kansan Cenozoic strata flanking the southern, west-dipping, Franklin Mountains horst precludes dating range tectonics accurately. Two dip-slip, gravity units, the Crazy Cat and Tom Mays slides, of conjectural ages, may be used along the western flank, however.

Mapping (1:6000) has provided geometry for comprehension of slide mechanics and genesis. The Crazy Cat megabreccia slide (discovered by L. A. Nelson ca. 1940) extends six miles along the range front, crosses the western frontal fault (displacement about 600 ft) but was displaced only tens of ft. The Tom Mays slide extends eleven miles, and was displaced 3000 to 3500 ft by frontal faulting. The Crazy Cat slide rests on Cretaceous strata; the base of the Tom Mays slide, although not seen, apparently overlies Cretaceous strata. No sub-slide, basin-fill deposits are evident. Locally, Crazy Cat slide overlies Tom Mays slide; both are pre-Kansan.

Interpretation:

Both slides formed as the rising Franklin block opposed slip planes (Percha shale for Tom Mays; top El Paso for Crazy Cat) with topographic surface of Cretaceous strata of downthrown block. Absence of sub-slide, basin-fill deposits (Late Miocene inception) suggest minimum age of slides. However, To Mays slide strikingly resemble Laramide-Paleogene, Basin Range thrusts. Crazy Cat slide strikingly resembles Mio-Pliocene, Basin Range megabreccia. Range tectonics were (3000-3500) /6000 finished in Tom Mays slide time (Paleogene?) and 95+ percent finished in Crazy Cat slide time (late Miocene?). Analysis of sub-slide pollen may solve the dating problem.

REGIONAL MEETING
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
Tuesday – April 30, 1968

Border Stratigraphy Symposium

This series of papers cites general and specific problems of the Precambrian, Paleozoic, and Late Cenozoic stratigraphy of West Texas and southern New Mexico. (Papers 20 minutes, discussion 5 minutes).

Chairman: Frank E. Kottlowski: New Mexico Bureau of Mines and Mineral Resources

General Session

1:00 I. Precambrian of West Texas and southern New Mexico

Roger Dennison (Mobil Oil Corporation)

1:25 II. Cambrian-Ordovician of West Texas and southern New Mexico

David V. LeMone (UTEP)

1:50 III. Silurian-Devonian of West Texas and southern New Mexico

Edward McGlasson (Mobil Oil Corporation)

2:15 IV. Late Paleozoic of West Texas and southern New Mexico

Frank E. Kottlowski (NMBMMR)

2:40-3:00 Coffee Break-

Late Cenozoic Session:

3:00 V. The Santa Fe Group in the South-Central New Mexico Border Region

John W. Hawley* (U.S.D.A Soil Conservation Service), Frank E. Kottlowski NMBMMR), William S. Strain (U.T. El Paso), William R. Seager (NMSU), William E. King (NMSU), and David V. LeMone (UTEP).

3:25 VI. The Neogene Rincon Hills Flora

David V. LeMone (UTEP), Raymond Roy Johnson (UTEP)

Frank E. Kottlowski (NMBMMR), and William R. Seager (NMSU).

3:50 VII. Late Cenozoic Stratigraphy in the El Paso Area

William S. Strain (UTEP)

4:15 VIII. Quaternary Geology of the South-Central New Mexico Border Region

John W. Hawley (U.S.D. Soil Conservation Service)

BOTANY LOG

R. Roy Johnson
Department of Biology
UT El Paso

INTRODUCTION

The flora of the Franklin Mountains is diverse and the vegetation patterns complex. Geologic factors are major contributors to this diversity and complexity (see abstract at the rear of the species list). The botanical section of this publication is offered as an aid to the interdisciplinary approach so necessary to modern scientific investigation.

A list of most of the species of plants that you will observe is to be found at the rear of this log. Of course, the plants as described will appear quite different in summer, except for evergreens.

