GUIDE TO THE GEOLOGY OF THE PICEANCE CREEK BASIN:
FIELD TRIP ROAD LOG

Road Log by Mitchell W. Reynolds,1 John R. Donnell2, and Road Log Committee, Dudley W. Bolyard2, Chairman

SUMMARY

The 1974 Field Trip of the Rocky Mountain Association of Geologists to the Piceance Creek basin, northwestern Colorado, will examine the rich deposits of oil shale in the Green River Formation and will view pilot mining and retorting projects that recover oil from the shale. During the 2-day field trip the route passes through sedimentary rocks ranging in age from Mississippian through Pleistocene; in Glenwood Canyon, east of the field trip route, older rocks of Devonian, Ordovician, and Cambrian age unconformably overlie Precambrian rocks. The Phanerozoic stratigraphic section in the area is about 25,000 ft thick. Pre-Tertiary rocks are exposed on the southwest and west flanks of the White River uplift off which they dip beneath the Piceance Creek basin. Tertiary rocks of Paleocene and early to middle Eocene age are widely exposed in the center of the basin where they crop out in the valleys of the Colorado River, Rifle Creek, Piceance Creek, and the White River and in spectacular exposures on the Roan Cliffs and Battlement Mesa. Remnants of once-continuous basalt flows occur south and north of the Colorado River on Battlement Mesa (Mamm Peak) and on the Roan Cliffs (Mount Callahan), respectively. Bases of the remnants of basalt define a datum surface to measure more than a mile of downcutting by the Colorado River since early Pliocene time. Pediment and terrace gravels in the valley of the Colorado River mark successively lower levels of erosion by the river and its tributaries.

Oil shale deposits of the Green River Formation of Eocene age are the principal subject of the field trip. The trip traverses the deposits from their currently exposed edges, where they are thin and their oil content is low, to near the depositional and structural center of the Piceance Creek basin where the oil shale deposits are thickest and richest and covered with thick overburden.

At three stops during the first day, the field trip will visit pilot plants or operations that are preparing to extract oil from the shale. The first stop at the Paraho Oil Shale Demonstration Plant at Anvil Points is the site for an introductory discussion of both the stratigraphy of the Green River Formation and oil shale in it and the general method of oil extraction at the Demonstration Plant. A second stop at Anvil Points demonstrates a research project examining problems of revegetation of spent shale. The mine from which shale is being extracted at Parachute Creek for retorting by the Colony Development Co. and the stratigraphy of the oil shale deposits are topics at the next stop. Finally, the trip will stop for a view and discussion of mining operations for in situ retorting of oil shale at the Garrett Research and Development Co., Inc., operation in Logan, Washington.

During the second day, the first stop near Rio Blanco at the east edge of the Piceance Creek basin, where oil shales of the Green River Formation are thin and lean, will contrast with the last two stops of the day in the north-central part of the basin where several intervals of oil shale are present in the stratigraphic lowest exposures of the formation. Two intervening stops allow for view and discussion of Federal Oil Shale Lease Tracts C-b and C-a. After the last stop the buses will return to Glenwood Springs, following the Grand Hogback that forms the east edge of the Piceance Creek basin.

---

ROAD LOG FOR THE FIRST DAY

<table>
<thead>
<tr>
<th>Mileage</th>
<th>Increment</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>Assembly and departure point in front of the Colorado Hotel, Glenwood Springs, at the intersection of Pine Street (Colorado Highway 82) and 6th Street.</td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>TURN LEFT, then immediately TURN RIGHT (west) onto Interstate 70, toward Rifle.</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>Red exposures on hillside at 10 o’clock (southwest) of Maroon Formation of Pennsylvanian and Permian age overlying the light-tan Eagle Valley Evaporite of Pennsylvanian age.</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>Quarries at 2 o’clock (north) are in the Leadville Limestone of Mississippian age. This limestone is used by the Holly Sugar-Co. for the purification of sugar.</td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>Outcrops of Belden Formation (Pennsylvanian) at 3 o’clock (north).</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>Dipslopes on skyline at 1 o’clock (northwest) are on Leadville Limestone.</td>
<td></td>
</tr>
<tr>
<td>0.3</td>
<td>Terrace gravels of the Colorado River in roadcuts at 3 o’clock (north).</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>Continue on I-70, past Exit 23 on right.</td>
<td></td>
</tr>
<tr>
<td>0.3</td>
<td>Light-tan and gray Eagle Valley Evaporite at 3 o’clock (north).</td>
<td></td>
</tr>
<tr>
<td>0.4</td>
<td>At 3 o’clock (north) on the west side of Mitchell Creek is the contact between the Eagle Valley Evaporite and the Maroon Formation.</td>
<td></td>
</tr>
<tr>
<td>0.7</td>
<td>Exposure of light-colored sandstone at the top of the red beds at 11 o’clock (west) is the Weber Sandstone (Pennsylvanian). Top of ridge in middle distance is capped by the Dakota Sandstone (Lower Cretaceous), and the ridge on the skyline is capped by the Mesaverde Formation (Upper Cretaceous).</td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td>On right is Exit 22. Continue west on I-70.</td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>Excellent exposures at 12 o’clock (west) of a sequence of red beds overlain by tan and light-gray units. Four units are present in the red slope; from bottom to top, they are the Maroon Formation (at base), the Weber Sandstone, lower red beds member (Permian), the thin South Canyon Creek Member (Permian), and overlying red beds of the upper member (Lower Triassic), all of the State Bridge Formation, and the Chine Formation (Upper Triassic). The Entrada Sandstone overlies the Chine. The vegetated slope is the Morrison Formation, and the Dakota Sandstone caps the ridge. The South Canyon Creek Member is correlative to part of the Phosphoria Formation and equivalent strata of Utah, Idaho, and Wyoming.</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>Excellent exposures of Morrison Formation at 9 o’clock (south-southwest) on end of hill.</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Exposures at 3 o’clock (north-northwest) of Maroon Formation. Ripple marks and desiccation cracks exposed on parting surfaces. Rock slabs are pinned with rock bolts.</td>
<td></td>
</tr>
<tr>
<td>0.4</td>
<td>Continue on I-70. On right is Exit 109 to Chacra.</td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>Cross over mainline tracks of Denver and Rio Grande Western Railroad.</td>
<td></td>
</tr>
<tr>
<td>0.3</td>
<td>At 11 o’clock (west) is low ridge capped by the Dakota Sandstone that lies on the Morrison Formation (Upper Jurassic). Mancos Shale (Upper Cretaceous) overlies the Dakota. Coal Ridge on the skyline at 10 o’clock (southwest) is supported by the Mesaverde Formation and forms an east-trending extension of the Grand Hogback.</td>
<td></td>
</tr>
<tr>
<td>0.4</td>
<td>Chacra railroad signal house on right (north).</td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>Enclosed in chain-link fence at 9 o’clock (south) is quarry in Morrison Formation (Upper Jurassic) that contains disarticulated and mixed dinosaur bones. Near the site is an earlier prospect pit for uranium in the Morrison.</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>Excellent exposures of Morrison Formation at 9 o’clock (south-southwest) on end of hill.</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Outcrops at 2 o’clock (northwest) of beds (Niobrara equivalent) in the Mancos Shale.</td>
<td></td>
</tr>
<tr>
<td>0.4</td>
<td>The Mesaverde Formation is exposed on the north face of Coal Ridge at 9 o’clock (south). Pale-red bands on the face mark the position of burned coal beds. The lower band is the Wheeler coal bed, about 40 ft thick;</td>
<td></td>
</tr>
</tbody>
</table>
and the higher burned coal is the Allen coal bed, about 20 ft thick.

