GENERAL GEOLOGY OF SOUTHEASTERN ARIZONA

TRIP V, ROAD LOG

First Day -- Sunday, April 5, 1959

Leaders: E. B. Mayo and W. D. Pye

Driving Distance: 141.7 miles Logged Distance: 132.9 miles

Starting Time: 8:00 A.M.

General Statement

This trip (fig. 48) begins at Tucson in the Santa Cruz valley and proceeds southeastward to Mountain View, between the Tanque Verde and Rincon Mountains on the north and the Santa Rita Mountains on the south. The route then turns southward, between the Empire Mountains on the east and the Santa Rita Mountains on the west, to Sonoita. From Sonoita the way leads eastward between the Mustang and Whetstone Mountains, crosses the San Pedro River, and continues to Tombstone. From Tombstone the trip proceeds southward into the Mule Mountains to Bisbee and then to Douglas.

The party will see: (1)The broadly folded, foliated gneisses of the Santa Catalina, Tanque Verde and Rincon Mountains; (2) the Paleozoic sediments of the Empire Mountains, thrust over Cretaceous rocks; (3) the Paleozoic sediments of the Mustang Mountains, and the Paleozoic section on the eastern face of the Whetstone Mountains; (4) the Paleozoic and Cretaceous sediments, Mesozoic and Tertiary intrusions, and Cretaceous volcanic rocks of the Tombstone Hills; (5) the Precambrian basement, overlain by Paleozoic and Cretaceous sediments, and intruded by Mesozoic granite in the Mule Mountains; (6) the open pit portion of the Phelps Dodge operation at Bisbee; (7) the Cretaceous section east of the Lavender pit; and (8) the southern part of Sulphur Springs Valley.

0.0	0.0	Junction, Palo Verde and Benson highway. Follow U. S. Highway 80 southeastward across Santa Cruz Valley. At 3:30 in distance is the dump of Pima open pit mine; Helmet Peak and Sierrita Mountains in background; (Trip I). From 9:00 to 10:00, the Santa Catalina (Trip III), Tanque Verde and Rincon Mountains, composed mainly of banded gneisses deformed into broad, westward-plunging folds; at 12:00, Whetstone Mountains; at 2:00, Santa Rita Mountains; at 5:00, Tucson Mountains (Trip IV). Highway leads up a nearly imperceptible grade; the desert floor here is clothed by dark green creosote bushes; with cholla cactus becoming more abundant eastward.
8.3	8.3	Palo verde (covered with yellow flowers in years of abundant rainfall) and slender, spiney ocotillo are abundant.
1.3	9.6	At 9:00: Bare slopes of the western spur of Tanque Verde Mountains are formed on a broad, westward-plunging anticline of gneiss.
5.0	14.6	Vail intersection. At 10:00: Foothills in Colossal Cave area are overthrust blocks of Paleozoic sediments. Patches of crystalline rocks are locally exposed between mountains to north and south. Much of the pass area is underlain by Miocene (?) Pantano beds and alluvium. Some crystalline plates have been thrust over the Miocene (?) sediments (Brennan, 1957).
2.9	17.5	Mountain View. TURN RIGHT on State Highway 83 to Sonoita. Empire Mountains are on left and Mt. Fagan, at north end of Santa Rita Mountains is on right. Yucca, ocotillo and mesquite cover ground.
3.0	20.5	Prospect dump at 2:00. Just after passing entrance to TM Ranch, road cuts through Cretaceous (?) sediments.
1.6	22.1	Andrada Ranch. Enter area shown on figure 23. Empire Mountains to left. Hill nearest road is Permian limestone thrust over Cretaceous (?) shale. Steep cliff on skyline is Eagle Bluff, composed of Permian limestone. Hills to right of road are Cretaceous (?) volcanic rocks. Exposures in wash south of Andrada Ranch are mostly Paleozoic limestones (Galbraith, 21).

