Upper Cambrian Orr Formation: Its Subdivisions and Correlatives in Western Utah

GEOLOGICAL SURVEY BULLETIN 1405-G

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CONTRIBUTIONS TO STRATIGRAPHY

GEOLOGICAL SURVEY BULLETIN 1405-G

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1976

UNITED STATES DEPARTMENT OF THE INTERIOR

THOMAS S. KLEPPE, *Secretary*

GEOLOGICAL SURVEY

V. E. McKelvey, *Director*

Library of Congress Cataloging in Publication Data

Hintze, Lehi F.
Upper Cambrian Orr Formation, its subdivisions and correlatives in western Utah. (Contributions to stratigraphy)

(Geological Survey Bulletin 1405-G)
Bibliography: p. G24-G25.
1. Geology, Stratigraphic–Cambrian. 2. Geology, Stratigraphic–Nomenclature–Utah. 3. Geology–Utah. I. Palmer, Allison R., joint author. II. Title: Upper Cambrian Orr Formation... III. Series: United States Geological Survey Bulletin 1405-G.
QE75.B9 no. 1405-G [QE656] 557.3'08s [551.7'2'09792] 76-19012

For sale by the Superintendent of Documents, U. S. Government Printing Office
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Stock Number 024-001-02836-1

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UPPER CAMBRIAN ORR FORMATION: ITS SUBDIVISIONS AND CORRELATIVES IN WESTERN UTAH

By LEHI F. HINTZE[1] and ALLISON R. PALMER[2]

ABSTRACT

Five mappable members are recognized in the Orr Formation in the House Range. In ascending order, these are the Big Horse Limestone Member (new), Candland Shale Member (new), Johns Wash Limestone Member (newly applied here), Corset Spring Shale Member (newly applied here), and Sneakover Limestone Member (new). These members can also be recognized in the Fish Springs Range and Cricket Mountains. The Johns Wash Limestone Member is absent in the southern House Range and Wah Wah Mountains so that the Candland and Corset Spring Members merge into one mappable unit herein named the Steamboat Pass Shale Member (new).

Trilobites representing eight of the standard North American assemblage zones have been identified within the Orr Formation. The Big Horse Limestone Member includes the upper *Cedaria* and *Crepicephalus* Zones; the Candland Shale Member contains the *Aphelaspis, Dicanthopyge, Prehousia* and low *Dunderbergia* Zones; the Johns Wash Limestone Member is barren but occupies the upper *Dunderbergia* Zone interval; the Corset Spring Shale Member contains the lower *Elvinia* zone; and the Sneakover Limestone Member includes the upper *Elvinia* and *Taenicephalus* Zones.

Because of facies changes, it is not likely that the Orr Formation and its members can be traced eastward into central Utah where equivalent beds are known as the Opex Formation, nor westward into Nevada where its partial equivalents include the Mendha and Lincoln Peak Formations and Kellogg's (1963) Shingle Limestone.

INTRODUCTION

In western Utah and eastern Nevada, stratigraphers and geological mappers must work with a sequence of Upper Cambrian rocks more than 1,000 m thick and composed mostly of repetitious carbonates. Walcott (1908a, b) was the first to subdivide these rocks into formations in his pioneer stratigraphic and paleontologic work in the House Range (fig. 1). Later, Nolan (1935), Drewes and Palmer (1975), Morris and Lovering (1961), and Staatz and Carr (1964) established different

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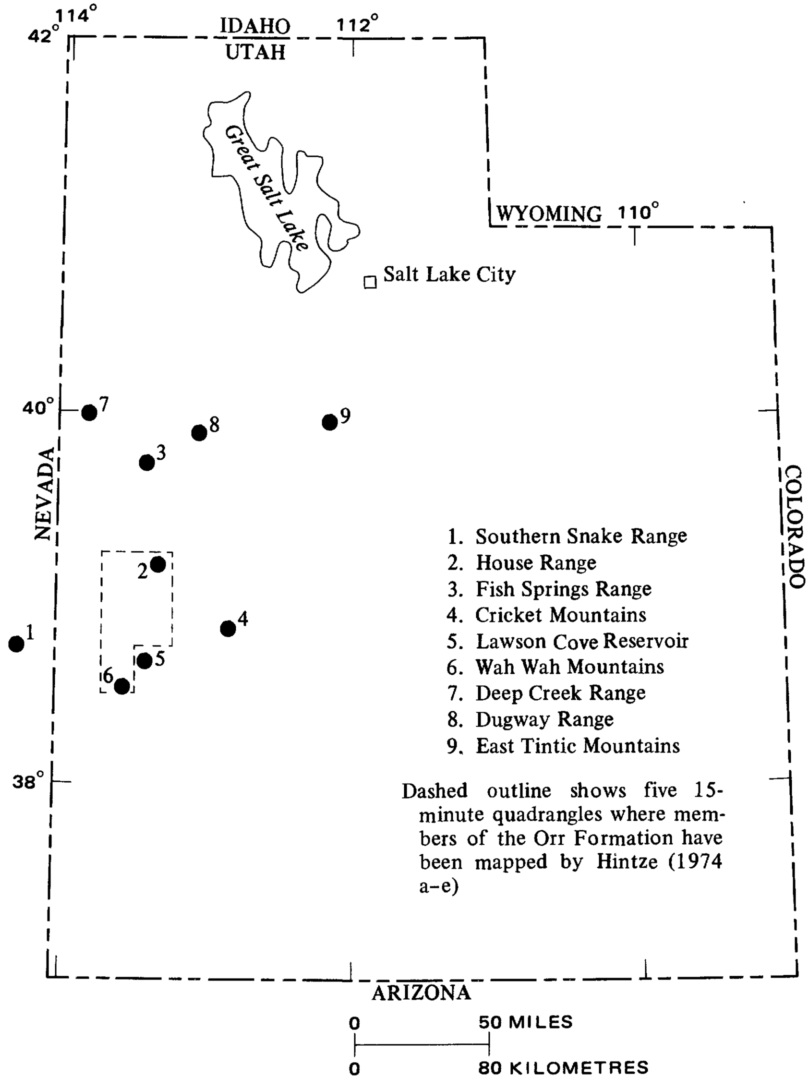
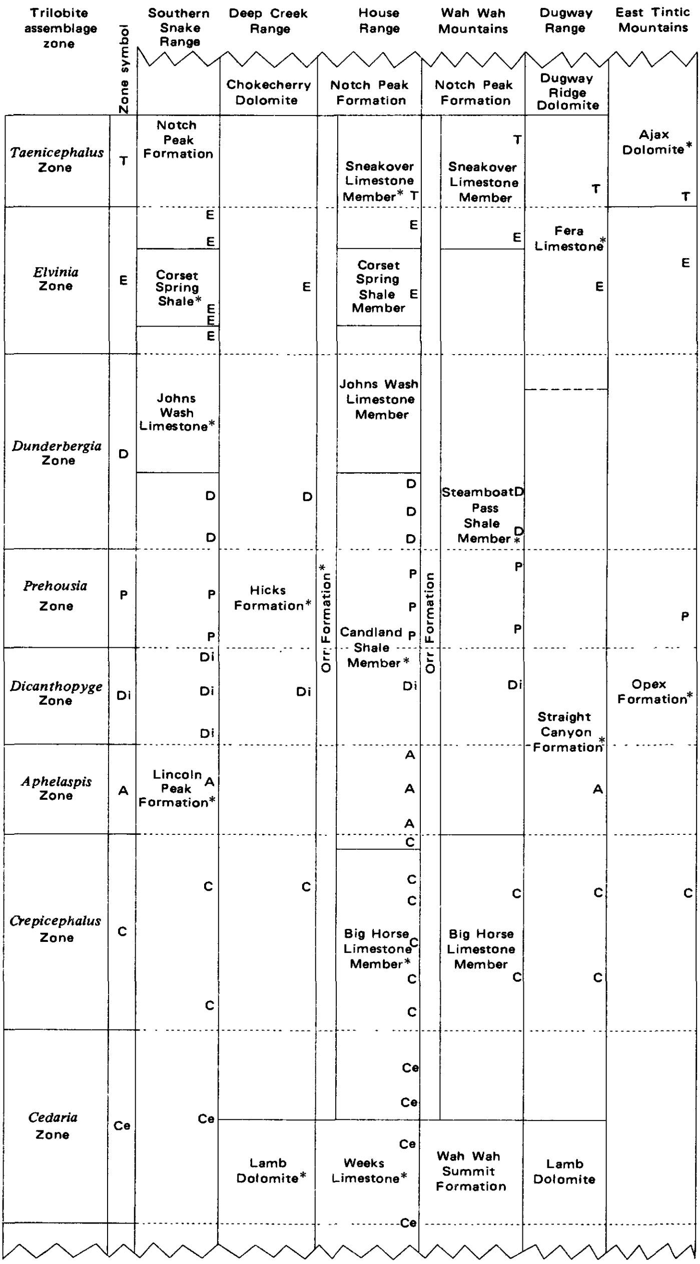