At 9 o'clock (south) is tipple used to load coal mined from the Wheeler and Allen beds. Small depressions aligned along foot of slope mark collapse of colluvium and alluvium along the trace of the burned Wheeler coal bed. Farther west along the ridge, smoke rises from the burning bed.

Ridge at 2 o'clock (west-northwest) is supported by sandstone and siltstone beds transitional from the Mancos Shale upward into the Corcoran Member (of Warner, 1964) of the Mesaverde Formation.

Continue on I-70. On right is Exit 105 to New Castle.

Exposures of Corcoran Member at 1 o'clock (northwest) and of the stratigraphically higher Cozzette Member (of Warner, 1964) of the Mesaverde at 11 o'clock (west). Natural gas is produced from these sandstone units of the Mesaverde Formation at Buzzard Creek and Divide Creek fields about 12 mi south of the highway. Production at Divide Creek between August 1965 and April 1974 has been 38,834,144 MCF natural gas; Buzzard Creek to date has produced 245,139 MCF of gas.

Red-colored bands in exposures of the Mesaverde Formation at 1 o'clock (northwest) mark the traces of burned coal beds. Northwest of New Castle along the Grand Hogback two mine disasters in the Wheeler coal bed in 1896 and 1918 claimed the lives of 86 miners.

Sandstone beds on the right (northwest) for the next mile are in the upper part of the Mesaverde Formation (Upper Cretaceous), and are of nonmarine origin.

At 9 o'clock (south) is pediment cut across tilted beds of the Wasatch Formation (Eocene). Gravels capping the pediment contain pebbles and cobbles of basalt derived from Tertiary flows in the vicinity of the Sunlight ski area to the southeast.

Lower (northerly) white and overlying red sandstone beds at 3 o'clock (north) belong to the Mesaverde Formation. Upper white sandstone bed is the Ohio Creek Conglomerate of Paleocene age. Beds here dip southwest off the Grand Hogback into the Piceance Creek basin.
0.3 15.0 Exposures at 3 o'clock (north) of the Wasatch Formation (Eocene).

0.7 15.7 Milepost 101 on I-70. On skyline at 10 o'clock (southwest) is Battlement Mesa. Upper part of Mesa is supported by the Uinta Formation and the lower part is in the Green River Formation. Discontinuous remnants of basalt flows of Pliocene age cap the Mesa. The most conspicuous point on the Mesa is North Mamm Peak, elevation 11,123 ft, supported by a remnant of basalt. The major drainage on the east-center face of the Mesa is Mamm Creek.

0.6 16.3 At 3 o'clock (north) is the Grand Hogback, supported by vertical or near-vertical beds of the Mesaverde Formation. Beds of Paleocene and Eocene age southwest of the Grand Hogback dip at progressively lower angles up-section into the Piceance Creek basin. Pediment surface in foreground is cut on gently tilted beds of the Wasatch Formation (Eocene). Near the skyline at 10 o'clock (south) is the Divide Creek anticline.

0.7 17.0 At 1 o'clock (northwest) are sandstone beds and variegated mudstone and siltstone beds of the Wasatch Formation.

0.8 17.8 Milepost 99 on I-70. Directly ahead (west) are the Roan Cliffs, in which are exposed beds of the Green River Formation. The road winding up the south face of the cliffs leads to the Anvil Points mine; oil shale from the mine was retorted at the experimental plant of the U.S. Bureau of Mines. The cliff to the right (east) of the road is one of the Anvil Points.

0.5 18.3 Switchback road at 12 o'clock (northwest) on the east face of the Roan Cliffs is the JQS trail that provides access to the Naval Oil Shale Reserve (NOSR) in the southeast corner of the Roan Plateau. Topographic elevations along the top of the cliffs are about 9,200 ft.

0.9 19.2 BEAR RIGHT on exit to Silt.

0.1 19.3 Stop sign. TURN RIGHT. At 12 o'clock (north) is Harvey Gap, cut through the Grand Hogback in upturned beds of the Mesaverde Formation.

0.1 19.4 Stop sign. TURN LEFT on U.S. Highway 6 and 24 through Silt.
FIRST DAY'S ROAD LOG

1.1 20.5 Valley of the Colorado River ahead (west) is eroded in Wasatch Formation (Eocene).

0.3 20.8 Series of pediments and terraces rising south above the Colorado River from 9 to 11 o'clock (south and southwest) are cut across the Wasatch Formation. The surfaces are mantled with gravels containing clasts of basalt derived from Battlement Mesa. The valley on the north side of the Colorado River is Cactus Valley.

1.2 22.0 National Forest access road to West Elk Creek at 3 o'clock (north).

0.9 22.9 Graham Mesa between 12 and 3 o'clock (west and northwest) is the low pediment cut on beds of the Wasatch Formation.

2.4 25.3 Junction with Mile Pond Lane. Outcrops of the Wasatch Formation from 2 to 3 o'clock (northwest).

0.5 25.8 Old river gravel exposed in the roadcut at 3 o'clock (northwest).

0.2 26.0 Grassy area below highway at 9 o'clock (south) is former site of Union Carbide Corp. vanadium and uranium mill. After the mill was dismantled, the site and tailings piles were leveled and seeded with grasses. Union Carbide Corp. has spent about $40,000 in their revegetation program here. The new Union Carbide mill is located at the green water tower at 12 o'clock (west), west of Rifle. Vanadium and uranium ore processed at the mill is mined from Jurassic rocks about 12 mi north-northeast of Rifle. Some ore processed at the mill is shipped from the Colorado Plateau.

0.5 26.5 Old river gravel exposed in roadcut at 3 o'clock (north).

0.3 26.8 Junction with Colorado - 13 and - 789 in Rifle. Continue west on U.S. - 6 and - 24. Rifle is at an elevation of 5,345 ft.

0.5 27.3 Cross Rifle Creek. Grass Mesa at 9 o'clock (south) and Taughenbaugh Mesa at 11 o'clock (southwest) across the Colorado River and Prefontaine Mesa at 1-3 o'clock (west-northwest and north) are pediments cut across the Wasatch Formation.

Exposed on the face of the Roan Cliffs at 2-3 o'clock (northwest and north) for the next 7 mi are the upper part of the Wasatch Formation and the Green River Formation. The top of the Wasatch Formation is mapped at the top of the highest continuous red bed. Overlying the Wasatch Formation and interfinger with it are siltstone, sandstone, and marlstone beds of the Anvil Points Member of the Green River Formation. The member weathers with brown and tan colors and is overlain by whitish-weathering precipitous slopes of the Parachute Creek Member of the Green River Formation. The Parachute Creek Member contains the richest oil shale beds of the Piceance Creek basin. Along the Roan Cliffs near Anvil Points the richest beds, named the Mahogany ledge, occur as ribs at the top of vegetated spurs at the base of the steep, bare cliffs. A 70-ft-thick section of shale in the Mahogany ledge averages about 27 gal of oil per ton (GOPT) and of that section, 60 ft averages 30 GOPT. Above the Mahogany ledge, about 450 ft of oil shale averages 10-15 GOPT.

