THE GEOLOGICAL SURVEY OF WYOMING
Gary B. Glass, State Geologist

PUBLIC INFORMATION CIRCULAR No. 21

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Front Cover. View east across Seminoe Reservoir from observation point along county road one mile south of Seminoe Dam (near end of field trip route). To the left in the distance, steeply-dipping Paleozoic limestones and sandstones form flatirons on the south flank of the Seminoe Mountains (Bennett Mountain block). In the middle, and slightly closer, late Paleozoic and Mesozoic rocks, including the white, hogback-forming Alcova Limestone in the Triassic redbed sequence, are complexly folded and faulted. The buff, tree-covered slopes in the foreground are underlain by the Pennsylvanian Tensleep Sandstone. Figure 37 is another view of this geology, with truer color. Photograph by R.W. Jones, August 1983.

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THE MEDICINE BOW MOUNTAINS (SUMMARY)

The road log begins where Highway 230 crosses the Colorado-Wyoming state line in the southern Medicine Bow Mountains (Plate 1). The first 15 miles of Highway 230 traverse amphibolite-grade metamorphosed Proterozoic schists and gneisses: the dominant rock types are quartzofeldspathic gneiss, hornblende gneiss, quartz diorite, and lesser amphibolite. The interpretation of the depositional and tectonic environments of these rocks is fairly ambiguous principally because most of the relict textures have been obliterated by intense deformation and metamorphism.

The Medicine Bow Mountains have basement rocks of two different ages that are separated by a zone of intense shearing termed the Mullen Creek-Nash Fork shear zone (Figure 1). Cataclastics of this shear zone are exposed 15 to 25 miles north of the state line, and form good exposures in the Centennial Ridge mining district located west of the town of Centennial.

Basement rocks north of the shear zone are Archean [more than 2.5 billion years old; see Table 1] and are overlain by thick successions of miogeoclinal metasediments and metavolcanics of Late Archean to Early Proterozoic age. Some fluvial metaconglomerates in these miogeoclinal sequences are uraniferous, and have been compared to the uraniferous metaconglomerates mined at Blind River, Canada, and the gold-rich metaconglomerates mined in the Witwatersrand of South Africa.

The basement rocks south of the shear zone are Proterozoic and are dated at about 1.8 to 1.6 billion years before present. The shear zone has been interpreted as a fossil plate suture where island arcs were accreted to the Archean craton about 1.7 billion years ago.

Recognized base and precious metals in these rocks occur as fissure filling veins and as fracture and breccia fillings intimately associated with mafic rocks and less commonly with calc-alkaline intrusives.

Some of the better preserved metavolcanic rocks south of the Mullen Creek-Nash Fork shear zone are located in the Green Mountain Formation of the Sierra Madre to the west of the Medicine Bow Mountains. Some stratabound volcanogenic massive sulfides (copper, lead, and zinc sulfides) have been discovered in the Green Mountain Formation in recent years although no similar deposits have been reported in the southern Medicine Bows.

Laramide deformation began in this region during latest Cretaceous time (see Table 1), and uplift was sufficient to strip all Paleozoic and Mesozoic rocks from the top of the Medicine Bow Mountains and expose the Precambrian core. The first direct evidence of uplift in this area is recorded as a conglomerate in the upper portion of the Medicine Bow Formation in the Mill Creek syncline a few miles northeast of Centennial.

Estimates of the maximum temperature and pressure at the base of the preexisting sedimentary cover are only 150° Centigrade and 1,000 bars. This temperature and pressure were probably not great enough for the load stress to have exceeded directed stress in the basement rocks. Thus, directed stress, originating in the basement, should also have affected the overlying sedimentary cover. Many of the geologic structures involving sedimentary rocks preserved on the north and east flank of the Medicine Bow Mountains apparently reflect deformation in the basement (Houston and others, 1968).

The present form of the Medicine Bow Mountains is a north-trending anticline. Structures on the flanks of the range trend north, northwest, and northeast, and generally show thrusting on their east flanks. These structures exhibit several characteristics as reported by Houston and others (1968):

Blocks of Precambrian basement are uplifted, and displaced to the northeast on west-dipping fault planes. Beds dip steeply on the thrust (northeast) side of the block and gently on the back side of the block (southwest).

Some blocks are also thrust to the southeast, but most thrust blocks terminate on the southeast in a northeast-trending transverse fault. Some of these transverse faults break out of Precambrian shear zones.

In the Coad Mountain-Pennock Mountain area as well as the Arlington area, blocks of Precambrian basement have been rotated during faulting.

Most thrust faults have sedimentary rocks on the hanging wall of the thrust that are steeply dipping, and locally overturned.

Red gypsiferous shale and sandstone beds of the Chugwater and Goose Egg Formations are commonly the youngest units exposed on the hanging wall of the thrust. Apparently when the fault propagates into these beds of low competence, the fault plane follows bedding planes in the red beds rather than cutting across more competent younger units.

The dip of the thrust planes has not been determined, but stratigraphic relationships show that some of the faults are low angle approaching 15 degrees in dip, at least, at the surface.

Most of the thrust blocks have a syncline in sedimentary rocks in the foot wall below the thrust

Figure 1: Generalized map of Precambrian geology of the Medicine Bow Mountains and Sierra Madre.

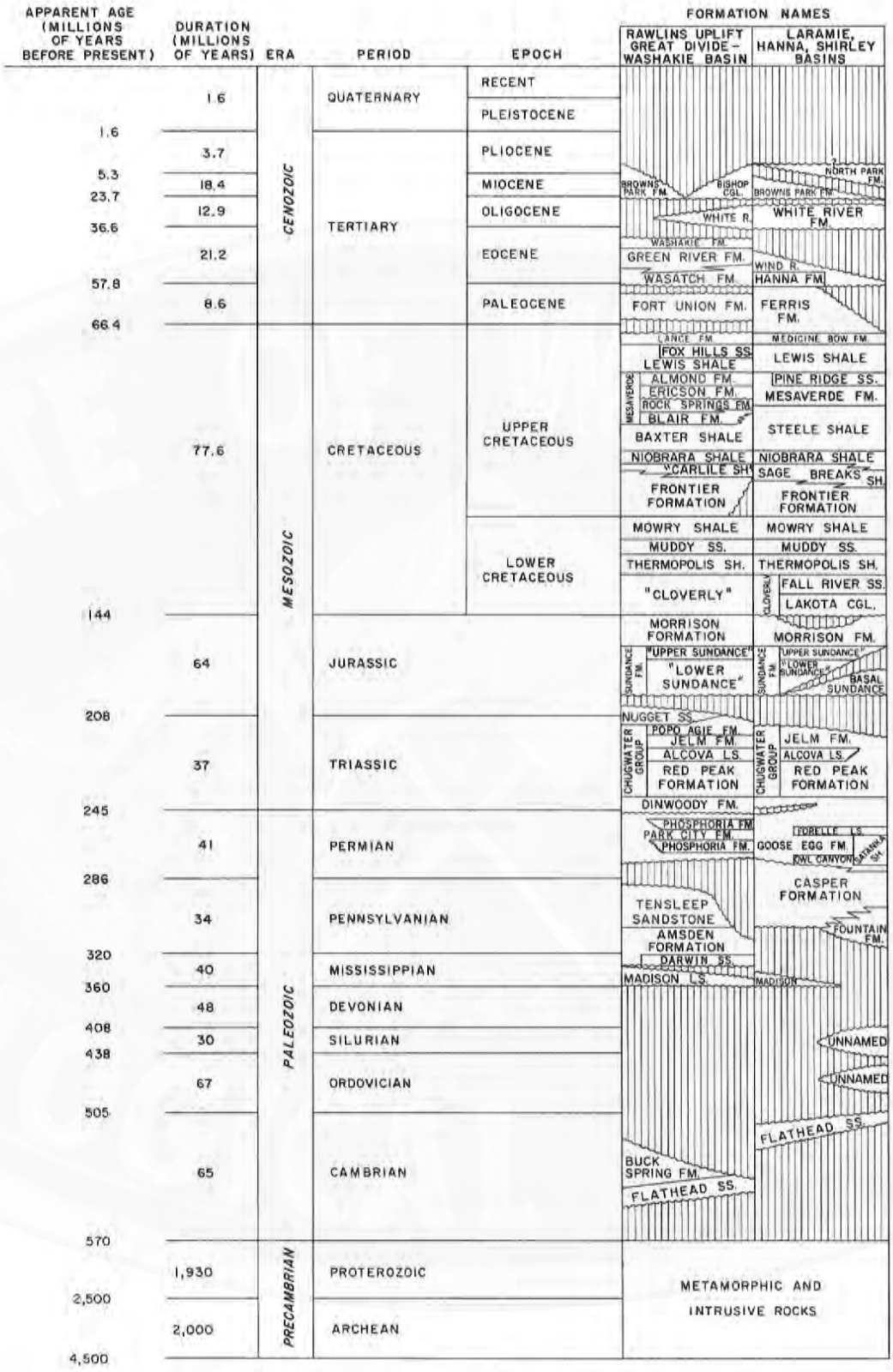


Table 1: Geologic time scale and stratigraphic nomenclature chart for southeastern Wyoming. Apparent ages and durations from Palmer, 1983. Formation names from Wyoming Geological Association, 1969. Chart modified from Wyoming Geological Association, 1969.

sheet, and anticlines and synclines with less amplitude may be present basinward.

Opposing thrusts with dips opposite to the main thrust may be present on the basinward side of the syncline.

Folding of sedimentary rocks was accomplished by flexure, and synclines near the surface that have steeply dipping limbs may pass downward to relatively moderately warped basement. Anticlines in sedimentary rocks may pass downward to faulted basement, rather than into tight folds with steeply dipping limbs.

STATE LINE TO HARMONY (STATE HIGHWAY 230)