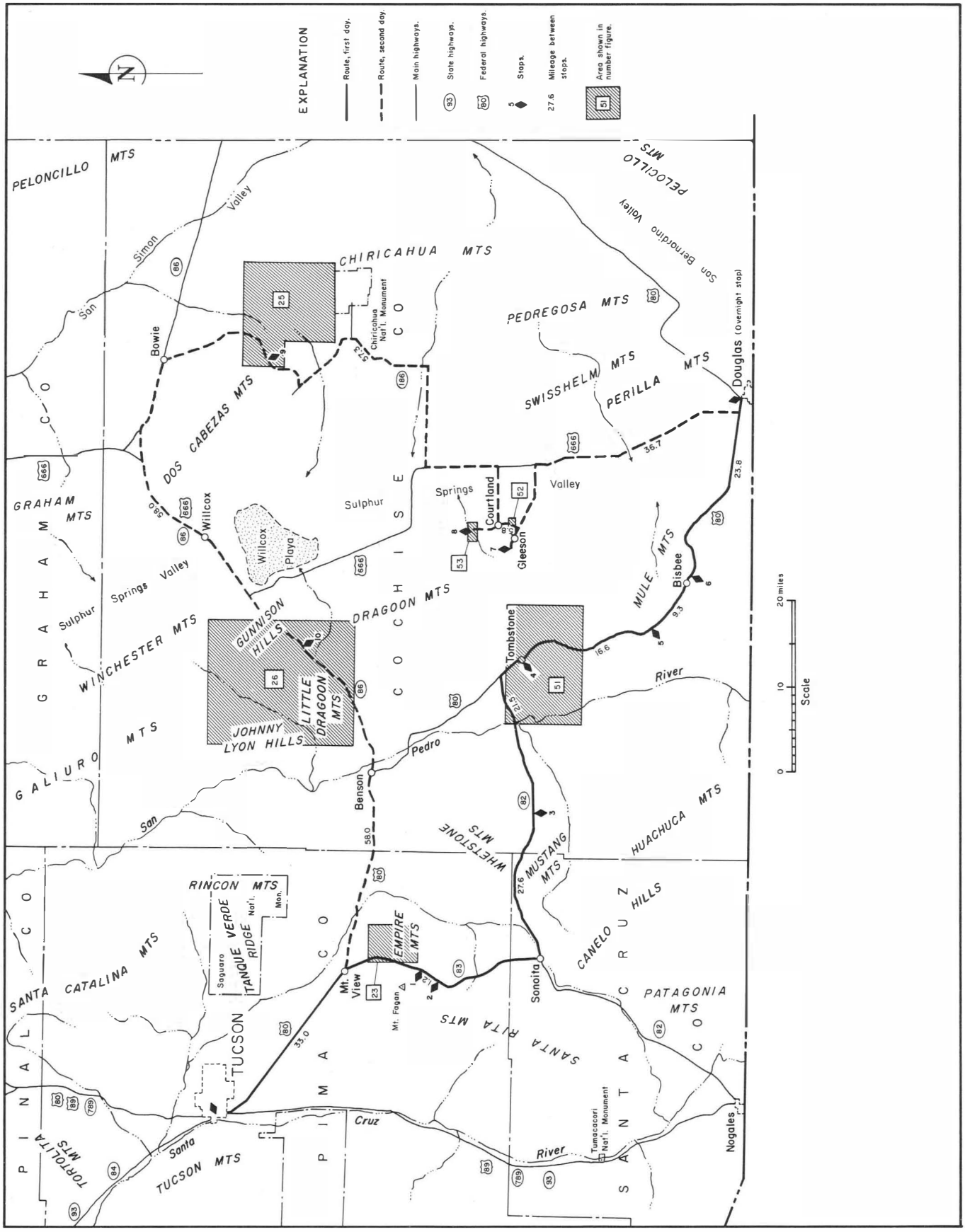


FIGURE 48. Index map of southeastern Arizona showing route of Field Trip V and locations of areas shown on smaller-scaled maps.

According to Schrader (1915), the Empire Mountains consist essentially of a granitic core, located some three miles south of the Andrada Ranch, surrounded by a mantle consisting chiefly of Cretaceous (?) sediments. Along the eastern and southeastern sides of this core, the Paleozoic floor on which the Cretaceous rests has been thrust northwestward over the granite; in the northern and western parts of the mountains, Paleozoic klippen rest on granite and Cretaceous rocks (Galbraith, 21).

3.0	25.1	Cretaceous (?) volcanic rocks along route for about 4.0 miles. Leave area shown on figure 23.
4.6	29.7	Road to Rosemont on right. At 2:30: Dumps of Rosemont mining district are near crest of ridge.
0.2	29.9	Cretaceous (?) conglomerate along road for next one-half mile.
0.6	30.5	Cuesta ahead, composed of Tertiary sediments of the Sonoita bolson, is being dissected by the north-flowing Cienega Wash. Cretaceous (?) beds crop out along north slope of escarpment.
1.9	32.4	STOP 1. (20 minutes) Whetstone Mountains are due east; Little Dragoon Mountains N. 65° E.; Empire Mountains N. 35° E.; Rincon peak, N. 30° E.; Tanque Verde Mountains, N. 10° E.; Mt. Fagan, N. 40° W.; dumps of Rosemont district, N. 80° W.; Mt. Wrightson (9,432 feet) in the Santa Rita Mountains, S. 65° W.; Cuesta ahead.

The geology of the Santa Rita Mountains has become known largely through the pioneering work of Schrader (1915), a recent study by the U. S. Geological Survey (Creasey and Quick, 1955), and theses by students of the Department of Geology, University of Arizona (Dunham, 1937; Popoff, 1940; Johnson, 1951; Anthony, 1951; Sulik, 1957; Browne, 1958; and Lutton, 1958). From the viewpoint at this stop one sees the eastern slope and skyline of the Santa Rita Mountains from the northern end to Mt. Wrightson (fig. 49A). Most of this slope consists of Cretaceous sediments which dip eastward. Underlying these, along the crest of the range, is the Paleozoic sequence, ranging from the Cambrian Bolsa quartzite upward to the Permian Scherrer formation. The Paleozoic rocks, according to Schrader (1915), have been thrust westward over a granitic basement which is west of the crest. In Sawmill Canyon, about 5 miles in front of Mt. Wrightson, is a west-northwest-trending left lateral strikeslip fault (Lutton, 1958). Mt. Wrightson itself is rhyolite, flanked on the east by andesite and on the west by quartz diorite, granite, and a thin septum of dark greenish schist, thought by Schrader (1915) to be of possible Cambrian age.

The Rosemont mining camp, a southeasterly extension of the Helvetia copper-gold-silver district, is located on the west side of the crest. According to Schrader (1915), the copper mineralization at Rosemont was mostly in silicified Paleozoic limestone near intrusive contacts.

0.4	32.8	Road climbs through southeast-dipping Tertiary beds, covered with grass, juniper, mesquite and scrub oak.
1.4	34.2	STOP 2. (20 minutes). View southeastward over grassy uplands, mountains and Sonoita Valley: On the left, the Whetstone Mountains; at 11:00, Mustang Mountains; 12:00, Huachuca Mountains; from 12:00 to 2:00, Canelo Hills; at 3:00, Mt. Wrightson.
1.6	35.8	Greaterville-Box Canyon road to right.
1.1	36.9	Coronado National Forest boundary.
0.8	37.7	At 2:30: Abandoned oil derrick; hole was drilled to depth of 3,394 feet and bottomed in "shale" (Johnson, 14).
2.2	39.9	Cenozoic red beds in bluff to right.
0.5	40.4	Enter Santa Cruz County. Rolling surface is covered by grass, bear grass, yucca, scrub oak and mesquite.

