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HORACE D. THOMAS, STATE GEOLOGIST

BULLETIN NO. 38

STRATIGRAPHIC SECTIONS OF MESOZOIC ROCKS IN CENTRAL WYOMING

BY

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UNIVERSITY OF WYOMING
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STRATIGRAPHIC SECTIONS OF MESOZOIC ROCKS IN CENTRAL WYOMING[1]

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J. D. Love, H. A. Tourtelot, C. O. Johnson,
R. M. Thompson, H. H. R. Sharkey, and A. D. Zapp[2]

INTRODUCTION

More than 30 detailed stratigraphic sections of Mesozoic rocks were measured in central Wyoming as part of the program of oil and gas investigations in Wyoming by the Geological Survey, U. S. Department of the Interior. The program was designed to furnish basic data necessary to: (1) establish consistent formation boundaries of regional significance; (2) establish a logical stratigraphic terminology; (3) construct thickness maps as a necessary foundation for a structural contour map; and (4) make facies studies that would yield data pertinent to evaluation of possible stratigraphic traps, porosity traps, and untested sandstones on anticlinal structures.

Many of the sections have been presented graphically on the following Preliminary Charts of the Oil and Gas Investigations series:

Stratigraphic sections and thickness maps of Triassic rocks in central Wyoming, *U. S. Geol. Survey Oil and Gas Invest., Prelim. Chart 17*, 1945.

Stratigraphic sections and thickness maps of Jurassic rocks in central Wyoming, *U. S. Geol. Survey Oil and Gas Invest., Prelim. Chart 14*, 1945.

Stratigraphic sections and thickness maps of Lower Cretaceous and nonmarine Jurassic rocks of central Wyoming, *U. S. Geol. Survey Oil and Gas Invest., Prelim. Chart 13, 1945.*

Stratigraphic sections and thickness maps of Upper Cretaceous Thermopolis, Mowry, and Frontier rocks in central Wyoming, *U. S. Geol. Survey Oil and Gas Invest., Prelim. Chart* (in preparation).

There have been many requests by oil geologists working in the region for detailed descriptions of the lithologic units, so seven representative sections measured in various parts of the Wind River Basin are presented here (Fig. 1). All the sections were measured by plane table methods and were located with respect to General Land Office section corners. Three-point dip control was obtained and the effects of changes in dip and strike on measurements of thicknesses were corrected, for the most part, by Hewett's method[3]. Supplementary methods of correction for use in areas of complicated structure and poor exposures were developed by the Geological Survey field party. Detailed measurements of beds were made either by tape or by Brunton compass method. Many lithologic specimens were collected and studied microscopically and the lithologic character of the surface sections was compared in detail with sections in adjacent oil and water wells.

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[2]Geologists, U. S. Geological Survey.

[3]Hewett, D. F., Measurements of folded beds; *Econ. Geol.*, vol. XV, no. 5, pp. 367-385, 1920.

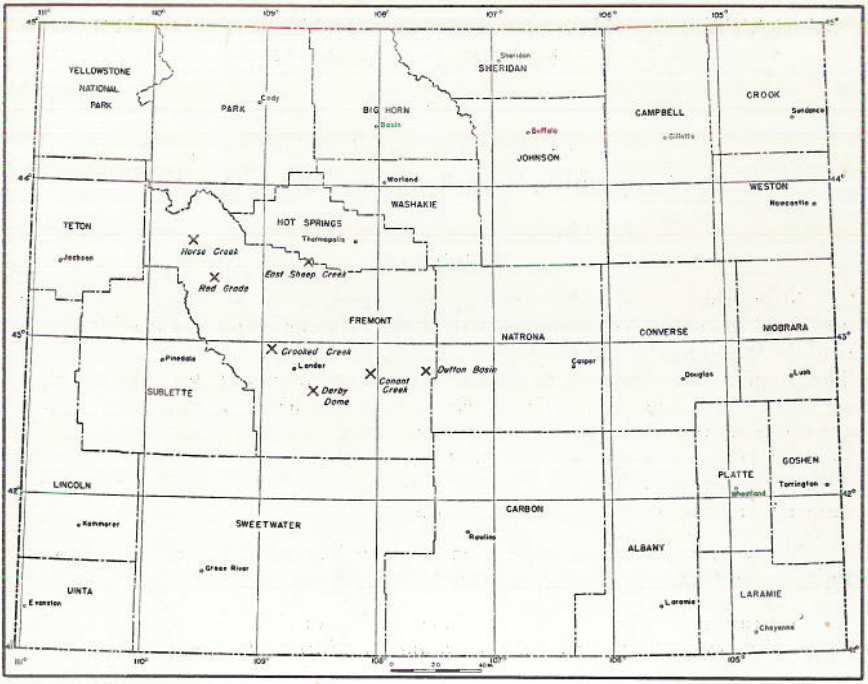

Figure 1. Index map of Wyoming showing locations of sections.

Jurassic fossils were identified by Dr. J. B. Reeside, Jr., and Dr. Ralph W. Imlay, and Cretaceous fossils were identified by Dr. Reeside and Dr. T. C. Yen, all of the U. S. Geological Survey staff.

Professor S. H. Knight, Chairman of the Department of Geology at the University of Wyoming and Dr. H. D. Thomas, State Geologist of Wyoming, have made many facilities available in connection with this work, and have contributed valuable suggestions. The University of Wyoming generously furnished office quarters. This wholehearted cooperation in every respect has aided materially in the completion of these studies and is gratefully acknowledged.

Responsibility of the individual authors is as follows: the study was initiated and directed by Love who wrote the text and adapted the lithologic descriptions from the field notes of the other authors, supplemented by microscopic studies in the office; Tourtelot and Johnson measured the East Sheep Creek section; Tourtelot and Zapp, assisted by H. D. Hadley measured the Derby Dome section; Tourtelot, Johnson, and Love measured the Conant Creek and Dutton Basin sections; Thompson, assisted by H. H. Gray measured the Horse Creek and Red Grade sections; Sharkey, Johnson, and Thompson measured the Crooked Creek-Mill Creek composite section.

HORSE CREEK SECTION

The following section was measured in the northwestern corner of the Wind River Basin, about seven miles north of Dubois, Fremont County, Wyoming.

This is an area of complex folds and faults and exposures are poor. Many supplementary sections, not given here, were measured to make sure that no faulting or excessive squeezing had been overlooked. Units are numbered consecutively from oldest to youngest.

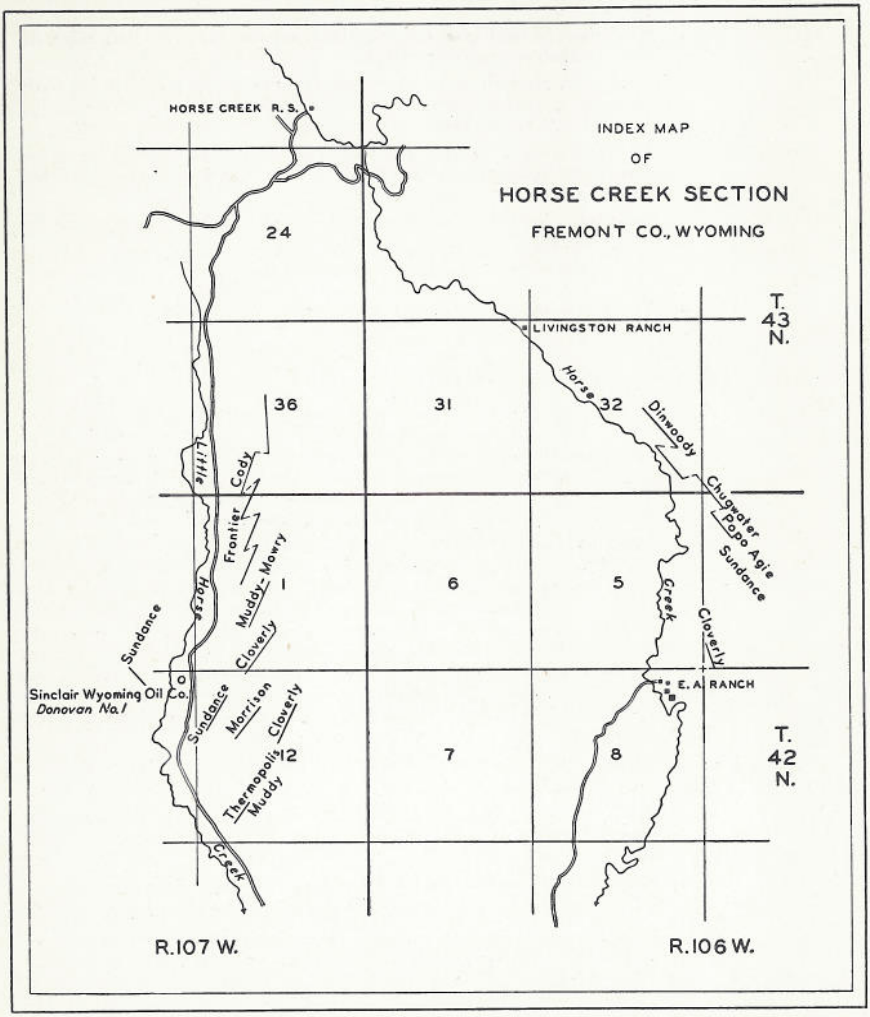

Figure 2. Index map of Horse Creek section, Fremont County, Wyoming.

Unit	*Thickness (in feet)*	*Lithologic Character*
Cody shale		
186	1500+	Shale, gray, soft, poorly exposed. Top of shale is obscured by landslide debris. No sandstone of the Mesaverde formation was found in the area, and the Cody shale is apparently overlain by Eocene rocks.
185	43	Sandstone, greenish gray, medium-grained, soft, cross-bedded; abundant dark minerals; interbedded with equal amounts of gray shale.
184	2	Sandstone, greenish gray, medium-grained, limy, hard, cross-bedded, with numerous dark minerals.

