URANIUM-VANADIUM DEPOSITS OF THE HENRY MOUNTAINS, UTAH

by William L. Chenoweth[1]

ABSTRACT

Uranium-vanadium deposits in the Henry Mountains are present in the Salt Wash Member of the Morrison Formation (Jurassic). The majority of the deposits are located in an elongated cluster in eastern Garfield County, Utah, known as the Henry Mountains mineral belt.

The deposits, discovered in 1913, were intermittently mined first for radium, and then for vanadium. Up to 1944, nearly 500 tons of high-grade ore were mined.

During the period 1948 through 1978, some 130 properties in the Henry Mountains had produced 79,500 tons of ore with an average grade of 0.30 percent U_3O_8 and containing 474,500 pounds of uranium oxide (U_3O_8). In addition, vanadium has been recovered from 63,000 tons with an average grade of 1.35 percent V_2O_5 and containing 1,694,100 pounds of vanadium oxide (V_2O_5).

The deposits that have been mined to date are small and oxidized. They consist of uranium and vanadium minerals which impregnate beds of argillaceous and carbonaceous sandstone. Other deposits consist of uranium and vanadium minerals occurring within and (or) forming haloes around fossil logs.

Recent discoveries, in excess of five million pounds uranium oxide, have stimulated exploration in the Henrys and adjacent areas. The known reserves and the favorable geology for undiscovered potential resources are expected to make the Henry Mountains a significant source of uranium in the immediate future.

INTRODUCTION

The Henry Mountains are one of the older uranium-vanadium areas of the Colorado Plateau. Because of the remote location, uranium mining in the Henrys did not reach full capability during the uranium boom of the 1950s. Early mining primarily consisted of removing the higher grade portions of the ore bodies in order to pay for the transportation charges to distant markets. The establishment of a buying station in the area and the discovery of large ore bodies have greatly stimulated recent activity in the region.

This paper is intended to present a brief overview of the geologic setting of the deposits, to review the geologic studies, and to summarize the development of the uranium industry in the area.

GEOLOGIC SETTING

The Salt Wash Member of the Morrison Formation of Jurassic age contains economic deposits of uranium-vanadium in the Henry Mountains region. A large cluster of deposits occurs in eastern Garfield County and is known as the Henry Mountains mineral belt. Scattered deposits are present in the western part of the Henry Mountains, principally in Wayne County (Fig. 1).

In the Henry Mountains, the Salt Wash Member of the Morrison Formation consists of fluvial and lacustrine deposits of slightly feldspathic, quartzose sandstone with interbedded lenses of red, green, and gray mudstone and siltstone. The sandstone beds are thin-bedded to massive, but medium to thick beds are dominant. Lenses of poorly sorted quartz, chert, and mudstone pebble conglomerate occur in the sandstone. The sandstone is white to light gray to buff in color and varies from fine- to very coarse-grained with sorting well to poor. Calcium carbonate is the common cement with silica present in lesser amounts. The stratigraphic and sedimentologic framework of the Salt Wash Member in the Henry Mountains is described by Fred Peterson elsewhere in this guidebook.

The deposits which have been mined to date have been small and oxidized. Grundy (1965, written communication) determined that 80 tons of ore was the mean size of the Henry Mountains deposits. The small size of the deposits is clearly evident by the extent of the mine workings mapped by Doelling (1967). Very little has been published on the mineralogy of the ore deposits. The following mineral identifications are from Grundy and Kastelic (1956, p. 5). Tyuyamunite is the principal uranium mineral. Carnotite and autunite also have been identified. Vanadium minerals identified include metahewettite and corvusite. An unidentified vanadium mineral is present in dark gray clay in many of the ore deposits. Commonly associated with the ore are pyrite, limonite, jarosite, and gypsum. The uranium to vanadium ratio of the ores produced during the Atomic Energy Commission (AEC) purchase program was 1:4.

[1]Staff Geologist, U.S. Department of Energy, P.O. Box 2567, Grand Junction, Colorado 81502.

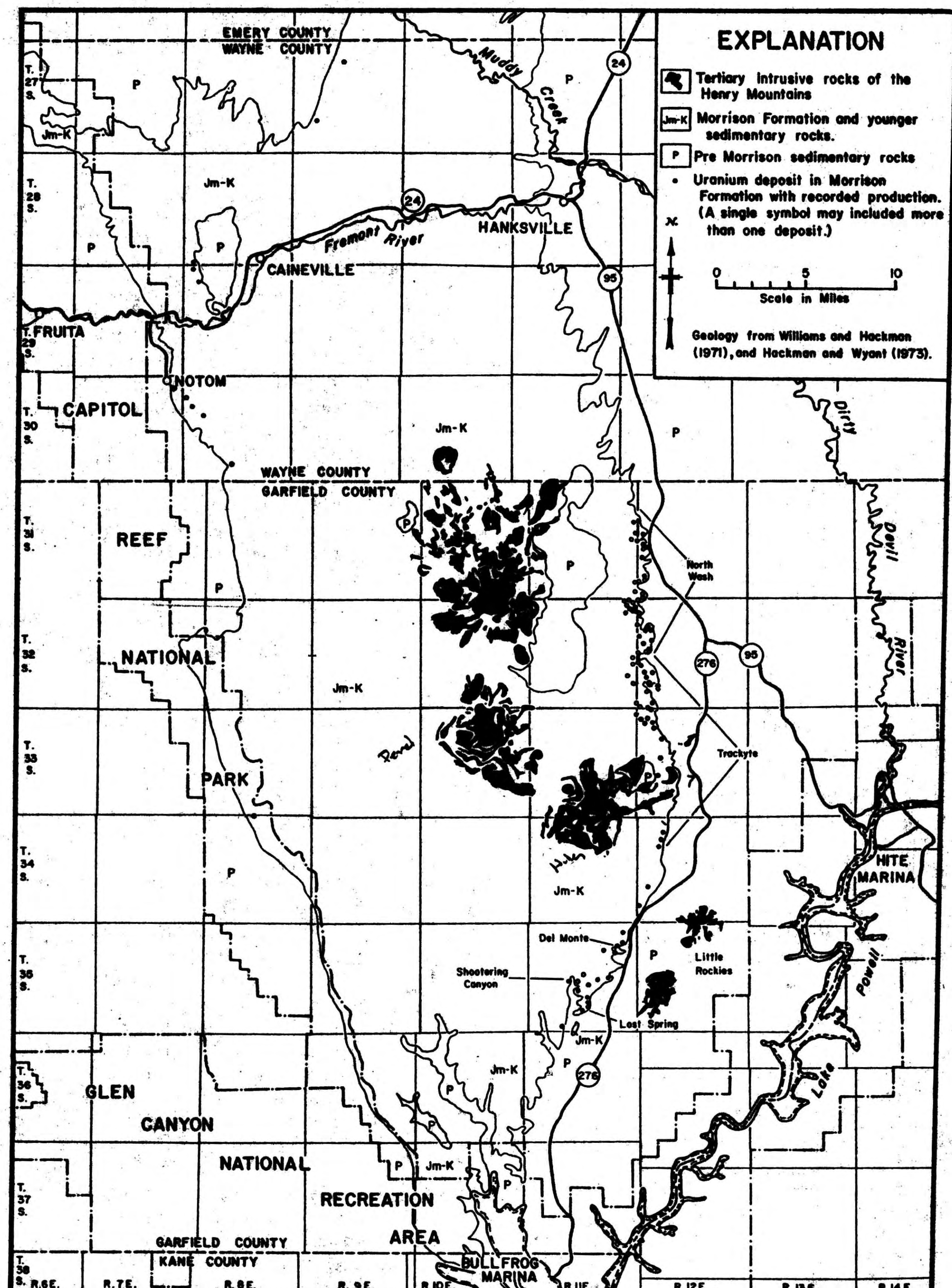

Figure 1.—Uranium-vanadium deposits, Henry Mountains, Utah

Ninety-eight percent of the uranium produced from the Henry Mountains has come from the mineral belt. The belt is subdivided into three localities–North Wash, Trachyte, and Little Rockies (Fig. 1). The following descriptions of the deposits in the three localities are taken from various AEC reports, principally from Grundy and Kastelic (1956).

The North Wash locality extends south from Butler Wash to North Wash (Fig. 1). In this locality, the principal ore bodies occur in a zone 150-180 ft above the base of the Salt Wash Member.

Uraniferous, carbonaceous trash zones account for much of the ore production. These deposits are a combination of uranium-vanadium minerals associated with carbonized logs and also impregnating argillaceous, carbonaceous sandstone lenses. The host rock is white to light gray, medium- to coarse-grained to conglomeratic sandstone, which is crossbedded, limonite-stained, and friable in part. Carbonaceous trash and gray to reddish brown mudstone lenses, galls, and blebs commonly are associated with the ore. Ore bodies are small and discontinuous. The uranium-vanadium ratio averages 1:5. Production from the North Wash locality accounts for 20 percent of the total uranium produced in the Henry Mountains.

The Trachyte locality extends south from North Wash to Woodruff Springs, on the east side of Mount Hillers (Fig. 1). Here, ore bodies are present in a zone 120 to 130 ft above the base of the Morrison Formation. Scattered deposits associated with fossil wood occur above and below this horizon, but are not economical.

As in the North Wash locality, uranium deposits at Trachyte are associated with carbonaceous trash and mudstone. The host rock is white to light gray, medium-grained to conglomeratic sandstone, which is crossbedded, limonite-stained, and friable in part. Ore bodies in the Trachyte area are larger and more continuous than those at North Wash. A typical ore body is 50 ft long, 20 ft wide, and averages 2 ft in thickness. Clusters of ore bodies may form a trend up to 400 ft in length. The ratio of uranium to vanadium is 1:8. Lime content of the ore generally is greater than 10 percent $CaCO_3$. The Trachyte area has been the source of 37 percent of the uranium produced in the Henrys.

The Little Rockies locality extends south from Woodruff Springs to the confluence of Shootering Creek and Lost Spring Wash. Three sublocalities are present in the Little Rockies–Del Monte, Lost Spring, and Shootering (Shitamaring), Canyon (Fig. 1). At Del Monte, ore bodies occur in a zone 50 to 100 ft above the base of the Morrison Formation; in Shootering Canyon, they are 20 to 50 ft above the contact; and at Lost Spring Wash, they are 10 to 50 ft above the contact. Except for these slight differences in stratigraphic position, ore deposits in the sublocalities are similar in their characteristics. The Little Rockies locality has contributed 41 percent of the total Henry Mountains uranium production.

Individual ore deposits consist of vertically and horizontally close-spaced, small, thin lenses of argillaceous and carbonaceous sandstone impregnated with tyuyamunite. Lenses are irregular in plain view and in cross-sections. They range from a fraction of an inch to 3 ft in thickness, and thicken and thin irregularly. The ore bodies average about 3 ft by 5 ft in lateral extent, and are generally elongated parallel to the dominant sedimentary trends, which range from northwest to northeast.

Ore-bearing lenses contain an abundance of carbon trash and abundant gray to red clay galls. The lower surface is nearly flat to gently irregular, and in places is a scour-surface. Many ore bodies are underlain by a gray mudstone seam or a tightly cemented sandstone containing up to 30 percent $CaCO_3$. Overlying ore generally contains less than 6 percent $CaCO_3$ and is relatively friable.

Commonly, gray mudstone seams directly overlie ore bodies or occur within 10 ft above them. The seams thicken conspicuously over many ore bodies and either thin to a feather edge over barren areas or continue several hundred feet as a parting between sandstone beds.

Uranium deposits commonly have abrupt lateral and vertical cutoffs, but gray, vanadium-bearing clay intercalated with sandstone may extend up to 20 ft laterally from uranium deposits and may extend from one uranium ore body to another. Haloes of limonite, presumably derived from oxidation of pyrite in ore bodies, may extend 10 to 15 ft laterally and vertically from the ore bodies.

Ore deposits in the Little Rockies are small and discontinuous. They are, however, exceptionally high grade with some deposits averaging 5 percent U_3O_8. The uranium-vanadium ration averages 1:3. Lime content of ore averages less than 6 percent $CaCO_3$.

GEOLOGIC INVESTIGATIONS

Geologic investigations of the uranium-vanadium deposits in the Henry Mountains began with Butler's (1920) visit to the Trachyte Creek area in 1913 as part of a survey of the ore deposits of Utah. Butler (1920, p. 630) notes the close association of the deposits with carbonaceous plant remains. Prior to this report, Boutwell (1905) had noted the reported occurrence of uranium in central Wayne County.

