GENERAL GEOLOGY OF SOUTHEASTERN ARIZONA

TRIP V, ROAD LOG

(Continued)

Second Day -- April 6, 1959

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

Driving Distance: 225.7 miles Logged Distance: 216.9 miles

Starting Time: 7:00 A.M.

General Statement:

The route leads northward, along the axis of Sulphur Springs Valley to Elfrida. From Elfrida the course is westward to the southern Dragoon Mountains and the old mining camps of Gleeson and Courtland. It will then continue northward along Sulphur Springs Valley, finally turning eastward to ascend the outwash apron of the Chiricahua Mountains. The route will then head northward and northeastward over Apache Pass, and on to Bowie and State Highway 86. From Bowie the route is southwestward to Willcox, then along the northern margin of Willcox Playa. It ascends southwestward past the northern edge of the Red Bird Hills, passes between the Gunnison Hills and Steele Hills, crosses the Little Dragoon Mountains via Texas Canyon, and descends to Benson on the San Pedro River. Beyond Benson the highway ascends westward between the Whetstone Mountains on the south and the Rincons on the north to Mountain View, and on to Tucson.

The party will see: (1) the thrust blocks, intrusions and abandoned mining camps of the southern Dragoon Mountains; (2) some of the volcanic rocks of the northern Chiricahua Mountains; (3) the Precambrian granite and the Cretaceous and Paleozoic sections in Apache Pass; (4) Willcox Playa, lowest part of Sulphur Springs Valley; (5) the Paleozoic section of the Gunnison Hills, and the younger Precambrian Apache and Paleozoic sequences of the Little Dragoon Mountains; (6) the porphyritic granite of Texas Canyon; and (7) the steeply-dipping Miocene (?) Pantano beds west of Benson.

0.0	132.9	Leave Gadsden Hotel.
0.3	133.2	Underpass, and curve left.
0.6	133.8	Leave Douglas.
1.0	134.8	U. S. Highway 666. TURN RIGHT. At 3:00, Perilla Mountains; at 1:00, Pedregosa Mountains, with Chiricahua Mountains beyond; at 12:15, Swisshelm Mountains; at 10:30, Dragoon Mountains; at 9:00 to 10:00, Mule Mountains. Route leads northward along Sulphur Springs Valley.

The correlation of lower Paleozoic strata in this area is in question at the present time. Sabins (1957a) described the Cambrian Bolsa and Abrigo strata in Arizona as the lithogenetic equivalents of the Cambrian Bliss and Ordovician El Paso strata in New Mexico, whereas Epis and Gilbert (1957) contend that they are not. The problem is reviewed by Dickenson (6); see road log at mileage 236.7. In the Chiricahua Mountains, Sabins (1957a) proposed the Devonian Portal formation which he suggested was a facies change between the Martin limestone of southern Arizona and the Devonian Percha shale of New Mexico. Epis, Gilbert and Langenheim (1957) suggested that, in the Pedregosa and Swisshelm Mountains, the equivalent of the Portal formation is only the lower part of the Martin limestone. They proposed to separate the lower part of the Martin as the Swisshelm formation and suggested that the Devonian Percha, Portal, Swisshelm and Morenci formations are all somewhat older than the Martin limestone (Pye, 7).

6.9	141.7	Bisbee-Douglas airport on right. Continue northward along axis of valley between Swisshelm Mountains on right and Mule Mountains on left.

Sulphur Springs Valley extends northward about 90 miles from the International Boundary. It has an average width of about 20 miles, and an area of about 1,800 square miles. The southern two-fifths of this area, the Douglas basin, is trib-