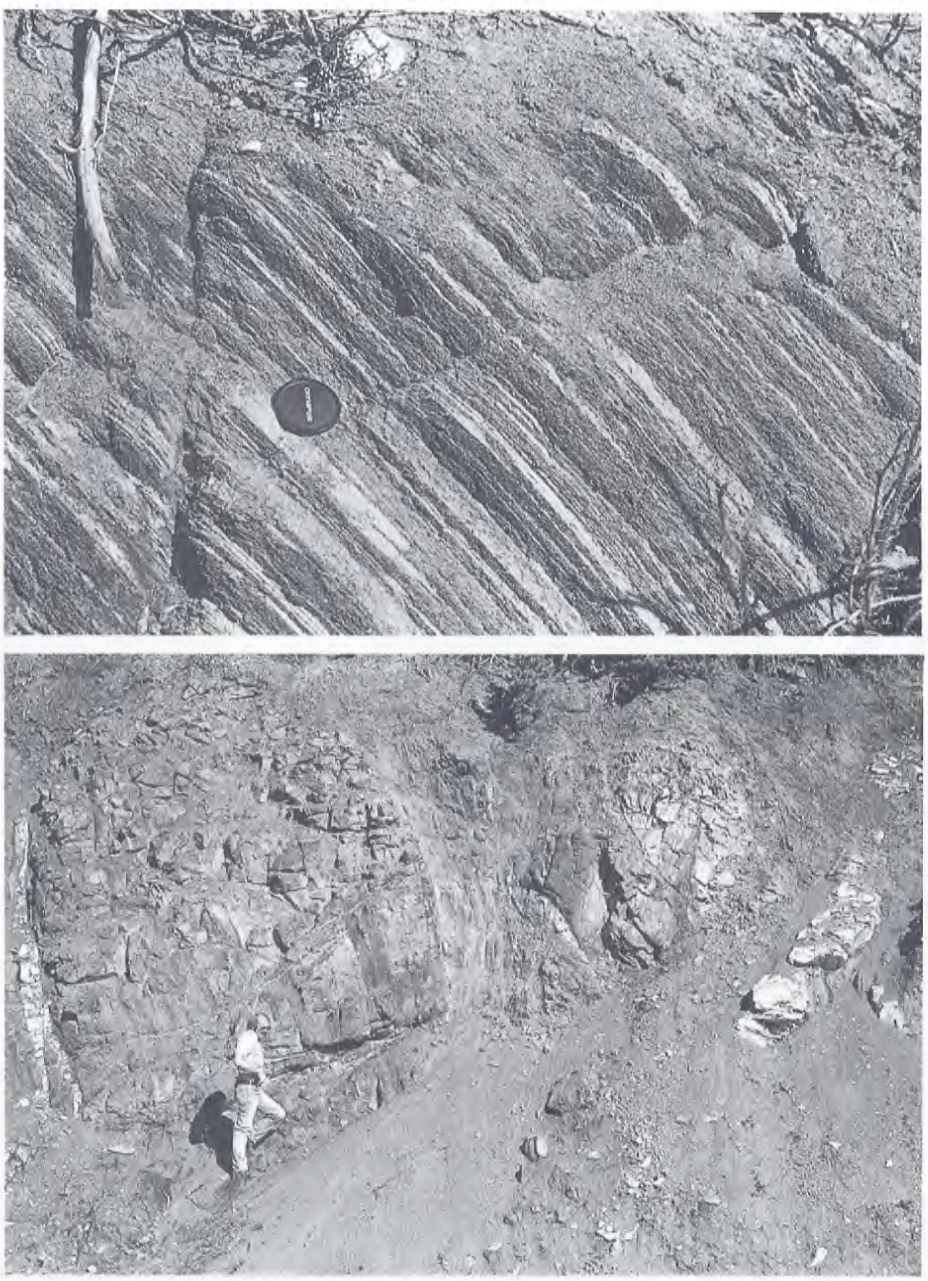
Cum. Mileage	Highway Marker*	(Interval) Description
0	None	Wyoming-Colorado state line. Mileages start here.
		(0.8)
0.8	None	Railroad underpass. Exposures of Precambrian quartzofeldspathic gneiss crop out along the railroad cuts. For the next nine miles, the route passes through alternating exposures of quartzofeldspathic gneiss and hornblende gneiss (dark grey to black).
		The quartzofeldspathic gneiss is a light-pink to grey rock that texturally varies from layered gneiss, to augen gneiss, to a faintly foliated massive rock. The gneiss has been metamorphosed to almandine-amphibolite-grade facies and consists of quartz, microcline, plagioclase, biotite, muscovite, and epidote. Chlorite, partially replacing epidote, is retrogressive.
		Although the origin of the gneiss is difficult to determine because of a lack of relict textures, the more massive varieties are mineralogically suggestive of a metasomatic origin. In addition, the massive rock is more microcline rich and sodic-feldspar rich than the layered gneisses. The habit of the microcline is suggestive of replacement inasmuch as it is interstitial and exhibits distinctly ragged borders as contacts with other minerals.
		Chemical compositions of the quartzofeldspathic gneiss show increases in K_2O and Na_2O and decreases in $FeO + Fe_2O_3$, CaO, MgO, and H_2O from the foliated gneiss to the more massive gneiss, indicating that metasomatism has affected the gneiss.
		These gneisses have been affected by a complex history and their genesis is a matter of speculation. However, the tectonic setting of the southern Medicine Bow Mountains suggests that probably both orthogneiss (igneous derived) and the paragneiss (sedimentary derived) are present (Houston and others, 1968).
		(0.8)
1.6	None	American Mine turnoff (south). The historic American copper-silver mine is located about ½ mile from the turnoff along the graveled road, and then less than ¼ mile north of the road is a clear-cut area. The mine location is shown on the U.S. Geological Survey's Foxpark, Wyoming 7½-minute topographic quadrangle. The American Mine was developed into N.15°W.-trending, silicified shears in granite. Excellent copper specimens containing green malachite and blue azurite can still be collected from the mine dump. A grab sample of copper-stained rock collected by W.D. Hausel of the Geological Survey of Wyoming assayed 1.4 percent copper and 3 ounces per ton in silver. Please do not trespass on the private property adjacent to the mine.
		(0.2)
1.8	None	Mountain Home. Rocks of the late Miocene - early Pliocene(?) North Park Formation (see Table 1) are exposed in road cuts. These rocks, which rest directly on the Precambrian, are predominately white to grey sandstones and siltstones with lenses of volcanic pebble conglomerate. It is believed that

*Indicates the highway marker immediately preceding the actual mileage given. Marked "None" when there are no mileage markers present.

Figure 2: Relief map showing field trip route.

Cum. Mileage	Highway Marker	(Interval) Description
		the pebbles in this conglomerate were derived from rhyolitic rock located at Specimen Mountain, about 45 miles to the southeast. (4.4)
6.2	None	Foxpark turnoff (north). Quartzofeldspathic gneiss exposed in low-lying road cut to south of intersection. This is near the summit of the Medicine Bow Mountains. (1.2)
7.4	None	Railroad crossing. Rocks are dominantly quartzofeldspathic gneiss. (1.2)
8.6	None	Chimney Park Scout Camp (south). Scattered, dark-grey hornblende gneissic float along the roadside. The float is derived from underlying hornblende gneiss which is mapped as a single unit. This unit consists of several rock types including fine-layered hornblende gneiss, coarse-layered hornblende gneiss, amphibolite, biotite gneiss, sillimanite-biotite gneiss, calc-biotite gneiss, diopside gneiss, and marble. Generally, these rocks are dark and strongly foliated (Houston and others, 1968). In many outcrops, the foliated rocks show complex passive folding, observable in hand specimen in the fine-layered gneiss. In the coarse-layered gneiss, the folds are observable over many feet of exposure. Hornblende gneiss and amphibolite may originate by metamorphism or metasomatism of a variety of rock types. The mineralogies of these rocks suggest that both orthogneiss and paragneiss are present, and it is reasonable to assume that they are the metamorphic equivalents of mafic flows, tuffs, and rare aluminous shaley beds — rock types that are expected in an island-arc to back-arc tectonic setting. Similar rock types in the southern Sierra Madre and the Laramie Range are not as intensely deformed and in many places retain relict textures. (0.7)
9.3	None	Truck turnout (south). Scattered outcrops of hornblende gneiss on roadside. For the next mile or so, the outcrops will consist of coarse-layered hornblende gneiss with individual gneissic layers ranging from two to several feet thick (Figure 3). Individual layers form sharp contacts with each other and are traceable for considerable distances. (1.6)
10.9	None	Approximate contact between hornblende gneiss and Keystone Quartz Diorite.
10.9-13.7	None	Keystone Quartz Diorite. The Keystone Quartz Diorite is younger than the hornblende gneiss and other igneous rocks in the area (gabbros, granites), with the possible exception of the amphibolites. The rock is a dark-grey to bluish-grey, medium-grained, faintly to strongly foliated intrusive characterized by resistant, elongate outcrops with widely spaced joints (Figure 4). Inclusions of gneiss are found throughout the quartz diorite and occur as small lenticular pods and schlieren. The quartz diorite is named after the "type-section" quartz diorite adjacent to the historic mining town and mine of Keystone, located 10 miles to the northwest along Douglas Creek. Most base and precious metal deposits in the Keystone region consist of gold- and copper-bearing, pyritic quartz-carbonate veins that occur in northwest-trending tensional cross fractures and faults subsidiary to the Mullen Creek–Nash Fork shear zone. Sparse mineralization also occurs within major northeast-trending shears. The Keystone Mine was developed on a steeply dipping, N.60°W. mineralized trend. The mineral deposits are accompanied by silicification in the form of small, irregular quartz veins and veinlets. At depth, the Keystone trend was reported to be a two- to six-foot-wide quartz vein that averaged 1.2 ounces of gold per ton. Records report that the Keystone

Figure 3: (A) Hornblende gneiss in road cut about 10 miles north of the state line. (B) At several localities this rock has been fractured and sheared. Photos by W. Dan Hausel (W.D.H.).



A

B

Cum. Mileage	Highway Marker	(Interval)	Description
			shaft was sunk 365 feet deep with nearly one mile of stopes and drifts. The property was developed in the late 1800's, and full-scale operations ceased in 1893. An estimated 5,260 ounces of gold were produced, and 100,000 tons of ore were reported, in place, when mining operations terminated. The village of Keystone is centered around the historic mine.
			Many of the mines in the Keystone area lie along the margin of the quartz diorite. The genesis of the mineral deposits is attributed to a late stage emplacement of a granitic melt (Curry, 1965).
		(2.8)	
13.7	None		Contact between Keystone Quartz Diorite (on the west) and hornblende gneiss (to the east). This contact is near the Medicine Bow National Forest Boundary sign.

Figure 4: Massive outcrops of the Keystone Quartz Diorite along Highway 230 (Photo by W.D.H.).

Cum. Mileage	Highway Marker	(Interval)	Description
		(1.0)	
14.7	27		Woods Landing. Exposed Laramide thrust fault on north side of road (Figure 5). Railroad ties cut in the Foxpark area were floated to Laramie on the Big Laramie River from this point. The last of these tie floats occurred about 50 years ago.

Directly to the east is Jelm Mountain (Figure 6), 9,656 feet high, the site of the University of Wyoming's new 92-inch infrared telescope and observatory. The historic Jelm Mountain copper-gold mining district (also known as the Brammel district) is located along the southern margin of the mountain. This district is accessible by driving 3 miles south along State Highway 10 to the observatory road. From the observatory road, several small prospect pits and mine dumps are visible. A few mines are also located to the west of the Laramie River. One mile south of the observatory road cutoff, along the Big Laramie River, is the historic mining camp of Old Jelm, or Cummins City (Figure 7). This town reportedly had as many as 60 citizens during

Figure 5: Exposure of Laramide thrust fault near Woods Landing. Rocks to the west (left) of the individual in the photo are Precambrian gneisses; outcrops to the east (right) consist of unconsolidated stream gravels deposited by the Big Laramie River. Photo by R.W. Jones (R.W.J.).

Figure 6: Jelm Mountain, looking west from Harmony. (Photo by W.D.H.)

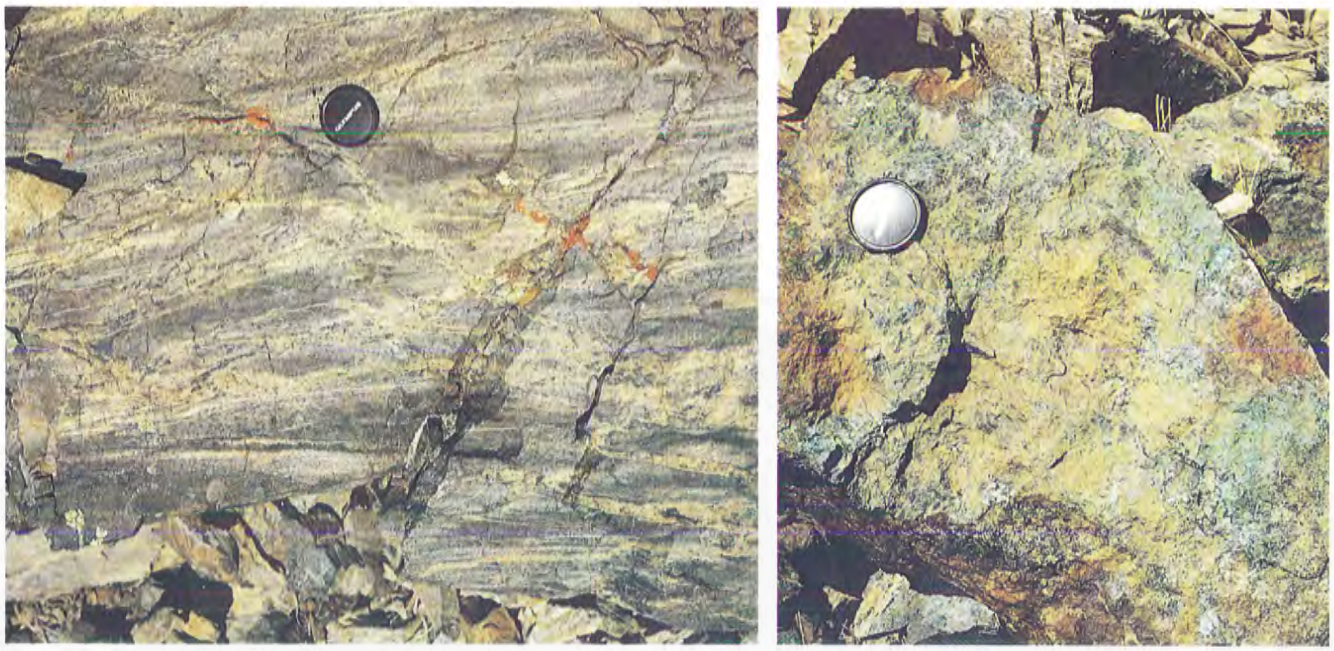
Figure 7: Old Jelm (Cummins City), as seen from the southern flank of Jelm Mountain along State Highway 10 south of Woods Landing. (Photo by W.D.H.)