4.3 31.6 Outcrops at 3 o'clock (northwest) on side of Webster Mesa are Wasatch Formation.

0.2 31.8 Major drainage at 9 o'clock (south) across the Colorado River is Porcupine Creek. Nearly 1,500 ft of beds belonging to the upper part of the Wasatch Formation, the Green River Formation, and the overlying Uinta Formation are well exposed in the upper reaches of the creek. Above Porcupine Creek the highest knob atop Battlement Mesa is North Mam Peak, a remnant of a basalt flow, dated radiometrically as 9.7 ± 0.5 m.y. old.

In the distance at 12 o'clock (west-southwest) is Mount Callahan, a triangular-faced peak rising 3,600 ft above the Colorado River. The peak is capped by a remnant of a basalt flow, undoubtedly once continuous with the flows that now cover Battlement and Grand Mesas. Erosion by
the Colorado River since early Pliocene time has isolated the flow remnant.

1.4  34.3 TURN RIGHT onto paved road to the Paraho Oil Shale Demonstration Plant at Anvil Points. Road ascends on alluvium of Sharrard Park. Variegated beds of the Wasatch Formation are exposed in hills at 9 o'clock (west) and 1 o'clock (north).

1.3  35.6 TURN RIGHT at sign pointing to Research Center.

0.4  36.0 Contact at 2 o'clock (north) between the Wasatch Formation below and the Green River Formation above follows top of continuous red beds.

0.3  36.3 STOP at guard station and gate to Paraho Research Center. Entry is by permit only. Road log resumes at this gate after the field trip stop with discussion inside the compound.

STOP ONE. Discussion of stratigraphy of the Green River Formation exposed in the Anvil Points area, and general discussion of history and experimental methods of retorting oil shale at the Anvil Points Research Center.

36.3 Road log resumes at gate to Research Center, with vehicles returning south downhill to Anvil Points.

0.7  37.0 TURN RIGHT at sign “Join APRA” and RIGHT onto Anvil Points Circle street.

0.3  37.3 STOP TWO. Revegetation Test Plot of Colorado State University. Discussion of revegetation experiment on spent oil shale under controlled conditions of slope, soil to spent-shale ratios, and irrigation. Spent shale was derived from earlier retorting experiments at the U.S. Bureau of Mines Anvil Points Research Center.

Rejoin and BEAR RIGHT (south) on road to return to U.S. - 6 and - 24. Ahead at 12 o'clock (south) across the Colorado River is a mesa on which Colony Development Co. proposes to develop a new town for workers in the oil shale extraction industry. Battlement Mesa forms the skyline at 12 o'clock (south), and Grand Mesa forms the skyline at 2 o'clock (southwest).

1.3  38.8 TURN RIGHT (west) onto U.S. - 6 and - 24. Good exposures of the Wasatch Formation on the right (north) side of the road for the next 8 mi.
Exposures of Wasatch Formation at 12 o'clock (northwest) and 3 o'clock (north) showing typical variegated siltstone and mudstone beds with lenticular sandstone units.

Townsite of Rulison at 3 o'clock (north) near highway.

Cottonwood Point, elevation 8,330 ft, is at 3 o'clock (north-northwest). Minor intertonguing of the Wasatch Formation and the overlying Anvil Points Member of the Green River Formation is exposed in the lower part of the steep slopes. The Anvil Points Member here contains sandstone and mudstone beds with thin interbeds of ostracodal and oolitic limestone. The Anvil Points Member is equivalent to the Douglas Creek, Garden Gulch and lowest part of the Parachute Creek Members of the Green River Formation to the west and north.

At 2 o'clock is the western part of the Naval Oil Shale Reserve, with the land on the north boundary owned by Mobil Oil Corp. Jeep trail ascending the cliff is the Mahaffey trail. Ahead at 1 o'clock (west-northwest) is Allen Point. On lower part of slope below Allen Point the contact between the Wasatch Formation and Anvil Points Member of the Green River Formation is sharp with no intertonguing. The color change from brown and tan below to light gray and white above, near the base of the steepest slope beneath the point, approximately marks the contact between the Anvil Points and Parachute Creek Members of the Green River Formation.

At 8 o'clock (south-southeast) across the Colorado River is Battlement Creek. About 5 mi up the Creek is the site of the Rulison underground nuclear test. During the test, a 40-kiloton nuclear explosive was detonated within the Mesaverde Formation to fracture the sandstone and shale sequence in an attempt to stimulate gas production from tight sandstone beds. The test developed a fractured cavity successfully, and well-head pressures increased as predicted after the shot. But owing in part to the high cost of the project, $5.9 million, it was not successful economically. The shot hole spudded at an elevation of 8,154 ft, about 300 ft beneath the exposures of the Green River Formation visible on the east side of the creek, and the device was detonated 8,426 ft beneath the surface.

Morrisania Mesa is the pediment on the east side of the lower part of Battlement Creek.

Road along Parachute Creek is nearly parallel to the Eocene depositional axis of the Piceance Creek basin. North along the cliffs bordering the valley, thin widely separated ledges of oil shale beneath the Mahogany ledge thicken and merge to form another oil shale ledge in which the Colony Development Operation plant is located about 11 mi up the valley.

Ridge at 10 o'clock (west-northwest) having beehive-weathering knobs on its crown is Haystack Mountain, site of an experiment by Sinclair Oil Co. on in situ retorting of oil shale. Small white scar near crown is drill site for experiment in the Parachute Creek Member of the Green River Formation. Oil was retorted during the experiment but could not be collected because it flowed from numerous fractures down the slopes of the ridge.

At 2 o'clock (northeast) is Wheeler Gulch and at 8 o'clock (southwest) is Riley Gulch. North of the gulches, Donnell (1961) and others have divided the Green River Formation into three units, which in ascending order are the Douglas Creek, Garden Gulch, and Parachute Creek Members.

Garden Gulch at 9 o'clock (west) is type locality of the Garden Gulch Member of the Green River Formation.
The Garden Gulch consists of marlstone, mudstone, some lenticular sandstone, and oolitic and algal limestone; it contains no significant oil shale deposits. Here the underlying Douglas Creek Member is thin and consists mainly of sandstone that forms a bench at the bottom of the slopes. Light-gray or white beds on the upper part of the ridges are the Parachute Creek Member.

1.4 56.7 Scarred slope on point ahead at 12 o'clock is above site of pilot retorting project by Union Oil Co. Natural spontaneous burning of oil shale produced the red coloration evident on the slopes at the point and at several sites along the valley walls. Some burns extend as far as 1,500 ft underground.

1.3 58.5 TURN LEFT (west) onto road to Colony Development Operation. Red coloration on point at 1 o'clock (northwest) is burned oil shale.

0.4 58.9 At 3 o'clock (east) are the remains of the Union Oil Co. pilot retort at the mouth of the East Fork of Parachute Creek. Shale ore for the retort was mined about 2 mi east of the retort up East Fork. East of the willows along Parachute Creek at 2 o'clock, the valley bottom consists of revegetated, leveled spent shale.
FIRST DAY'S ROAD LOG

0.6 59.5 West Fork of Parachute Creek is ahead at 12 o'clock (west-northwest).

0.5 60.0 Exposures of the Garden Gulch Member of the Green River Formation on the left (west). At 12 o'clock (north) a prominent ledge of oil shale of minable thickness here occurs beneath the Mahogany ledge.