3.7	44.1	Sonoita. STOP. TURN LEFT (east) on Highway 82. In the Canelo Hills to the south, a sequence of Cretaceous (?) and Tertiary (?) conglomerates, redbeds and volcanic rocks, totalling perhaps 3,500 feet, has been overridden, possibly from northeast to southwest, by about 2,200 feet of Permian deposits. Route leads toward pass between Whetstone Mountains on left and Mustang Mountains on right.
5.2	49.3	Bridge. Road winds over Tertiary valley fill. Yucca becomes abundant near base of Mustang Mountains on right.

The western half of the Mustang Mountains, southwest of Rain Valley (fig. 49B), is composed of Permian sediments which were first described as the Snyder Hill formation and divided into 5 members (Bryant, 1951). Later, Bryant (1955) correlated the 4 lower members with the Scherrer and Concha formations and described the top member as the "Rainvalley formation." These rocks are locally overlain by Cretaceous (?) clastics and Tertiary rhyolite. The massive cliffs south of the highway are Permian Concha limestone.

Grantham Mountain, the summit near the southern end of the ridge, is rhyolite, and Quail Peak, the highest point near the northwestern end, is capped by Cretaceous clastics and rhyolite. On Grantham Mountain, the Permian rocks may have overridden the Cretaceous (?), possibly from northeast to southwest, on a gently-inclined thrust. Cretaceous (?) rocks are exposed at several places along the northeastern base of the ridge. Postthrust (?) normal faults have divided the area into many small fault blocks.

The Mustang Mountains northeast of Rain Valley and the southern part of the Whetstone Mountains have not been mapped in detail. The northern half of the Whetstones has been mapped by Tyrrell (1957).

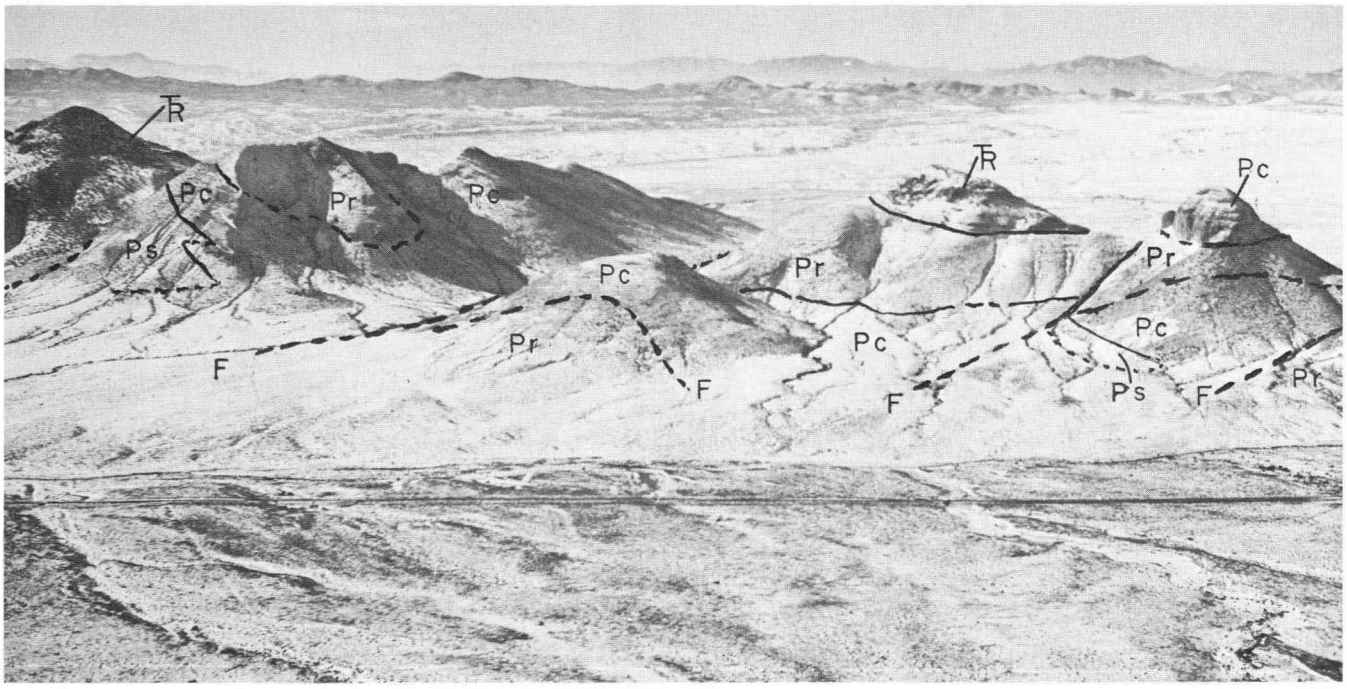
2.5	51.8	At 2:00: High dome is "The Biscuit", with cliffs of Concha limestone; at 10:00, granitic core of Whetstone Mountains, flanked by Paleozoic formations from 11:00 to 12:00.
2.6	54.4	At 2:30: Sharp folding in Permian limestones, near northwestern end of Mustangs.
2.4	56.8	Rain Valley ranch on right.
0.4	57.2	Road passes around south end of Whetstones with their sharply folded Paleozoic sediments. Enter Cochise County.
4.6	61.8	STOP 3. (15 minutes). There will be a brief discussion of the Paleozoic section exposed in the east face of the Whetstone Mountains to the left of the road (fig. 50A). The San Pedro Valley lies ahead, and beyond, the Dragoon Mountains are at 11:00, and the Mule Mountains are at 1:00. The Huachuca Mountains are at 3:00.

