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Geology of the Central House Range Area, Millard County, Utah*

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ABSTRACT.—The House Range is a northerly trending fault block typical of eastern Great Basin structures. The thick Cambrian section exposed in the range was accumulated near the center of deposition in the Cordilleran miogeosyncline. An aggregate approximately 7700 feet thick of Lower, Middle, and Upper Cambrian quartzites, shales, and limestones are well exposed in the map area. Strata commonly strike northeast and have a gentle to moderate southeasterly dip. Unconsolidated alluvium and conglomerates of Tertiary age cover dip slopes on the eastern flank of the range. Quaternary sediments include alluvial fans, lake terraces, stream deposits, and valley fill.

A granitic stock intruded in the sedimentary units caused doming and metamorphism of adjacent strata. Isolated remnants of roof cover lie on the granite at the crest of the divide and on the western front of the range. Tabular dikes and sills associated with the orthomagmatic body extend into sedimentary units near the contact.

Low grade tungsten mineralization in tactite zones near the periphery of the stock has given rise to limited mining operations. Placer gold occurs in arkosic sands and gravels derived from mechanical weathering of the porphyritic granite.

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Purpose and Scope

The House Range Cambrian section, located near the center of deposition in the Cordilleran miogeosyncline, has been famous among stratigraphers since

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it was first described by Walcott in 1908. Until recently, however, the area had not been mapped in detail. It is the purpose of this thesis to present an accurate report and geologic map of Cambrian strata and igneous rocks exposed in the central part of the House Range.

Location and Accessibility

The area considered in this report is located 50 miles southwest of Delta, Utah, in the south-central part of the House Range, Millard County, Utah. (Text-fig. 1). The mapped area comprises approximately 50 square miles and extends the width of the range. It is bounded on the north by former U.S. Highway 50-6 through Marjum Pass, and on the south by an east-west line approximately through the center of the Notch Peak intrusive.

The area is accessible either by former U.S. Highway 50-6 through Marjum Canyon, or present U.S. Highway 50-6 to the south end of the range; these routes are connected by an improved dirt road along the west side of the range. Unimproved roads in Weeks Canyon on the east, Bird Spring Canyon on the north, and Painter Canyon on the west give additional access to the area.

Physical Features

The House Range is a northerly trending fault block typical of the Basin and Range Province. In the area mapped, the maximum elevation is slightly over 9000 feet. The steep western front of the range is a dissected fault scarp. The more gently dipping eastern slope, essentially a dissected dip slope, is principally drained by Weeks Canyon and its tributaries. Marjum Canyon, Bird Spring Canyon, and numerous smaller tributaries effect the drainage of the northern slopes of the area.

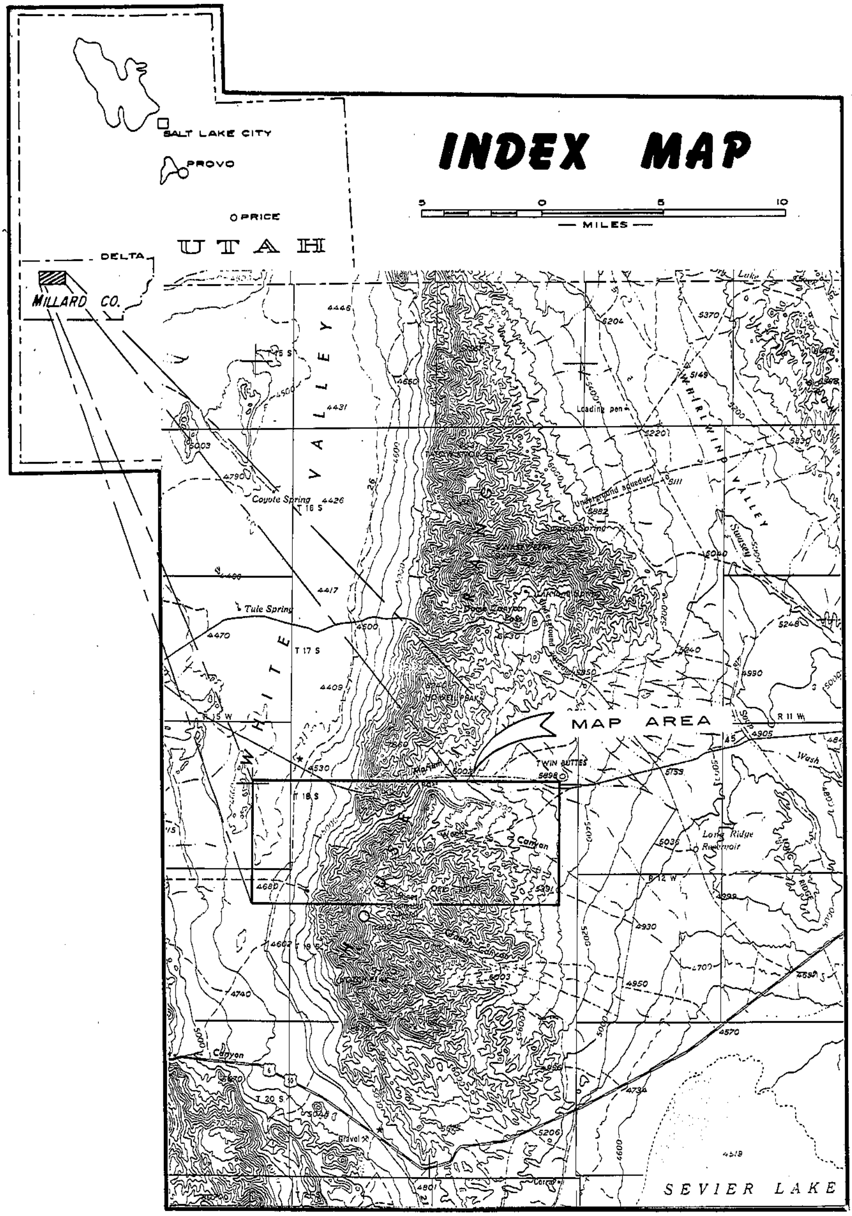
The area is located in an arid to semi-arid climatic region that is conducive to sparse vegetation cover. Although there are several springs in the area, there are no perennial streams. Water stored in two small shallow reservoirs in Amassa Valley on top of the Notch Peak intrusive has been utilized in limited mining operations.

Previous Work

The first geologic work in the House Range was done by Gilbert, who, in 1875 published a measured section of Lower and part of the Middle Cambrian strata. Davis (1905), and Gilbert (1928) described various structural features of the House Range.

In 1908, Walcott measured and published the first complete Cambrian section of the area. This section, revised in part, has remained the standard to the present time.

Deiss (1938) remeasured the Lower, Middle and part of the Upper Cambrian strata in the vicinity of Marjum Canyon. He largely emended Walcott's Lower and Middle Cambrian sections. Wheeler (1948), and Wheeler & Steele (1951) further emended the sections of Walcott and Deiss. These revisions resulted principally in the subdivision of established formational units, and were made on the following bases: (1) recognition of the regional distribution of the lithologic units, and (2) priority of definition. Robison (1960b) made additional revisions in the nomenclature and correlation of stratigraphic units.



TEXT-FIGURE 1.—Index and locality map.

Crawford & Buranek (1943) made the first study of the Notch Peak intrusive earlier referred to by Walcott as a granite porphyry. Kerr (1946) discussed the molybdenum and tungsten mineralization associated with this intrusive body. A later more detailed and comprehensive study of the Notch

Peak intrusive and associated metamorphic rocks by Gehman was published in 1958.