FIGURE 1.—Location map of sections shown in figures 2 and 3.

suites of formation names for map units in the Deep Creek Range, Snake Range, East Tintic Mountains, and Dugway Range respectively (fig. 2).

The Upper Cambrian rock sequence is not so variable as the large number of names might imply. This is particularly true in the area between the Deep Creek, House, and Dugway Ranges in western Utah,



* Type area of formation or member

FIGURE 2.—Correlation of the Orr Formation with units in adjacent areas. Trilobite collections, by zone, approximately located to show basis of correlation.

which is the focus of this paper. In this area, the uppermost unit—the Notch Peak Formation of Walcott, Chokecherry Dolomite of Nolan, and Dugway Ridge Dolomite of Staatz and Carr—is the most uniform. It is entirely limestone and dolomite, much of it in massive beds that tend to be very resistant and form great cliffs along the crests of the ranges.

Beneath the Notch Peak Formation, the middle part of the Upper Cambrian sequence was called the Orr Formation by Walcott, the Hicks Formation by Nolan, and the Straight Canyon and Fera Formations by Staatz and Carr. This part of the Upper Cambrian sequence is the most variable and the most fossiliferous in western Utah.

Beneath the Orr Formation in the House Range, the thin-bedded fossiliferous Weeks Limestone represents deep water, outer shelf sediments deposited in the proximal part of an embayment opening westward towards Nevada (Palmer, 1971, p. 67). The embayment is bounded to the north and south by shallow-water dolomites that make up the cliff-forming Lamb Dolomite (Nolan, 1935) and Wah Wah Summit Formation (Hintze and Robison, 1975) in western Utah.

This paper defines the members of the Orr Formation, as identified and mapped by Hintze (1974a–e), and documents the biostratigraphic control on their ages.

ORR FORMATION AND ITS MEMBERS

The Orr Formation was named by Walcott (1908a, b) for rocks underlying Orr Ridge in the central House Range. Walcott (1908b, p. 174) characterized the Orr as "thin-bedded limestones with two bands of arenaceous shale," and this paper is intended to formalize this subdivision. The type section for these members of the Orr (see "Measured sections" at end of report) is believed to be located in substantially the same place as Walcott's original section. Members of the Orr Formation, as defined herein, can be identified and mapped in the House, Fish Springs, Cricket, and Wah Wah Mountains and, according to R. B. Koepnick (written commun., 1974), can be identified in the Deep Creek Range as well. The Hicks Formation of Nolan (1935) is essentially a synonym for the Walcott's Orr Formation.

BIG HORSE LIMESTONE MEMBER (NEW)

The Big Horse Limestone Member is here named for exposures in Big Horse Canyon as shown on the 1960 U.S. Geological Survey Notch Peak 15-minute quadrangle. Location and description of the type section are given in the section on "Measured sections." This member is believed to represent the same beds designated as units 2a and 2b of the Orr Formation by Walcott (1908b, p. 176–177). Walcott's unit 2c did not prove to be a practicable map unit and was included with the upper part of the Weeks Limestone on the geological map of the Notch Peak quadrangle by Hintze (1974a). The most readily mappable contact between the Weeks and Orr Formations in the House Range occurs at both a lithologic and topographic change from the thin-bedded slope-forming platy arenaceous limestones of the Weeks Limestone to the thicker bedded, ledge- and cliff-forming, coarser grained bioclastic limestones and calcarenites of the Big Horse Limestone Member.

In other ranges in western Utah (fig. 3) the basal contact of the Big Horse Limestone Member is taken at a prominent but different lithologic change. In the Fish Springs Range, the Lamb Dolomite is overlain abruptly by oolitic and clastic limestone assigned to the Big Horse Limestone Member. In the sections in the southernmost end of the House Range and southward in Utah, the Big Horse Limestone Member is underlain by the white marker member of the Wah Wah Summit Formation of Hintze and Robison (1975). The white marker member is a dolomite boundstone-limestone unit nearly 50 m thick, which forms the most conspicuous white band of strata in any part of the Cambrian section in the Wah Wah, Cricket, and southern House Ranges (Hintze and Robison, 1975). The Big Horse Limestone Member generally forms bold cliffs wherever exposed in these ranges. In thickness it ranges from 135 m in the Fish Springs Range to 237 m in the Wah Wah Mountains. In addition to the sections shown in figure 3, it is probably recognizable in the lower part of the Hicks Formation (Nolan, 1935) in the Deep Creek Range.

The type section is the most fossiliferous section of the member known to the writers. In its lowest 60 m it contains the upper *Cedaria* Zone; the remainder of the member bears the *Crepicephalus* Zone.