Unit	Thickness (in feet)	Lithologic Character
183	102	Shale, dark gray, laminated, with a few thin layers of greenish gray sandstone.
182	28	Sandstone, greenish gray, coarse-grained, slabby; interbedded dark gray shale.
181	65	Sandstone, greenish gray, coarse-grained, angular; numerous dark minerals, cross-bedded; some shale partings.
180	15	Sandstone, greenish gray, coarse-grained, angular; ledgy near base; shaly in upper part; poorly preserved pelecypods in basal 2 feet. Niobrara (?) fauna (U.S.G.S. Loc. 19539): *Inoceramus* sp., *Cymbophora* sp., *Ostrea* sp.
179	172	Shale, brownish gray, laminated; sandy in lower 50 feet; 6-inch sandstone, fine to medium-grained, carbonaceous, with sparse pelecypods, 50 feet above base.
178	2	Sandstone, light greenish gray, coarse-grained, angular, limy; numerous dark minerals.
177	1080	Shale, brownish gray, laminated, soft; some sandy zones.
	3009+	Total measured part of Cody shale.

Contact between Cody shale and Frontier formation.

176	20	Covered interval forming dip slope and supporting a heavy growth of trees. One-quarter mile east along strike this zone consists of sandstone containing abundant pelecypods and gastropods overlain by brownish gray shale containing numerous flat black chert pebbles. Niobrara fauna (U.S.G.S. Loc. 19534): *Ostrea anomioides* Meek, *Camptonectes* n. sp., *Tellina?* cf. *T. subalata* Meek, *Cardium curtum* Meek and Hayden.
175	30	Sandstone, gray to brown, medium-grained, limy, hard, petroliferous. A highly limy zone 5 feet thick near the center of the unit and one 10 feet thick near the top contain an abundant and well-preserved fauna of pelecypods, bizarre gastropods, echinoids, and ammonites. Niobrara fauna (U.S.G.S. Loc. 19537): *Inoceramus deformis* Meek, *Ostrea anomioides* Meek, *Exogyra* sp., *Camptonectes* n. sp., *Cardium curtum* Meek and Hayden, *Cardium pauperculum* Meek, *Tellina* n. sp., *Cymbophora* cf. *C. arenaria* Meek, *Gyrodes* sp., *Pugnellus fusiformis* Meek, *Pyropsis?* n. sp., *Volutoderma* sp., *Placentoceras planum* Hyatt, gastropods, several undetermined new forms.
174	40	Partly covered interval. A few gray sandstone ledges visible.
173	15	Shale, black to brown, laminated.
172	20	Sandstone, gray; hard, fine-grained, limy near top. Abundant pelecypods present. Poorly exposed. Niobrara fauna (U.S.G.S. Loc. 19538): *Ostrea sannionis* White.
171	6	Shale, black to brown; sandy in lower part.
170	20	Partly covered interval. A few gray glauconitic sandstone ledges visible.
169	11	Sandstone, light gray to yellowish gray, highly glauconitic, limy, cross-bedded, very fossiliferous with abundant pelecypods and a few ammonites. Niobrara fauna (U.S.G.S. Loc. 19535): *"Gervillia" propleura* Meek, *Pteria gastrodes* Meek, *Inoceramus* sp., *Cardium pauperculum* Meek.
168	16	Sandstone, gray, fine-grained, soft, very shaly.
167	1	Shale, brownish gray, sandy.
166	6	Sandstone, gray, medium-grained, limy; abundant rounded grains of glauconite.
165	25	Shale, black, laminated; yellowish fine-grained slightly carbonaceous sandstones in upper 5 feet.
164	6	Sandstone, gray, fine-grained, limy, cross-bedded; soft in lower half.
163	5	Shale, brown, sandy, soft, with a carbonaceous layer near middle.
162	11	Sandstone, yellowish brown, fine-grained, limy, hard, slightly carbonaceous.
161	44	Covered interval. Lower part probably dark gray carbonaceous shale and upper part probably black fissile shale.
160	1	Lignite, black to brown, shaly.

Unit	*Thickness (in feet)*	*Lithologic Character*
159	6	Sandstone, yellowish brown, medium-grained, cross-bedded, limy, locally with ironstone concretions.
158	6	Shale, black, laminated.
157	9	Sandstone, yellowish brown, medium-grained, cross-bedded, limy, locally with ironstone concretions.
156	1	Shale, black, laminated; 0.2 feet of greenish yellow bentonite at top.
155	4	Sandstone, yellowish brown, fine-grained, limy, slabby, finely cross-bedded.
154	16	Shale, black in lower part; brownish near top; laminated; moderately sandy near middle.
153	65	Sandstone, yellowish gray, medium to fine-grained, interlaminated with black shale near middle.
152	45	Shale, black, laminated in lower 40 feet; abundant secondary gypsum.
151	4	Sandstone, yellowish gray to white, coarse-grained, soft.
150	2	Shale, dark gray, sandy, with thin lignite beds.
149	9	Sandstone, yellowish gray, fine-grained, soft in lower part; coarser and somewhat shaly near top.
148	4	Shale, black, laminated.
147	1	Sandstone, yellowish gray, fine-grained, soft.
146	20	Shale, black, laminated, poorly exposed.
145	5	Bentonite, yellow; abundant secondary gypsum.
144	2	Shale, black, laminated.
143	3	Sandstone, yellowish gray, soft, fine-grained, bentonitic.
142	5	Shale, greenish gray; soft and bentonitic in lower 3 feet, then 2 inches of soft yellowish gray sandstone overlain by black laminated shale, sandy near top.
141	1	Lignite in lower half; carbonaceous gray siltstone in upper half.
140	7	Shale, black and very lignitic near base; gray and silty in middle and upper parts.
139	10	Bentonite, gray, sandy.
138	27	Sandstone, brownish gray, very coarse-grained, very limy; soft in lower 10 feet; abundant dark minerals.
137	2	Shale, carbonaceous, with thin coal layers.
136	12	Bentonite, white, with coarser tuff beds.
135	3	Coal. This bed has been mined for local use.
134	4	Shale, black to brown, very sandy.
133	10	Sandstone, white to yellowish, cross-bedded, fine to medium-grained, nodular; with numerous dark minerals; with thin carbonaceous shale beds.
132	15	Shale, black, fine-grained, soft; bentonitic in lower half; slightly sandy, brown, hard, silty in upper half; thin bentonite at top.
131	11	Sandstone, gray to yellowish, soft; carbonaceous and bentonitic near base; abundant dark minerals.
130	2	Shale, black, laminated.
129	1	Coal, black, soft.
128	3	Sandstone, brownish gray, fine-grained, silty to shaly, soft.
127	15	Shale, brown to black; bentonitic in lower 5 feet.
126	2	Sandstone, gray to brown, weathering black, hard, cross-bedded, slightly limy; numerous dark minerals.
125	11	Shale, black, laminated, very bentonitic. Abundance of bentonite makes weathered slopes appear white.
124	6	Lignite and carbonaceous shale; sandstone lenses in middle of unit; more nearly pure lignite near base and top.
123	6	Bentonite, yellow; shaly in lower part.
122	3	Tuff or very fine-grained tuffaceous sandstone, gray, with interbedded bentonite.
121	9	Bentonite, gray.

Unit	*Thickness (in feet)*	*Lithologic Character*
120	14	Bentonite, gray; a highly carbonaceous brown tuff 1.5 feet thick, full of poorly preserved plant remains in lower part.
119	1	Tuff, brown, highly carbonaceous; abundant poorly preserved plant remains.
118	7	Bentonite, white to yellowish, interbedded with coarser bentonitic tuffs containing plant remains.
117	3	Shale, black, bentonitic, with thin ironstone zone at top.
116	2	Sandstone, dark gray, very coarse-grained, angular, very hard, tuffaceous, with abundant dark minerals and glassy fragments resembling shards.
115	3	Bentonite, gray, very impure, with a thin coarse-grained sandstone containing wood and bone fragments at base of unit.
114	3	Lignite, and dark gray carbonaceous shale.
113	18	Sandstone, gray, coarse-grained, angular; soft in lower part; hard in upper 15 feet; cliff-forming; a few thin carbonaceous shale partings; abundant dark minerals.
112	2	Lignite, black, interbedded with black carbonaceous shale.
111	2	Bentonite, gray.
110	2	Sandstone, white, with thin shale partings and thin ferruginous sandstone containing shard-like fragments.
109	8	Shale, black, hard, bentonitic.
108	16	Sandstone, gray to yellowish, coarse to medium-grained, hard, lenticular; numerous thin shale partings; abundant dark minerals.
107	7	Shale, black to brown, laminated.
106	10	Sandstone, white to yellow, coarse-grained, cross-bedded, cliff-forming; sandy gray shale partings.
105	8	Sandstone, gray, medium-grained, moderately soft; numerous black shale partings.
104	2	Sandstone, tan to yellowish, fine-grained, moderately hard; numerous dark minerals, and numerous brown glossy fish scales.
	752	Total thickness of Frontier formation.

Contact between Frontier formation and Mowry shale.

103	27	Shale, black, laminated; thin yellowish gray siltstone, and fine-grained sandstone partings.
102	3	Sandstone, green, fine to medium-grained, slabby, hard, with silty and shaly partings.
101	3	Bentonite, pale yellowish green, with a few black shale partings.
100	31	Shale, black, laminated, slightly carbonaceous; thin bentonite beds near base.
99	20	Sandstone, dull green, fine to medium-grained, slabby, hard, silty at base; some shale partings.
98	4	Bentonite, shaly.
97	5	Shale, yellowish brown to silvery gray, hard.
96	2	Bentonite, pale yellow.
95	2	Shale, yellowish brown to silvery gray, hard, containing sparse poor pelecypod casts and molds.
94	4	Bentonite with interbedded black shale.
93	24	Shale, dark gray, weathering silver gray, siliceous, hard, splintery, containing fish scales.
92	4	Sandstone, dull greenish gray to buff; silty layers; numerous dark grains; numerous fish scales and teeth.
91	2	Bentonite, pale yellow; a thin black shale at top.
90	2	Sandstone, dull greenish gray to buff; silty layers; numerous dark grains and fucoidal markings.
89	5	Shale, black, bentonitic, with 0.5 feet of bentonite at base and a thin greenish gray sandstone in middle.

Unit	*Thickness (in feet)*	*Lithologic Character*
88	2	Sandstone, dull greenish gray to buff; silty layers; numerous dark grains; fish teeth and scales.
87	108	Shale, black to brown, weathering gray, hard, silty, with a few poorly preserved lucinoid type pelecypods. A shaly white bentonite 0.5 feet thick is present 15 feet above base, and 90 feet above base are several thin bentonites, above which the shale is harder and more siliceous.
86	245	Covered interval.
85	113	Shale, black, soft, laminated; thin bentonite layers throughout sequence but less abundant in upper part.
84	6	Bentonite, yellow, hard, with coarser tuffaceous materia!.
83	73	Shale, black, soft, with numerous soft yellow bentonite beds.
82	12	Shale, black, bentonitic, with a few ironstone concretions.
81	8	Bentonite, gray; thin hard white tuffaceous beds in upper part and black shales in lower part. A few bone fragments present.
80	12	Shale, black, bentonitic; a thin yellowish green bentonite 2 feet above base.
	717	Total thickness of interval between top of Mowry shale and top of Muddy sandstone member of the Thermopolis shale. Contact between Mowry and Thermopolis shales probably some distance above this point, and is a matter of individual interpretation.