Powell (1959) mapped approximately 100 square miles of the House Range bordering the present area on the south. Regional correlation of the Upper Cambrian formations of western Utah and faunal zonation of these units are contributions of Bentley (1958) and Robison (1960a) respectively.

Present Work

Field work was begun in June, 1957, and continued intermittently to the summer of 1960. Geologic features were mapped on 1:20,00 air photos and later transferred to a semi-controlled photo mosaic that was used as a base map. At the present time the only topographic map of the area available has a scale of 1:250,000. Stratigraphic sections were measured by the use of a Brunton compass and steel tape.

Laboratory work consisted of petrographic studies of thin-sections made from igneous rocks sampled in the area and identification of fossils collected during the mapping process.

ACKNOWLEDGMENTS

The writer is grateful to Drs. Lehi F. Hintze and Kenneth C. Bullock of the Geology Department, Brigham Young University, for supervision of field work and constructive criticism of the manuscript. The field companionship of Keith Powell was greatly appreciated. Thanks are due Richard Robison for aid in identification of fossils collected by the writer. The assistance and encouragement of my wife, Pat, is sincerely appreciated.

STRATIGRAPHY

Introduction

The sedimentary sequence in the central House Range includes a thick section of Cambrian marine strata, partially consolidated Tertiary clastics, and Quaternary alluvium (Text-fig. 2).

An aggregate thickness of approximately 7700 feet of Lower, Middle, and Upper Cambrian quartzites, shales, and limestones are well exposed in the mapped area.

Tertiary conglomerates and unconsolidated alluvium cover dip slope areas of the eastern flank of the range. Quaternary sediments form valley fill, lake terraces, and alluvial fans.

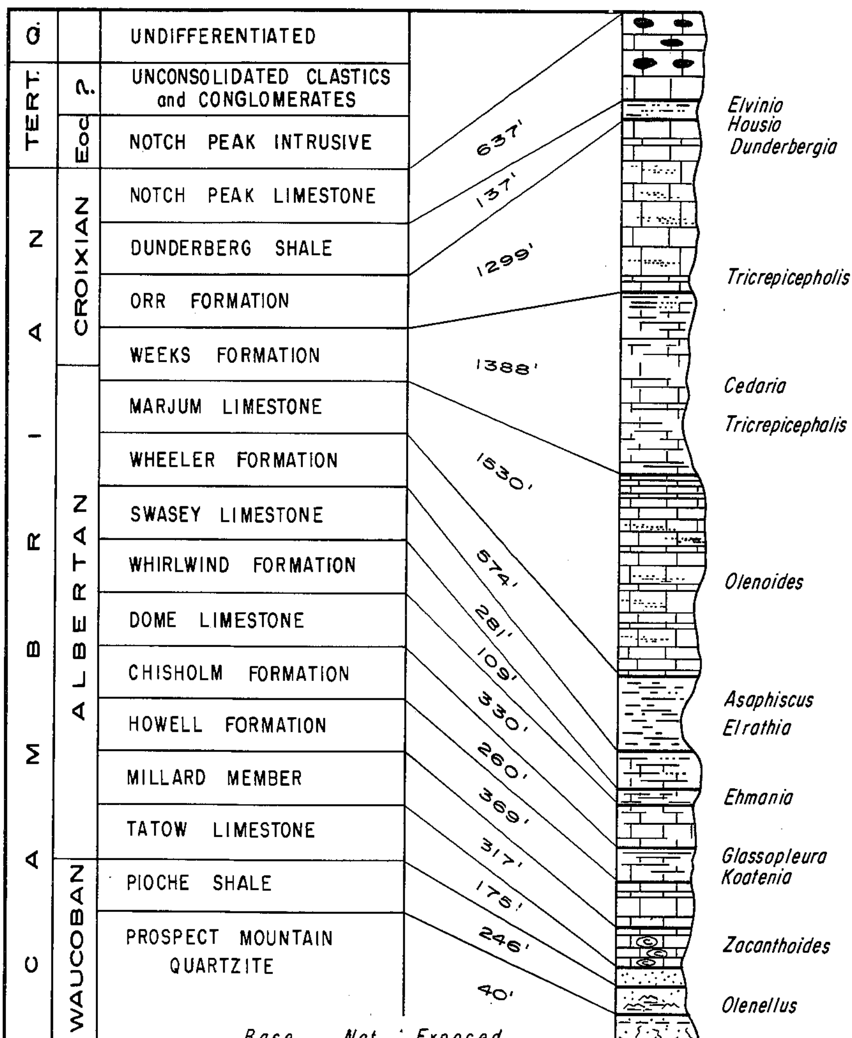
Cambrian System

Pioche Shale

The Pioche Shale crops out in an area of small extent at the mouth of Marjum Canyon in the northwest part of the area mapped. It is 246 feet thick at this point and conformably overlies a small exposure of pink cross-bedded quartzite 40 feet thick. Since this quartzite does not contain any phyllitic interbeds, which is the basis for differentiating the Pioche from the underlying Prospect Mountain Quartzite, it is tentatively assigned to the latter formation.

The Pioche Shale is thin- to thick-bedded, gray-green, slightly cross-bedded quartzite, interbedded with thin micaceous and arenaceous hard green phyllitic shale. The quartzite weathers dark purple, red-brown, dark green, and black; the shales weather light gray and green. The formation is a slope and ledge forming unit.

Walcott (1908, p. 11) defined the Pioche Shale from exposures near Pioche, Nevada, describing it as ". . . . 210 feet of arenaceous and argillaceous shaly layers with some thin layers and bands of limestone more or less irregularly interbedded and limited in horizontal distribution." He correlated the shale in the House Range with the type section on the basis of lithologic similarity and stratigraphic position (1908, p. 184). Wheeler (1948, p. 25) reported the type section in the Pioche district contains an *Olenellus* zone near the base



TEXT-FIGURE 2.—Columnar stratigraphic section of central House Range area.

and an *Albertella* zone at the top, and therefore bridges the Lower-Middle Cambrian boundary. The present writer noted the occurrence of *Olenellus* near the middle of the formation in the House Range. On the basis of this evidence it is merely assigned an Early Cambrian age.

The following section of the Pioche Shale and small exposure of the Prospect Mountain Quartzite was measured near the road at the mouth of Marjum Canyon. Stratigraphic sections reported in this thesis were measured in part by field parties of the 1957 Geology Summer Field Camp, Brigham Young University.

Unit	*Description*	*Feet*
4	Quartzite; light brownish-gray; fine- to medium-grained; weathers dark green, dark brown, or brownish black; micaceous, with thin argillaceous interbeds; forms slopes	83
3	Quartzite and shale; quartzite is tan; weathers dark brown; thin- to thick-bedded, with interbeds of green phyllitic shale; forms series of prominent ledges; *Olenellus* fragments in quartzite beds.	59
2	Quartzite; greenish-gray to light brown; medium- to thick-bedded, with green phyllitic interbeds; basal 8 feet is quartzose gritstone; forms ledges and slopes; contains worm ? trails.	67
1	Quartzite, with interbedded phyllitic siltstones; thin-bedded; weathers reddish-brown, greenish-gray, and light brown; forms slopes and ledges.	37
	Total Pioche Shale	246
Prospect Mountain Quartzite		
	Quartzite; gray-pink; cross-bedded, with inter-bedded medium- to coarse-grained sandstones.	40

Tatow Limestone

Exposures of the Tatow Limestone lie conformably over the Pioche Shale at the mouth of Marjum Canyon. The typical red-brown weathered surface and calcareous nature of the Tatow clearly mark the contact with the Pioche.