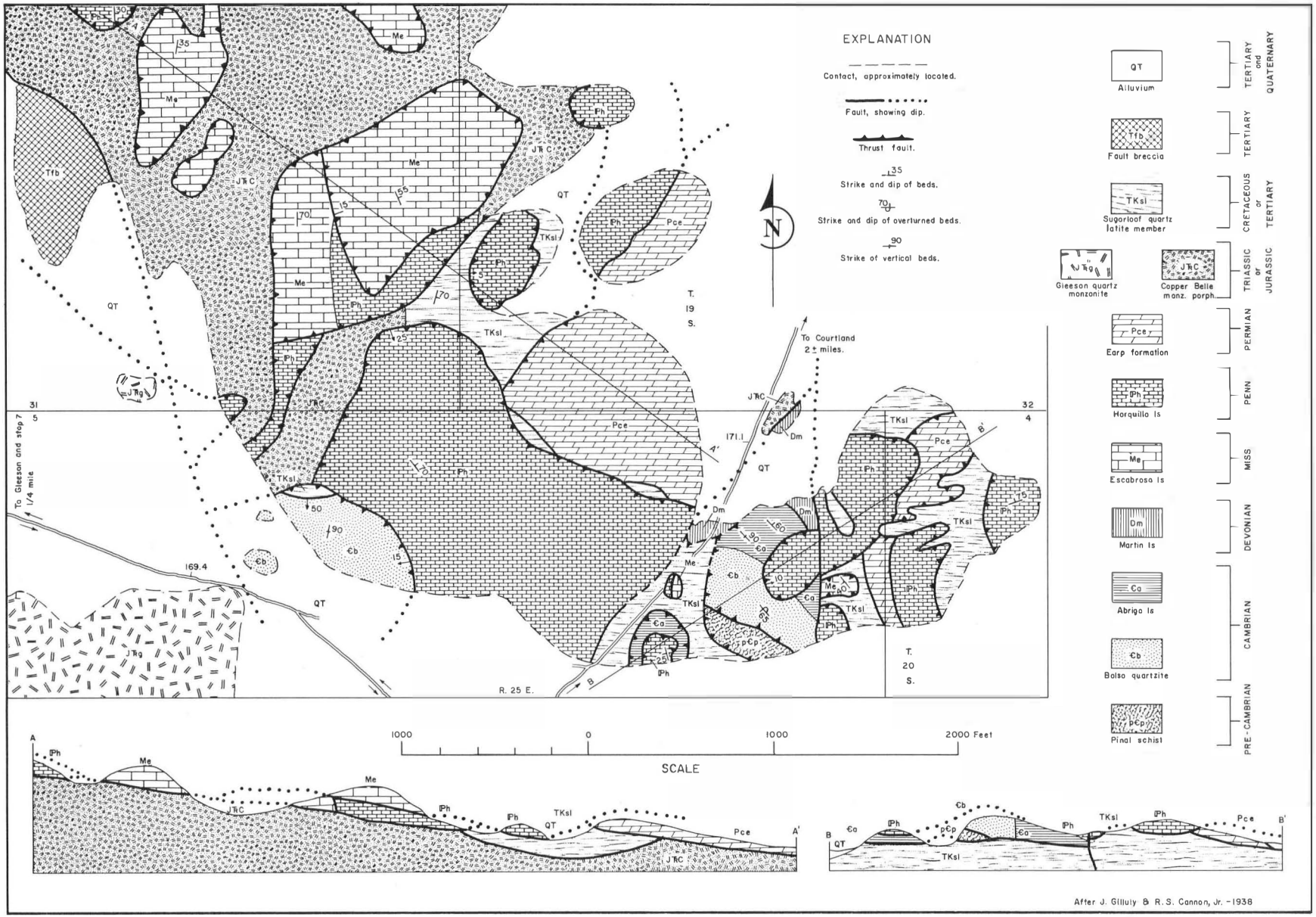


FIGURE 52. Geologic sketch map and cross sections of area east of Gleeson, Cochise County, Arizona, illustrating representative relationships in the thrust breccia of the Courtland-Gleeson area, (after Gilluly, 1956).

utary to Whitewater Draw, which drains into the Yaqui River in Mexico; the northern three-fifths forms a depression of interior drainage, the Willcox basin, with a large barren alkali flat, the Willcox Playa (mileage 274. 6), in the lowest part. The valley is named for Sulphur Springs at the southern end of the alkali flat, about six miles north of Pearce. The valley alluvium ranges in thickness from less than 100 feet to more than 2, 000 feet (Meinzer and Kelton, 1913; McKee, 1951). Lake beds are known to occur within the valley fill (Meinzer and Kelton, 1913; Coates, 1955).

Irrigation farming, mostly concentrated near and south of Elfrida, is the most important industry in the southern basin of Sulphur Springs Valley, except for copper smelting. The agricultural areas are determined by depth to water and character of the soil. The Willcox basin is also extensively farmed except for the alkali flat. Ranching is practiced mostly in the higher lands bordering the valley.

7. 6	149. 3	Dos Cabezas Mountains at 1:00; Pinaleno, or Graham, Mountains at 12:30 in far distance; Sulphur Hills in foreground.
1. 1	150. 4	Curve right. Flat-topped Bowie Mountain at northern end of Chiricahua Mountains at 1:00 (fig. 54A); Square Top Hills at 12:30.
3. 0	153. 4	McNeal, altitude 4, 154 feet. Road enters from left; KEEP STRAIGHT AHEAD. Pinaleno (Graham) Mountains at 12:00, with Pearce Hills and Sulphur Hills in foreground. From here northward, agriculture increases.
3. 7	157. 1	Cochise Head (fig. 24), named for its resemblance to the head of the famous Apache chief, is in view on the Chiricahua skyline at 2:00; Swisshelms at 3:00. Granitic intrusions into Paleozoic sediments are visible on western slope of the northern end of the Swisshelms.

Loring (1947) mapped the Mountain Queen area on the eastern side of the Swisshelms near their northern end. The structure is a large anticline with a granitic core dated by Loring as Cretaceous. The granite is partly sheathed by the Bolsa quartzite which is overlain by the younger Paleozoic succession. The Paleozoic formations on the eastern limb of this fold have been thrust westward toward the granite core, according to Loring, and, locally, Upper Paleozoic strata rest with thrust contact on the Cambrian. To the east, Tertiary volcanic rocks overlie the thrust structure.

2. 2	159. 3	Road from Bisbee enters at left. KEEP STRAIGHT AHEAD into Elfrida.
1. 3	160. 6	Gleeson road. TURN LEFT.
1. 0	161. 6	Pavement ends. KEEP STRAIGHT AHEAD. Red, biscuit-like knob at 12:30 is Sugarloaf Hill (not Sugarloaf Mountain shown in fig. 24), composed of Sugarloaf quartz latite. The geology and structure of the Dragoon Mountains has been mapped in detail (Gilluly, 1956). Older Precambrian Pinal schist is exposed along the southwestern base and in the southern part of these mountains; the Paleozoic section, sliced by many flat thrusts and cut by later steep reverse faults, lies in disorder along the eastern slope (fig. 52). Northwest of Courtland, along the eastern base of the mountains, the Bisbee formation lies under the thrust plates in a northeastwardly-overturned, southeastward-plunging syncline. Most of the southern end of the Dragoon Mountains is composed of Gleeson quartz monzonite, a possible correlative of the Juniper Flat granite of the Mule Mountains. Associated rocks in the Dragoons that may be of approximately the same age are the Copper Belle monzonite porphyry, the Cochise quartz monzonite and the Turquoise granite.

Subsequent to emplacement of these granitic rocks, but before the thrusting, a volcanic formation, the Sugarloaf quartz latite, accumulated. The thrust sheets seem to have advanced from southwest to northeast. The belt of thrust slices bends abruptly eastward along the northern border of the Gleeson quartz monzonite, then bends southward again to Courtland and Gleeson. The east-west portion of the thrust belt may be a tear, controlled by the shape of the Gleeson quartz monzonite, or by the southward plunge of the syncline of the Bisbee formation. The thrusting movements have resulted in extremely complicated struc-

tures. The thrusts originated in post-Bisbee time. The earliest adjustments were on flat overthrusts; later ones were on steep upthrusts.