CANDLAND SHALE MEMBER (NEW)

The Candland Shale Member is named for exposures at the mouth of Candland Canyon which drains the south side of Orr Ridge in the House Range as shown on the 1960 U.S. Geological Survey Notch Peak 15-minute quadrangle. The type section is described in the section on "Measured sections" and is located about 3 km north of Candland Canyon. The Candland Shale Member was designated unit 1e of the Orr Formation by Walcott (1908b, p. 175).

The Candland Shale Member is an easily mappable unit for it forms broad benches and slopes between the underlying cliff-forming Big Horse and overlying Johns Wash Limestone Members. It is also the most fossiliferous unit in the Upper Cambrian section in western Utah; its slopes are littered with thin limestone plates, many of which are near coquinas of inarticulate brachiopod and trilobite fragments.

The Candland Shale Member is composed of interbedded fissile shales and dark-gray thin-bedded limestone. Although limestone makes up much of the Candland, it is designated as a shale in order to emphasize the shaly nature of this part of the Upper Cambrian as contrasted with the nonshaly character of most of the section. Koepnick and Brady (1974) interpret the shale as having been deposited in quiet water below wave base. Certain of the interbedded limestones are believed to be allogenic deposits derived from shelf margin environments peripheral to the deeper basin. The Candland belongs to the outer detrital belt of Palmer (1971, fig. 16F–H). This belt extends from western Utah to central Nevada.

The Candland Shale Member ranges in thickness from about 50 m in the Cricket Mountains to 125 m in the House Range. Its lithology can also be identified within part of the Hicks Formation in the Deep Creek Range (R. B. Koepnick, written commun., 1974) where it is about 60 m thick (fig. 2). Trilobite zones that have been identified in the Candland Shale Member include the uppermost *Crepicephalus* Zone (only in the House Range) *Aphelaspis, Dicanthopyge, Prehousia,* and lower *Dunderbergia* Zones of Palmer (1965). Palmer (1965, 1971) has discussed the correlation of these faunas with the Upper Cambrian in other areas.

JOHNS WASH LIMESTONE MEMBER

Drewes and Palmer (1957) named the Johns Wash Limestone for its occurrence in the southern Snake Range, Nev. Palmer (1965, fig. 9) recognized that the Johns Wash was equivalent to units 1c and 1d of the Orr Formation in the House Range as defined by Walcott (1908b, p. 176). The Johns Wash in western Utah was reduced to a member of the Orr Formation (Hintze, 1974c).

In western Utah the Johns Wash is a ledge- and cliff-forming unit between the underlying slope-forming Candland and overlying Corset Spring Shale Members. As such it is an easily traceable unit on maps (Hintze, 1974a) and aerial photographs. In the House Range the lower half of the Johns Wash is generally dark-gray oolitic limestone, and the upper half is a lighter gray massive limestone. No fossils have been obtained from the Johns Wash Limestone Member in western Utah. It probably represents the time equivalent of the upper part of the *Dunderbergia* Zone according to Palmer (1965, fig. 9).

The Johns Wash Limestone Member ranges in thickness from 26 m in a faulted section in the Cricket Mountains to 76 m in the type section. Within the House Range, the Johns Wash ranges in thickness from 41 to 80 m according to Rees (1975). The Johns Wash Limestone Member is not present in the southern (Black Hills) sector of the House Range nor in the Wah Wah Mountains.

CORSET SPRING SHALE MEMBER

The Corset Spring Shale was defined by Drewes and Palmer (1957) in the southern Snake Range, Nev. Palmer (1965, fig. 9) indicated that the Corset Spring Shale was equivalent to unit 1b of the Orr Formation as defined by Walcott (1908b, p. 176). In western Utah the Corset Spring was reduced by Hintze (1974c) to member rank and applied to the upper shale in the Orr Formation.

The Corset Spring Shale Member is considerably thinner than the Candland Shale Member, and its shales are generally a brighter green and contain fewer limestone interbeds than those of the Candland. The Corset Spring Shale Member always forms a bench or slope between the Johns Wash and Sneakover Limestone Members. Actual exposures of the Corset Spring Shale Member are rare and usually limited to gullies or steep slopes; it ranges in thickness from 12 m in the Fish Springs Range to 36.6 m in the House Range. The Corset Spring Shale Member is generally not so fossiliferous as the Candland Shale Member in western Utah, but it usually yields *Housia* and other trilobites which place it in the *Elvinia* Zone. Palmer (1965) has discussed the correlation of this zone with the Upper Cambrian in other areas. Palmer (1971, fig. 16H) has indicated that the Corset Spring Shale Member is part of an inner detrital belt and is associated with a Cambrian shoreline to the east of the present study area.

STEAMBOAT PASS SHALE MEMBER (NEW)

In the Wah Wah Mountains and the south end of the House Range where the Johns Wash Limestone Member is absent, the Candland Shale Member cannot be mapped separately from the Corset Spring Shale Member, and it is proposed that this interval be called the Steamboat Pass Shale Member of the Orr Formation. The name is taken from Steamboat Pass (Sec. 19, T. 23 S., R. 13 W.) as shown on the 1960 U.S. Geological Survey The Barn 15-minute quadrangle. Although this unit is named for exposures on the north side of Steamboat Pass (Hintze, 1974b), the section 10 km to the southwest near Lawson Cove Reservoir, Frisco Peak 15-minute quadrangle, is designated as the reference section (see section on "Measured sections"). This is the best exposed section known to the writers. A few kilometres to the southwest of the type section, the Steamboat Pass Shale Member forms a bench extending northward from Wah Wah Summit for nearly 20 km along the west face of the Wah Wah Mountains, but throughout this length there are no good exposures except at Wah Wah Summit (see Hintze, 1974e).

The Steamboat Pass Shale Member has yielded trilobites assigned to all five of Palmer's (1965) Pterocephalid biomere zones: *Aphelaspis*, *Dicanthopyge, Prehousia, Dunderbergia,* and *Elvinia.* Within the Steamboat Pass Shale Member, the stratigraphic interval between the lowest *Dunderbergia* Zone and the lowest *Elvinia* Zone occurrence is less than 30 m (fig. 3). But in the Ruby Mountains and near McGill in east-central Nevada, the same interval is nearly three times as thick (Palmer, 1965, pls. 22, 23). We speculate whether this thinning may be related to the brief pre-*Elvinia* regression discussed by Palmer (1971, p. 69–70). However, no physical evidence of an erosional break is apparent within the Steamboat Pass Shale Member.

SNEAKOVER LIMESTONE MEMBER (NEW)

The Sneakover Limestone Member, the uppermost member of the Orr Formation, takes its name from Sneakover Pass in the central House Range as shown on the 1960 U.S. Geological Survey Notch Peak 15-minute quadrangle. The Sneakover Limestone Member represents the interval that Walcott (1908b, p. 175) designated as 1a. The type section is on the east end of Orr Ridge as described in the section on "Measured sections." The Sneakover Limestone Member is a consistently recognizable map unit in most ranges in western Utah where it occurs as ledge-forming outcrops beneath the cliffs of the Notch Peak Formation and above the slopes of the Corset Spring or Steamboat Pass Shale Members. It ranges in thickness between 50 and 60 m, somewhat less than Walcott's original estimate.