During World War II, the Union Mines Development Corporation, contractor to the Army Corp of Engineers, systematically studied the uranium-vanadium deposits in the Morrison Formation of the area. This work was part of a general uranium resource appraisal of the Colorado Plateau by the federal government for the Manhattan Engineer District. Union Mines' studies in the Henry Mountains produced reports by Coleman and others (1945), Eakland (1945), Mastrovich (1943, 1945), and Webber (1947). The reports by Mastrovich and Coleman and others are significant as they contain the first detailed descriptions of the individual ore deposits.

A brief description of the deposits is given by Hunt and others (1953) in their classic study of the Henrys. Since their work is prior to the uranium boom, only the vanadium content of the deposits is stressed.

Geologic investigations by the AEC and U.S. Geological Survey (USGS) during the early 1950s produced numerous reports. Noteworthy are studies by Grundy and Kastelic (1956), and by Johnson (1959). These reports contain observations on the lithology of the Salt Wash Member and the environments of the ore deposits. The Grundy and Kastelic report also contains geologic maps showing the locations of the principal mines.

Doelling (1967) presents an excellent summary of the uranium-vanadium deposits in Garfield County, including maps of nearly all of the mines. In a later report, Doelling (1975) shows uranium production data through 1970 for Garfield County, including the Henry Mountains, Circle Cliffs and Poison Springs mining areas.

Recently, Peterson (1977), and Peterson and Turner-Peterson (1979), have studied the depositional environment of the Salt Wash Member and describe a model for the uranium mineralization. The basic premise of the model is that humic and fluvic acids generated in the offshore muddy sediments of humus-bearing lakes were expelled by compaction or seepage into nearby sandstone beds where the acids were fixed as tabular humate deposits. Subsequently, uranium-bearing ground water passed through the sandstone where the humate fixed and concentrated the uranium, forming tabular sandstone uranium deposits.

HISTORY AND PAST PRODUCTION

The history of uranium mining in the Henry Mountains reflects the importance of three metals–radium, vanadium, and uranium. Shortly after 1910, the carnotite deposits in the Salt Wash Member in southwestern Colorado became one of the world's principal sources of radium. This activity led to the prospecting for similar deposits in the Salt Wash Member in eastern Utah. According to Hunt and others (1953, p. 20), Hess Hatch located the carnotite-bearing outcrops in the Del Monte and Trachyte areas. His claims, placed in 1913, were purchased by Standard Chemical Company. In 1914, and in the years following World War I, Standard Chemical explored and mined the outcrops in the Del Monte area. Some 80 to 100 tons of radium ore were hand-picked and shipped to Colorado for processing (Mastrovich, 1945, p. 6). Mining of the carnotite deposits for radium ceased in 1924 when the lower-priced Belgian Congo pitch-blende ores forced the Colorado Plateau ores out of the market.

After the radium market ended, the carnotite deposits of the Colorado Plateau were mined for vanadium. Activity in the Henry Mountains resumed in 1936 when Cornelius and Horace Ekker relocated the Standard Chemical Company's claims and commenced mining. After 15 tons of high-grade vanadium ore were produced from the Del Monte area, the area once again became inactive. During this time, the Ekkers also mined at The Point (Lost Creek) and in the Shootering Canyon areas (Mastrovich, 1945, p. 6).

In 1942, in order to stimulate the production of strategic materials, the government formed the Metals Reserve Company. Vanadium was one of the materials included, and Metals Reserve began an ore purchasing program and increased the base price paid for vanadium. In the early 1940s, Cornelius Ekker and Ray Bennett built a small plant at the Trachyte Ranch to upgrade the vanadium ores using a sand-slime separation (Mastrovich, 1979, pers. commun.). A small amount of the upgraded product was shipped to Metals Reserve Company. After the termination of the program in March, 1944, vanadium mining all but ended on the Colorado Plateau.

On April 7, 1944, the Canadian Radium and Uranium Corporation bought and relocated the Ekker's claims in the Del Monte area (Mastrovich, 1945, p. 6). Concurrently, the firm acquired claims in the Trachyte and North Wash areas.

As part of their study for the Manhattan Engineer District, Union Mines determined the amount of vanadium that previously had been mined. For the Henry Mountains, this amounted to 485 tons of ore averaging 3.20 percent V_2O_5, containing 31,054 pounds of vanadium oxide (Webber, 1947, Fig. 59). This ore was estimated to have averaged 0.32 percent U_3O_8. Webber (1947, p. 194) notes that the Henry Mountains were "greatly handicapped by isolation and lack of transportation facilities."

In 1948, prospecting for uranium was stimulated by the ore-buying schedules and other incentives of the Atomic Energy Commission. The Metals Reserve plant at Monticello, Utah, and the Vanadium Corporation of America's plant at Naturita, Colorado, were altered to permit the recovery of uranium, and in 1951, the first mill designed in the United States primarily for the production of uranium with vanadium as a byproduct began operating at Grand Junction by Climax Uranium Company. Union Carbide Corporation opened a buying station at Thompson, Utah, and later operated an upgrading plant at Green River, Utah. Ores from the Henry Mountains usually were shipped to these markets. Although closer, the mill at Moab, Utah, did not recover vanadium until the late 1960s.

The long distances to the markets had a negative effect on mining in the Henry Mountains. Considering that vanadium was purchased and the AEC provided a haulage allowance, the miners had to maintain the shipping grades higher than the usual Colorado Plateau operations to make a profit because of excessive transportation costs.

The yearly production of uranium oxide (U_3O_8) in ore from the Henry Mountains is shown in Figure 2. This chart was compiled from the records of the Grand Junction Office of the Department of Energy. Starting in 1948, production reached an early peak in 1952 when 7,484 tons of ore with an average grade of 0.31 percent U_3O_8 and containing 46,300 pounds of U_3O_8 were produced. After a

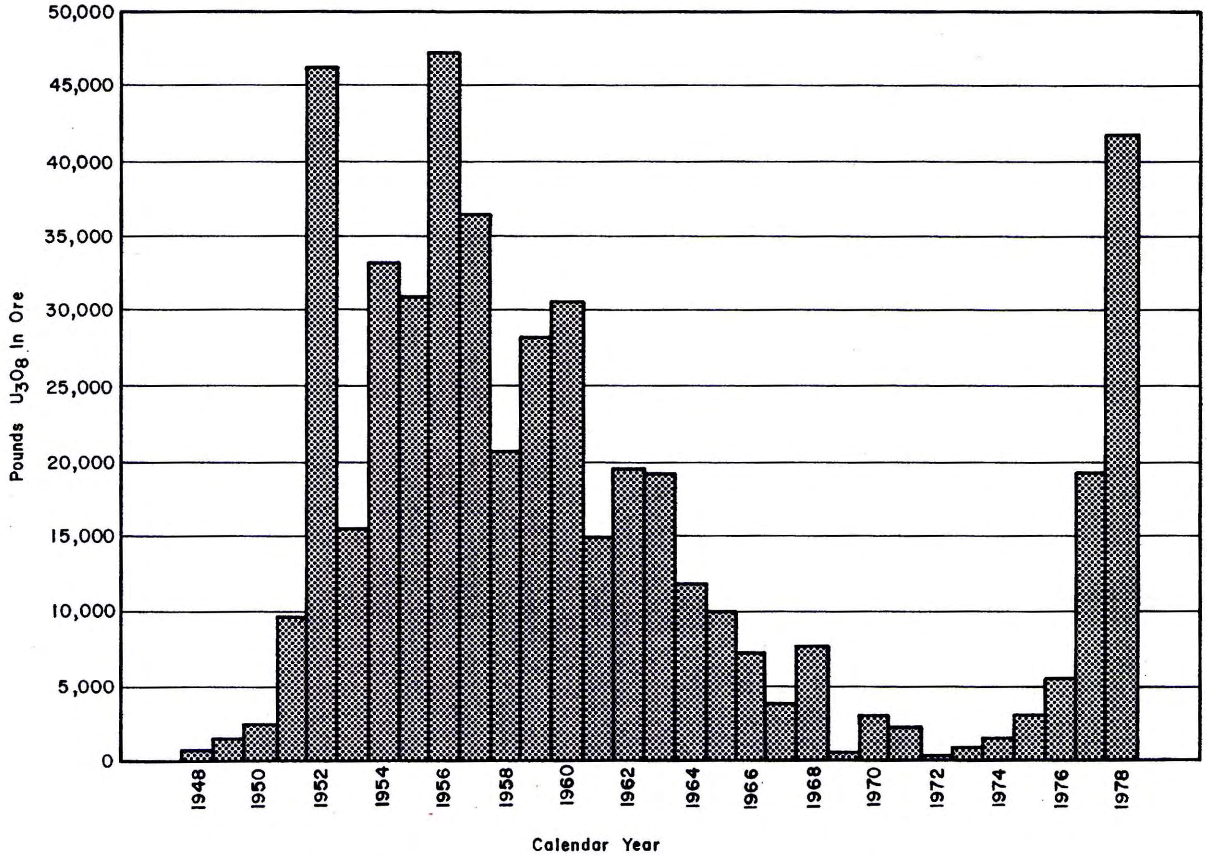

Figure 2.—Uranium production, Henry Mountains, 1948-1978.

slump in 1953, which reflects the lack of developed ore, production reached an all-time high in 1956 when 6,571 tons of ore with an average grade of 0.36 percent U_3O_8 and containing 47,211 pounds of U_3O_8 were mined. Production gradually declined to a low of 69 tons averaging 0.35 percent $U_3O_8$and containing 494 pounds U_3O_8 in 1969.

The AEC purchasing program ended on December 31, 1970. Total production under that program was 48,400 tons of ore averaging 0.41 percent U_3O_8 and containing 400,200 pounds U_3O_8. Since the Climax mill at Grand Junction did not participate in the program beyond 1966, a small amount of ore was produced in 1967-70 for private sales to electrical utilities. Since January 1, 1971, the only market for uranium has been the nuclear electrical power industry.

In the late 1960s and early 1970s, a few companies began investigating the possibilities of upgrading the low-grade ores in the Shootering Canyon area. Drilling along the established ore trends also was undertaken. By 1977, Plateau Resources, Ltd., a wholly-owned subsidiary of Consumers Power Company, announced plans to construct a new mine-mill complex in the Shootering Canyon area. In that same year, Energy Fuels Nuclear opened an ore-buying station near Hanksville. Both of these actions did much to stimulate exploration and mining in the Henry Mountains.

During the period 1948 through 1978, uranium production from the Henry Mountains has amounted to 79,500 tons of ore averaging 0.30 percent U_3O_8 and containing 474,500 pounds U_3O_8. Vanadium has been recovered from 63,000 tons with an average grade of 1.35 percent V_2O_5 and containing 1,694,100 pounds of vanadium oxide.

OUTLOOK

The recent discovery of large uranium deposits in the Little Rockies locality has sparked exploration throughout the Henry Mountains. These discoveries also have stimulated geologists to consider similar possibilities in other older uranium mining areas of the Colorado Plateau. As a result, there is scarcely an area today that is not being explored in view of the success in the Henry Mountains.

Published reserves for Plateau Resources' Shootering Canyon project were 5,800,000 pounds U_3O_8 as of January 1, 1978, (NRC, 1979, p. 3-1). These reserves are in three ore deposits—the Tony M in the Shootering Canyon area, the Frank M in the Del Monte area, and the Lucky Strike 10 in the vicinity of an existing mine in the Shootering area (NRC, 1979, p. 3-2). The Tony M deposit, currently under development appears to be unlike any of the known deposits in the Henry Mountains as the uranium mineralization is of greater thickness and is more continuous. Exploration by other companies has developed reserves on properties in the Trachyte and North Wash localities.

In addition to the known reserves in the Henry Mountains, the possibilities of finding additional deposits are excellent. Geologists of the Department of Energy (DOE) have estimated 21,800,000 pounds U_3O_8 of probable potential resources, and 15,900,000 pounds U_3O_8 of possible potential resources, may be present in the Henrys (DOE, 1979, p. 55). Both estimates are in the $50-per-pound forward-cost category as used by DOE.

The known reserves and the favorable geology for undiscovered potential resources are expected to make the Henry Mountains a significant source of uranium in the immediate future.

