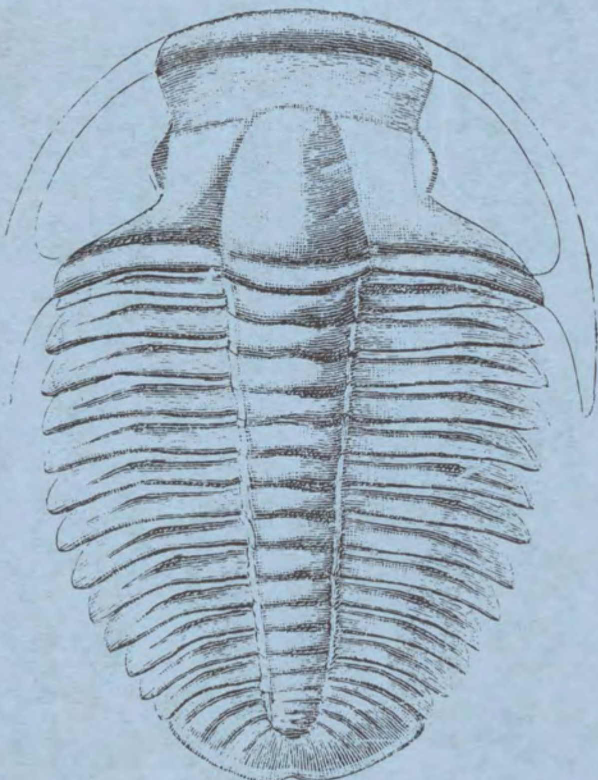
Geologic Road Logs of Western Utah and Eastern Nevada

Part 1 — Provo, Utah, to Delta, Utah, via Nephi
Part 2 — Delta, Utah, to Ely, Nevada, via Antelope Spring Trilobite Locality
Part 3 — Utah-Nevada Line to Santaquin, Utah, via Tintic Mining District and U. S. Highway 6-50



by

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With Illustrations by Ivan D. Sanderson

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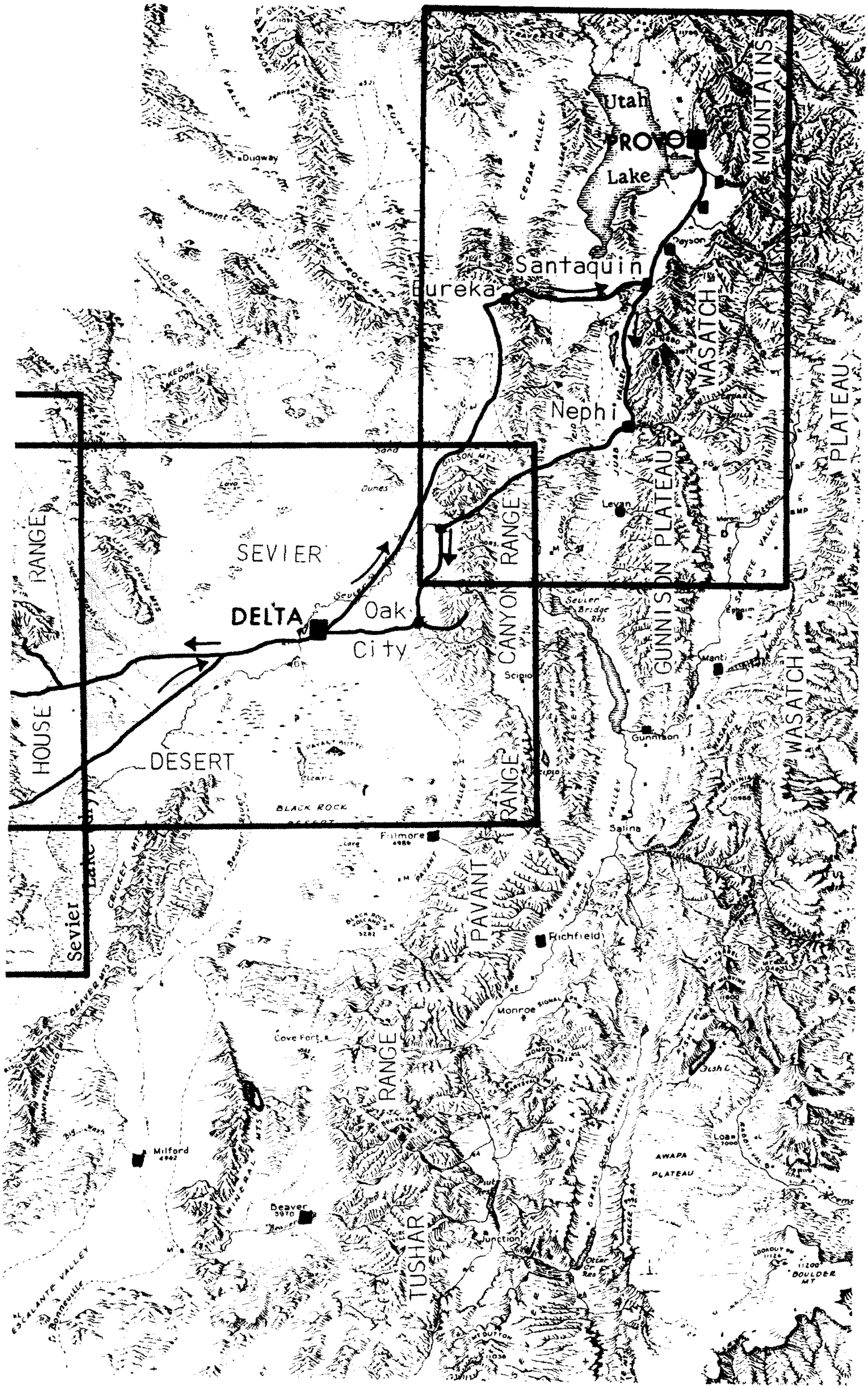
Frontispiece: Index map of central and western Utah and east-central Nevada ,showing route of field trip.



Utah
PROVO
Lake
MOUNTAINS
Santaquin
Eureka
Payson
WASATCH
Nephi
PLATEAU
GUNNISON PLATEAU
CANYON RANGE
SEVIER
DELTA
Oak
City
DESERT
HOUSE RANGE
Sevier Lake
PAVANT RANGE
TUSHAR RANGE
WASATCH
Fillmore
Richfield
Milford
Beaver
Cove Fort
Monroe
Gunnison
Salina
Manti
Levan
Dugway
CEDAR VALLEY
GILSON MTS
BLACK ROCK
AWAPA PLATEAU
BOULDER MT
ESCALANTE VALLEY

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INTRODUCTION

This field trip traverses a major part of the Great Basin, which is an area of interior drainage with no outlet to the sea. The Great Basin occupies a large portion of the western interior of the United States and is part of the Basin and Range geologic province. Characterized by alternating mountain ranges and intervening valleys, the Basin and Range Province was formed by extensive block faulting, in which some areas were displaced upwards, and others, downwards. The upthrown blocks, called *horsts,* now form the mountain ranges; the downthrown blocks, called *grabens,* have since been deeply buried by erosional debris and now form the valleys. The valleys in the Basin and Range Province are characterized by thick layers of unconsolidated sand, gravel, and clay, which form the valley floors and are underlain by bedrock, often at considerable depths. The mountains expose mainly Paleozoic marine strata and early Cenozoic volcanic rocks.

During the Ice Age, which ended some 10,000 years ago, the Great Basin was the site of several pluvial lakes which have left marks of abandoned shorelines on most elevated areas. Much of western Utah and parts of Nevada and Idaho were occupied by Lake Bonneville, which at its maximum level was similar in size to Lake Michigan. Other lakes contemporaneous with Lake Bonneville occupied parts of central and western Nevada, southeastern Oregon, and southeastern California.

Lake Bonneville is of major interest in the area traversed by this field trip, since it occupied the major valleys and modified the sediments deposited in them. Most of the mountain ranges of interest in this area were once islands or peninsulas, and they still carry the marks of abandoned beaches and wave-cut terraces at various levels maintained by the lake during its existence.

Utah Valley, which lies at the eastern edge of the Great Basin, is a major graben and is bounded on both sides by faults of vertical displacement. The Wasatch Mountains on the east side of the valley have moved upwards about 15,000 feet relative to the bedrock beneath the valley floor. During the faulting, which has been occurring slowly and intermittently over the last 30 million years, streams have brought sediments into the sinking valley from the rising mountains and have built up deposits of alluvial fill, which are now more than 6,000 feet thick beneath the city of Provo.

Lake Bonneville has left a significant record of deposition in Utah Valley. Consisting chiefly of stream-transported gravel, sand, silt, and clay, these sediments were deposited in deltas at canyon mouths and reworked by waves and currents, which left beach deposits at three major lake levels in the valley Finer portions of the sediment were deposited on the valley floor, forming the present surface, as the coarser portions formed wave-built terraces along the mountain front.

The shoreline terraces have been grouped into three ages of deposits and consist of beach and deltaic sediments composed mostly of sand and gravel. The oldest is the Alpine Stage, which consists of partly dissected terraces with conspicuous yellow silts and is located at an elevation of 5,100 feet above sea level. The Bonneville Stage follows the Alpine in age but is at an elevation of 5,135 feet and consists of a narrow, somewhat inconspicuous terrace located highest on the mountain front. The Provo Stage terrace is the broadest of all Lake Bonneville terraces and represents a delta formed by the Provo River when the lake level was constant over long periods of time. At an elevation of 4,800 feet, it forms the bench upon which the Brigham Young University campus and most of the city of Orem are built.

Bissell (1963, 1969) has written in detail about the Lake Bonneville deposits. The interested student can obtain further information from his papers.

This field-trip road log has mileage figures to help the student locate himself. At each entry in the road log two mileage figures are given: the first is the distance since the last entry in the road log, and the second is a cumulative total, giving the distance from the beginning The cumulative mileage begins at Provo and is continuous to Delta, Utah. At Delta the cumulative mileage begins again, and it is continuous to Ely, Nevada. The return trip, following a somewhat different route, uses the Utah State Road Commission mileage signposts located along the highway, which begin with zero at the Utah state line and increase towards Salt Lake City. Side trips contained in this road log are also given separate cumulative totals.

Illustrations in this guidebook were prepared by Ivan Sanderson under the Brigham Young University Graduate Internship Program 1971-72. Physiographic bases for the route map illustrations were modified from the physiographic map of Utah by M. K. Ridd.

ROAD LOG: PART 1 — PROVO TO DELTA, UTAH

Mileage

0.0 0.0 START at the intersection of 1230 North and University Avenue, near Provo High School. Proceed south on University Avenue (U.S. Highway 189) to Interstate Highway 15. Downtown Provo is built on a recent alluvial deposit of the Provo River that is younger than the Provo Stage of Lake Bonneville. The main part of the Brigham Young University campus is located on the Provo Stage, which here consists of deltaic deposits of sand and gravel. The Wasatch Mountains east of Provo expose rocks ranging in age from Late Precambrian to Pennsylvanian. (Study the stratigraphic chart of the Provo area, Text-fig. 2.)

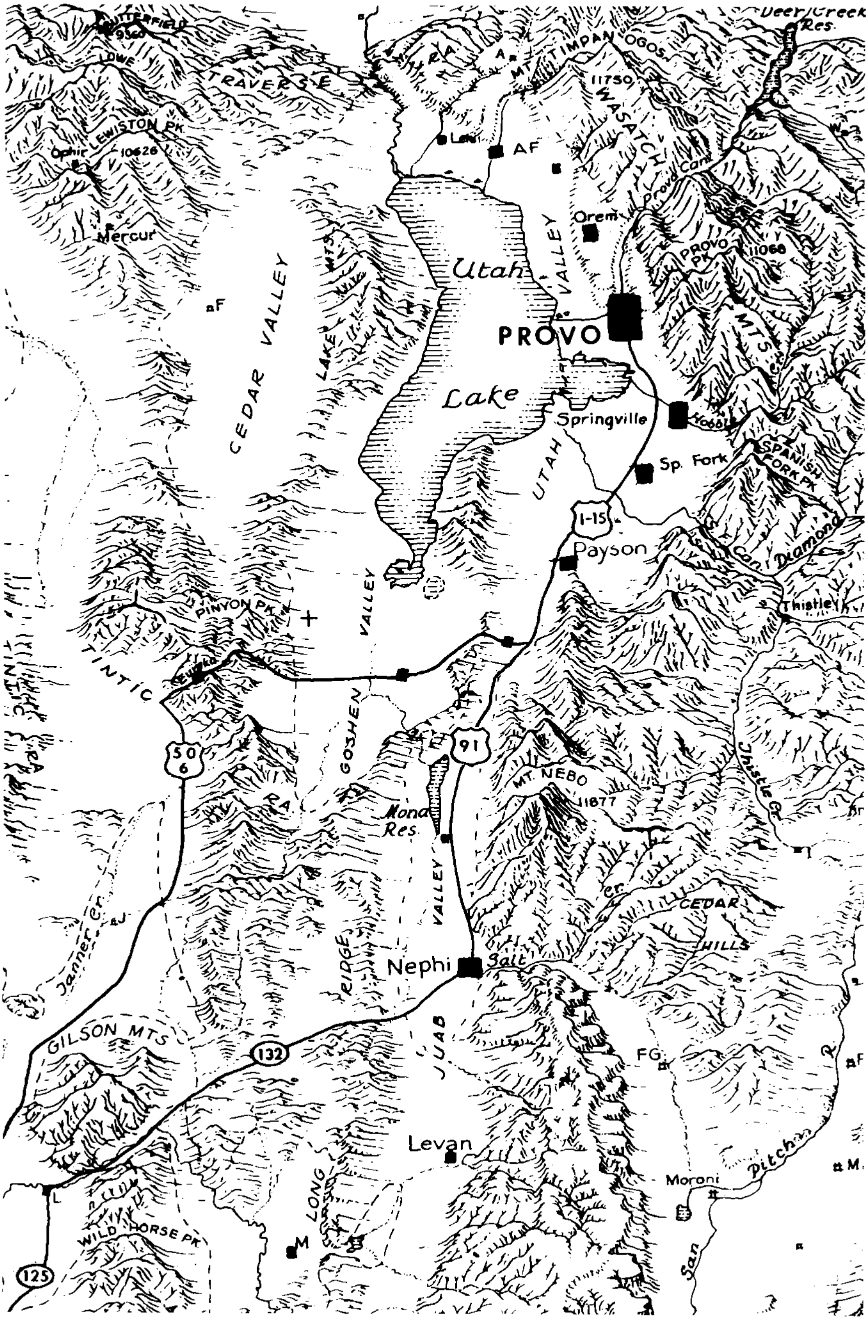
1.1 1.1 Intersection of University Avenue and Center Street, in downtown Provo. The Utah County Courthouse is located on the east side of the street, and the Provo Tabernacle is on the west side. Settlement in the Provo area began in 1849 when John S. Higbee brought 30 families to establish a Mormon colony on the Provo River. The Provo Tabernacle was built by Mormon volunteers between 1883 and 1898. The elevation here is 4,550 feet.

0.6 1.7 Overpass crosses railroad tracks.

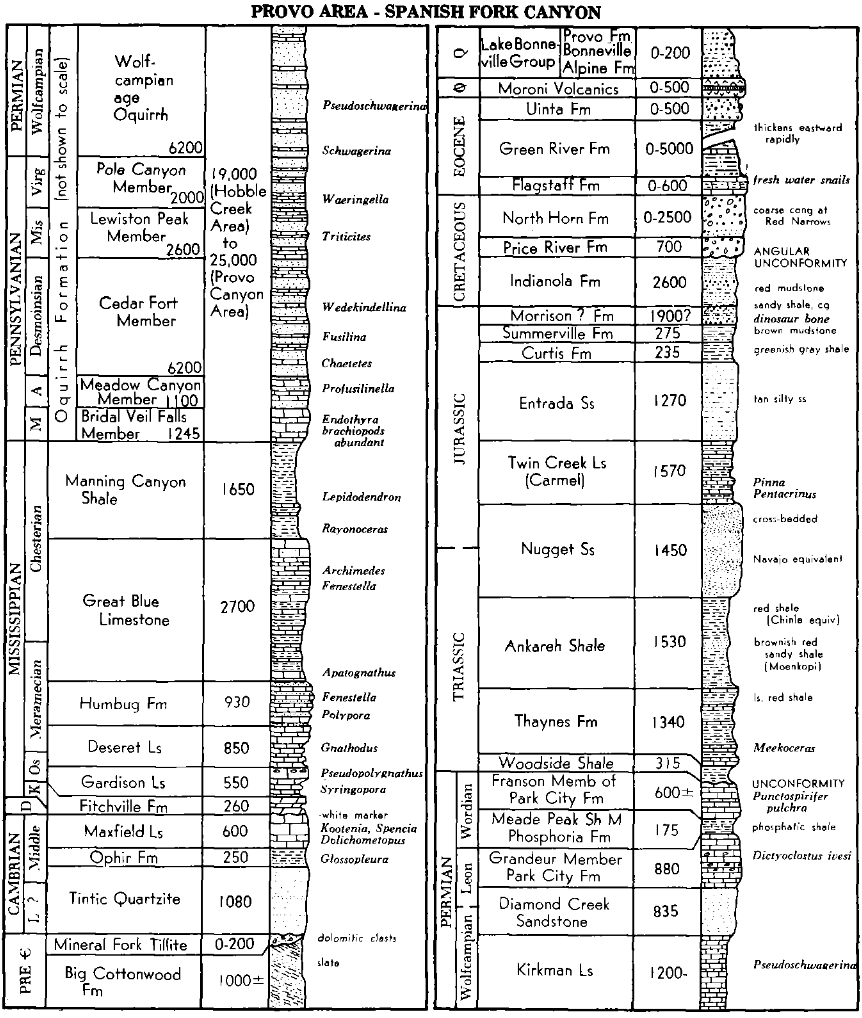
0.7 2.4 Holiday Inn is on the right. Take Interstate 15 south towards St. George.

0.4 2.8 ENTER I-15. The marshy area near the freeway entrance is Provo Bay, located on the east side of Utah Lake. Utah Lake is shallow and contains fresh water which drains northward into Great Salt Lake through the Jordan River. It is used as a reservoir for water users in Salt Lake Valley, and its level is controlled by agreement between the water users and the land owners along the shores of the lake. Recent clayey sediments deposited on the bottom of the lake cover the older more areally extensive clay bottom deposits of the Provo Stage of Lake Bonneville.

Some of the industries in Utah Valley include the United States Steel Geneva Works and related operations, such as the Pacific States Cast Iron Pipe Plant visible east of the freeway.



TEXT-FIGURE 1.—Map of the area between Provo and Canyon Range, showing road log routes.



After: Baker (1947),(1964); Hunt and others (1953); Bissell (1962a),(1963); Hardy (1962)
Mississippian: Woodland (1958); Pinney (1965); Permian: McKee and others (1967); Jurassic: Wright and Dickey (1963a); Imlay (1967); Pinnell (1972); Green River Fm: Baer (1969); Flagstaff Fm: Weiss (1969)

TEXT-FIGURE 2.—Provo area stratigraphic chart.

Near the mountain front east of the Pipe Plant is the site of the Ironton Plant, built in 1924, donated by U. S. Steel to Brigham Young University in 1968, and subsequently razed.

Iron ore for smelting at the Geneva Works comes from Tertiary intrusions near Cedar City, Utah, and from Precambrian metamorphic rocks near Lander, Wyoming. Coal, necessary for the production of coke used in the smelting process, comes mostly from Cretaceous deposits near Price, Utah and from western Colorado.

Visible in the lower mountain front to the east are dark blue gray limestone ledges of Mississippian age. Structurally, these masses of rock, called "horses," are slivers that have been dragged down along the Wasatch Fault and placed against older rocks. Higher on the mountain side, the orange exposures are Cambrian Tintic Quartzite, above which can be seen a sequence of grayish limestones and dolomites ranging in age from Cambrian to Mississippian (Text-fig. 2).

1.8 4.6 Pass under north Springville exit. Cross Hobble Creek on the south side of the interchange—little water flows in the creek bed, being almost entirely diverted into irrigation canals. The prominent bench or terrace that can be seen at the mountain base to the east and southeast is the Provo level of Lake Bonneville, here extensively developed. Springville is named for its springs which arise at the front edge of the delta where the sediments become finer and less permeable. Underground waters coming from the mountains rise to the surface at this location because of the change in permeability of the lake deposits. Note the intricately folded Mississippian strata on the mountain front at the south-plunging end of the Buckley Mountain overturned anticline.