The formation is 175 feet thick in Marjum Canyon. It consists of thin- to thick-bedded, fine and medium-grained calcareous sandstone interbedded with gray arenaceous limestone and lenses of gray-green micaceous and arenaceous shale. The limestone is fine- to medium-grained and contains tan arenaceous nodules and stringers.

The type section of the Tatow Limestone defined by Deiss (1938, p. 1143)is one and one-half miles north of Marjum Canyon. This unit had previously been doubtfully assigned to the Langston Formation by Walcott (1908, p. 8) and was later correlated by Wheeler (1948, p. 29) with the Busby Quartzite as defined by Nolan (1935, p. 7-8). The writer concurs with Robison (1960b) in retaining Deiss's terminology. A comparison of Lower and Middle Cambrian stratigraphic terminology is shown in Text-figure 3.

The writer found no fossils in the Tatow Limestone. Deiss, however, reported the occurrence of three species of *Poulsenia* and *Zacanthoides* cf. *levis* (Walcott) in the formation. This evidence places the Tatow in the lower Middle Cambrian, and suggests the series boundary probably closely coincides with the Pioche-Tatow contact.

The following section of the Tatow was measured on the north side of Marjum Canyon by members of the 1957 B.Y.U. Geology Summer Camp.

Unit	Description	Feet
3	Limestone; light gray; sandy; weathers tan; medium-bedded; fossiliferous; forms ledge.	4
2	Arenaceous limestone and calcareous standstone; fine- to medium-grained; tan to dark brown; weathers dark reddish-brown; micaceous; forms ledges and slopes.	31
1	Sandstone; calcareous; dark reddish-brown to gray, with thin beds of greenish-gray calcareous shale; fine- to medium-grained; thin-to medium-bedded; contains 4 foot bed of coarsely crystalline fossiliferous limestone 31 feet above base; forms ledges and slopes.	140
	Total Tatow Limestone	175

Howell Limestone

The "Howell Formation" was originally defined by Walcott (1908, p. 11) from exposures in the House Range about four miles north of Marjum Canyon. Deiss (1938, p. 1144-45) remeasured the formation near Marjum Canyon and emended the description of Walcott. Three distinct lithologic units were included in the formation as described by Deiss. Wheeler (1948, p. 35-38) elevated these units to formational rank, designating them the Millard Limestone, Burrows Limestone, and Burnt Canyon Limestone, from oldest to youngest respectively, correlating the latter two with type sections in the Pioche District, Nevada. Robison (1960b, p. 49-50) reported these correlations are not valid, making a revision of House Range terminology necessary. He further showed that the upper unit of the "Howell Formation" defined by Deiss is correlative with the Chisholm Formation in the Pioche District. Robison proposed, therefore, to use the term Howell Limestone to include only the carbonate sequence overlying the Tatow Limestone and underlying the Chisholm Formation. He also proposed the "Millard Limestone" be dropped from formational rank to that of member of the Howell Limestone. The present writer concurs with these proposals.

Exposures of the Howell Limestone crop out in Marjum Canyon and extend along the west face of the range between the canyon and Rainbow Valley. The formation conformably overlies the Tatow Limestone and constitutes the lowermost limestone unit in the section without appreciable detrital material.

The Millard Member is 317 feet thick in Marjum Canyon. It is medium blue-gray, fine- to medium-grained, thin- to very thick-bedded limestone containing thin lenses and nodules of clay. The rough weathered surface is medium to dark gray and is mottled with orange and brown splotches. Exposures are continuous and commonly form ledges.

The remainder of the Howell Limestone forms light gray prominent cliffs that contrast sharply with the darker colored units above and below it. In Marjum Canyon the massive weathering upper Howell is 369 feet thick. It is predominantly light gray and pink-gray, thin- to thick-bedded, fine-grained limestone that exhibits a pitted and rough weathered surface. Numerous tan clay flakes and white calcite blebs occur throughout the limestone.

No identifiable fossils were found in the Howell Limestone by the writer, although trilobite fragments and algal balls ranging up to two inches in diameter were noted in the Millard Member. However, Wheeler (1948, p. 36) reported the occurrence of *Zacanthoides* in the Millard Limestone, thereby establishing a Medial Cambrian age for the formation.

The following section of the Howell Limestone was measured on the north side of Marjum Canyon:

Unit	*Description*	*Feet*
9	Limestone; light gray; fine-grained; mottled, with darker bands; middle one-third quite shaly; forms top of cliff.	56
8	Limestone; light bluish-gray; fine-grained; somewhat shaly; thin-bedded; forms slopes and ledges.	44
7	Limestone; pinkish-gray; weathers light gray; sub-lithographic; thin-bedded; forms slopes.	16
6	Limestone; same as unit 2, but forms prominent ledge.	30
5	Limestone; light gray; fine-grained; weathers with darker bands about 10 feet thick; mottled; thick-bedded; ledge former.	197
4	Limestone; medium dark gray; weathers same; fine-grained; massive uneven weathering; forms ledges and cliffs above the Millard Member.	26
	Total upper Howell Limestone	369
3	Limestone; medium bluish-gray; medium crystalline; medium-bedded; forms ledges.	109
2	Limestone; bluish-gray; weathers dark gray; bioclastic; algal bodies up to one inch diameter 15 feet above base; forms ledges.	46
1	Limestone; medium-grained; thick-bedded; light bluish-gray; silty and shaly 50 to 70 feet above base; weathers gray, darker toward top, mottled with orange and brown splotches; forms ledges.	162
	Total Millard Member	317
	Total Howell Limestone	686

Chisholm Formation

The upper unit of the "Howell Formation" defined by Walcott (1908, p. 11) and emended by Deiss (1938, p. 1144-45) has been shown by Robison (1960 b, p. 49) to be similar in lithology to the Chisholm Shale of the Pioche District, Nevada, and that it lies within the same faunal zone. This unit was correlated with the Burnt Canyon Limestone of the Pioche District by Wheeler (1948, p. 38), but Robison proved the units are noncorrelative. Concerning the unit, Robison wrote:

> "The first major Middle Cambrian regressive movement in the eastern Great Basin area occurred during *Glossopleura* time. A regressive tongue of green fissile shale was derived from sediments that were swept out over the top of older carbonate deposits in an area that now includes the Pioche District, Wah Wah Mountains, Cricket Range, House Range,, Drum Mountains, Sheeprock Range, Gold Hill District, and the Stansbury Mountains. The name, Chisholm Formation, is here extended to include all occurrences of that facies in the localities listed above." (1960b, p. 47)

The present writer concurs with this definition proposed by Robison.

The Chisholm Formation is a slope and ledge forming unit that weathers dark gray. It is well defined between the cliff-forming light gray limestones that lie in contact with it. Exposures of the formation follow the same outcrop pattern exhibited by the Howell Limestone.

The lower part of the formation is composed of dark gray, fine-grained massive limestone containing thinly spaced tan and brown irregular argillaceous bands. These bands weather differentially and form a very rough surface. The upper part of the formation is largely thin-bedded, but contains a few medium beds and some thin fossiliferous tan and dull gray fissil shales. Fossils are locally abundant.

The following fossils were collected from exposures of the Chisholm Formation in Marjum Canyon:

Glossopleura producta (Hall & Whitfield)
Alokistocare (2 species)
Kootenia sp.

On the basis of this evidence the formation is assigned to the *Glossopleura* zone of the Albertan Series.