Cum. Mileage	Highway Marker	(Interval)	Description

the short-lived mining boom around 1872.

Jelm Mountain is an uplifted and rotated block that is fault bounded on its western and eastern flanks. The thrust on the east flank dips 60 degrees west, and may have more than 2,000 feet of displacement. On the northeastern flank, the mountain has been thrust to the east, whereas on the southwestern flank, thrusting is to the west. In other words, rotation has been clockwise.

If this block were returned to its former position prior to thrusting, the foliation of the Precambrian rocks would more closely match the trend of foliation in the adjacent Medicine Bow Mountains.



A B

Figure 8: Outcrops in the Jelm Mountain mining district. (A) Rehealed mineralized fracture exhibiting pervasive epidotization, and (B) several specimens of copper-stained gossans. (Photos by W.D.H.)

Figure 9: As evidenced by road cuts, the Casper Formation in this area is typified by light-colored, cross-bedded sandstone. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval)	Description

The western and southern flanks of Jelm Mountain contain numerous prospect pits and small mines developed on gold- and copper-bearing quartz veins and shears in amphibolite schist and gneiss (Figure 8). Near the southeastern edge of the district, a few mine dumps contain gneissic and schistose rock fragments as well as fragments of Fountain Formation (Pennsylvanian) sedimentary rocks. Presumably, these mine workings penetrated the thrust sheet and bottomed out into the Paleozoic footwall.

Three stamp mills that served the Jelm Mountain mines were constructed at the present site of Woods Landing.

Cum. Mileage	Highway Marker	(Interval)	Description
			A north-trending fold in sedimentary rocks extends north of the uplifted block of Precambrian rock that comprises Jelm Mountain. This fold has been tested for oil and gas on its down-plunge end. A second fold, trending northeastward from the eastern flank of Jelm Mountain, has also been tested. Both folds were drilled to the Casper Formation, and all of the wells were unsuccessful.
		(1.1)	
15.8	26		West side of road. Exposures of Casper Formation (Figure 9).
		(0.2)	
16.0	26		West side of road. Exposures of Fountain Formation red beds (see Table 1). The Casper and Fountain Formations (Pennsylvanian-Permian) form the eastern flank of a complexly faulted, northwesterly-plunging syncline with Cretaceous and Jurassic rocks exposed in the core.
		(0.9)	
16.9	25		Large brick house on the north side of road sits on the edge of Precambrian rock.
		(2.4)	
19.3	23		Road cut. Exposures on the north side of the road are light yellow to tan chalks of the Niobrara Formation (Cretaceous). The Niobrara contains three persistant "chalk" beds in the Laramie Basin (D.L. Blackstone, Jr., personal communication, 1983).
		(0.5)	
19.8	—		Crossing the Pioneer Canal.
		(1.0)	
20.8	22		Sodergreen Lake to north (left). This lake is filled from the Pioneer diversion canal on the Laramie River and is part of the City of Laramie's water supply system. Light yellow shaley limestone of the Niobrara Formation is exposed around the lake.
		(4.0)	
24.0	18		Road intersection, Albany County 44 and State Highway 230 at Harmony.

HARMONY TO AIRPORT SURFACE (ALBANY COUNTY 44)

Cum. Mileage	Highway Marker	(Interval)	Description
0	None		Turn north on Albany County 44 at the Harmony Bar and Cafe. The settlement of Harmony was named for the Harmony Church, which was built in 1907 in an effort to establish harmonious relations between several church denominations. Mileages start at Harmony.
		(2.4)	
2.4	None		Leaving Harmony surface. The route will be on the Pahlow Lane surface. These surfaces are composed of caliche-cemented river gravels that were deposited on former flood plains of the Laramie River.
		(0.9)	
3.3	None		Bear right. Road to west (left) leads to Lake Hattie Reservoir, a deflation basin that has been dammed up for water storage.
		(1.4)	
4.7	None		Turn left on road to north.
		(0.2)	
4.9	None		Twin Buttes Reservoir to west. Water from the Big Laramie River is diverted to maintain the water level of the reservoir. Fish in this lake have unusually high concentrations of selenium which is derived from the Niobrara Formation (D.L. Blackstone, Jr., personal communication, 1983).
		(1.4)	
6.3	None		Entering Big Hollow. Ridge to right is an extension of the Airport surface which bounds Big Hollow on the north. Gravels here are locally cemented by hydrocarbons from an oil seep (D.L. Blackstone, Jr., personal communication, 1983). The road parallels Big Hollow anticline, a sharp, north-northwest-trending, asymmetric, faulted fold. The steep limb of the anticline is on the east side. The scarp to the west of the road is in lower Mesaverde Formation underlain by Steele Shale.

Cum. Mileage	Highway Marker	(Interval)	Description
			The road lies on the Niobrara Formation: the Frontier Formation, which occurs in the core of this anticline, is found a few hundred feet to the east. For the next 3.8 miles, the field trip route traverses Big Hollow, a large east-northeast-trending, wind-excavated depression nine miles long, three miles wide, and 150 feet deep. It is thought that the gravel-armored surfaces that bound Big Hollow on the north and south are relics of the former stream channel of the Laramie River that protected the weak Cretaceous shales from wind erosion. Big Hollow, then, formed where the fluvial channel gravel was absent. (2.4)
8.7	None		Big Hollow oil field. This field was discovered in 1938; production is from the Muddy Sandstone at a depth of about 800 feet in the Big Hollow anticline described previously. Nine wells also tested the Casper Formation, at a depth of about 3,000 feet: no oil or gas were found and all of the wells produced water. (1.6)
10.3	None		Intersection of Albany County 44 with State Highway 130.

AIRPORT SURFACE TO CENTENNIAL TO LARAMIE (STATE HIGHWAY 130)

Cum. Mileage	Highway Marker	(Interval)	Description
0	None		Turn left (west) towards Centennial and begin new mileage readings. Road lies on the Airport surface, an extensive pre-Wisconsin pediment surface that truncates Upper Cretaceous bedrock. The surface is capped by a caliche-cemented veneer of alluvial gravel and cobbles composed primarily of Medicine Peak metaquartzite (Precambrian) derived from the core of the Medicine Bow Mountains to the west. (0.5)
0.5	None		View to south of part of the Airport surface. The slope of this surface apparently increases to the west toward the mountains; the pediment gravels become coarser as one approaches the mountains. The minor pediment surfaces that dip away from the Airport surface

Figure 10: Large sandstone concretions in the Mesaverde Formation are exposed in road cut. (Photo by R.W.J.)

Figure 11: North end of Sheep Mountain as viewed from the roadway. The west-dipping thrust is located below the steep, tree-covered slopes and above the hummocky landslide topography in the foreground. (Qacg, Quaternary alluvium, colluvium, and glacial deposits; Qls, Quaternary landslide deposits; pC, Precambrian granite.) (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval) Description
		into Big Hollow and the dissection of the Airport surface in this area indicate that both the deflation basin and the pediment surface are quite old.
		(2.2)
2.7	16	Leaving the Airport surface. Note the white caliche-cemented pebbles and cobbles of this surface in the roadcuts to the north and south.
		(2.2)
4.9	18	The road has been on a pediment surface below the Airport surface. To left (southwest) is the Table Mountain surface, which stands about 100 feet above the Airport surface and is the highest and oldest pediment surface in the area.
		(0.8)
5.7	19	Westward-dipping Mesaverde Formation in roadcuts to left and right.
		(0.3)
6.0	19	Mesaverde rocks crop out (Figure 10) in road cut to the north.
		(0.6)
6.6	20	Porters Lake to south of highway is another water-filled deflation basin that parallels the dominant wind direction. Silt-size material in dune-shaped forms often occurs on the downwind side of the deflation basins and represents material that has been picked up and carried out of the basins by the wind. Mesaverde Formation crops out in the low hills immediately southwest of the lake. Now driving on the Centennial surface, a much younger surface than the Table Mountain and Airport surfaces. The surface is capped by up to eight feet of outwash and fluvial debris derived from the Medicine Bow Mountains.
		(0.7)
7.3	—	Intermediate pediment surfaces are visible to the north of the road on the skyline.
		(0.6)
7.9	—	Sheep Mountain, located to south. Sheep Mountain is composed almost entirely of Sherman Granite (1.4 billion years old) (Figure 11). At the base of Sheep Mountain, along its northeastern edge, the Mesaverde Formation contains some localized outcrops of black titaniferous sandstone (Figure 12).

Figure 12: Outcrop of titaniferous black sandstone in the Mesaverde Formation about one mile south of the road. Photograph shows Wyoming Geological Survey geologist conducting magnetometer survey over the black sand. Because the black sandstones contain abundant magnetite, they are highly magnetic and susceptible to this kind of exploration technique (see Hausel and Jones, 1982). (Photo by W.D.H.)

Cum. Mileage	Highway Marker	(Interval)	Description
			These are fossil beach placers, rich in magnetite, ilmenite, and numerous other opaque heavy minerals.
			(0.5)
8.4	21.62		Intersection. Road to south leads to Albany, Keystone, and Foxpark. Continue straight ahead to the west.
			(0.4)
8.8	22.04		Crossing Little Laramie River. The Rex Lake oil and gas field is located about three miles to the north. The field is developed on an asymmetrical, northeast-trending anticline and is separated from the Medicine Bow Mountains to the west by a sharp syncline (Mill Creek syncline) containing rocks of the Lewis, Medicine Bow, and Hanna Formations. The steep flank of the anticline is to the northwest. The field was discovered by the Ohio Oil Company in 1923 in the Muddy Sandstone and Cloverly Formation at about 4,000 feet depth. In road cuts to the north, on the hill beyond the bridge, are outcrops of the Mesaverde Formation that dip 70 degrees to the northeast. At the top of the hill, the road crosses northwest-plunging folds and faults associated with the north plunge of the Sheep Mountain uplift. Four oil and gas tests have been drilled on these folds; the deepest test was to the Casper Formation at a depth of 4,516 feet.
			(4.6)
13.4	25		Centennial Valley. Very generally, much of the Centennial Valley syncline lies directly to the south. On the east edge of Centennial Valley, Paleozoic rocks dip 45°W. (Figure 13), and on the west edge they dip 45°E., possibly reflecting folding in the underlying basement rocks.
			Bald and Corner Mountains, to the north and northwest, are related to the Arlington thrust fault. Corner Mountain, which is in the hanging wall of the fault, consists of Precambrian basement which has been thrust over the entire stratigraphic section up to and including the Cretaceous Medicine Bow Formation. Bald Mountain is capped by conglomerates of the Hanna Formation underlain by a steeply dipping section of Medicine Bow Formation, Lewis Shale, and Mesaverde Formation. The trace of the Arlington fault is at the base of the hill, and continues to the southwest where it becomes a shear in Precambrian rock to the west. The Mill Creek syncline, which contains exposures of

Figure 13: View to south from State Highway 130 of west-dipping Paleozoic and Mesozoic rocks exposed on east flank of the Centennial Valley syncline. The red beds to the left of the highway are in the Triassic Chugwater and Jelm Formations. The tree-covered ridge to the right of the highway is held up by sandstones in the Cloverly Formation. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval)	Description

Medicine Bow conglomerate, is visible to the north and northeast.

Sheep Mountain, to the southeast, is formed primarily of Sherman Granite thrust over Paleozoic rock on its eastern flank.

Along the southeastern edge of Centennial Valley (directly to the south), a hinged thrust fault that is fairly typical of many thrusts along the flanks of the Medicine Bow Mountains separates Precambrian Sherman Granite on the hanging wall from the footwall Paleozoic rocks. The Sherman Granite has been thrust over progressively younger rocks to the southeast, such that rotation has been counterclockwise on a hinge located on the northern edge of the fault. The hinge of the thrust is located to the southwest (7 o'clock) in the Middle Fork Canyon.