Subsequent to the thrusting, in the Cochise Stronghold area, the Stronghold granite was emplaced, apparently causing only a broad, gentle doming of pre-existing structures. Southeast of the main mass, dike-like or sill-like bodies of the Stronghold granite were injected along the strike of the Bisbee formation.

The mining camps of Courtland and Gleeson are located in the most complicated portion of the belt of thrust slices, east of the Gleeson quartz monzonite. The geology and ore deposits of the Courtland-Gleeson area were briefly discussed by Ransome (1913) and later by Wilson (1927).

2.1	163.7	Road bends to northwest; Sugarloaf Hill at 11:30.
3.2	166.9	Road bends to north-northwest.
0.4	167.3	Thrust blocks ahead.
0.5	167.8	At 2:00, reddish-colored Brown's Peak composed of Cambrian Bolsa quartzite. Road passes over Horquilla limestone in thrust block.
0.8	168.6	Courtland turn off to right. KEEP STRAIGHT AHEAD. Enter area shown on figure 52 in 0.3 mile.
0.6	169.2	Gleeson Hill on right, with contorted Escabrosa and Horquilla limestones thrust over Copper Belle monzonite porphyry. Dumps of Silver Bill mine.
0.5	169.7	Shannon Mining Company road on right. KEEP STRAIGHT AHEAD.
0.2	169.9	TURN RIGHT into Gleeson.
0.2	179.1	STOP 7. (30 minutes). Workings on Gleeson Hill to east explore thrust faults dipping east. Escabrosa limestone is overlain by Horquilla on ridge top. Copper Belle monzonite porphyry forms slopes below limestone. Small block of Bolsa quartzite makes knob at southwest base. Copper Belle monzonite porphyry, Cretaceous-Tertiary Sugarloaf quartz latite, Cambrian Abrigo limestone and Mississippian Escabrosa limestone are exposed in patches. Brown's Peak, with Bolsa quartzite underlain by Turquoise granite, is on skyline to northeast. The pink mountain to the northwest is alaskite associated with Gleeson quartz monzonite. TURN AROUND.
0.2	170.3	TURN LEFT on main road.
1.2	171.5	TURN LEFT on Courtland road. Sugarloaf quartz latite to right before turn. Low hills to left are Gleeson quartz monzonite.
0.5	172.0	Bolsa on Brown's Peak at 10:00. Exposures at 11:00 to 1:00 are Escabrosa limestone, Horquilla limestone and Sugarloaf quartz latite. Leave area shown on figure 52.
0.5	172.5	Hill at right of road is composed of thrust slices. Tertiary (?) Sugarloaf quartz latite rests on Horquilla limestone. In hill at left of road, Mississippian Escabrosa limestone rests on Pennsylvanian Horquilla.
0.6	173.1	At 9:00, on northeast side of Gleeson Hill, note Escabrosa and Horquilla limestones on Copper Belle monzonite porphyry. The dumps are located approximately along trace of thrust. Low ridge of Sugarloaf quartz latite extends east from Brown's Peak at 10:30.
0.1	173.2	At 9:00, in gap between Gleeson Hill and Brown's Peak, note Sugarloaf quartz latite on Escabrosa limestone. Pinkish summit beyond, on skyline, is alaskite.
0.6	173.8	Ridge of pink Sugarloaf quartz latite at 9:00. Road enters from left. KEEP STRAIGHT AHEAD.
0.1	173.9	Hill ahead at 11:30 is Escabrosa limestone on Copper Belle monzonite porphyry.

		Old buildings of Courtland at 10:00; red, mineralized zone to left. Bolsa along ridge on skyline overlies Abrigo limestone and Sugarloaf quartz latite, all in thrust slices. At 10:00 is rounded pink hill of Sugarloaf quartz latite. Hill at 1:30 is of Escabrosa and Martin limestones on Copper Belle monzonite porphyry.
0.6	174.5	Road intersects from right. STRAIGHT AHEAD to Courtland.
0.4	174.9	Courtland. Enter area shown on figure 53.
0.4	175.3	Road crosses thrust slice of Escabrosa limestone and descends to North Courtland.
0.2	175.5	North Courtland. Bolsa knobs are on right of road.
0.6	176.1	Top of rise. Hill to north is Sugarloaf quartz latite.
1.1	177.2	STOP 8. (20 minutes). Road intersects from left. Bold, jagged outcrops of the post-thrust, Tertiary (?) Stronghold granite at 10:30 in the Dragoon Mountains. At 10:00, minor, northwest-trending masses of Stronghold granite are intruded along the strike of the Bisbee formation. The strong, east-west fault zone along the northern border of the Gleeson quartz monzonite is to the west. Alaskite forms the high peak, which was also seen from Gleeson. North of the fault zone are northwest-trending ridges, capped by Bolsa quartzite, with Paleozoic sediments, Bisbee formation, Cretaceous volcanic rocks and Copper Belle quartz monzonite in successive thrust slices down slope. Hills to east and northeast are Sugarloaf quartz latite. TURN AROUND, retrace route through Courtland.
2.7	179.9	TURN LEFT (east).
0.7	180.6	From left to right on far side of Sulphur Springs Valley are the Dos Cabezas, Chiricahua and Swisshelm Mountains. The sharp peak at the northern end of the Chiricahua Mountains is Helen's Dome; to the right, the nearby flat-topped summit is Bowie Mountain. Cochise Head is at 11:00 and the high part of the Chiricahua Range is at 11:30-12:00. The volcanic hills in the valley are mostly Tertiary Pearce volcanics. Road again descends the long bajada to the valley floor. For 20 years following the Gadsden Purchase in 1853, the Chiricahua Apaches virtually controlled Sulphur Springs Valley and the surrounding territory. After 1872, when danger from the Indians had somewhat lessened, many cattle ranches were established in the valley and near the surrounding mountains. Gilbert and Loew (1873) studied the northeastern part of the valley. Loew remarked concerning the shallow depth to water and announced that "crops will be raised this year for the first time". In 1880, the main line of the Southern Pacific Railroad was built across the northern part of the valley, and the village of Willcox grew to be the supply station for a large surrounding area (Meinzer and Kelton, 1913).
6.2	186.8	STOP SIGN. TURN LEFT ON Highway 666.
1.9	188.7	Hills to right, extending north from the Swisshelm Mountains are Cambrian, Devonian and Mississippian sediments and Tertiary volcanics (Darton and others, 1924).
5.6	194.3	Square Top Hills on right are Bisbee formation and Escabrosa limestone (Gilluly, 1956). Pearce Hills ahead and on left are Tertiary Pearce volcanics. The rich silver-gold ore bodies of the Pearce district occurred on north-of-west-striking veins in the volcanic rocks (Endlich, 1897) and were mined out long ago.
1.2	195.5	TURN RIGHT on State Highway 181.
1.2	196.7	Ash Creek Ridge, with Bisbee group and Paleozoic limestone, to south. Chiricahua Mountains ahead.
0.8	197.5	Curve right, then left, toward Chiricahua Mountains. The Chiricahua Mountains, once the heart of Chiricahua Apache territory, are one of the most impressive