The following section of the Chisholm Formation was measured north of the road in Marjum Canyon:

Unit	*Description*	*Feet*
7	Limestone; dark gray; weathers same; thin- to medium-bedded; shaly; forms lower 50 feet of cliff of Dome unit one, from which it is differentiated by abrupt color change.	50
6	Limestone; dark bluish-gray; coarse-grained; bioclastic; shaly; thin-bedded; forms slope.	51
5	Limestone; dark gray; shaly; laminated; fine-grained; forms ledge.	8
4	Limestone; dark bluish-gray; finely crystalline; thin- to medium-bedded; weathers dark sooty gray with orange stains on parting surfaces; forms massive ledges. Fauna: *Glossopleura* sp.	41
3	Limestone; dark bluish-gray; fine-grained; thin-bedded; some banded chert; weathers very dark gray and massive.	20
2	Limestone; dark bluish-gray; weathers sooty dark gray; thick-bedded to massive; forms prominent cliff.	43
1	Limestone; light bluish-gray; weathers same; medium- to thick-bedded; medium- to coarsely-crystalline; silty interbeds; pisolitic interbeds; trilobite fragments in certain layers.	47
	Total Chisholm Formation	260

Dome Limestone

The Dome Limestone lies conformably over the Chisholm Formation and follows the same general outcrop pattern. Exposures are continuous, forming prominent light gray cliffs that distinguish it from adjacent formations. The Dome is fine-grained, medium to dark gray, generally thick- to massive-bedded limestone, but contains a few thin-bedded units. Some argillaceous limestone occurs near the top of the formation that closely resembles units in the underlying Chisholm section. The formation is 330 feet thick in Marjum Canyon.

Walcott (1908, p. 11) defined the Dome Limestone from exposures at the head of Dome (Death) Canyon. He described the formation as "massive bedded, cliff forming, gray, siliceous limestone."

Fossils are found in restricted areas of exposure, but in general are quite rare throughout the formation. R. Robison collected and identified the following fauna from the Dome Limestone that clearly indicates it is Medial Cambrian in age:

Kootenia sp.
Hyolithus sp.
Eoorthis sp.
Undetermined trilobites (2 genera)

The following stratigraphic section of the Dome Limestone was measured in Marjum Canyon on the north side of the road:

Unit	*Description*	*Feet*
5	Limestone; dark gray; thick-bedded to massive; caps cliff.	5
4	Limestone; dark gray, grading to lighter gray in upper part; fine- to medium-grained; mottled in lower half; forms massive cliff.	89
3	Limestone; medium gray; argillaceous; thick- to medium-bedded; platy and laminated with shaly material; forms re-entrant.	33
2	Limestone; medium gray; weathers to very light gray with darker bands in upper one-third; medium- to fine-grained; massive; forms prominent cliff.	83
1	Limestone; dark to medium gray; weathers light gray; iron stained; contains shaly nodules; forms cliff with blocky talus at base.	120
	Total Dome Limestone	330

Whirlwind Formation

The Whirlwind Formation was originally included in the "Swasey Formation" as defined by Walcott (1908, p. 11). Wheeler (1948, p. 39) noted the regional extent of the two distinct lithologic units comprising the "Swasey Formation" and proposed the lower unit be designated the "Condor Member." He established the type section two miles south of Condor Canyon in the Panaca Hills, Pioche, District, Nevada. Fossils collected by Robison (1960b, p. 51) revealed that the "Condor Member" defined by Wheeler is younger than the basal shaly unit of the "Swasey Formation" of Walcott, and is therefore not correlative. Since this left the shaly unit in the House Range without a valid name, Robison proposed it be termed the Whirlwind Formation, deriving the name from Whirlwind Valley east of the range. Usage of the name was also proposed to extend to other localities in the eastern Great Basin, since the unit is mappable and forms an easily recognizable stratigraphic marker. The formation is described in the present paper as defined by Robison.

Paralleling the outcrop pattern of the formations previously described, the Whirlwind Formation crops out conformably over the Dome Limestone in the northwest part of the map area. It is predominantly medium gray, thin-bedded, fine-grained argillaceous limestone interbedded with tan and green calcareous shale and is 109 feet in thickness. Weathered slopes are tan-buff in color except for a distinct ledge of dull gray thin-bedded arenaceous limestone that is almost a trilobite coquina in which *Ehmania* predominates and *Ehmaniella* was noted. The occurrence of *Kootenia* near the middle of the Whirlwind section was noted by R. Robison thereby extending the *Glossopleura-Kootenia* zone described by Wheeler (1948, p. 53).

The following section of the Whirlwind Formation was measured north of the road in Marjum Canyon:

Unit	*Description*	*Feet*
5	Limestone; medium gray; thin-bedded; shaly; weathers to tan and reddish-brown slope; *Ehmania* abundant.	30
4	Limestone; dark gray; weathers orange-tan; thin-bedded; shaly; finely crystalline; forms talus covered slope.	19
3	Limestone; medium gray; weathers light gray; thin-bedded; oolitic and pisolitic in beds; forms ledge; *Ehmania* abundant in several thin beds.	26
2	Limestone; medium gray; weathers orange-gray; thin- to medium-bedded; finely crystalline; forms slope	12

1	Limestone; medium to dark gray; weathers orange-tan to dark gray; finely crystalline; shaly; thin-bedded; forms talus covered slope.	22
	Total Whirlwind Formation	109

Swasey Limestone

The Swasey Limestone caps the dip slope of the wedge-shaped block that forms the south wall of Marjum Canyon and dips southeasterly into Rainbow Valley. As here described, the formation includes approximately the upper two-thirds of the Swasey as defined by Walcott (1908, p. 11), who designated the southwest ridge of Swasey Peak, 12 miles northeast of Marjum Canyon, the type locality.

The lowermost unit of the Swasey is thin-bedded shaly limestone that has a gradational contact with the underlying Whirlwind Formation. The remainder of the formation is predominantly dark gray, fine- to medium-grained, thin- to thick-bedded limestone that is generally a cliff-forming unit. The light to medium blue-gray weathered surface is very rough and exhibits some mottling and banding. Oolites and pisolites are present throughout most of the beds. The upper 25 feet of the formation weathers to rounded buff-tan slopes.

The Swasey Limestone is 281 feet thick in Marjum Canyon. Although no fossils were found in the section, it is definitely dated by its position between two Middle Cambrian formations.

The Swasey Limestone was measured north of the road at Marjum Pass.

Unit	*Description*	*Feet*
5	Limestone; medium to dark gray; thin-bedded; forms weathered slope at top of more resistant cliffs.	25
4	Limestone; medium to dark gray; thick-bedded to massive; finely crystalline; some oolitic and pisolitic beds; forms cliff.	59
3	Limestone; light to medium gray; massive-bedded; coarsely crystalline; oolitic and pisolitic; weathers to rough-surfaced cliff.	118
2	Limestone; medium gray; finely crystalline; thin- to thick-bedded; oolitic and pisolitic; mottled; iron stained; forms ledges.	44
1	Limestone; dark gray; oolitic; thin- to medium-bedded; shaly; finely crystalline; forms ledges.	35
	Total Swasey Limestone	281

Wheeler Formation

The Wheeler Formation crops out in the north part of the mapped area from the summit of Marjum Pass to the head of Marjum Canyon and westward throughout the extent of Rainbow Valley. The cliffs on the south side of the road east of Marjum Pass, the pass itself, and Rainbow Valley are geomorphic features that have resulted from extensive erosion of the formation in those areas. Wherever it is found the Wheeler is typically a valley and slope forming unit.

The Wheeler Formation is 574 feet thick at the head of Rainbow Valley. It consists of fine-grained, dull black, calcareous, platy and fissle shale that contains numerous trilobite fossils. Argillaceous and arenaceous limestones are intercalated with the shale and increase towards the top of the formation. The weathered surface is light blue-gray, tan, and buff. Contact between the basal Wheeler and the upper unit of the Swasey Limestone is marked by an abrupt lithic change and is easily discernable. A distinctive orange-tan weathering limestone bed four feet thick is a good horizon marker 88 feet below the top of the formation.