Elvinia Zone trilobites can usually be cracked out of limestone beds in the lower half of the member. Orthid brachiopods, many silicified, occur in a thin zone near the middle of the member. The upper half of the Sneakover Limestone Member is characterized by phosphatic brachiopods and hard-to-identify trilobite scraps on pinkish silty limestone bedding surfaces. The contact with the Notch Peak Formation is conformable but well defined by the base of towering cliffs of the Notch Peak. Powell (1959), Hanks (1962), and Whitebread, Griggs, Rogers, and Mytton (1962) included the Sneakover Limestone Member within the Notch Peak Formation on their maps; however, Hintze (1974a–e) included the member in the Orr Formation on his geologic maps.

As shown in figure 3, the fivefold subdivision of the Orr Formation in the House Range becomes a threefold subdivision with the wedging out of the Johns Wash Limestone Member to the south. Equivalents of the upper two subdivisions can be recognized in the Dugway Range (figs. 1 and 2). The Sneakover Limestone Member is equivalent to units 1–4 of the type section of the Fera Limestone measured by Staatz and Carr (1964, p. 29). We obtained *Parahousia* and *Housia* from their unit 5 in its type section and correlate that unit with the Corset Spring Shale Member. The underlying units of the Fera Limestone and Straight

Canyon Formation do not separate readily into our Johns Wash, Candland, and Big Horse Members. Apparently facies changes between the Fish Springs and the Dugway Ranges cause deeper water lithologies typical of the Candland Shale Member to give way to shallower water, less fossiliferous limestone and dolomite so that the identity of the lower subdivisions of the Orr is lost. The Orr Formation is the near equivalent of the Opex Formation of the East Tintic Mountains (Morris and Lovering, 1961) as shown in figure 2. In eastern Nevada the Orr Formation is in part the equivalent of the Mendha Formation of the Pioche mining district (Merriam, 1964), of the Emigrant Springs Limestone in the Schell Creek and Egan Ranges (Kellogg, 1963), and of the upper Lincoln Peak, Johns Wash, Corset Spring, and Notch Peak Formations of the southern Snake Range (Drewes and Palmer, 1957; Whitebread and others, 1962). Correlations with other Upper Cambrian formations in western United States are discussed by Palmer (1971) in a recent paper.

MEASURED SECTIONS

Type section of the Orr Formation, House Range, Utah. The type section of the Orr Formation is a composite of two measured sections on the northeast side of Orr Ridge in the House Range, Millard County, Utah (fig. 4). Units 2–11, the lower part of the formation, were measured on the northeast face of hill 6593 in SE¼ sec. 28, T. 18 S., R. 13 W. The remainder of the formation was measured about half a mile to the south along the ridge between Little Horse Canyon and Big Horse Canyon commencing at about the 6,400-foot contour line in SW¼, SE¼, NE¼, sec. 33, and proceeding south and southwestward along the ridge crest to about the 7,000-foot contour in the south-central part of sec. 33.

The Orr Formation in its type section conformably overlies the Weeks Limestone and conformably underlies the Notch Peak Formation. Massive basal limestones of the Notch Peak form nearly vertical cliffs above the ledges of the Sneakover Limestone Member. All fossils listed below were identified by A. R. Palmer unless otherwise indicated. The number in parentheses after fossil collection identification letters and numbers indicates footage above the base of the unit from which the collection was obtained.

Notch Peak Formation

44. Cliff-forming massive calcilutite and calcisilite bearing less than 5 percent chert. Cliff contrasts markedly with ledges of underlying Sneakover Limestone Member.

Orr Formation

Sneakover Limestone Member (type section)

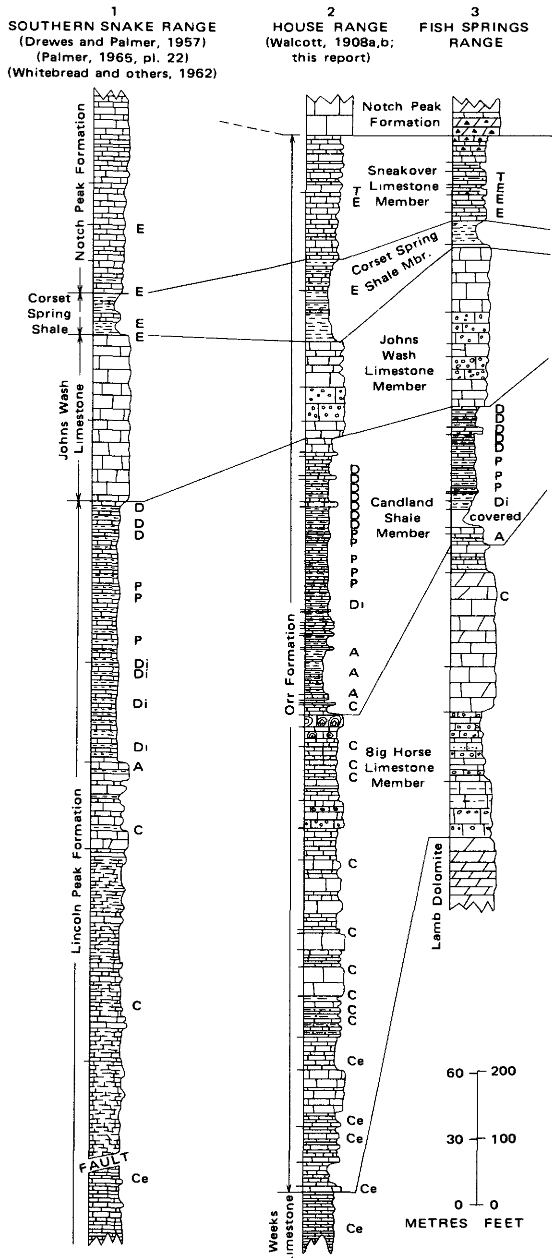


FIGURE 3.—Columnar sections of the Orr Formation in western Utah and equivalent strata in the southern Snake Range, Nev.