CAMPUS (ANDESITE) HILLS

Hillside vegetation is almost entirely of shrubs. Creosote bush is dominant with occasional big-leaf yucca, ocotillo and lechuguilla. Arroyo plants are largely four-wing saltbush (with its large, winged fruit), poreleaf (short broom like sub-shrub), white-thorn (reddish, spiny) and remains of stinging cevalia. In places escaped cultivated plants such as mulberries, elms, and Bermuda grass or weedy things such as cattails, sunflowers and tamarix occur.

Campus to Stop 1

Leave Campus and proceed to Stanton. On Stanton as you approach the light at the intersection with University Ave. note the large disturbed corner lot with its almost pure stand of both male and female plants of four-wing saltbush (bluish tinged). Continue to corner of Ange and Rim Rd. On the down slope side of Rim Rd. are ocotillo, yucca, cholla, and sotol (resembling large clumps of pampas grass). Continue toward the Franklins on Rim Rd. The first road off to the R is Brown. After Brown, on the R are creosote bush, mesquite, lechuguilla and four-wing saltbush. Continue to where Rim Rd. narrows so you can see off both sides of the road at once. Note the large mesquites in the wash to L. Also on the flat below you and L (Arroyo Park) note the evenly spaced creosote bushes, affecting “proper” spacing.

Stop 1 – Junction of Rim Road and Scenic Drive

Look up at the “C” and note the thick stand of lechuguilla (miniature century plants with dead stalks bearing a few oblong capsules). Additional prominent plants are ocotillo (wand-like), creosote-bush, white-thorn and the sub-shrub, grey coldenia. The obvious green blotches, beginning at about 4400’ and continuing to the crest of the mountains are sotols.

Stop 1 to Edgar Park Quarry

Continue along scenic Dr. up to Murchison Park Lookout and down the other side. About ¼ mi. after passing the Police Academy note the red hill of Ft. Bliss Sandstone with its creosote-bush and prickly pear. This is quite different from the lechuguilla-ocotillo-creosote vegetation, which you saw previously on the Montoya and El Paso limestone. Near the bottom of the Dr. note the dense stands of lechuguilla on the rubble. As you near McKelligon Canyon note again the prevalence of lechuguilla on rubble as well as on many slopes. Note also the prevalence of creosote bush on the firm but well drained bajadas. As you progress along Alabama note that stools are as low as 4100'. This is unusually low.

Stop 2 – Edgar Park Quarry

Note the lush stand of sotol on the N-facing slope of the canyon. In addition to several species already mentioned the slopes here support (largely on rubble) several grasses, prickly pear, grey-thorn, *Brickellia*, skeleton-leaf goldenrod, ephedra and little-leaf sumac. In waste areas are tumbleweed, poreleaf, fluff-grass and *Brickellia*. Shrub on N-facing slopes at the upper end of the quarry is silk tassel.

Stop 3 – McKelligon Canyon

The flora here is so diverse that our coverage can only be superficial. As you turn from Alabama on to McKelligon Canyon Rd. note that the E-facing slope on Sugarloaf is covered with both lechuguilla and creosote bush while on the W-facing slope lechuguilla is prevalent but creosote bush is lacking. Proceed up canyon. At the sign (on R) saying the Park closes at 11 p.m. look toward the small rock house (uphill on L) and note the large grey little-leaf sumac in a low area on L side of the road. After the second streambed crossing note the oaks on the L where a ridge comes down to the road. Continue to road-end (loop). In the arroyos note desert willow (taller trees with occasional remaining dead leaves and long pods), Apache plume, sumac, mesquite, four-wing saltbush, skeleton-leaf goldenrod, snakeweed and poreleaf. Slope vegetation has been discussed previously.

Stop 4 – Water Tank

Most of the hillsides here are covered with lechuguilla and creosote bush. The wide, flat "ravine" SE of the tank (Arroyo Park) is discussed under "Campus to Stop 1." In the wet ravine paralleling the dirt road leading to the tank is mesquite, four-wing saltbush, tamarix, grasses (e.g. plains bristlegrass) and purple nightshade (with small yellow berries) along the road.