ACKNOWLEDGEMENTS

Publication of this paper is authorized by the U.S. Department of Energy, Grand Junction Office. The assistance of Elizabeth A. Learned in preparing the historical production data deserves special recognition.

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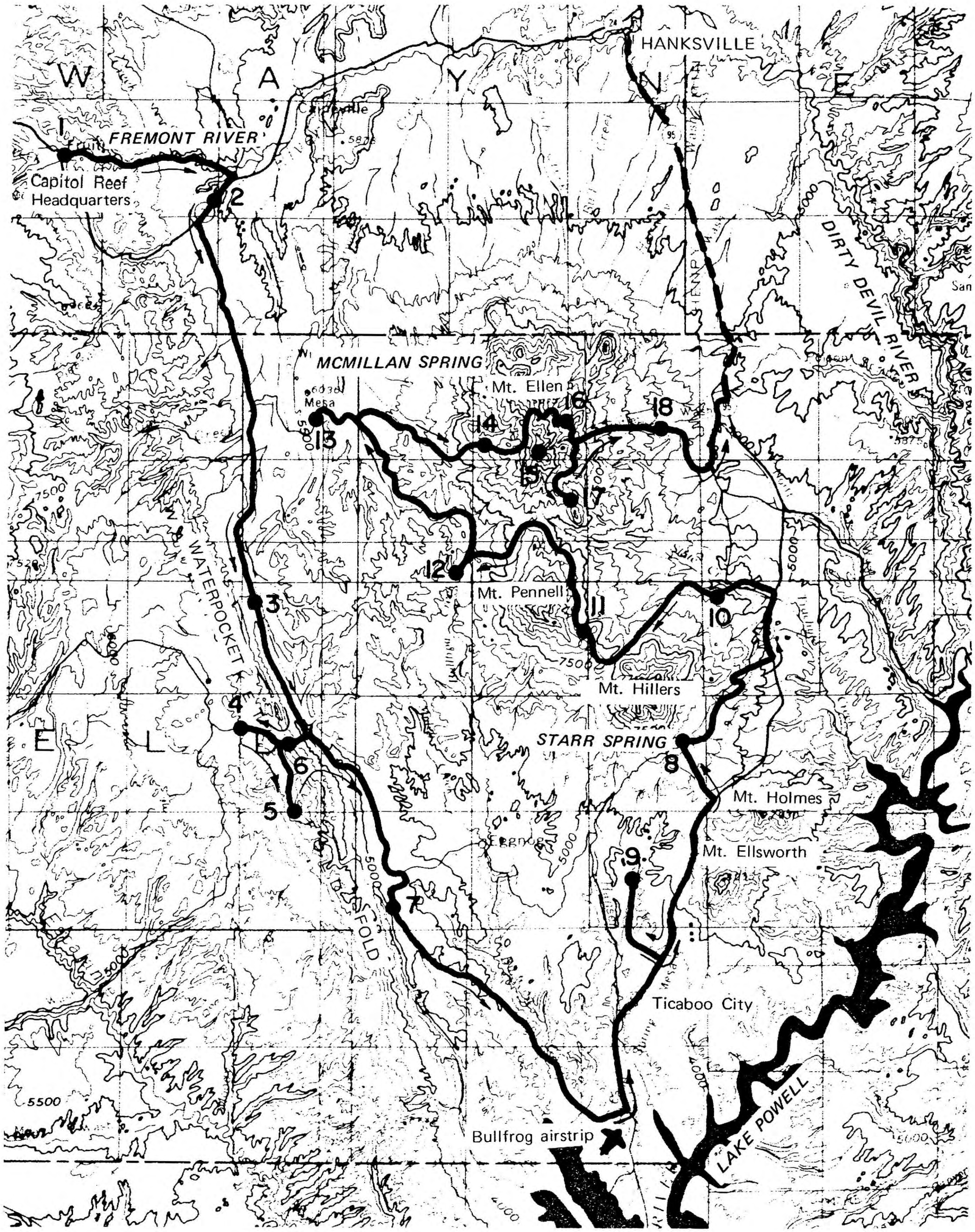
FIELD TRIP ROAD LOG

by H. H. Doelling[1]

September 12 to 14, 1980. Approximate distance Capitol Reef National Park to Hanksville via field-trip route 268 miles; see Route Map, Figure 1.

FIRST DAY ROAD LOG STARTING AT THE CAPITOL REEF NATIONAL PARK VISITOR CENTER, FRUITA, WAYNE COUNTY, UTAH. About 121 miles to Starr Campground; assemble at Visitor Center 8 AM sharp, September 12.

Miles Interval	Miles Accumulative	
0.0	0.0	STOP NO. 1. Capitol Reef National Park Visitor Center, elevation about 5,480 ft. View to north shows Triassic sequence of rocks along the northeast edge of the northwest-trending Teasdale anticline (Fig. 2). The slope-forming Chinle Formation rises from the top of the Moenkopi Formation and is about 450 ft thick. The Shinarump Member is missing at this locality. The cliff-forming Wingate Sandstone overlies the Chinle and is 320 ft thick, and is overlain by the ledgy 350-ft Kayenta Formation. The uppermost rocks are remnants of the Jurassic Navajo Sandstone. South of the Visitor Center is an outcrop of upper Moenkopi Formation capped by pediment gravels. Caravan will travel east on Utah Highway 24 along the Fremont River. The first day's field trip will amount to 121 miles.
0.8	0.8	School and orchards of old Fruita.
0.4	1.2	Petroglyphs to left (north); Chinle-Wingate contact, notice the crossbedding in the Wingate Sandstone.
0.8	2.0	Cross Fremont River, pass parking area for Hickman Natural Bridge trail (left), Wingate-Kayenta contact.
0.5	2.5	Pass Kayenta-Navajo contact visible on both sides of the highway. The Navajo Sandstone weathers into domes, several of which resemble the dome of the Nation's Capitol in Washington, D. C.
0.5	3.0	Kayenta Formation vees out completely.
0.8	3.8	Mesa capped by Carmel Formation can be seen ahead a little to the left of the road.
0.9	4.7	Pass entrance to Grand Wash Narrows to right of highway.
0.9	5.6	Note the "joint canyons" and crossbedding in the Navajo Sandstone.
0.5	6.1	Elijah Behunin cabin, erected in 1892 and occupied by a family of 9, right side of highway.
1.1	7.2	Navajo-Carmel contact. Note the quarry in the lower Carmel Formation and in the adjacent terrace gravels; the lower Carmel makes excellent road base material.
0.7	7.9	Carmel-Entrada contact (Fig. 3). The Carmel is about 725 ft thick and the Entrada is about 650 ft thick at this location.
0.7	8.6	Leave Capitol Reef National Park.
0.7	9.3	Junction with west Notom road, continue eastward on Utah Highway 24. Exposures are of the Summerville and Curtis Formations. The Curtis is about 80 ft thick and the Summerville is about 200 ft thick at this location. The lower part of the Salt Wash Member of the Morrison Formation can be seen at the top of the bluffs.
0.7	10.0	Good view of the Brushy Basin Member of the Morrison Formation. The upper part of the Brushy Basin may include beds of Early Cretaceous age, equivalent to the Cedar Mountain Formation. Each of the Morrison members is about 200 ft thick.
1.0	11.0	Moki ruins, note igneous slope debris (Fig. 4).
0.7	11.7	Additional excellent exposures of the Brushy Basin Member.
0.4	12.1	Junction with east Notom road, make sharp turn to the right (south). The Cretaceous Dakota Formation, which rests on the Morrison Formation, is discontinuous in this area and its remnants are partly buried in the valley. Outcrops to the east are of the Mancos Shale. The lowest member of the Mancos is the Tununk Shale.
0.7	12.8	Road turns up dip-slope, *Gryphaea* and/or *Exogyra* litter is present on both sides of the road (Fig. 5). These fossils are common near the Dakota-Tununk contact.
0.7	13.5	STOP NO. 2. Panorama view and discussion of Jurassic stratigraphy. The stop is located on the Brushy Basin Shale. In view are Boulder and Thousand Lake Mountains, Navajo Sandstone capped by Car-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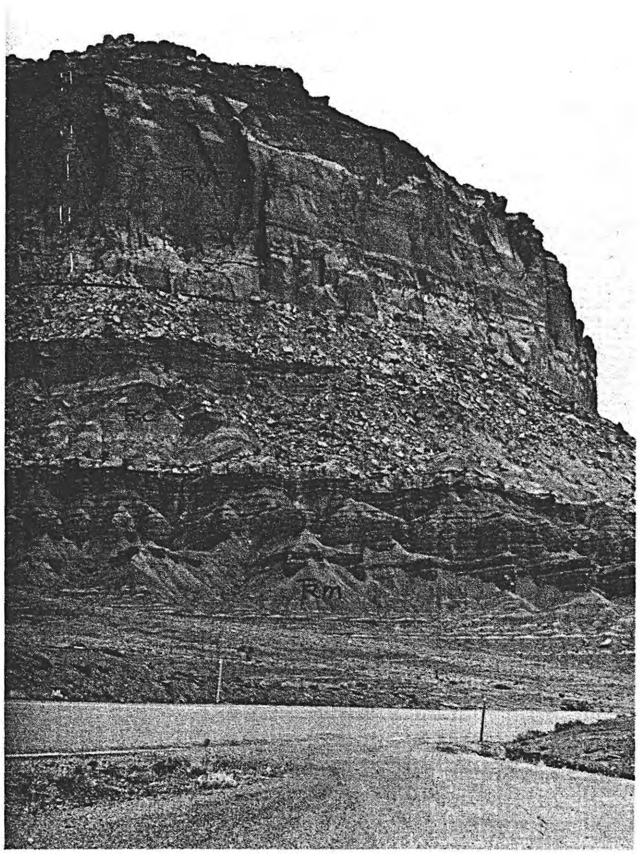


Figure 2.—Triassic units exposed near Capitol Reef National Park Visitor Center. Upper cliff-former is the Wingate Sandstone, the slope-former is the Chinle Formation, and the lower unit has been named the "Mummy Member" of the Moenkopi Formation. In many places the weathered forms on the cliffsides appear like standing Egyptian mummies.

Figure 3.—Truncated beds of Carmel and Entrada Formations overlain by pediment gravels along Utah Highway 24 along the Fremont River. First day mileage 7.9.

Figure 4.—Small basalt boulder derived from lava flows on Boulder Mountain west of Capitol Reef National Park. White carbonate coatings are usually found on their undersides as shown on the left side of the photo.

mel Formation on the east flank of the Teasdale anticline to the west and the Caineville mesas to the east. Considering the Mancos members from the base up, the Tununk is about 640 ft thick, the Ferron Sandstone is 345 ft thick, and the Blue Gate Shale is about 1,400 ft thick. The Emery Sandstone is incomplete with 200+ ft in the Caineville Mesas. Continue south on east Notom road.

0.9	14.4	Road is now on the Salt Wash Member of the Morrison Formation.
0.5	14.9	Salt Wash-Summerville contact.
0.4	15.3	Junction, east and west Notom roads join, continue left (south). Elevation is about 5,200 ft.
0.5	15.8	Notom, keep left. Notom is an unincorporated village containing the homes of a few ranchers.
0.5	16.3	Primitive grave to left, road continues on Summerville Formation.
0.4	16.7	Grave on hill to right.

Figure 5.—*Gryphaea* litter along the Tununk-Dakota contact, first day mileage 12.8.

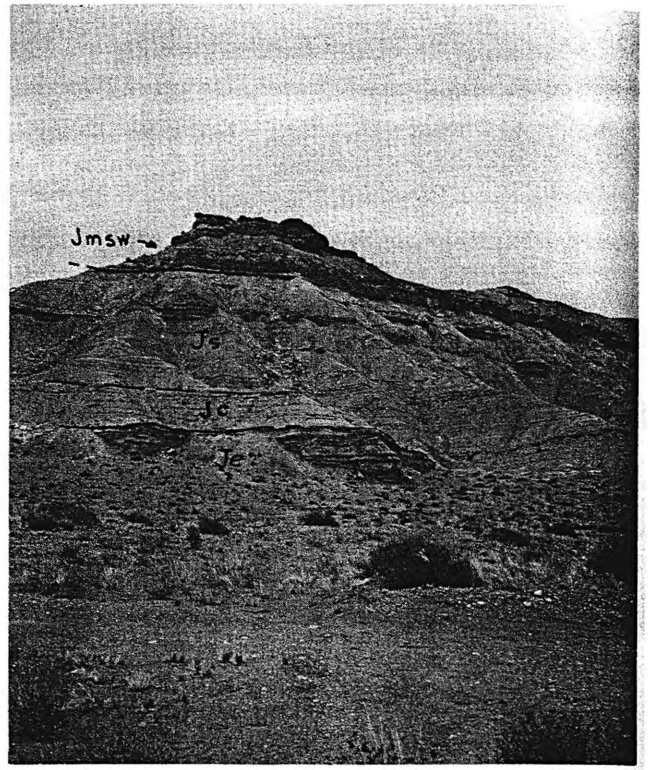


Figure 6.—Jurassic outcrops south of Notom; Je=Entrada Sandstone, Jc=Curtis Formation, Js=Summerville Formation, and Jmsw=Salt Wash Member of the Morrison Formation.