The Wheeler type locality (Walcott, 1908, p. 10) is Wheeler Amphitheater, approximately five miles north of the mapped area. A Medial Cambrian age assignment is indicated by the following fossils collected in the formation by the writer: (Field collecting localities are shown on geologic map).

Fauna	*Field Location*
Peronopsis interstrictus White	87
Peronopsis bidens (Meek)	87
Elrathia kingi (Meek)	87
Asaphiscus wheeleri Meek	87
unidentified inarticulate brachiopods	87

The Wheeler Formation was measured on a ridge where it is well exposed at the head of Rainbow Valley.

Unit	*Description*	*Feet*
10	Shale interbedded with limestone; shale is platy; calcareous; medium gray; weathers light brownish-gray. Limestone; thin-bedded to laminated; argillaceous; dark gray; weathers medium gray; forms slopes. Fauna: *Asaphiscus wheeleri* Meek *Elrathia kingi* (Meek)	79
9	Shaly limestone with subordinate limy shales; laminated shaly limestone weathers medium gray from dark gray; forms slopes covered with thin platy talus. Fauna: *Asaphiscus wheeleri* Meek *Elrathia kingi* (Meek) *Peronopsis* sp.	108
8	Limy shale; very fine-grained; medium gray; weathers light brownish-gray; contains a few interbedded shaly limestone beds; forms slopes; fauna same as unit 9.	97
7	Shaly limestone; laminated; dark gray; weathers lighter gray; forms a series of ledges. Fauna: *Elrathia kingi* (Meek)	86
6	Shaly limestone; laminated; medium gray; weathers light brownish-gray; forms slopes. Fauna: *Elrathia kingi* (Meek)	56
5	Shaly limestone; laminated; dark gray; weathers medium gray; iron stained. Fauna: *Elrathia kingi* (Meek) *Peronopsis* sp.	36
4	Shaly limestone; thinly laminated; medium gray; abounds with *Peronopsis*.	22
3	Limy shale and laminated shaly limestone; dark gray; weathers light brownish-gray; forms slope. Fauna: *Peronopsis* sp.	57
2	Shale; medium gray; weathers light yellowish-gray; friable; crumbles to slopes.	20
1	Shaly limestone; laminated; medium gray; weathers to tan platy slopes. Fauna: *Asaphiscus wheeleri* Meek *Elrathia kingi* (Meek) *Peronopsis* sp.	13
	Total thickness Wheeler Formation	574

Marjum Limestone

The Marjum Limestone is the youngest Middle Cambrian formation in the House Range. The type locality designated by Walcott (1908, p. 10) is the cliff paralleling the road at Marjum Pass. Exposures in the mapped area continue from Marjum Pass into Bird Spring Canyon, extend west to the head of Rainbow Valley, and from there south to Lost Spring Canyon. The Marjum also crops out in the low hills fronting the Notch Peak intrusive on the west side of the range.

A complete stratigraphic section of the formation 1530 feet thick is well exposed on a steep spur at the head of Rainbow Valley (Powell 1959, p. 10-11). Lower units of the Marjum are similar in lithic character to the upper part of the Wheeler Formation, but are more calcareous. These units are composed of thin-bedded, medium to dark gray, fine to medium-grained argillaceous and arenaceous limestone interbedded with black calcareous platy shale. The weathered surface is gray, buff, yellow, and orange-brown, and exhibits red-brown and yellow-brown argillaceous parting surfaces. The Wheeler-Marjum contact is at the base of some "clinker-like" thin-bedded limestone underlain characteristically in the area by a thin calcite layer two to three inches thick.

Upper units of the Marjum weather to lead-gray steep slopes and cliffs. For the most part, these units consist of thin-bedded, medium to dark gray, finely crystalline limestone, but also contain shaly limestone, and some tan, brown, and yellow fissile shale. Flattened chert nodules and irregular cherty layers occur in the limestone, increasing in abundance towards the top of the section.

Fossils are fairly abundant in the lower part of the formation, but are relatively scarce towards the top, except for agnostid trilobites that range into the base of the overlying Weeks Limestone. Fauna representative of the Marjum collected in the mapped area indicate it is entirely Medial Cambrian in age.

Fauna	*Field Location*
Asaphiscus wheeleri Meek	97
Elrathia kingi (Meek)	79, 121
Peronopsis sp.	97
Orria sp.	117

Weeks Limestone

The type section of the Weeks Limestone (Walcott, 1908, p. 10) is exposed in the mapped area from the base of the massive brown cliff on the south side of Weeks Canyon to the top of the cliff south of Marjum Pass. Further exposures of the Weeks, metamorphosed to some extent, crop out in contact with the north and east margins of the Notch Peak intrusive.

The basal Weeks is fine-grained, thin and medium-bedded, dark gray limestone that forms blocky angular talus. Contact with the underlying Marjum Limestone is apparently conformable and marked by five to ten feet of folded cherty limestone at the top of the formation. The bulk of the Weeks formation is dark gray, fine-grained, thin-bedded, shaly limestone. Upper units contain more argillaceous material and weather orange-brown, yellow-brown, and tan. For the most part, the type section has a poor dip-slope exposure covered in part by Tertiary alluvium. Light gray, pink, and buff "tinkly" talus is common on poorly exposed slope areas.

	WALCOTT 1908	DEISS 1938	WHEELER 1948	ROBISON 1960
MIDDLE CAMBRIAN	LOWER WEEKS FM.	LOWER WEEKS LS.	LOWER WEEKS LS.	LOWER WEEKS LS.
	MARJUM FORMATION	MARJUM LIMESTONE	MARJUM LIMESTONE	MARJUM LIMESTONE
	WHEELER FORMATION	WHEELER SHALE	WHEELER SHALE	WHEELER SHALE
	SWASEY FORMATION	SWASEY LIMESTONE	SWASEY LIMESTONE	SWASEY LIMESTONE
			CONDOR MEMBER	WHIRLWIND FORMATION
	DOME LIMESTONE	DOME LIMESTONE	DOME LIMESTONE	DOME LIMESTONE
	HOWELL FORMATION	HOWELL FORMATION	BURNT CANYON LIMESTONE	CHISHOLM FORMATION
			BURROWS LIMESTONE	HOWELL LIMESTONE
			MILLARD LIMESTONE	MILLARD MEMBER
	SPENCE SH.	TATOW LIMESTONE	BUSBY QUARTZITE	TATOW LIMESTONE
	LANGSTON (?) FORMATION			
LOWER CAMBRIAN	PIOCHE FORMATION	PIOCHE SHALE	PIOCHE SHALE	PIOCHE SHALE
	PROSPECT MOUNTAIN FORMATION	PROSPECT MOUNTAIN QUARTZITE	PROSPECT MOUNTAIN QUARTZITE	PROSPECT MOUNTAIN QUARTZITE

TEXT-FIGURE 3.—Comparative stratigraphic terminology of Lower and Middle Cambrian rocks of central House Range area.