About one mile north of this hinge, the southern edge of Centennial Ridge (Figure 14A) is fault bounded and exhibits apparent right-lateral movement. This northeast-trending fault continues into the Chugwater Formation along its northeasternmost extent, and to the southwest it passes into a Precambrian shear.

Several shears as well as small quartz veins occur along the flank of Centennial Ridge. These contain some spotty gold and platinoids associated with sulfides and arsenides. These mineralized areas occur as fracture and breccia fillings and lenses where branches of the Mullen Creek–Nash Fork shear zone cut mafic metaigneous and amphibolitic rock units. During the late 1800's, the Centennial Ridge District realized some production. Estimates suggest that about 5,000 ounces of gold were extracted. The metals are intimately associated with mafic Precambrian rock and may have been leached from these rocks during a hydrothermal event and transferred to dilation zones (Figure 14B). The age of the mineralization is assumed to be pre-Laramide (see McCallum, 1968; Hausel, 1982a).

Continue on to Centennial. The pine-tree-covered hogback to the left, as the Little Laramie River is crossed, is formed of Cloverly Formation sandstone (Figure 15).

Figure 14: (A) View looking west at Centennial Ridge. (Photo by W.D.H.)

Cum. Mileage	Highway Marker	(Interval)	Description
			This sandstone has been quarried and used for building stone (Figure 16).
		(4.7)	
18.1	26		Crossing bridge of North Fork of the Little Laramie River.
		(0.7)	
18.8	27.44		Centennial, Wyoming was founded in 1876 and named in honor of the centennial anniversary of the United States (Figure 17). At this point, the route will turn back east and head toward Laramie along Highway 130.
		(14.2)	
33.0	13		Intersection Highway 130 and Albany County Road No. 44. Big Hollow oil field to south. Continue east on Highway 130. For the next 13.2 miles, the route is on the Airport pediment surface, which obscures most of the bedrock.
		(3.5)	
36.5	10		Overland Trail historical marker. From this point, the view to the south shows the major features that bound the Laramie Basin on the south and southwest. The high, snow-covered peaks on the

Figure 14: (B) An adit developed into sheared cataclastics along the Middle Fork of the Little Laramie River within the Centennial Ridge gold-platinum district. (Photo by W.D.H.)

Figure 15: Hogback of Cloverly Formation south of Highway 130. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval)	Description
			skyline to the south are the Rawah Peaks of Colorado. The elongate, tree-covered ridge below the peaks is Bull Mountain, a shallow syncline capped by Lower Cretaceous Cloverly Formation. To the east of Bull Mountain is Boulder Ridge. Immediately east of Boulder Ridge is the State Line diamond district (see Hausel and others, 1979, and Hausel, 1982a). This district contains one of only two known verified deposits of diamondiferous kimberlite found on the North American continent. At least fourteen kimberlites in the State Line diamond district are diamondiferous. To the west of Bull Mountain is Red Mountain. Jelm Mountain is the prominent feature between Sheep Mountain and Red Mountain.
		(7.0)	
43.5	3		Laramie Municipal Airport (Brees Field) turnoff to the south.
		(2.3)	
45.8	None		Road is now on the Pahlow Lane surface, a lower and younger pediment surface. Entering West Laramie.
		(0.4)	

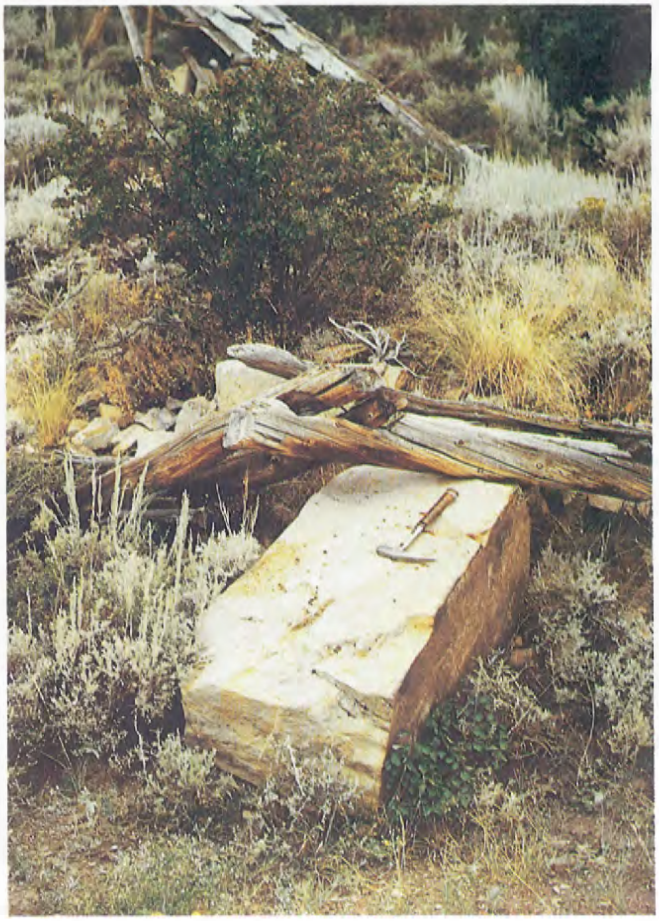


Figure 16: Large blocks of yellowish-brown sandstone like this one were quarried from the Cloverly Formation and used as building stone. (Photo by W.D.H.)

Cum. Mileage	Highway Marker	(Interval) Description
46.2	None	Intersection of Highways 130 and 230. Woods Landing and Walden, Colorado to the west, Laramie to the east. Turn left to Laramie. (0.6)
46.8	None	Stock Farm pediment surface. (0.2)
47.0	None	Interstate 80 underpass. (0.3)
47.3	None	University of Wyoming stock farm to left. Large stone buildings are remnants of the former Territorial and State Prison. (0.4)
47.7	None	Crossing Laramie River. (0.3)
48.0	None	Entering Laramie. The city's population is about 25,000 and the largest employer is the University of Wyoming.

LARAMIE TO SINCLAIR (SUMMARY)

The narrative of this trip will describe a wide variety of structural features on the flanks of the Laramie and Hanna Basins. The Arlington fault bounds the west side of the Laramie Basin and represents the boundary of the basin with the Medicine Bow Mountains. The Rock Creek anticline on the northwestern edge of the Laramie Basin is typical of the most common oil producing structures in the area. The route will proceed northeastward from Arlington, passing north of the Cooper Lake Basin, a small subsidiary basin within the Laramie Basin that contains Eocene rocks of the Wind River Formation. The route will then pass by Como Bluff anticline, a well exposed structure on the north end of the Laramie Basin, and thence to the Saddleback Hills anticline, a feature that separates the Hanna from the Carbon Basin.

The Hanna Basin is a small but extremely deep basin (40,000+ feet of structural relief on the top of the Precambrian) that received a large volume of Tertiary sediments as the Medicine Bow Mountains impinged on the basin from the south and the Shirley and Seminoe Mountains impinged from the north. The route will traverse the southern part of the basin and cross several structural features that comprise the southwestern part of the basin. From Sinclair to Seminoe Dam, the route traverses well exposed stratigraphic sections and structural features of the western and northwestern flanks of the Hanna Basin, culminating in the Precambrian rocks of the Seminoe Mountains.

LARAMIE TO ARLINGTON (INTERSTATE 80)

Cum. Mileage	Highway Marker	Interval Description
0.0	310	Mileages start at the Junction of Curtis Street with Interstate 80. For the next 1.3 miles, the road will be on the Stock Farm surface. (3.0)
3.0	307	Parking area to the north and south of highway. (1.4)
4.4	306	Near crest of low fold. On the right are Niobrara chalks weathering yellow-tan along fold crest. Also on the right is Bamforth Lake, which occupies a deflation basin. (1.1)
5.5	305	Highway built on gravel-capped surface (Airport surface?). Note the abundant lakes to the north and west in this part of the basin. These lakes occupy deflation basins. (1.6)
7.1	302.91	Herrick Lane underpass. (1.9)
9.0	301	Knadler Lake deflation basin on right. (3.3)
12.3	297.66	Herrick Lane overpass and flood plain of Little Laramie River. Immediately to the west is the Little Laramie oil field. The field was discovered in 1948 following seismic work by Superior Oil Company. Production is from six wells that penetrate the Casper Formation at an average depth of 3,700 feet. Several miles west of this field is the Herrick oil field, which was discovered by Superior in 1947. Production is also from the Casper Formation. Both structures are asymmetric to the east and fault bounded. The Little Laramie fold extends to the north over 15 miles, and has been tested by numerous wells, all failures. (2.1)
14.4	296	Low ridge on both sides of highway is held up by the Steele Shale. (4.5)

Figure 17: Even today, the Old Corral saloon and restaurant and other establishments in Centennial capture some of the color of its early mining history. (Photo by R.W.J.)

Figure 18: The snow-capped peaks form the crest of the Snowy Range. Medicine Bow Peak, elevation 12,006 feet, is the highest point in the Snowy Range and the Medicine Bow Mountains. (Photo by W.D.H.)

Cum. Mileage	Highway Marker	(Interval)	Description
18.9	291		Quealy Dome exit sign. The route for the next few miles is on Steele Shale, Mesaverde Formation, and Lewis Shale. These formations dip east into the Laramie Basin. The Lewis Shale crops out in the low hills to the northeast. These hills are overlain by basal Wind River(?) Formation. To the south is the Colorado Interstate Gas compression station.
			The east flank of the Medicine Bow Mountains, which is bounded by the west-dipping Arlington thrust fault (Figure 18), is due west. The Mill Creek syncline, as outlined by hogbacks of the Medicine Bow Formation and conglomeratic beds of the Hanna Formation, is east of the thrust.
		(2.2)	

Cum. Mileage	Highway Marker	(Interval)	Description
21.1	289		Quealy Dome oil field in the foreground (west) is the site of Wyoming's first seismic discovery of oil. The field was discovered by the California Company in 1934. Oil is produced from 21 wells into the Muddy, "Dakota," and Sundance sandstones, and the Casper Formation. The dome has been drilled to the Precambrian at 6,135 feet depth. The southern end of the field is offset by a normal fault that trends about N.70°E. and has 1,400 feet of slip, down to the south. This fault is crossed by the highway between mileages 21.9 to 22.3.
		(0.8)	
21.9	288		Start up toward crest of hill. Mesaverde is exposed in gullies on the left side of the road. The Mesaverde dips northeast (away from Quealy Dome).
		(0.7)	
22.6	288		Traveling across arkosic conglomerate in the basal Wind River Formation. The beds exhibit low-angle, easterly dip into the Cooper Lake Basin.
		(1.9)	
24.5	285.44		Cross Four Mile Creek.
		(1.6)	
26.1	284		Crest of hill. Contact between Hanna Formation and Lewis Shale; dip of the Lewis is about 50° east. Descend into the valley of Cooper Creek. Cooper Cove oil field is visible on the left side of the road to the west. The Cooper Cove Field is one of five northwest-trending anticlinal fields that lie between Cooper Lake Basin to the east and the Medicine Bow Mountains to the west. The Dutton Creek, Dutton Creek North, and Rock River oil fields are all located north of Cooper Cove. South of Cooper Cove is the Seven Mile Field. The Dutton Creek Field was discovered in 1926 by Midwest Refining Company (using cable tools). Cooper Cove was discovered in 1944 and is the southern extension of Dutton Creek and North Dutton Creek structures. Production is from the Shannon, Muddy, and "Dakota" sandstones at depths from 1,700 to 4,830 feet. Recent seismic work has indicated that the sedimentary section in this area may extend westward beneath the Arlington thrust for some distance. However, a well drilled by Exxon in 1980 about 1½ miles south of Cooper Hill (described below) penetrated over 4,500 feet of Precambrian and was abandoned at that depth without reaching an interpreted seismic structure at 8,500 feet (Gries, 1983). A second well, drilled by Moncrief Oil Company about 2.3 miles southeast of the Exxon well, was drilled through a lower subthrust and bottomed in the Niobrara Shale at a depth of about 7,500 feet (D.L. Blackstone, Jr., personal communication, 1983).
		(0.5)	
26.6	283		Cooper Hill is located to the west (Figure 19, second treeless hill in the foreground). This hill is the largest of four allochthonous masses of Precambrian rock that lie to the east of the trace of the Arlington fault. It is believed that Cooper Hill and the other three Precambrian masses may have been emplaced by gravity sliding downslope to the east of the mountain front. Cooper Hill is formed of folded Precambrian metasediments and mafic metavolcanics. The metasediments are paragneisses, marbles, chlorite schists, calcic schists, and quartzites, and the metavolcanics are amphibolites. Some gold, silver, copper, and lead were produced from silicified zones here during the late 1800's. Two different stages of silicification are reported. The first-stage veins commonly are displaced by fractures and follow steeply dipping, north-south to east-west joint trends. These veins are generally barren although some chalcopyrite occurs where the veins cross-cut marble or calcic schist.