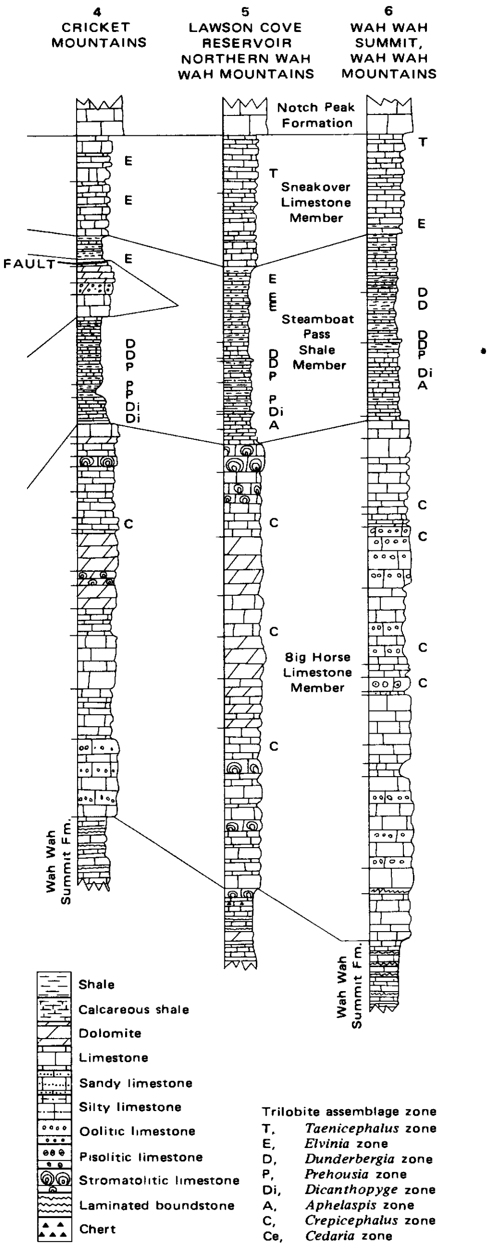


FIGURE 3.—Continued.

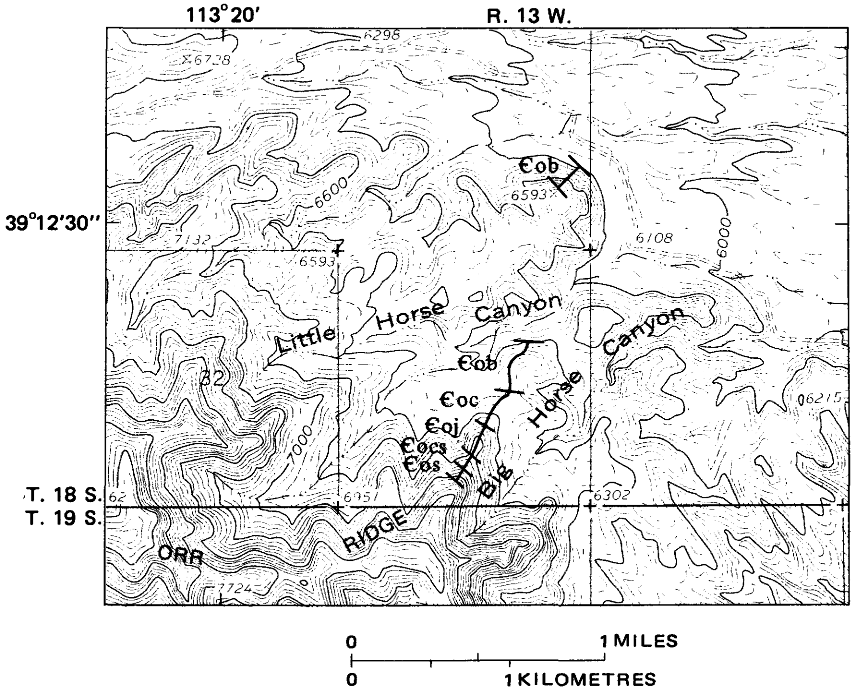


FIGURE 4.—Type section of the Orr Formation and some of its members, House Range, Utah. Ꞓob, type section of Big Horse Limestone Member; Ꞓoc, type section of Candland Shale Member; Ꞓoj, Johns Wash Limestone Member; Ꞓocs, Corset Spring Shale Member; Ꞓos, type section of Sneakover Limestone Member.

Unit	*Feet*	*Metres*
43. Calcisiltite, medium to dark-gray, with pinkish and purplish-gray silty partings; forms 2–4-foot ledges to base of cliff of Notch Peak Formation. Fossils from USGS loc. 7660–CO (+5) were identified by M. E. Taylor as follows: *Parabolinoides* sp. Ptychoparioid trilobite, gen. and sp. indet. Acrotretoid brachiopods, gen. and sp. indet. Linguloid brachiopods, gen. and sp. indet.	85	25.9
42. Calcarenite, light to medium-gray, thin- to thick-bedded, forms continuous low ledgy outcrops. Trilobite fragments common. Fossils from 88 feet above base of unit: *Eoorthis* sp. *Linnarssonella* sp.		

Unit	*Feet*	*Metres*
Pterocephaliid trilobite, gen. and sp. indet.	100	30.5
Total thickness Sneakover Limestone Member	185	56.4
Corset Spring Shale Member		
41. Calcisiltite and calcarenite, dark-gray, in nodular lenses 5–15 cm thick with 30 percent interbedded shale, forms slope with low ledges, transitional contact with Sneakover Limestone Member. Fossils from 4 feet above base of this unit: *Kindbladia* sp. *Iddingsia* sp. *Linnarssonella* sp.	44	13.4
40. Shale, light-olive-gray, fissile, slope-forming. Upper 40 feet includes 10 percent interbedded dark-gray thin-bedded calcarenite; lower part apparently mostly shale; here forming a covered slope	76	23.2
Total thickness Corset Spring Shale Member	120	36.6
Johns Wash Limestone Member		
39. Calcisiltite, medium-light-gray, mottled; lower 20 feet is massive, cliff-forming, the remainder forms ledges, unfossiliferous	70	21.3
38. Oolitic limestone, weathers banded dark to light gray in bedded streaks up to 5 cm, some minor crossbedding; few beds pisolitic, forms massive cliff	50	15.3
37. Calcisiltite, medium-dark-gray, mottled, silty, irregular bedding, forms cliff	25	7.6
Total thickness Johns Wash Limestone Member	145	44.2
Candland Shale Member (type section)		
36. Calcisiltite, medium-dark-gray, uneven bedding, forms talus-covered slope at base of cliff. Lithology similar to basal Johns Wash except that 1 percent of float chips indicate thin-bedded tan-weathering limestone interbedded in this unit	21	6.4
35. Calcisiltite, medium-dark-gray, uneven parting, massive bedding, forms ledge	5	1.5