The following fossils were collected from the Weeks Limestone by the writer:

Fauna	*Field Location*
Asaphiscus ? sp.	99
Cedaria minor (Walcott)	134
Oedorhachis ? sp.	134
Peronopsis interstrictus White	134
Tricrepicephalus coria (Walcott)	137

The formation is clearly Late Cambrian in age above the first noted occurrence of *Cedaria* and *Tricrepicephalus* approximately 400 feet above the base of the section. The occurrence of *Asaphiscus ?* approximately 100 feet above the Marjum-Weeks contact indicates the basal Weeks is Medial Cambrian in age and the series boundary lies between the two levels discussed. Robison (1960b, p. 49) confirmed this viewpoint when he reported the late Medial Cambrian agnostid *Lejopyge* was found 150 feet above the base of the Weeks in the House Range and early Late Cambrian *Cedaria* was found at 290 feet. Wheeler (1948, p. 41-42) and Bentley (1958, p. 13) also reported the basal Weeks is part of the Albertan Series. No apparent break in the lithic sequence was noted at the series boundary.

Complete descriptions of stratigraphic sections of the Upper Cambrian formations exposed in the mapped area have been reported by Bentley (1958) and Powell (1959).

Orr Formation

The type locality of the Orr Formation (Walcott, 1908, p. 10) is Orr Ridge, extending east from the Notch Peak intrusive and paralleling Weeks Canyon. The formation was originally defined by Walcott as 1825 feet of arenaceous limestones and shales lying conformably between the Weeks Limestone and the Notch Peak Formation. Bentley (1958, p. 14) divided the Orr Formation into two separate formations, retaining the name Orr Formation for the lower part, and extending the term Dunderberg Shale to the House Range to describe the upper unit.

The Orr Formation is a slope and ledge forming unit 1299 feet thick measured from the nose of Orr Ridge southward to the contact with the Dunderberg Shale. It is light to dark gray, thin- to thick-bedded, fine- to medium-grained arenaceous limestone. The formation is particularly characterized by organic fragments that sometimes comprise a large percentage of the rock material. Oscillation ripple marks are discernable on bedding planes and are more prevalent in upper beds of the section. The weathered surface is usually medium to dark gray, but is reddish-brown in the lower part of the formation. The uppermost unit of the formation is a distinctive horizon marker 42 feet thick composed of light gray fine-grained metamorphosed limestone that weathers light gray.

According to Bentley (1958, p. 17) the Orr Formation was deposited during the second part of the Dresbachian Stage. The following fossils were collected from the type section by the writer and identified by Richard Robison:

Fauna	*Field Location*
Dunderbergia ? granulosa (Hall and Whitfield)	146
Pterocephalia sanctisabae Roemer	146
Tricrepicephalus coria (Walcott)	146

Dunderberg Shale

The type locality of the Dunderberg Shale is exposed near the Dunderberg and Hamburg mines near Eureka, Nevada. This formation was previously designated the Hamburg Shale by Hague (1883, p. 255-56) and later termed the Dunderberg Shale by Walcott (1908, p. 184).

The Dunderberg Shale is a relatively thin unit of broad lateral extent. The writer concurs with the proposal of Bentley (1958, p. 21) that the term be extended in usage to the House Range for beds previously included in the "Orr Formation" described by Walcott (1908, p. 10).

The formation crops out in the mapped area east of the Notch Peak intrusive, conformably overlying the light gray horizon marker at the top of the Orr Formation. The Dunderberg is a slope former composed of two units totaling 137 feet in thickness. The lower unit is 26 feet of medium gray, very fine-grained, fissile shale that weathers olive brown. The upper unit is composed of thin-bedded, fine- to medium-grained, argillaceous and arenaceous gray limestone interbedded with shale similar to that found in the lower unit. The limestone weathers medium gray and has tan and pink mottled blotches.

Fossils collected in the Dunderberg Shale by the writer and identified by Richard Robison indicate the formation belongs to the Franconian Stage.

Fauna	*Field Location*
Elvinia roemeri (Shumard)	147
Iddingsia robusta ? (Walcott)	147
Iddingsia similis (Walcott)	147
Labiostria ? sp.	147

Notch Peak Limestone

Walcott (1908, p. 9) designated the east and southeast slopes and ridges of Notch Peak, located a short distance south of the present area, as the type locality for the Notch Peak Limestone. Approximately the lower 390 feet of the formation as here described and the interval designated the Dunderberg Shale were included in Walcott's original definition of the Orr Formation (1908, p. 10). This limestone unit above the Dunderberg Shale is included in the Notch Peak Limestone on the basis of lithologic continuity.

Only the basal 637 feet of the Notch Peak Limestone is exposed in the area mapped. Bentley (1958, p. 39) reported 1939 feet total thickness in the House Range. Apparently conformable contact with the underlying formation is marked at the base of the massive gray cliffs overlying the slopes formed by the Dunderberg Shale.

Exposures of the formation crop out on the higher slopes and ridges east of the Notch Peak intrusive. At the base, it is largely thick-bedded, but contains some thin-bedded units. Composition is predominantly medium gray, very fine-grained, cherty limestone that is silicified in the area described. Chert occurs as nodules and irregular bands up to two inches in thickness. The weathered surface is very rough in the lower cliff-forming unit, but is smooth and undulating on bedding planes in higher units. Orange-tan, pink, and buff splotches mottle the light to medium gray weathered surface.

No fossils were found in the portion of the formation exposed in the area mapped. Bentley (1958, p. 25) assigned the Notch Peak Limestone to the middle and upper Franconian and the Trempealeauan stages.

Tertiary System

Tertiary alluvium is present in unconsolidated and partially consolidated patches that lie unconformably on dip slope exposures of the Weeks Limestone north of Weeks Canyon and extend into Whirlwind Valley. These deposits consist of angular to rounded material ranging from sand to boulders in size. White volcanic tuff beds exposed near the road at the mouth of Weeks Canyon are interbedded with these clastic deposits.

Comparison of the lithology of the detrital material with formations exposed in the Confusion Range west of the area indicates the Eureka Quartzite and Fish Haven and Laketown dolomites were the major sources of clastics. Boulders of Eureka Quartzite are particularly characteristic and easily recognizable. Partially consolidated deposits are bonded with calcareous and ferruginous cement, giving them red-brown weathered hues. Rock material weathered from the Notch Peak intrusive was also noted in the alluvium.

Deposition of the Tertiary alluvium apparently began with uplift of the eastern Great Basin region and continued until block-faulting produced present structural features.

Quaternary System

The Quaternary System is represented by recent stream deposits and Lake Bonneville sediments. Alluvial fans are present near the mouths of several canyons on the western front of the range. These deposits have been covered or reworked in part by the action of Lake Bonneville. Distinct wave-cut terraces are evident just south of Marjum Canyon in the northwest part of the area. A large portion of the lake sediments has been covered or reworked by intermittant stream action. No attempt was made to differentiate these deposits.

Recent alluvium and colluvium form valley fill in Weeks Canyon and Rainbow Valley. Deposits in Weeks Canyon include reworked Tertiary alluvium and considerable material weathered from the Notch Peak intrusive.

IGNEOUS ROCKS

The Notch Peak intrusive is an apically truncated orthomagmatic stock approximately three by four miles in size. The stock crops out in an oval pattern with the long axis perpendicular to the trend of the range. Contact with surrounding country rock is sharp, fairly steep, and generally discordant. Large sills project from the main body of the intrusive along the western base of the range in the area mapped by Powell (1959). Many smaller dikes and sills, usually only a few feet in thickness, extend from the stock into adjacent sedimentary units. Several tabular dikes also cut the intrusive body and commonly stand out in relief due to greater resistance to erosion.

Linear arrangement of outcrop patterns on aerial photos of the intrusive suggests distinct joint systems are present, but in the field they are not readily apparent. Outcrops are commonly rounded and characterized by concentric sheets formed by exfoliation.