Figure 19: Cooper Hill, the treeless ridge in the center of the photo, may be a gravity-emplaced mass of Precambrian rocks east of the Medicine Bow mountain front. Oil wells in the foreground are located in the Seven Mile Field. (Photo by W.D.H.)

Figure 20: Small normal fault exposed in Pine Ridge Sandstone in road cut on northeast side of road. (Photo by W.D.H.)

Cum. Mileage	Highway Marker	(Interval)	Description

The second-stage veins follow foliation trends of the country rock. Where the host rock is quartzite, these veins contain argentiferous galena, pyrite, and some gold. In calcic schist host rock, the veins contain chalcopyrite and chalcocite. Five mines had limited development. Assays of selected samples from the Albion Mine (which had nearly 500 feet of tunnels and shafts) ranged from 0.70 to 5.3 ounces of gold and 2.2 to 50 ounces of silver per ton. One assay showed 0.83 percent lead.

The district was abandoned principally because of ore processing problems. For example, the tailings from the Cooper Hill stamp mill were reported to be as rich as, and in some cases richer

Cum. Mileage	Highway Marker	(Interval)	Description
			than, the unprocessed ore.
			(0.6)
27.2	283		Grave of C.S. Bengough, a colorful early settler, is on the right. Flowers often seen at the grave site are placed there by University of Wyoming coeds who believe that doing so will help them pass University exams. Cannonball concretion zone in the Lewis Shale is exposed in the hillside. The ridge top of Bengough Hill is formed of quartzite cobble conglomerate of the Hanna Formation.
			(1.3)
28.5	282		Pine Ridge Sandstone of the Mesaverde Group crops out in the road cut on the right. Note the small faults (Figure 20).
			(0.6)
29.1	280		Albany-Carbon county line. Wind River Formation.
			(0.7)
29.8	280		Cooper Cove exit. Limited exposure of Wind River Formation in road cuts on right (north).
			(2.8)
32.6	278		Exposures of Pine Ridge Sandstone. Steep dip is associated with a small, tight, northwest-plunging anticline.
			(1.0)
33.6	277		Wind River Formation crops out on the hill to north of road.
			(1.1)
34.7	277		The ridge in the foreground to the south is capped by Hanna conglomerates that dip to the west. Outcrops along the road are greenish-olive sandstones, sandy siltstones, and some carbonaceous shales of the Hanna Formation.
			(1.1)
35.8	275.37		Greenish Hanna Formation crops out in road cuts for the next two miles.
			(2.7)
38.5	272		Arlington exit from Interstate 80. Gravel pits on south side of road are in Pleistocene gravels derived from glaciers that originated from the upper Rock Creek Valley. Turn left to Arlington and immediately turn right on gravel road after passing under Interstate 80 overpass. Proceed about two miles west on gravel road that parallels the interstate. Make a U-turn here and stop. Arlington was founded in 1860 as Rockdale at the crossing of Rock Creek on the Overland

Figure 21: Looking east at the Arlington thrust fault from west of Arlington. The north end of the Medicine Bow Mountains (to right) is thrust northward over Cretaceous and Tertiary rocks. Th, Tertiary Hanna Formation; Ku, Cretaceous rocks, undivided; pC, Precambrian rocks. (Photo by R.W.J.)

Figure 22: The Rock River oil field as seen from Highway 13 (view looking north). (Photo by W.D.H.)

Cum. Mileage	Highway Marker	(Interval) Description
		Trail. The name was changed to Arlington when the Post Office was established. The steep slopes to the south are crystalline Precambrian rocks forming the hanging wall of the Arlington thrust fault (Figure 21). The fault trace is located near the base of the slope. Proceed back two miles to the Interstate 80 overpass, and continue northward on to Highway 13.

ARLINGTON TO ROCK RIVER (STATE HIGHWAY 13)

Cum. Mileage	Highway Marker	(Interval) Description
0.0	None	Mileage begins at junction of Interstate 80 (Arlington exit) and State Highway 13. Head north on Highway 13 along Rock Creek valley.
		(0.2)
0.2	17	As exposed in the ridge to the left, the Hanna Formation dips to the northeast along the southwest flank of the Arlington syncline. In the next 2½ miles, the route passes across the axis of a north-trending splay of the Arlington syncline and onto the southwest-dipping flank of the Rock River anticline. The Hanna Formation in this syncline has been truncated and is unconformably overlain by gently dipping, variegated claystones and sandstones of the Wind River Formation.
		(0.1)
0.3	17	Scar of Kansas-Nebraska Trailblazer pipeline.
		(0.2)
0.5	17	Colorado Interstate Gas Company (CIG) pipeline scar.
		(1.0)
1.5	16	Approximate axis of syncline. Rocks in the Hanna Formation are now dipping to the southwest. The Wind River Formation is exposed near the top of the steep slope to the left above the landslide debris. The Arlington Pediment forms the gently sloping, gravel-capped surface overlying the Wind River Formation. This surface is traceable northeastward for more than 15 miles.
		(0.8)
2.3	15	In the distance at 10 o'clock, the

Cum. Mileage	Highway Marker	(Interval)	Description
			westward dipping Pine Ridge Sandstone of the Mesaverde Group (tree-covered) crops out. West of this exposure are outcrops of Lewis Shale (2,500 feet thick) and Hanna Formation; these rocks are truncated by flat-lying Wind River Formation (with tree-covered landslide debris near its base); finally, the Wind River Formation is capped by Arlington Pediment gravels (on the skyline). The Hanna Formation in this area was previously mapped by the U.S. Geological Survey as Dutton Creek Formation. This name was formally abandoned in 1970 when it was shown that the Dutton Creek was a coarse-grained facies of the Late Paleocene part of the Hanna Formation.
			(0.9)
3.2	14.05		Rock Creek bridge.
			(2.0)
5.2	12		Terrace of Rock Creek overlooking Rock River oil field. This is the largest oil field in the Laramie Basin (Figure 22). The major structure of the field is a north- to northwest-trending asymmetric anticline: the east flank of the anticline dips into the basin at angles up to 70°; the west flank (defined by the tree-covered Pine Ridge Sandstone) dips between 20° and 35°. The Rock River Formation of the Mesaverde Group crops out to the east of the Pine Ridge and is about 1,700 feet thick. A sandstone in the Steele Shale is exposed in the center of the anticline. The field was discovered by surface geologic mapping in 1918. Production is from the Frontier Formation, Muddy and "Dakota" sandstones, and Sundance Formation at depths from 1,750 to 3,600 feet.
			(0.7)
5.9	12		McFadden (Figure 23). Company town named after "Uncle" Joe McFadden, a very colorful early production manager for the Ohio Oil Company.
			(0.4)
6.3	11		Directly to the north, a north-northeast-trending anticline occurs off the eastern flank of the Rock Creek structure. The Diamond Ranch oil field and the Diamond Dome gas field occur on this anticline. To the northwest along the valley of Rock Creek is a shallow, east-northeast-trending anticline

Figure 23: The town of McFadden (view looking west). (Photo by R.W.J.)

Figure 24: Pine Ridge Sandstone of the Mesaverde Group exposed along Union Pacific Railroad east of Rock River. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval) Description
		whose axis extends from this point to the town of Rock River. The Pine Ridge Sandstone is well exposed along the southern flank of this anticline and extends some distance to the east.
		(1.8)
8.1	10	Gravel road to right leads to Diamond Lake (Bosler Reservoir) public fishing area. Continue east on paved road.
		(1.1)
9.2	8.04	Albany-Carbon county line. About two miles to the south, rocks of the Medicine Bow and Hanna Formations dip to the southeast into the Cooper Lake Basin. Several coal beds occur in the Medicine Bow (formerly mapped as the Foote Creek) Formation; the beds are lenticular and intertongue with carbonaceous shales and siltstones. The thickest coal bed is up to 15 feet thick at the Fry mine; at the Terry mine, this bed was mined for local use as late as 1966. The as-received heat value of these coals, based on two samples, is 8,890 to 9,590 Btu/pound; the coals are reportedly subbituminous in rank.
		(1.3)
10.5	7	Driving over terrace gravels covering Lewis Shale along the north flank of Cooper Lake Basin. Southward-dipping Pine Ridge Sandstone exposures lie straight ahead.
		(3.8)
14.3	3	Approximate contact between the Lewis Shale and Mesaverde Group. Lenticular coal beds, from 1.5 to 3.5 feet thick, occur in the Pine Ridge Sandstone, and have periodically been mined or prospected at various locations along the outcrop for eight or ten miles.
		(0.5)
14.8	3	Rock Creek bridge. Road is on Steele Shale from here to Rock River.
		(0.8)
15.6	2	Pine Ridge Sandstone exposures to the south along the Union Pacific main line (Figure 24). The type section of the Upper Cretaceous Rock River Formation, which lies stratigraphically below the Pine Ridge, was measured about 2.5 miles southeast of Rock River. The Rock River Formation is equivalent in part to the Parkman Sandstone in the Powder

Cum. Mileage	Highway Marker	(Interval)	Description
			River Basin, the Iles Formation of Colorado, and the Allen Ridge Formation to the west in the Hanna Basin. It interfingers with the marine Pierre Shale to the east and the nonmarine Allen Ridge to the west.
		(2.0)	
17.6	0		Junction of Highway 13 and U.S. 30/287. Turn north on U.S. 30/287.

ROCK RIVER TO SINCLAIR (U.S. HIGHWAY 30/287)

Cum. Mileage	Highway Marker	(Interval)	Description
0.0	None		Mileage begins at junction of Highway 13 and U.S. Highway 30/287.
		(0.9)	
0.9	288		Site of Fort Halleck-Fort Laramie Trail (monument on right side). Fort Halleck was established at the north foot of Elk Mountain in 1862, and was a strategic post on the Overland Stage route. Highway is on the Steele Shale, but outcrops are uncommon.
		(2.1)	
3.0	286		Panoramic view of the Laramie Range. Laramie Peak, on the skyline to the north-northeast (Figure 25), is the highest point in the Laramie Range (10,270 feet). The peak is formed of Archean granite (2.5 to 2.6 billion years old). Laramie Peak was a well-known landmark for westbound travelers on the Oregon Trail. Mark Twain writes in his book, **Roughing It:** *"We passed Fort Laramie in the night, and on the seventh morning out, we found ourselves in the Black Hills"* [many early authors and travelers mistakenly referred to the Laramie Range as the Black Hills] *"with Laramie Peak at our elbow (apparently) looming vast and solitary — a deep, dark, rich indigo blue in hue, so portentously did the old colossus frown under his beetling brows of storm cloud. He was thirty or forty miles away, in reality, but he only seemed removed a little beyond the low ridge at our right."*
		(4.2)	
7.2	282		Road crosses abandoned Union Pacific Railroad grade.

Figure 25: Telephoto view of Laramie Peak, in the distance, from the valley of Rock Creek. (Photo by R.W.J.)