1.9 6.5 Pass under main SPRINGVILLE exit. Springville, two miles to the east, has a fine collection of paintings and sculpture housed in an Art Museum built by the Works Project Administration in 1937. Springville is built on post-Bonneville alluvial fan gravel deposited at the mouth of Hobble Creek Canyon.

Southeast of Springville, Maple Mountain, whose highest point is Spanish Fork Peak (elev. 10,192), was made geologically famous by the physiographer William Morris Davis, who described the "triangular facet" form of its interstream spurs and interpreted them as indicating repeated movement along the Wasatch Fault with erosional retreat of the facets between fault movements. On some of the spurs as many as six sets of triangular facets can be observed (Text-fig. 3).

1.2 7.7 Pass under Palmyra road; no entry. The Springville-Spanish Fork airport is about a mile west of I-15. Alkali marsh clays here are assigned to the clay members of the Provo stage of Lake Bonneville (Bissell, 1963).

0.4 8.1 Pass over Union Pacific railroad track.

0.4 8.5 Pass over Denver and Rio Grande Western railroad track. I-15 parallels this track southwestward for the next nine miles.

0.3 8.8 Pass under exit leading to U. S. Highway 6-50-89 in Spanish Fork Canyon.

0.4 9.2 PASS OVER MAIN SPANISH FORK exit on northwest corner of town. The Dominguez-Escalante expedition, searching for a route between Spanish New Mexico and California, were the first white men to enter Utah Valley. They entered via Span-

TEXT-FIGURE 3.—Faceted spurs, formed by intermittent movement of the Wasatch Fault. Northern part of Maple Mountain, east of Mapleton, Utah.

		ish Fork Canyon on September 23, 1776, camped three days with the friendly "Yuta" Indians on the shores of the lake, and then proceeded southward to cross the Virgin River near St. George.
		Spanish Fork is built on Lake Bonneville deltaic gravels of Provo age.
1.0	10.2	Pass under Utah 147 to Benjamin; no entry.
0.5	10.7	Pass over railroad spur. Note yellow CO-OP feed elevator east of the freeway.
0.2	10.9	Pass over Utah Highway 115. Note the buildings and smokestack southeast of the overpass. This was a sugar processing plant but is now used for other purposes. The trailers in Wyview Park (BYU married students' housing) were constructed here.
0.5	11.4	Cross Spanish Fork River. Upstream much of its water is diverted for irrigation in Utah Valley. I-15 crosses a typical cement-lined irrigation canal a half mile south of the river crossing.
0.5	11.9	Pass under Utah Highway 115; no entry. The white structure near the base of the Wasatch Range five miles to the southeast is the Dream Mine.
		A dugway road angles up the mountain front from the mine buildings. The Dream Mine has been promoted intermittently since 1894 in a vain search for gold treasure. The mine is entirely in sedimentary strata belonging to the Pennsylvanian-

Permian Oquirrh Formation. Bullock (1962) has written a more detailed account of the Dream Mine venture.

1.1 13.0 PASS OVER BENJAMIN-SALEM EXIT. West Mountain, five miles west of I-15, is comprised of vertical to overturned Pennsylvanian-Permian Oquirrh Formation striking nearly north-south, and is capped by small patches of flat-lying Cretaceous-Tertiary North Horn Formation. The Pennsylvanian-Permian mass was thrust southeastward in Cretaceous time over Cambrian to Mississippian strata now exposed in the low hills at the south end of West Mountain.

About a mile west of I-15 in the foreground is a low ridge with a few pine trees, marking the Benjamin Cemetery. This ridge exposes the Tertiary Salt Lake Formation, surrounded by Provo age Lake Bonneville clay on the lower ground. The Bonneville deposits have been broken here by movement along the Benjamin Fault. A series of hot springs marks the fault line for three miles northward from Benjamin Cemetery. The hot water from these springs is used at Arrowhead Resort for swimming.

To the east, Loafer Mountain (elev. 10,685) is also comprised of Pennsylvanian-Permian Oquirrh Formation quartzites and limestones.

2.6 15.6 Pass over Payson-Benjamin exit (Utah Highway 115). The Block "P" on the hillside above Payson is on a spur of Tertiary volcanics which has deflected Lake Bonneville's longshore currents to form a gravel spit extending northward. The next spur to the southwest, called "Red Point," exposes the lower Pennsylvanian part of the Oquirrh Formation, here a fossiliferous shaly limestone containing brachiopods and crinoid stems.

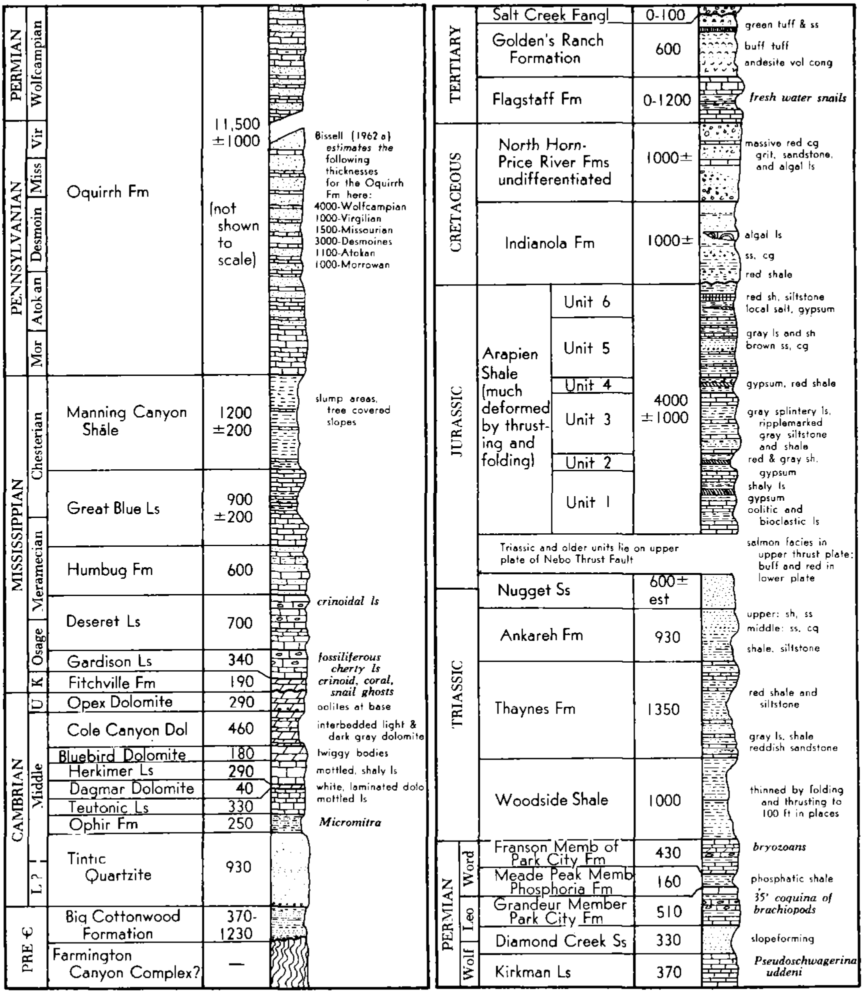
1.0 16.6 Pass over Payson-Goshen road (Utah Highway 147); no exit. The Payson Golf Course is west of I-15. The low hill near the Payson railroad station about a mile west of I-15 exposes Permian Diamond Creek Sandstone, indicating that valley fill in the south end of Utah Valley cannot be very thick.

1.2 17.8 Pass under secondary road; no exit.

1.3 19.1 Pass under secondary road; no exit.

0.6 19.7 Pass under secondary road; no exit. A gravel pit in Bonneville gravel can be seen to the east at the base of Dry Mountain. The bedrock of Dry Mountain dips eastward fairly regularly with dips of 30-50 degrees. Precambrian foliated rocks exposed along the lower west face are similar to those of the Farmington Canyon Complex north of Salt Lake City. These are overlain by Precambrian through Upper Paleozoic strata, as is shown on the stratigraphic chart of Mt. Nebo area (Text-fig. 4). The Humbug Formation forms the crest of Dry Mountain. Keigley Quarries, two miles to the west at the south end of West Mountain, produce limestone which is used as flux in steel production at Geneva Steel Plant.

MT. NEBO AREA, SOUTHERN WASATCH MTNS.



After: Black (1965); Brady (1965); Bissell (1962a); North Horn-Flagstaff Fms: Weiss (1969)

TEXT-FIGURE 4.—Mount Nebo area stratigraphic chart.

1.9	21.6	SANTAQUIN NORTH EXIT. Continue southward on I-15.
0.3	21.9	Pass over SANTAQUIN exit. Santaquin is built on alluvial-fan gravel of Provo age (Bissell, 1963).
0.9	22.8	Pass over road leading southeastward into Santaquin Canyon. The Late Cretaceous North Horn Formation and Tertiary volcanics conceal Paleozoic formations in the foothills. At the base of the main mountain range three miles to the east, Cambrian rocks are thrust over Oquirrh Formation—as mapped by Brady (1965).

1.4 24.2 Santaquin, south exit. Temporary end of I-15. Continue southwards on U. S. 91.

1.0 25.2 Juab-Utah county line (elev. 5,120). This is a natural boundary drawn on a bay bar of Bonneville gravel resting on paleosol developed on Alpine silt. This relationship can be seen in a railroad cut a third of a mile west of the highway.

1.3 26.5 East of the stone-walled ranch can be seen the toe of a Pleistocene landslide mass composed mostly of boulders and red clayey material derived from the North Horn Formation, which crops out at the head of the slide area.

1.5 28.0 Directly to the west, the low hills at the north end of Long Ridge expose Mississippian strata. To the southwest in the valley bottom, the Mt. Nebo Reservoir ponds Currant Creek, which originates in springs in the valley floor west of Mona. West of the reservoir the Paleozoic strata of Long Ridge pass beneath an extensive cover of Early Tertiary latites.

Visible to the southeast, Mt. Nebo (elev. 11,928) supports several small cirque basins above 9,500 feet. They are developed in the nearly vertical Oquirrh Formation, which forms the resistant ridges of the upper half of the mountain. A weak zone formed by the Mississippian Manning Canyon Shale creates a prominent bench halfway up. Beneath the Manning Canyon Shale, Cambrian and Mississippian carbonates form the foothills. Cambrian Tintic Quartzite forms a prominent orange exposure near the base (Text-fig. 4). The Wasatch Fault zone truncates the Paleozoic bedrock along the west base of Mt. Nebo. Juab Valley is a graben filled with several thousand feet of alluvium.

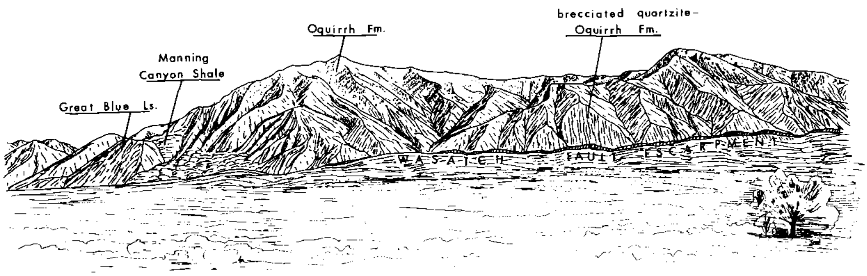
5.6 33.6 ENTERING MONA, a pioneer Mormon town. East of Mona the Manning Canyon Shale has nurtured a landslide mass which has flowed across the Wasatch Fault zone and can be seen from the highway.

1.0 34.6 Leaving Mona. Between Mona and Nephi a recent fault scarp cuts the heads of alluvial fans at the base of Mt. Nebo. A displacement of about 60 feet occurred prior to Mormon settlement of Utah in 1847. The escarpment has not yet been modified seriously by erosion. (Text-fig. 5.)

2.8 37.4 Just inside the canyon mouths, the hummocky surfaced alluvial fan-landslide mass coincides with the northernmost exposure of the Nebo thrust. Brecciated Oquirrh Formation quartzite, which is used for road material, is quarried at the base of the range.

3.3 40.7 ENTERING NEPHI. STOP at Frosty Freeze for a view of the Nebo overthrust at the south end of Mt. Nebo. This area was mapped by Black (1965). (Text-fig. 6.)

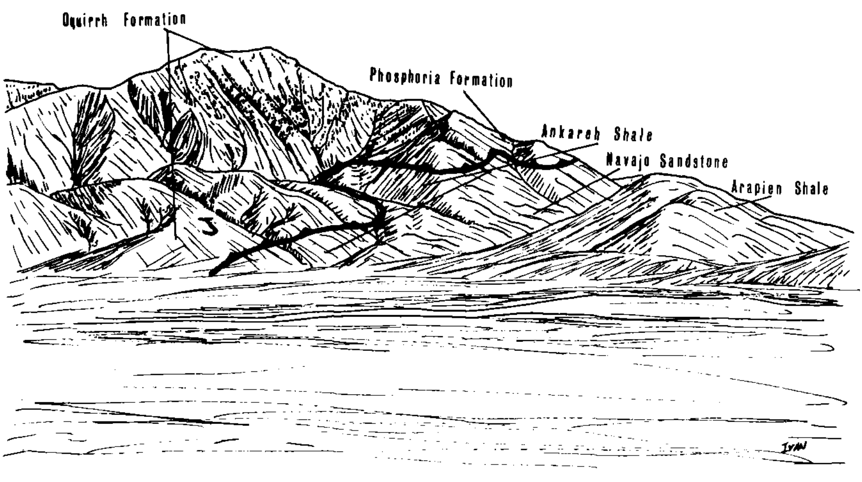
The Nebo overthrust places gray Permian Park City, Phosphoria, and Oquirrh strata over reddish Triassic Ankareh Shale



TEXT-FIGURE 5.—Wasatch fault scarp on Mt. Nebo. Movement along the fault here has been so recent that the erosion has not yet obliterated the fault trace. View is from just south of Mona.

and Jurassic Nugget (Navajo) Sandstone and Arapien Shale (Twin Creek-Carmel equivalent). Both the upper and lower plate rocks are overturned to the southeast. From just east of the block "J" (which is on Oquirrh strata of the upper plate), the thrust trends diagonally up the hill to the east. The reddish color identifies the Mesozoic strata of the lower plate. Just above the Nephi City dump are abandoned gypsum mines in the Arapien Shale.

The Nebo overthrust marks the south end of a great overthrust sheet of rock which comprises most of the Wasatch Range between Nephi and American Fork Canyon. Southeast-



TEXT-FIGURE 6.—Nebo overthrust exposed on the south flank of Mt. Nebo. Notice that older rocks (Pennsylvanian and Permian Oquirrh and Phosphoria Formations) are thrust on top of overturned younger rocks (Triassic Ankareh Shale, Jurassic Navajo Sandstone, and Arapien Shale). Based on evidence visible here, it can be determined that the thrusting took place sometime after Arapien time. View is from north edge of Nephi.

ward transport of the upper plate has been estimated at from 20 to 80 miles, 40 to 50 miles being the most probable amount.

The mountains south of Nephi are not part of the thrust mass. The gray semibadlands forming the partly barren foothills south of Nephi are Jurassic Arapien Shale (Text-fig. 4). Above the Arapien, the reddish cliffs are sandstones and conglomerates of the Cretaceous Indianola Group. The Cretaceous System attains its maximum thickness in Utah about 10 miles east of Nephi where 20,000 feet of Cretaceous sandstone, shale, and conglomerate have been reported. Latest Cretaceous deposits conceal the trace of the Nebo thrust to the east and thereby date it as occurring prior to the end of Cretaceous time.

0.9	41.6	DOWNTOWN NEPHI. TURN WEST ON UTAH 132. Nephi, the Juab County seat, was settled in 1851 and in early days was fortified with a moated wall. It is a center for livestock and dry-farm wheat growing.
0.3	41.9	Cross Union Pacific railroad tracks.
3.0	44.9	Curve. In the highway pass ahead, the Early Tertiary volcanic rocks, which cover most of Long Ridge, have been stripped away, exposing Upper Paleozoic strata.
2.4	47.3	Overturned Permian Phosphoria Formation is exposed in road cuts and south of the highway; overturned Permian Diamond Creek-Oquirrh strata are seen just north of the road. These are part of the upper plate of the Nebo overthrust as extended westward.
0.5	47.8	Summit of Long Ridge.
0.4	48.2	Edge of cultivated field. Milepost 27. Nugget Sandstone is exposed in the juniper-covered hills to the south. They are on the lower plate (autochthon) beneath the Nebo overthrust.
1.5	49.7	The hill immediately south of the road exposes Oquirrh Formation.
5.2	54.9	JUNCTION, UTAH HIGHWAY 148. Continue west on Utah Highway 132. Latite welded tuffs are a common volcanic rock here.
0.7	55.6	Road cut in early Cenozoic volcanics. Stop to examine the lithology of these latite tuffs and flows. They are part of an Oligocene volcanic field that centers around the Tintic mining district 15 miles to the north.
5.9	61.5	The low reddish hills to the south expose Canyon Range Fanglomerate, which was originally thought to correlate with the Lower Cretaceous Indianola Conglomerate to the east. However, it is now considered to be of latest Cretaceous or Early Paleocene age and is correlated with the Price River, North Horn, and Flagstaff Formations (Text-fig. 8). The Canyon Range Fanglomerate, which lies with angular unconformity across the

Canyon Range thrust plate, was probably derived from erosion of the upper plate of the thrust, since it is composed mostly of late Precambrian quartzite boulders similar to those of the thrust mass. The boulders cannot have been transported very far from their source, because some of them exceed eight feet in diameter.

1.2 62.7 Cross Union Pacific railroad track.

0.1 62.8 CROSS SEVIER RIVER. This stream, which begins near Bryce Canyon in southern Utah, here cuts westward through Leamington Canyon to the Sevier Desert, where it finally ends in the Sevier Lake Playa.

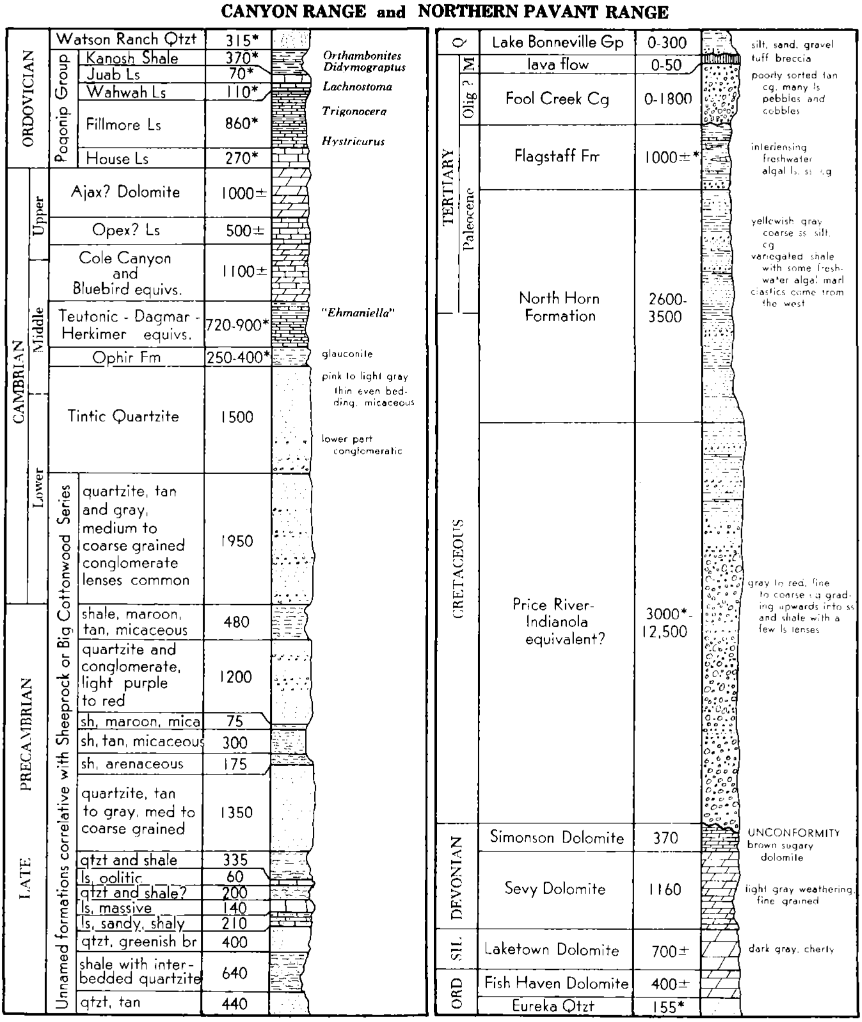
The quarry south of the road is in Cambrian Tintic Quartzite.