1.2 61.2 At 2 o'clock (northeast) is East Middle Fork of Parachute Creek. Fee land north of East Middle Fork is the Dow property, source of oil shale retorted by Colony Development Co. Fee land at 4 o'clock (southeast) between East Middle Fork and East Fork is owned by Union Oil Co., and fee land south of East Fork to the NOSR is owned by Mobil Oil Corp.

0.6 61.8 Road at right leads to experimental revegetation plot, operated by Colony Development Operation.

0.1 61.9 STOP at gate and guard house of Colony Development Operation. Entrance is restricted and requires official permission in advance of arrival. Mileage from 61.9 to 65.7 is within the restricted area. Road log from restricted area resumes at this gate at mile 65.7.

Vugs in ledges on the cliff at 3 o'clock (east) are dissolution vugs from which nahcolite (NaHCO₃) was naturally leached.

0.2 62.1 At 9 o'clock (west) are the temporary engineering offices and research laboratory of Colony Development Operation. The weather station in the rear, operated by Colony, is accumulating meteorologic data for air pollution control and revegetation studies.

0.5 62.6 Blocky "talus" slope at 3 o'clock (east) is an ore dump from the mine high above on the valley wall. Run-of-the-mine oil shale here averages about 35 GOPT. More than a million tons of oil shale has been mined by Colony from the pre-development mine.

0.2 62.8 Low piles of silt-sized spent shale from the Colony retorting operation along road at 3 o'clock (east).

0.1 62.9 Davis Gulch at 9-10 o'clock (northwest), with waterfall.

0.1 63.0 At 3 o'clock (east) is the retort of the Colony Development Operation. Colony uses the Tosco II retorting technique described in the guidebook articles by Kilburn, Atwood, and Bronman, and by Prien.

0.2 63.2 Hairpin curve in road; waterfall at 9 o'clock (north) on Parachute Creek.

0.1 63.3 Secondary crusher for retorting operation at 9 o'clock (east).

0.3 63.6 Hairpin curve in road; here road ascends through the Parachute Creek Member of the Green River Formation.

0.3 63.9 Primary crusher for retorting operation at 9 o'clock (west) and parking area for mine entrance.

STOP THREE. Discussion of stratigraphy of Green River Formation and of the mining and retorting operation by Colony Development Operation. View Colony mine from its entrance.

West across Parachute Creek is Davis Gulch. East-flowing tributaries to Davis Gulch will be used by Colony to dispose of spent shale. A dam to be built above the waterfall in the gulch will trap particulate materials from the disposal sites. Conspicuous reddish discoloration on dark-gray rocks is naturally burned oil shale. Mine entrance is in the Mahogany ledge in the Parachute Creek Member of the Green River Formation. Solution cavities in beds on left (north) side of entrance were formerly filled with nahcolite. The darkest-colored bed with vugs is the Mahogany bed, 5-6 ft thick, that contains about 60 GOPT; other sequences of beds in the Mahogany ledge here have the following values: 60-ft beds average about 35 GOPT, and 90-ft beds average about 30 GOPT.

RETURN to gate at entrance to Colony Development Operation. After stop, proceed down-canyon (south) along the Colony road.

TURN RIGHT (south) at junction with Parachute Creek road. Depositional axis of basin during Eocene time was nearly coincident with a
structural sag in this area during Late Cretaceous and Paleocene time between the Douglas Creek arch on the west and White River uplift on the east, for beds of those ages thicken into the Parachute Creek area.

Wheeler Gulch at 8 o'clock (northeast).

TURN RIGHT onto U.S.-6 and -24 in the center of Grand Valley.

Cross bridge over Parachute Creek. High Mesa is the pediment, dissected by Dry Creek, at 9 o'clock (south) across the Colorado River. Oil shale lands above High Mesa are owned by Gulf Oil Corp.

Mount Callahan at 3 o'clock (north). Lenticular sandstone beds in variegated siltstone and mudstone at the base of the slope belong to the Wasatch Formation.

Wallace Creek at 9 o'clock (south) across the Colorado River was part of the route purportedly travelled to Grand Mesa by the Ute Indians with white women and children hostages taken during the Meeker massacre of September 29, 1879.

Mount Logan at 2 o'clock (west), capped by a veneer of Uinta Formation of Eocene age. [Cashion and Donnell (1974) demonstrated that these rocks, formerly known as the Evacuation Creek Member of the Green River Formation, belong to the Uinta Formation.] The Mahogany...
ledge in the Parachute Creek Member of the Green River Formation is the lowermost ledging unit just above the saddle. Logan Wash, route of the field trip to the Garrett mine, is on the back (north) side of Mount Logan.

2.1 87.7 Highway is on terrace supported by sandstone beds of the Molina Member of the Wasatch Formation. The member forms the middle part of the formation, and is overlain by the Shire Member, composed dominantly of variegated siltstone and mudstone, exposed at base of slope at 3 o'clock (north). Sandstone beds of the Molina increase in number and thickness southward toward the type locality near Molina on the south side of Battlement Mesa.

3.0 90.7 TURN RIGHT onto road to DeBeque.

0.5 91.2 Grand Mesa is on skyline between 9 and 11 o'clock (southwest).

0.3 92.0 Carbonaceous mudstone and lignitic coal beds at 3 o'clock (north) in Atwell Gulch Member of the Wasatch Formation. The Atwell Gulch is the lowest member of the formation and crops out along the road between here and DeBeque. Vertebrate remains and plant fossils in the lower part of the member are late Paleocene (Tiffanian) in age.

0.6 92.6 Contact beneath cap on small butte at 3 o'clock (northeast) between the Atwell Gulch Member below and the Molina Member of the Wasatch Formation above.

0.1 92.7 TURN RIGHT.

0.1 92.8 TURN RIGHT onto Roan Creek road. At 9 o'clock (west-southwest) is general view of the DeBeque anticline. At 8:30 o'clock (southwest) beds dip gently south, whereas at 10 o'clock (west) beds dip gently north. The anticline plunges gently east. Near DeBeque shallow wells found shows of gas and oil with salt water in sandstone beds of the Wasatch and Mesaverde Formations. About 8 mi west of DeBeque on the Coon Hollow Unit, gas was found on the anticline in sandstone beds of the Fort Union, Mesaverde and, reportedly, the Dakota Sandstone. A test to the Entrada Sandstone found uneconomic amounts of gas in the Mesaverde. The unit is shut in.

Ledges of oil shale ahead on high slopes at 12 o'clock (north-northwest). Thin dark line is Mahogany ledge. Oil shale beds become leaner and the ledge thins toward the southwest margin of the Piceance Creek basin.

Road traverses Atwell Gulch Member of Wasatch Formation.

2.1 95.4 Mount Logan at 3 o'clock (east).

0.3 95.7 Road to Dry Fork on left (west).

0.5 96.2 Road crosses basal contact of Molina Member of the Wasatch Formation. Square-topped butte ahead at 11:30 o'clock (north-northwest) is Mount Blaine. At the foot of Mount Blaine is the site of the Index Oil Shale Plant that was in operation during the 1920's.

1.2 97.4 Road rises onto lower part of Shire Member of Wasatch Formation.

0.6 98.0 TURN RIGHT onto road to Garrett Research and Development Co., Inc. The company is a subsidiary of Occidental Petroleum Co. Entrance to the in situ retorting operation is restricted beyond this point and requires official permission in advance of arrival. Mileage from 98.0 to 110.9 is within the restricted area. Road log from restricted area resumes at this point at mile 110.9.