Water Tank to Lomas del Rey

A couple of blocks after leaving the water tank you approach the El Paso Tennis Club (on L, in Arroyo Park). Note the "weepy" Jerusalem thorn trees and also the shorter bird-of-paradise bushes (with a few remaining flat, wide pods) in the cactus garden. Also in the "cactus garden" are planted cholla, barrel cactus and other cacti, ocotillo, prickly pear, lechuguilla, century plant and others. Near the utility pole just before the Club turnoff are two bird-of-paradise plants and two Mexican lavender shrubs (with clustered capsules at the ends of branches).

Stop 5 – Loma Del Rey

The vegetation here is largely lechuguilla-creosote bush-ocotillo. Note that the lower surfaces toward the river support almost pure stands of creosote bush.

Interstate 10 from Mesa Ave. To Vinton Rd.

Plants which have been planted along the road include tamarix, Yucca, desert willow, and cottonwood. Trees in the arroyos are largely mesquite, white-thorn (reddish), desert willow, small-leaf sumac, and occasional tamarix. Large stands of poreleaf occur in the middle of wide arroyos and a few snakeweeds. Of particular interest here are sand dunes that support narrow-leaf yucca, mesquite, broom dalea (restricted to dunes), ephedra, creosote bush and often grasses.

Vinton Rd. to Wolfcamp Quarry

Creosote bush abounds in this area. Ocotillo is largely replaced with lechuguilla above the cattle guard.

Stop 6 – Wolf Camp Quarry

The large washed-out arroyo, which prevents driving cars to the quarry, contains mesquite, desert willow, four-wing saltbush, Apache plume, a big red *Condalia* ca. 20 yd. To R of rd., poreleaf on islands in the middle of the wash and skeleton-leaf goldenrod with its persistent seed heads.

Vinton Cantyon

Vegetation in the washes remains the same as previously mentioned. In the swales and waste areas one finds groundsel (whitish, with persistent seed heads), leaves and grasses such as three-awns, and beardgrass. Vegetation on the slopes has mostly been mentioned previously. Note the reddish-leaved evergreen sumac, mariola, sage-brush, and grasses including fluff-grass, bush muhly and side oats grama. In addition to the evergreen sumac we find silk tassel and oaks.

Stop 7 – Cristo Rey

Note the large cottonwood trees along the river. The slopes are covered with creosote bush, *Krameria* and *Coldenia*. Armed saltbush occurs in swales near the last RR crossing before the parking area. Small washes contain *Krameria*, mesquite, tobosa grass and armed saltbush. Larger washes contain tamarix, greythorn, fur-wing saltbush, and the slopes bear yucca, sotol and creosote-bush.

SPECIES LIST

TREES OR LARGE SHRUBS

THORNY

Prosopis juliflora Mesquite

To 15', knotty branches, younger stems yellowish, with or without long straight thorns, vary in silhouette (see Acadia).

Acacia constricta White-thorn

To 10', thinner branches than mesquite, with or without long straight thorns, small silhouette at bottom – bushing out at top.

Mimosa biuncifera Catclaw

To 10', short heavy curved thorns, often with persistent spiny pods.

Condalia spathulata Squaw-bush

Evergreen to 7', spatulate leaves in fascicles (=bundles), side twigs often long straight leafy spines.

Fouquieria splendens Ocotillo, Devil's Coachwhip

To 10', several green furrowed whiplike straight stems from common base, with many stout spines.

Parkinsonia aculeate Jerusalem-thorn (Palo Verde)

To 25', green smooth bark, thorns similar to white thorn or mesquite, leaf rachis persistent after leaflets fall giving tree "weeping" aspect.

Caesalpinia gilliesii Bird-of Paradise

To 8', green smooth bark shrub, several dry small bean-like leaves usually persist as well as a few garden pea-like pods.

THORNLESS

Larrea divaricata Creosote bush

Aromatic evergreen to 8', yellow-green leaves two lobed, common on bajadas.

Atriplex canescens *Four-wing Saltbush*

Grayish evergreen to 6', profusely branches, dioecious, female plant with fruit ca. ½" dia. -- bearing 4 membranous wings.