0.4 63.2 Canyon Range Fanglomerate with conspicuously large quartzite boulders in a red matrix (Text-fig. 7) is seen standing nearly vertically on the hillside to the south.

0.4 63.6 Tintic Quartzite.

0.3 63.9 Tan Lake Bonneville silts filled Leamington Canyon during Pleistocene time to an elevation of about 5,000 feet and built a broad delta which extended 15 miles to the west, to the pres-

TEXT-FIGURE 7.—The Canyon Range Fanglomerate, here viewed in Leamington Canyon, is composed of varied sizes of boulders of various lithology but mainly of quartzite. Some boulders are in excess of eight feet in diameter (Dr. L. F. Hintze in photo).



After: Christiansen (1952), with modifications; Ordovician: Hintze (1951); Webb (1958); Silurian-Devonian: Winkler, unpublished notes; Quaternary: Varnes and Van Horn (1961); Flagstaff-North Horn Fms: Weiss (1969)
*thickness figures for northern Pavant Range only

TEXT-FIGURE 8.—Canyon Range stratigraphic chart.

ent town of Delta. After the water of Lake Bonneville lowered, the Sevier River carved its present channel, eroding the deltaic deposits and leaving them as patches on the sides of Leamington Canyon. The present elevation of the Sevier River here is 4,700 feet.

A major transverse fault parallels the canyon on the lower slopes of the Gilson Range to the north. South of this fault, Precambrian, Cambrian, and Cretaceous rocks comprise the

		Canyon Range assemblage shown in Text-figure 8. North of the fault, the Gilson Mountains expose chiefly Mississippian limestone in the higher parts, and these are in fault contact with the Oquirrh Formation, lower on the flank. The Oquirrh, in turn, is in fault contact with purple Precambrian rocks just northward across the Sevier River.
2.5	66.4	Millard-Juab county line.
0.8	67.2	West end of Leamington Canyon. Late Precambrian purple quartzites are exposed to the south and are overlain by yellow Cambrian Tintic Quartzite. This point marks the eastern edge of the Sevier Desert.
1.1	68.3	Note the pioneer charcoal-burning ovens on the north side of the road (Text-fig. 9).
0.5	68.8	From this point is a good view northward, showing an angular unconformity between Lake Bonneville silts and Precambrian quartzite.
0.7	69.5	ENTERING LEAMINGTON.
0.1	69.6	TURN SOUTH ON UTAH HIGHWAY 125 toward Oak City.
1.3	70.9	Top of Lake Bonneville delta. Good exposures of Provo age sand and gravel are exposed in the road cut. The top of the delta here is of reworked late alluvial silt derived from Bonneville silts.

TEXT-FIGURE 9.—Pioneer charcoal-burning oven at Leamington Canyon.

1.4	72.3	Gravel road to the east leads over Leamington Pass.
1.3	73.6	Scattered farmhouses make up the village of Fool Creek. Vertical Precambrian quartzite is seen along the west side of the Canyon Range.
0.6	74.2	Curve, in downtown Fool Creek. The low westward-extending spur south of town is composed of postthrust Oligocene (?) Fool Creek Conglomerate. The anticlinal structure of the Canyon Range can be noted to the south, on the west slope of the range.
2.7	76.9	The road curves around a Fool Creek Conglomerate spur. The road elevation at this point is 5,040 feet. The highest shoreline of Lake Bonneville (the Bonneville Level) at elevation 5,120 flanks the hillside east of the road. Because post-Bonneville isostatic rebound has not been as great here as near Provo, the Bonneville level here is 15 feet lower. The recent valley of the Sevier River (elev. 4,700) has cut into Bonneville deltaic sediments to the west. Sand dunes, chiefly reworked Bonneville material, have accumulated along the northeast margin of the Sevier Desert because of the direction of prevailing winds. To the north this dune sand has nearly buried some of the Paleozoic bedrock hills near Jericho. Several active crescentic dunes (barchans) can be seen to the west.
4.9	81.8	ENTERING OAK CITY.
0.5	82.3	Downtown Oak City; junction Utah Highway 135. The central part of the Canyon Range consists of a north-south synclinal plate of late Precambrian quartzite thrust over north-south anticlinal folds in Cambrian through Devonian strata. At the crest of the range the overthrust upper plate moved a short way over the Late Cretaceous Canyon Range Fanglomerate, riding over its own erosional product.

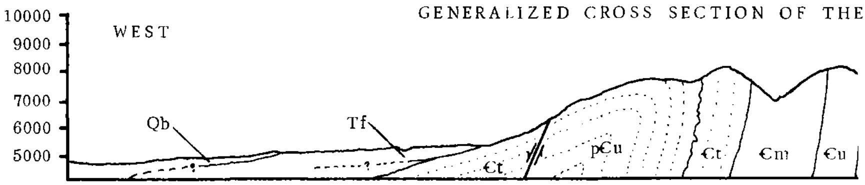
OPTIONAL SIDE TRIP—OAK CREEK CANYON IN CANYON RANGE

The following side trip allows a closer look at the thrust-fault relationships in the Canyon Range. The trip will take an hour or more. The main road log continues at mile 82.3 following the side trip. Text-figure 10 shows the structural relationships in Oak Creek Canyon.

0.0	0.0	START. Downtown Oak City (elev. 5,100); same as mile 82.3 on main part of road log. At Oak City Ward Chapel TURN EAST on road to Oak Creek Canyon Forest Camp.
1.6	1.6	View of the west side of Canyon Range. Cambrian Tintic Quartzite forms a light orange band north of the road and low on the hillside, on the west limb of a tightly folded north-south-trending anticline. Purple Precambrian quartzite in the anticlin-

al core is higher on the hillside, and light-colored Tintic Quartzite is repeated near the crest of the range, on the east limb of the anticline. South of the road the gray rocks are Middle Cambrian carbonates on the south-plunging nose of the same anticline. The juniper-covered low foothills west of the range are Oligocene (?) Fool Creek Conglomerate lying with angular unconformity on the older folded strata.

0.4	2.0	Milepost 2.
0.5	2.5	Dry Creek road to the south. Continue eastward.
0.3	2.8	Sign: "Enter Fishlake National Forest." Tintic Quartzite outcrops on both sides of the road.
0.6	3.4	Cattleguard. Late Precambrian quartzite is visible on the west limb of the anticline.
0.5	3.9	This point marks the anticlinal axis. The east limb is overturned and dips 70 degrees to the west.
0.4	4.3	Oak Creek National Forest Campground, to the south of the road. Overturned Tintic Quartzite on the east limb of the anticline dips 75 degrees to the west.
0.5	4.8	Limekiln Canyon trail leads northward.
0.3	5.1	Big Spring picnic area. Cattleguard. Overturned Ophir Formation strikes northward and dips 80 degrees to the west on the west side of Limekiln Canyon. Overturned Cambrian and Lower Ordovician limestone are exposed on both sides of the canyon between here and Walker Canyon ahead.
1.1	6.2	South Walker Canyon. Precambrian quartzite of the west limb of the overthrust syncline here rests on Ordovician limestone of the east limb of the overturned anticline. The trace of the overthrust contact parallels North and South Walker canyons and is exposed on their west side.
0.1	6.3	Sign: "North Walker Canyon 5, Fool Creek 4."
0 4	6.7	Plantation Flat picnic area.
0.4	7.1	Little Creek Campground to the north, one-half mile. This point marks the axis of the broad syncline in the overthrust Precambrian quartzite. Patches of Fool Creek Conglomerate here uncomformably overlie the quartzite.
0.7	7.8	End of road (elev. 7,000 feet). A ¾-mile hike to the divide (elev. 7,450) crosses over exposures of Fool Creek Conglomerate. At the summit, Precambrian rocks can be seen to the north in thrust contact over Late Cretaceous Canyon Range Fanglomerate. Also, a good view of the ranges to the east—Long Ridge, Gunnison Plateau, and in the distance the Wa-



Age	Symbol	Name
Quaternary	Qb	Lake Bonneville alluvium
Tertiary	Tf	Flagstaff Limestone
Cretaceous	Kc	Indianola (?) Formation conglomerates
Lower Ord.	Ol	Pogonip Group limestones
Upper Cambrian	€u	Ajax Dolomite Opex Formation

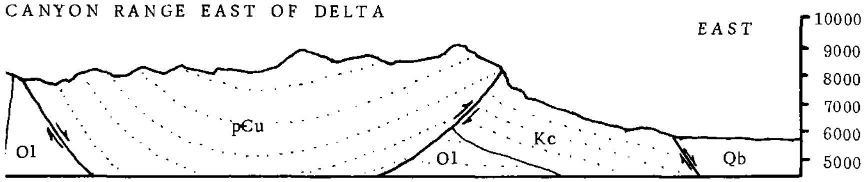
TEXT-FIGURE 10.—Canyon Range cross section, taken at Oak Creek Canyon (after Christiansen).

satch Plateau—can be had at the summit.
End of side trip—retrace route to Oak City.

CONTINUATION OF MAIN ROAD LOG, OAK CITY TO DELTA

	82.3	TURN SOUTH on Utah Highway 135 toward Delta.
4.4	86.7	Active barchan sand dunes south of the highway are comprised of particles derived mostly from Lake Bonneville sediments. Some dark, coarser particles in the sand are derived from the Quaternary volcanic field near Pavant Butte, a volcano to the south. The dunes are migrating northward.
5.2	91.9	Junction, Utah Highway 26. Proceed westward to Delta.
3.2	95.1	Entering DELTA, Utah (elev. 4,630). The town was settled in 1905 and now has a population of 2,000. Delta is at the southwest toe of the Lake Bonneville fossil delta, which heads at Leamington Canyon. The Sevier River cuts through the delta edge about two miles north of town. The upper surface of the delta can be seen north of town, rising about 100 feet above the town's elevation. Delta is the agricultural center for western Millard County and is the chief alfalfa-seed producer of Utah. Recently it has become a prominent livestock-feeding center because of its open winters. The farmland west and south of town is on the bottom of ancient Lake Bonneville. An extensive canal system utilizes fully the last dregs of the Sevier River (called the "dammedest river in the state") so that almost no water proceeds beyond this area into the Sevier Lake playa 30 miles to the southwest. Delta, on the Union Pacific main line, is also the railhead for shipment of fluorspar from the Topaz-Spor Mountain area

CANYON RANGE EAST OF DELTA



Middle Cambrian	€m	Cole Canyon Dolomite
		Bluebird Dolomite
		Herkimer Limestone
		Dagmar Dolomite
		Teutonic Limestone
		Ophir Formation
Lower Cambrian	€t	Tintic Quartzite
Precambrian	p€	unnamed quartzites

about 50 miles northwest of town. Beryllium ore (bertrandite) from the same area is now being processed at a new $10 million Brush Beryllium Corporation reduction plant about 12 miles northeast of town near Lynndyl.

END OF PART 1 OF THE ROAD LOG

ROAD LOG PART 2—DELTA, UTAH, TO ELY, NEVADA, VIA MARJUM PASS, PAINTER SPRING AND MILE-AND-A-HALF CANYON

Delta, Utah, sits near the center of the Sevier Desert, a basin roughly 40 miles east-west by 60 miles north-south. Like the Great Salt Lake Desert, its larger counterpart to the north, the Sevier Desert is structurally a series of north-south fault blocks bounded by major horsts: The Pavant-Canyon Range horst to the east, and the House Range horst to the west. Alluvium has filled this valley, Lake Bonneville sediments constituting the uppermost layers.

Structure of the bedrock beneath the valley floor (as interpreted recently by W. F. Isherwood of the University of Utah) indicates that the town of Delta is over a major graben system about 10 miles wide and 50 miles long. Pleistocene basalts seen on the Sevier Desert floor probably came up along graben boundary faults. Only one well has penetrated the valley fill to a significant depth. Gulf Oil Number 1 Gronning (1956-57), sec. 24, T. 16 S., R.8 W., eight miles northwest of Delta, penetrated the following:

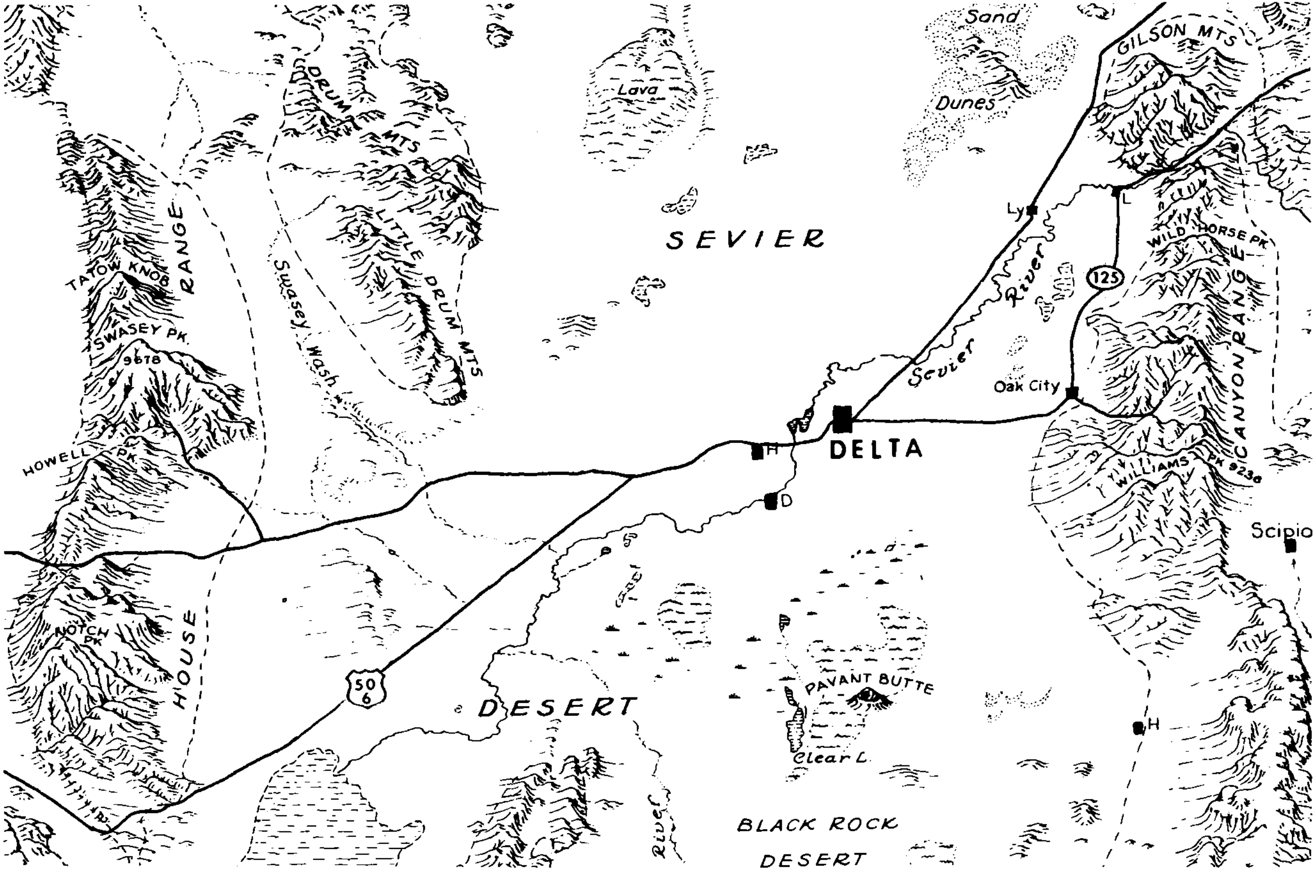
surface — 250':	sand, clay, some gypsum, freshwater snails *Valvata, Gyraulus*
250' — 2,510':	tan claystone, sandstone, pebble conglomerate
2,510' — 2,706':	basalt
2,706' — 2,803':	claystone, sandstone
2,803' — 2,920':	basalt
2,920' — 3,300':	claystone, sandstone
3,300' — 3,350':	basalt
3,350' — 3,518':	claystone, sandstone
3,518' — 6,255':	latite agglomerate and tuffaceous sandstone, Eocene (?)
6,255' — 8,061':	red shale and reddish to gray arkosic sandstone, most likely Triassic, but possibly Eocene Claron.

The well encountered water sand at 1,826 feet but recorded no oil or gas shows.

Several small volcanic fields sit on the lake sediments of Sevier Desert. Most of these volcanic patches have been erosionally modified by Lake Bonneville. The largest volcanic field extends from Pavant Butte southward for 20 miles. The asymmetrical cone of Pavant Butte volcano can be seen nearly due south of Delta, some 16 miles distant.

Mileage

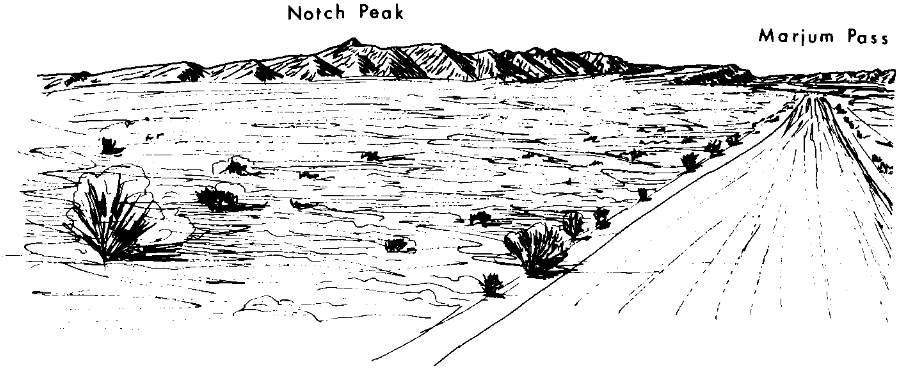
0.0 0.0 START. TOP OF UNION PACIFIC RAILROAD OVERPASS at the west edge of Delta.



TEXT-FIGURE 11.—Map of the Sevier Desert area, from the Canyon Range to the House Range, showing road log route.