Road along Logan Wash ascends northeast through exposures of the Shire Member of the Wasatch. Pedi- ment surface cut across beds is mantled with resistant marlstone fragments derived from the Green River Formation exposed on the cliffs above. Long Point, elevation 7,907 ft, is at 9 o'clock (north).

1.5 99.5 A tongue of the Green River Formation consisting of thin-bedded siltstone with thin ostracodal limestone lenses of lacustrine origin crops out ahead at 12 o'clock (north) within red beds of Shire Member of the Wasatch Formation.

0.1 99.6 At 10 o'clock (north) are next higher beds of Shire Member above the thin tongue of the Green River Formation.
Base of the main body of the Douglas Creek Member of the Green River Formation is exposed at 11 o'clock (north). Contact is drawn at the top of the maroon-brown and red beds.

Road crosses contact between Shire Member of Wasatch Formation below and Douglas Creek Member of Green River Formation above.

Road passes through ledge-forming sandstone beds in the upper part of the Douglas Creek Member.

Road crosses basal contact of Garden Gulch Member of the Green River Formation.

High on the ridge at 3 o'clock (south) east of the saddle is a tipple at the John Savage quarry. Oil shale quarried there from the Mahogany ledge was loaded for transport to oil company research laboratories.

Bluish-gray bed near top of butte ahead (east-northeast) is the Mahogany bed.

STOP at horseshoe bend in road. Dismount from buses for hike to STOP FOUR. Buses will turn around and wait for boarding after the stop at a wide area adjacent to the road about 0.1 mi down-canyon (west) from this point.

STOP FOUR. Follow road to second switchback about 0.6 mi south-west, then continue about 0.5 mi southwest on abandoned jeep trail to tipple near saddle east of Mount Logan. Discussion and detailed inspection of Mahogany ledge oil shale, including analcime tuff marker beds, Mahogany bed, and origin of the oil shale.

RETURN TO BUSES for return trip to Glenwood Springs.

STOP. TURN LEFT (south) onto paved road down Roan Creek valley to DeBeque.

Junction at 9 o'clock (northeast) between Roan Creek road and old DeBeque road. Continue straight (south) into DeBeque.

Main intersection in DeBeque. TURN LEFT.

Bridge over Colorado River. TURN LEFT (east) on south end of bridge.

TURN LEFT (northeast) onto U.S. 6 and 24.

Bridge over Colorado River.

On left (north) is junction with DeBeque road (mile 90.7 of log above). Continue east on U.S. 6 and 24.

ROAD LOG FOR THE SECOND DAY

<table>
<thead>
<tr>
<th>Mileage</th>
<th>Increment</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>0.9</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>1.4</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>0.3</td>
<td>3.3</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Assembly and departure point in front of the Colorado Hotel, Glenwood Springs, at the intersection of Pine Street (Colorado Highway 82) and 6th Street. Follow road log of the first day to mile 26.8 at Rifle.

Road Log begins at 1st and Railroad Streets, just north of the junction of U.S. 6 and 24 and Colorado 13 and 789 in Rifle.

0.6 0.6 Cross Rifle Creek.

0.9 1.5 Water gap through Grand Hogback at 1 o'clock (north) is Rifle Gap, site of a noted transitory phenomenon; artist Cristo erected a 3,000-ft-long orange nylon curtain across the gap in August 1972. The wind, disregarding the artistic merits of the curtain, blew it down 2 days later.

1.4 3.0 Trail ascending the steep slopes at 9 o'clock (west) to the Roan Plateau is the JQS trail, which provides access to the Naval Oil Shale Reserve.

0.3 3.3 Road on right (east) leads to Rifle Gap and the Rifle Creeks. The gap at 1 o'clock (north) is eroded in steeply dipping beds of the Mesaverde Formation. In the distance through the gap are red beds of the Chinle Formation (Triassic) and white outcrops of the Glen Canyon (Triassic and Jurassic) and Entrada (Jurassic) Sandstones. The Morrison Formation forms the slope above the Entrada and the Dakota Sandstone (Lower Cretaceous) caps the slope.

Cross Government Creek. Road passes through outcrops of the Wasatch Formation exposed on the sides of pediments cut by Rifle and Government Creeks.
A well drilled in 1959 in NW 
3 sec, T. 5 S., R. 92 W., about 
3.3 mi east-northeast of this junction, 
discovered oil in the Weber Sand- 
stone at 11,003-11,087 ft. The initial 
pump potential of the well was 18 
bbl of oil per day, with some water, 
but the well has not been produced. 
Several Weber tests drilled in the vi-
cinity since that time have been un-
successful.

About 4 mi northeast along the 
road up East Rifle Creek are the 
Garfield and Rifle mines that pro-
duced vanadium ore and minor 
amounts of uranium ore from the 
Glen Canyon (Triassic and Jurassic) 
and Entrada (Jurassic) Sandstones. 
Fischer (1960) described the geology 
of the deposit.

0.9 4.2 Flatirons at 12 o'clock (north) are 
sandstone beds in the upper part of 
the Mesaverde Formation. The beds 
dip southwest of the Grand Hogback 
into the Piceance Creek basin.

2.8 7.0 Road follows Grand Hogback at 3 
o'clock (northeast) to Rio Blanco.

1.1 8.1 Access road on right to McGuire Oil 
No. 3 North Rifle well, a 10,500-ft 
test of the Mesaverde Formation. 
Hole spudded in November 1973; as 
of the middle of June 1974, after 
reaching 10,600 ft T.D., 7⅛-in. 
casing had been cemented at 7,297 
ft, and operators are waiting on com-
pletion tools.

1.5 9.6 On lower flatiron at 3 o'clock (north-
east) are steeply dipping beds of the 
Wasatch Formation. Stratigraphically 
higher in the formation southwest of 
the highway, dips decline rapidly into 
the Piceance Creek basin.

0.3 9.9 At 3 o'clock (east) white pebbly 
sandstone bed with a brown cap is 
the Ohio Creek Conglomerate of Paleoe-
cene age. The conglomerate rests 
conformably on the underlying Mesa-
verde Formation and is overlain con-
formably by carbonaceous mudstone 
and siltstone beds of Paleocene age, 
equivalent to the Fort Union Forma-
tion. These beds were assigned to 
the Wasatch Formation during early 
reconnaissance mapping. The Ohio 
Creek also forms the western part 
of the higher flatiron on the north-
west side of the exposures.

1.8 11.7 At 3 o'clock (northeast) is dry hole 
No. 1 North Rifle Unit, drilled by 
Atlantic Richfield and others in 1970-
71. The hole bottomed at 17,279 ft 
in the Dakota Sandstone, without 
encountering commercial shows of 
petroleum; however, untested oil and 
gas shows were recorded by the mud-
logging unit during drilling through 
the Mesaverde Formation and Mancos 
Shale.

1.5 13.2 Ranch house.

1.2 14.4 White slope at 3 o'clock is dipslope 
of Ohio Creek Conglomerate.

0.3 14.7 Anvil Points Member of the Green 
River Formation is exposed on steep 
slope at 9 o'clock (west-southwest) 
on the lower part of the Roan Cliffs.

1.9 16.6 Drainage divide between Government 
Creek that flows south to Rifle and a 
tributary to Piceance Creek that flows 
north.

0.5 17.1 Road crosses Rio Blanco County line.