Unit		*Feet*	*Metres*
34.	Calcisiltite, medium-gray, silty, thin-bedded, forms slope, a few beds are thin-bedded nodular calcarenite with phosphatic brachiopod hash.		
	BHC 365 (+9): Indet. pterocephaliid free cheeks	30	9.3
33.	Calcisiltite, medium-gray, silty, forms ledge. Units 33–36 are transitional with the basal part of the Johns Wash Limestone Member	5	1.5
32.	Limestone, poorly exposed, thin-bedded brown-weathering, with some shaly partings.		
	BHC 349 (+32): *Elburgia* sp.		
	BHC 340 (+23): *Dunderbergia* sp.		
	BHC 335 (+18): *Elburgia* sp., *Strigambitus* sp.		
	BHC 334 (+17): *Elburgia granulosa* (Hall and Whitfield)		
	BHC 325 (+8): *Elburgia granulosa* (Hall and Whitfield)		
	BHC 323 (+6): *Strigambitus* sp.		
	BHC 320 (+3): *Dunderbergia* sp.	34	10.4
31.	Calcisiltite, medium-gray, uneven bedding, forms most prominent ledge in upper part of Candland.		
	BHC 315 (+6) : *Dunderbergia* sp.	8	2.4
30.	Calcarenite, thin-bedded, nodular, phosphatic brachiopod hash abundant, weathers olive to brown, with interbedded olive shale on partings, forms slope.		
	BHC 305 (+150): *Dunderbergia? anyta* (Hall and Whitfield)		
	BHC 292 (+137): *Dunderbergia? anyta* (Hall and Whitfield)		
	BHC 269 (+114): *Prehousia* sp.		
	BHC 258 (+103): *Prehousia alata* Palmer		
	BHC 233 (+78): *Prehousia* sp.		
	BHC 215 (+60): *Dytremacephalus* sp?		
	BHC 210 (+55): *Prehousia* sp.		
	BHC 200 (+45): *Prehousia* sp.		
	BHC 192 (+37): *Bromella* sp.		
	BHC 172 (+17): *Tumicephalus* sp.		
	BHC 161 (+6): *Dicanthopyge convergens* Palmer	154	46.9

Unit		Feet	Metres
29.	Calcarenite, medium-gray, silty, forms ledge	2	.6
28.	Calcisiltite, poorly exposed, thin-bedded, medium-gray, interbedded with brownish-weathering calcarenite and olive shale	18	5.5
27.	Calcarenite, silty, medium-gray, unevenly bedded, forms low ledges	6	1.8
26.	Calcisiltite, medium-gray, thin-bedded, platy, poorly exposed on slope	8	2.4
25.	Calcisiltite, medium-gray, phosphatic brachiopod hash abundant, forms ledge	3	.9
24.	Calcarenite, thin-bedded, nodular, abundant phosphatic brachiopods, probably interbedded with olive shale, forms slope	18	5.5
23.	Calcisiltite, medium-gray, silty, forms ledge	3	.9
22.	Mostly covered, few thin-bedded platy dark-gray limestone beds exposed, probably interbedded with olive shale. BHC 95 (+67): *Aphelaspis haguei* (Hall and Whitfield) BHC 60 (+32): *Aphelaspis haguei* (Hall and Whitfield) BHC 32 (+4): *Cheilocephalus* sp. *Aphelaspis* sp.	69	21.0
21.	Calcarenite, oolitic in part, medium-gray, medium- to thick-bedded, forms low ledges	9	2.8
20.	Covered, thin-bedded limestone float. Thin ledge exposed at top. BHC 19 (+6): *Coosina* sp., *Crepicephalus* sp. hyolithid	6	1.8
19.	Calcarenite, medium gray, silty, forms ledge. BHC 13 (+2): *Tricrepicephalus* sp.	2	.6
18.	Covered, thin-bedded limestone float, medium-gray calcarenite and calcisiltite	11	3.4
	Total thickness Candland Shale Member	412	125.6

Big Horse Limestone Member (type section)

Unit		Feet	Metres
17.	Stromatolitic limestone, medium-gray, forms massive ledge, prominent on aerial photographs as mapping horizon	20	6.1
16.	Interbedded stromatolitic limestone and trilobite-bearing calcarenite, thin to medium bedded, forms dip slope along ridge crest.		

Unit		Feet	Metres
	LH 280 (+5): *Crepicephalus* sp.		
	Kingstonia sp.	30	9.2
15.	Calcarenite, medium-gray, thin-bedded, silty, forms low ledges and benches to top of hill along traverse.		
	LH 250 (+55): *Crepicephalus* sp.		
	Coosina sp.		
	LH 233 (+38): *Crepicephalus* sp.		
	Coosina sp.		
	Lonchocephalus? sp.	80	24.4
14.	Calcarenite, medium-gray, with oolite and pisolitic beds, forms ledges	40	12.2
13.	Calcarenite, medium-gray, thin- to medium-bedded, includes 5 percent oolite layers, forms slope	50	15.2
12.	Calcisiltite and fine-grained calcarenite, medium- to dark-gray, medium- to thick-bedded, forms ledge-slope sequence. Trilobite fragments are common in the calcarenite, but none complete enough to be identified	105	32.0
11.	Calcisiltite, medium-gray, contains stromatolitic algal bed 30 cm thick, forms backslope on hill crest of lower part of measured section.		
	NC 387 (+2): *Crepicephalus* sp.	5	1.5
10.	Calcisiltite, medium-dark-gray, massive, contains about 1 percent bedded chert, forms massive cliff that caps hilltop	25	7.6
9.	Calcisiltite, medium-gray, thin-bedded, forms steplike ledges	27	8.2
8.	Calcarenite, medium-gray, silty, forms massive cliff.		
	NC 333 (+44): *Blountia* sp.		
	Crepicephalus sp.		
	Kingstonia sp.		
	Kormagnostus sp.		
	Meteoraspis sp.		
	Tricrepicephalus sp.		
	NC 291 (+2): *Arcuolimbus* sp.		
	Blountia sp.		
	Coosella sp.		
	Kingstonia sp.		
	Lonchocephalus sp.		
	Pseudagnostina sp.		

Unit	Feet	Metres
Tricrepicephalus sp. ------	44	13.4
7. Calcarenite, medium-gray, weathers moderate brown, thin-bedded, contains about 50 percent silt in thin-bedded zones, forms dark-brownish-gray ledges. NC 273 (+43): *Blountia* sp. *Crepicephalus* sp. NC 257 (+27): *Blountia* sp. *Coosella* sp. *Crepicephalus* sp. *Pseudagnostina* sp. ------	59	18.0
6. Calcarenite, bioclastic, similar to unit 4 except thin-bedded and slope forming. NC 195 (+15): *Genevievella* sp. *Blountia* sp. *Kingstonia* sp. *Meteoraspis* sp. *Pseudagnostina* sp. echinoderm plates ------	50	15.2
5. Calcarenite, thin- to medium-bedded, medium gray, weathers reddish brown, lowest 2 m forms ledge, next 4 m form a slope, highest 19 m forms a prominent cliff line along this hill front. NC 107 (+13): *Blountia* sp. *Kingstonia* sp. ----------	86	26.2
4. Calcarenite, medium- to dark-gray, with yellowish and pinkish-gray silty material on bedding surfaces. Thin to medium bedded, in part bioclastic with much fragmental trilobite material, forms ledges to 1.3 m high. NC 80 (+37): *Genevievella?* sp. *Coosella* sp., *Blountia?* sp. *Kingstonia* sp. *Tricrepicephalus* sp ------	51	15.6
3. Calcarenite, medium-gray, silty, weathers brownish gray, forms covered slope with about 10 percent exposure ----------------	39	11.9
2. Calcarenite, medium-gray, weathers brownish gray, silty, trilobites abundant in nonsilty calcarenite lenses. NC 4 (+4): *Genevievella* sp.		