2.0	2.3	Junction: road to Oasis, 3 miles south. Continue west on U.S. 6-50. Pleistocene volcanoes and flows on the lake-floor plain can be seen to the south.
0.4	2.7	Cross Sevier River. Most of the water has been diverted into irrigation canals upstream. Elevation at this point is 4,600 feet.
0.2	2.9	Cross the Lowline Irrigation Canal, which originates at the Gunnison Bend Reservoir three-quarters of a mile to the north of the highway.
1.4	4.3	Utah Highway 140 leads south three miles to Deseret. Continue on U.S. 6-50.
0.7	5.0	ENTERING HINCKLEY, a farming community and last gas station for 80 miles.
1.1	6.1	Leaving Hinckley. Eight miles to the south the Black Table Mesa is pre- or intra-Bonneville basalt. This basalt may have issued along the west boundary fault of the Delta graben. Beyond and west of Black Table Mesa are the Cricket Mountains, comprised almost entirely of block-faulted Cambrian strata. Sevier Lake playa borders the west side of the Cricket Mountains.
1.5	7.6	MILEPOST 81. Do NOT take the road west from this point.
1.0	8.6	MILEPOST 80. (Distance from Utah-Nevada line via U.S. 6-50). Note mounds of dirt marking irrigation canals.
3.0	11.6	MILEPOST 77.
0.6	12.2	LEAVE PAVED U.S. 6-50; turn right onto graded dirt road.
0.7	12 9	Curve left to head due westward on old highway. This road served as U. S. Highway 6-50 until 1950, when the new route over waterless Skull Rock Pass and King Canyon was engineered. Old U. S. 6 followed the Indian water-hole route via Antelope Spring, Tule Spring, Cowboy (Skunk) Spring, and Robinson's Ranch. Directly ahead (west) is the House Range; the low point in the center is Marjum Pass, through which this road leads. Left of Marjum Pass is Sawtooth or Notch Peak (elev. 9,655). To the right of Marjum Pass the highest point is Swasey Peak, about 50 feet lower than Notch Peak. The House Range is made up mostly of Cambrian strata, except that a Jurassic granitic intrusion occupies about 10 square miles between Marjum Pass and Notch Peak on the west side of the range. The old highway here proceeds across the floor of Lake Bonneville. At almost any place along here one can stop and find thousands of tiny high-spired, freshwater snail shells in the tan silt. To the northwest, the Drum Mountains are comprised of Cambrian strata covered unconformably on the south by Tertiary volcanics. Lake Bonneville beach ridges occur at many elevations between the lake bottom here (elev. 4,570) and the

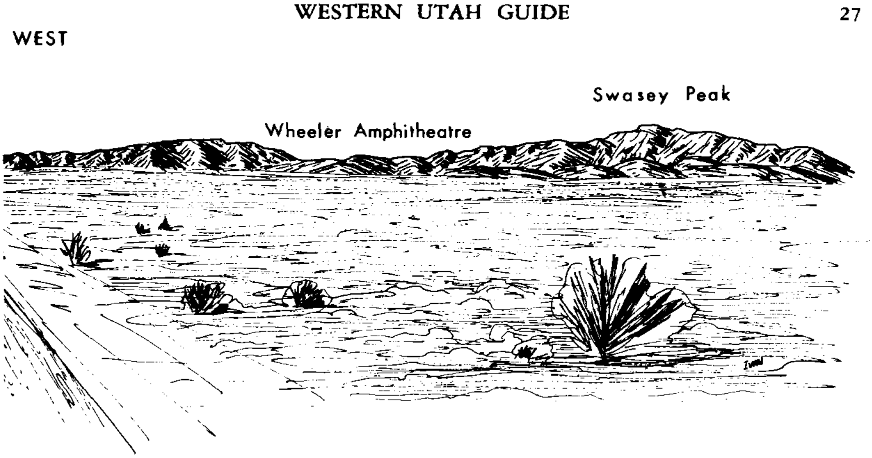
		flanks of the surrounding ranges (elev. 5,100). Tertiary valley fill here is probably more than 6,000 feet thick—as judged from the Gulf Oil Gronning well discussed above.
7.7	20.6	Slight rise in the road to climb onto a Lake Bonneville gravel beach.
2.9	23.5	Side road heads north to Swasey Wash, Little Drum Mountains, and Swasey Spring. Continue west on the main road.
0.3	0.3	Junction, Utah Highway 99. TURN LEFT toward Ely on U.S. 6-50.
0.5	24.0	Some pilings to the north of the road can be seen where light yellow, clayey, diatomaceous earth of a Lake Bonneville shoreline was mined until proven uncommercial. This impure diatomaceous bed is a widespread marker horizon in the Lake Bonneville basin.
1.8	25.8	Cross south end of hills composed of Tertiary volcanics and gravel deposits. This western edge of the Sevier Desert is marked by outcrops of Tertiary rocks, suggesting that valley fill is not nearly as thick here as at Delta. Ahead and to the south, a low fault escarpment, Long Ridge, exposes the same Tertiary material.
3.7	29.5	The low hills just north of the road expose semiconsolidated Tertiary conglomerates derived most probably from west of the present position of the House Range and deposited here prior to the uplift of the House Range fault block.
1.4	30.9	Cross Soap Hollow wash (Text-fig. 12).
0.5	31.4	Coarse deposits just south of road contain Ordovician, Silurian, and Devonian boulders whose nearest exposed source is west of the House Range. Patches of these Tertiary conglomerates are found well up on the flanks of the House Range, suggesting a western source.
1.4	32.8	Note gravel pit in Lake Bonneville deposits, which here form a thin veneer over the volcanic bedrock.
1.0	33.8	CATTLEGUARD.
0.3	34.1	The low point ahead is Marjum Pass. The low area below Swasey Peak at two o'clock is the Wheeler Amphitheatre, toward which we will turn. It is developed on the nonresistant Middle Cambrian Wheeler Shale (Text-fig. 13).
0.6	34.7	ROAD JUNCTION. TURN RIGHT toward a trilobite collecting locality in Wheeler Amphitheatre at Antelope Springs. The main road through Marjum Pass continues to the west; the road to the south passes Long Ridge Reservoir to join paved U.S. 6-50 in about 10 miles.
1.3	36.0	Swasey Peak, straight ahead, is capped by the dolomitic facies



TEXT-FIGURE 12.—Panoramic view of the central part of the House Range as seen from the east, near Soap Hollow Wash.

of the Middle Cambrian Marjum Formation. To the west the shaly limestone facies of the Marjum Formation forms the cuesta on the south side of Marjum Pass. Robison (1960) assigns the dolomite facies to a carbonate belt which extends eastward; the shaly limestone facies he assigns to a western detrital belt.

3.4	39.4	PASS LOWER ANTELOPE SPRING STANDPIPE AND POND. Proceed ahead. The water here is piped six miles from Antelope Spring, on the northeast side of Swasey Peak. The standpipe is for filling sheep-watering trucks during the winter grazing season. The road east leads to Swasey Spring, on the northeast side of Swasey Peak. The rocks ahead are the upper-Middle Cambrian Marjum Formation, composed of alternating limestone and dolomite.
1.0	40.4	The road winds through Marjum Formation, composed of dark gray limestone and brownish dolomite.
1.1	41.5	Cross wash in Marjum Formation.
0.4	41.9	Cross wash. This wash follows the strike of the Wheeler Shale northward. A dip slope on the Swasey Limestone can be seen west of the road. The contact between the Marjum and Wheeler formations is taken at the lowest prominent limestone ledge. The lower part of the Marjum Formation is shaly limestone ledges and slopes; upper part is massive dolomite and limestone cliffs.
1.1	43.0	Good view of silvery Wheeler Shale, exposed in the wash east of the road. Agnostid trilobites are common in the slope between the road and the wash.
0.3	43.3	ROAD JUNCTION. Death (Dome) Canyon Road leads to the west. Take the right fork towards Sinbad.

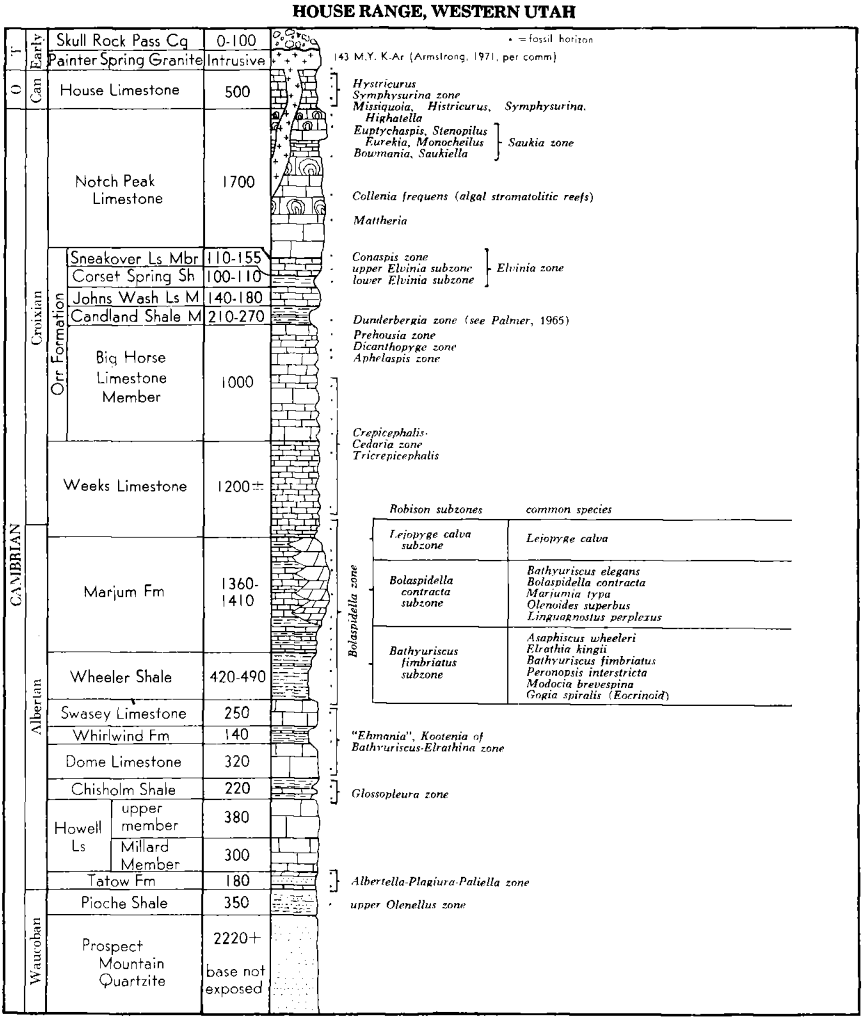


0.1 43.4 Wheeler Amphitheatre road junction. STOP TO COLLECT TRILOBITES. Just east of the junction is a water pipe. West of the road is Antelope Spring corral and two ancient Lombardy poplar trees. The actual spring is a mile to the north on the flank of Swasey Peak. The road northward follows a bench on the Wheeler Shale around Swasey Peak to Sinbad Spring, on the west face of the mountain.

To collect trilobites, follow the road to the east as far as possible, then walk to the collecting beds. A pick and shovel are needed for extended collecting. Trilobites occur in many horizons in the Wheeler Shale and lower Marjum Formation—as is shown on the House Range stratigraphic chart (Text-fig. 13)—but in most places the trilobites cannot be liberated from the matrix as easily as they can here. The trilobites here are not silicified but have been thickened by a "fortification structure" of calcite, which has grown between the top and the bottom of the trilobite carapace, strengthening it so that the trilobites can be broken entirely free of the matrix.

Trilobites from here were first collected by Indians who used them as charms. Charles D. Walcott, then Director of the U. S. Geological Survey, spent the entire summer of 1905 collecting Cambrian fossils in the House Range, naming about 50 new species of trilobites taken mostly from the Wheeler and Marjum formations. A detailed restudy and careful zonation of the trilobites of the Wheeler and Marjum formations are published by Robison (1964).

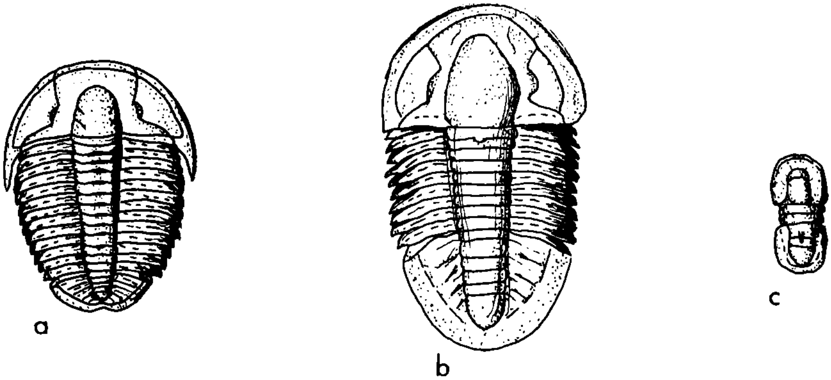
By far the most common trilobite in the Wheeler Shale is *Elrathia kingii;* the next two most common are the small agnostid *Peronopsis,* and the *Asaphiscus wheeleri,* which is characterized by its large pygidium (tail) (Text-fig. 14). Small phosphatic brachiopods are also common. The horizon from which whole trilobites are most commonly obtained is near the



After: Hintze, unpublished notes; Hose (1961); Palmer (1960),(1965); Powell (1959); Bentley (1958); Hanks (1962); Robison (1960),(1964),(1971); Notch Peak Conodonts: Miller (1969)

TEXT-FIGURE 13.—House Range stratigraphic chart.

top of the Wheeler Shale and is marked by reject talus from the "strip mining" operation now necessary to obtain many good specimens. This is probably the most famous trilobite locality in the world. *Elrathia* specimens from here are found in every university and museum collection, and nearly every day amateur collectors are here digging. Robert Harris of Delta has been collecting trilobites commercially here for the past few years. He has turned the less common specimens over to Dr. Richard Robison of the University of Utah, who has described



TEXT-FIGURE 14.—Trilobites commonly found at Antelope Spring in the Cambrian Wheeler Shale. a. *Elrathia*, b. *Asaphiscus*, c. *Peronopsis*.

the recent finds (Robison, 1971). Fourteen different species of trilobites have been recovered so far from the Wheeler Shale, as have three species of phosphatic brachiopods, three species of sponges, and an early crinoid.

AFTER COLLECTING, RETURN TO ROAD JUNCTION at mile 34.7 via the same road past Antelope Spring Pond. A good view can be had of Sevier Lake playa on the return trip.

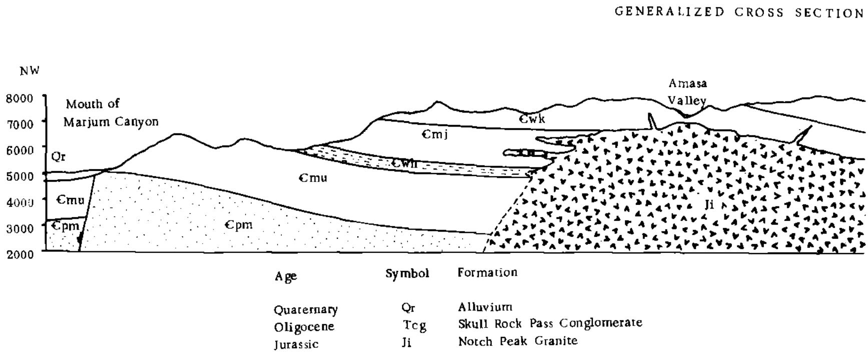
8.8 52.2 Road junction, same as 34.7. TURN WEST toward Marjum Pass.

3.6 55.8 Marjum Formation is exposed north and south of the road.

0.3 56.1 Amasa Valley road to the left leads to the top of the House Range where the roof of an intrusion has been mined for tungsten and gold. See Text-figure 15 for a cross-section showing this granitic intrusion. Continue ahead toward Marjum Pass. The cuesta to the south marks the top of the Marjum Formation and the top of the Middle Cambrian. The House Range south of the cuesta is mostly Upper Cambrian (Text-fig. 13).

5.8 61.9 MARJUM PASS SUMMIT, named for William Valentine, nicknamed "Marjum," a young freighter from Deseret who pioneered the pass. The old freight route across the House Range went from Antelope Spring down Death (Dome) Canyon, a steeper route.

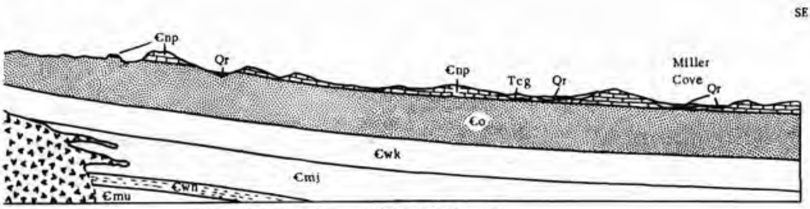
Wheeler Shale is exposed south of the road; Swasey Limestone forms the dip slope north of the road. The Wheeler Shale here has trilobites, but they do not separate from the rock as freely as those at Wheeler Amphitheatre. The Wheeler Shale occupies only lower slopes here. Higher alternating limestone-shale ledges are of the Marjum Formation.



TEXT-FIGURE 15.—Generalized cross section through the House Range, from the mouth of Marjum Canyon southeast to Miller Cove.

1.5	63.4	Rainbow Valley. The Jurassic intrusion one mile to the south has caused chemical alteration of the Wheeler and Marjum formations, resulting in vivid red and yellow colors.
0.4	63.8	Turn into head of Marjum Canyon. The Swasey Limestone forms a medium gray cliff underlain by slope-forming yellow shaly limestones of the Whirlwind Formation, which contain abundant *Ehmania* trilobite hash.
0.1	63.9	The yellow shaly slope below the Swasey Limestone cliff north of the road is the Whirlwind Formation. The darker limestone beneath Whirlwind is the top of the Dome Limestone. (See House Range stratigraphic chart, Text-fig. 13.)
0.1	64.0	A good view of the Dome Cliffs can be seen ahead at the base of the hill, a bench formed on the Whirlwind Formation and covered with juniper trees; and the Swasey cliff can be seen at the top of the hill (Text-fig. 16).
0.6	64.6	Wash, to the south from Rainbow Valley. The hillside to the south shows Swasey Limestone (top cliff), Whirlwind Formation (slope), and Dome Limestone (at road level). Minor faults offset the beds.
1.0	65.6	Most of the Middle Cambrian sequence can be seen on the hillside to the west and south: Swasey Limestone — top cliff Whirlwind Formation — upper bench Dome Limestone — cliffs with reddish alteration here Chisholm Shale — bench Howell Limestone — ledges near road level Northward, the two members of the Howell can be seen: the basal Millard Member is dark gray; the Upper Howell weathers very light gray and forms a cliff.
0.1	65.7	Dark brownish orange Tatow Formation, underlain by green-and-brown quartzite and phyllite of Pioche "Shale," are exposed here.

OF THE HOUSE RANGE

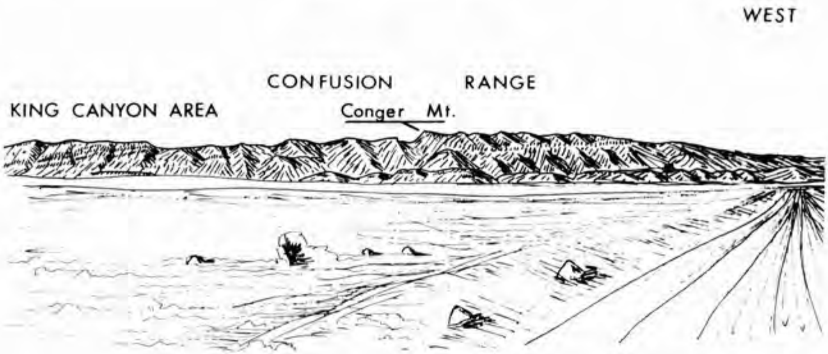


Upper Cambrian	Ꞓnp	Notch Peak Formation
	Ꞓo	Orr Formation
	Ꞓwk	Weeks Limestone
Middle Cambrian	Ꞓmj	Marjum Formation
	Ꞓwh	Wheeler Shale
	Ꞓmu	Middle Cambrian undivided
Lower Cambrian	Ꞓpm	Prospect Mountain Quartzite:

0.4 66.1 Cross wash at the mouth of Marjum Canyon at the head of the alluvial fan. The Pioche Shale just north of the road has yielded oldest trilobites yet collected in Utah: large *Olenellus* impressions in the quartzites were described by Robison and Hintze (1972).

Visible across White Valley, as shown on Text-figure 17, Conger Mountain is the highest point in the Confusion Range. The Deep Creek Range on the Utah-Nevada line can be seen to the northwest, and the Fish Springs Range is seen at the north end of White (Tule) Valley.

TEXT-FIGURE 16.—Marjum Canyon, House Range. The cliffs at the top of the hill are Swasey Limestone; the juniper-covered slope below the Swasey cliffs is the Whirlwind Formation; and the cliffs forming the lower half of the hill are Dome Limestone.

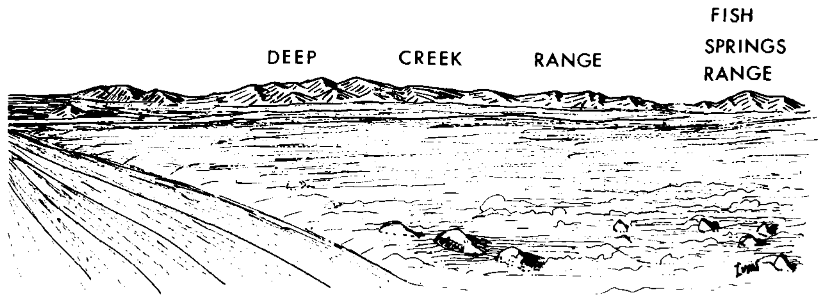


TEXT-FIGURE 17.—Panoramic view west from the mouth of Marjum Canyon, showing the Confusion Range, the Deep Creek Range, and the Fish Springs Range. White Valley is in foreground.

2.5 68.6 ROAD JUNCTION. TURN SOUTH toward Painter Spring. From here one has a fine view of the House Range formations to the east (Text-fig. 18).

1.2 69.8 Descend off Lake Bonneville shore terrace. The low hills in the bottom of White Valley are fault blocks of Upper Cambrian Notch Peak Formation, relatively displaced about 5,000 feet down from their occurrence in the House Range. White Valley is also known as Tule Valley because of the rushes which grow

TEXT-FIGURE 18.—West face of the House Range north of Marjum Canyon, showing Lower Cambrian strata at base of hill and Middle Cambrian strata forming the cliffs.



around the small springs in the valley bottom. The horizontal line near the top of the hills is a resistant ledge of cemented Lake Bonneville shore talus and gravel.