Contact between upper black shale member and Muddy sandstone member of Thermopolis shale.

79	2	Sandstone, gray, weathering brown, coarse-grained, conglomeratic; contains small pebbles and black grains that may be phosphatic; a few fish teeth present.
78	4	Shale, black to brown, sandy.
77	3	Sandstone, gray, weathering brown, medium-grained, fucoidal.
76	11	Sandstone, gray, weathering brown, thin-bedded; black silty shale partings.
75	14	Sandstone, gray, weathering brown, moderately thin-bedded, cross-bedded, fucoidal, medium-grained, with numerous dark minerals, non-calcareous.
	34	Total thickness of Muddy sandstone member of the Thermopolis shale.

Contact between Muddy sandstone member and lower black shale member of Thermopolis shale.

The underlying beds were measured a mile south, in sec. 12, T. 42 N., R. 107 W.

74	136	Shale, black, soft, laminated; numerous ferruginous concretions, and dahllite concretions.
	136	Total thickness of lower black shale member of Thermopolis shale.

Contact between Thermopolis shale and "Rusty beds" of Cloverly formation.

The exposed portions of the "Rusty beds" of the Cloverly formation were measured in detail in the SE¼ SW¼ sec. 1, T. 42 N., R. 107 W., and the total interval was measured in the SW¼ SW¼ sec. 4, T. 42 N., R. 106 W. The total thickness is only approximate.

73	57	Sandstone, gray, weathering rusty brown, fine-grained, hard, thin-bedded, highly fucoidal; interbedded with thin black shales. At a point 35 fee above the base there is 6 feet of black laminated shale overlain by 6 inches of sandstone, then 6 feet of black laminated shale.
72	20	Siltstone, black, hard, shaly from 5 to 8 feet above base; minor amounts of interbedded sandstones.
71	10	Sandstone, gray, weathering rusty; thin-bedded in lower part; slightly shaly near top.
70	10	Shale, brown to black; thin interbedded sandstones and siltstones.
69	5	Sandstone, gray, weathering brown, fine-grained, hard, thick-bedded.
68	30	Partly covered interval. Some exposures of sandstone, gray, weathering rusty, thin-bedded, fine-grained, highly fucoidal; interbedded with minor amounts of dark gray shale.
67	28	Covered interval.

Unit	*Thickness (in feet)*	*Lithologic Character*
		Contact between the "Rusty beds" and the variegated claystone member of Cloverly formation. The underlying beds were measured in the SW¼ SW¼ sec. 4, T. 42 N., R. 106 W.
66	155	Claystone, variegated, gray, light red, with lilac zone in upper 60 feet. Partly covered.
65	10	Sandstone, gray, medium-grained, sparkly, clean; numerous pink minerals.
64	20	Claystone, variegated, gray, red, and purple; largely covered.
63	8	Sandstone, gray, coarse-grained, sparkly, clean; numerous pink minerals. A quarter of a mile east along strike this unit contains chert pebble conglomerates.
		Possible contact between Cloverly and Morrison formations. There is a marked lithologic change at this point. There are no quartz crystal sandstones and conglomerates below; the underlying claystones are harder and not as brightly variegated. These differences are of regional extent. The underlying beds were measured in the NW¼ sec. 12, T. 42 N., R. 107 W.
62	16	Claystone, red and purple, lavender in upper 3 feet.
61	6	Sandstone, dark gray, with prominent yellowish layers, soft, silty and clayey; contains numerous polished pebbles.
60	4	Shale, dark gray, laminated; a thin sandstone in middle.
59	1	Sandstone, white, medium-grained, limy; sparse pink grains.
58	13	Siltstone and sandstone, grayish green to dark gray, shaly, hard; contains dinosaur bones.
57	24	Sandstone, gray, lenticular; contains variegated claystone lenses; dinosaur bones. Sandstone is soft in lower part, hard in upper part.
56	7	Claystone, red, blocky; numerous sandstone lenses, more abundant near top.
55	11	Sandstone, greenish gray, lenticular, fine-grained, variegated claystone lenses.
54	92	Claystone, variegated red, blue, green, and gray, silty; contains numerous thin hard sandstone lenses, layers of limestone nodules, and a few polished pebbles.
53	4	Sandstone, greenish gray; very lenticular; limy, medium to coarse-grained.
52	3	Claystone, red, sandy, hard.
51	5	Siltstone, red, hard, with some claystone and sandstone near top.
	539	Total thickness of Cloverly and Morrison formations, undivided.
		Contact between Morrison formation and "upper Sundance". The underlying beds were measured in the NE¼ Sec. 11, T. 42 N., R. 107 W., on the west side of Little Horse Creek.
50	20	Sandstone, grayish green, limy, medium-grained, soft to hard, slabby, with some pink grains and a moderate amount of emerald-green glauconite in rounded grains.
49	10	Sandstone, grayish green, very limy, hard, coarse-grained, glauconitic. Upper 2 feet is a sandy limestone with sporadic small limestone pebbles.
48	10	Sandstone or greensand, green, coarse-grained, highly glauconitic; abundant dark greenish gray shale in upper part.
47	2	Sandstone, grayish green, glauconitic, coarse-grained, slabby.
46	57	Greensand, green, medium-grained; a thin sandy limestone 40 feet above base.
45	4	Limestone, gray, hard, glauconitic, highly fossiliferous.
44	5	Greensand, green, fine-grained, limy.
43	3	Limestone, gray, very conglomeratic and fossiliferous. Pebbles as much as ½ inch in diameter in upper part.
42	14	Greensand, green; very glauconitic in upper half; shaly near base; partly covered.
41	5	Limestone, gray, very conglomeratic; some pink and pale green rounded grains; slightly oolitic near top.
	130	Total thickness of "upper Sundance".

Unit	*Thickness (in feet)*	*Lithologic Character*
Contact between "upper Sundance" and "lower Sundance".		
The underlying beds were measured in the NW¼ NW¼ sec. 4, T. 42 N., R. 106 W.		
40	95	Shale, gray green, sandy in upper 10 feet; containing abundant *Gryphaea nebrascensis*, and *Pentacrinus* sp.
39	180	Covered interval.
38	8	Limestone, bluish gray, hard, very oolitic, fossiliferous.
37	1	Shale, greenish to red, limy.
36	2	Limestone, gray, hard, fine-grained.
35	3	Siltstone, green to gray, limy at top.
34	2	Limestone, bluish gray, hard, oolitic, fossiliferous.
33	2	Shale, green, laminated.
32	2	Limestone, bluish gray, very oolitic, very fossiliferous.
31	6	Partially covered interval; probably limestone in lower 4 feet and green shale in upper 2 feet.
30	4	Limestone, bluish gray, oolitic, hard; highly fossiliferous, containing *Pentacrinus* sp., and bryozoans.
	305	Total thickness of "lower Sundance".
Contact between the "lower Sundance" and Gypsum Spring formation.		
29	1	Limestone, earthy; obscure fossil fragments.
28	1	Shale, red.
27	2	Limestone, green, silty, soft; poorly exposed.
26	2	Limestone, green to tan, dolomitic, moderately fossiliferous.
25	10	Shale, red, with thin green siltstone 2 feet above base.
24	6	Dolomite, white to grayish green, slabby, moderately pure
23	10	Shale, red, soft, silty in lower 2 feet.
22	2	Limestone, bluish gray, brecciated; locally dolomitic and slabby in upper part; probably a residual breccia from which gypsum has been leached.
21	14	Shale, red, soft, with thin green shale at top.
20	34	Covered interval. Apparently mostly red shale.
19	19	Limestone breccia, dolomitic, with cavities filled with gypsum crystals. Apparently this is a residual breccia resulting from leaching out of the main gypsum bed in the Gypsum Spring formation. Thickness maps indicate that probably at least 100 feet of gypsum has been leached out of this section, most of it probably from this unit.
18	8	Shale, red, fine-grained; dolomite nodules near top; a thin purple shale at top.
	109+	Partial thickness of Gypsum Spring formation from which all gypsum (an estimated 100 feet or more) has been leached.
Contact between Gypsum Spring formation and Nugget sandstone.		
17	15	Sandstone, red, massive to thin-bedded, fine to medium-grained.
16	5	Sandstone, red, massive, fine to medium-grained; rounded frosted grains; a few green shale fragments near top.
15	11	Sandstone, white, fine-grained, rounded grains, thin-bedded, limy.
	31	Total thickness of Nugget sandstone.
Contact between Nugget sandstone and Popo Agie member of Chugwater formation.		
14	1	Shale, red and green, soft, limy.
13	82	Claystone, ocher, soft, silty, blocky.
12	144	Covered interval.
11	300	Sandstone; buff in upper part; red and silty in lower part; numerous shaly beds near top.

Unit	*Thickness (in feet)*	*Lithologic Character*
10	292	Siltstone, red, soft to hard; numerous red shale partings.
9	6	Sandstone, white, fine-grained, soft, clean; rounded grains; forms prominent white zone marker bed.
8	246	Siltstone, red, hard to soft; numerous red shale partings; a few thin white siltstones in upper 70 feet.
7	222	Siltstone, red, shaly; locally gray and red in lower 20 feet; increasingly silty near top; partly covered.
	1293	Total thickness of Chugwater formation.

Contact between Chugwater and Dinwoody formations.

6	66	Sandstone, brown, very limy, thick to thin-bedded, ripple-marked; fine rounded grains; upper 20 feet is a slabby siltstone containing *Lingula*.
5	58	Sandstone, brown, fine-grained, very limy, thin-bedded, slabby, hard to soft, containing *Lingula*.
4	8	Covered interval. Probably all fine-grained sandstone.
3	15	Sandstone, pink, fine-grained, slabby.
2	5	Sandstone, pink, coarse-grained, very limy; sub-angular grains; numerous calcite vugs.
1	2	Sandstone, yellowish, very fine-grained, limy, slabby, brecciated.
	154	Total thickness of Dinwoody formation.