Unit		Feet	Metres
	Kingstonia sp.		
	NC 3 (+3): *Genevievella* sp.		
	Kingstonia sp.		
	Meteoraspis sp.		
	Deiracephalus sp.		
	Blountia sp.		
	Brassicicephalus sp.		
	Coosella sp.	4	1.2
	Total thickness Big Horse Limestone Member	715	217.9
	Total thickness of Orr Formation	1,577	480.7
	Contact conformable		

Weeks Limestone

1. A slope-forming platy silty calcilutite, that contrasts both lithologically and in topographic expression with the ledge- and cliff-forming partly bioclastic calcarenite strata of the overlying Big Horse Limestone Member.

Reference section of the Orr Formation, near Lawson Cove Reservoir, northern Wah Wah Mountains, Utah. Section is located half a mile west of Lawson Cove Reservoir on the east side of Hill 6190 in SW¼ sec. 29, T. 24S., R. 14W., as shown on the USGS 1960 Frisco Peak 15-minute topographic map (fig. 5). All fossils listed below were identified by A. R. Palmer unless otherwise indicated. The number in parentheses after fossil collection identification letters and numbers indicates footage above the base of the unit from which the collection was obtained.

Notch Peak Formation

Basal limestone is medium gray, massive calcisiltite and calcilutite with almost no partings. It is about 100 m thick, caps hill 6190, and forms a smooth cliff rising prominently above the ledge-slope topography of the upper part of the Orr Formation.

Conformable contact.

Orr Formation

Sneakover Limestone Member

Unit		Feet	Metres
11.	Calcisiltite and calcilutite, medium-light- to dark-gray, medium- to thick-bedded with pinkish silty parting on bedding surfaces. Phosphatic brachiopods common in dark layers. Forms ledges. Fossils from USGS loc.		

Unit		*Feet*	*Metres*
	7668–CO (+28) were identified by M. E. Taylor as follows:		
	Parabolinoides sp.		
	Acrotretoid brachiopods, gen. and sp. indet.		
	Linguloid brachiopods, gen. and sp. indet.	85	25.9
10.	Calcisiltite and calcilutite, medium-light-gray, silty, forms regular ledges 0.6–1.2 m high	110	33.5

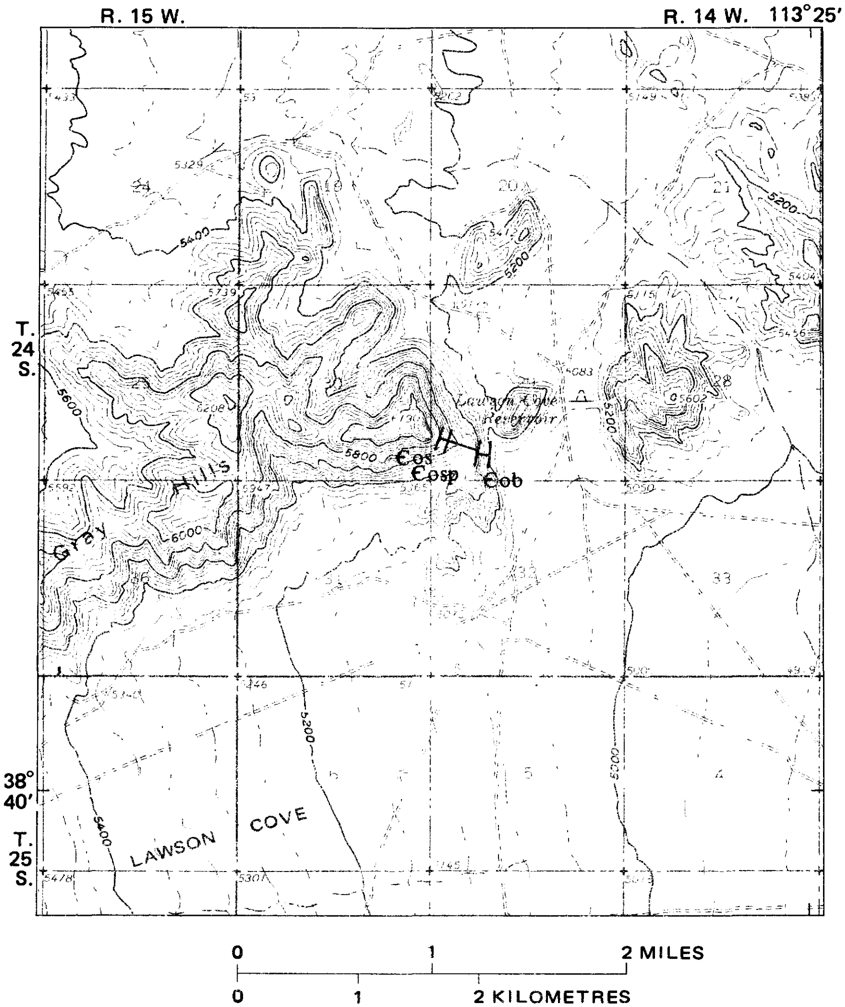


FIGURE 5.—Reference section of the Orr Formation and its Steamboat Pass Shale Member, northern Wah Wah Mountains, Utah. €ob, Big Horse Limestone Member; €osp, Steamboat Pass Shale Member; €os, Sneakover Limestone Member.

Unit	*Feet*	*Metres*
Total thickness Sneakover Limestone Member	195	59.4
Steamboat Pass Shale Member (reference section)		
9. Shale, light-olive-gray, flaky, with 50 percent interbeds of medium-gray thin-bedded calcarenite; forms steep slope at base of Sneakover ledges. LC 247 (+97): *Iddingsia* sp. LC 245 (−95): *Iddingsia* sp. LC 216 (+66): *Iddingsia* sp. LC 215 (+65): *Iddingsia* sp., *Kindbladia* sp. LC 205 (+55): *Kindbladia affinis* (Walcott)	115	35.1
8. Calcisiltite with some interbedded calcarenite, dark-gray, silty, thin-bedded, 10 percent exposure, forms slope. LC 135 (+10): *Aphelotoxon acuminata* (Palmer), *Elburgia intermedia* Palmer *Prehousia diverta*	25	7.6
7. Calcarenite, medium-gray, ledge. LC 125 (+2): *Pterocephalia* sp. *Dunderbergia* sp.	2	.6
6. Calcarenite, medium-dark-gray, weathers olive gray, thin-bedded, nodular bedding with silty partings, large trilobites abundant. LC 105 (+15): *Prehousia alata* Palmer LC 100 (+10): *Prehousia alata* Palmer	33	10.1
5. Calcisiltite, dark-gray, thin-bedded, with shaly partings, forms low ledges and platy talus. LC 70 (+25): *Bromella*? sp. LC 64 (+19): *Bromella*? sp. LC 55 (+10): *Tumicephalus depressus* Palmer LC 50 (+5): *Tumicephalus depressus* Palmer	45	13.7
4. Calcisiltite, medium-dark-gray, ledge	2	.6
3. Calcisiltite and fine-grained calcarenite, with a few intraformational conglomerate lenses, medium-dark-gray, thin-bedded, forms slopes and platy talus.		