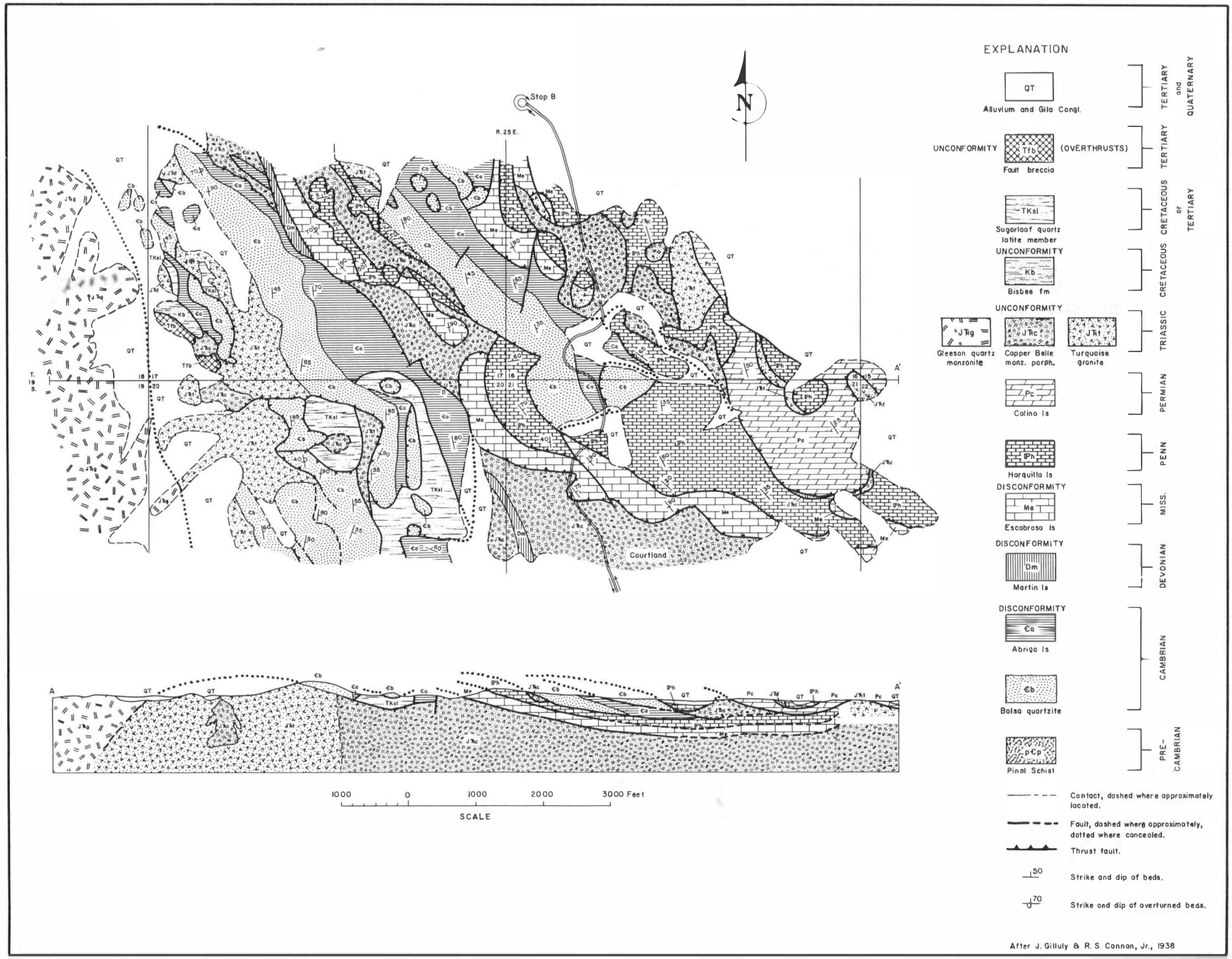


FIGURE 53. Geologic sketch map and cross section of thrust breccia near Courtland, Cochise County, Arizona (after Gilluly, 1956).

ranges in southeastern Arizona. They are about 40 miles long and 20 miles wide; the two summit peaks, Fly's Peak and Chiricahua Peak are nearly 9,800 feet above sea level. The higher portion of the Chiricahuas is dark with a conifer forest.

The high, central portion of the Chiricahuas is composed mostly of Tertiary volcanic rocks, although Paleozoic and Cretaceous rocks crop out locally. The geology at the northern end has been described by Enlows (1955) and Sabins (1957b). The Chiricahua Range is essentially a north-trending mass, but near its northern end, it turns westward and continues, beyond Apache Pass, as the Dos Cabezas Mountains.