Contact between Dinwoody and Phosphoria formations.

	10+	Limestone, gray, hard, cherty, with numerous bryozoans.

Base of measured section.

RED GRADE SECTION

The following section was measured across U. S. Highway 287, about 12 miles southeast of Dubois, Fremont County, Wyoming.

Red sandstone cliffs of Chugwater formation are on the west edge of the highway and Wind River is on the east edge at this locality, which is known as the "Red Grade". The section from the Tensleep sandstone to the Morrison formation is well exposed, and without structural complications. The upper part of the section, however, is cut by numerous small faults and sharp folds. Units are numbered consecutively from oldest to youngest.

Unit	*Thickness (in feet)*	*Lithologic Character*
Thermopolis shale (in part)		
161	50+	Shale, black, fine-grained, flaky, soft; contains several bentonite beds and numerous gypsum crystals; phytosaurian reptile skeleton associated with black highly polished chert pebbles.

Contact between upper black shale member and Muddy sandstone member of Thermopolis shale.

160	16	Sandstone, brown, fine-grained at top; underlain by brown sandstone and siltstone interbedded with gray shale.
159	10	Shale, black, laminated, flaky; bluish gray siltstone containing numerous fish teeth and phosphatic pellets 3 feet above base.
158	5	Sandstone, light brown to gray, fine to coarse-grained, limy; numerous dark minerals; contains light yellow clay pellets, fragments of wood, and smooth tubular borings with a thin white periphery; numerous gypsum crystals.
	31	Total thickness of Muddy sandstone member of Thermopolis shale.

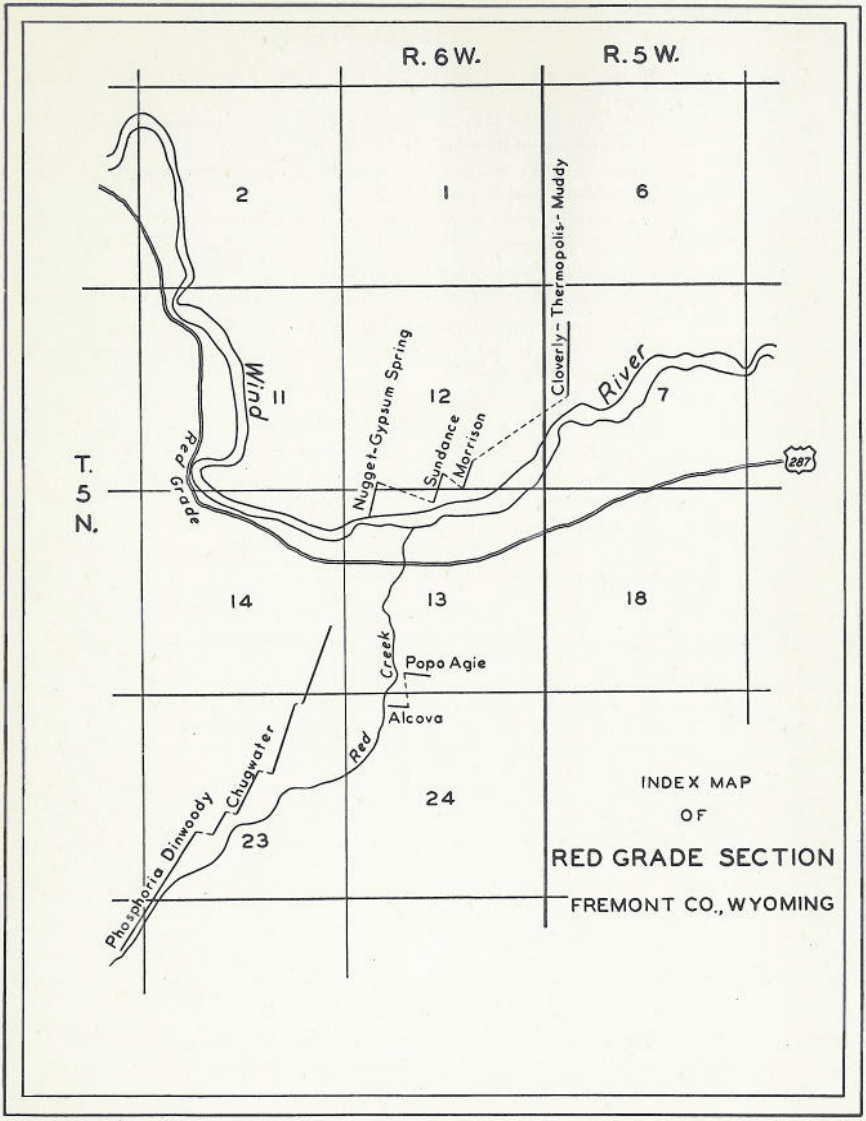

Figure 3. Index map of Red Grade section, Fremont County, Wyoming.

Unit	Thickness (in feet)	Lithologic Character
Contact between Muddy sandstone member and lower black shale member of Thermopolis shale.		
157	144	Shale, black, fine-grained, flaky, soft, containing dahllite concretions near base; fine-grained thin buff sandstone bed 28 feet above base and a similar sandstone bed 40 feet above base.
	144	Total thickness of lower black shale member of Thermopolis shale.
Contact between Thermopolis shale and "Rusty beds" of Cloverly formation.		
156	30	Sandstone and siltstone, brown to gray, fine-grained, hard, slabby, with bluish gray shale partings; highly fucoidal.

Unit	*Thickness (in feet)*	*Lithologic Character*
155	17	Shale, dark gray to greenish gray, silty, flaky; a thin black siltstone 6 feet above base.
154	11	Shale, dark bluish gray and greenish gray, flaky, interbedded with nearly equal amounts of light buff hard siltstone.
153	5	Sandstone, dark reddish brown to black, hard, thin-bedded, fucoidal; forms ledges; some greenish siltstone partings.
152	3	Shale, grayish green to yellowish, flaky, fine-grained.
151	4	Siltstone, light gray to brown, thin-bedded; forms ledges.
150	5	Shale, bluish gray to greenish gray, silty.
149	1	Sandstone, yellowish brown, with black layers, fine-grained, hard.
148	8	Shale, gray to greenish gray, fine-grained, hard.
147	4	Sandstone, buff, very fine-grained, limy, hard, fucoidal; forms ledge; thin shale and siltstone partings.
146	8	Shale, bluish gray, flaky, silty; grades upward into siltstone.
145	1	Siltstone, light gray, hard, limy.
144	4	Claystone, red and green, hard, blocky, sandy to silty.
143	1	Sandstone, rusty grayish brown, fine-grained, thin-bedded, soft to hard, ripple-marked, fucoidal; numerous dark mineral grains.
142	8	Shale, bluish gray to greenish gray, flaky.
141	5	Sandstone, rusty grayish brown, fine-grained, thin-bedded, soft to hard; numerous dark mineral grains.

Contact between "Rusty beds" and variegated claystone member of Cloverly formation.

140	86	Claystone, green, gray, black, white, lilac colors. The lilac color is most conspicuous in the upper part where it forms a very striking zone. Several bentonitic beds are present in the upper part. Thin limestones, limy nodules, and lime pellet conglomerates are common near the base. Much of claystone is very fine-grained, waxy, and soft.
139	1	Sandstone, white to greenish; contains some red and pink grains; medium to coarse-grained, thin-bedded.
138	8	Claystone, green, purple, and red, soft, plastic, appears bentonitic; silty, gypsiferous; contains limy nodules in lower 4 feet.
137	15	Sandstone, white, hard, fine-grained, thin-bedded, limy; contains a few black mineral grains; forms ledges.
136	8	Claystone, red, purple, and green; 2 feet of soft green siltstone at base.
135	2	Sandstone, green, quartzitic, thin-bedded, limy; forms ledge.
134	26	Claystone, bright green, lavender, brick red, soft, fine-grained; some thin limy nodular siltstone layers.
133	3	Sandstone, white, weathers buff, quartzitic, fine-grained, limy.
132	31	Claystone, chiefly light purple, with thin white, gray, and olive green zones; numerous thin siltstone lenses.
131	6	Sandstone, white; sparkly, with abundant quartz crystal facets; hard, limy; grains medium-sized and rounded; some rose quartz; forms ledges; thin chert-pebble conglomerate lenses occur throughout but are more abundant near base; some chert pebbles as much as one-half inch in diameter.

Possible contact between Morrison and Cloverly formations. There is a marked lithologic change at this point. There are no quartz crystal sandstones and conglomerates below; the underlying claystones are harder and not as brightly variegated. These differences are of regional extent.

130	35	Claystone, lavender, olive brown, bluish gray, green, and yellowish; numerous silty layers.
129	7	Claystone, brick red and light gray, blocky; interbedded with siltstone.
128	15	Claystone, chiefly red, with some brown, green, and white layers; hard; numerous silty layers in upper part.

Unit	*Thickness (in feet)*	*Lithologic Character*

The underlying beds were measured one-half mile southwest in the SW¼ SE¼ section 12, T. 5 N. R. 6 W., on the west side of a highly folded, faulted, and slumped area. The bed underlying Unit 128 is common to both sections.

127	18	Sandstone, olive green, weathering reddish brown; locally massive, medium-grained; zone of shale pellets near middle; numerous shaly zones containing sandstone and siltstone concretions; highly lenticular; cliff-forming; grades down into underlying unit.
126	86	Claystone, dully variegated, red, grayish green, and bluish gray, hard, blocky; contorted sandstones and red claystones in upper 6 feet.
	462	Total thickness of Cloverly and Morrison formations, undivided.

Contact between Morrison formation and "upper Sundance".