On the northeastern slope of the northern Huachuca Mountains, older Precambrian granite crops out with a few small patches of gently northeast-dipping Cambrian Bolsa Quartzite resting on the granite near the foot (Alexis, 1949). High within the mountains, the Bolsa quartzite and overlying Paleozoic rocks are overlain by a thick Cretaceous section. This entire section dips rather steeply southwestward. The Cretaceous rocks are broadly folded and the beds are locally overturned.

The structure is a huge anticline with a Precambrian core and limbs of Paleozoic and Cretaceous sediments overturned and overthrust to the southwest (Alexis, 1949). The crest has been eroded and the present highest part of the Huachucas is the steep southwest flank of the fold. The thrust surface rises at a moderate angle toward the southwest from beneath the granite core, then flattens, and locally reverses in dip. Weber (1950) shows essentially the same structural picture in the east-central Huachucas, except that the southwestward thrusting is developed on both sides of the core and imbrication is well developed.

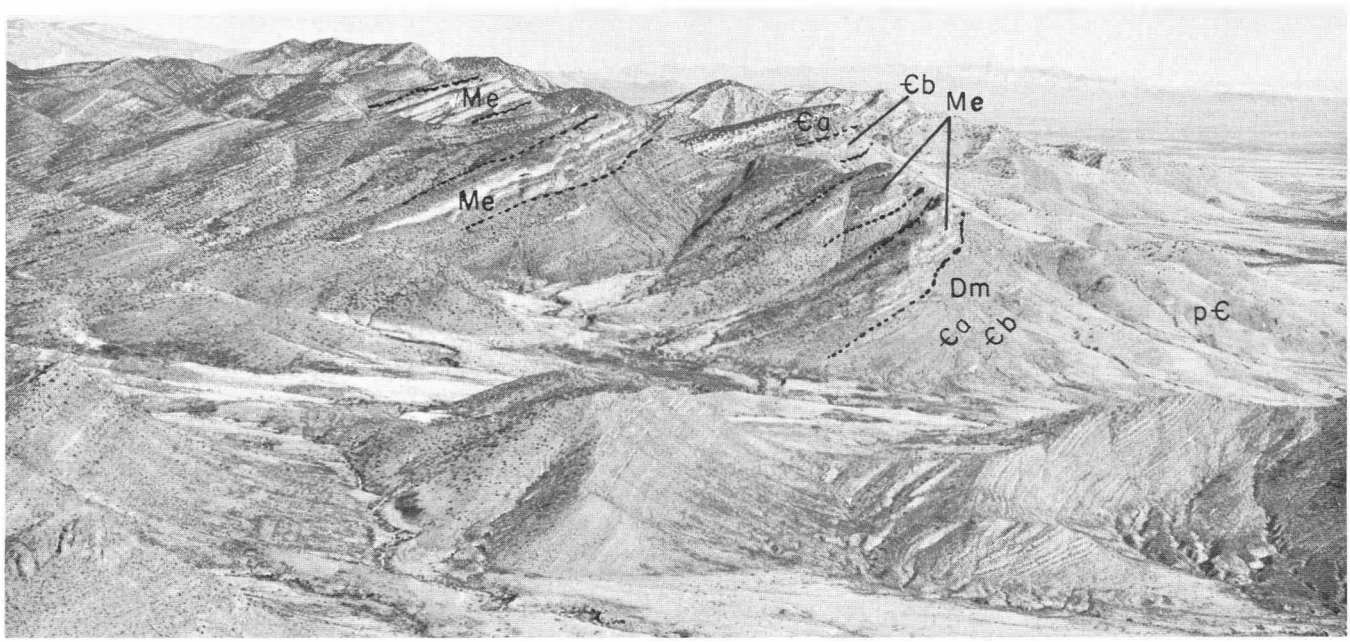
0.8	62.6	Sands Ranch entrance on left. Eight miles north on Sands Ranch Road (for jeeps only) is an excellent Paleozoic section from Precambrian through Permian (fig. 50A).

A. Mount Wrightson, Santa Rita Mountains, from northeast. The Sawmill Canyon fault zone occupies the transverse trench in foreground.