Chilopsis linearis *Desert Willow*

To 20', often with leaning trunk, bean-like 4-10 pods often persistent, often with persistent dead willow-like leaves.

Rhus microphylla Little Leaf Sumac

To 10', clump forming gray shrub with profuse short crooked branches, young reddish buds-compact.

Populus wislizenii Rio Grande Cottonwood

To 70', whitish-barked deciduous tree, broad cotton.

Fallugia paradoxa Apache Plume

Evergreen to 7', cp\copiously branched shrub with small leaves clustered in fascicles, often with masses of seeds bearing reddish "plumes" on bare white stem tips, usually along arroyos.

Garrya wrightii Wright Silktassel

Oak-like evergreen to 10', leathery opposite leaves with complete (smooth) margins and prominent veins.

Quercus spp. Shrub Oak

Evergreen to 10', leaves with spiny or smooth margins.

Ephedra spp. Ephedra, Mormon Tea
Gymnosperm with yellow-green stems to 4', broom-like branches opposite or whorled (several arising on same plane), scale-like leaves.

Tamarix spp. Salt Cedar
To 20', old contorted stems grey, young broom-like stems red.

SMALL AND MEDIUM SHRUBS

Condalia spp. Gray-thorn
To 8', grayish twigs often like long straight spines at right angle to main stems (one sp., C. spathulata, evergreen).

Brickellia spp. Brickellia
To 6', erect white branches, few with fluffy seed heads along stem, in rocky stream beds.

Dalea scoparia Broom Dalea
To 4', naked yellow-green and white broom-like stems, on sand

Senecio longilobus Groundsel
Whitish evergreen to 2', lobed leaves, few large persistent heads.

Porophyllum scoparium Pore-leaf
To 2', yellow-green erect twigs often bearing star-like remains of seed heads at tips, especially abundant in bottoms of large arroyos.

Gutierrezia lucida Snake-weed
To 1 ½', tight dark green foliage with dead terminal twigs bearing small yellowish heads.

Viguiera stenoloba Skeleton-leaf Goldenrod
To 3', tips of many naked brown twigs with brown heads ca. ½" dia.

Parthenium incanum Mariola
To 2', whitish, with persistent dead wavy margined leaves, numerous small white heads at tips of leafy twigs.

Dyssodia spp. Dogweed
To 1', with numerous small cup shaped heads bearing translucent glands (many still with fruits= "seeds").

Krameria spp. Krameria
To 2', grey dense naked intricately branched shrub, branches all ending in spines.

Coldenia canescens Gray Coldenia
To 1 ½', dense intricately branched, often with many small persistent dry hairy grey leaves and fuzzy ball-like remains of flower heads at twig-tips.

Atriplex acanthocarpa Armed Saltbush
To 1 ½', evergreen with long triangular whitish leaves and persistent bur fruit at twig-tips.

SHRUBBY MONOCOTS

Yucca torreyi Torrey yucca
Wide-leafed "Spanish bayonet' often with loose fibers but no teeth on leaf margins, in sandy or rocky areas

Yucca elata Soaptree Yucca
With trunk, leaves ½" or less broad, old flower stalks often with large dried pods, usually in sandy areas, often on dunes.

Dasylirion wheeleri Wheeler Sotol

Yucca-like plant with coarse-toothed leaf margins, narrow leaves to 3' long, flower stalks to 12' with feathery masses of flowers.

Agave lechuguilla Lechuguilla
Miniature century plants, leaves to 2' long, strong apical spine, entire plant dies after flowering, unlike 3 previous species.

SHRUBBY CACTI

Opuntia engelmanni Engelmann Prickly-pear
The large Platyopuntia with plate-like stem pads.

Opuntia spp. Cholla
Several species of Cylindropuntia with erect stem segments varying in size from pencil size to pickle size.

Echinocactus wislizeni Southwest Barrel-cactus
Up to 4', like small barrel with rounded top.