125	5	Sandstone, white, weathering buff; sub-rounded sorted grains; slabby in upper part; cross-bedded; soft in part; contains sparse bright green rounded pellets of glauconite.
124	37	Shale, brownish red to green, interbedded with lesser amounts of gray limestone and greenish gray glauconitic sandstone. The sandstone and limestone units are very lenticular.
123	1	Sandstone, yellowish gray, fine-grained, hard, limy.
122	3	Shale, reddish brown, fine-grained, flaky.
121	2	Sandstone, buff, yellowish, and white, fine to medium-grained, non-glauconitic, cross-bedded near top; green shale parting near middle.
120	2	Shale, bluish black, flaky.
119	9	Sandstone, buff; bright green in upper 3 feet; medium-grained, limy; some very thin red and green shale partings.
118	34	Shale, dark grayish green, sandy in upper part; a thin glauconitic fossiliferous limestone near middle.
117	14	Sandstone, brown, very limy, hard, cliff-forming, cross-bedded; abundant bright green rounded glauconite grains; basal 4 feet and top 4 feet very limy and highly fossiliferous; forms cliffs on outcrop.
116	36	Sandstone, grayish green, shaly, soft, limy, very fossiliferous; abundant large rounded bright green glauconite grains.
115	10	Shale, greenish gray, silty to sandy, soft.
114	12	Sandstone, grayish green to brown, coarse-grained; thin conglomerate lenses with chert and sandstone pebbles and many fossil fragments; highly glauconitic, with large rounded bright green grains; very limy and shaly; fossiliferous.
113	2	Shale, green, very sandy, glauconitic, fossiliferous, with thin green bentonite (?) layers.
112	2	Bentonite (?), green, soapy, soft.
111	5	Shale, bluish gray; flaky at base, sandy in middle; grades up into a shaly greenish sandstone; fossiliferous; highly glauconitic.
110	6	Sandstone, shale, and limestone. Lower part is shale, grayish green, silty, flaky, capped by a thin gray hard fossiliferous limestone. Upper part is sandstone, gray, very limy, fine-grained, hard, platy, shaly.
109	6	Sandstone, yellowish brown, hard, medium-grained, cross-bedded, slightly ripple-marked, limy; contains pale green glauconite (?).
	186	Total thickness of "upper Sundance".

Contact between "upper Sundance" and "lower Sundance".

108	7	Sandstone, light grayish green, limy, very fine-grained with rounded grains; forms ledges separated by weak greenish shale beds; contains *Pentacrinus* stem fragments.
107	125	Shale, grayish green, fine-grained, flaky; some gypsum crystals; a few thin limy fossiliferous beds near base. *Gryphaea nebrascensis* very abundant throughout.
106	5	Limestone, gray, oolitic, fossiliferous; forms ledges separated by thin shaly layers.

Unit	*Thickness (in feet)*	*Lithologic Character*
105	7	Shale, bluish gray to green, fine-grained, limy; oolitic limestone beds 3 feet and 5 feet above base.
104	2	Limestone, brown, highly oolitic, hard, shaly at top.
103	2	Shale, green, soft.
102	6	Limestone, greenish gray; numerous shale partings; abundant oolites in upper part, traces of oolites near base; poorly preserved fossils.
	154	Total thickness of "lower Sundance".
Contact between "lower Sundance" and Gypsum Spring formation.		
101	58	Shale, red, blocky near base; 2 feet of white dolomite with purple and brown layers 21 feet above base; top 2 feet green and limy.
100	10	Limestone, gray to greenish, dolomitic, interbedded with red and purplish shale; large calcite geodes in upper part; brecciated in lower 1 foot.
99	8	Shale, red, blocky; green and white siltstone lenses; limy nodules just above middle.
98	3	Dolomite, white to gray, soft; apparently grades down into underlying unit.
97	7	Shale, red at base, grading upward to gray; flaky in lower part, blocky in upper; limy.
96	1	Limestone, gray, slabby.
95	2	Shale, green in lower part, red in upper; flaky; calcite nodules near top.
94	2	Limestone, grayish green; forms ledge; numerous calcite crystals.
93	4	Shale, purplish near base, red in middle, green at top; somewhat blocky.
92	2	Dolomite, gray, limy; forms ledge; calcite crystals in lower part.
91	34	Shale, red, upper 6 inches green and silty; blocky.
90	2	Limestone, gray, hard, forms ledge; locally a limestone breccia.
89	1	Shale, gray, limy, brecciated.
88	4	Dolomite, gray to reddish, hard; rough surface and very irregular bedding.
87	4	Breccia. Gray angular fragments of limestone, dolomite, chert, and red shale in a sandy shaly limestone matrix. Thin red shale at top. This is probably a residual breccia resulting from complete solution of the thickest gypsum bed in the formation. From data in adjacent areas, it is estimated that about 100 feet of gypsum has been removed.
86	2	Limestone, gray dolomitic, with shaly partings.
85	12	Dolomite and shale. Dolomite is bluish gray, limy, crinkled. Shale is red, blocky, silty. About 10 feet of shale interbedded with 2 feet of dolomite. Basal bed is 1 foot of gray crinkled dolomite containing large chert nodules.
	156+	Partial thickness of Gypsum Spring formation from which all gypsum (an estimated 100 feet) has been leached.
Contact between Gypsum Spring formation and Nugget sandstone.		
84	133	Sandstone, reddish buff, fine-grained; lowest 4 feet conglomeratic, with small sandstone pebbles; a conspicuous red shale 1 foot thick 14 feet above base; red shale partings in lower 75 feet; coarser and more massive sandstone in upper part; limy in upper 10 feet; shaly and with small sandstone pebbles in top 3 inches.
83	2	Sandstone, buff, fine-grained; hard siltstone at base; purple shale partings and reworked shale fragments in upper part; 1 inch of purple and green shale at top.
	135	Total thickness of Nugget sandstone.
Contact between Nugget sandstone and Popo Agie member of Chugwater formation.		
82	3	Siltstone, bluish gray, limy, hard, concretionary; forms ledges; hard purple siltstone lenses up to 1 foot thick.
81	50	Claystone, ocher; becomes red and more shaly in upper 20 feet, and grayish green in upper 6 feet.

Unit	*Thickness (in feet)*	*Lithologic Character*
80	3	Conglomerate, dark gray; limestone pebbles and chert pebbles as much as ½ inch in diameter; numerous calcite geodes and limestone nodules as much as 3 inches in diameter
79	13	Claystone, ocher, with red and purple mottling; hard, blocky; several concretionary siltstone ledges.
78	1	Conglomerate, lenticular; consists of red shale, limestone, and sandstone fragments.
77	3	Claystone, ocher; contains numerous calcite nodules.

The underlying units were measured a mile south, in the SE¼ SW¼ section 13, T. 5 N., R. 6 W., Wind River Meridian.

76	12	Shale, light purple, soft, poorly exposed.
75	1	Siltstone, grayish green, blocky; forms ledge.
74	2	Shale, green, silty.
73	26	Shale, deep reddish purple; changes laterally to lighter red.
72	16	Claystone, ocher, blocky, fine-grained, moderately soft; numerous calcite geodes; numerous reptilian bone fragments; limestone pebble lenses occur at several horizons.
71	50	Shale, purple near base, remainder red and light gray, soft.
70	4	Conglomerate, red to greenish gray; contains thin yellow sandstone lenses; top is yellow sandy limestone.
69	10	Shale, red, purple; somewhat blocky; thin white siltstone at base and near middle; yellow sandy zone near top contains sporadic limestone pebbles; thin green limestone pellet conglomerate 7 feet above base.
68	1	Conglomerate, red to greenish gray; contains sandstone and limestone pebbles up to 1 inch in diameter in a limy matrix.
67	42	Shale, red, purple, green, bluish gray; locally contains massive limy concretionary siltstone beds.
66	3	Siltstone, white, limy, hard; forms ledge.
65	2	Shale, red; blocky in part; thin green siltstone at top.
64	1	Sandstone, white, fine-grained, hard, limy.
63	18	Siltstone and fine-grained sandstone, red, hard; forms cliffs; cross-bedded, ripple-marked, limy; thin red shale at top.
62	5	Shale and siltstone, color alternates from light red to dark red.
61	26	Sandstone, red, fine-grained.

Top of Alcova limestone member of Chugwater formation.

60	2	Limestone, white to gray; crinkly bedding; brecciated in places; hard.

Contact between Alcova limestone member and Red Peak member of Chugwater formation.

59	16	Shale, red, with purple zone from 5 to 10 feet above base; silty.
58	13	Siltstone, red, sandy at top; ripple-marked, cross-bedded; a few minor red shale beds.
57	2	Sandstone, buff, fine to medium-grained, clean, well-sorted rounded grains.
56	47	Siltstone, red; a few green siltstones near base; interbedded with red shale that is most abundant in upper half; a thin fine-grained sandstone 10 feet above base
55	2	Sandstone, buff, fine to medium-grained, ripple-marked; well-sorted grains.
54	179	Siltstone, red, blocky; thin red shale partings; concretionary; two prominent green siltstone beds 88 feet above base.
53	2	Siltstone, green, locally with red shale in middle; ripple-marked; conspicuous unit.
52	62	Siltstone, red, shaly; numerous thin soft green layers; a thin prominent white siltstone underlain by 4 feet of green and red limy siltstone 44 feet above base.

Unit	*Thickness (in feet)*	*Lithologic Character*
Offset ½ mile northwest to NE¼ SE¼ section 14, T. 5 N., R. 6 W.		
51	1	Sandstone, white; yellowish well sorted and rounded grains; medium-grained.
50	1	Siltstone, green, shaly.
49	12	Shale, red; several very thin light-colored siltstone beds.
48	20	Siltstone and shale, red; interbedded in 1 to 2 inch layers; cross-bedded; thin white siltstone at top.
47	4	Shale, dark red; 1 inch green siltstone in middle.
46	16	Siltstone, red; interbedded with fine-grained white to red sandstone.
45	14	Shale, dark red, very silty; thin fine-grained sandstone 2 feet below top.
44	63	Siltstone and shale, red, interbedded; thin white and green layers of siltstone near base and top.
43	1	Siltstone, green and white; shaly in part; hard; conspicuous.
42	102	Siltstone and shale, dark red; a few thin white siltstone layers in lower 10 feet; and 8-inch bluish green siltstone 62 feet above base; limy; weak; less shaly and more massive in upper 20 feet.
41	10	Siltstone, white; greenish shale laminae at base; grades up into fine sandstone; contains pea-size limonite concretions near top; limy; several red shale laminae.
40	88	Siltstone, red, hard; forms ledges and cliffs; some thin red shale beds and some sandy zones.
39	6	Siltstone, white, with some red irregular masses; limy.
38	220	Siltstone, red; interbedded with some fine-grained sandstone, limy; thin-bedded; some gypsiferous shales.
Underlying units 34, 35, and 37, composed of light gray siltstones and shale are lithologically similar to the Chugwater except for the lack of red color.		
37	2	Siltstone, white, with thin red layers; limy.
36	10	Siltstone, red, limy, gypsiferous, soft.
35	80	Shale, bluish gray, very limy, soft, with sporadic thin soft siltstones, gypsiferous.
34	28	Siltstone and very fine-grained sandstone, light gray to bluish gray, soft, very limy; abundant secondary gypsum.
	1295	Total thickness of Chugwater formation.
Contact between Chugwater and Dinwoody formations.		
33	3	Sandstone, yellow to gray, limy, medium-grained; many dark mineral grains.
32	52	Sandstone, brown to light gray; forms cliffs; slabby, very limy in lower part and in several higher beds; some limy shale beds; upper 10 feet massive, weathering dark brown; numerous *Lingula*.
31	5	Limestone, gray, thin-bedded, locally sandy.
30	6	Sandstone, white to brown, limy; sandstone alternates with marly layers; upper beds contain abundant *Lingula*.
29	2	Limestone, white, thin-bedded.
28	4	Breccia, siliceous, in limy matrix.
	72	Total thickness of Dinwoody formation.
Contact between Dinwoody and Phosphoria formations.		
27	7	Limestone, dark gray, hard; forms ledges; several thin marls contain abundant bryozoans.
26	5	Chert, dark brown, interbedded with fossiliferous marl.
25	4	Limestone, bluish green, marly at top, thin-bedded, abundantly fossiliferous; contains bryozoans and small spiriferids.