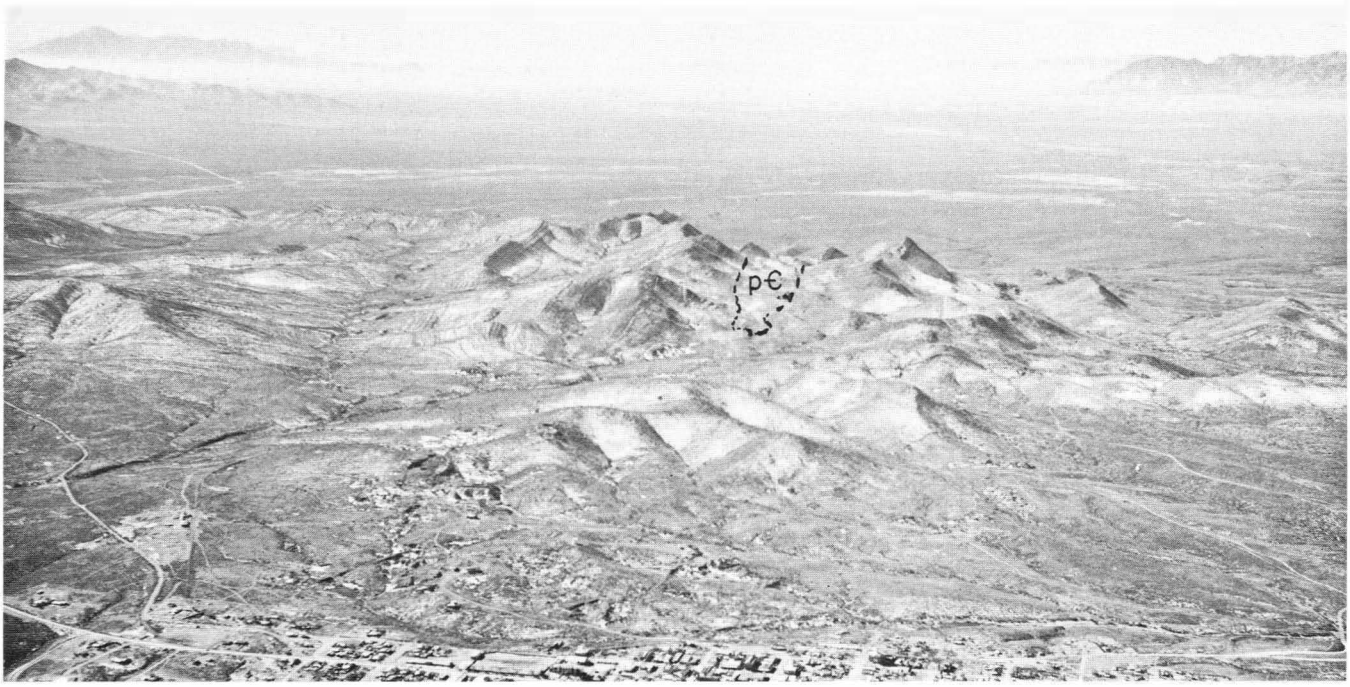


B. Mustang Mountains from north. Left to right: Grantham Mountain; Cave Cliff; Quail Peak; The Bisbuit. Tertiary rhyolitic volcanic rocks underlain by Cretaceous (?) clastic rocks (Tr); Permian "Rainvalley" formation (Pr), Concha limestone (Pc), Scherrer formation (Ps). Canelo Hills in background.

FIGURE 49. Aerial views of Mount Wrightson in the Santa Rita Mountains and the Mustang Mountains, Cochise, Pima, and Santa Cruz Counties, Arizona. Photos by Tad Nichols.



A. Faulted Paleozoic section on east face of Whetstone Mountains, seen from the south. Smooth slopes at right are on Precambrian rocks. Cambrian Bolsa quartzite (€b), Abrigo formation (€a); Devonian Martin formation (Dm); Mississippian Escabrosa limestone (Me), overlain by Pennsylvanian-Permian succession. Hills in foreground are Pennsylvanian strata.



B. Tombstone Hills from north (fig. 51). Precambrian (p€)core of north-south anticline. On east flank, Paleozoic formations, west to east, are Cambrian Bolsa quartzite and Abrigo limestone, Devonian Martin limestone, Mississippian Escabrosa limestone, Pennsylvanian Horquilla limestone. The Horquilla limestone underlies Grand (Emerald) Gulch in the left hand part of the picture. Huachuca Mountains in distance on right; Mule Mountains on left, in front of the haze.

FIGURE 50. Aerial views of Whetstone Mountains and Tombstone Hills, Cochise County, Arizona. Photos by Tad Nichols.

0.7	63.3	Fort Huachuca turn off on right. Continue STRAIGHT AHEAD. Tombstone Hills lie ahead. The Tombstone Hills are a minor geologic province of great interest and complexity. The type localities of four Paleozoic formations, the Pennsylvanian Horquilla limestone, the Pennsylvanian-Permian Earp formation, and the Permian Colina limestone and Epitaph dolomite are in these hills (Gilluly, 1956). Some two to five miles south-southwest of Tombstone, a north-trending anticline (fig. 50B), flanked on the east by the Paleozoic sequence and overlain unconformably on the west by the Cretaceous Bisbee formation, brings up a core of older Precambrian Pinal schist and albite granite. In the southern part of the hills and in Government Butte to the southeast, the Paleozoic rocks are in east-west folds that have been overturned to the south, and, locally, have ridden, relatively, southward on north-dipping flat thrusts. Following this deformation, the area apparently was eroded, and a volcanic sequence (Tertiary Bronco volcanics), commencing with andesite and progressing to quartz latite tuff, was erupted. Gilluly (1956) suggested that subsequent to this, northwest-trending folds and thrusts and some east-northeast tear faults were formed. These events seem to have been followed by emplacement of the Uncle Sam (quartz latite) porphyry (Gilluly, 1945), the Schieffelin granodiorite, intrusive rhyolite (?) and andesite porphyry. The Uncle Sam porphyry may have been emplaced, in part, along a flat thrust. Most of the productive silver-lead mines of Tombstone were located in a north-of-west-trending syncline in the Cretaceous Bisbee formation. The ore was associated with northeast fissures, where these crossed the famous "rolls" -- intense minor contortions within the syncline. The stratigraphy of the Tombstone district was discussed by Ransome (1916) and the geology in relation to the ore deposits has been described by Butler, Wilson and Rasor (1938) and by Butler and Wilson (1938).
1.2	64.5	Graham village; road continues eastward over Tombstone pediment (Bryan, 1926; Gilluly, 1956). Bryan (1926) described 3 pediments in the San Pedro Valley. The Tombstone surface is the oldest and highest; the Whetstone surface is younger than the Tombstone surface and is the most widely developed in the valley. The youngest and lowest surface is called the Aravaipa and is developed locally along the San Pedro River, a few feet above the flood plain of the inner valley.
3.2	67.7	At 11:00: Cochise Stronghold, retreat of the famous Apache chief, is in the Dragoon Mountains.
0.6	68.3	At 2:30: Fairbank Hills, composed of Tertiary Uncle Sam porphyry intruded into Cretaceous or Tertiary Bronco volcanics; at 4:00: Ft. Huachuca at the base of Huachuca Mountains; at 9:30 to 10:00: Little Dragoon Mountains.
2.3	70.6	Road descends from Tombstone pediment to younger Whetstone pediment.
2.8	73.4	Bridge across the San Pedro River. The San Pedro River rises in Sonora, Mexico, and flows northward to join the Gila River at Winkelman, Arizona. Higher cliffs along edges of inner valley are composed of beds of late Pliocene (?) or early Pleistocene age. The flood plain of the inner valley of the San Pedro River and the Aravaipa surface form the two successive surfaces above the channel of the river. Mesquite and cottonwood trees grow profusely on the floodplain of the inner valley. Overpass crosses Southern Pacific tracks; Fairbank station on left. Enter area shown on figure 51.
3.0	76.4	At 7:00 to 9:00: Dissected alluvial deposits of the San Pedro Valley; at 2:00 to 3:00: Tombstone Hills.
1.3	77.7	At 3:00: Uncle Sam Hill, composed of Tertiary Uncle Sam porphyry.
0.7	78.4	At 2:00: Tombstone.
0.6	79.0	Stronghold granite at Cochise Stronghold in Dragoon Mountains to the north.
0.7	79.7	Intersection with U. S. 80. STOP. TURN RIGHT.