3.7 73.5 PAINTER SPRING WATER TANK. TURN WEST on the road across White (Tule) Valley. The road eastward leads to Painter Spring in the canyon mouth, in granitic rocks (Text-fig. 19). The lowest bedded units to the east are contact-metamorphosed Marjum Formation, here invaded by pink granite sills. The Notch Peak Formation forms the upper cliffs on Notch Peak. The ledgy slopes beneath are the Dunderberg Shale, Orr Limestone, and Weeks Formation, all contact metamorphosed adjacent to the Jurassic granitic intrusion. A prominent white marbleized bed can be seen on the west side of Notch Peak .

1.3 74.8 Bottom of White (Tule) Valley. (See Text-fig. 20 for geography of this area.) To the west, in the Confusion Range, the light-colored exposures are Ordovician Eureka Quartzite, underlain by thin darker units, the Crystal Peak Dolomite. This in turn is underlain by orange "Swan Peak" Quartzite. (See the Confusion Range stratigraphic chart, Text-fig. 21.)

Above the light-colored Eureka Quartzite, the dark cliffs are Upper Ordovician Fish Haven Dolomite and Silurian Laketown Dolomite. At the very top of the hill, the light mouse-gray nonledgy slope is the Devonian Sevy Dolomite.

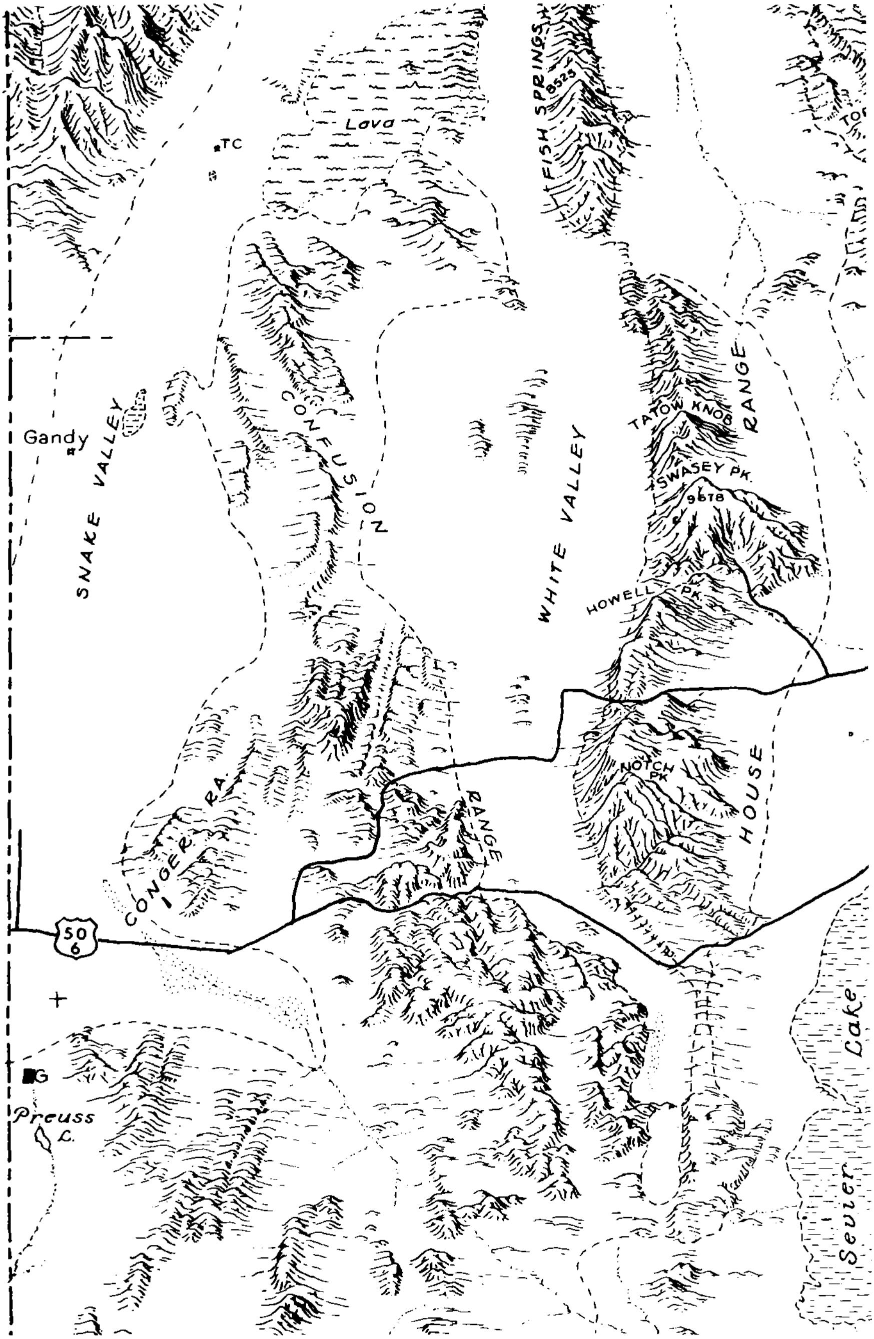
2.1 76.9 Light-colored, impure diatomaceous deposits of Lake Bonneville are exposed on both sides of the road. The general structure of the Confusion Range ahead is a faulted synclinorium, in which Ordovician rocks are exposed on the east and west flanks, and rocks as young as Lower Triassic are preserved in the center of the downfold (Text-fig. 22).

2.4 79.3 Junction with road along the east side of the Confusion Range. Continue west on Mile-and-a-Half Canyon road. The hills to

TEXT-FIGURE 19.—Painter Spring area, showing the Notch Peak Granite intrusion. The sedimentary rocks at the base of the mountain are Marjum Formation.

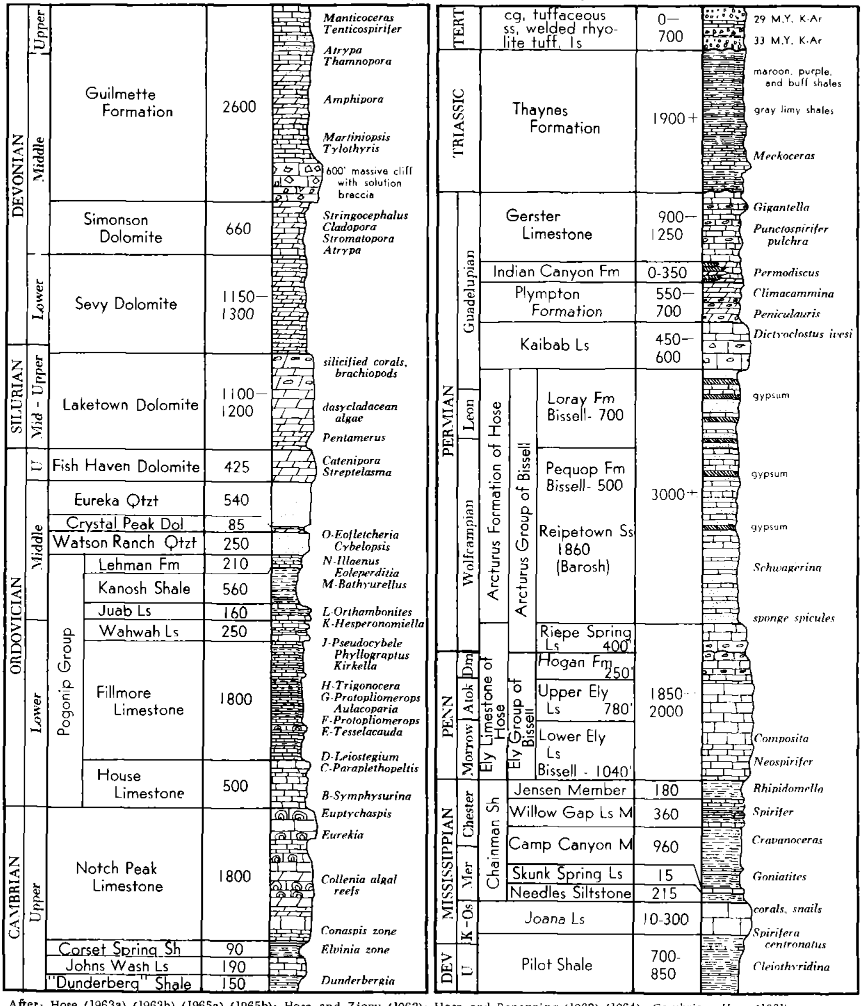
the north expose dark-colored Silurian Laketown Dolomite at the extreme east side. The low, rounded, nonledgy slopes of light gray color are Devonian Sevy Dolomite; the banded dark and light ledges are Simonson Dolomite; and the ragged, rounded cliff at the top is the basal member of the Guilmette Formation. The elevation is 5,120 feet at the road junction.

1.5	80.8	A north-south normal fault repeats the stratigraphic section on the west side of the Confusion Range. The hills to the north again show the low, rounded slopes of the Sevy Formation and the striped slopes of the Simonson Formation. At the top of the low hill just to the west are the ragged, rounded cliffs of the lower part of the Guilmette Formation.
0.6	81.4	The road crosses pinkish outcrops of Tertiary (Oligocene) volcanic rocks.
0.2	81.6	Roadcut in volcanic rocks.
0.1	81.7	The lower member of the Guilmette Formation is exposed at road level.
0.4	82.1	Guilmette Formation (Text-fig. 21).
0.1	82.2	The whitish limestone at the north side of the road is Tertiary freshwater limestone, probably equivalent to the Eocene White Sage Formation of the Gold Hill Mining District to the north. Small patches of this limestone and associated volcanics, un-



TEXT-FIGURE 20.—Map of the Confusion and House Ranges, showing road log routes.

CONFUSION RANGE, MILLARD COUNTY, UTAH



After: Hose (1963a),(1963b),(1965a),(1965b); Hose and Ziony (1963); Hose and Repenning (1963),(1964); Cambrian: Hose (1961); Ordovician: Hintze (1951),(1952); Webb (1958); Ketner (1968); Braithwaite (1972); Silurian: Waite (1956); Devonian: Hose (1966); Osmond (1962); Mississippian: Ogden (1951); Sadlick (1965); Penn-Triassic: Hose and Repenning (1959); Bissell (1962b),(1964a),(1970); McKee and others (1967); Barosh (1964); Steele (1960); Chainman-Ely conodonts: Dunn (1970)

TEXT-FIGURE 21.—Confusion Range stratigraphic chart.

conformable on the folded Paleozoic rocks, are found throughout the Confusion Range.

0.1 82.3 Cross wash.

0.1 82.4 The ungraded truck road to the north leads up Little Mile-and-a-Half Canyon. This side canyon affords a better view of the stratigraphic section and is the one followed by the road log. DO NOT take this side road in wet weather or if you are driving a low-centered vehicle. (An alternate road log of the geology along the graded Mile-and-a-Half Canyon road follows mile 90.4.)

The light-colored rock at the road junction is Tertiary freshwater limestone. Proceed WITH CAUTION to the right, up Little Mile-and-a-Half Canyon.

0.2 82.6 Cross wash. The light exposures to the left are Tertiary limestones. At the base of the hill to the east is the top of the lower member of the Guilmette Formation.

1.6 84.2 After crossing the wash several times, the road enters the mouth of Little Mile-and-a-Half Canyon. The Guilmette Formation is exposed on both sides of the road. The road proceeds upward through a good stratigraphic section of the upper part of the Guilmette Formation as described by R. K. Hose (1966). Common fossils in the Guilmette Formation are stromatoporoids and brachiopods. Conodonts have also been obtained from acid-leached residues.

1.1 85.3 Head of Little Mile-and-a-Half Canyon. This marks the top of the Guilmette Formation. The valley opens out along the strike of the Devonian Pilot Shale. The Pilot Shale is not exposed well in most places, since it is covered with slope wash. Some of the best exposures can be seen directly ahead in the gullies at the base of the Joana Limestone cliff.

0.2 85.5 A sheepherder road leads along the strike of the Pilot Shale valley. Continue straight ahead on the main road.

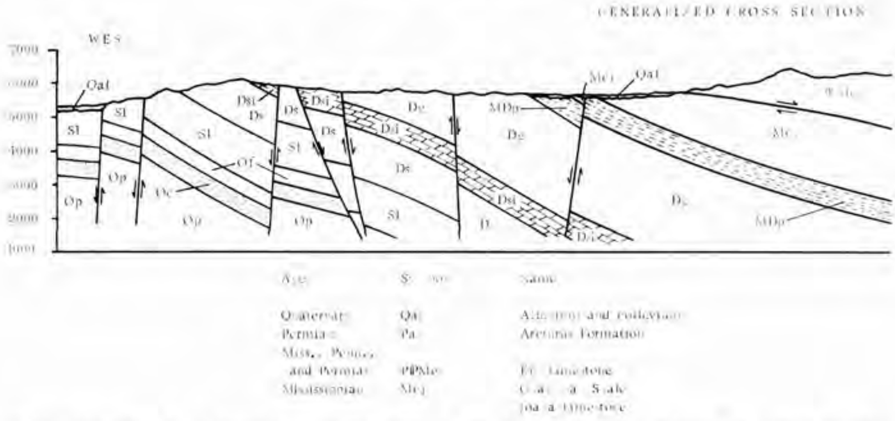
0.4 85.9 Water gap, in a cliff of Mississippian limestone.

0.2 86.1 Road junction, in Chainman Shale valley. Turn left along Chainman Shale valley towards the south. The Chainman Shale is about 1,500 feet thick here and can be seen well exposed in the first cuesta on the west side of this valley. The dark gray limestone ledges above the Chainman Shale are the Ely Limestone forming the top of Conger Mountain here (Text-fig. 23).

4.3 90.4 ROAD JUNCTION. TURN RIGHT (northwest) to Conger Spring for fossil collecting in the Chainman Shale. The road has been following along a broad valley in the Chainman Shale between Joana and Ely Limestone ledges. Ely Limestone is exposed at the top of Conger Mountain. Conger Mountain and this road junction both lie along the axial trend of a broad northward-plunging syncline.

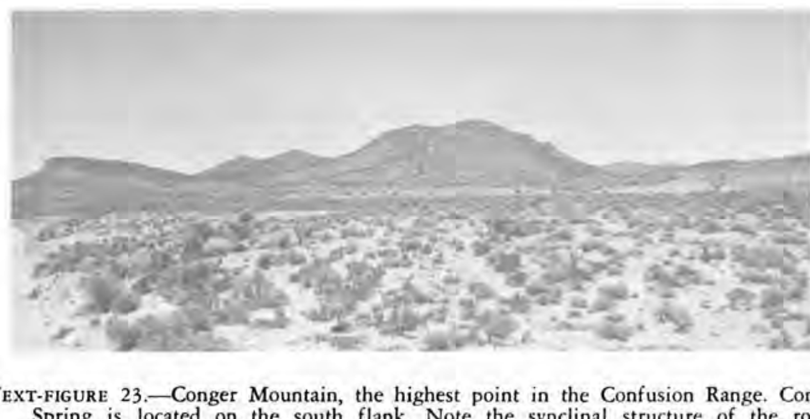
ALTERNATE ROUTE

82.4 With low vehicles or in bad weather, proceed straight ahead on the main road up Mile-and-a-Half Canyon. A good view of middle and upper Guilmette Formation is ahead. The light-colored rocks north of the road are Tertiary freshwater lime-



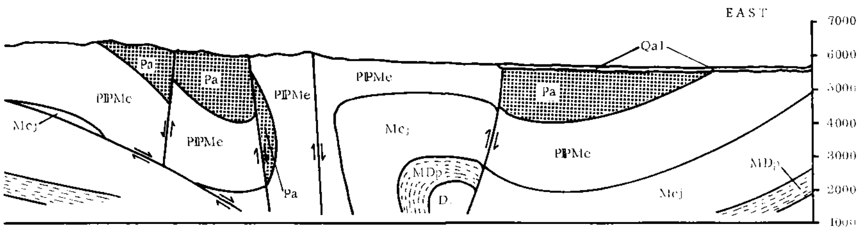
TEXT-FIGURE 22.—Generalized cross section of the Confusion Range in the Conger Mountain area.

		stone. For the next ten miles, the Guilmette Formation comprises all of the Paleozoic bedrock adjacent to the road. This is the thickest Devonian sequence in Utah.
3.5	*85.9*	*Summit of Mile-and-a-Half Canyon. The elevation here is 6,440 feet. The road ahead leads down Sheepmen's Little Valley.*
1.1	*87.0*	*Dowdell Canyon road joins from the east.*
0.9	*87.9*	*Payson Canyon road joins from the east.*
1.1	*89.0*	*To the west, the highest mountain is Wheeler Peak, in the South Snake Range in Nevada.*
1.8	*90.8*	*To the north is a good view of Conger Mountain, which lies*



TEXT-FIGURE 23.—Conger Mountain, the highest point in the Confusion Range. Conger Spring is located on the south flank. Note the synclinal structure of the rocks. Cuestas of Joana Limestone on either side display rocks which dip toward the center of the photo. Conger Mountain is made of Ely Limestone.

OF THE CONFUSION RANGE



Devonian and Mississippian	MDp	Pilot Shale
Devonian	Dg	Guilmette Formation
	Dsi	Simonson Dolomite
	Ds	Sevy Dolomite
Silurian	Sl	Laketown Dolomite
Ordovician	Of	Fish Haven Dolomite
	Oe	Eureka Quartzite
	Op	Pogonip Group

on the axis of the north-plunging Conger Mountain Syncline (Text-fig. 23).

1.2 92.0 Road junction. Same as mile 90.4. Proceed ahead (north) to Conger Spring.

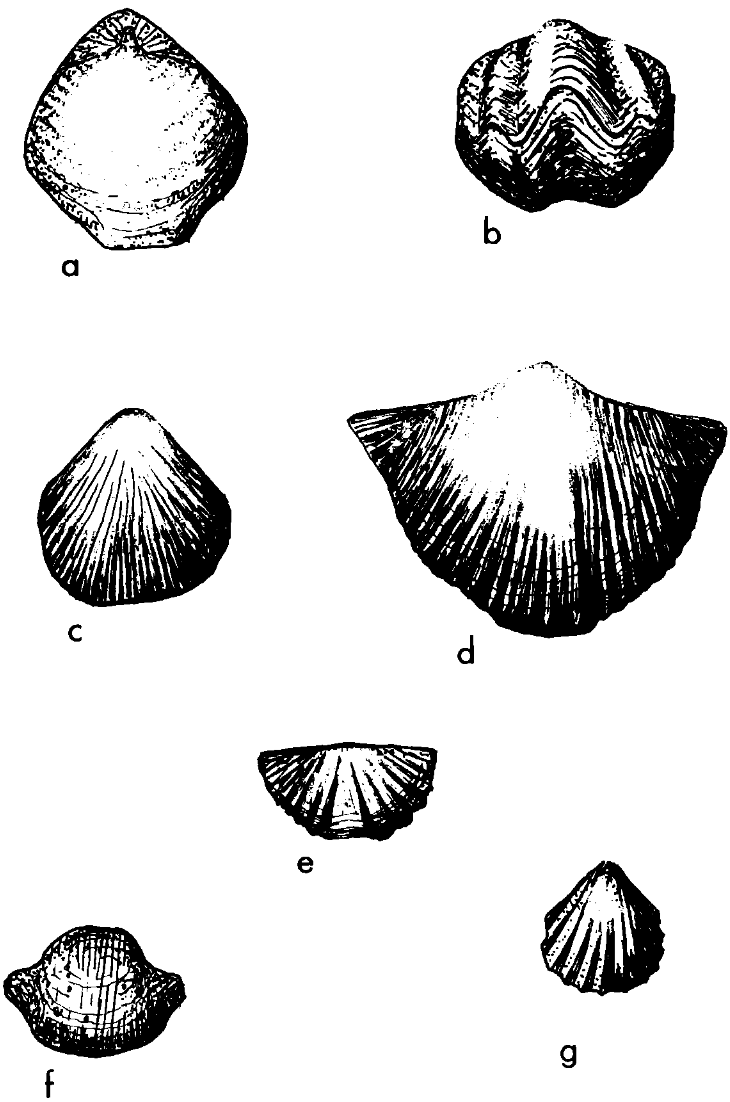
END OF ALTERNATE ROUTE

1.3 91.7 CONGER SPRING. STOP TO COLLECT. The upper part of the Chainman Shale is exposed at the Spring and has a prolific fauna of several different types of brachiopods, corals, and crinoids (Text-figs. 24 and 25). These weather out whole here and can be picked out of the shale. This fauna has been studied by Walter Sadlick (1965), who has named various members in the Chainman Shale in this area. After collecting, retrace route southward to the road junction at mile 90.4.