Figure 26: Wall Creek Sandstone Member of Frontier Formation forms hogback at top of railroad cut. Note experimental wind turbines near horizon in center and right hand part of photograph. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval)	Description
		(1.6)	
8.8	280		On the east side of highway are outcrops of south-dipping, white, argillaceous limestones in the Niobrara Formation.
		(0.6)	
9.4	280		Dark shale outcrops of the Frontier Formation on east side of road. A complete section of Lower Cretaceous rocks, including Cloverly, Thermopolis, and Mowry Formations, is exposed on the south flank of Como Bluff anticline to the north. Road lies on Frontier Formation for the next three to four miles.
		(0.4)	
9.8	279		Wall Creek Sandstone Member of the Frontier Formation exposed along the west side of the highway. This sandstone forms the prominent hogback south of the highway. Road parallels southward-dipping rocks on the flank of Como Bluff anticline (Figure 26).
		(0.2)	
10.0	278.98		Dinosaur bone cabin on north side of highway, Albany/Carbon county line (Figure 27). This cabin was constructed entirely of fossil dinosaur bones collected from the Morrison Formation. Evidently, a hillside in the Morrison some distance to the north of Como Bluff was so covered with the fossil bones that a sheepherder had used them for building stones. Rumor has it that the level of radioactivity (from these bones) inside the cabin is so high that even beginning geology students are no longer allowed inside! Measured radioactivity around the bone cabin is actually between ten and twenty times the local background radioactivity.
		(1.5)	
11.5	278		Como Bluff. For the last several miles, the road has paralleled Como Bluff, the ridge north of the highway. The top of the ridge is capped by conglomeratic sandstones of the Cloverly Formation, which forms a south-dipping hogback. Lower Cretaceous rocks (including Thermopolis Shale, Muddy Sandstone, and Mowry Shale) stratigraphically above the Cloverly are well exposed at the base of the slope. The highway is built in a strike valley of Upper Cretaceous Frontier Formation.

Cum. Mileage	Highway Marker	(Interval)	Description
			Stratigraphically below the Cloverly on the north side of Como Ridge are varicolored shales of the Morrison Formation (Figure 28). The fossiliferous (marine) Sundance Formation underlies the Morrison. Triassic red beds occupy the axial part of the anticline. Dinosaur bones were discovered in the Morrison Formation in 1877, and collecting continued under the supervision of O.C. Marsh until 1883. Sporadic collecting continued by others until 1903. Many of the specimens are presently displayed in the Peabody Museum at Yale University, the National Museum of the Smithsonian Institution in Washington, D.C., and the American Museum of Natural History in New York. Presently, there are no bones or bone fragments left in the old abandoned quarries.
		(0.2)	
11.7	278		The Wall Creek Sandstone Member of the Frontier Formation is exposed in the railroad cut to the west (see Figure 26). The highway crosses the southwest-plunging axis of the Como Bluff anticline. The nose of this structure is well defined by grey shales of the Mowry along the north side of the road.
		(2.6)	
14.3	274.6		Medicine Bow River. Road is on Steele Shale for the next seven miles. The large, flat-topped hill about eight miles to the north is composed of Casper Formation in the core of Flat Top anticline.
		(2.8)	
17.1	272		Town of Medicine Bow. The Virginian Hotel on the north side of the highway was so named because Medicine Bow was the scene of parts of Owen Wister's novel, **The Virginian.**
		(0.2)	
17.3	272		Intersection of U.S. Highway 30/287 and U.S. Highway 77/487 north to Casper. Continue westward on U.S. Highway 30/287 toward Hanna.
		(0.6)	
17.9	271		The U.S. Bureau of Reclamation's experimental wind generators are located to the south (see Figure 26). These two turbine generators stand nearly 400 feet above the ground and have designed capaci-

Figure 27: Dinosaur bone cabin at Como Bluff. (Photo by R.W.J.)

Figure 28: Eastward view of Como Bluff anticline from near U.S. Highway 30. The high ridge on the skyline is composed of Morrison and Cloverly Formations exposed on the gently dipping south limb of the anticline. Steeply dipping rocks of the Cloverly, Thermopolis, Mowry, and Frontier Formations are exposed on the northwest limb of the anticline in the low hills in the foreground. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval) Description
		ties of 2.5 and 4.0 megawatts, respectively (enough power to meet the energy needs of about 3,000 homes).
		(2.0)
19.9	268.74	The abandoned Allen Lake gas field is located to the north of the highway. Gas was produced from the Muddy and "Dakota" sandstones and the Sundance and Casper Formations at 1,735 to 4,362 feet. The center of the anticline contains outcrops of Niobrara Formation. Southeast about four miles is a similar structure along the same trend, the East Allen Lake dome, which produces oil and gas from the Tensleep at about 3,930 feet.
		(1.2)
21.1	268	Small bentonite pits and prospects in the Steele Shale on north side of the road trend northwesterly and can be found both north and south of the highway.
		(0.5)
21.6	268	Transition zone between the Steele Shale and lower Mesaverde. The type area for the Allen Ridge Formation of the Mesaverde Group is located about three miles to the north.
		(1.6)
23.2	266	Pine Ridge Sandstone is exposed in road cuts to north and south. Note thin coal beds.
		(0.4)
23.6	265	Contact between Mesaverde Group and Lewis Shale. The contact is somewhat arbitrary, in that the uppermost unit of the Mesaverde Group, the Almond Formation, is transitional between the fluvial environment of the underlying Pine Ridge Sandstone and the overlying marine Lewis Shale.
		(1.0)
24.6	264	Approximate contact between Lewis Shale and Medicine Bow Formations. Like the Mesaverde-Lewis contact described above, the contact between the marine Lewis and the basal marine and brackish part of the Medicine Bow is arbitrary because of the transitional nature of the contact. North of the highway, these rocks dip steeply into the Hanna Basin; south of the highway they dip less steeply into the Carbon Basin.
		(0.6)

Cum. Mileage	Highway Marker	(Interval)	Description
25.2	264		Approximate contact between Medicine Bow and Ferris Formations. Como Lake to south of road.
		(0.6)	
25.8	263		Crossing northernmost plunge of Simpson Ridge (or Saddleback Hills) anticline. Tree-covered hill on the skyline to the south is the Mesaverde Group on Simpson Ridge. Thin uppermost sandstones on the ridge exhibit oil staining on both flanks of the structure. The Simpson Ridge Field produced about 238,000 barrels of oil from the Quealy Sandstone, which is a transition sand between the Steele Shale and the Mesaverde, at about 660 feet depth. Reserves are depleted. The anticline has only been tested to the Frontier.
		(1.1)	
26.9	263		The gravel road to south of highway leads to the old coal mining town of Carbon, four miles south. The first commercial mining of coal in Wyoming began in Carbon, which was on the Union Pacific Railroad line in 1868. Twenty years later the Union Pacific Railroad moved its line north of Carbon to its present location near Hanna.
		(2.2)	
29.1	260		Rosebud Coal Sales Company draglines can be seen to the north and northwest. For the next 8.7 miles, the route traverses the southern part of the Hanna Basin, progressing up section through the Hanna Formation. Rosebud is mining several coal beds in the Hanna Formation. Although Hanna Formation coals are up to 35 feet thick, most currently mined coals in the area are less than 20 feet thick. The mine has produced up to 4.2 million tons in one year.
		(0.6)	
29.7	259		Approximate contact between Ferris and Hanna Formations. This contact is somewhat arbitrary and difficult to define in this part of the Hanna Basin.
		(5.7)	
35.4	252		Approximate axis of the Hanna syncline. This shallow, northeast-trending syncline is defined by coal beds in the Hanna Formation (Figure 29). The syncline is broken by numerous northwest-trending normal faults that are perpendicular to the synclinal axis.

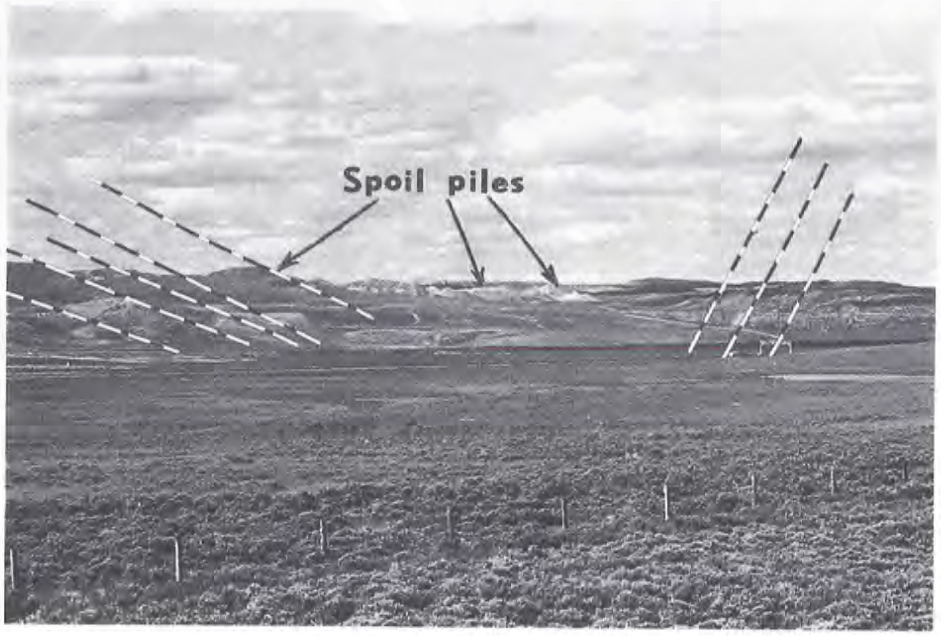


Figure 29: The Hanna syncline. View to northeast from intersection of U.S. Highway 30/287 and State Route 72. Spoil piles on the horizon are from Rosebud Coal Sales Company's active strip mines. Dashed lines show approximate dip of bedding. (Photo by R.W.J.)

Figure 30: Elk Mountain as viewed west from Como Bluff. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval) Description
		The Hanna No. 1 coal bed is stratigraphically the highest coal bed in the Hanna syncline (but not the highest coal bed in the Hanna Basin), and this coal bed may mark the contact between Paleocene and Eocene epochs within the Hanna Formation.
		(1.0)
36.4	252.77	Intersection. Town of Hanna to north, State Route 72 to Elk Mountain interchange on Interstate 80 to south. Continue westward on U.S. Highway 30/287. Prior to January 1, 1983, about 231 million tons of coal had been extracted from the Hanna coal field by underground or strip mining. Currently, three companies operate mines within the basin. Up until 1979, the U.S. Department of Energy operated an experimental *in situ* coal gasification project in the Hanna No. 1 coal bed south of Hanna.
		Although the Almond, Medicine Bow, Ferris, and Hanna Formations host minable coal beds, the thicker and more persistent coal beds occur in the Ferris and Hanna. The rank of the coals varies from subbituminous A to high volatile C bituminous.
		(0.3)
36.7	252.77	Gravel road to left leads to U.S. Department of Energy's abandoned coal gasification site located on the hill to the south.
		(2.8)
39.5	250	Crest of hill; thin coal beds in Hanna Formation are exposed on north side of road.
		(1.0)
40.5	249	Approximate contact between Hanna and Ferris Formations.
		(1.0)
41.5	248	Resource Exploration and Mining Inc.'s former coal strip pits to the north of the road. Production from Bed No. 65 in the Ferris Formation was several hundred thousand tons per year.
		(0.6)
42.1	247	Road to north leads to the Medicine Bow and Seminoe No. 1 mines, which suspended mining (at least temporarily) in 1983. Production was from coal beds in the Ferris Formation in the western and southwestern part of the

Cum. Mileage	Highway Marker	(Interval)	Description
			Hanna Basin. These coals were 3 feet to 25 feet thick. Each mine had a capacity of 3 million tons per year.
		(0.4)	
42.5	246.7		Crossing Saint Mary's ditch. For the next 5.5 miles, the road will be on light-colored tuffaceous rocks that have been mapped as either Pliocene and Miocene (Love, et al., 1955) or as Miocene (Love and Christiansen, 1983). Because no datable fossils have been found in this rock unit, its age is not known and its correlation with the North Park or Browns Park Formations into the Saratoga valley to the south has not been established.
		(1.0)	
43.5	246		To the southwest about four miles is Dana Ridge, a northwest-southeast-trending ridge formed by Pass Creek anticline. The surface expression of this anticline is controlled by thrusting from the north to northeast while the structure, at depth, is probably controlled by compression from the south to southwest. Whether or not this structure and a similar structure to the northwest (Saint Mary's anticline) are controlled by the basement is subject to debate.
			Elk Mountain (11,160 feet) is visible along skyline to the south. Sheephead Mountain is to the right (west) and below Elk Mountain. Elk Mountain is a large asymmetrical anticline with Precambrian rocks exposed in its core. Steep dips and faulting occur on the southeast and northeast limbs; the western and northwestern limbs are gently dipping. The planar erosion surface on top of the Precambrian (Paleozoic rocks have been stripped off) is well preserved on the upper slopes of the mountain; this surface is especially prominent when the mountain is viewed in profile from the east or west (Figure 30). Sheephead Mountain is an asymmetrical, north-plunging anticline that also contains Precambrian rocks in its core; Paleozoic rocks dip steeply on its flanks.
		(2.5)	
46.0	244		About 2.5 miles to the north is the abandoned Dana railroad station. In 1934, an ex-convict attempted to hold up the Portland Rose train in the Dana area.