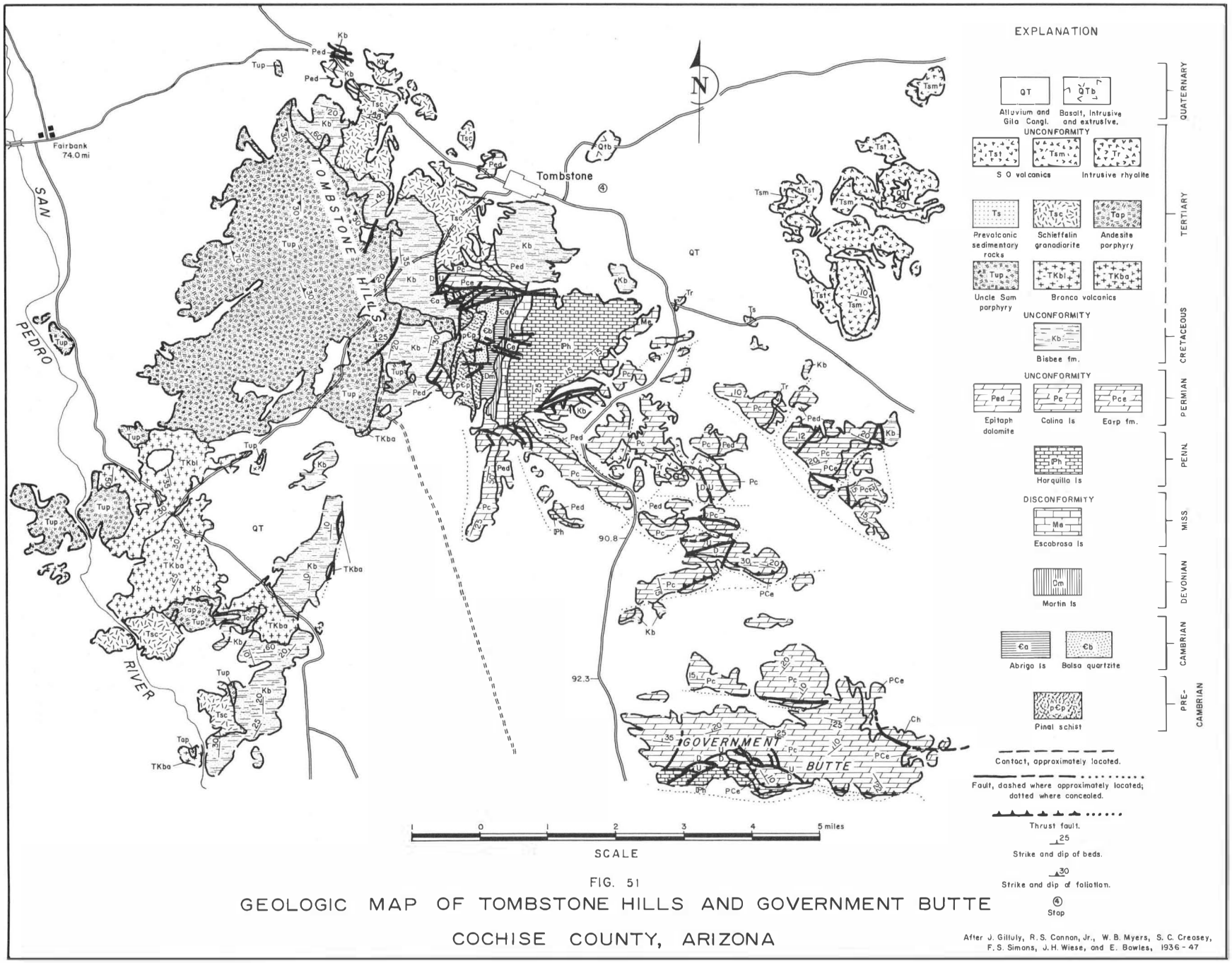


FIG. 51

GEOLOGIC MAP OF TOMBSTONE HILLS AND GOVERNMENT BUTTE

COCHISE COUNTY, ARIZONA

After J. Gilluly, R. S. Cannon, Jr., W. B. Myers, S. C. Creasey, F. S. Simons, J. H. Wiese, and E. Bowles, 1936 - 47