Unit	Feet	Metres
LC 35 (+15): *Aphelaspis*? sp. (toward *Tumicephalus*)		
LC 30 (+10): *Aphelaspis*? sp	23	7.0
2. Calcisiltite, dark-gray, thin-bedded, with 20 percent interbeds of light-brownish-gray laminated dolomite	20	6.1
Total thickness Steamboat Pass Shale Member	265	80.8

1. Big Horse Limestone Member of Orr Formation lies conformably beneath Steamboat Pass Shale Member and is about 700 feet (213 m) thick in this section. It consists mostly of massive medium- to dark-gray limestone with a few thin stromatolitic algal beds and a few bioclastic calcarenite beds. It forms steep ledges and cliffs to the base of the hill. Underlying formations are not exposed here.

Fossil identifications for collection locations shown in figure 3.
Fish Springs Range

Sneakover Limestone Member: Collections from NW, NE, NW, sec. 10, T. 13 S., R. 14 W. Number in parentheses is footage above base of member.

FS 555 (+60): *Billingsella* sp.
Parabolinoides sp.
Pseudagnostus sp.
FS 545 (+50): *Irvingella major* Ulrich and Resser
FS 525 (+30): *Elvinia*? sp.
Pterocephalia sp.
FS 505 (+10): *Irvingella flohri*? Resser
Elvinia sp.
Kindbladia sp.
Iddingsia sp.

Candland Shale Member: Collections from NE, NE, SE, sec. 27, T. 12 S., R. 14 W. Identification number is footage above base of member.

FS 198: *Elburgia granulosa* (Hall and Whitfield)
Strigambitus sp.
Dytremacephalus sp.
FS 186: *Strigambitus utahensis* (Resser)
FS 177: *Strigambitus utahensis* (Resser)
FS 158: *Dunderbergia*? *anyta* (Hall and Whitfield)
Pseudagnostus sp.
Dunderbergia bigranulosa? Palmer
FS 138: *Dunderbergia bigranulosa*? Palmer

Unit *Feet* *Metres*

Cernuolimbus granulosus Palmer
Aphelotoxon sp.
Homagnostus sp.
FS 125: *Prehousia alata* Palmer
FS 100: *Prehousia alata* Palmer
Pseudagnostus sp.
FS 85: *Bromella* sp.
Dysoristus sp. (very distinctive brachiopod)
FS 67: *Tumicephalus depressus* Palmer
Dicanthopyge convergens Palmer
FS 61: *Tumicephalus depressus* Palmer
Dicanthopyge? sp.
FS 58: *Tumicephalus depressus* Palmer
FS (Zero): *Aphelaspis* sp.
Cheilocephalus sp.
Homagnostus sp.

Big Horse Limestone Member:
FS minus 75: (75 feet below top of member)
Crepicephalus sp.

Cricket Mountains

Candland Shale Member: Collections from NE¼ sec. 8, T. 23 S., R. 9 W. on Hall Mountain. Identification number is footage above the base of member.

HM 245: *Housia* sp.
HM 240: *Housia* sp.
HM 120: Pterocephaliid trilobites
HM 95: *Dunderbergia*? sp.
Elburgia? sp.
HM 85: *Prehousia alata* Palmer
HM 50: *Bromella*? sp.
HM 40: *Bromella*? sp.
HM 30: *Tumicephalus depressus* Palmer
HM 25: *Tumicephalus depressus* Palmer
HM 20: *Tumicephalus depressus* Palmer
HM 10: *Tumicephalus depressus* Palmer

Wah Wah Mountains: Collections from Wah Wah Summit, sec. 21. T. 26 S., R. 15 W. Number in parentheses is footage above the base of the Steamboat Pass Shale Member.

Sneakover Limestone Member:
WS 895 (+425): *Parabolinoides* sp.
WS 765 (+295): *Housia* sp.

Unit		*Feet*	*Metres*
Steamboat Pass Shale Member:			
WS 660 (+190):	*Dunderbergia* sp.		
	Erixanium carinatum Palmer		
	Pterocephalia sp. (early form)		
WS 645 (+175):	*Dunderbergia* sp.		
	Prehousia sp.		
WS 597 (+127):	*Elburgia* sp.		
	Strigambitus sp.		
WS 584 (+114):	*Dunderbergia*? *anyta* (Hall and Whitfield)		
	Elburgia sp.		
WS 573 (+103):	*Prehousia alata* Palmer		
	Pseudosaratogia? sp.		
WS 533 (+63):	*Aphelaspis* or *Bromella*		
WS 525 (+55):	*Aphelaspis* n. sp. with occipital spine		

Big Horse Limestone Member: Number in parentheses is the footage below the top of the member.

WS 340 (−130):	*Crepicephalus* sp.		
	Kingstonia sp.		
	Tricrepicephalus sp.		
WS 295 (−175):	*Crepicephalus* sp.		
	Tricrepicephalus sp.		
	Coosina sp.		
	Llanoaspis sp.		
	Terranovella sp.		
WS 132 (−338):	*Coosella* sp.		
	Kingstonia sp.		
WS 78 (−392):	*Kingstonia* sp.		
	Meteoaspis? sp.		

ACKNOWLEDGMENTS

This work is the outgrowth of a field-mapping program conducted in western Utah since 1955 by the senior author in connection with Brigham Young University Department of Geology summer camps. Several scores of students have sharpened the writers' perception of the map units described herein, in particular Bentley (1958), Powell (1959), Kepper (1960), Robison (1960), and Hanks (1962). Dick Koepnick and Peggy Rees, graduate students currently at the University of Kansas, have been most helpful as has K. C. Lohmann, a graduate student at the State University of New York at Stony Brook. Thanks are due Ralph Holmgren, director of the U.S. Forest Service Desert Range Experiment Station and to Lee Herzberger and Rolf Kraft of the Fish Springs National Wildlife Refuge for providing camp facilities which ameliorated life on the desert. The U.S. Geological Survey and the Utah Geological and Mineralogical Survey have supported the quadrangle mapping program in the past 6 years. Thanks are due to William Hewitt and Donald McMillan of the Utah Survey and to Max Crittenden, Hal Morris, and George Walker of the U.S. Geological Survey for their interest in the work and their assistance in making the mapping program possible. Michael E. Taylor of the U.S. Geological Survey in Washington has been most helpful in identifying fossils from the Sneakover Limestone Member.

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☆GPO 691-311–1976