1.1 92.8 Road junction. (Same as 90.4.) Continue straight ahead south. The road to the left leads back to Little Mile-and-a-Half Canyon. The road to the right is a rocky road across the Conger Anticline. The Conger Anticline parallels the Conger Syncline but is a narrower structure. Its rimrock is the Joana Limestone, whose back slope is just to the west. At the north end of the anticline, the Joana forms a somewhat higher ledge-forming rimrock. The road ahead proceeds over the lower portion of the Chainman Shale, along the axis of the Conger Mountain syncline. The Joana rimrock on both sides of the syncline can be seen east and west of the road as we proceed southward.

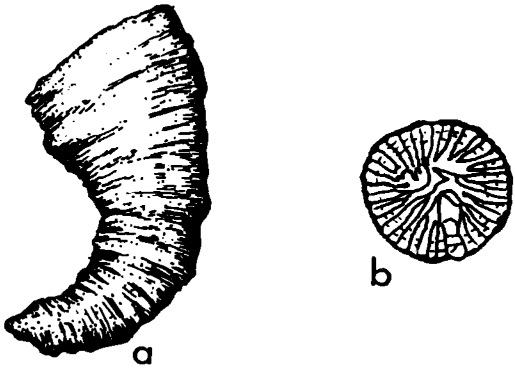
1.5 94.3 Cross wash. The top of the Joana Limestone is exposed on both sides of the road. Proceed down through the Joana Limestone along the axis of the Conger Mountain Syncline.

0.7 95.0 Base of Joana Limestone. The underlying Pilot Shale is here



TEXT-FIGURE 24.—Brachiopod assemblage at Conger Spring (shown actual size): a. *Composita,* b. *Spiriferina,* c. *Eumetria,* d. *Spirifer,* e. *Punctospirifer,* f. *Marginifera,* g. *Hustedia.*

		concealed by alluvium. The ledges west of the road are the upper part of the Guilmette Formation.
0.7	95.7	The Guilmette Formation crops out on both sides of the road.
1.5	97.2	Road junction. Conger Spring Road joins main Mile-and-a-Half Canyon Road. Proceed west.



TEXT-FIGURE 25.—*Amplexizaphrentis,* a rugose coral found at the Conger Spring locality. a. lateral view, b. cross section.

0.5	97.7	Road junction. Bear left. The road to the right leads into the Confusion Range.
2.6	100.3	The road to the west leads to Little Valley water tank. The south end of the Confusion Range is here called the Buckskin Hills, and the ledgy units obvious in the hills belong to the Ely Formation. The Buckskin Hills are in an eastward-overturned syncline, the core of which exposes Permian Arcturus Formation. Strike faults complicate the synclinal structure (Text-fig. 22).
1.3	101.6	JUNCTION OF LITTLE VALLEY ROAD WITH U.S. HIGHWAY 6-50. Turn west on U.S. 6-50.
1.2	102.8	Milepost 15. (Mileposts denote the highway mileage from the Utah-Nevada state line.)
1.9	104.7	Milepost 13. Cross the south end of the Buckskin Hills. Ely Limestone is exposed here.
1.4	106.1	Cattleguard.
1.6	107.7	Milepost 10. To the north, the eastward-dipping Ely Limestone beds can be seen on the west flank of the Buckskin Hills Syncline.
1.2	108.9	The road to Eskdale leads towards the north. The west side of the Buckskin Hills exposes Middle Paleozoic formations. The light-colored noncliffy exposures of the Sevy Formation can be seen overlying the dark Laketown Dolomite. These formations are in fault contact with upper Paleozoic beds in the westernmost side of the range as shown by Hose (1963a, 1963b).
1.8	110.7	Milepost 7. Valley bottom, Snake Valley. To the west, Sacramento Pass separates the North Snake Range from the South Snake Range.

The highest point in the South Snake Range, Wheeler Peak (elev. 13,063), is the second highest point in Nevada. It is composed of Prospect Mountain Quartzite and supports glacial cirques on its north and south flanks. The South Snake Range, mapped by Harold Drewes (1958) and Whitebread (1962), is composed chiefly of Paleozoic sedimentary rocks thrust-faulted along bedding-plane faults and intruded by granitic stocks just south of Wheeler Peak. The North Snake Range, mapped by Peter Misch and John Hazard (as yet unpublished), contains a large area in the vicinity of a decollement detachment surface where the Precambrian and Paleozoic rocks have been somewhat metamorphosed. This can be seen by taking a short trip into the base of the North Snake Range (Text-fig. 26).

6.0 116.7 Milepost 1. In 1956, the Shell Oil Company drilled Baker Creek Number 1 Government Well about a quarter of a mile south of here in sec. 19, T. 20 S., R. 19 W. The upper 730 feet were identified as Pleistocene clay. Dolomite, ash, and gypsum beds beneath this were assigned to the Salt Lake Group. The well penetrated 4,180 feet of Cenozoic valley fill before bottoming in Prospect Mountain Quartzite at a total depth of 4,218 feet.

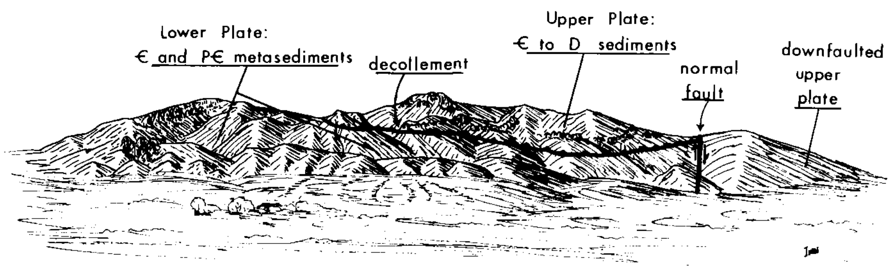
0.4 117.1 ROAD JUNCTION. TURN NORTH ON ROAD TO GANDY to see decollement surface at the east side of the North Snake Range. (Note: This side trip between miles 117.1 and 140.0 takes at least one hour.)

0.8 117.9 Gravels represent Lake Bonneville deposits. Snake Valley is the westernmost area covered by Lake Bonneville, and shoreline remnants can be seen in the lower parts of the valley.

2.6 120.5 Road east leads to Eskdale, at the base of the Buckskin Hills.

4.7 125.2 Road Junction. Turn sharply back to the left, heading directly towards Wheeler Peak. DO NOT veer left, onto the main road.

0.3 125.5 Turn right, off the road onto a trail leading towards North Snake Range. The dark hills in the foreground are Ordovician



TEXT-FIGURE 26.—North Snake Range decollement, as seen from U. S. 6-50 near Utah-Nevada state line.

and Silurian rocks. The Laketown Dolomite forms the dark exposures, and the Eureka Quartzite forms the light-colored exposures. Through the gap, the light exposures are Precambrian quartz schists. On top of the range, the dark rocks are a jumble of Paleozoic units, chiefly Cambrian formations.

2.0 127.5 Water gap at the head of the alluvial fan. The dark rocks on both sides of the road are Silurian Laketown Dolomite. These Paleozoic rocks are on the upper plate of the decollement and have been severely jostled about, so that they are shattered with many faults. The light-colored, rounded slopes through the water gap are exposures of Precambrian quartz schist, a platy rock which is mined here for building stone. The light band at the top of the quartzite exposures and beneath the ragged cliffs of limestone represents a marbleized limestone zone at the base of the decollement upper plate. The decollement surface is a detachment surface between the autochthonous Precambrian quartzite rocks and the overlying allochthonous decollement of Paleozoic carbonates. The marbleized limestone at the contact was probably a Middle Cambrian limestone. Trilobite fragments have been found in the marbleized rock. To the north, the contact between the darker-colored Laketown Dolomite and the light-colored quartzites of Precambrian age can be seen at the low saddle. The decollement surface dips eastward at a low angle of about 20 degrees.

0.9 128.4 STOP AND TURN AROUND at abandoned truck and sheep wagon. A view of the actual decollement surface can be had by a short hike either to the hillside on the west or to the hillside on the north. After viewing the decollement, RETURN TO U.S. HIGHWAY 6-50 by the same route. Drive down the fan, noting the good view of the south end of the Confusion Range and the Buckskin Hills. The light-colored exposures on the west side of the Buckskin Hills are Permian limestones in fault contact with the darker middle Paleozoic formation just to the east. Conger Mountain is the prominent flat-topped peak with a south-facing point.

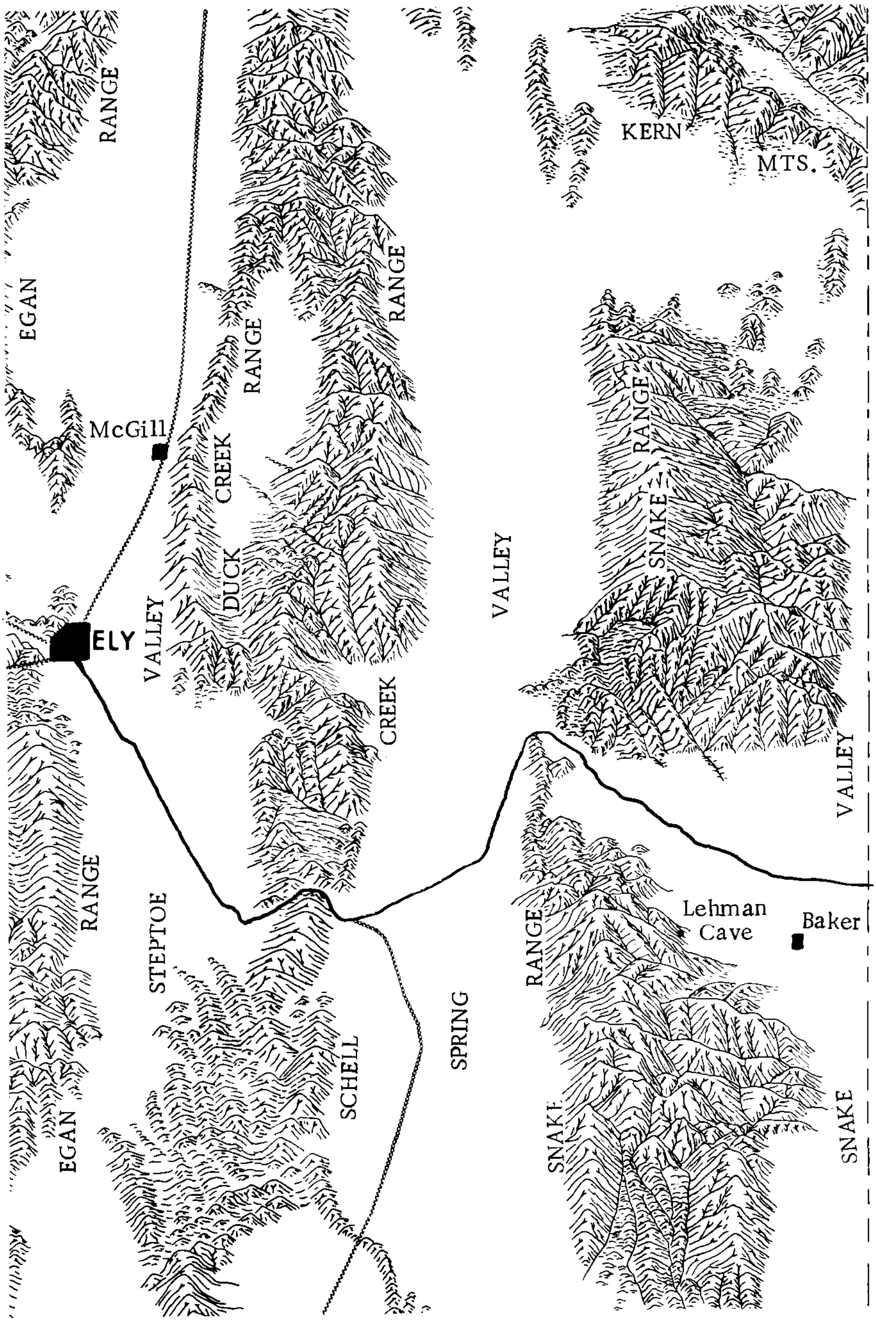
2.7 131.1 Turn left (north) on main road.

0.3 131.4 Turn sharply right (south) on graded road.

5.8 137.2 Small pond east of the road is from a pump well. Groundwater exploitation of Snake Valley has just begun. Most of the farming in Snake Valley is along the east toe of the Snake Range, where the meltwater streams furnish irrigation water.

2.4 139.6 JUNCTION WITH U.S. 6-50 (same as mile 117.1). TURN WEST. The Burbank Hills to the south of Snake Valley are similar to the Confusion Range in stratigraphy and structure. (See Text-fig. 27 for remainder of route.)

0.6 140.2 Nevada state line gasoline station. The trees 5 miles to the



TEXT-FIGURE 27.—Map of east-central Nevada, showing road log route and adjacent mountains.

		south mark Baker, Nevada. The trees 10 miles to the south are at Garrison, Utah, settled first in the 1850s by cattle rustlers.
3.0	143.2	Cattleguard, immediately beyond which is a cutoff to Baker, Nevada. Baker, at the foot of the Snake Range, is a small farming community at the mouth of Baker Creek. Lehman Cave National Monument is about seven miles up the canyon from Baker, at the foot of Wheeler Peak. The cave, named for Absalom Lehman, a rancher who explored the cave in the 1880s, is in middle Cambrian limestone and is famous for the variety of cave formations to be found. In addition to stalagmites and stalactites, there are beautiful examples of helictites, drapery, cave coral, and unusual shields or pallettes.
3.8	147.0	Junction. Nevada Highway 73 leads southward to Baker and Lehman Cave. Continue on U.S. 6-50.
0.5	147.5	Additional junction of Nevada Highway 73. Gas station north of road. Continue on U.S. 6-50.
1.8	149.3	The rolling hills across the wash north of the road are westward-dipping Cretaceous(?)-Early Tertiary conglomerates and sandstones. These clastics interfinger with nonmarine limestones and mudstones and are overlain by Miocene or Pliocene tuffaceous limestones and mudstones in this area, according to Van Houten (1956).
1.0	150.3	Ranch to the right. Ordovician Eureka Quartzite appears in yellowish exposures behind and a half mile north of the ranch. Red igneous rocks in the low valley are unconformable on Paleozoic exposures here. Paleozoic rocks are exposed in patches largely covered by the thick sequence of Cretaceous(?)-Tertiary sandstone and conglomerate through the Sacramento Pass area.
1.2	151.5	Outcrops of Cretaceous(?)-Tertiary rocks occur along the north side of the road. Large residual boulders of Eureka Quartzite are prominent in these outcrops.
2.3	153.8	Note reddish outcrops of consolidated Cretaceous(?)-Tertiary conglomerate.
0.3	154.1	Excavation is in Ordovician Pogonip Group. Above it on the hillside the dark rocks are Fish Haven Dolomite and the light-colored rocks are Eureka Quartzite. These rocks are much jumbled here on the upper plate of the Snake Range decollement.
0.3	154.4	Roadside rest. The wash crosses exposures of Eureka Quartzite.
0.9	155.3	Road junction. Oceola road leads off to the left. Oceola, an old mining district, is now abandoned. Outcrops to the right of the road are red Cretaceous(?)-Tertiary conglomerate.
2.3	157.6	SACRAMENTO PASS (elev. 7,154). Schell Creek Range appears on the skyline to the west, across Spring Valley.

1.8	159.4	Gas station and ranch south of the road. Cambrian limestones are exposed in the hills north and south of the highway here.
4.9	164.3	Cambrian limestones form massive cliffs on the west side of the Snake Range. Purplish exposures east of the limestone ledges are Prospect Mountain Quartzite.
5.3	169.6	Road to Oceola on the east.
3.5	173.1	The small hill south of the highway is Oligocene dacite. We are entering the southwest corner of the Conner's Pass Quadrangle, mapped by Harold Drewes as U. S. Geological Survey Professional Paper 557 (1967). The quadrangle includes the south part of the Schell Creek Range.
2.4	175.5	Spring Valley Road leads northward. Schell Creek Range is a complex of thrust-faulted Paleozoic rocks. On its east base, the Cambrian Prospect Mountain Quartzite forms the low hills and is succeeded by Cambro-Ordovician limestones in thrust-fault contact with the overlying upper Paleozoic rocks.
1.3	176.8	Road left to Pioche. Continue straight ahead toward Ely.
0.6	177.4	MAJOR'S PLACE. Road Junction. Cambrian limestones exposed at the junction belong to the Coke Canyon Formation.
0.7	178.1	Slaty, shiny rocks along the highway here for a mile or so are slightly metamorphosed Cambrian limestones of the Lincoln Peak Formation.
0.9	179.0	Entering Humboldt National Forest.
0.3	179.3	Limestones at the north end of the roadcut are thrust-faulted Cambro-Ordovician limestones.
0.5	179.8	Cross a fault onto upper Paleozoic limestones.
0.7	180.5	Yellowish road cut exposes Permian Arcturus Formation
0.5	181.0	Limestone exposed here is of the Pennsylvanian-Permian Ely Formation.
1.1	182.1	CONNER'S PASS (elev. 7,723). South of the road at Conner's Pass is a small faulted exposure of the Rib Hill Sandstone. North of the pass is the Ely Limestone. The rocks in the Schell Creek Range have been considerably jostled about on numerous bedding thrust faults, so that good stratigraphic sections are scarce.
1.1	183.2	Chainman Shale crops out at the road level and is overlain by Ely limestones appearing on the hillside to the north. The valley opens out into Chainman Shale exposures.
0.4	183.6	Leaving Humboldt National Forest.
0.8	184.4	The route returns to Ely Limestone exposures as the road curves northward out of the Schell Creek Range.

3.2	187.6	Sign to the left: "Entering Conservation Area."
2.7	190.3	The road to the east leads to the Taylor Canyon Mining area. The basal half of the range to the east is Devonian carbonate; the break in slope is Chainman Shale; and the upper part is Ely Limestone. The diagonal valley coming in from the north conceals a fault.
0.5	190.8	Roadside rest, west of highway.
5.6	196.4	The road heading east is Success Summit Drive, leading to Steptoe Creek, Cave Lake, and Cave Mountain.
0.9	197.3	Reservoir, southwest of the road. The escarpment on the east side of the valley bottom was probably caused by faulting along the valley, which resulted in rejuvenation of streams.
1.2	198.5	Road to Coke Oven State Park.
0.6	199.1	Road to Lowry Spring.
3.2	202.3	Squaw Peak is the hill just north of Ely. The light-colored cliff in the middle of Squaw Peak is the Ordovician Eureka Quartzite with the Pogonip Limestone beneath and the upper Ordovician Ely Springs Dolomite above.
1.8	204.1	JUNCTION WITH U.S. 93, IN EAST ELY. Ely is the center of the largest mining operation in Nevada. A little over 225 million tons of ore averaging one percent copper have been mined in the district by Kennecott and older companies. The ore has produced over 7 billion pounds of copper, nearly 2 million ounces of gold, 7 million ounces of silver, and some molybdenum, for a total value of about $1 billion. The total value of mineral production in the entire state of Nevada has been approximately $3 billion, so that this single mining district has furnished about one-third of Nevada's total mineral production. The mining district is in an easterly-trending zone of monzonite porphyry intrusions and mineralization. The mining is now done mostly by open-pit methods at the Ruth area west of town, and the ore is processed at McGill, which is up the valley, north from Ely.

END OF PART 2 OF THE ROAD LOG

ROAD LOG PART 3—UTAH-NEVADA LINE TO SANTAQUIN, UTAH, VIA TINTIC MINING DISTRICT AND U.S. HIGHWAY 6-50.

Note: To use these road logs traveling from Ely to Provo on U.S. highway 6-50, one must read Part 2 backwards from Ely, at mile 204.1, to the Utah-Nevada state line, at mile 139.6, where Part 3 begins. Mileage figures in Part 3 are coordinated with the metal mileposts established by the Utah Highway Department along the south edge of this highway.