Unit	*Thickness (in feet)*	*Lithologic Character*
24	52	Limestone, black to dark gray, very hard; alternates in 1 to 4-inch beds with yellowish brown marly and sandy siltstone; numerous calcite and siliceous geodes; near top geodes contain petroleum residue.
23	8	Shale, black at base, dark gray above; may contain thin phosphate lenses; limy.
22	2	Phosphate, black, sandy.
21	2	Marl, yellow, sandy.
20	4	Limestone, dark gray; slightly marly; thin sandstone lenses near top; extremely fossiliferous.
19	11	Marl, gray; extremely fossiliferous; excellent specimens of *Plicatoderbya*, *Punctospirifer*, *Pustula*, *Bellerophon*, and many other fossils.
18	24	Limestone, dark gray to nearly black, hard, forms cliffs; very fossiliferous; contains large bryozoans.
17	41	Marl and limestone, red and cherty in lower 5 feet; light gray to bluish above; upper 20 feet shaly, poorly exposed, thin-bedded.
16	2	Limestone and chert, gray to light red, well-bedded.
15	13	Chert, bluish to white, marl, and limestone, brecciated.
14	3	Limestone, bluish gray, hard; many chert nodules near top; fossiliferous at base.
13	3	Sandstone, grading laterally to a limestone or limy quartzite; bluish gray; 6-inch sandy marl at top and near middle a 2-inch brown sandstone composed largely of small shells, fish bones, and teeth; quartz grains in sandstone fine and well-rounded.
12	3	Limestone, reddish to gray, sandy; many calcite vugs; chert nodules up to 2 inches in diameter.
11	1	Marl, brown, very soft.
10	3	Limestone, dark gray; bryozoans very abundant.
9	13	Limestone, white, hard; numerous thin soft marly layers; thin chert layers 3 feet and 7 feet above base.
8	14	Sandstone, white to yellowish, limy, very hard, thin-bedded to massive; locally quartzitic.
7	1	Chert, dark gray, brittle.
6	3	Sandstone, bluish gray, limy, very hard; well-rounded grains; balls of chert; queerly-shaped tubes.
5	5	Chert, light brown, slightly laminated, highly fractured; black asphaltic residue in fractures.
4	1	Limestone, dark gray, hard; numerous calcite vugs.
3	2	Chert, dark brown and bluish, hard; nodular to bedded; highly fractured.
2	3	Limestone, light gray; silty to quartzitic; very hard; forms ledges.
1	15	Covered interval. Intermittent outcrops of marl.
	245	Total thickness of Phosphoria formation.

Contact between Phosphoria formation and Tensleep sandstone.

10+	Sandstone, gray, fine-grained, hard.

Base of measured section.

EAST SHEEP CREEK SECTION

The following section was measured along the East Fork of Sheep Creek, about 18 miles east of the Maverick Springs oil field, on the south flank of the Owl Creek Mountains, Fremont County, Wyoming.

The Jurassic and Cretaceous parts of the section are well exposed and not faulted but part of the Triassic section is poorly exposed and is cut by at least

one significant fault. Units are numbered consecutively from oldest to youngest.

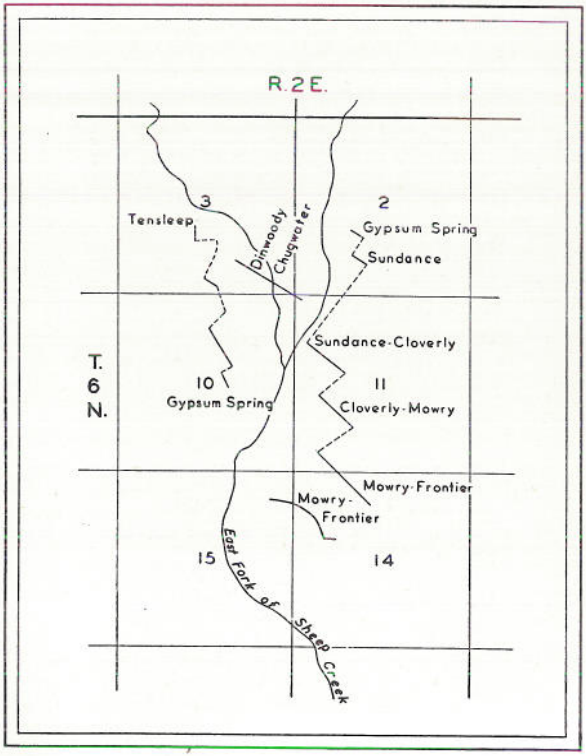

Figure 4. Index map of East Sheep Creek section, Fremont County, Wyoming.

Unit	*Thickness (in feet)*	*Lithologic Character*
Cody shale		
149	50+	Shale, gray, sandy, soft.
Contact between Cody shale and Frontier formation.		
148	115	Sandstone, gray, fine-grained to medium-grained, clayey, limy, soft; upper 30 feet is coarse-grained, with many chert pebbles as much as ¼ inch in diameter; brown limy concretionary masses contain the following lower Niobrara fossils (U.S.G.S. Loc. 19532): *Inoceramus deformis* Meek, *Pholadomya* n. sp., *Anatina lineata* Stanton, *Crassatellites* n. sp., *Cardium* sp., *Cyprimeria* n. sp., *Cymbophora* aff. *C. formosa* Meek and Hayden, boring mollusk in wood (n. gen.?) *Gyrodes* sp., *Anchura* sp. (n. sp. ?), *Volutoderma* sp., *Anisomyon* n. sp. A, *Anisomyon* n. sp. B, gastropods (2 undetermined new forms), *Eutrephoceras* sp., *Baculites* sp., *Scaphites ventricosus* Meek and Hayden, *Placenticeras planum* Hyatt, *Placenticeras* aff. *P. guadalupae* (Roemer).
147	256	Shale, dark gray; silty and sandy in part.
146	126	Sandstone, yellowish gray, chiefly fine-grained; shaly, many laminae of black shale along bedding planes; upper 50 feet thin-bedded and harder, forms inconspicuous ledge.
145	33	Shale, dark gray, silty, bentonitic throughout.
144	4	Sandstone, light gray, fine-grained to medium-grained, non-calcareous; stained yellowish brown; much dark gray interstitial clay.
143	90	Shale, dark gray to black, silty; 10 feet of very sandy shale 5 feet above base.

Unit	*Thickness (in feet)*	*Lithologic Character*
142	10	Sandstone, yellowish gray, fine-grained to medium-grained; many dark-colored mineral grains.
141	50	Shale, dark gray, silty; bentonitic in upper part.
140	3	Sandstone, gray, locally iron-stained, fine-grained, non-calcareous, thin-bedded.
139	43	Shale, light to dark gray, bentonitic.
138	15	Shale, gray, silty and sandy in part, siliceous.
137	7	Tuff, creamy yellow to white, soft; massive and waxy in lower half; harder and bedded near top; capped by 0.4 feet of hard thin-bedded white tuff.
136	4	Shale, black, flaky, soft.
135	6	Sandstone, yellowish tan to gray, fine-grained to medium-grained; many dark colored mineral grains; much interstitial gray clay; siliceous, carbonaceous, nodular; forms ledge.
134	106	Sandstone, light gray to olive brown; weathers gray to rusty brown; fine-grained to medium-grained; many chert grains; non-calcareous to slightly calcareous; contains irregular masses of interstitial clay; thin-bedded; lower 30 feet forms prominent slabby ledge and upper 10 feet forms prominent smooth outcrop.
133	21	Shale, dark olive gray, silty and sandy; basal contact sharp; limy and harder near top.
	889	Total thickness of Frontier formation.

Contact between Frontier formation and Mowry shale.

The following section was measured half a mile to the northeast, in the SW¼ section 11, T. 6 N., R. 2 E. Offset was made on contact between the two formations.

132	47	Shale, dark gray, weathering bluish gray, silty, hard, brittle, siliceous; fish scales up to within 3 feet of top; scattered sand grains; 3 feet of bentonite 36 feet above base; lower 25 feet poorly exposed.
131	3	Sandstone, light bluish gray, weathering brownish gray, fine-grained to medium-grained; many chert grains; much interstitial clay; hard, quartzitic, caps ridge.
130	343	Shale, dark gray, weathers light gray, hard, siliceous; fish scales throughout except in basal 5 feet; some black soft shale in lower 50 feet; 3 feet of bentonitic shale 21 feet above base; 6 feet of bentonite 45 feet above base; 3 feet of bentonite 114 feet above base; 1 foot of bentonite 130 feet above base; 3 feet of bentonite 340 feet above base.
129	167	Shale, dark gray to black, flaky; some silty layers; contains scattered limonite concretions; 1 foot of bentonite 69 feet above base; 3 feet of bentonite 78 feet above base; alternating beds of bentonite and shale, each about 1 foot thick, from 135 to 147 feet above base; 1 foot of bentonite 166 feet above base.
	560	Total thickness of interval between top of Mowry shale and top of Muddy sandstone member of Thermopolis shale. Contact between Mowry and Thermopolis shales probably some distance above this point, and is a matter of individual interpretation.