SKELETONS OF HERBACEOUS PLANTS

Salsola kali Russian Thistle (Tumbleweed)
Spiny, pyramidal plants to 3' high by 3' across, easily detached.

Solanum eleagnifolium Purple Nightshade
To 2', bearing numerous yellow tomato-like berries ca. ½" dia.

Cevallia sinuate Stinging Cevallia
To 2', persistent dead wavy leaves, white lacey dried flowers persistent, foliage with stinging hairs when green.

Allionia incarnata Trailing Four-o'clock
Often forms dense mats of trailing straw-colored stems on slightly weathered rock, many curled crinkled opposite leaves persist on dead stems.

GRASSES

Sporobolus cryptandrus Sand Dropseed
To 2', bare seed stalks dense over large areas of flatter grassland on valley fill.

Tridens pulchellus Fluffgrass
Ca. 4", short fluffy mats bearing sticky heads, on weathered rock and disturbed areas.

Andropogon barbinodis
A. saccharoides Beardgrass
To 2', wide persistent reddish dead leaves.

Aristida spp. Three-awn grass
To 2', many heads still with seeds bearing three awns (=bristles) at apex.

Bouteloua curtipendula Side-oats Grama
To 2', seed stalks mostly bare, occasionally with seeds banging from (only) one side of a stalk.

Muhlenbergia porteria Bush Muhly
Clump former, lax stems found clambering through bushes, fruit with long bristle.

Cynodon dactylon Bermuda Grass

Common mat forming lawn grass, seed stalks (few remain) look like bird’s foot.

Hilaria mutica Tobosa

To 2’, forms leafy clumps, some erect seed stalks still with clumps of “tufted” seeds on all sides of stalk.

Setaria macrostachya Plains Bristlegrass

To 2’, erect seed stalks often with remains of bristly foxtail-like head.

Lithologic Controls of Vegetation in the Southeastern Franklin Mountains El Paso County, Texas

R. Roy Johnson
Department of Biological Sciences
UT El Paso

David V. LeMone
Department of Geological Sciences
UT El Paso

The diverse flora and complex vegetation patterns found in the Franklin Mountains are due to several interrelated factors. We are here concerned with edaphic rather than climatic or other factors. These include degree and direction of slope, degree of erosions and depths of canyons, and size and composition of ground particles (affecting sol chemistry and water retention) to mention a few. The importance of lithology is observed is several striking instances. One example is noted on scenic drive (ca. ¼ mile east of the Police Academy). Here the dark reddish brown Bliss Sandstone (quartzite) supports a creosote bush and prickly pear flora in sharp contrast to the adjacent El Paso Group (limestone and dolomite) which bears lechuguilla, ocotillo, and creosote bush.

Another example of lithologic influence on vegetation may be seen from the Aerial Tramway parking lot on the southeastern side of the Franklin Mountains. Several hundred yards below the lot a caliche cemented boulder conglomerate supports lechuguilla, a few scrawny ocotillos, and other dwarfed plants. The adjacent Precambrian Red Bluff Granite supports an ambulance of Torrey yucca and sotol, while lechuguilla is missing. Upslope from the Tramway lot in the Bliss Sandstone Torrey yucca diminishes, but sotol is common. The overlying El Paso and Montoya Groups are seen to contain ocotillo and lechuguilla, with Torrey Yucca and sotol missing. In contrast to previous vegetation types, the Campus "Andesite" Hills (Tertiary volcanic intrusion) support mostly creosote bush with scattered Torrey yucca, ocotillo and lechuguilla.

Checklist of Species of Amphibians and Reptiles
El Paso County, Texas

Robert G. Webb
Department of Biology
The University of Texas at El Paso

This list is conservative. It excludes some questionable species previously reported from the county, but includes some unreported species whose occurrence in the county is most probable. Doubtless, other species will be added to the list. This list is to be considered tentative; emendations are welcomed by the author.