Mileage		
0.0	0.0	UTAH-NEVADA STATE LINE.
1.0	1.0	Milepost 1, Garrison Road. In 1956 the Shell Oil Company drilled Baker Creek Number 1 Government Well about a quarter of a mile south of here in sec. 19, T. 20 S., R. 19 W. The upper 730 feet were identified as Pleistocene clay. Dolomite, ash, and gypsum beds beneath this were assigned to the Salt Lake Group. The well penetrated 4,180 feet of Cenozoic valley fill before bottoming in Cambrian Prospect Mountain Quartzite at a total depth of 4,218. Twelve miles south of here another exploratory well was drilled in the core of an anticlinal structure in the Burbank Hills. Standard Oil of California Number 1 Burbank in sec. 3, T. 22 S., R. 19 W. was drilled in 1952. The well spudded in Devonian Pilot Shale and was abandoned at a depth of 6,955 feet in Ordovician Pogonip Limestone with the following formation tops: Devonian Guilmette 916'; Simonson 3,026'; Sevy 3,610'; Silurian Laketown 4,742; Ordovician Eureka Quartzite 6,128'; and Pogonip 6,444'.
1.0	2.0	Milepost 2. Burbank Hills appear southeast of the road. The west end has an anticline in Mississippian rocks, and the central and highest portions of the Burbank Hills expose evenly bedded Ely Limestone. Confusion Range appears ahead and north of the road. This segment is called the Buckskin Hills, the west side of which exposes Silurian and Devonian strata. The central portion of the Buckskin Hills exposes Ely and Arcturus Formations in a syncline overturned to the east. The general structure of the Burbank Hills to the south is similarly a syncline overturned to the east with older Paleozoic rocks exposed on both the east and west sides, and younger Paleozoic rocks in the middle.
6.8	8.8	Eskdale road on the north.
4.2	13.0	Milepost 13. The road crosses the south end of the Buckskin Hills. Ely Limestone crops out at the roadside.
3.1	16.1	Little Valley road leads northward. Ferguson Well road heads off to the south. Directly ahead the King's Canyon section of the Confusion Range is composed of Devonian Guilmette

Formation, as is also the small isolated hill directly south of the road.

2.3 18.4 REST AREA IN SANDY AREA WITH JUNIPER TREES. The sand has accumulated at the northeast corner of the Ferguson Desert. Prevailing winds from the southwest move the sands from the desert bottom up to the side of the valley, where their progress is impeded by the surrounding mountains. Ahead, the road cut is in the Devonian Guilmette Formation. Stop there to examine the Guilmette Formation: it has abundant stromatoporoid beds of both the "spaghetti" and the "cabbage" types, and it has some layers with abundant snails. The snail beds and the stromatoporoid layers alternate, indicating a succession of changing environments.

2.6 21.0 Milepost 21. The highway crosses a north-south normal fault along the west face of the Confusion Range. The west side has been dropped down, repeating the lower Guilmette.

0.9 21.9 The road cut is in the lower Guilmette Formation. Milepost 22 is at the east end of the road cut.

1.1 23.0 MILEPOST 23 AT THE SUMMIT; King's Canyon appears ahead.

0.1 23.1 The road cuts through pink latite welded tuff of Oligocene age, which occurs here as patches on the Paleozoic rocks. Along the summit of the King's Canyon portion of the Confusion Range, the Devonian rocks are well exposed. (Refer to the stratigraphic chart of the Confusion Range, Text-fig. 21.) The light-colored, regularly bedded, ledgeless unit is the Sevy Dolomite. It is overlain by a step-ledge light and dark unit, the Simonson Dolomite, which is in turn overlain by the massive ledge-forming member of the lower Guilmette Formation.

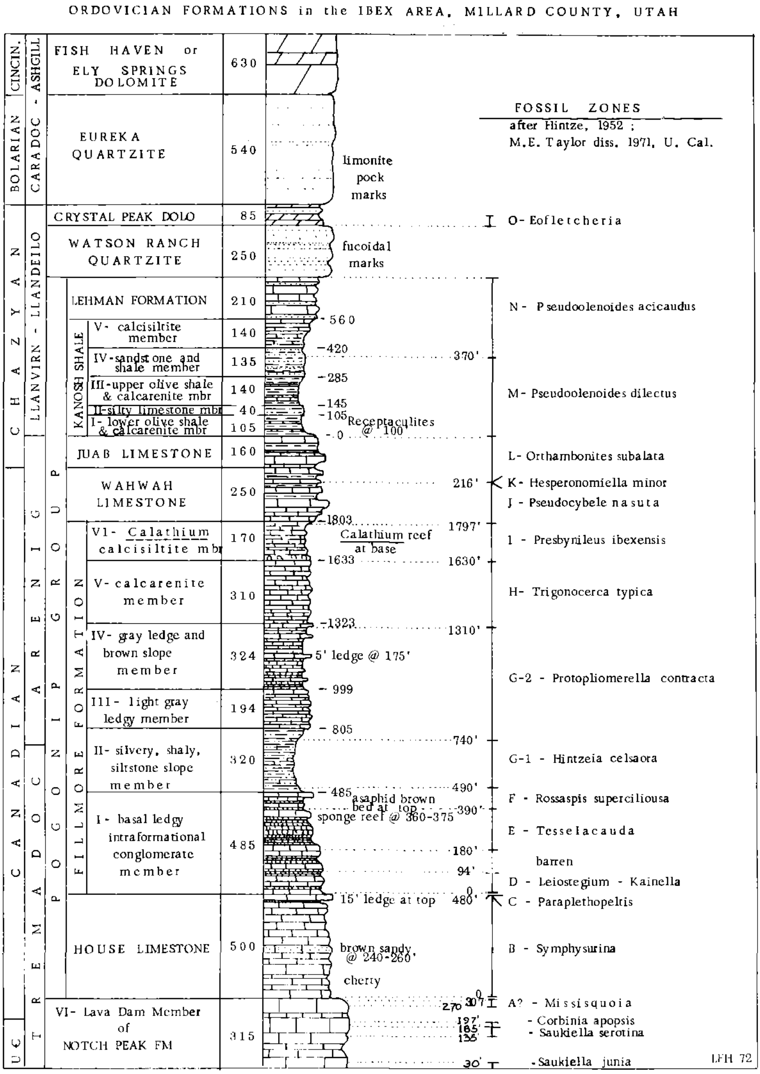
1.4 24.5 The road to the right leads to a telephone relay station on top of the hill. The Guilmette Formation forms the lower slopes of the hill.

0.5 25.0 Milepost 25. The pink rocks north of the road are Oligocene latites resting on the upper part of the Silurian Laketown Formation. The Laketown-Sevy contact is near here. The Laketown is a dark, cliff-forming unit, which is exposed in King's Canyon ahead. The Sevy Dolomite, the less resistant, light-colored unit, forms the open pass area at the head of King's Canyon.

1.0 26.0 Milepost 26. Laketown Dolomite crops out at the roadside.

0.3 26.3 A view up the canyon to the north shows Silurian Laketown Dolomite as a small dark-colored knob (a "klippe") on light-colored Devonian Sevy Dolomite. The King's Canyon thrust fault crosses the highway at the curve. For several miles

		along the thrust fault, the Laketown Dolomite is overthrust onto the Sevy Dolomite. On the other side of the thrust, the basal beds of the Sevy Dolomite are on the underlying plate of the thrust.
0.4	26.7	Normal contact. The Devonian Sevy Dolomite overlies the dark-colored Laketown Dolomite. Turn out at the parking area for a view of this contact. The road down King's Canyon continues through Laketown Dolomite.
0.7	27.4	The dirt road to the northeast leads toward Painter Spring.
0.6	28.0	Milepost 28. This is an excellent view of the House Range to the east. The Painter Spring Granite, just north of Notch Peak, intrudes Middle and Upper Cambrian limestones. At the base of the House Range, the Marjum Formation is intruded by granite. Successively the Weeks, Orr, Dunderberg, and Notch Peak formations are intruded by the granite towards the top of Notch Peak. At the top of Notch Peak is the Notch Peak Formation. The tree-covered bench about a third of the way below the top of Notch Peak is the Dunderberg Shale. Beneath that is the Orr Formation, a gray cliff; and the brownish Weeks Formation is beneath that. The white streaks are marbleized beds in the Notch Peak Formation. The marbleization is apparently selective, extending outward from the granitic mass on some beds and not on others (Text-figs. 13 and 15).
1.8	29.8	Silurian Laketown Dolomite crops out just north of the road
2.2	32.0	Milepost 32. To the south is a good view of the east face of the King's Canyon section of the Confusion Range A normal fault at the base of the main range repeats the Devonian section. The light-gray unit that forms the smooth slopes is the Sevy Dolomite, and the heavy-ledged unit forming the top of the range is the Guilmette Formation.
1.3	33.3	THE DIRT ROAD to the north leads to Painter Spring.
0.7	34.0	Milepost 34. The Silurian Laketown Dolomite forms the hills just south of the road.
1.0	35.0	Milepost 35. East of the highway, the beds dip southward from Notch Peak, resulting in successively younger beds appearing to the south. The massive cliff of the Notch Peak Formation is overlain by the thinner-bedded Ordovician Pogonip Group units. The basal Ordovician House Limestone is exposed in the low, ledgy hills just east of the road opposite Milepost 36. A prominent limestone ledge about 20 feet thick marks the top of the House Limestone Above it, the Fillmore Limestone lacks conspicuous ledges. The Fillmore is an alternating series of limestones and shales; the limestones are mostly of an unusual rock type called "intraformational conglomerate" (Text-fig. 28).



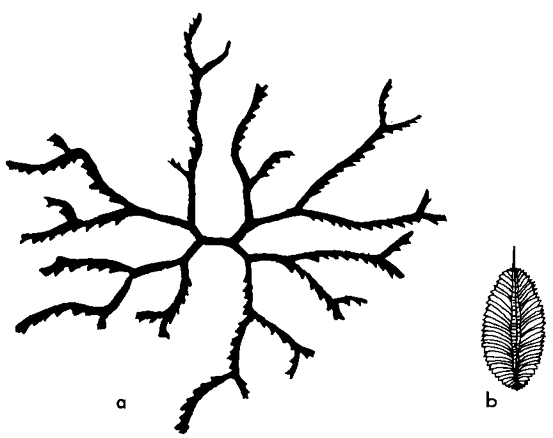
TEXT-FIGURE 28.—Ordovician formations in the Ibex area.

2.5	37.5	Bonneville diatomaceous earth crops out at road level.
1.5	39.0	Milepost 39.
0.4	39.4	Road junction. The Ibex Well road leads southward. Stop here for a view of the south end of the Confusion Range across Gettel Playa to the south. Light-colored exposures on the east side of the range are Middle Ordovician Eureka Quartzite, which is overlain by dark-colored Ordovician Fish

Haven Dolomite and Silurian Laketown Dolomite. On the east side of the valley the House Range fault block exposes the Lower Ordovician Fillmore Limestone. Patches of coarse, bouldery Cenozoic conglomerate can be seen scattered on top of the Fillmore Limestone at the southern end of the House Range. At this road junction the road cut exposes typical beds of the Fillmore Formation. Graptolites belonging to the genera *Clonograptus, Adelograptus,* and *Phyllograptus* (see Text-fig. 29) can be obtained from the interbedded shales in this road cut by excavating to fresh shales. The interbedded limestones contain a sparse number of silicified trilobites, *Protopliomerella* and *Protopresbynileus,* belonging to the G-2 fossil zone shown in Text-figure 28. The trilobites are generally broken up and apparently represent a rather vigorous wave action during deposition of the Fillmore intraformational conglomerate.

1.6 41.0 MILEPOST 41, SUMMIT OF SKULL ROCK PASS at the south end of the House Range. At the east end of the road cut, in Ordovician Fillmore Limestone, the small, nodular deposits two to three feet in diameter are sponge-algal reef masses interbedded in the Fillmore Limestone. Here this horizon is about 360 feet above the base of the Fillmore Limestone, and it contains the *Tesselacauda* fauna of fossil zone E. To the north the Cambrian beds that form the top of Notch Peak can be seen dipping toward us. Most of the ledges exposed in the high area are part of the Notch Peak Formation. The thin-bedded units at the very top of the hill belong to the Ordovician House Limestone.

0.6 41.6 Skull Rock, a large boulder of Eureka Quartzite, sits directly to the south. This is a part of an Oligocene conglomerate that can be seen scattered in the pass area overlying the gently dip-



TEXT-FIGURE 29.—Ordovician graptolites: a. *Clonograptus,* b. *Phyllograptus.*

ping Ordovician and Cambrian rocks. These deposits apparently originated to the west of the present House Range, in the vicinity of Gettel Playa, in pre-House Range block-fault time, when these deposits could be spread toward the east. Now that the House Range has been elevated, these conglomerate deposits are being eroded away, and the coarse residual boulders of Eureka show up prominently in the deposits.

3.4	45.0	Milepost 45. A good view of Sevier Lake. Across the lake the Cricket Mountains are composed almost entirely of Cambrian strata. The reddish unit that can be seen is the Prospect Mountain Quartzite. Above it, the Middle Cambrian carbonates form the gray-banded exposures on the west face of the range.
1.3	46.3	Junction with a graded road on the east side of the House Range.
0.7	47.0	Milepost 47. Diatomaceous deposits of Lake Boneville are exposed at the roadside.
3.0	50.0	Milepost 50. The edge of the Sevier Lake Playa is just south of the road. Sevier Lake being the lowest point in the Sevier Desert area, all drainage in this vicinity goes into the lake. Except after storms, however, the Sevier Lake is nearly dry. The main feeder for the Sevier Lake has been the Sevier River, which begins far south in southern Utah in the Bryce Canyon vicinity, flows northward through Sevier Valley, cuts westward and drains into Leamington Canyon, and then passes through Leamington and Delta. But all along its course, its waters have been used for irrigation, which began in early settlement days and culminated in the development of the large irrigation district around Delta, Utah, in the early 1900s. Since most of the water is taken out of the river for irrigation purposes, little of it ordinarily reaches the lake. Nonetheless, the Sevier Lake Playa is seldom entirely dry or even dry enough to drive across, usually remaining a semimuddy flat.
4.0	54.0	Milepost 54. North of the road, Lake Bonneville deposits can be seen much gullied by flood waters coming off the House Range and Long Ridge into the Sevier Lake Basin.
2.6	56.6	A dirt road leads northward along the valley between Long Ridge and the House Range to join former U.S. Highway 6 near Antelope Spring.
1.4	58.0	Milepost 58. Cross south end of Long Ridge, composed here of Tertiary conglomerates similar to those at Skull Rock Pass. The boulders on the slopes to the north have been somewhat reworked by the wave action of Lake Bonneville. Farther to the north, the east face of Long Ridge exposes a volcanic sequence interbedded with the Oligocene conglomerates. Long Ridge is apparently bounded along the east side by a normal fault.

4.0	62.0	Milepost 62. Ahead in the distance the snowcapped peak is Mt. Nebo, about 75 miles away. At one o'clock in the middle distance is the Canyon Range. In front of the Canyon Range is Black Table Mesa, composed of basaltic lava flows. To the right of and beyond Black Table Mesa, the conical peak on the floor of the Sevier Desert is Pavant Butte, a Pleistocene volcano. Between Pavant Butte and the north end of the Cricket Mountains, which are just to the south, is an isolated volcanic hill, called "Dunderberg Butte" by Gilbert in 1890. The top of the hill was truncated by the wave action of Lake Bonneville, but two jagged projections were left as stacks in the ancient lake. Directly to the south, the reddish hills at the north end of the Cricket Mountains are mostly Lower Cambrian Prospect Mountain Quartzite. In the distance beyond Pavant Butte, the high mountains along the Wasatch Front are called the "Pavant Range" in the north and the "Tushar Range" in the south. The highest peaks in the south are Mt. Belnap (elev. 12,139) and Delano Peak (elev. 12,173).
15.9	77.9	A dirt road heads southward to the Gunnison Massacre Site. Captain John Gunnison, a topographic engineer, and seven companions were killed in an ambush early on the morning of October 26, 1853, by Moshoquope and his followers in reprisal for the killing of Moshoquope's aged father by the Hudspeth California emigrant train two weeks earlier. Four others who were with Gunnison escaped with their lives.
0.1	78.0	Milepost 78.
0.8	78.8	Former U.S. Highway 6 joins from the west
0.5	79.3	Bonneville clays and silts can be seen, stacked up along drainage and irrigation canals in the Sevier Desert.
2.7	82.0	Milepost 82. Gulf Oil Number 1 Gronning, an 8,000-foot exploration well, was drilled 6 miles due north of here in 1956-57. A summary of the beds penetrated is listed at the beginning of Part 2 of this Road Log.
1.0	83.0	Milepost 83. ENTERING HINCKLEY.
1.3	84.3	Utah Highway 140 leads due south three miles to the town of Deseret.
1.4	85.7	Cross the Lowline Irrigation Canal which originates at the Gunnison Bend Reservoir which dams the Sevier River three-quarters of a mile to the north of the highway. Most of the agricultural activity in this valley depends on the controlled use of the waters of the Sevier River (as discussed under Mile 95.1 of Part 1 of this Road Log).
0.2	85.9	Cross Sevier River. Elevation 4,600 feet.
2.6	88.5	Union Pacific Railroad overpass at the west side of Delta, Utah

0.5	89.0	DOWNTOWN DELTA.
0.4	89.4	Turn left at the east edge of Delta, on U.S. 6-50.
0.6	90.0	Milepost 90. Elevation 4,630 feet. Begin a gradual ascent of the leading edge of a delta built into Lake Bonneville by the Sevier River during Pleistocene (Ice Age) time. The Delta Airport, three miles ahead, is on the top of this fossil delta.
3.3	93.3	Delta Airport road (elev. 4,750).
0.5	93.8	Dmad Reservoir road to the east.
0.2	94.0	The Sevier River has carved this 120-foot-deep, mile-wide valley in its Pleistocene deltaic deposits. Provo-age sands and silts at the top of the delta overlie some 40 feet of Bonneville-age silt exposed along the sides of the valley. The Bonneville-age material overlies silt of earlier Pleistocene age, according to Varnes (who has mapped these deposits for the U.S. Geological Survey).
0.4	94.4	Cross canal.
0.1	94.5	CROSS SEVIER RIVER.
0.5	95.0	Provo-age sands and silts form the top of the delta. The delta, which began at the mouth of Leamington Canyon to the northeast, extended as much as 18 miles west of its head and formed a crudely arcuate (delta-shaped) deposit covering nearly 400 square miles. The town of Delta, Utah, is not on the delta itself but is built on the former lake-bottom sediments just southwest of the edge of the deltaic fan. U.S. Highway 6-50 for the next 15 miles is built on Provo-age deltaic deposits which form the top of the delta. The highway parallels the valley which the modern Sevier River has carved into its own deltaic deposits. Between here and Lynndyl are several good views of the Recent river valley to the east.
5.0	100.0	Beryllium road to the west. Brush Beryllium Company Mill, built in 1968-70 at a cost of $10 million, is the world's largest beryllium plant. Ore is mined at the Topaz-Spor Mountain area and is hauled 50 miles to the plant. The ore contains beryllium in a mineral known as bertrandite. The bertrandite is in microscopic particles disseminated in a volcanic ash bed. It is anticipated that the mill will produce $2 million worth of beryllium a year. To date, the lightweight metal has found its chief use in space craft and as a fatigue-resisting alloy with copper. Between the beryllium plant and the town of Lynndyl, the face of the Canyon Range to the east is chiefly of Precambrian quartzites overthrust on Cambrian quartzite and limestone.
4.7	104.7	ENTERING LYNNDYL, originally a railroad roundhouse town in the steam engine days.
0.9	105.6	Road junction. Utah Highway 132 leads east to Leamington