1.9	18.6	Descend down hill. Cross greenish band of the Curtis Formation and continue on the Entrada Sandstone. The Curtis Formation thins rapidly to the south and soon disappears. Exposures of the Summerville Formation can still be seen above the greenish Curtis band to the left. (See Figure 6).
1.2	19.8	Cross Burro Wash, elevation 5,200 ft.
0.6	20.4	Entrada monuments and goblins, road drops onto Carmel Formation.
0.7	21.1	Cross Cottonwood Wash, elevation 5,120 ft.
1.0	22.1	Cross Fivemile Wash into Garfield County. Contorted Carmel Formation outcrops can be noted to the right, Entrada Formation outcrops to the left.
2.9	25.0	Cross Sheets Gulch, elevation 5,180 ft.
0.8	25.8	Sandy Ranch Junction, continue south.
0.3	26.1	Cross Oak Creek, keep to the right at the next junction.
0.2	26.3	Rise onto Sandy Creek Benches, pediment gravels on the Entrada Sandstone. Note the basalt boulders.
1.9	28.2	South end of Sandy Creek Benches. Good viewpoint to the south. Good exposures of Chinle, Wingate, Kayenta, Navajo, Carmel, Entrada, Summerville, Salt Wash units, plus the Cretaceous cliff-formers and sand dunes.
0.8	29.0	Cross Wash.
1.0	30.0	Cross Wash.
1.1	31.1	View of unconformable Entrada-Summerville contact.
0.5	31.6	Enter Capitol Reef National Park on the Salt Wash-Summerville contact. A gypsum bed marks the top of the Summerville. The contact is an unconformity.
1.0	32.6	Good Cedar Mountain-like outcrops in the upper part of the Brushy Basin Member to the left.
0.6	33.2	Good Brushy Basin Member outcrops to the right.

0.4 33.6 Pass Cedar Mesa campground, continue down main road, elevation 5,587 ft.

1.1 34.7 Cross Wash.

2.6 37.3 STOP NO. 3. Bitter Creek Divide, elevation 5,650 ft. This is a drainage divide; to the north drainage is to the Fremont River, Dirty Devil River to Lake Powell, to the south drainage is down Halls Creek which flows directly into Bullfrog Bay on Lake Powell. The stop is at the Dakota-Morrison contact. Short walk to inspect coal prospects in the Dakota and Oyster Shell Ridge. Continue south along Halls Creek drainage.

1.3 38.6 Another coal prospect in the Dakota Formation, left.

0.3 38.9 Cross Oyster Shell Ridge, another coal prospect is noticeable on the right.

0.4 39.3 Recross Oyster Shell Ridge.

2.2 41.5 The large canyon opening to the left contains Bitter Spring Creek. Canyon walls are of Blue Gate Shale capped by Emery Sandstone.

0.5 42.0 Hogback on the left exposes Brushy Basin Shale outcrops.

0.9 42.9 Road makes sharp turn across a conglomeratic reef. Out-of-view behind the Salt Wash outcrops to the right is the Dream uranium mine. Uranium mineralization is present in the Salt Wash Member along Waterpocket Fold for the next few miles.

0.8 43.7 The pastel-colored hogback to the left is Cedar Mountain Shale (upper part of the Brushy Basin Shale Member) capped by Dakota Formation.

1.0 44.7 The large canyon opening in the Cretaceous units to the left is Swap Canyon. Swap Mesa is supported by the cliff-forming Emery Sandstone. Coal beds are found above the cliff.

0.5 45.2 Burr Trail Junction, elevation 4,980 ft. Turn right.

0.3 45.5 Cross Halls Creek.

0.1 45.6 Exposures of the Entrada Sandstone (orange), also the underlying Carmel Formation (reddish and gypsiferous). Road crosses the Waterpocket Fold (Fig. 7).

0.1 45.7 Exposures of the Navajo Sandstone, 978 ft thick at this location.

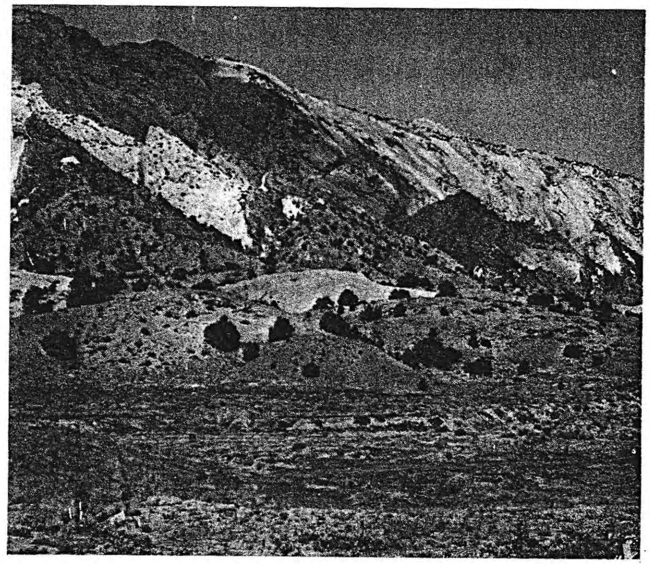


Figure 7.—Dip slope along Waterpocket Fold. Flat irons of red (dark on photo) Carmel Formation rest on light Navajo Sandstone. Entrada Sandstone crops out in foreground.

0.3 46.0 The reddish purple sandstone is the Kayenta Formation, 307 ft thick. Start ascent up the Burr Trail. Please follow the leader and move continuously to the top. The road is steep with many switchbacks. A stop for photography will be made on the return trip when the sun is better.

1.3 47.3 Top of grade, sharp turn to the right, Wingate Sandstone outcrops.

0.5 47.8 Enter Circle Cliffs area, elevation about 5,680 ft.

0.5 48.3 Good view of stratigraphy from north to northeast; Moenkopi, Chinle, Wingate, Kayenta Formations with the Navajo Sandstone on the skyline. The small arch in the Navajo is Peekaboo Rock.

1.9 50.2 STOP NO. 4 AND LUNCH. Picnic area and viewpoint. The axis of the northwest-trending Circle Cliffs anticline is about 1½ miles to the west. Wagon Box Mesa, on the axis and highest point in the area, is capped with the Shinarump and Petrified Forest Members of the Chinle and is in view to the south. The oldest rocks exposed in the core are Permian in age (White Rim Sandstone). All of the Henry Mountains Peaks can be seen from this point with the Henry Mountains Basin and Waterpocket Fold in the middle ground to the east. Elevation about 6,300 ft. After lunch turn around and proceed towards Burr Trail.

Figure 8.—Petroleum saturated outcrops of the Moenkopi Formation in the Circle Cliffs area. First day mileage 54.7.

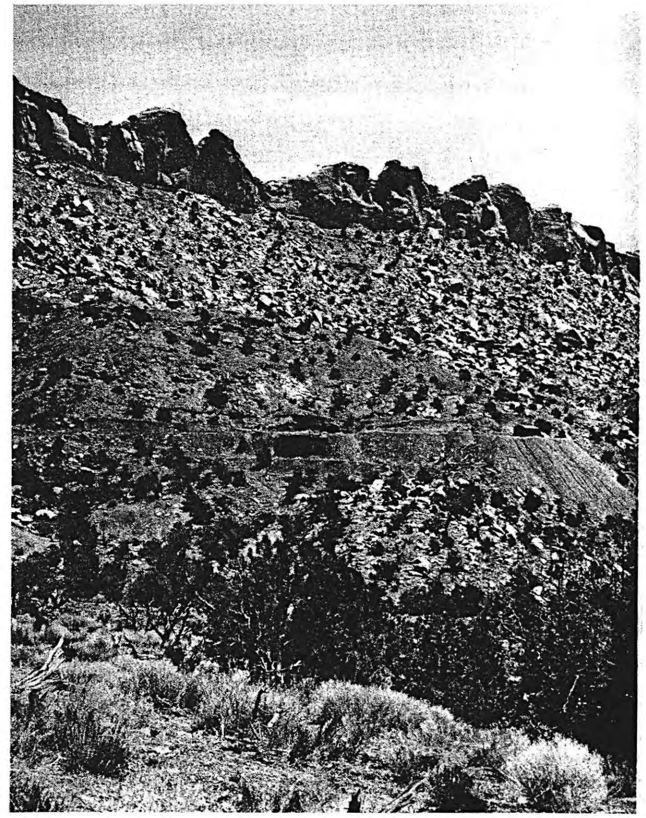


Figure 9.—Dump of Rainy Day mine (Stop No. 5). Rubble covered slope exposes the Chinle Formation; the sandstone at the top is the Wingate.

2.4 52.6 Junction, make a sharp turn to the right. Rough road, proceed with caution.

1.1 53.7 Cross wash. The road is proceeding on the Moenkopi Formation, exposures of the Chinle and Wingate can be seen along the escarpment to the left. Note the bleached (yellow) portion of the Moenkopi Formation.

0.6 54.3 Platy weathering exposures of the Moenkopi Formation on the right.

0.4 54.7 Cross main wash (tributary to Muley Twist Creek). Part of the Moenkopi is saturated with tar at this location (Fig. 8).

0.7 55.4 Divide, begin descent with sharp turns, first view of Rocky Mountain uranium workings.

0.6 56.0 Rocky Mountain portals to left, at base of Shinarump Member of the Chinle Formation.

0.6 56.6 STOP NO. 5. Rainy Day Mine (Figs. 9 and 10). Tight turn around, follow and observe the directions of the leader. The Rainy Day is the largest producer of uranium in the Circle Cliffs area to date. The ore body is a long slender pod in Moenkopi siltstone at the south end of a Shinarump channel 3,300 ft wide and 40 ft deep. The ore body has been mined along a continuous length of 1,800 ft. Minerals include uraninite, torbernite, autunite, uranyl sulfates, sphalerite, chalcopyrite, pyrite, and galena. The average ore grade was 0.30 percent U_3O_8 and 0.15 percent V_2O_5. Return to Burr Trail road; views of cuestas along the way (Fig. 11).

4.4 61.0 Junction, continue right (east) along the main Circle Cliffs road to Burr Trail.

0.6 61.6 STOP NO. 6. Top of Burr Trail (Fig. 12). Photography stop, good view of Waterpocket Fold, Henry Mountains Basin, Henry Mountains Peaks, post-Kayenta units. Line up along extreme right side of road. Continue down the Burr Trail.

1.9 63.5 Burr Trail Junction, keep right. Continue south along Halls Creek drainage. Morrison Formation crops out on the east side of the road. The Morrison is capped by lower Dakota Formation.

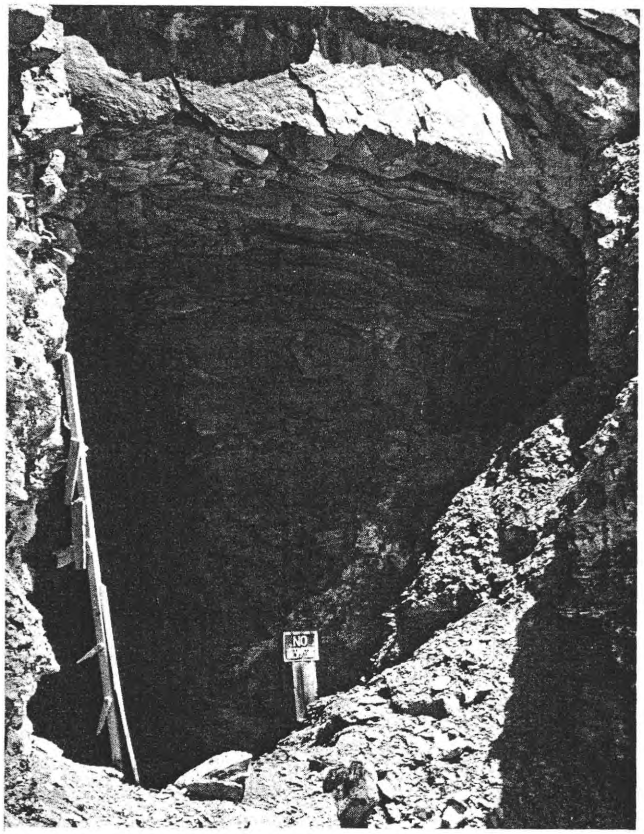


Figure 10.—Portal of Rainy Day mine.