Figure 31: Faulting in sandstones within the Lewis Shale on northeast flank of the Walcott syncline. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval)	Description
			He derailed the engine, a baggage car, and one coach — then hastily retreated. The coach was full of U.S. Marines!
		(1.0)	
47.0	243		Crest of hill.
		(1.2)	
48.2	242		Approximate contact between Miocene rocks (Love and Christiansen, 1983) and Lewis Shale.
		(0.2)	
48.4	241		Road cut. Note the numerous tensional faults in sandstones within the Lewis Shale (Figure 31).
		(0.4)	
48.8	241		Road crosses the approximate axis of the west-northwest-trending Pass Creek anticline. The core of the anticline exposed here is composed of sandstones in the upper part of the Mesaverde Group.
		(0.4)	
49.2	241		Coyote Springs. Driving across overturned Lewis Shale on the northeast flank of the Walcott syncline.
		(1.0)	
50.2	239		Contact between Lewis Shale and overturned Medicine Bow Formation. The Walcott syncline contains Medicine Bow Formation in its core and trends northwest-southeast parallel to the Pass Creek and Saint Mary's anticlines.
		(0.9)	
51.1	238		Approximate location of angular unconformity between the Late Cretaceous Medicine Bow and the Miocene Browns Park (Love and Christiansen, 1983) Formations. The northeast-dipping rocks on the southwest flank of the Walcott syncline are covered by the soft, white, tuffaceous sandstones of the Brown's Park Formation here and to the southeast. The hills located 2.5 miles to the northwest on the crest of Saint Mary's anticline are composed of rocks in the Mesaverde Group. This northwest-southeast-trending anticline is controlled by a 40°- to 50°-northeast-dipping thrust fault.
			Large-scale normal faulting is present on the northeast flank of the structure. Saint Mary's Hill, the highest point on this feature, is 7,496 feet in elevation. The Saint Mary's structure was tested to the Madison Limestone at 15,553 feet depth by Amoco Production Company in 1974. The well was abandoned.
		(1.5)	
52.6	237		Cross Union Pacific Railroad tracks. Travel on Browns Park Formation. The Medicine Bow and Mesaverde Formations and the Lewis Shale are covered by Browns Park to the south and west.
		(0.6)	
53.2	236		Former Walcott Junction station on the right.
		(0.6)	
53.8	—		Entrance to Interstate 80. Turn west onto Interstate 80.
		(0.9)	
54.7	234		Approximate contact of Browns Park Formation and Steele Shale. Road parallels the axis of east-plunging Fort Steele anticline.
		(1.2)	
55.9	233		Patterned ground on right (north) in borrow ditch is developed in Steele Shale. These are silt-filled fossil ice wedges developed during periods of colder climate.
		(4.1)	
60.0	229.03		Bridge over North Platte River. Hills to north are composed of northeast-dipping rocks of the Mesaverde Group. Low hills to the south are south-dipping sandstones that form the transition from Steele Shale to the Mesaverde Group.
		(0.5)	
60.5	228.34		Exit to Fort Steele. The fort was an active army post from 1868 to 1886. Although that part of the state geologic map shown on Plate I (Love, and others, 1955) shows Fort Steele on the Cody Shale, Fort Steele is the type locality for the Steele Shale; the proper terminology is Steele, not

Cum. Mileage	Highway Marker	(Interval) Description
		Cody Shale.
		(1.5)
62.0	227	The low-lying hills to the southwest (trending east-west) are formed of Frontier sandstones which rim the Grenville Dome. The Lower Cretaceous Thermopolis and Mowry Shales crop out in the core of this anticline. The Grenville Dome was tested to the Cambrian at 3,327 feet with practically no oil shows. In the foreground is a Colorado Interstate Gas Company compression station.
		(4.7)
66.7	None	Exit to Sinclair. The Sinclair refinery has a capacity of 49,000 barrels per day. The Rawlins uplift is visible on the skyline to the west.
		(2.3)
69.0	None	The Parco Inn located on north side of road. The town of Sinclair was formerly named Parco for Producers and Refiners Corporation. The town was originally the Grenville railroad station until the refinery was built in the 1920's. This area received a lot of attention around 1871 and 1872 because of the great diamond hoax which occurred in the southern Green River Basin. Some of the field parties investigating the dia-

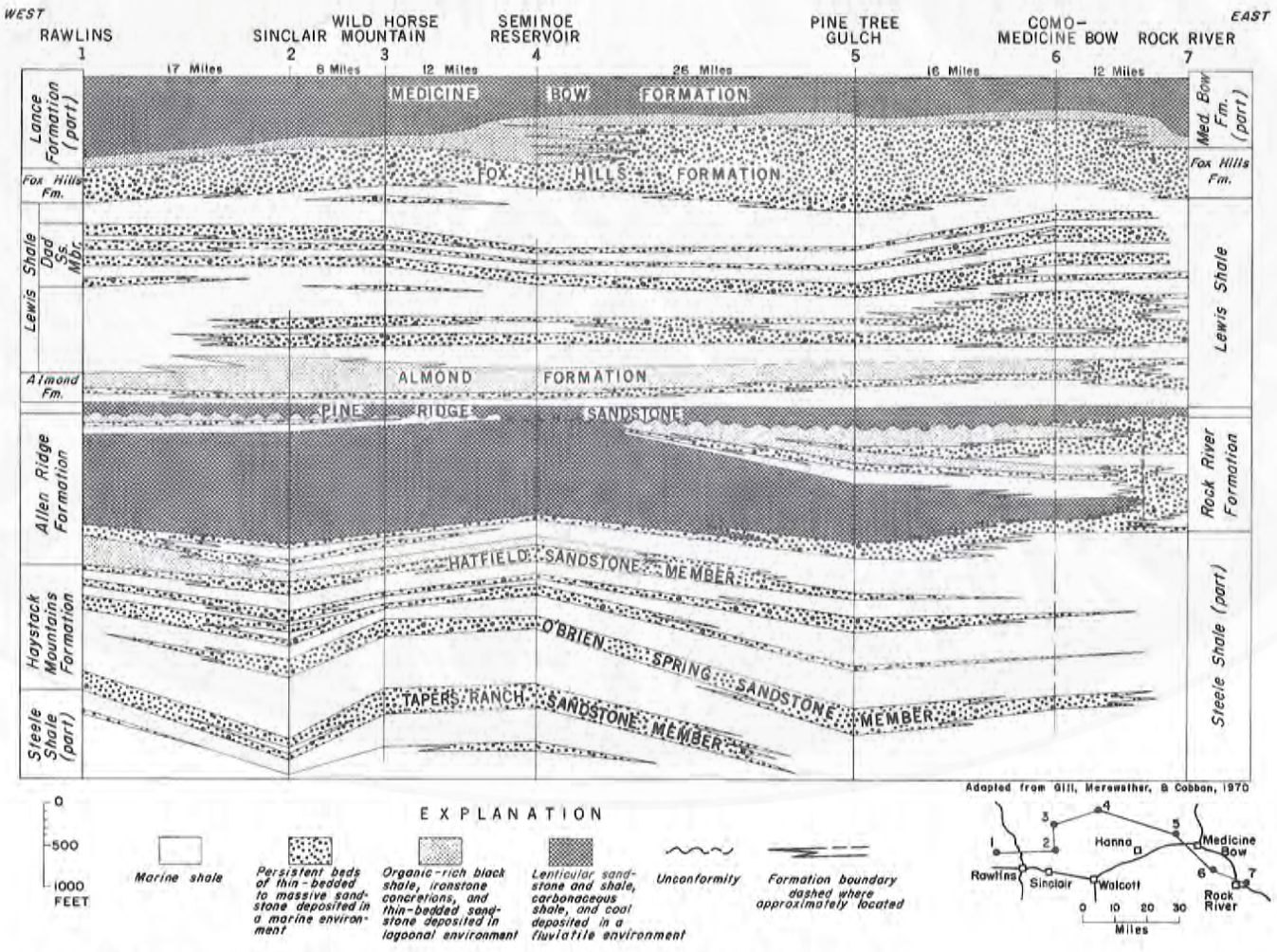


Figure 32: Stratigraphic diagram of Upper Cretaceous rocks in southcentral Wyoming.

Cum. Mileage	Highway Marker	(Interval)	Description
			mond hoax originated at Grenville station (L.S. Hilpert, personal communication, 1983).
		(0.3)	
69.3	None		Turn north on Seminoe State Park road at Deb's Bar.

SINCLAIR TO SEMINOE DAM (SEMINOE STATE PARK ROAD)

Cum. Mileage	(Interval)	(Description)
0.0		Mileage starts at junction of Seminoe State Park road and U.S. Highway 30/287.
	(0.4)	
0.4		Cattle guard on north side of Sinclair townsite.
	(2.6)	
3.0		Haystack Mountain syncline visible to north.
	(0.8)	
3.8		Road curves to the right. To the west, sandstones in the Cloverly Formation form the dipslope on the skyline. The lower, light-colored ridges are formed by the Frontier Formation.
	(0.6)	
4.4		Road crosses the Northern Gas Company high-pressure pipeline. To the northwest is a prominent Mesaverde sandstone ridge which forms part of a northeast-plunging syncline.
	(1.1)	
5.5		Stabilized dunes on either side of road.
	(0.3)	
5.8		Crossing structural axis of a broad structural nose that plunges eastward off the Rawlins uplift. The dipslope, to the west on this feature, is formed by the Cloverly Formation. Presently, the road is built on the Steele Shale.
	(1.2)	
7.0		Crossing ridge held up by sandstone in the Steele Shale.
	(0.2)	
7.2		Road turns sharply to the right. To the left, the basal Tapers Ranch Sandstone Member of the Haystack Mountains Formation (Mesaverde Group) forms the prominent ridge. The road follows the North Platte River as it cuts progressively younger rocks of the Mesaverde Group (see Figure 32 for stratigraphic relationships and nomenclature in this area).
	(0.8)	
8.0		Contact between Steele Shale and Haystack Mountains Formation at base of hogback (Figure 33). The Haystack Mountains Formation is about 2,500 feet thick and consists of an alternating sequence of yellowish-grey, fine-grained marine sandstones up to 275 feet thick (designated as Tapers Ranch, O'Brien Springs, and Hatfield Sandstone Members) and grey marine shales in units from 25 to 700 feet thick.
	(0.6)	
8.6		Approximate contact of Haystack Mountains Formation with the overlying Allen Ridge Formation. The Allen Ridge Formation is about 1,500 feet of brown and rusty brown shales and sandstone that usually form high ridges around the margins of the basins. The Allen Ridge in this area is characterized by a 125-foot-thick lower unit of black shale, ironstone, and sandstone deposited in a lagoonal environment, a middle unit of alternating marine shales and sandstones 300 feet thick, and an upper unit of fluvial sandstone, shale, and coal over 1,000 feet thick.
	(0.5)	
9.1		Allen Ridge–Pine Ridge contact straight ahead in the sandstone cliff on the far side of the North Platte River (Figure 34). Note the large cross-bedded channel sand a little more than halfway up the cliff. This channel is in the lower part of the Pine Ridge Sandstone, and the contact lies at its base.