Class Amphibia

Order Urodela – Salamanders

Ambystoma tigrinum…………………………………………………….…Tiger Salamander

Order Anura – Frogs and Toads

Scaphiopus couchi……………………………………………………...Couch's Spadefoot
Scaphiopus bombifrons………………………………………………...Plains Spadefoot
Scaphiopus hammondi…………………………………………...….Western Spadefoot
Bufo woodhousei……………………………………………………...Rocky Mountain Toad
Bufo cognatus………………………………………………………..…Great Plains Toad
Bufo speciosus………………………………………………………………...Texas Toad
Bufo punctatus……………………………………………………..……Red-Spotted Toad
Bufo debilis……………………………………………………………………Green Toad
Rana catesbeiana………………………………………………………………..Bullfrog
Rana pipiens………………………………………………………….………Leopard Frog

Class Reptilia

Order Testudines – Turtles

Kinosternon flavescens………………………….……………………..……Yellow Mud Turtle
Terrapene ornata……………………….…………………………….………………..Box Turtle
Chrysemys picta……………………….……………………………….….….……Painted Turtle
Pseudemys scripta……………………………………………………………...Pond Slider
Trionyx spiniferus……………………….…………………………..…..Texas Softshell

Order Squamata

Suborder Sauria – Lizards

Coleonyx variegatus……………………………………………..…………Banded Gecko
Holbrookia maculata……………………….…………………..…….Lesser Earless Lizard
Cophosaurus texanus……………………….……………………….Greater Earless Lizard
Crotaphytus collaris……………………….…………………….……….Collared Lizard
Crotaphytus wislizeni……………………….……………………..…..Leopard Lizard
Sceloporus magister……………………….……………………..……….Desert Spiny Lizard
Sceloporus undulatus……………………………………………………...Prairie Lizard
Uta stansburiana……………………….………………………..…….Side-blotched Lizard
Urosaurus ornatus……………………….……………………….….…..Tree Lizard

Phrynosoma cornutum…………………….……………………….Texas Horned Lizard
Phrynosoma modestum…………………….…………………Round-tailed Horned Lizard
Phrynosoma douglassi…………………….……………….……Short-horned Lizard
Eumeces obsoletus………………………………………………...Great Plains Skink
Cnemidophorus neomexicanus…………………….………….....New Mexican Whiptail
Cnemidophorus inornatus…………………….…………….…..Little Striped Whiptail
Cnemidophorus uniparens…………………….………………Desert-grassland Whiptail
Cnemidophorus exsanguis…………………….…………….……Chihuahua Whiptail
Cnemidophorus tesselatus…………………….…………….…Checkered Whiptail
Cnemidophorus tigris…………………….……………………..…..Marbled Whiptail

Suborder Serpentes – Snakes

Leptotyphlops humilis……………………………………………….Western Blind Snake
Leptotyphlops dulcis……………………………………………….....Texas Blind Snake
Diadophis punctatus…………………………………………….………Ringneck Snake
Heterodon nasicus……………………………………...……Western Hognose Snake
Opheodrys aestivus………………………………………………....Rough Green Snake
Masticophis taeniatus…………………………………………..……Striped Whitesnake
Masticophis flagellum…………………….…………………….……….……Coachwhip
Salvadora hexalepsis……………………………….………Western Patch-nosed Snake
Salvadora grahamiae………………………………….….Mountain Patch-nosed Snake
Elaphe guttata…………………………………………………....Great Plains Rat Snake
Elaphe subocularis……………………………………………....Trans-Pecos Rat Snake
Arizona elegans……………………………………………………………Glossy Snake
Pituophis melanoleucus………………………………………...……Gopher Snake
Lampropeltis getulus……………………………………………….Common Kingsnake
Rhinocheilus lecontei……………………………………………..…Long-nosed Snake
Thamnophis cyrtopsis………………………………………Black-necked Garter Snake
Thamnophis marcianus…………………………………...Checkered Garter Snake
Sonora semiannulata……………………………………….……Western Ground Snake
Ficimia cana…………………………………………………..Western Hook-nosed Snake
Tantilla nigriceps……………………………………………Plains Black-headed Snake
Tantilla planiceps…………………………………………Western Black-headed Snake
Hypsiglena ochrorhyncha……………………………………………..…Night Snake
Trimorphodon vilkinsoni…………………………………………..Texas Lyre Snake
Sistrurus catenatus…………………………………………………………..Massasauga
Crotalus atrox………………………………………Western Diamondback Rattlesnake
Crotalus lepidus……………………………………………………….Rock Rattlesnake
Crotalus molossus……………………………………...…Black-tailed Rattlesnake
Crotalus viridis……………………………………………………..Western Rattlesnake
Crotalus scutulatus…………………………………………….....Mojave Rattlesnake