The geology of the northern Chiricahuas and of the Dos Cabezas Mountains differs from that of the southern end. In the Dos Cabezas Mountains, the older Precambrian rocks are Pinal schist, intruded by foliated Sheep Canyon granite and nonfoliated Rattlesnake Point granite. The younger Precambrian Apache group is not present (Lance, 4).

The Paleozoic section includes the Cambrian Bolsa quartzite; the Cambrian and Ordovician El Paso formation (Dickenson, 6); the Upper Devonian Portal formation (Pye, 7); Lower Mississippian Escabrosa limestone; Upper Mississippian Paradise formation (Thomas, 8); Pennsylvanian Horquilla limestone; Pennsylvanian and Permian Earp formation (Havenor, 9); and the Permian Colina limestone, Scherrer formation and Concha limestone (Bryant, 10). These are unconformably overlain by the Cretaceous Glance conglomerate and "Middle and Upper Bisbee strata" (Sabins, 1957a; Fergusson, 11). Southward, the latter in turn are overlain by Tertiary volcanic rocks (Mayo, 22).

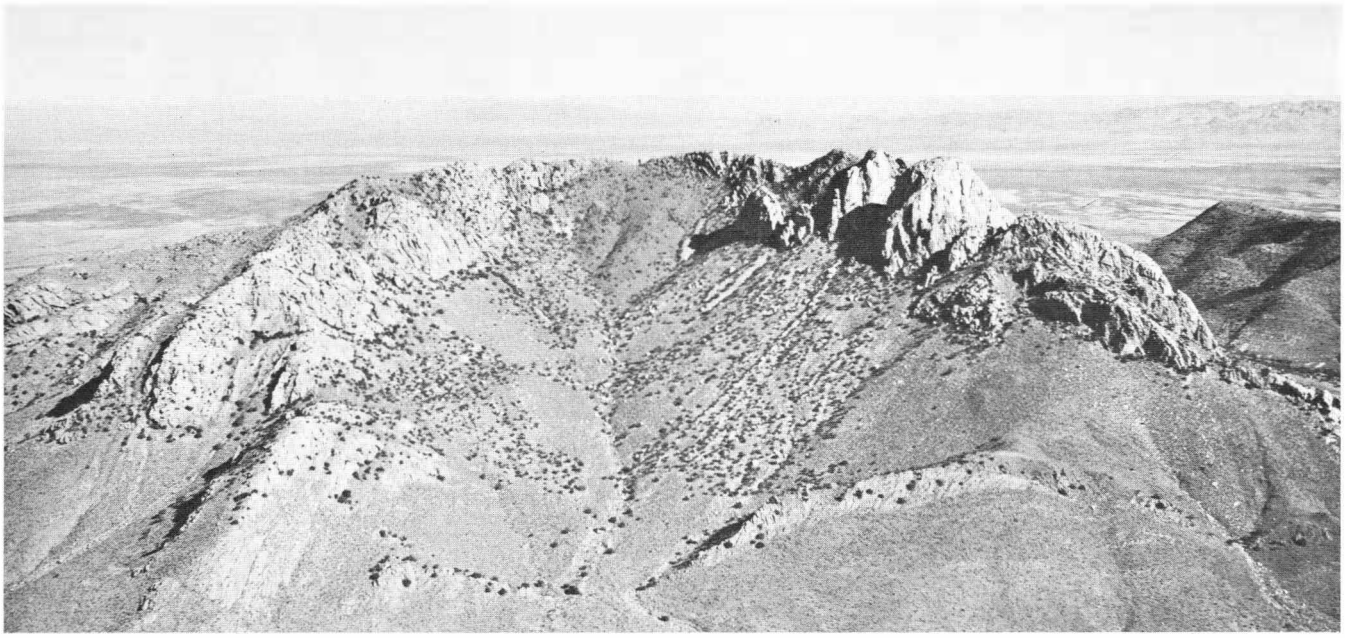
The change in trend from a northerly direction in the main mass of the Chiricahuas to a westerly direction in the northern Chiricahuas and Dos Cabezas seems to have been adjusted in post-Comanche time by curved overthrusts, concave to the southwest. There were two periods of thrusting here, as in the Dragoon Mountains, and some of the earlier thrusts were folded as the later ones came forward. The allochthonous blocks moved northward, or northeastward, from the concave toward the convex sides of the arcs. Several tear faults were formed; one, the fault in Emigrant Canyon, has a strike slip of perhaps 2 miles (Sabins, 1957b; fig. 25).

8.5	206.0	Cochise Head at 10:30 (fig. 24). This rugged, 8,000-foot mountain was eroded from the Tertiary volcanic Faraway Ranch formation.
2.0	208.0	TURN LEFT, follow Highway 181. Dirt road to Turkey Creek Recreation Area continues eastward.
0.8	208.8	Cross tree-lined channels of Turkey Creek.
0.8	209.6	Dos Cabezas Peaks at 11:00; Helen's Dome and flat-topped Bowie Mountain at 1:00. Tertiary volcanic rocks to right of road and in Pat Hills to left ahead. Volcanic rocks in Sulphur Hills far down slope to left may be Cretaceous in age.
2.9	212.5	Hills are Tertiary volcanic rocks, probably of the Faraway Ranch formation.
2.2	214.7	Curve right. Conical peak at 1:00 is Sugarloaf Mountain, composed of welded rhyolite tuff, capped by a thick flow of rhyodacite, youngest member of the Rhyolite Canyon formation.
3.5	218.2	Cross usually dry bed of Pine Creek. Bowie Mountain ahead (fig. 54A).
0.4	218.6	Paved road to Chiricahua National Monument turns right. KEEP STRAIGHT AHEAD on dirt road.
0.8	219.4	Cross dry bed of Pinery Creek. Chiricahua National Monument to right. Finely pinnacled topography has been etched on welded tuff of the Rhyolite Canyon formation.
0.9	220.3	Bowie Mountain at 3:00 with Helen's Dome immediately to left. Both mountains are steeply south-plunging synclines of older Precambrian quartzite in Pinal schist (Sabins, 1957b). To right is the area where the steeply southwest-dipping