Cum. Mileage	Highway Marker	(Interval)	Description
		(1.3)	
10.4			Allen Ridge–Pine Ridge contact. The Pine Ridge Sandstone is from 100 to 200 feet thick and is composed of white to light-grey, nonmarine sandstone, carbonaceous shale, and impure coal. It usually crops out as a distinctive, tree-covered unit that often forms a pronounced topographic ridge.
		(0.2)	
10.6			Approximate contact between the Pine Ridge Sandstone and Almond Formation. The Almond is about 450 feet thick in this area and consists of a 140-foot-thick lower unit of nonmarine sandstones, shales, and coal beds, and a 390-foot-thick upper unit of shallow marine sands and shales, thin coal beds, and brackish water shales. This formation grades upward into marine shale of the Lewis Shale.
		(0.2)	
10.8			Cattle guard. Note the small fold in the Mesaverde across the river to the north-northeast.
		(0.3)	
11.1			Contact between Almond Formation and Lewis Shale.
		(0.2)	
11.3			Road crosses dry creek. Sandstones in the Lewis Shale are exposed on both sides of the road.
		(0.3)	
11.6			Cattle guard.
		(0.6)	
12.2			Crossing a west-northwest-trending synclinal axis developed in the Lewis Shale. This synclinal axis separates the Haystack – Cedar Ridge anticlinal trend northeast of the axis from the Fort Steele anticlinal trend southwest of the axis. The Walcott syncline to the southeast may be related to this syncline.
		(1.1)	
13.3			To the northwest (10 o'clock), the Lewis Shale forms the valley. A high angle reverse fault follows the base of the Mesaverde ridge (11 o'clock). The fault is downthrown about 500 feet on the southwest side. To the southeast (4 o'clock), the Cedar Ridge anticline (in the distance) is formed in the Mesaverde. This structure is downfaulted to the northeast.
		(0.6)	
13.9			Lewis-Mesaverde contact located

Figure 33: Contact between the Steele Shale and Haystack Mountains Formation along the Seminoe State Park road. Steele Shale exposed in valley; Haystack Mountains Formation forms distinctive ridges. (Photo by R.W.J.)

Figure 34: Contact between Allen Ridge Formation and Pine Ridge Sandstone (at top of hill) is defined by sandstones filling large channels cut into Allen Ridge Formation. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval)	Description
			in the ridge on left. The road is constructed on Lewis Shale.
		(0.1)	
14.0			View to the northwest (10 o'clock) is looking up the plunge of the Haystack anticline, a structure that has about 150 feet of closure in the surface Mesaverde beds. This structure is complicated by several high-angle faults. Dry holes have been drilled on this structure.
		(1.5)	
15.5			Approximate Lewis-Mesaverde contact. Lewis Shale is on the east side of the road.
		(1.5)	
17.0			Crossing Lewis Shale - Fox Hills Sandstone contact. The Fox Hills was formerly mapped as the basal few hundred feet of marine sandstones and shales of the Medicine Bow Formation. However, because it contains a distinctive lithology (shallow marine, barrier bar, and beach deposits) that is transitional between the predominately marine Lewis Shale below and the predominately fresh (fluvial) and brackish-water (lagoonal) Medicine Bow above, the Fox Hills is mappable as a separate unit.
			The Fox Hills - Medicine Bow contact occurs several hundred feet past this point. Note typical brown sandstones of the Medicine Bow Formation.
		(0.6)	
17.6			Cattle guard. Driving on Medicine Bow Formation, named for exposures along the North Platte River near the mouth of the Medicine Bow River (now on the east side of Seminoe Reservoir). The formation is over 6,000 feet thick and is composed of Upper Cretaceous continental rocks, including fluvial sandstones, shales, siltstones, and persistent coal beds near the base of the formation.
		(0.4)	
18.0			Corral Canyon and other economic coal deposits occur in the Almond Formation (uppermost Mesaverde) that crops out in the hills to the west.
		(2.5)	
20.5			Crossing axis of east-plunging syncline between O'Brien Springs anticline to the north and Haystack anticline to the west. The high peak on the skyline to the northwest (Figure 35) is Bradley

Cum. Mileage	Highway Marker	(Interval)	Description
			Peak and forms a portion of the Seminoe Mountains greenstone belt. Bradley Peak consists of Archean metavolcanics, ultramafics (including spinifex komatiites) and oxide facies iron formations that have been intruded by a granodiorite and at least two generations of metagabbro. Of economic interest are auriferous quartz vein deposits and iron formations associated with silicification, chloritization, and carbonatization in the historic Penn mine area on the east flank of Bradley Peak (see Hausel, 1981, and Hausel and Harris, 1983). Iron formations in the Bradley Peak area form a 50- to 100-million-ton iron ore resource. Both the iron formation and quartz veins at Bradley Peak are limited at depth by the Bradley Peak (Seminoe Mountain) thrust. The Archean rocks of Bradley Peak form the hanging wall of the thrust, which overlies Cretaceous sedimentary rocks.
			(2.1)
22.6			Cattle guard.
			(0.8)
23.4			Cross creek draining into Seminoe Reservoir. The reservoir is visible to the northeast. The steeply dipping beds at 1 o'clock are part of the Medicine Bow Formation.
			(0.5)
23.9			Two thin Medicine Bow coal beds are exposed in the road cut on the east side of the road.
			(0.6)
24.5			Sand dunes resting on Cretaceous Lewis Shale.
			(0.3)
24.8			Lewis Shale exposed in the road cut.
			(1.5)
26.3			The road curves sharply to the left. Public boat ramp sign on right. The road crosses the east-west axis of the O'Brien Springs oil field. Production has been from the Tensleep and Nugget Sandstones at 5,400 to 6,900 feet in the eastward-plunging anticline.
			(0.7)
27.0			Dune field (both sides of road) (Figure 36). These dunes are located near the eastern terminus of the Ferris dune field, a large deposit of wind-blown sand that

Figure 35: Bradley Peak (looking north). (Photo by W.D.H.)

Figure 36: Active sand dunes along the road on south side of Seminoe Mountains near Seminoe Reservoir. (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval)	Description
			extends nearly thirty miles to the west. The dune field is composed of a large area of stabilized dunes (covered with sagebrush and other vegetation) and a smaller central area of active dunes (bright yellow color). The source of sand for the dunes was probably Cretaceous and Tertiary sandstones south of the Muddy Gap-Lost Soldier area, the Battle Spring Formation (Eocene) of the northern Red Desert, and the tail of the Killpecker dune field of the central Red Desert.
		(0.5)	
27.5			Medicine Bow Formation coal beds exposed in road cut to left. These beds dip to the south into Camp Creek syncline, which separates the O'Brien Springs anticline on the south from the Seminoe uplift on the north. The lower part of the Medicine Bow Formation forms the center of this syncline, and coal beds up to 12 feet thick dip steeply on both limbs.
		(0.4)	
27.9			Lewis Shale in road cut on the right.
		(0.4)	
28.3			I.D. Ridge. Crest of ridge is formed of south-dipping Pine Ridge Sandstone (exposed in road cut). To the immediate north are active sand dunes. The rocks that form I.D. Ridge continue eastward across Seminoe Reservoir (forming Horseshoe Ridge) for more than 10 miles before they are overridden by Precambrian rocks of the Shirley Mountains.
		(0.3)	
28.6			Cattle guard. Traveling on dune field which lies on a valley underlain by Steele Shale.
		(1.5)	
30.1			Cross under telephone line. Approximate contact of Steele Shale with Niobrara Formation.
		(0.1)	
30.2			Crossing creek valley located in Upper Cretaceous Niobrara shale(?).
		(0.1)	
30.3			The road cuts through a steeply dipping Upper Cretaceous Frontier (Wall Creek Sandstone) hogback.
		(0.3)	
30.6			The light grey shales in the road cut to the north are Lower Cretaceous Mowry Shale. The sand-

Cum. Mileage	Highway Marker	(Interval)	Description
			stone hogback is the Cloverly Formation.
		(0.5)	
31.1			Crossing Cloverly-Thermopolis contact.
		(0.1)	
31.2			Seminoe Park (1 mile) sign on the right. The strike valley is in Morrison Formation. Sandstone ridge to north is formed of Sundance Formation.
		(0.2)	
31.4			Road cut on left exposes Sundance Formation which overlies Chugwater red beds in the valley. Much of the hogback to the north is formed by the Alcova Limestone of the Chugwater Group.
		(0.1)	
31.5			Note the faulted limy bed of the Chugwater Group in the road cut on the right.
		(0.2)	
31.7			Goose Egg Formation (limestone and red shale) overlain by Chugwater in the valley. To the left is the contact between the Goose Egg Formation and the Tensleep Sandstone.
		(0.2)	
31.9			At 3 o'clock, the Alcova Limestone caps the hill. At 9 o'clock, the Tensleep forms the ridge. The road follows the fault trace approximately. The Alcova Limestone on the right is downthrown.
		(0.3)	
32.2			Pipeline passes beneath the road. Road to Seminoe boat launch is on the right.
		(0.4)	
32.6			Tensleep - Goose Egg contact. Permian red beds in the stream valley to the right.
		(0.2)	
32.8			Cattle guard. Driving on Tensleep which dips to the south. Note cross-bedding. A spectacular view of Seminoe Reservoir and the structure on the south flank of the Seminoe Mountains to the east are visible after rounding the curve to the left (Figures 37 and 38).
		(0.3)	
33.1			The massive white rocks of the Madison Limestone contact the red, poorly resistant Amsden Formation.

Figure 37: Seminoe Reservoir and south side of Seminoe Mountains. View to east shows steeply dipping beds of Tensleep Sandstone that form the prominent flatirons in the distance. (Photo by W.D.H.)

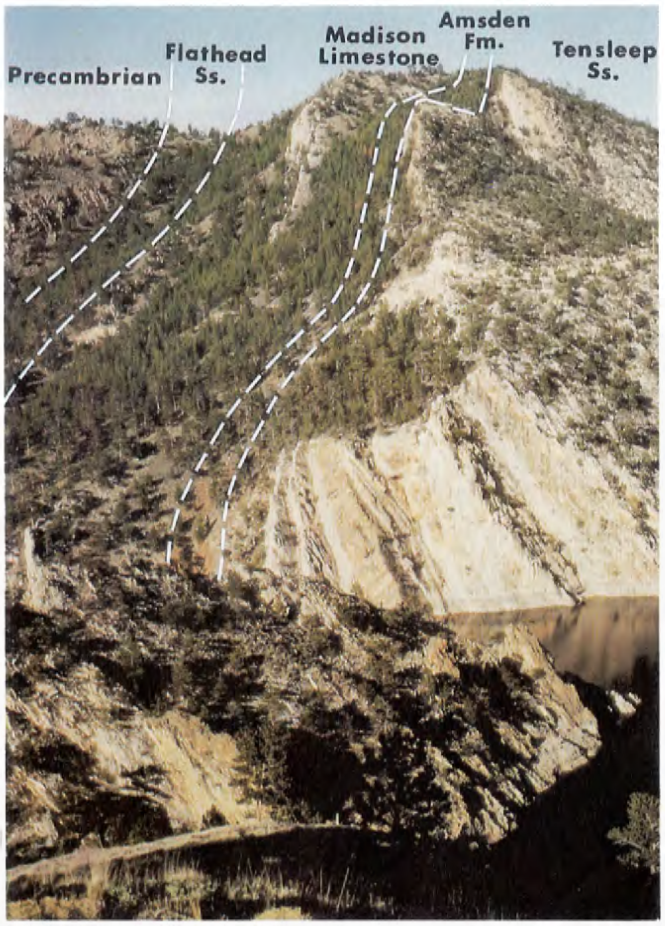


Figure 38: Steeply dipping Paleozoic rocks lie against Precambrian rocks on the south flank of the Seminoe Mountains: Flathead Sandstone (Cambrian), Madison Limestone (Mississippian), Amsden Formation (Pennsylvanian), and Tensleep Sandstone (Pennsylvanian). (Photo by R.W.J.)

Cum. Mileage	Highway Marker	(Interval)	Description
		(0.6)	
33.7			Madison Limestone contact with dark reddish-brown Flathead Sandstone.
		(0.1)	
33.8			Flathead Sandstone contact with the Precambrian. Here, Precambrian crystalline rocks form a sharp contact with the adjacent, unconformably overlying, bedded Flathead Sandstone.
		(0.4)	
34.2			Observation point to the right. The road approximates the fault trace of Precambrian against Tensleep (note faults in Precambrian outcrops, Figure 39).

End of road log.

Figure 39: Faulting in Precambrian rocks near Seminoe Dam overlook. (Photo by W.D.H.)

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