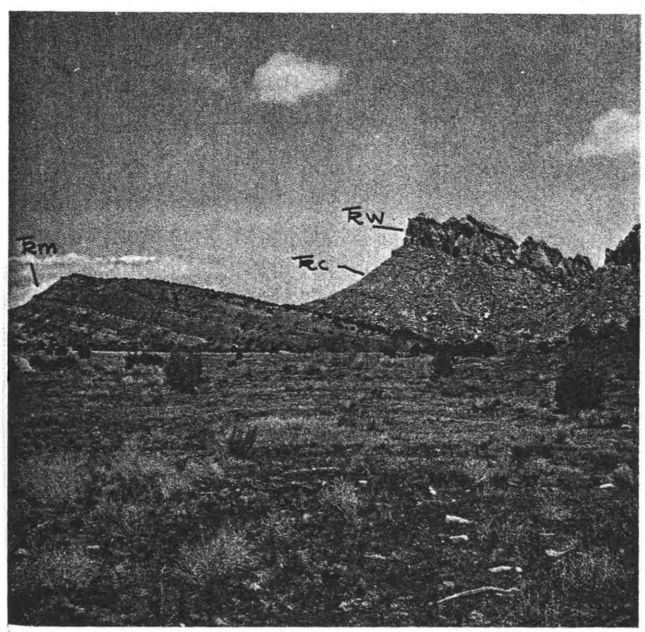


Figure 11.—Triassic cuestas in the Circle Cliffs area. Cuesta to left is mostly Moenkopi Formation with a skiff of Monitor Butte Member of the Chinle Formation on top. Second cuesta (right) is the remainder of the Chinle (slope) capped by Wingate Sandstone.

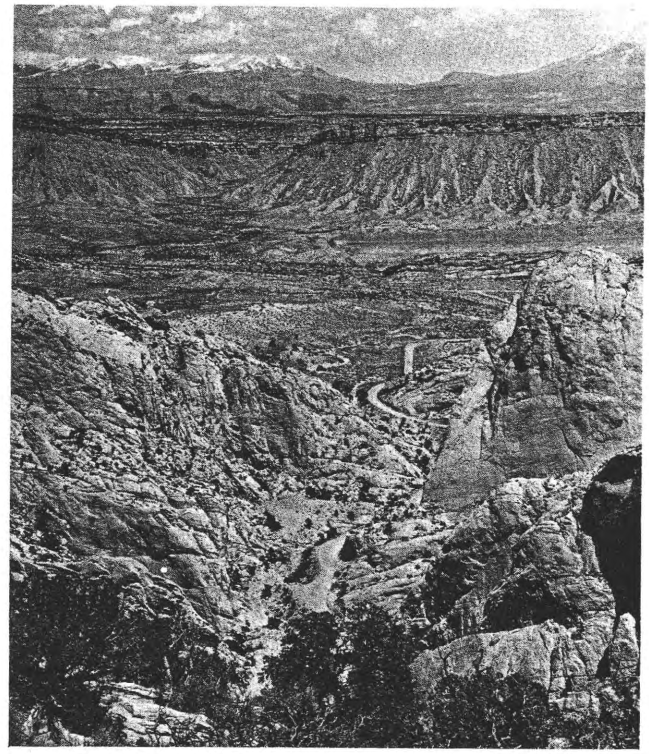


Figure 12.—View east from Burr Trail (Stop No. 6). In the distance: Mt. Ellen on the left, Mt. Pennell on the right, with The Horn between them.

1.8	65.3	Exposures of upper Entrada (white sandstone), a thin Summerville Formation, Morrison Formation and Dakota. Narrow canyons, cutting the Waterpocket Fold to the west, are in Navajo Sandstone. These are favorite hiking areas for tourists.
0.6	65.9	The Post. Road turns eastward out of Halls Creek drainage.
0.4	66.3	Cross Dakota Formation outcrops, notice thin coal bed.
0.6	66.9	Leave Capitol Reef National Park, road continues on the Tununk Shale Member of the Mancos.
0.4	67.3	A good place to view Cretaceous units (Fig. 13). The Dakota Formation provides the dip slope on the west side of the road, the Tununk Shale is exposed (black) in the first cliff to the east and is capped by the yellow-gray Ferron Sandstone. Behind this cliff is the curtain-like gray Blue Gate Shale capped by the Emery Sandstone (Sheer Point).
3.0	70.3	Climb on dip-slope of Dakota and Morrison Formations.

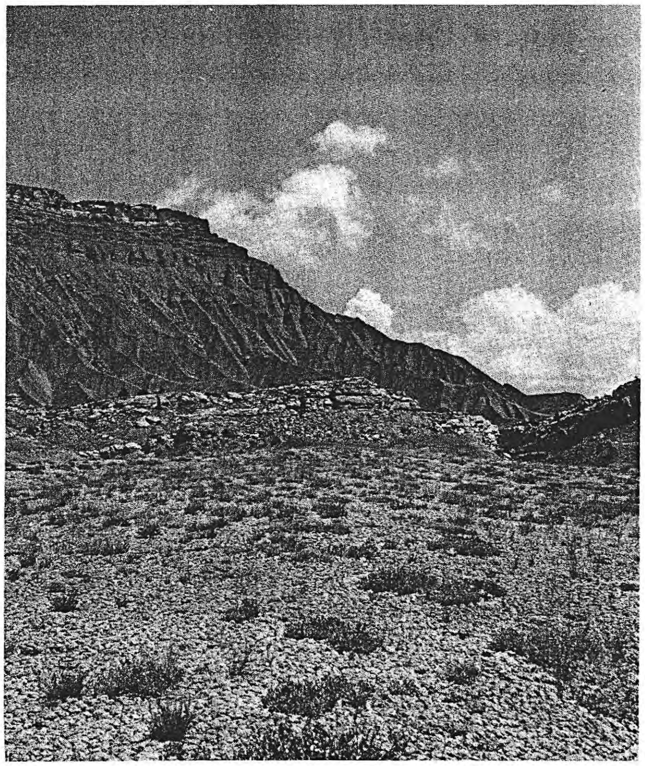


Figure 13.—Cretaceous outcrops at Sheer Point, first day mileage 67.3. Shale in the foreground is the Tununk, lower sandstone is the Ferron, curtain-like slope-former below Sheer Point is the Blue Gate Shale, and the sandstone at the stop is the Emery.

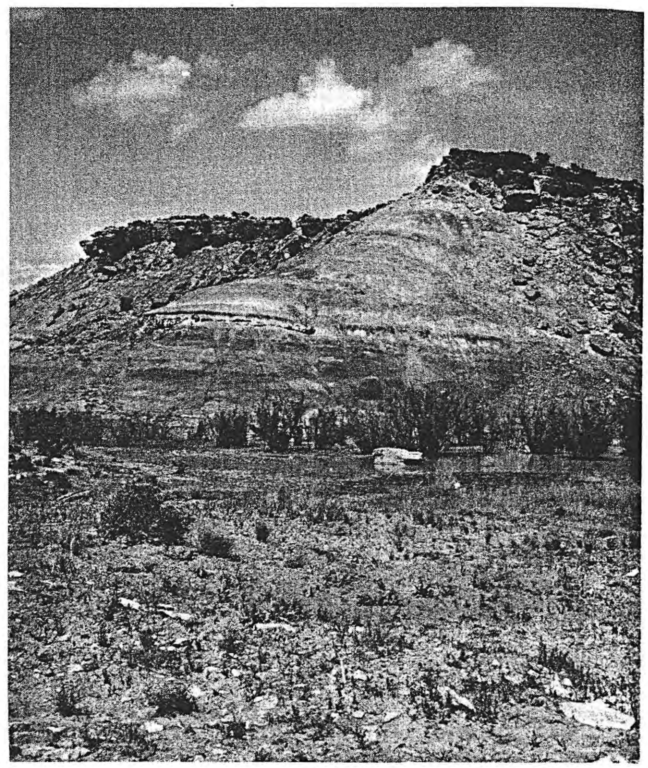


Figure 14.—Brushy Basin Shale outcrops, mileage 70.6.

0.3	70.6	Brushy Basin Member of Morrison Foration (Fig. 14).
2.8	73.4	Road turns eastward onto the Dakota and Morrison dip-slope, Mt. Hillers can be seen directly to the east.
1.4	74.8	Junction, turn right (south).
0.9	75.7	Scenic drive junction, elevation 5,080 ft, turn right. Road continues on Brush Basin Member.
1.1	76.8	Climb onto Dakota Formation and Big Thomson Mesa.
1.6	78.4	Halls Creek overlook junction, turn right.
0.3	78.7	STOP NO. 7. Wingate Bridge overlook. View across Halls Creek to Deer Point. Many stratigraphic units exposed, as well as an interesting landslide to the south. One of the best views of Waterpocket Fold. Return to Halls Creek overlook junction and turn right (south).
3.2	81.9	More good Brushy Basin outcrops.
4.1	86.0	Middle Point Junction. The Brushy Basin Member is about 250 ft thick and the Salt Wash Member is about 650 ft thick in this area.
2.4	88.4	View of Lake Powell directly ahead, road drops onto Salt Wash Member of Morrison Formation.
3.0	91.4	Road along edge of cliff overlooking Bullfrog Creek (Fig. 15). View is of Entrada-Summerville-Morrison sequence (left) and pediment gravels on the Entrada Sandstone (right).
.07	92.1	Begin descent into the Cane Spring Desert and Bullfrog Creek Valley.
1.4	93.5	Cross Bullfrog Creek, elevation about 3,900 ft.
3.0	96.5	Cross gulch cut into the Entrada Sandstone.
0.4	96.9	Hoskinnini Mesa in the distance to right beyond Lake Powell.
1.9	98.8	Junction with Utah Highway 276. Turn left and north on the highway. Route to right is to the Bullfrog marina (5.1 miles) and airstrip (2.6 miles), elevation about

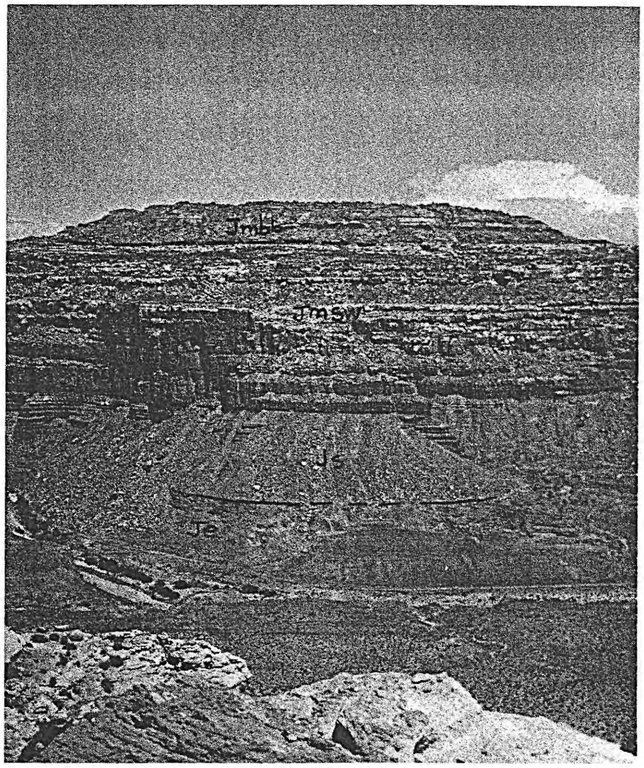


Figure 15.—Bullfrog Creek canyon, units in ascending order include: Je=Entrada Sandstone, Js=Summerville Formation, Jmsw=Salt Wash Member, Jmbb=Brushy Basin Member.