		Paleozoic and Cretaceous rocks are thrust northeastward against the Marble Quarry syncline block which contains the folded Fort Bowie thrust (fig. 25).
2.5	222.8	Dos Cabezas Mountains at 12:00 to 1:00. The two summit peaks are Cretaceous or Tertiary volcanic rocks.
4.6	227.4	Apache Pass road. TURN RIGHT to Bowie.
1.3	228.7	Curve left.
1.2	229.9	At 3:00, on lower southwestern slope of Bowie Mountain, Bolsa quartzite, overlain by younger Paleozoic and Cretaceous strata, rests with steeply south-dipping depositional contact on tightly folded Pinal schist and quartzite. The synclines of older Precambrian quartzite acquired their steep plunge after the Paleozoic and Comanche sediments had been deposited on them (Sabins, 1957b).
1.2	231.1	Low hills ahead and to the right are Precambrian Rattlesnake Point granite. Paleozoic and Comanche (Bisbee) rocks on skyline at 12:00. Enter area shown on figure 25.
0.9	232.0	Curve right; Apache Pass ahead.
1.7	233.7	Top of Apache Pass, altitude 5,115 feet, is in Precambrian Rattlesnake Point granite. Peloncillo Mountains ahead on skyline. The Overland Mail, from St. Louis to San Francisco and return, which first moved over the Butterfield Trail in 1858, was routed through Apache Pass. The service was interrupted by Indian trouble for the first time in its history one night in 1861 (Judd, 1958). Following a battle between the Indians and Union troops near the pass in 1862, Fort Bowie was established by Colonel George W. Bowie. In spite of every military effort however, Cochise, whose stronghold was in the rugged, easily defended portion of the Dragoon Mountains, prevented white settlement in the region for ten more years. In 1872, General O. O. Howard concluded a treaty of peace with Cochise, which was honored until the great war chief's death in 1874. Following the death of Cochise, there were other Indian uprisings, but never again were the Apaches so effective a bar to white settlement as they had been under Cochise.
0.4	234.1	Site of wagon train massacre, 1861.
0.2	234.3	Butterfield stage trail at right, below road.
0.8	235.1	STOP 9. (One hour, lunch will be served.) Old Fort Bowie ruins are about 2 miles southeast. Helen's Dome is tower-like peak nearly due south. High, flat-topped mountain to left is Bowie Mountain. Contact between Horquilla limestone and upthrust Rattlesnake Point granite is just west of ruins.
0.4	235.5	Granite is highly disturbed and darkened, and intruded by dikes.
0.2	235.7	Steep, upthrust contact of Bisbee group, with a limestone conglomerate member, to east and crushed granite to west. Road leads down through sheared and contorted Bisbee group.
0.6	236.3	Thin layer of Glance conglomerate by rock cairn on turn, underlain successively by marbleized Escabrosa limestone, thin-bedded Portal formation, and the El Paso limestone. The absence of younger Paleozoic rocks may be due to thrusting.
0.2	236.5	El Paso limestone on Bolsa quartzite to right, in ridge across canyon.
0.2	236.7	Bolsa quartzite, overlain by El Paso limestone and dipping southward, is exposed both east and west of the road. In wash to the right (east), the upper, silty portion of the Bolsa is well exposed (Dickenson, 6).
0.1	236.8	Pinal schist below Bolsa on right. Emerge from canyon.
0.4	237.2	On left, high on mountain, the contact is in view between the foliated, older Pre-

		cambrian Sheep Canyon granite on the northeast and the Pinal schist on the southwest. Leave area shown on figure 25.
2.5	239.7	San Simon valley ahead. Peloncillo Mountains, along Arizona-New Mexico State Line, form northeast side of the valley. Pinaleno (Graham) Mountains form a high ridge at 10:00, with low Fisher Hills in front. Mt Graham rises to an altitude of 10,716 feet. Whitlock Hills at 12:00. Smelter smoke at Morenci can sometimes be seen at about 1:30. The San Simon Valley, beginning about 18 miles north of the International Boundary, extends north-northwestward 85 miles to the Gila River near Safford. Maximum width of the valley is about 35 miles. According to Schwennesen (1917), the valley fill in this vicinity consists of three units: (1) about 150 feet of stream deposits, (2) 350 feet of blue clay lake beds, and (3) a basal series of stream deposits, including conglomerate, exceeding 850 feet in thickness. Knechtel (1936), on fossil evidence, assigned a Pliocene age to deposits near Safford. The stratigraphic relationships between sub-surface units near San Simon and Safford are not known. Although some ground water near San Simon is under artesian pressure, wells must be pumped to supply sufficient water for agricultural purposes. Water is pumped for irrigation purposes near Bowie, also. The geologic control of ground water in this valley is discussed briefly by DeCook (1952). Deep wells and test holes are discussed by Konlowski (1953) and Johnson (14). According to Sabins (1957b), the Portal Drilling Co. well No. 1, located about 16 miles south of San Simon, penetrated about 2,000 feet of alluvium above rhyolite and bottomed at 5,800 feet in rock like that of the Rhyolite Canyon formation. The Arizona Oil & Gas Corp. State No. 1 well, drilled to a depth of 7,568 feet, three miles from bedrock outcrop north of Dunn Springs Mountain, encountered only valley fill and deposits of rhyolite gravel. These data indicate large-scale normal faulting marginal to the northern Chiricahuas (Sabins, 1957b).
3.0	242.7	At 9:00, bold outcrops of light-colored Tertiary silicic intrusion in contact with Sheep Canyon granite on ridge. Dos Cabezas Peaks on skyline at 9:30.
3.0	245.7	Back on pavement.
3.2	248.9	STOP SIGN. Bowie, altitude 3,762, and intersection with State Highway 86. TURN LEFT.
2.0	250.9	Bridge over Buckeye Wash. Highway 86 leads westward over rolling plain, covered by mesquite and occasional yucca.
2.7	253.6	Culvert. On right, Fisher Hills, of Tertiary volcanic rocks, trend west-northwest, parallel to front of Dos Cabezas Mountains on left. Foothills of the Dos Cabezas range, near highway, are older Precambrian Pinal schist.
2.5	256.1	Going into right turn. Bridge over Gold Gulch; underpass just beyond. Graham Mountains ahead are older Precambrian granite and gneiss.
1.7	257.8	Road to Safford, Globe and Morenci turns off at right. Greasewood Mountains, at southern end of Grahams, at 1:30, are mostly Tertiary volcanic rocks with exposures of Precambrian granite. Winchester Mountains at 12:00.
1.1	258.9	Road cuts in alluvial conglomerate for next several miles. Rolling surface, leading through Railroad Pass, is covered with grass and yucca.
2.7	261.6	West branch of Safford road joins highway from right.
3.5	265.1	Railroad Pass, altitude 4,932. Circle I Hills of Tertiary volcanic rocks on Precambrian granite and schist at 1:30; Winchester Mountains at 1:00; Little Dragoon Mountains at 12:00; Dragoon Mountains at 11:00. Road passes around northwestern end of Dos Cabezas Mountains.
3.4	268.5	Spike E. Hills, of Precambrian granite, at 2:30, seem to be a continuation of the westward trend of the Dos Cabezas Mountains. Good view of Winchester