1.5 18.6 Road crosses Piceance Creek.

0.4 19.0 TURN LEFT at Rio Blanco onto 
Piceance Creek road, marked by sign 
Piceance Creek Wildlife Area Road.

0.8 19.8 Outcrops of Anvil Points Member of 
Green River Formation on both sides 
of road. The Anvil Points Member 
represents a shoreline facies of the 
Green River Formation.

1.1 20.9 Road crosses contact between Anvil 
Points Member below and Parachute 
Creek Member of Green River For-
mation above. The Parachute Creek 
Member, a lacustrine facies of the 
Green River Formation, thickens and 
its oil content increases basinward 
(west) from this eastern part of the 
basin.

0.2 21.1 STOP ONE. Mahogany ledge in 
Parachute Creek Member of Green 
River Formation exposed on north 
side of road. Inspection of oil shale 
of the Mahogany ledge and discussion 
of the stratigraphy of the Green River 
and Uinta Formations on the east 
flank of the Piceance Creek basin.
0.4 21.5 At 3 o'clock (north) is adit driven by Continental Oil Shale Co. in the 1920's during early exploration of the basin. Note while driving along the road that dips of beds are flattening gradually westward.

0.7 22.2 Pits at 3 o'clock (north) are assessment pits, dug to validate oil shale claims.

0.2 22.4 Cow Creek enters the valley of Piceance Creek from the south at 9 o'clock.

0.2 22.6 Contact above road at 3 o'clock (north) between the Parachute Creek Member of the Green River Formation below and the Uinta Formation above. Base of sandstone ledge is the contact.

0.8 23.4 Cliff ahead at 12 o'clock (northwest) is in sandstone beds of the Uinta Formation.

0.5 23.9 Road crosses contact between Green River and Uinta Formations. Northwest into the basin, successively higher tongues of the Green River Formation interfinger with the Uinta Formation.

0.3 24.2 Contact between Green River and Uinta Formations.

1.0 25.2 Davis Gulch enters Piceance Creek valley from 3 o'clock (northeast).

0.5 25.7 Contact between Parachute Creek Member and Uinta Formation crosses road on right (northeast).

0.5 26.2 Ranch house at 9 o'clock (southwest).

1.6 27.8 Fourteenmile Creek enters Piceance Creek valley from 9 o'clock (northeast).

0.8 28.6 At 12 o'clock (west) is compressor station for South Piceance Creek gas field; field produces from sandstone beds in the lower part of the Green River Formation and from sandstone beds of the Wasatch Formation. Production from the field through March 1974 totalled about 2,000,000 MCF gas.

0.7 29.3 Dry Thirteenmile Creek joins Piceance Creek at 4 o'clock (northeast). Thin unit of light-gray and tan marlstone and siltstone exposed at 3 o'clock (north) at mouth of creek and on the north side of the road for the next 1.2 mi is the Black Sulphur Tongue of the Green River Formation. Tongues of the Green River Formation that interfinger with the Uinta Formation in the north-central and north part of the Piceance Creek basin have been named by Duncan and others (1974).

0.6 29.9 Story Gulch enters valley of Piceance Creek from the south at 9 o'clock.
Wieland Ranch at 9 o'clock (south).

Access road to Sprague Gulch at 9 o'clock (south). Piceance Creek road passes through outcrops of Uinta Formation.

Black Sulphur Tongue of the Green River Formation at 3 o'clock (north) interfingers with sandstone beds of the Uinta Formation.

White band on slope at 12 o'clock (northwest) is oil shale, assigned to the Black Sulphur Tongue of the Green River Formation.

Junction with Stewart Gulch road on left (south). Road provides access to Federal Oil Shale Lease Tract C-b.

TURN RIGHT (north) on Collins Gulch road. Road ascends the south flank of Piceance Creek dome that trends west-northwest. Outcrops along the road are in the Uinta Formation.

Gas well at 9 o'clock (west) produces from sandstone beds in the Wasatch Formation. Piceance Creek field is operated by Mobil Oil Corp. Cumulative production from the field through March 1974 has been 117.2 billion cu ft of gas, 93,000 bbl of condensate, and 784 bbl of oil.

Sandstone beds at 9 o'clock (west) are dropped into juxtaposition with a tongue of oil shale along a narrow graben. The graben trends N. 70° W. and lies about 1,000 ft south of the surface trace of Piceance Creek dome.

Thin intervals of marlstone are interbedded with sandstone beds of the Uinta Formation. Gas wells produce from the Wasatch Formation.

TURN LEFT (west) at crest of hill at Magnolia Camp. Camp is on north flank of the dome.

TURN LEFT (south-southwest) on unimproved road.

Continue south-southwest on landing strip.

Stop at south end of landing strip.

STOP TWO. Geographic orientation to Piceance Creek basin from atop the Roan Plateau. Discussion of Federal Oil Shale Lease Tract C-b, between Stewart and Scandard Gulches south of Piceance Creek, and of plans for mining oil shale on the tract. Tract C-b was leased by a group of companies including Atlantic Richfield, Ashland Oil, Tosco (The Oil Shale Corp.), and Shell Oil.

Return to buses and return north-northeast along landing strip.

Rejoin unimproved road.

TURN RIGHT (east) onto paved Collins Gulch road, past Magnolia Camp, and descend to Piceance Creek through outcrops of Uinta Formation.

TURN RIGHT (west) onto paved Piceance Creek road.

Roadcuts are in sandstone units of the Uinta Formation.

P-L Ranch road at 9 o'clock (south) to Willow Creek. This road provides access to the western part of Tract C-b.

Thin beds of marlstone of tongue of Green River Formation interbedded with sandstone beds of Uinta Formation at 10 o'clock (southwest) along west bank of Hunter Creek.

Road on left (south) to Hunter Creek which joins Piceance Creek at 10 o'clock (southwest).

Thirteenmile Creek Tongue of Green River Formation forms light-gray shale slope above road level on right (north and northwest) and across the valley at 9 o'clock (southwest).

Rock Creek School at 3 o'clock (east). After rocks were first repointed with mortar and the building shored by 2 x 10 boards, the historic school house withstood unharmed the ground tremors from the underground nuclear explosion of Project Rio Blanco, detonated several miles to the southwest.

Exposures of the Thirteenmile Creek Tongue of the Green River Formation continue north on either side of the valley of Piceance Creek. Valley here follows the part of the Piceance Creek basin containing the thickest and richest deposits of oil shale.

At 9 o'clock (west) is graben with down-dropped block of sandstone of the Uinta Formation juxtaposed against marlstone beds of Thirteenmile
Creek Tongue. This graben is the west-northwest continuation of the graben first encountered at mile 39.1 in Collins Gulch.

1.6 58.4 TURN LEFT (west) onto Ryan Gulch road. Road is access to Federal Oil Shale Lease Tract C-a.

0.8 59.2 The Thirteenmile Creek Tongue of the Green River Formation is exposed on both sides of Ryan Creek along the next 0.6 mi.

1.2 60.4 White calcite at 3 o'clock (northwest) fills fault on northeast side of graben. Graben is continuation of the one observed at mile 39.1 and 56.8, in Collins Gulch and Picance Creek valley respectively.

Ledges along road are sandstone beds of Uinta Formation.

1.0 61.4 Cross Cascade Pipeline that transports natural gas.