		3,990 ft. (Vehicles may obtain fuel at this marina.)
3.3	102.1	Road parallels Hansen Creek, note pediments to east.
1.5	103.6	Cross Hansen Creek.
2.6	106.2	Ticaboo motel and village road to left. continue on Utah Highway 276.
4.2	110.4	Junction to Shootaring Canyon mines, left side of highway, continue on state highway. Mt. Ellsworth straight ahead (Fig. 16).
2.7	113.1	Road cuts are in the Summerville Formation, Mt. Ellsworth is in view to the right.
0.7	113.8	View of Mt. Hillers to the left (north), with Del Monte uranium mines in the middle ground (Fig. 17).
0.5	114.3	Road cuts are in the Entrada and Summerville Formations. Some interesting deformation can be observed in a few of the Summerville cuts.
2.7	117.0	Junction, Utah Highway 276 and road to Starr Spring campground, turn left.
1.6	118.6	Approaching Mt. Hillers, cross Jurassic-Cretaceous boundary.

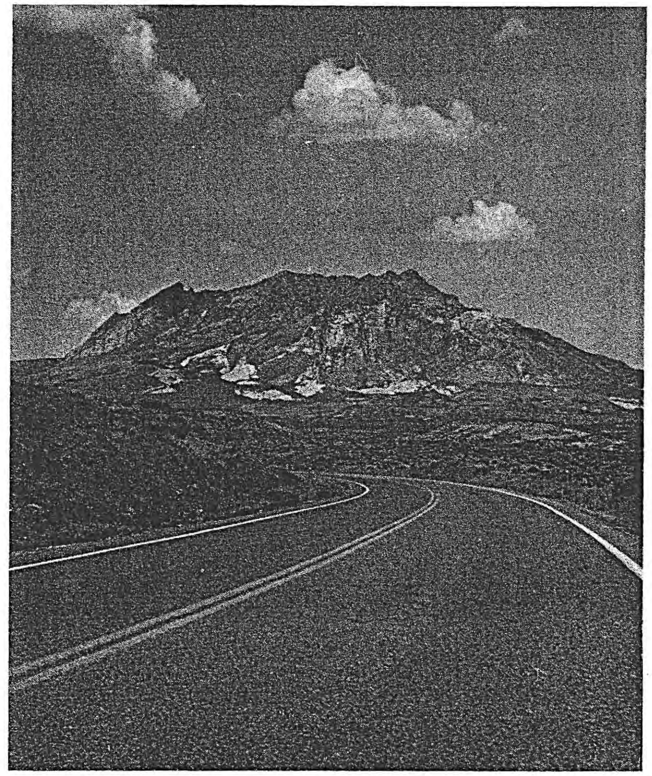


Figure 16.—Mt. Ellsworth, highest elevation is 8,235 ft.

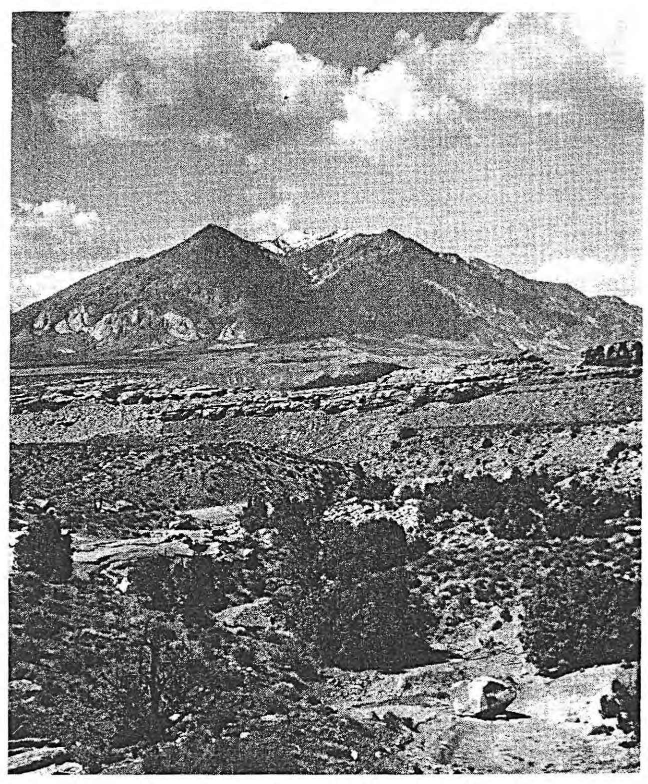


Figure 17.—Mt. Hillers, elevation 10,723 ft with Del Monte uranium mines in middle ground.

2.4	121.0	Enter Starr Spring campground. This ends the first day road log. Overnight camp. If time permits a hike will be organized across upturned strata along the south flank of Mt. Hillers.

SECOND DAY ROAD LOG COMMENCING AT STARR SPRING CAMPGROUND, GARFIELD COUNTY, UTAH. About 93 miles to McMillan Campground. Assemble promptly at 7:30 AM, September 13.

Miles Interval	Miles Accumulative	
0.0	0.0	STOP NO. 8. Before proceeding with the field trip a discussion will point out the important structural and topographic features visible from the campground (Fig. 18). The caravan will then proceed to the Shootaring Canyon uranium mines.
10.0	10.0	STOP NO. 9. Shootaring Canyon uranium mines. After the discussion the caravan will return to Starr Spring campground.
10.0	20.0	From Starr Springs campground, continue to the right in a northeasterly direction. Campground elevation is 6,300 ft.
2.9	22.9	Junction, Woodruff Springs to the right, continue straight ahead.
1.2	24.1	Dike crosses road at right angle.
0.5	24.6	Viewpoint, excellent vistas: to the east, Elk Ridge, La Sal and Abajo Mountains; to the south Mt. Holmes, Mt. Ellsworth, Navajo Mountain, and Lake Powell.
1.0	25.6	Sharp turn to left around the Hogs Back.
0.5	26.1	Many igneous boulders.
0.8	26.9	Black Mesa bysmalith (Black Table) directly ahead.
1.5	28.4	Junction, Utah Highway 276, turn left.
1.1	29.5	Entrada road cut, note sharp contact betweeen gravel and sandstone. Trachyte Mesa laccolith ahead and a little to the left.
1.0	30.5	Cross Trachyte Creek, elevation 4,720 ft.
0.2	30.7	Junction, turn left onto county road leading to Trachyte uranium mines.
0.6	31.3	View of all three major Henry Mountains peaks ahead; from north to south, Mt. Ellen, Mt. Pennell, and Mt. Hillers (11,522, 11,371, 10,723 ft respectively). The road is on pediment gravel developed on the Entrada Sandstone.

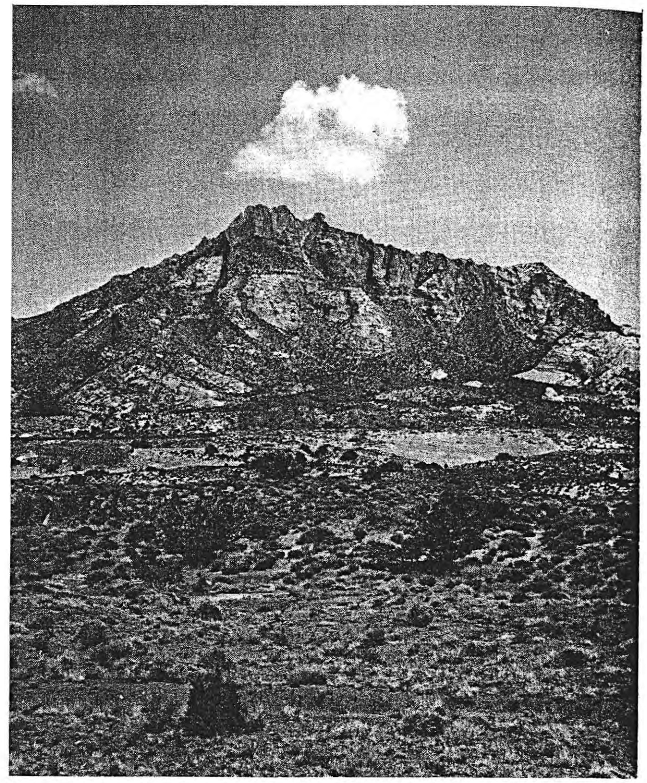


Figure 18.—Mt. Holmes, elevation 7,930 ft.

2.2	33.5	Trachyte Ranch with Farmers Knob directly ahead. Units exposed here include the Summerville Formation capped by the Salt Wash Member of the Morrison Formation. The uranium-bearing Salt Wash Sandstone is almost 350 ft thick in this area.
0.4	33.9	Cross Trachyte Creek.
0.5	34.4	Pass Farmers Knob uranium mines (left).
0.1	34.5	Junction, keep right, proceed on road marked to Aspen Spring.
0.2	34.7	STOP NO. 10. John Hill, Trachyte uranium-vanadium mining area, Henry Mountains mining district (Fig. 19). A 40- to 60-foot sandstone lens, 110 to 130 ft above the Summerville contact has yielded most of the ore. Most ore bodies are of the trash-pocket type and many show a crude zonal arrangement of uranium mineralization. These mines contain a high ratio of vanadium with respect to uranium, about 5:1. The average ore body is 50 x 20 x 2 ft and in a few areas the ore bodies are clustered. The average shipped ore grade has been 0.33 percent U_3O_8 and 1.48 percent V_2O_5. The area has produced about 30,000 tons of ore since mining

Figure 19.—Trachyte uranium-vanadium mining area. Most mines produced from the thick sandstone above the dumps near center of photo.

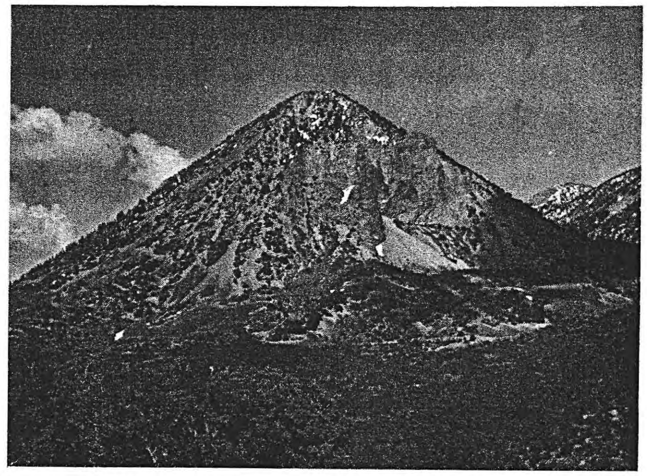


Figure 20.—Cass Creek Peak bysmalith. Peak is at 9,428 ft.

		began in the early 1900s. Continue along road to Aspen Spring.
0.3	35.0	Turn right along main road, other roads lead to more uranium mines.
0.2	35.2	Cross Trachyte Creek. More uranium and vanadium mines may be observed on both sides of the road.
0.7	35.9	Road rises above Salt Wash outcrops into mostly covered hills of Brushy Basin Shale.
0.7	36.6	Junction, turn left to Aspen Springs.
0.3	36.9	Cross Trachyte Creek, road proceeds on gravel-covered Mancos Shale.
0.8	37.7	Corral on left; sandstone in hills ahead is in Ferron Sandstone Member of Mancos Shale.
0.8	38.5	Road cuts are in the Ferron Sandstone, Mt. Hillers is in view to the left.
1.3	39.8	View to the right (north) is across the chained Coyote Benches to Ragged Mountain and Bull Mountain bysmaliths. An escarpment of Blue Gate Shale capped with Emery Sandstone can be observed ahead.
1.1	40.9	Aspen Spring. Caution, area may be very muddy.
1.3	42.2	Stanton Pass, elevation 7375 ft. Cass Creek Peak and Mt. Hillers are to the south, Bulldog Ridge and Mt. Pennell are to the north. Cass Creek Peak is another bysmalith.
0.9	43.1	Junction, turn right to north.
0.3	43.4	Cross Pennell Creek.
0.2	43.6	Steep road with many switchbacks.
0.3	43.9	Excellent view of Cass Creek Peak (Fig. 20) and Mt. Hillers.
0.2	44.1	Road is in Emery Sandstone at end of switchbacks. Glimpse of the Waterpocket Fold is available westward.
0.5	44.6	Dike outcrop on right side of road.
0.5	45.1	Mud Spring and Viola V gold mine, left.
1.0	46.1	STOP NO. 11 AND LUNCH. Flat above Browns Knoll and below Bulldog Ridge. Discussion of igneous geology of Henry Mountains and mineralization on Mt. Pennell and Mt. Hillers. Continue north after discussion.
0.6	46.7	Cross Browns Creek.
0.9	47.6	Cross Straight Creek.
0.3	47.9	Junction with Straight Creek road, continue straight ahead. Coyote Benches to east.
0.7	48.6	Turkey Haven campsite, elevation about 7,900 ft.
0.1	48.7	Cross creek and thin coal outcrop.
0.5	49.2	Cross creek, bedrock geology indicates a shatter zone; Cretaceous sedimentary units intercalated with diorite porphyry.
0.5	49.7	Sharp turn to the left.
0.6	50.3	Igneous dike exposure, left side of the road.
0.4	50.7	Cross creek.