1.6	81.3	Bridge. Road cut in Pliocene-Pleistocene conglomerate.
0.9	82.2	Entering Tombstone, famous old silver mining camp. Today Tombstone prides itself on being "the town too tough to die". Boothill Graveyard at left. Altitude, 4,539 feet.
0.8	83.0	STOP 4. (One hour). Lunch and visit to Million Dollar Stope and other points of interest. According to Meinzer and Kelton, (1913, p. 14) the rich silver deposits of Tombstone were discovered in February, 1878, by A. E. Schieffelin. Schieffelin had been warned that he would find a tombstone instead of a fortune in Cochise's domain, and in remembrance of this warning he named the district Tombstone. "Thousands of locations were staked out and many valuable discoveries made and a city sprang into existence as if by magic." It enjoyed great fame and prosperity in the early eighties, but was later eclipsed by the Bisbee district. Among the surviving features of this picturesque old mining camp are the Boothill Graveyard at the northern edge of the town, and the Million Dollar Stope, one block west of the center of town.
0.7	83.7	Gleeson-Pearce road turns off at left. Continue on Highway 80, through road cuts in Pliocene-Pleistocene conglomerate.
0.7	84.4	At 2:00: Hill is mostly Pennsylvanian Horquilla limestone and Tertiary intrusive rhyolite.
0.2	84.6	Permian Colina limestone exposed in ridge on right. For next two miles road cuts are in the Colina and Mississippian Escabrosa limestones.
1.4	86.0	At 3:00: Contact between Escabrosa limestone below and Horquilla limestone above.
1.1	87.1	At 12:00: Government Butte; Paleozoic limestones in hills to right and left; Colina limestone to right.
0.8	87.9	Road descends rapidly through cuts in Colina limestone and intrusive rhyolite.
0.3	88.2	Tertiary intrusive rhyolite in red hill at left and in low red hills to right. Colina limestone in hills above and behind rhyolite; Huachuca Mountains at 2:00; Cananea Mountains in Mexico at 12:00. On some days, smoke from the Cananea smelter can be seen in front of the Cananea Mountains.
0.7	88.9	At 3:00: Colina limestone dipping steeply northward. At 9:00: Contact between Permian Epitaph dolomite and the underlying Colina. At 8:30 nearly horizontal beds of the Epitaph form the rounded hill.
0.5	89.4	At 10:00: Earp Hill, type locality of Pennsylvanian-Permian Earp formation. Anticline exposed in grey Colina limestone is thought by Gilluly to be related to a flat thrust that crops out on south slope of Earp Hill.
0.5	89.9	Looking back at Earp Hill, pinkish beds of Earp formation appear to be overridden by Colina limestone.
1.6	91.5	Government Draw. At 11:00: Government Butte is Colina limestone. Cretaceous Bisbee group and volcanic rocks are exposed in San Pedro Valley at right.
1.5	93.0	At 9:00: Complicated structure on south side of ridge in Colina, Horquilla and Epitaph formations. In Government Butte and in Earp Hill, some formations are thought to have moved relatively southward, overriding other rocks. Leave area shown on figure 51.
1.2	94.2	At 7:00 to 8:00: Complex structure on south side of Government Butte. Mule Mountains at 9:00 to 2:00. Ransome's (1904) classic paper on the Bisbee mining district gave the Mule Mountains a prominent position in southeastern Arizona geology. Here the Paleozoic

section was described and the Cambrian Bolsa quartzite and Abrigo limestone, the Devonian Martin limestone, the Mississippian Escabrosa limestone, and the Pennsylvanian-Permian Naco limestone (since raised to group status) were named (see articles 6 through 10). In the Cretaceous system, the Lower Cretaceous Bisbee group, consisting of the Glance conglomerate, Morita formation, Mural limestone and Cintura formation, was defined (Fergusson, 11).

The oldest rock found in the Mule Mountains is the older Precambrian Pinal schist, which was intruded by the Juniper Flat granite. The age of the Juniper Flat granite has long been under discussion. It is known to intrude the Paleozoic sequence, and Ransome assigned the granite to the Triassic or Jurassic. The upper contact is not so readily defined and it was only recently that the Juniper Flat granite was shown clearly to be overlain depositionally by the Bisbee group. It could be Nevadan in age.

Although interpretations of structure are handicapped by a lack of information on the southwestern part of the Mule Mountains, the structure of this area resembles that of the Tombstone Hills. Nearly east-west structural trends occur in the Bisbee and Tombstone districts, whereas to north and south the trends are more nearly meridional. The resulting over-all pattern resembles a large "S"-curve with a nearly east-west central bar. A thrust fault southeast of Bisbee appears to have adjusted north-south trends to east-west structures in that area.