3.0 64.4 TURN RIGHT (northwest) at Ryan School, a Rio Blanco County historical site; road leads to Yellow Creek Deer Area and 84 Ranch.

1.3 65.7 Road on left (southwest) leads to Cathedral Bluffs, 12 mi distant. Continue north. About 100 yd north of intersection, a core hole was drilled under a sodium prospecting permit. Hite and Dyni (1967) reported that beneath the Mahogany zone the hole encountered 761 ft of oil shale, assaying 31.1 GOPT, 628 ft of beds averaging 10.7 percent dawsonite [NaAl(OH).CO₃], 238 ft of beds averaging 12.8 percent nahcolite (NaHCO₃), and 230 ft of beds averaging 18.4 percent nahcolite.

Rolling surface ahead crossed by the road is eroded on the Uinta Formation.

1.6 67.3 Pipeline at 2 o'clock (north) crosses Yellow Creek. Alluvium in creek bottom is 50-100 ft thick.

0.5 67.8 Dirt road on left. Continue straight ahead.

0.3 68.1 Site of 84 Ranch. BEAR LEFT (west) around curve. Road continues west up Corral Creek through outcrops of the Uinta Formation. Corral Creek and Stake Springs Creek merge 0.1 mi southwest of the 84 Ranch to form Yellow Creek.

Pass through gate on range fence.

2.2 71.4 Stream-gauging station on Corral Creek at 9 o'clock (south).

0.4 71.8 Road crosses contact between the Parachute Creek Member of the Green River Formation below and the Uinta Formation above.

0.2 72.0 Drill site at eastern edge of Federal Oil Shale Lease Tract C-a, Cameron Hole C702. Occidental Petroleum No. 1 Government-Cascade well is at 9 o'clock (south) near Corral Creek (SE 1/4 NE 1/4 sec. 34, T. 1 S., R. 99 W. After drilling to 6,433 ft in the Mesaverde Formation, the well was abandoned in January 1970. The well encountered oil staining in sandstone beds of the Wasatch and Mesaverde Formations and non-commercial gas shows in sandstone beds of the Fort Union and Mesaverde Formations.

TURN LEFT (south) on road leading to ridge. Road is on the nonorganic upper part of the Parachute Creek Member of the Green River Formation, and was made for access to test hole for petroleum west of the west boundary of Tract C-a.

1.7 74.1 View at 3 o'clock (north) across Corral Gulch. Uppermost part of Green River Formation is widely exposed in the Gulch, and oil shale is exposed only near bottom of the Gulch.

0.8 74.9 Turnout for bus parking and turnaround. Dismount and walk west up road.

0.2 75.1 STOP THREE. Discussion of stratigraphy of the Green River Formation exposed in the area, the quality of the oil shale present under Tract C-a, and the proposed mining techniques to be used by Standard Oil Co. of Indiana (Amoco), and Gulf Oil Corp., lessees of the Tract. Stop is near the west edge of the tract.

Cathedral Bluffs form the skyline to the west; Corral Gulch is on the north and Box Elder Gulch on the south. Trace of a narrow graben
is exposed on the north side of Corral Gulch north of the stop.

0.2  75.3  Return to buses. Retrace route to Corral Creek.

2.5  77.8  TURN RIGHT onto Corral Creek road.

3.2  81.0  Pass through gate on range fence.

1.1  82.1  BEAR RIGHT (south) at site of 84 Ranch.

About 1 mi down Yellow Creek at 8 o'clock (northeast) was the site of an experiment by Sinclair Oil and Gas Co. on \textit{in situ} retorting of oil shale. Results of the experiment have not been released.

2.4  84.5  Junction with road to Cathedral Bluffs; continue south to Ryan Creek.

1.3  85.8  TURN LEFT (east) at Ryan School and continue east to junction with Piceance Creek road.

6.0  91.8  TURN LEFT (north) onto paved road in valley of Piceance Creek. Road is in Uinta Formation. Thirteenmile Creek Tongue of Green River Formation is on ridge at 9 o'clock (west).

1.0  92.8  At 9 o'clock (west) is site of Shell Oil Co. experiment on \textit{in situ} retorting of oil shale.

1.2  94.0  At 9 o'clock (west) and in roadcuts at 3 o'clock (east) are beds of a tongue of Green River Formation interbedded in the Uinta Formation. Roadcuts for next 2 mi are in sandstone units of Uinta Formation. The sandstone units are contorted channel sandstone bodies containing locally abundant tuffaceous material.

1.5  95.5  Square-S Ranch, now owned by Colorado Division of Wildlife, is at 9 o'clock (northwest).

0.7  96.2  Thin unnamed tongue of Green River Formation interbedded with Uinta Formation in the roadcut at 3 o'clock (southeast).

1.0  97.2  At 12 o'clock (northeast) above Piceance Creek is Dry Fork Tongue of Green River Formation that is interbedded in Uinta Formation.
SECOND DAY'S ROAD LOG

1.0  98.2 Dry Fork Tongue caps hill at 10 o'clock (west-northwest).

0.9  99.1 Road on right (northeast) leads to Little Hills Game Experiment Station of the Colorado Division of Wildlife.

1.4 100.5 At 2 o'clock (northeast) is the Yellow Creek Tongue of the Green River Formation that interfingers with the Uinta Formation.

0.5 101.0 Contact at 2 o'clock (northeast) between the Uinta Formation above and the main body of the Parachute Creek Member of the Green River Formation below.

0.6 101.6 Alkali soil on grassy flat at 3 o'clock (east) surrounds saline springs emerging from aquifer of the leached zone in the Parachute Creek Member. Valley floor in this vicinity is named Alkali Flat.

0.3 101.9 Yellow Creek road on left (west); continue north on Piceance Creek road.

0.4 102.3 Highway crosses approximate contact between the main body of the Uinta Formation above and the top of the Parachute Creek Member of the Green River Formation below. Here the uppermost part of the Green River contains very thin tongues of Uinta Formation.

0.5 102.8 Sandstone tongue of Uinta Formation in the Green River at 9 o'clock (northwest).

0.1 102.9 STOP FOUR. Examine outcrops of the Mahogany ledge, with the contained Mahogany marker and Mahogany bed. Discussion of sequence of oil shale zones exposed north of the stop. Erosion in this vicinity has exposed the deepest and richest part of the oil shale units of the Green River Formation, beneath the Mahogany ledge. Oil shale zones beneath the ledge are termed in descending order R₆, R₅, and R₄. From the Mahogany ledge into R₅ is the leached zone. The Superior Oil Co., owner of fee land in this vicinity, plans to drive a shaft beneath zone R₅ and mine west and southwest toward the center of the basin. North-northeast across the road, note the vugs in the lower exposures, produced by natural leaching of nahcolite.

At north edge of exposures at Stop Four is the Rocky Mountain Natural Gas pipeline that was laid in 1973 from Big Hole field in the Sand Wash basin (Moffat County) south into the northern part of the Piceance Creek basin.

0.5 103.4 Just above road at 11 o'clock (north) are ledges of the R₆ zone.

0.4 103.8 R₅ oil shale zone is at 10 o'clock (north-northeast). Pit near base of R₅ on left was excavated to obtain bulk samples to experiment on extraction methods for dawsonite.

0.1 103.9 R₄ oil shale zone is at 12 o'clock (northeast) on skyline.

0.5 104.4 At 9 o'clock (west) the Garden Gulch Member forms vegetated slopes beneath the Parachute Creek Member of the Green River Formation.