0.5	51.2	Corral and Willow Spring Junction, continue straight ahead.
1.1	52.3	After crossing creeks in intervals of 0.5 and 0.2 miles, road passes onto Brushy Basin Shale. The Salt Wash Member outcrops can be noted in the canyon to the right. Mt. Ellen and Ragged Mountain bysmalith are in view to the north.
0.9	53.2	Cross Dark Canyon, excellent view of Ragged Mountain thereafter.
1.4	54.6	The Horn laccolith, the highest elevation on the Horn is 9,047 ft. The road elevation is just below 8,000 ft.
0.3	54.9	Large boulders of diorite porphyry.
1.6	56.5	Pennellen Pass Junction, keep left.
0.5	57.0	Junction, keep right.
3.3	60.3	Cross North Fork Bullfrog Creek.
0.1	60.4	Junction, turn hard to the left.
0.5	60.9	Enter Turn of the Bullfrog gap and cross Bullfrog Creek twice.
0.4	61.3	In the gap are good exposures of Blue Gate Shale, Emery Sandstone and the transitional units between them. Road continues in the creek bed.
0.7	62.0	STOP NO. 12. Cave Flat coal area. Short walk to coal outcrops. Seven drill holes have probed the coal in the Cave Flat area to the south indicating that the principal bed is 6 to 9 ft thick and strip-minable. Return to vehicles, turn them around and return to the junction through Turn of the Bullfrog gap.
1.6	63.6	Junction, continue straight ahead on Blue Gate Shale.
0.9	64.5	Junction with Tarantula Mesa road, continue straight ahead. Tarantula Mesa lies to the west.
1.0	65.5	Approach Stevens Narrows, note slumping Emery Sandstone on the Blue Gate Shale.
0.9	66.4	Enter Stevens Narrows gap. West-dipping rocks area tilted by doming of the Henry Mountains on the east. Road passes exposures of Blue Gate Shale, Emery Sandstone, and Masuk Shale.
1.8	68.2	Travelling northwesterly down valley at an elevation of about 6,100 ft. The Masuk Member of the Mancos Shale is exposed in most slopes. Mesas are capped with Mesaverde Sandstone. Cross creek 8 times in next 4.5 miles.
4.5	72.7	First gate at King Ranch.
0.7	73.4	Last gate at King Ranch.
1.8	75.2	Thin coal beds exposed along Sweetwater Creek.
0.3	75.5	Pass Sweetwater Creek mine (coal) on the right. Coal was mined here to supply local ranchers. The coal bed is a little over 8 ft thick in the mine.
0.3	75.8	Junction, continue straight ahead and cross Sweetwater Creek. Sweetwater Creek is approximately aligned along the Henry Mountains Basin synclinal axis. Road continues westward and crosses the south end of Wildcat Mesa.
3.6	79.4	STOP NO. 13. Head of Blind Trail Canyon (Fig. 21). Examine coal beds and if time permits to examine excellent exposures of Blue Gate-Emery-Masuk strata. Discussion of Wildcat Mesa and King Ranch coal areas. Turn around and return to Sweetwater Creek Junction.

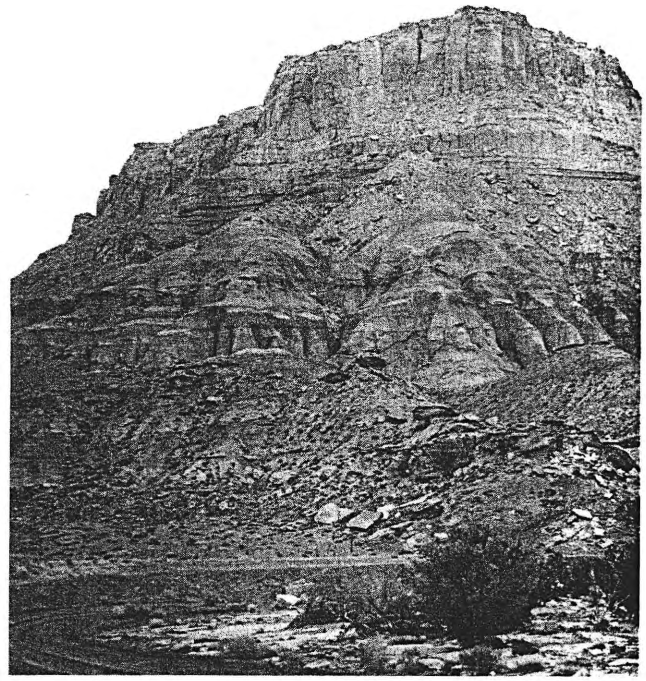


Figure 21.—Butte rising above the south end of Wildcat Mesa near the head of Blind Trail Canyon. Lowermost rocks are coal-bearing Emery Sandstone, the middle slopes are Masuk Shale, and the capping sandstone is the Mesaverde (Stop No. 13).

3.6	83.0	Sweetwater Creek Junction, turn left. After turning there are thin coal beds above and below a white ledge to the right.
0.9	83.9	Rise onto Pete Steele Bench and top of the Emery Sandstone. Proceed on top of gravel covered pediment eastward. Steele Butte can be seen to the southeast and Mt. Ellen straight ahead. Table Mountain bysmalith can be seen at the north end of Mt. Ellen.
1.8	85.7	Junction with Stevens Mesa road, continue straight ahead.
1.3	87.0	Steele Butte to the right, Emery Sandstone cuesta straight ahead.
0.1	87.1	King Ranch Junction, continue straight ahead, note thin coal beds to right.
0.4	87.5	Road proceeds on Blue Gate Shale.
1.0	88.5	Cross wash.
0.6	89.1	Cross South Creek, road is on slope wash of igneous cobbles and boulders, Blue Gate Shale capped by Emery Sandstone can be seen ahead.
1.4	90.5	Junction, turn left to McMillan Springs campground. Cross creek, steep road ahead, keep moving.
2.6	93.1	Junction, turn left into McMillan Springs campground. Overnight camp. End of second day road log.

THIRD DAY ROAD LOG COMMENCING AT McMILLAN SPRING CAMPGROUND, GARFIELD COUNTY, UTAH. About 54 miles to Hanksville; depart McMillan promptly at 7:30 AM, September 14.

Miles		
Interval	Accumulative	
0.0	0.0	STOP NO. 14. McMillan Spring Campground junction. The field trip will proceed by turning left at the junction toward Mt. Ellen, elevation at the junction is 8,350 ft.
0.6	0.6	Willow Springs and cabin, turn right on main road. Porphyry in this area contains horblendic inclusions (Fig. 22).
1.4	2.0	Dry Lake Flat, elevation 9,150 ft.
0.8	2.8	Nasty Flat Junction, keep left.
0.7	3.5	Cross Dugout Creek. An optional hike of 1½ miles over Mt. Ellen to visit Bromide Basin mining area can begin here. The hike will pass over South Summit Ridge, 1,000 ft above road level and down to

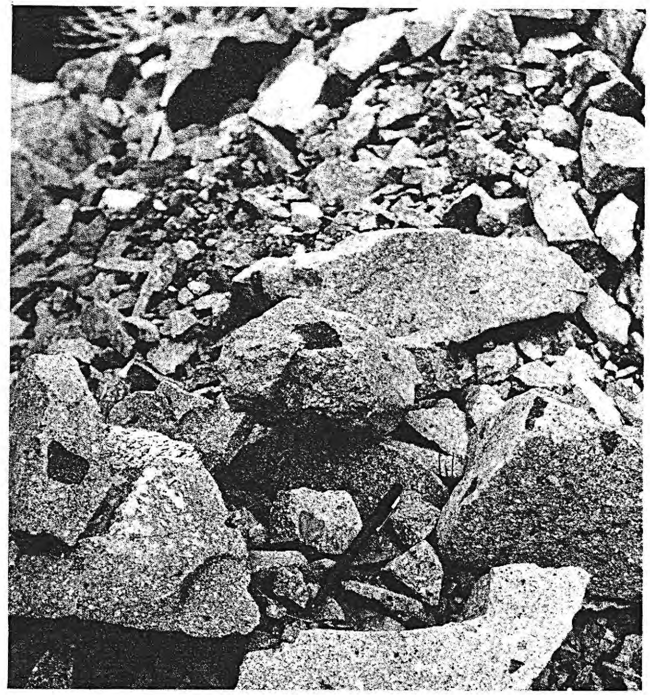


Figure 22.—Hornblendic inclusions in porphyry, Mt. Ellen.

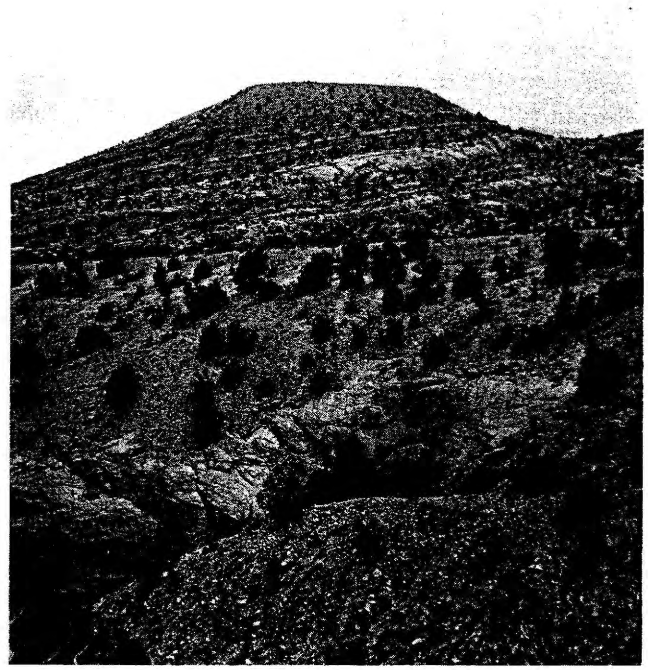


Figure 23.—Entrada Sandstone outcrop covered by gold-bearing gravels, north of Maze Arch, east side of Mt. Ellen.

		Bartons Peak for pickup. Road elevation is about 10,000 ft. Road continues along west side of Mt. Ellen, excellent regional views to the west. Bromide Basin is STOP NO. 15.
1.4	4.9	Bull Creek Pass, elevation, 10,480 ft. North Summit Ridge, 2 miles north of the pass, has the highest Henry Mountains prominence at 11,522 ft.
2.6	7.5	Wickiup Pass Junction, turn right, elevation 9,240 ft. Road left continues into Blue Basin past Lonesome Beaver campground, and down Bull Creek to Hanksville (Sawmill Basin road).
0.3	7.8	View of the La Sal Mountains in Grand and San Juan Counties, on the horizon. The Orange Cliffs and Canyonlands area can be seen in the mid-ground to the east.
0.4	8.2	Cross Granite Creek.
1.1	9.3	Excellent view to the east, Bull Mountain bysmalith can be seen to the north across Granite Creek. La Sal and Abajo Mountains are visible on the skyline. View of Orange Cliffs in middle ground includes Sunset Pass and Gunsight Butte. The Maze Arch, an anticlinal feature, can be seen immediately below the mountain. Road continues to give excellent views toward the east for several miles.
0.4	9.7	STOP NO. 16. Skyline Drive road. Contact between shale and diorite is exposed in road cuts. Such contacts extend for ½-mile along the road and participants may wish to walk the distance.
1.3	11.0	Junction, Skyline Drive and Crescent Creek road. Cross Crescent Creek and continue along Skyline Drive. Road continuing up the canyon gives access to Bromide Basin mining area (unusually strenuous 4-wheel drive road).
1.6	12.6	Cross Copper Creek.
0.9	13.5	Copper Ridge Junction, continue straight ahead. A few vehicles should turn right and travel to Bartons Peak to pick up Bromide Basin hikers (7 miles round trip with leg to Stop 17).
1.3	14.8	Ragged Mountain Junction, turn left.
1.7	16.5	STOP NO. 17. Ragged Mountain bysmalith. A hike will be made to explore a bysmalith close-up. After hike turn around and return to Garden Basin.