Contact between upper black shale member and Muddy sandstone member of Thermopolis shale

128	6	Sandstone, gray to pinkish brown, weathering light gray, stained with limonite; fine-grained to medium-grained; many chert grains; very shaly, thin-bedded; forms a ledge.
127	15	Shale, dark gray to black, flaky; silty and sandy; some layers of very shaly fine-grained sandstone near base; 6 inches of very shaly medium-grained sandstone 5 feet above base; more sandy near top; 1 foot of bentonite 6 feet above base.
126	2	Sandstone, pinkish brown, very fine-grained, shaly, massive, hard; caps ridge; contains scattered lignite fragments.
125	1	Sandstone, light gray, mottled black; very carbonaceous, almost a sandy coal; very shaly.

Unit	*Thickness (in feet)*	*Lithologic Character*
124	17	Sandstone, buff to pinkish brown, weathering light yellowish gray, limonitic; medium-grained; many chert grains; non-calcareous, argillaceous; laminae of carbonaceous material in lower 2 feet; thin-bedded; forms rounded ledge.
123	7	Sandstone and shale, in alternating beds. Sandstone is dark gray, shaly, fine-grained. Shale is black, fissile.
	48	Total thickness of Muddy sandstone member of the Thermopolis shale.
Contact between Muddy sandstone member and lower black shale member of Thermopolis shale.		
122	163	Shale, dark gray to black; chiefly flaky but with thin silty layers and sparse shaly sandstone partings; scattered limonitic concretions; bentonitic layers 30 to 60 feet above base; poorly exposed.
	163	Total thickness of lower black shale member of Thermopolis shale.
Contact between Thermopolis shale and "Rusty beds" of Cloverly formation.		
121	68	Shale and sandstone, light gray to dark gray, weathering olive brown; sandy shale alternates with thin layers of platy very fine-grained very shaly drab sandstone; soft and forms slope; hard sandstone ledge 1 foot thick 15 feet below top and another hard ledge 1 foot thick at top.
120	14	Sandstone, light tan, stained rusty brown to nearly black; fine-grained to medium-grained; many well rounded grains, well-bedded, cross-bedded in part; soft, friable; forms prominent ledge.
119	9	Shale, light gray, sandy and silty, soft; some ironstone concretions.
118	2	Sandstone, light gray, weathering light rusty brown; very fine-grained, non-calcareous, hard, irregularly bedded; forms inconspicuous ledge.
117	15	Sandstone, olive brown, gray in lower part; fine-grained, shaly, soft.
116	2	Sandstone, grayish tan, fine-grained; shaly particularly in lower half; non-calcareous, hard; forms ledge.
115	9	Partly covered interval. Poor exposures of shale, lower part gray but stained brick red, upper part dark gray to black; sandy, with several layers of soft shaly sandstone in lower half.
114	9	Sandstone, light yellowish brown, stained rusty brown; fine-grained, moderately clean, slightly limy, well-bedded, hard; locally forms prominent ledge.
113	12	Siltstone, gray, slabby; upper part interbedded with fine-grained thin-bedded sandstone weathering rusty brown to black; upper 4 feet all sandstone.
112	12	Sandstone, gray to yellowish gray, weathering olive and buff, fine-grained; lower part weathers into small olive-colored angular fragments; upper part forms small rusty ledge.
Contact between "Rusty beds" and variegated claystone member of Cloverly formation.		
111	22	Siltstone and silty claystone, reddish at base, gray and buff in upper part; soft, blocky.
110	11	Sandstone, white, weathering yellowish buff, medium-grained; subangular to rounded grains; some black mineral grains; two beds of olive green sandstone in upper part; porous, cross-bedded; some beds form ledges.
109	81	Claystone, variegated; purplish in lower 45 feet; overlain by 10 feet of hard gray siltstone and claystone; then 6 feet of medium-grained white sandstone with limy layers; then 20 feet of purplish siltstone and claystone becoming nearly black at top; bone fragments, chalcedony nodules, and dark purplish ironstone concretions weather out on slope; polished chert pebbles; poorly exposed.
108	10	Sandstone, white, weathering gray and brown, medium-grained to fine-grained, porous; very limy at top and contains sandy limy concretions; sparse polished chert pebbles.
107	30	Siltstone and claystone, variegated, chiefly purple and red; some greenish gray layers; 1 foot of soft very limy red sandstone 9 feet above base.

Unit	*Thickness (in feet)*	*Lithologic Character*
106	1	Claystone, gray, stained yellow, soft, blocky; forms prominent zone.
105	35	Claystone and siltstone, brilliant red, interbedded with dull red and yellow zones; some layers of red sandstone and quartzite; bright red claystone and siltstone at top.
104	30	Covered interval on valley floor. Probably underlain by purple and gray claystone and siltstone.
103	27	Conglomerate and sandstone. Conglomerate consists of rounded chert fragments ranging in size from coarse sand to pebbles one inch in diameter; fairly well sorted. Sandstone is white, cross-bedded, with rounded to subangular grains; soft, porous, sparkling with abundant quartz crystal facets; some irregular limonitic staining. Both conglomerate and sandstone are apparently channel deposits cut into underlying rocks.

Possible contact between Cloverly and Morrison formations. There is a marked lithologic change at this point. There are no quartz crystal sandstones and conglomerates below. The underlying sandstone grades laterally into dully variegated claystone.

102	162	Sandstone, white; forms conspicuous rounded smooth cliff; medium-grained to fine-grained; remarkably homogeneous, moderately soft, porous; some limonite-stained zones. At 70 and 125 feet above base of cliff are lenses of gray compact limy sandstone weathering light brown. The upper 32 feet is soft, very argillaceous with pale greenish white color and containing hard sandstone balls up to 1 foot in diameter, with small round ironstone centers.
	561	Total thickness of Cloverly and Morrison formations, undivided.

Contact between Morrison formation and "upper Sundance". This contact appears gradational, possibly because of extensive reworking of sandstone of the "upper Sundance" at the time of deposition of the remarkably thick sandstone of the Morrison formation.

101	15	Sandstone, gray to green; pale green glauconite in rounded grains near base; fine rounded grains of bright and pale green glauconite near middle; medium-grained to fine-grained, thin-bedded; several thin beds of hard very limy greenish gray sandstone containing lenses of green shale near base.
100	1	Limestone, gray, greenish, and brick red, very sandy; finely disseminated bright green glauconite; forms conspicuous dip slopes.
99	1	Sandstone, light grayish green, medium-grained to fine-grained; soft and friable; abundant finely disseminated bright green glauconite.
98	2	Siltstone, dark red to brick red.
97	1	Limestone, red, very hard; forms small ledge; weathers into rounded blocks.
96	1	Siltstone, dark grayish green at base, purplish in middle, light green at top; flaky, fractures into small pieces.
95	19	Sandstone, light green, medium-grained, rounded grains; abundant grains of bright green glauconite; even-textured, soft, friable, thin-bedded, cross-bedded in part.
94	8	Sandstone, greenish gray, weathering yellow; many black grains and rounded bright green glauconite grains; friable, medium-grained, soft; hard ledge at top.
93	19	Sandstone, yellowish green, medium-grained; rounded orange and black mineral grains; abundant glauconite; moderately soft; forms conspicuous cliff; massive to thickly bedded; 4.5 feet above base is 1 foot of gray sandy fine-grained glauconitic limestone.
92	7	Sandstone, gray, weathering yellow, medium-grained; rounded grains of black mineral and bright green glauconite.
91	3	Sandstone, grayish green, weathering buff, medium-grained, soft, friable; one thin bed of sandy limestone.
90	13	Covered interval, probably underlain by gray glauconitic soft sandstone.
89	2	Limestone, gray, weathering light brown, very sandy, fossiliferous, forms ledge; many black grains and abundant glauconite.

Unit	*Thickness (in feet)*	*Lithologic Character*
88	18	Sandstone, gray, weathering yellowish to buff; central part hard enough to form prominent cliff; very limy, glauconitic, fossiliferous; rounded sand grains; numerous dark mineral grains.
87	1	Limestone, brown, with gray and orange flecks; weathers tan; coarsely crystalline, very hard and compact, fossiliferous; contains small black mineral grains and glauconite.
86	8	Covered interval, apparently underlain by sandstone, yellowish green to gray, soft, friable, medium-grained, glauconitic.
85	3	Limestone, gray, weathering rusty, hard, irregularly bedded, fossiliferous.

Offset one-half mile northeast along strike, to SE SW section 2, T. 6 N., R. 2 E.

84	28	Siltstone and sandstone, dark green to black; thin fossiliferous limestones near base; glauconitic; contains gypsum crystals; well-defined glauconitic sandstone near top.
83	1	Limestone, gray, weathers reddish buff, crystalline, glauconitic; forms ledge.
82	40	Sandstone and siltstone, dark green, highly glauconitic; fossiliferous, with thin beds of fossil coquina; "*Belemnites*" in place at base; sporadic pebbles and large sand grains at base.
81	1	Siltstone and shale, dark green to gray, glauconitic.
	192	Total thickness of "upper Sundance".

Contact between "upper Sundance" and "lower Sundance".

80	5	Shale, olive green to gray, soft; gypsum crystals at top.
79	1	Sandstone, gray, fine-grained to medium-grained, non-glauconitic; interbedded with olive green shale.
78	7	Shale, olive green, soft; contains gypsum crystals; lenses of dark green fine-grained hard sandstone.
77	12	Sandstone, white to gray, fine-grained, thin-bedded; some gray shale partings; forms ledges.
76	1	Limestone, brownish gray, sandy; composed chiefly of oolites.
75	4	Sandstone, gray, fine-grained, thin-bedded; gray shale partings.
74	1	Limestone, dark gray, weathering light gray, sandy; composed chiefly of small gray oolites.
73	14	Sandstone, gray to white, fine-grained, thin-bedded; interbedded with gray shale; forms ledges.
72	13	Shale, gray, silty; a few thin beds of grayish white fine-grained sandstone; poorly exposed.
71	9	Sandstone, brownish gray, weathering buff; contains abundant calcareous oolites and sparse large rounded frosted sand grains; forms ledges.
70	3	Limestone, white, weathering buff, sandy, oolitic.
69	2	Sandstone, light gray, thin-bedded, fine-grained; abundant calcareous oolites.
68	1	Limestone, grayish white, fine-grained, sandy.
67	5	Sandstone, gray, weathering brown to yellowish, fine-grained, with small rounded red grains scattered among clear quartz grains of the same size; thin greenish sandy shale parting at top.
66	6	Limestone, gray, interbedded with grayish brown sandstone and greenish gray shale; some red oolites and large rounded sand grains.
65	5	Shale, grayish green, silty, soft; a lens of salmon-colored siliceous material 2 inches thick.
64	7	Sandstone, shale, and limestone, interbedded. Sandstone is gray to greenish and reddish, limy, very fine-grained, oolitic. Shale is dark greenish gray, sandy. Limestone is brownish gray, oolitic, sandy.
63	9	Sandstone and siltstone, dark red and brown, very fine-grained, moderately soft. One mile southwest the following fossils were collected from this