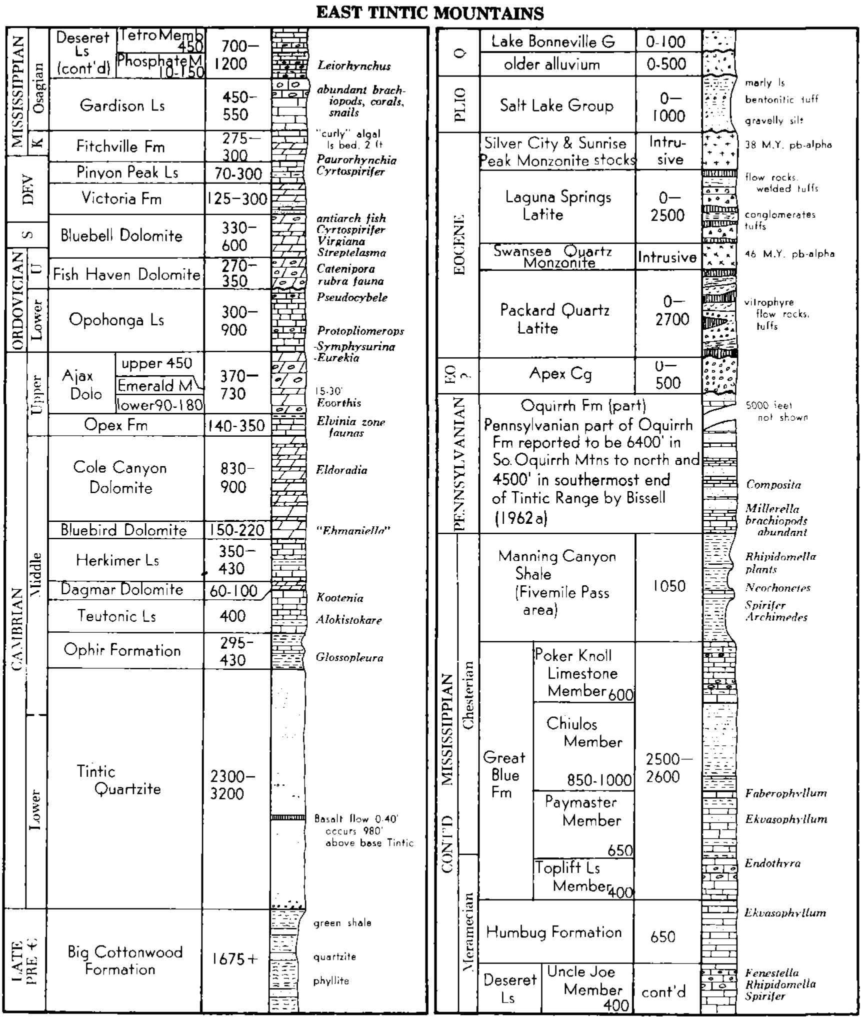
		and Nephi. Continue northward on Highway 6-50. Leamington Canyon to the east separates the Canyon Range to the south from the Gilson Mountains to the north.
2.2	107.8	Juab-Millard county line. Wind-blown sands become more prevalent northward from this point. Prevailing winds from the southwest have reworked and transported sands and silts derived chiefly from the Lake Bonneville deltaic deposits. This sand has accumulated in the northeast corner of Sevier Desert valley, where its further progress to the northeast is impeded by bedrock hills.
7.7	115.5	Gravel pits in Lake Bonneville beach deposits. The bedrock in the road cut is Mississippian Gardison Limestone. The Gilson Mountains to the east consist chiefly of Middle and Upper Paleozoic limestones in relatively simple fault blocks. The "Little Sahara" sand dunes lie to the west.
0.5	116.0	Two miles to the northwest on the west side of the railroad tracks is Black Mountain, which exposes Ordovician Opohonga Limestone, Fish Haven Dolomite, and Silurian Laketown Dolomite.
4.0	120.0	The road ascends slightly from tan Lake Bonneville sediments onto reddish sediments assigned to the Tertiary Salt Lake Formation. Lake Bonneville shorelines can be seen to the west beyond the railroad. To the east the pink and red hills are erosional remnants of the Salt Lake Formation at the base of the Gilson Mountains.
1.3	121.3	Road cut in Tertiary Salt Lake Formation. This unit forms the "bedrock" of the Tintic Valley bottom for the next several miles.
0.6	121.9	JUNCTION. Continue on U.S. Highway 6-50. Utah Highway 148 leads eastward to Nephi. A dirt road leads westward to the sand dunes.
2.6	124.5	Road west to Jericho railroad siding and sheep shearing corral. Beyond is the "Little Sahara" sand-dune park.
0.9	125.4	Fieldstone monuments here mark the site of an old CCC camp, the Civilian Conservation Corps of the early 1930s. Young men employed by this depression-born government agency improved many of the dirt roads in western Utah.
1.6	127.0	Entering Tintic Resource Conservation area.
0.1	127.1	PAUL BUNYAN turnoff. A dirt road leads southeast from here for $3\frac{1}{2}$ miles to a parking area from which one can hike a quarter of a mile to the base of the Paul Bunyan Woodpile. The "woodpile" is a dike of igneous rock with horizontal columnar joints (Text-fig. 30). The entire round trip from the highway intersection takes about an hour but should not be attempted if the dirt road is wet or muddy.

TEXT-FIGURE 30.—Paul Bunyan's postpile, south of Eureka in the East Tintic Mountains. The postpile is produced by horizontal columnar jointing in an intrusive dike.

2.2	129.3	REST AREA, south entrance. Water, rest rooms, and picnic tables are located here. This is near the south end of a Bureau of Land Management experimental area. This range land, in a strip seven miles long, has been mostly cleared of juniper trees and sagebrush and planted with various range grasses to improve the grazing yield.
0.1	129.4	Rest area, north entrance.
1.4	130.8	Dirt road west to McIntyre railroad siding. Note the BLM sign "Tintic Valley Cooperative Research Project." Bench-mark elevation is 5,848 feet.
5.4	136.2	Leaving Tintic Resource Conservation area. Across the Tintic Valley to the west, the West Tintic Mountains are a complex normal and thrust-faulted mass of Precambrian and Paleozoic rocks. Some minor mineralization accompanied an igneous intrusion on the southwest side of the West Tintic Mountains.
0.9	137.1	Railroad crossing. The road east leads one-half mile to the abandoned mining town of Silver City, which in the late 1800s had a population of more than 1,500.
0.2	137.3	JUNCTION. Stay on U.S. Highway 6-50. Utah Highway 36 heads northwest to Tooele.

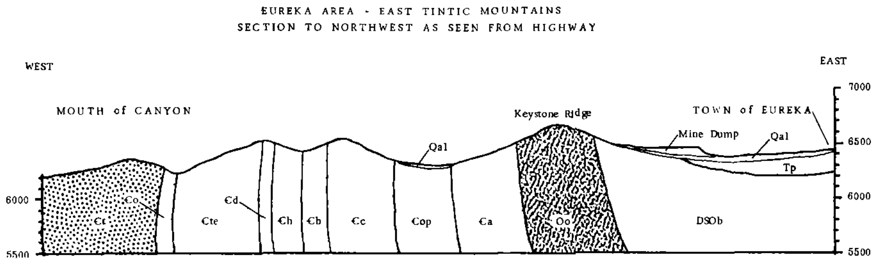
0.7 138.0 Road east to Mammoth, Utah, another virtually abandoned mining town, which is located on the southward continuation of a mineralized zone which passes through Eureka, Utah.

1.0 139.0 Road junction with Utah Highway 36. Between here and downtown Eureka the highway passes upward through the entire Cambrian stratigraphic sequence of the Tintic District. (See cross section, Text-fig. 32, and stratigraphic chart, Text-fig. 31.)



After: Morris and Lovering (1961); Morris (1964a), (1964b)

TEXT-FIGURE 31.—East Tintic Mountains stratigraphic chart.



LEGEND

Age	Symbol on Large Section	Symbol on Small Section	Formation and Description
Quaternary	Qal	Qal	Alluvial deposits
Tertiary	Tp	Tp	Packard quartz latite: tuff, lava, and flow breccia
Upper Miss.	Md	—	Deseret Limestone: light gray to blue-gray, chert
Lower Miss.	Ml	—	Gardison Limestone: blue-gray, fossiliferous
Upper Dev.	Dpv	—	Pinyon Peak Limestone: blue-gray, silty Victoria Formation: gray sandstone and dolomite
Dev., Sil., and Ord.	DSOb	DSOb	Bluebell Dolomite: light gray to blue-gray
Upper Ord.	Ofh	—	Fish Haven Dolomite: gray, cherty
Lower Ord.	Oo	Oo	Opohonga Limestone: yellow to red, cherty, shaly
Upper Cambrian	€u	€a	Ajax Dolomite: dark blue-gray, cherty
		€op	Opex Formation: dark gray dolomite
Middle Cambrian	€m	€c	Cole Canyon Dolomite: light gray to blue-gray
		€b	Bluebird Dolomite: dark blue-gray
		€h	Herkimer Limestone: dark blue, mottled, shaly
		€d	Dagmar Dolomite: prominent white band, shaly
		€te	Teutonic Limestone: dark mottled, shaly
		€o	Ophir Formation: weak green-brown shale
Lower Cambrian	€t	€t	Tintic Quartzite: pure, weathers orange

TEXT-FIGURE 32.—Cross section of the East Tintic Mountains west of Eureka, north of U. S. Highway 6-50.

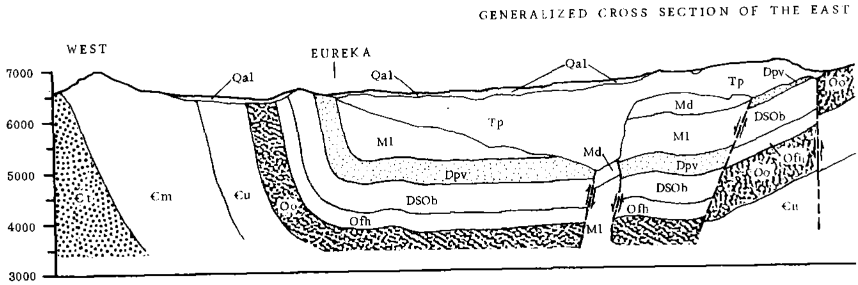
0.3 139.3 Garity silica quarry can be seen to the north. Cambrian Tintic Quartzite is used as high-grade silica in silica brick.

0.1 139.4 The gully joining Eureka Creek from the north follows weak Cambrian Ophir Formation.

0.1 139.5 The white streak on the hillside to the north is the nearly vertical Middle Cambrian Dagmar Dolomite.

0.3 139.8 Cole Canyon joins Eureka Creek from the north. On the east side of Cole Canyon the Ajax Dolomite is exposed; on the west side the Cole Canyon Dolomite dips 70 degrees eastward. The Opex Formation is concealed beneath alluvium in the canyon bottom here.

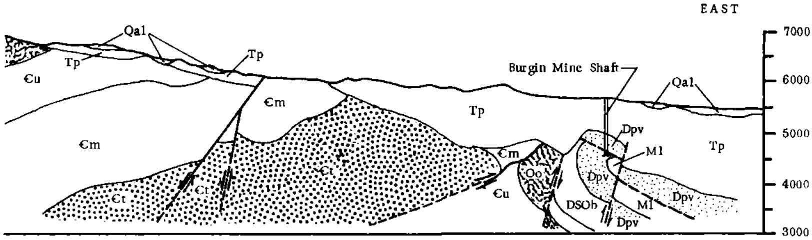
0.3 140.1 Note the abandoned head frame just north of the railroad. The Gemini ore zone, the second largest producer in the area at $100 million, runs southward from here nearly to Mam-



TEXT-FIGURE 33.—Generalized cross section through the East Tintic Mountains, through Eureka. See Text-figure 32 for legend.

		moth. The Ordovician Fish Haven Dolomite lies north of the head frame. (See Text-fig. 33 for structural cross section of the East Tintic Mountains.)
0.1	140.2	Railroad crossing.
0.2	140.4	Gemini Mine dump north of the road on the west edge of Eureka.
0.3	140.7	EUREKA POST OFFICE. Eureka is the only town in this area that retains any population. Other towns that flourished in the East Tintic Mountains but that are now essentially abandoned include Mammoth, Dividend, Silver City, Diamond, and Knightsville. Part of the town of Eureka is directly above the Chief ore zone, which at $150 million was the most productive in the area. Most of the ore came from limestone replacement ore bodies in four zones (named from west to east): Gemini, Chief, Godiva, and Iron Blossom. The ore is a complex sulphide, with the metals listed in order of value: silver (50 percent); lead (20 percent); gold (20 percent); copper (8 percent); and zinc (2 percent). A total of nearly one-half billion dollars' worth of metal has been taken from the mines in the East Tintic Mountains. For a more complete discussion of this famous mining area, see Morris (1964) and a Utah Geological Society Guidebook (Cook, 1957). That guidebook, which was written by various mining authorities familiar with this area, contains road logs and discussions of the ore controls.
0.4	141.1	Tintic High School is north of the highway.
0.5	141.6	Railroad crossing.
0.1	141.7	UTAH-JUAB COUNTY LINE. Summit elev. 6,583.
0.2	141.9	Junction, Dividend road. The hills to the north are Packard quartz latite. These igneous rocks are shown on Text-figure 31 as Eocene but more recent information (H. T. Morris, pers. comm.) indicates that they are early Oligocene.
1.3	143.2	West end of Homansville Canyon. Packard quartz latite is ex-

TINTIC MOUNTAINS THROUGH EUREKA



posed in the roadcut. To the north, the Mississippian Gardison Limestone has been calcined to lime. Ahead in Homansville Canyon, road cuts show Cambrian dolomite.

0.8 144.0 STOP in parking area on the east side of the road to examine hydrothermal alteration of dolomite adjacent to a small monzonite plug exposed across the highway in the road cut. The Herkimer Limestone has been dolomitized and leached. The plug itself is intensely altered to clay. Farther from the plug, the Herkimer grades into fresh limestone.

To the south along the road, the Herkimer Limestone is overlain steeply by Packard quartz latite, as a result of the filling of a small prelava canyon.

0.2 144.2 STOP to examine "pebble dikes" exposed in the road cut (Text-fig. 34). These dikes cut the Packard quartz latite and consist predominantly of abrasion-rounded quartzite pebbles probably derived from the Cambrian Tintic Quartzite about 1,000 feet beneath. The dikes were probably emplaced explosively by steam generated during the emplacement of Oligocene monzonite intrusions. Some of the dikes are pyritized and silicified.

These mineralized pebble dikes are one of the best guides to ore in the East Tintic District. This particular dike swarm occupies fissures that, farther to the south, acted as feeders for the North Lily and Eureka Lily ore bodies.

0.3 144.5 Road junction; road heads south to the Burgin Mine. The abandoned Copper Leaf shaft can be seen on top of the hill north of the road. Good exposures of Oligocene Packard quartz latite appear in the larger road cut just west of the junction. This volcanic formation includes tuff, lava, vitrophyre, and flow breccia and is the only formation exposed in the road cuts of U.S. Highway 6-50 for the next three miles. It represents the deeply eroded remnants of a composite volcano the core of which is located a few miles to the southwest.

1.5 146.0 Milepost 146. A good view of Burgin Mine four-fifths of a mile to the south. The Burgin Mine, owned by Kennecott Cop-

TEXT-FIGURE 34.—A pebble dike, common in this part of the East Tintic Mountains. Ore bodies are often associated at depth with these pebble dikes. The pebbles are fragments of Tintic Quartzite which have been rounded as they were blown upward by steam associated with intrusive rocks below.

per Corporation, has been in operation since 1958 and is the only major property now operating in the area. It was discovered as a result of detailed geological mapping from 1943 to 1956 by Thomas S. Lovering and Hal T. Morris of the U.S. Geological Survey. Results of their investigations were made available to the public, and several companies initiated exploration programs in the district largely as a result of their encouraging reports. These USGS geologists concluded that thrust faults played a key role in the localization of the ore, and they projected the East Tintic Thrust Fault beneath the cover of Oligocene lavas. Bear Creek Mining, Kennecott's exploration subsidiary, gambled the cost of an exploration shaft to locate this buried thrust fault. A major zone of thrusting was penetrated by a westward drift tunnel from the 1,050-foot level of the Burgin shaft, and a $100 million ore body was outlined by diamond drilling. (Structure in the Burgin Mine vicinity is shown on the right side of Text-fig. 33.)

Ores produced from the Burgin Mine come from a replacement complex in the Ophir Formation in the upper plate of the East Tintic Thrust Fault and consist of a mixture of galena and sphalerite with argentite, rhodochrosite, and barite in the unoxidized ore and with cerussite, anglesite, smithsonite, cerargyrite, and pyrolusite in the oxidized portions. Ores from the Burgin Mine contain less silver and more zinc than those from other mines in the district. Preliminary estimates based on diamond drilling indicate a minimum of 1,250,000 tons of high-grade ore with 10 ounces per ton of silver, 15 percent lead, and 12 percent zinc. The high-grade ore is surrounded by great masses of mineralized breccias with lesser amounts of silver, lead, and zinc but with considerable manganese.

Further information on the Burgin Mine may be obtained from Shepard, Morris, and Cook, (1969).

1.1 147.1 Utah Highway 159 diagonals westward toward the Burgin Mine and Dividend.

0.2 147.3 Railroad crossing (elev. 5,275). Begin a three-mile descent of an alluvial fan at the base of the East Tintic Mountains.

3.3 150.6 ELBERTA. Utah Highway 68 leads northward along the west side of Utah Lake from this point.

1.1 151.7 Goshen Reservoir, south of the highway, dams Currant Creek. The tan soils are Provo-age silt and clay deposits of Lake Bonneville.

1.9 153.6 DOWNTOWN GOSHEN. The road south out of town leads to Currant Creek Canyon, a water gap through Long Ridge exposing Lower Paleozoic rocks. Continue on U.S. Highway 6-50.

1.8 155.4 Railroad crossing. The concrete foundations on Warm Springs Mountain to the east are the remains of the Tintic Standard Mining Company Mill built in 1921 by Emil Raddatz because he felt that the American Smelting Company at Garfield was overcharging for handling the low-grade sulfide ore mined at Dividend. After operating for only four years, this mill was abandoned because the Garfield smelter lowered its prices to meet this competition.

At its peak, the mill employed 100 men. The ore was hauled 15 miles on the D&RGW railroad from Dividend to the base of Warm Springs Mountain. Conveyor belts lifted the ore to the top of the plant, where it was crushed, screened, mixed with coal and salt, and roasted. Then it flowed by gravity into eight large tanks filled with sulfuric acid, where it was dissolved. Silver and lead were precipitated out of this solution by passing it through boxes filled with scrap iron and tin.

0.9 156.3 Chaffin Quarry to the east is in the Mississippian Humbug Formation, according to Sirrine (1953).

0.4 156.7 Railroad crossing. The shaly ledges east of the road are Mississippian Great Blue Limestone.

1.7 158.4 Small reservoir north of the highway. Geneva Road leads north. The Mississippian Great Blue and Humbug formations form the south end of West Mountain to the north. Lake Bonneville shorelines are prominently incised here.

1.1 159.5 Union Pacific Railroad underpass. Lake Bonneville sediments cover the low hills south of the highway. Two miles to the north, the Keigley limestone quarries produce flux for iron smelting at Geneva Steel Plant near Provo.

0.9 160.4 DOWNTOWN SANTAQUIN. Junction with U.S. Highway 91.

0.9 161.3 I-15 freeway underpass, at the east side of Santaquin.

END OF ROAD LOG

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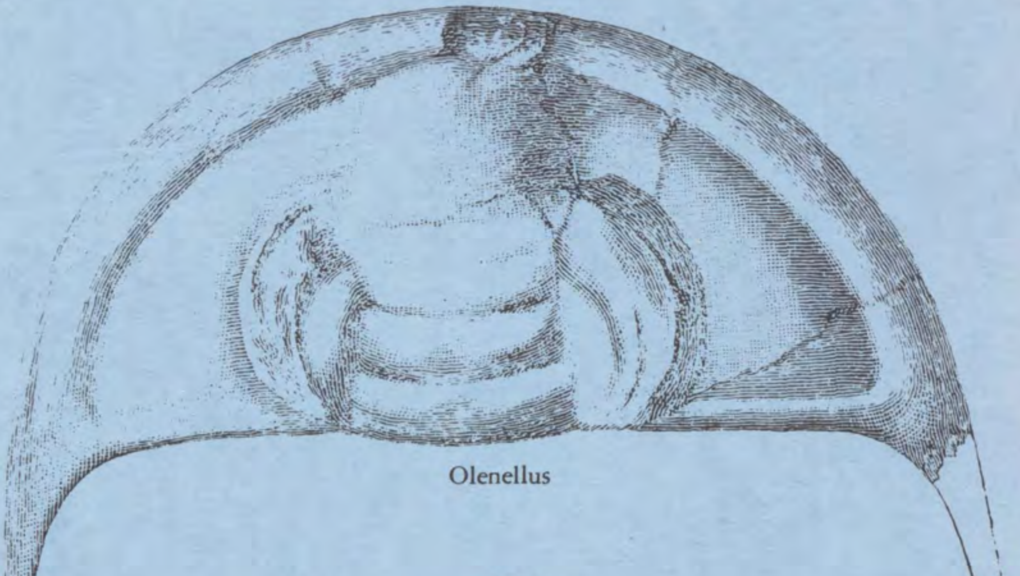
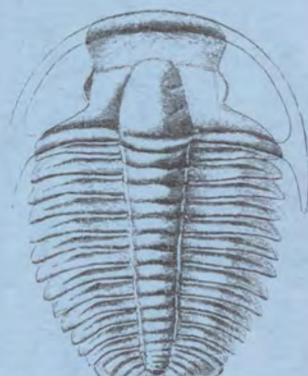


Olenellus

Agnostus

Asaphiscus



Elrathia

Acrothele