The writer classified the Notch Peak intrusive as porphyritic granite. Results of a chemical analysis of a sample of the intrusive reported by Powell (1959, p. 37) also indicated the stock is granitic in composition. In hand specimen, the rock is a medium grained phanerite containing euhedral to subhedral phenocrysts of orange-pink orthoclase commonly up to an inch in length.

Other minerals in abundance are quartz, plagioclase, and biotite. The relative abundance of orthoclase gives a pink color to the weathered rock surface.

Microscopic examination of the igneous rock revealed that orthoclase, oligoclase, microperthite, and quartz are essential minerals. Orthoclase occurs in the groundmass and as phenocrysts; Carlsbad twinning was noted in some phenocrysts. Albite occurs as perthitic intergrowths in orthoclase and as small grains commonly bordering or penetrating orthoclase crystals. Oligoclase usually occurs in subhedral crystals exhibiting albite twinning and sometimes good zoning. Quartz grains are interstitial to other minerals and vary in size and shape.

Accessory minerals are biotite, sphene, zircon, apatite, and magnetite. Biotite, the most abundant accessory, is strongly pleocloric from almost colorless to dark brown. Alteration products include chlorite replacing some of the biotite, and sericite and kaolinite formed at the expense of feldspar.

Rosiwal analyses of three slides of the igneous rock gave the following percentages of minerals present: (Field locations shown on geologic map).

Field location	47	83	29
Orthoclase	38	36	30
Oligoclase	19	20	23
Microperthite	12	11	18
Quartz	26	28	22
Biotite	4	4	5
Others	1	1	2

Numerous aplite dikes and sills extend from the granite body into surrounding sedimentary rocks. Commonly the dikes are less than five feet thick and tabular in shape. Sills vary in thickness, and like the dikes, are variable in color, grain size, and composition. In order of relative abundance, they are almost entirely composed of oligoclase, quartz and orthoclase.

Aplite dikes within the stock usually are only a foot or two thick and often they pinch out abruptly. Mineral composition is the same as aplites cutting the sedimentary rocks, but orthoclase predominates over plagioclase feldspar. Sericite is abundant as an alteration product.

METAMORPHIC ROCKS

The aureole of metamorphic rocks surrounding the Notch Peak intrusive generally extends outward one to two miles from the periphery. Gehman (1958, p. 34) recognized three distinct types of metamorphism in his study of the granite stock and adjacent strata. These include widespread thermally metamorphosed rocks, extensive areas altered by silica metasomatism, and localized tactitic zones formed by iron-silica metasomatism.

Iso-chemical thermal metamorphism, states Gehman (1958, p. 34), resulted in an amphibolite facies represented by brown-weathering biotite-anorthite hornfels, gray slightly recrystallized limestone containing minute grains of metamorphic minerals, and banded biotite marble. Exposures of the Marjum and Weeks limestones west of the intrusive body and in the north fork of Painter Canyon typify the brown weathering hornfels. The banded biotite marble is composed of alternating layers about an inch thick of biotite-anorthite hornfels and calcite marble. Some lower units of the Weeks Limestone are typically altered in this manner.

The Weeks Formation lies in contact with the north side of the Notch Peak intrusive. Metamorphism of the formation commonly produced thin alternating layers of olive-gray and light gray rock containing euhedral garnet crystals and anhedral crystals of idocrase (vesuvianite). Other minerals noted include diopside, albite, epidote, and wollastonite. The light gray bands are predominantly composed of calcite grains. Gehman (1958, p. 35) classified this rock as banded idocrase marble that was formed by silica metasomatism principally through addition of silica with lesser amounts of alumina. Bedding plane joints primarily controlled passage of metasomatizing solutions.

Tactite zones formed by iron-silica metasomatism lie close to the contact between the granite intrusive and surrounding metamorphic rocks. Aplite dikes are often closely associated with these tactite zones. Nearly black andradite garnet crystals are particularly characteristic of altered areas. Other minerals present are pyrite, quartz, scheelite, and molybdenite. Scheelite is abundant enough in some zones to have been of commercial value during periods when tungsten prices were supported by the federal government. Three samples from the tactite bodies analyzed spectrographically for the writer by the United States Bureau of Mines, Salt Lake City Division, showed the following percentages of elements present:

Ca, Fe, Si	Probably greater than 10 percent
Al, Mg	Probably 1 to 10 percent
K, Mn, Na, Sr, Ti	Probably 0.1 to 1 percent
Ba, Co, Cu, Li, Mo, Ni, V, Zr	Probably 0.01 to 0.1 percent
Cr, Ga, Pb, Rb	Probably 0.001 to 0.01 percent
Be	Probably 0.0001 to 0.001 percent

According to Gehman (1958, p. 41-53) the sequence of metamorphism during granitic intrusion was as follows: Isochemical thermal metamorphism occurred during the intrusion of the magma, and was closely followed at a somewhat lower temperature by silica metasomatism caused by heated connate or meteoric waters. Intrusion of the aplite bodies followed the silica metasomatism and preceded the iron-silica metasomatism that accompanied tungsten mineralization.

STRUCTURE

The House Range is a north-south trending fault block typical of eastern Great Basin structures. Strata in the area generally stike northeast and dip 10 to 20 degrees to the southeast. The attitude of the beds probably has a close relationship to north-south trending folds in the Confusion Range a few miles west of the area, and has led several investigators to conclude the House Range lies on the eastern flank of a northerly trending anticline. Nolan (1943, p. 173) referred to the range as a faulted monocline of large dimensions. Powell (1959, p. 43) reported a 60 mile northerly traverse from Steam Boat Pass in the Ibex Area to Sand Pass at the north end of the House Range showed the structure is further complicated by a broad low syncline and anticline. The present attitude of the sedimentary units has probably also been determined in part by tilting movement associated with the block-faulting process.

Emplacement of the Notch Peak intrusive caused doming of the adjacent sedimentary rocks. Strata near the periphery of the intrusive generally have a tangential strike and vary in dip from moderate on the north and essentially unchanged on the east to comparatively steep on the west.

The mapped area is not complicated by many faults, particularly near the granite intrusive, suggesting the magmatic and metamorphic processes effectively increased the competency of surrounding sedimentary strata. Faulting has been almost entirely restricted to the northwest part of the area, except for the White Valley fault paralleling the west side of the range. In contrast, a structural map of the House Range by Powell (1959, p. 44) shows northeast and particularly southeast trending faults are common south and north of the present area. Hintze, *et al.* (1958, p. 1689) reported major transverse faults disrupt the strata between Marjum Pass and Sand Pass.

The White Valley fault is a high-angle normal gravity fault. The approximate position of the fault is inferred on the geologic map since it is obscured by valley fill and Lake Bonneville sediments. Outcrops of Upper Cambrian limestone in White Valley opposite Lower Cambrian strata near Marjum Canyon indicates vertical displacement approaches 8,000 feet near that area. Six miles to the south, Powell (1959, p. 45) estimated 9,000 feet displacement near Notch Peak, narrowing to 3,000 feet at the south end of the range.

The only other major faulting occurred along what appears to be re-entrant branches of the White Valley fault in the area west and south of Rainbow Valley. Near the steep face of the range between Rainbow Valley and the mouth of Lost Spring Canyon, the Weeks Limestone has been down-faulted opposite the Marjum Limestone. Westward extensions of this fault appear to connect to the White Valley fault below the alluvial cover. A second branch of the fault nearer White Valley cuts across this down-faulted block, placing Notch Peak Limestone in contact with the Marjum and Weeks limestones. Total vertical displacement where the Notch Peak Limestone lies opposite the Marjum Limestone exceeds 3000 feet.