0.5	94.7	Gently dipping Cretaceous Morita formation in ridge at left. At 11:00; apparent contact of Morita on Pinal schist. Gilluly (1956) shows a thin layer of Glance conglomerate at the contact. A fault separates the Morita and Paleozoic rocks along the south side of Government Butte.
1.5	96.2	Escabrosa limestone is in hill to left of road; Horquilla in hill to right.
0.3	96.5	Bridge, just past curve. Route ascends southward into the Mule Mountains. On skyline ahead, the west-dipping Paleozoic sediments seem to change strike from south toward east.
0.4	96.9	Cambrian Bolsa Quartzite and Abrigo limestone are cut by Triassic or Jurassic Juniper Flat granite along ridge to left of road ahead. Escabrosa limestone at right.
0.5	97.4	Juniper Flat granite and Devonian Martin limestone on right of road.
0.9	98.3	Enter highway cut in Martin limestone. Just before entering cut, Bolsa quartzite on left. On right side of cut, intrusive rhyolite. On emerging from cut, note stock of intrusive rhyolite in late Paleozoic sediments straight ahead.
0.2	98.5	Cliff of Escabrosa limestone on right.
0.1	98.6	Exposures of Cambrian Bolsa quartzite and Abrigo limestone on left.
0.2	99.7	STOP 5. (15 minutes) Juniper Flat granite straight ahead and on left, where it intrudes Paleozoic rocks and Early Precambrian Pinal schist. At 8:30 to 9:00, Bolsa quartzite overlain by Abrigo limestone; at 9:30, knob of granite; at 10:30, Pinal schist on hill. At 10:00, on skyline, Morita formation dipping gently northeast. Fault passes up valley. Upthrown side is on the north. To the south, Escabrosa limestone on skyline overlies Martin limestone; Abrigo limestone is present under Martin beyond ridge. Escabrosa to west; exposures of Horquilla limestone in distance, through gap.
0.2	99.9	Road ascends Tombstone Canyon through cuts in granite and in faulted slivers of Cambrian Bolsa and Abrigo rocks.
0.7	100.6	Cliffs ahead are Juniper Flat granite.
0.8	101.4	Juniper Flat granite to left and Pinal schist at right. Road and stream apparently follow contact up canyon. Ransome's map shows an intrusive contact, but the contact may be the westward continuation of the Dividend fault (B. S. Butler, oral communication).

1.5	102.9	Road cuts in Pinal schist. Granite in cliffs and slopes to left of road.
1.9	104.8	TURN LEFT on old road over pass.
0.3	105.1	Tunnel entrance below at right.
0.2	105.3	Mule Pass (altitude 6,038 feet). Road loops down Mule Gulch. Dumps at new Lavender pit can be seen below in canyon. Granite and Pinal schist in road cuts.
0.3	105.6	Hairpin turn. At 11:00, top of Mural Hill on skyline, capped by Mural limestone; below is the southeast end of the Juniper Flat granite. Hill east of granite is Pinal schist. Road enters Bisbee, altitude 5,300 feet, and winds downward, through sharp curve in Martin limestone at Castle Rock in middle of town.
2.4	108.0	Copper Queen Hotel. Pinal schist crops out at its back door; bright colored granite porphyry at 10:00; Naco group at 3:00.
1.0	109.0	STOP 6. (30 minutes) Lavender pit of Phelps Dodge Corporation. Talks will be given on the open pit operation and on the geology of the Bisbee mining district, which has a production in excess of 2 billion dollars.
0.8	109.8	Traffic circle, TURN RIGHT, off circle at sign reading El Paso and Douglas. The Glance conglomerate is exposed in road cut to right just beyond circle. To the left is a cliff of Mural limestone near the crest of a ridge with Morita underneath.
0.2	110.0	Shattuck Denn Mine at 9:00.
0.4	110.4	Stripping dump on right. Morita formation in hills to the left and right dips eastward.
1.1	111.5	Paved road turns off to right. CONTINUE STRAIGHT AHEAD.
0.9	112.4	To left is a gray cliff of Mural limestone. Stoyanow (1949) separated the less resistant lower beds from Ransome's Mural and called it the Lowell formation. Here, the Lowell formation forms a smooth slope just below the Mural limestone (restricted) cliff and is underlain by the Morita beds. The Cintura formation lies above the Mural cliff. At 1:00 is a fault with Morita (?) at right, Mural on left.
0.4	112.8	Road cut in vertical beds; highway crosses the Mural limestone, and continues in the Cintura formation.
1.0	113.8	Leave lower Mule Gulch.
0.2	114.0	Sulphur Springs Valley ahead.
0.1	114.1	Elfrida short cut on left; CONTINUE ON HIGHWAY. Highway bears right along base of mountains composed of Cretaceous sediments. Sulphur Springs Valley on left; Perilla Mountains at 10:00, with Guadalupe Mountains beyond in New Mexico; Swisshelm Mountains at 8:30, Pedregosa Mountains at 9:00 to 9:30.
2.4	116.5	Phelps Dodge smelter at 10:30.
1.3	117.8	High mountain at 1:30 is in Mexico.
0.9	118.7	Culvert over Glance Creek. At 3:00, limestone of the Naco group in the Mule Mountains are thrust westward (?) over Cretaceous sediments. In hills at 12:00, the Cretaceous Mural limestone dips gently southwest.
1.1	119.8	Pass exposure of Mural limestone on left; curve left; pass Mural exposure on right.
0.9	120.7	At 9:00, Swisshelm Mountains; at 9:30, Chiricahua Mountains (high and dark) in distance; at 10:00, Pedregosa Mountains; at 10:30, Perilla Mountains, all on the far side of Sulphur Springs Valley. Mural limestone quarried on right for smelter flux.

9.8	130.5	Phelps Dodge smelter on right; cross bridge over Whitewater Draw. Whitewater Draw flows into Mexico and joins the Rio Yaqui which flows into the Gulf of Lower California.
0.6	131.1	Road to Elfrida enters on left. CONTINUE STRAIGHT AHEAD.
1.0	132.1	Enter Douglas, altitude 3,990 feet, founded 1902 and named after Dr. James Douglas, one of the principal developers of large scale mining operations in Arizona.
0.4	132.5	Underpass and curve right.
0.4	132.9	Gadsden Hotel.

- END OF FIRST DAY -