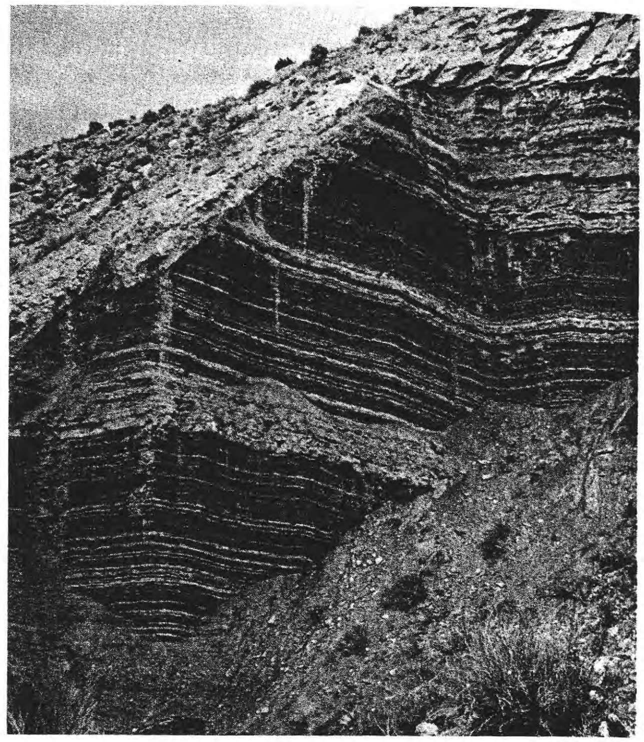
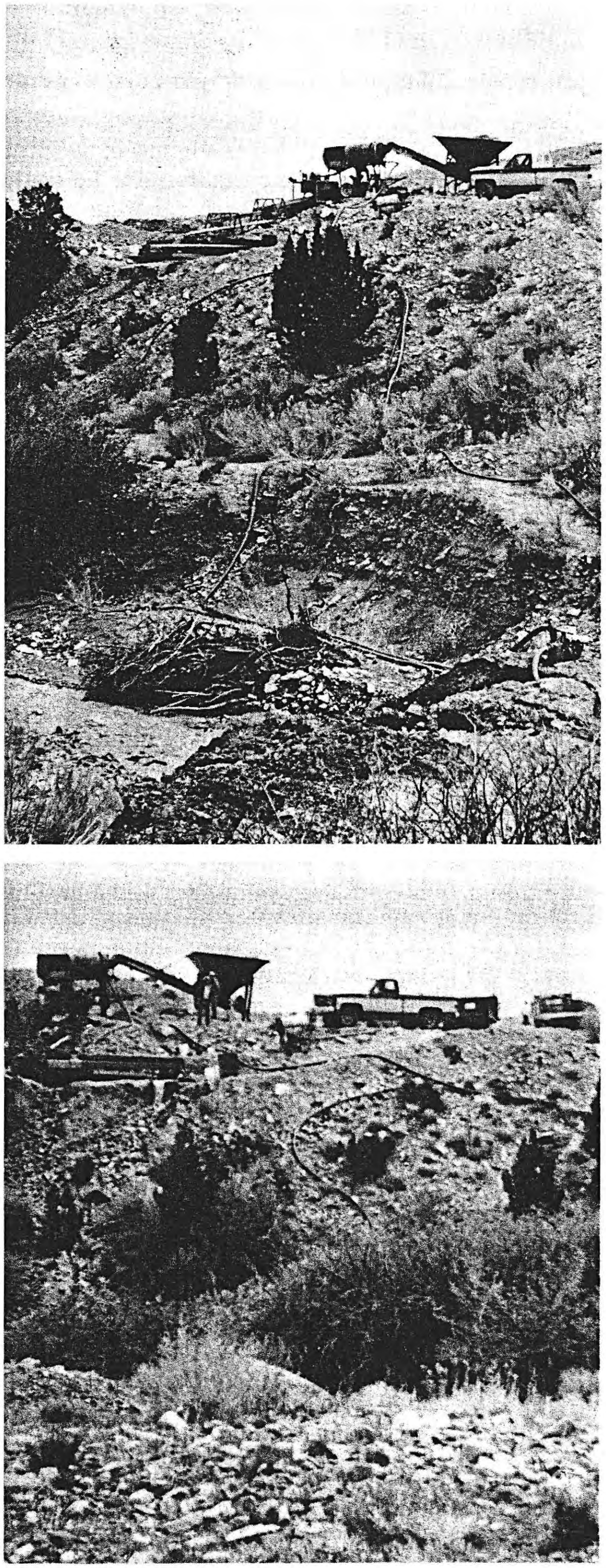


Figure 24.—Excellent exposure of Summerville Formation along the steep east flank of the anticline east of the mountains.

1.2	17.7	LUNCH STOP. Garden Basin, elevation 8,480 ft. After lunch return to Skyline Drive-Crescent Creek road junction.
4.3	22.0	Junction, Skyline Drive and Crescent Creek road, turn right down Crescent Creek road.
0.5	22.5	Immediately to the right of the road is an old road destroyed by spring flooding. The road is on Mancos Shale.
0.2	22.7	Remains of Eagle City. The last building was still up in 1975 and was destroyed by heavy snows. Eagle City flourished in the early 1890s.
0.9	23.6	Proceed onto Eagle Benches, covered with gold-bearing gravels.
0.4	24.0	Westward dipping cliffs of Morrison Formation on the anticline east of the Mountains. To the north exposures of Carmel Formation capping Navajo Sandstone can be seen.
0.4	24.4	Two small Entrada knolls to the left. (north).
0.9	25.3	Cross anticlinal axis north of Maze Arch, note Entrada outcrops covered with gold-bearing gravels to the south (Fig. 23).



igure 25.—Gold placer operation, Spring, 1980. Location is along Crescent Creek.

1.7	27.0	Begin descent into gulch of Crescent Creek. Ahead is steep east limb of anticline, exposing Entrada-Summerville-Salt Wash (Fig. 24).
0.4	27.4	Enter Crescent Creek City gold camp. Commence travel through gorge (gap) in Salt Wash Member.
0.5	27.9	STOP NO. 18. Site of gold placer operations (Fig. 25). Gravel covers Brushy Basin Member. Operations began in 1914 and 300 to 500 ounces of gold have been recovered. Placer operations are conducted on these benches every Spring when there is runoff and gold prices are high.
0.1	28.0	Stone building to the left was used by Crescent Creek gold operators in the early days.
0.2	28.2	Cross Crescent Creek and drive up gravel-covered bench.
0.9	29.1	Road continues on Salt Wash Sandstone.
0.7	29.8	Uranium-vanadium mines in the Salt Wash to the left, cross Crescent Creek.
0.2	30.0	Open-pit uranium mines to the left, small adits to the right.
0.4	30.4	Cross Crescent Creek several times, evidence of gold placering.
0.5	30.9	Junction, continue straight ahead.
0.4	31.3	Summerville Formation outcrop to the left, cattle loading chute to the right.
0.3	31.6	Junction, turn left and north to Utah Highway 95. The road proceeds on the Entrada Sandstone. Note the unconformity at the top of the Entrada.
2.2	33.8	Little Egypt. Stone babies in the Entrada Sandstone (Fig. 26).
0.6	34.4	Cross Wash.
1.1	35.5	Junction, Utah Highway 95, turn left to Hanksville. END OF FIELD TRIP. Road log continues to Hanksville.
1.8	37.3	Excellent pediment surfaces are on the Entrada Sandstone.
1.5	38.8	Cross Poison Springs Canyon. Oil and uranium prospecting has been carried out to the east in this canyon. Poison Springs Creek is a tributary of the Dirty Devil River. Many springs issue into this canyon most of which contain excellent drinking water. Junction with Poison Springs Can-

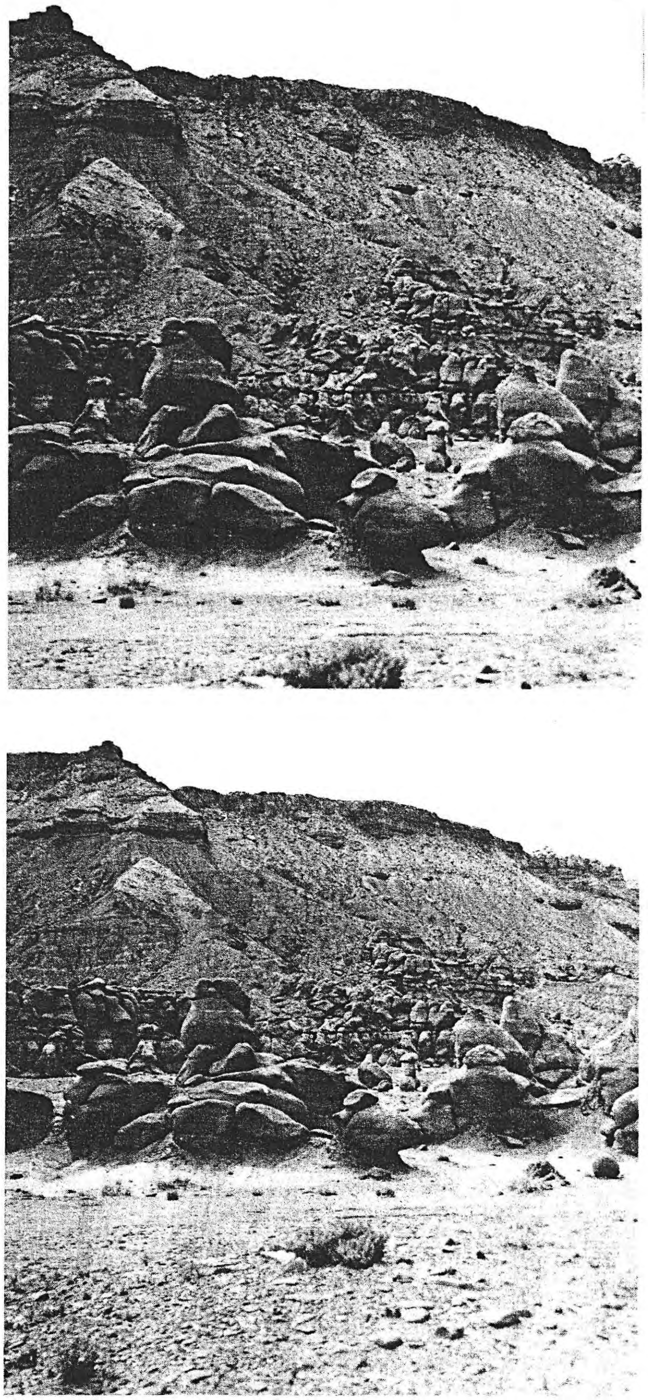


Figure 26.—Entrada Sandstone stone babies at little Egypt. Third day mileage 33.8.

		yon road (right), continue on Utah Highway 95.
1.0	39.8	Garfield County-Wayne County line, elevation about 5,025 ft.
0.5	40.3	Goatwater Point to left, first in a series of points exposing Summerville Formation capped by Salt Wash Sandstone.
3.8	44.1	Sandslide Point to left.
2.0	46.1	Energy Fuels Nuclear buying station road to left.
0.4	46.5	Penitentiary Point to left, road proceeds down Halfway Bench.
6.2	52.7	Entrada Sandstone goblins on right side of road.
1.3	54.0	HANKSVILLE, UTAH. Elevation approx. 4,306 ft. Utah Highway 24, junction to right continues north providing access to Salt Lake City (240 miles) and Grand Junction, Colorado (180 miles). Left route passes through Hanksville and returns to Capitol Reef National Park headquarters. END OF ROAD LOG.

HENRY MOUNTAINS SYMPOSIUM

M. DANE PICARD, Editor

UTAH GEOLOGICAL ASSOCIATION
SALT LAKE CITY, UTAH
1980

UTAH GEOLOGICAL ASSOCIATION PUBLICATION 8