SUMMARY OF GEOLOGIC HISTORY

The present position of the House Range was the site of accumulation of an enormous thickness of Cambrian sediment in the eastern Great Basin. According to Robison (1960b, p. 43) Lower and Middle Cambrian rocks represent sediments deposited in a generally eastward transgressing sea, with minor regressive movements producing the Chisholm and Whirlwind formations. Nearly 5000 feet of Upper Cambrian rocks are exposed in the range. Bentley (1958, p. 4) reported these miogeosynclinal deposits were the thickest encountered in his study of the Upper Cambrian stratigraphy of western Utah. There are no rocks exposed in the map area representing the time elapsed between the Cambrian and Tertiary. Undoubtedly younger sediments were accumulated but have since been removed by extensive erosion.

The Great Basin Province became the site of diastrophism during the Jurassic Period that continued recurrently into early Tertiary (Christiansen, 1951, p. 79-80; Nolan, 1943, p. 171). Active forces that caused faulting, folding, and over-thrusting in the region apparently came from the west. These compressional movements resulted in the general uplift of the area that had persisted as the Cordilleran geosyncline. Major strike-slip transverse faults in the north part of the House Range were probably a result of these forces.

Only a post-Cambrian age can be assigned the Notch Peak intrusive by stratigraphic units present. Nolan (1943, p. 164) states that intrusive bodies at several localities in western Utah are considered to be Eocene. This concurs with the late Eocene or early Oligocene date assigned the Sheeprock stock, 70 miles to the northeast, as determined with samaraskite panned from the intrusive (Harris, 1958, p. 40).

Tertiary alluvium covers dip slopes on the eastern side of the range. Deposition of these clastic sediments followed uplift of the region and continued until block-faulting produced present Basin and Range features. Normal block-faulting is believed to have begun during Miocene and continued to Recent (Christiansen, 1951, p. 80). Quaternary sediments have since been deposited in alluvial fans and as valley fill. These sediments have been partly reworked or covered by the action of Lake Bonneville.

ECONOMIC GEOLOGY

Mines

Mining operations in the vicinity of the Notch Peak intrusive have been confined to small low-grade tungsten deposits in tactite bodies near the periphery and to recovery of placer gold found in arkosic sands and gravels.

Tungsten is derived from scheelite found associated with quartz, andradite, pyrite, and molybdenite. Operation of tungsten mines has been limited to periods when prices have been supported by the federal government, and are closed at the present time. Open pit mining methods have been utilized, but some ore has been recovered from shafts and adits. Records of the United States Bureau of Mines, Salt Lake Division, show tungsten production of the area as follows:

Treasure Mountain Mining and Milling Company—4,300 tons crude ore, averaging 0.8 percent WO_3, that yielded 2,384 units and netted $146,842. A mill built by this company in Amassa Valley to concentrate tungsten ore reportedly will process 100 tons daily.

Mid-States Development Company—recovered 360 units WO_3 which netted $21,231.

Scheelite Queen—2449 tons crude ore, average 0.73 percent, from which 794 units were recovered with a value of $38,912.

Miscellaneous mines—435 units WO_3 with a value of $15,757.

All of these mines are located near the contact of the granite intrusive with metamorphosed sedimentary strata. Favorable beds intersected by joints or dikes controlled localization of ore bodies.

Placer gold has been recovered from arkosic sands and gravels formed by mechanical weathering of the intrusive stock. Operations by the Mineral Valley Gold Company in Amassa Valley atop the intrusive body recovered 43 units of gold that sold for $2577.

Water Supply

Water in the area is derived from springs associated with the granitic stock and from intermittent streams in early spring. Water stored in two small reservoirs in Amassa Valley has been utilized to concentrate tungsten ore and recover placer gold. Water from springs in Painter Canyon on the west side of the range is stored in a steel tank to water livestock. Many of the small springs in the area have been dry during the summer in recent drought years.

REFERENCES CITED

Bentley, C. B., 1958, Upper Cambrian stratigraphy of western Utah: Brigham Young Univ. Geol. Studies, v. 5, no. 6, 70 p.

Christiansen, F. W., 1951, A summary of the structural history of the Great Basin Province in Utah and eastern Nevada: Guidebook to the Geology of Utah, no. 6, Geology of the Canyon, House, and Confusion Ranges, Millard County, Utah, p. 68-80.

Crawford, A. L. & Buranek, A. M., 1943, Amazon stone—a new variety of feldspar for Utah—with notes on the laccolithic character of the House Range intrusive: Utah Acad. Sci., Arts, and Letters, Proc. 19, p. 125-127.

Davis, W. M., 1905, The Wasatch, Canyon, and House Ranges: Harvard Coll. Mus. Comp. Zool. Bull. 49, (g.s. 8), p. 13-56.

Deiss, Charles, 1938, Cambrian formations and sections in part of the Cordilleran trough: Geol. Soc. Amer. Bull., v. 49, p. 1067-1168.

Gehman, H. M., Jr., 1958, Notch Peak intrusive, Millard County, Utah; geology, petrogenesis, and economic deposits: Utah Geol. Mineral. Surv. Bull. 62, 50 p.

Gilbert, G. K., 1875, Report on the geology of portions of Nevada, Utah, California, and Arizona: U.S. Geol. Surv. West 100th Mer. (Wheeler), 3, p. 17-187, 196.

———, 1928, Studies of Basin Range Structure: U.S. Geol. Surv. Prof. Paper 153, 92 p.

Hague, Arnold, 1883, Geology of the Eureka District, Nevada: U.S. Geol. Surv. 3rd Ann. Report, p. 237-290.

Harris, DeVerle, 1958, The geology of Dutch Peak area, Sheeprock Range, Tooele County, Utah: Brigham Young Univ. Geol. Studies, v. 5, no. 1, 82 p.

Hintze, L. F., Powell, Keith, & Hanks, Keith, 1958, Geology of the House Range, Millard County, Utah (Abstract): Geol. Soc. Amer. Bull., v. 69, p. 1689.

Kerr, P. F., 1946, Tungsten mineralization in the United States: Geol. Soc. Amer. Mem., v. 15, 241 p.

Nolan, T. B., 1935, The Gold Hill Mining District, Utah: U.S. Geol. Surv. Prof. Paper 177, 172 p.

———, 1943, The Basin and Range Province in Utah, Nevada, and California: U.S. Geol. Surv. Prof. Paper 197-D, p. 141-196.

Powell, D. K., 1959, Geology of the southern House Range, Millard County, Utah: Brigham Young Univ. Geol. Studies, v. 6, no. 1, 49 p.

Robison, R. A, 1960a, Some Dresbachian and Franconian trilobites of western Utah: Brigham Young Univ. Geol. Studies, v. 7, no. 3, 59 p.

———, 1960b, Lower and Middle Cambrian stratigraphy of the eastern Great Basin: Intermount. Assoc. Petrol. Geol., Eleventh Ann. Field Conference, Guidebook to the Geol. of East Central Nevada, p. 43-52.

Walcott, C. D., 1908, Cambrian sections of the Cordilleran area: Smithsonian Misc. Coll., v. 53, no. 1 (no. 1804), p. 5-12; no. 5, (no. 1812), p. 167-185, 189-200.

Wheeler, H. E., 1948, Late Precambrian-Cambrian stratigraphic cross-section through southern Nevada: Univ. Nevada Bull., v. 42, no. 3, 61 p.

——— & Steele, Grant, 1951, Cambrian sequence of the House Range, Utah: Guidebook to the Geology of Utah, no. 6, Geology of the Canyon, House, and Confusion Ranges, Millard County, Utah, p. 29-37.

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