0.1 104.5 Road crosses upper contact of Douglas Creek Member, lowest unit of the Green River Formation here.

0.3 104.8 STOP FIVE. Pull off left edge of road into flat area for parking. Discussion of the stratigraphy of the Green River Formation and adjacent units.

Return to pavement of Piceance Creek road.

0.3 105.1 Cross bridge over Piceance Creek. Buttes at 10 o'clock (northwest) are capped by the Douglas Creek Member of the Green River Formation.

0.5 105.6 Exposures ahead (north) across the White River are in the Wasatch Formation.

0.4 106.0 Road ascending slot in pediment at 12 o'clock (north) provides access to White River gas field, that produces gas and some oil from the Wasatch, Fort Union, and Mesaverde Formations. Cumulative production through March 1974 from the Mesaverde was 709,165 MCF gas and 1,310 bbl oil, and from Tertiary rocks was 599,645 MCF gas.
Strawberry, Wilson Creek Camp, Price road. Continue east on Colorado 64, TURN RIGHT (east) onto Colorado - 64, the main route between Meeker and Rangely.

0.5 117.7 Entering Powell Park, a wide, flat valley nearly 5 mi long. The Park is named for John Wesley Powell, who wintered here during 1868-69, prior to his historic first trip down the Colorado River.

0.4 118.1 Highway crosses contact at 9 o'clock (north) between the Wasatch Formation below and the Douglas Creek Member of the Green River Formation above.

0.7 118.8 Highway along north edge of Powell Park follows hills cut on the Wasatch Formation.

0.9 119.7 Cross bridge over Jordan Gulch. On the flat at 3 o'clock (south) is the site of Powell Park gas field that produced about 251,000 MCF gas, 190 bbl condensate, and 1,000 bbl oil from the Wasatch Formation before its abandonment in 1966.

0.2 119.9 Pediment at 9 o'clock (north) is capped by old gravels deposited by the White River.

0.8 120.7 Cross bridge over Strawberry Creek. At 8-9 o'clock (north-northwest and north) is possible flattening of dips in the Wasatch Formation that suggests a low anticline.

0.8 121.5 Ahead is the west flank of Wilson Creek anticline, along the Grand Hogback. Resistant beds forming the hogback are sandstones of the Mesa Verde Formation.

0.8 122.3 Point of Interest: Site of the Meeker Massacre on September 29, 1879, is 0.6 mi directly south of the commemorative sign on the road. Nathan Meeker and his men were massacred here by the Ute Indians and the women and children were taken hostage.

0.5 122.8 Steeply dipping sandstone beds on pediment surface at 9 o'clock (north), capped by gravels.

0.5 123.3 Road at 9 o'clock (north) is the Strawberry, Wilson Creek Camp, Price road. Continue east on Colorado - 64.

0.4 123.7 First hogback ridge at 10 o'clock (east-northeast) is supported by the Ohio Creek Conglomerate of Paleocene age.
SECOND DAY'S ROAD LOG

0.5 124.2 Higher hogback at 9-11 o'clock (northeast) is supported by sandstone beds of nonmarine origin near the top of the Mesaverde Formation.

0.4 124.6 BEAR RIGHT (south).

0.05 124.65 BEAR RIGHT (southwest).

0.05 124.7 STOP. TURN RIGHT (southwest) onto Colorado 13 and 789.

0.2 124.9 Cross bridge over White River. Outcrops at 10 o'clock (south) are sandstone beds in Mesaverde Formation.

0.8 125.7 At 3 o'clock (west) terrace gravels cap low hill, on the face of which are exposed sandstone beds of the Mesaverde Formation. At 9 o'clock (east) is Grand Hogback, supported by beds in the lower part of the Mesaverde Formation.

0.3 126.0 Light-gray and white beds at 3 o'clock (west) are the Ohio Creek Conglomerate overlain here by lignitic interval that contains petrified wood.

1.4 127.4 Burned coal beds forming reddish bands among dipslopes of sandstone beds of the Mesaverde Formation crop out in the gulch at 8 o'clock (east-northeast) below Sunny Point. The Mesaverde Formation along the Grand Hogback is about 6,000 ft thick.

0.3 127.7 Coal in Mesaverde Formation at 9 o'clock (east) along shoulder of road.

1.5 129.2 White conglomeratic sandstone ahead at 12 o'clock (south) is the Ohio Creek Conglomerate of Paleocene age.

0.8 130.0 Ohio Creek Conglomerate forms rounded white outcrops at 3 o'clock (west), and forms discontinuous outcrops for next 1.1 mi, cropping out behind ranch buildings at mile 131.2.

2.0 132.0 Brownish-black coal bloom in roadcut at 9 o'clock (east).

1.0 133.0 Anvil Points Member of the Green River Formation on skyline at 3 o'clock (west) is saturated with oil, giving the name Petrolite Hills to the area.

1.0 134.0 Window rock at 3 o'clock (west) is eroded in Ohio Creek Conglomerate. (See Donnell, 1961, pl. 56.)

0.3 134.3 Highway traverses higher beds in the section, and so the Ohio Creek Conglomerate is now on the left (east) side of the road.

0.6 134.9 Cuts at 9 o'clock (east) and low hills at 2 o'clock (southwest) are in Wasatch Formation.

1.2 136.1 Rounded white ledges at 9 o'clock (east) are Ohio Creek Conglomerate.

1.0 137.1 Carbonaceous mudstone and siltstone and lignitic beds at 9 o'clock (east) are of Paleocene age, equivalent to the Fort Union Formation.

0.6 137.7 Light-colored beds exposed near the top of the ridge at 3 o'clock (west) are the Anvil Points Member of the Green River Formation. Road follows outcrops of the Wasatch Formation.

0.8 138.5 Road here crosses down the stratigraphic section onto the Mesaverde Formation. White pebbly sandstone at 8 o'clock (northwest) is Ohio Creek Conglomerate.

0.7 139.2 High distant ridge on skyline to left (east) is supported by Paleozoic rocks of the White River uplift. Ridge of Mesaverde Formation in middle distance is separated from the high ridge by a strike valley eroded in the Mancos Shale.

0.6 139.8 Exposures of Anvil Points Member of the Green River Formation at 3 o'clock (west) along Fourteenmile Creek.

0.7 140.5 Sandstone beds of the Mesaverde Formation form the dipslope at 9 o'clock (east).

1.6 142.1 Carbonaceous rocks in cut at 9 o'clock (east) have been assigned to the lowest part of the Wasatch Formation.

0.3 142.4 Outcrops of main body of Wasatch Formation at 2 o'clock (west-southwest), with the Green River Formation on the skyline. Transmission line in valley on right (west) transmits electricity to Rifle from the Colorado-Ute coal-fired steam-generating plant at Hayden, in Routt County.

Sheep rancher Rigas Hallandras advertises on the slope at 3 o'clock (west) with his initials, R. H., trimmed in large sagebrush letters.

0.7 144.0 White-colored outcrops of Ohio Creek Conglomerate at 9 o'clock (east) are overlain by tan, olive, and brown
mudstone, siltstone, and silty sandstone of Paleocene age.

1.2 145.2 Rio Blanco store on left (east) and junction with Piceance Creek road on right. The intersection is mile 19.0 of second-day road log. Continue straight ahead on paved highway to Rifle.

ROAD LOG ENDS

REFERENCES CITED