MAMMALS OF THE EL PASO AREA

Arthur H. Harris
Museum of Arid Land Biology
Department of Biological Sciences
U T El Paso

Although large numbers of mammals occur near El Paso (Table I), most are small, active only at night, and not apt to be seen by the casual observer. Close inspection of the ground around the base of vegetation and among rocks will reveal many tracks, runway systems, and burrows, indicating the intense nocturnal activity.

Prominent among the few forms active during the day are the ground squirrels. Along rocky outcrops, the Rock Squirrel (Citellus variegates) may sometimes be glimpsed. This animal is about the size of a tree squirrel and, true to its scientific name, has a variegated pattern of white and grey mixed with a little brown.

The same general habitat is frequented by a smaller and somewhat less wary squirrel, the Texas Antelope Ground Squirrel (Citellus interpres). Its size is that of a large chipmunk and it is often taken for one, but chipmunks are not known in the Franklins. The grey color and single white stripe along each side characterize it as does the way in which the tail is carried over the animal's back, prominently displaying the tail's white underside.

The Spotted Ground Squirrel (Citellus spilosoma) prefers a habitat with a less rocky substratum and thus occurs mainly on the flats and in the valley. Only slightly smaller than the antelope ground squirrels, this creature is brownish with light colored spots over its body; its tail is less full than in the two previously mentioned species.

Desert Cottontails (Sylvilagus auduboni) and the much larger Black-tailed Jack Rabbit (Lepus californicus) are common in most of the region, though the latter prefers more level, open habitat than found in the Franklin Mountains. Likely, neither will be seen unless their resting areas are disturbed.

In mountain canyons, small mounds of freshly turned dirt without a visible entrance mark the burrow systems of Botta's Pocket Gopher (Thomomys bottae), while the far larger mounds of the Desert Pocket Gopher (Geomys arenarius) can hardly be missed along the Rio Grande floodplain.

About the bas of bushes or in jumbled rocks, wood rat nests are commonly seen though the rats themselves remain well hidden. Most nests pertain to the common White-throated Wood Rat *(Neotoma albigula*), but the Southern Plains Wood Rat (Neotoma micropus), is responsible in some cases.

Deer and any of the carnivores may show up at unexpected times, but usually confine their activities to later or earlier than our own active period.

Table I. Mammals.

Mammals occurring in the vicinity of El Paso. There are no definite records known to me for those species marked by an asterisk, but they almost undoubtedly occur or did in historic times. With further study, other species will be added.

ORDER INSECTIVORA	
Notiosorex crawfordi	Desert Shrew
ORDER CHIROPTERA	
Myotis lucifugus	Little Brown Bat
**Myotis thysanodes*	Fringed Myotis
**Myotis californicus*	California Myotis
**Myotis subulatus*	Small-footed Myotis
Pipistrellus Hesperus	Western Pipistrelle
**Plecotus townsendi*	Townsend's Big-eared Bat
Antrozous pallidus	Pallid Bat
Tadarida brasiliensis	Brazilian Free-tailed Bat
ORDER LAGOMORPHA	
Sylvilagus auduboni	Desert Cottontail
Lepus californicus	Black-tailed Jack Rabbit
ORDER RODENTIA	
Citellus interpres	Texas Antelope Ground Squirrel
Citellus mexicanus	Mexican Ground Squirrel
Citellus spilosoma	Spotted Ground Squirrel
Citellus variegates	Rock Squirrel