		Mountains beyond. Little Dragoons at 1:00; Dragoons at 12:00. Willcox Basin ahead. The geology of this basin and its surroundings has been reviewed by Jones and Cushman (1947).
1.4	269.9	Northeast edge of ancient Lake Cochise (Meinzer and Kelton, 1913). Chiricahua Mountains at 9:30; Pat Hills, Sulphur Hills and Swisshelm Mountains at 10:00.
2.8	272.7	Entering Willcox, altitude 4,168, in the Willcox basin of Sulphur Springs Valley. Ranching and irrigation farming, using pumped water, are practiced near Willcox. The status of the underground water supply has been reviewed by Coates (1952). Sites of nearby oil test holes and of one deep water well are shown on figure 10 (Johnson, 14).
1.9	274.6	Leaving Willcox, highway traverses flat grassland, growing on lacustrine sediments of Lake Cochise, along the northern border of Willcox Playa.
		Ancient Lake Cochise (Meinzer and Kelton, 1913) possibly existed during the Wisconsin stage of the Pleistocene epoch. The lake may have been 20 miles long and 11 miles wide. Near Willcox, its shore line is marked in part, today, by a gravelly beach ridge buried by post-Wisconsin wind-blown sand. Data from wells indicate that, beneath thicknesses ranging up to 280 feet of alluvial sediments, there exists a thick layer of dark blue to black clay, probably deposited in a large, quiet body of water. Thus there seems to have been another, older and larger lake in this basin long before the time of ancient Lake Cochise. Meinzer and Kelton suggested that this lake existed during one of the earlier glacial stages, possibly the Kansan.
		The Winchester Mountains, at 2:30, are mostly Tertiary-Cretaceous volcanic rocks, but rocks ranging in age from Precambrian to Cretaceous crop out in the southern spurs.
2.9	277.5	Santa Catalina Mountains in view in distance at 1:30; Little Dragoon Mountains ahead; Dragoons at 10:00 to 11:00. Passing around southern end of Winchesters.
2.5	280.0	Willcox Playa at 9:30. Croton Springs, near which the beach ridge is especially well developed, are on the northwest edge of the playa. Highway crosses beach ridge.
2.0	282.0	Bisbee-Douglas turn off on left; underpass. Start climb out of Willcox basin, up mesquite covered slopes.
3.3	285.3	Pass between Red Bird Hills on left and Steele Hills on right. Road cut at north end of Red Bird Hills in Bisbee formation. The Little Dragoon Mountains and outlying ridges contain well-exposed sections of Paleozoic sediments (Gilluly, Cooper and Williams, 1954). The geology of this area is shown on figure 26 (Cooper, 23).
1.4	286.7	Road cut in alluvial conglomerate.
1.7	288.4	Cross low gap in Scherrer Ridge, a northern extension of the Gunnison Hills. On Scherrer Ridge, south of the highway, are the type localities of the Permian Scherrer formation and Concha limestone, and, in the Gunnison Hills three miles farther south is the type section of the Upper Mississippian Black Prince limestone (Gilluly, Cooper and Williams, 1954). Steeply dipping Paleozoic rocks can be seen in the Gunnison Hills to south (left).
1.3	289.7	Older Precambrian Pinal schist overlain by younger Precambrian Apache group and by Paleozoic sequence in Little Dragoon Mountains at 3:00 (fig. 54B). Start climb toward Texas Canyon, through road cuts in alluvial conglomerate.
1.5	291.2	Johnson Camp turn off on right. Underpass. Contact of Texas Canyon granite with older Precambrian Pinal schist at 1:30.
0.6	291.8	Curve left. Entering Texas Canyon. Road cuts are in Texas Canyon granite.
		The Little Dragoon Mountains and the Johnny Lyon Hills, to the northwest, have been mapped by Cooper, Silver and others (Cooper and Silver, 1954; Cooper, 23).



A. Bowie Mountain from southwest. Syncline of older Precambrian quartzite plunges toward observer. Sharp, narrow ridge in foreground is Cambrian Bolsa quartzite, overlain toward observer by the succession of Paleozoic strata.

B. South face of Little Dragoon Mountains from east-southeast (fig. 26). Ground in lower left is Precambrian Pinal schist, overlain on right by younger Precambrian Apache group, and this in turn is overlain by Paleozoic strata up through the Mississippian Escabrosa limestone, which caps Johnson Peak (right center) and the high peak to its left. Rincon Mountains on distant skyline.

FIGURE 54. Aerial views of Bowie Mountain and Little Dragoon Mountains, Cochise County, Arizona. Photos by Tad Nichols.

		The Texas Canyon granite has been shown to be of Tertiary age. The well developed joints in this granite and an elusive parallelism of feldspar phenocrysts strike northeast.
1.6	293.4	STOP 10. (20 minutes). Texas Canyon rest area. Exposures of jointed porphyritic Texas Canyon granite. View westward into San Pedro Valley with Whetstone Mountains beyond. Ridge to left of highway is of Mesozoic volcanic rocks. Mt. Glen, in Dragoon Mountains across highway to south. Dos Cabezas Peaks to east beyond and to left of the Gunnison Hills. High Chiricahuas to southeast beyond Sulphur Springs Valley.
0.4	293.8	Pinnacles of Tertiary Stronghold granite at Cochise Stronghold in Dragoon Mountains at 9:30. Highway descends through cuts in Texas Canyon granite.
1.3	295.1	Turn off to Dragoon is on left. Dark patches of Mesozoic volcanic and sedimentary rocks in granite on ridge to right. Ridge of Mesozoic rocks on left.
2.4	297.5	Emerge from Texas Canyon. Whetstone (?) pediment cut on granite at left, descends toward San Pedro Valley.
0.6	298.1	Huachuca Mountains at 10:30; Whetstones at 11:30, with Mustangs at southern end and Santa Ritas in view beyond. Younger Precambrian Apache group and Paleozoic sediments exposed in Little Dragoons at 3:30.
1.4	299.5	Johnny Lyon Hills, with core of older Precambrian granite and schist, bordered by rocks ranging in age from Precambrian to Cretaceous, at 3:00; Rincon Mountains at 2:00. Gneisses in Rincons dip moderately northeastward, and are cut by a set of strong, steep fractures. Tombstone Hills at 9:00.
3.6	303.1	San Pedro Valley beds of probable Pliocene to Pleistocene age appear in gullies to left of road.
0.2	303.3	Begin descent through San Pedro Valley beds from Whetstone pediment to Arivaipa surface. Late Pliocene or early Pleistocene fossils have been found in these beds at a lower level near the valley axis, (Gidley, 1922; Gilmore, 1922; Wetmore, 1924; Gidley, 1926; Bryan, 1926; Stirton, 1931; Gazin, 1942). The geology of the San Pedro Valley in relation to ground water has been briefly discussed by Heindl (1952a and b).
2.1	305.4	Entering curve right. San Pedro Valley beds in view across valley.
2.4	307.8	Bridge across San Pedro River.
0.7	308.5	Underpass. Benson, altitude 3,580. Benson is the principal community in the San Pedro Valley north of Bisbee. The main industry in the San Pedro Valley is cattle ranching, with some irrigation farming, mining and tourist trade.
1.7	310.2	Leaving Benson. Red sediments to south and southwest of highway contain the Benson fauna of Blancan (late Pliocene to early Pleistocene) age.
1.9	312.1	Whetstone overpass. Whetstone Mountains at 10:00; Rincon Mountains at 2:00. Curve right, enter cuts in red sediments.
5.1	317.2	Underpass. Santa Rita Mountains on skyline at 10:00.
1.6	318.8	Road cut in alluvial conglomerate.
1.0	319.8	Road cut in Cretaceous sediments, dipping steeply southward. Rincon Mountains at 3:00; small hills at 9:00 are Cretaceous (?) sediments. Empire Mountains at 10:30, with Santa Ritas beyond.
2.2	322.0	Amole overpass. Road cuts beyond are in moderately west-dipping Miocene (?) Pantano beds (Brennan, 1957; Wood, 13).
3.1	325.1	Pantano underpass and bridge over Cienega Creek, followed by road cuts in Pantano beds, unconformably overlain by alluvial conglomerate.

1.3	326.4	Bridge over wash. Road cuts in steeply-dipping Pantano beds beyond.
1.6	328.0	Wash, with very steeply dipping Pantano beds, unconformably overlain by gently dipping alluvial conglomerate in west bank.
0.5	328.5	Cretaceous sediments to left of road and more in cuts beyond.
0.7	329.2	Wash. Pantano beds in road cuts beyond.
0.9	330.1	Davidson Canyon; cuts in alluvial conglomerate beyond.
1.1	331.2	Santa Catalina Mountains in view at 2:00 (Trip III); Mt. Fagan at north end of Santa Ritas at 9:30.
1.1	332.3	Sonoita turn off at left. Mountain View. Colossal Cave area at 3:00; Sierrita Mountains at 10:00, with Pima open pit dump in front (Trip I).
2.9	335.2	Saguaro National Monument and Vail road turns off at right.
1.9	337.1	Curve left, then right. Tucson Mountains at 12:00; Black Mountain at 11:00; Sierrita Mountains at 10:00 (Trip I); Coyote-Quinlan Mountains in far distance at 10:30; Santa Catalinas at 2:00.
10.8	347.9	Tucson Mountains ahead (Trip IV). The three pyramidal peaks are Tertiary Cat Mountain rhyolite. Black Mountain at southern end is composed of Tertiary volcanic and alluvial rocks (Heindl, 25). Pinnacles between are in the Beehive-Saginaw Hill area (Kinnison, 24). In low pass between Santa Catalina and Rincon Mountains, at 4:00, are klippen (?) of limestone and Pantano red beds resting on the gneisses.
1.9	349.8	TRAFFIC LIGHT. Intersection of Benson Highway and Palo Verde road. Via Palo Verde and Speedway, it is 8.8 miles to University of Arizona Campus.

- END OF TRIP -