Unit	*Thickness (in feet)*	*Lithologic Character*
		bed (U.S.G.S. Loc. 19358) *Trigonia quadrangularis* Whitfield, *Pleuromya* sp., *Cardinia* sp.
	105	Total thickness of "lower Sundance".
Contact between "lower Sundance" and Gypsum Spring formation.		
62	9	Dolomite, light gray to white, earthy, dense to porous, irregularly bedded.
61	30	Siltstone, brick red near base, purplish red near top, soft; contains thin beds of grayish green siltstone.
60	3	Dolomite, gray, chalky, porous, silty.
59	4	Siltstone, lavender, limy, soft.
58	11	Dolomite and dolomitic siltstone, gray, lavender, buff, and salmon red, well-bedded to poorly bedded, moderately hard; forms ledges.
57	3	Limestone, light gray, fine-grained, sub-lithographic, poorly bedded.
56	1	Siltstone, dark red, slightly mottled with green.
55	2	Dolomite, white, chalky, mottled with lavender color, fine-grained, hard, homogeneous.
54	5	Siltstone, dark red, slightly mottled with green.
53	1	Dolomite, white, chalky, mottled with lavender color, fine-grained, hard, homogeneous.
52	5	Siltstone, dark red, slightly mottled with green.
51	2	Dolomite, gray and red, weathers reddish buff, homogeneous, crystalline, limy, slabby.
50	3	Limestone, gray, porous to dense, sub-lithographic to crystalline.
49	1	Dolomite, white, chalky, homogeneous, hard.
48	1	Siltstone, dark red, hard.
47	3	Limestone, light gray, poorly bedded, sub-lithographic, interbedded with reddish and greenish silty shale.
46	2	Dolomite, white, chalky, limy, porous, poorly bedded.
45	32	Siltstone, dark red to brick red; some green mottling.
44	1	Gypsum, white, crystalline.
43	1	Siltstone, dark red, mottled with black spots.
42	45	Gypsum, white; interbedded with thin red shale laminae; forms cliff.
41	10	Siltstone, dark red, interbedded with fine-grained red sandstone; poorly exposed.
	175	Total thickness of Gypsum Spring formation.
Contact between Gypsum Spring formation and Nugget sandstone. Because of poor exposures the contact is only approximate.		
40	8	Sandstone and siltstone, dark red; some small angular fragments of white to yellow siltstone; poorly exposed.
39	1	Sandstone, dark red, fine-grained; many small rounded grains and a few large frosted grains; many small angular fragments of white to yellow siltstone.
38	1	Sandstone, bluish gray, stained yellowish brown; large rounded frosted quartz grains in matrix of smaller rounded grains.
37	30	Sandstone, dark red; some bluish gray sandstone beds; large rounded frosted quartz grains in finer-grained matrix.
36	4	Sandstone, dark red, shaly; large rounded frosted quartz grains in a finer-grained matrix; some small black grains; angular fragments of yellow siltstone from underlying rocks reworked into basal part of sandstone.
	44	Total thickness of Nugget sandstone.
Contact between Nugget sandstone and Popo Agie member of Chugwater formation.		
35	7	Siltstone, mustard yellow; sporadic large rounded sand grains in lower part.

Offset 1¼ miles southwest to the center of sec. 10, T. 6 N., R. 2 E. Nowhere in this area is the entire Popo Agie section exposed, nor are there key beds on which to offset. Therefore, the thickness of the interval between the top of the Popo Agie member and Alcova limestone member of the Chugwater formation is an approximation.

Unit	*Thickness (in feet)*	*Lithologic Character*
34	37	Covered interval. Probably underlain chiefly by red siltstones, red and purple shales, and fine-grained red sandstones.
33	68	Shale, grayish purple to maroon, silty, limy; many limestone nodules which are ferruginous; gypsum nodules in lower half; 6 inches of limestone pellet conglomerate 2 feet below top.
32	20	Sandstone, light orange-red, fine-grained, limy, soft; 2 feet of white sandstone forms ledge at base.
31	14	Shale, grayish purple, very limy; many small limestone nodules; a 6-inch bed of nodular limestone 5 feet above base.
30	39	Sandstone and shale. Purplish gray limy silty shale alternates with gray to purplish massive to thin-bedded fine-grained limy sandstone.
29	31	Sandstone and conglomerate. Sandstone is light orange-red, fine-grained, limy, interbedded with irregular lenses of purplish gray limestone pellet conglomerate. Conglomerate most abundant near top and bottom of unit.
28	52	Sandstone, light brownish red to gray, fine-grained; chiefly clean but with a few soft shaly beds; lower half forms cliff.
27	36	Sandstone, light brownish red, fine-grained to medium-grained; some larger well-rounded and frosted grains in a finer matrix; forms massive smooth cliff; irregular thin bedding; striking cross-lamination in part; lithologically identical to Nugget sandstone; small angular fragments of underlying Alcova limestone in lower 1 foot.
Top of Alcova limestone member of Chugwater formation.		
26	4	Limestone, gray, with some violet red laminae and surface stains; finely crystalline to sub-lithographic; laminated, with irregular contorted laminae; hard; forms prominent ledge.
Contact between Alcova limestone member and Red Peak member of Chugwater formation.		
25	8	Sandstone, light yellowish brown, with irregular layers of pastel pink and violet; fine-grained to medium-grained; limy, soft.
24	5	Sandstone and shale, light brownish red; sandstone very fine-grained and slabby; shale silty and soft.
23	52	Sandstone, light brownish red, fine-grained, moderately clean, with little silt content in lower half; silty and shaly in upper half; limy; lower half forms two prominent ledges.
22	151	Sandstone, light brownish red, slabby; 2 feet of bluish violet waxy shale and thin-bedded dolomitic siltstone 62 feet above base; upper half of unit chiefly silty shale interbedded with soft shaly sandstone.
Fault.		
21	273	Estimated interval of section cut out by fault. This figure derived by subtracting thickness of beds between top of Alcova limestone and fault plus thickness of beds between fault and base of Chugwater formation from total thickness of unfaulted interval of 909 feet between top of Alcova limestone and base of Chugwater formation as measured by plane table ¼ mile northeast.
20	155	Sandstone, and shale. Sandstone is light brownish red, soft, shaly, thin-bedded, ripple-marked. Shale is brownish maroon, silty. Some thin beds of greenish gray limy sandstone. Three prominent ledges of sandstone 15 feet thick at top of unit; 30 feet thick, 50 feet below top; and 10 feet thick 100 feet below top.
19	101	Sandstone, light brownish red, fine-grained, shaly, limy, thin-bedded; many beds ripple-marked; in beds 2 to 10 feet thick, alternating with beds of more clayey and finer-grained sandstone and maroon shale 1 to 5 feet thick; lower two-thirds forms prominent cliff.

Unit	*Thickness (in feet)*	*Lithologic Character*
18	123	Sandstone, siltstone, and shale. Sandstone is brownish red, fine-grained, clayey, soft in lower half, grading up into sequence of brownish red shaly sandstone and shale interbedded in about equal amounts; limy; two beds of greenish gray sandstone, each 4 feet thick, one 41 feet below top, and the other 20 feet below top.
17	41	Siltstone, light ocher; slightly limy or dolomitic; blocky in upper part, thin-bedded in lower part; soft; color change at top is sharp and even; poorly exposed in part.
	1217	Total thickness of Chugwater formation.

Contact between Chugwater and Dinwoody formations.

16	13	Limestone, dolomitic limestone, and dolomite. Unit consists chiefly of finely crystalline sandy limestone with thin beds of sub-lithographic dolomite. A six-inch bed of porous brownish violet crystalline limestone is present near middle. Some grayish green silty shales are present in upper part. Sequence is thin-bedded, slabby, ripple-marked.
15	8	Siltstone, greenish gray, weathering tan, shaly, very slightly limy or dolomitic, slabby; harder near top; intertongues with overlying unit.
14	2	Dolomite and dolomitic limestone, gray to tan; some greenish layers near top; fine-grained, sandy, very thin-bedded and slabby; forms ledge.
13	5	Limestone, white to gray, soft, chalky; thin lenses of dolomite; grayish violet layers of crystalline sandy limestone near base.
12	1	Breccia, consisting of fragments of laminated white chalky dolomite in a matrix of very limy fine-grained sandstone; some spongy masses of limestone; in places the dolomite is contorted without being brecciated; thin partings of grayish green silty shale near top.
11	5	Sandstone and shaly dolomite, light tan, weathering brown; some green layers, thin-bedded; shale blocky and soft.
10	6	Sandstone, light tan to gray with greenish tinges, very fine-grained, clayey, non-calcareous, thin-bedded; ripple marks conspicuous in some beds; forms slabby ledge.
9	30	Partially covered interval; sporadic outcrops of tan thin-bedded platy soft dolomitic shales and siltstones. Basal contact sharp and uneven; overlain by 6 inches of fine-grained sandstone; contrasts sharply with underlying crystalline limestone and dolomite.
	70	Total thickness of Dinwoody formation.

Contact between Dinwoody and Phosphoria formations. The underlying beds were measured about one-fourth mile to the north. Offset was made on the dolomitic limestone directly below the contact. Because of structural complications, and possible slight facies changes, there may be a discrepancy in correlation of as much as 20 feet.

8	15	Limestone and dolomitic limestone bed 1 foot thick, at top, violet gray, crystalline, porous, hard, weathering to a rough surface. Remainder of interval is covered.
7	33	Limestone, gray, medium crystalline, hard; dolomitic in part; local abundance of white to gray chert, especially in upper part; much pyrite; massive to well bedded; weathers to a rough surface; softer layers clayey and glauconitic; fossiliferous throughout but fossils more abundant in softer layers.
6	25	Chert and limestone in proportion of 7 to 3. Chert is gray, in irregular nodules as much as 2 inches thick, with thinner branches roughly aligned in layers in a matrix of grayish violet crystalline limestone; some round nodules of white granular chert 1 inch in diameter; hard, massive; forms prominent cliff.
5	137	Covered interval, probably underlain by soft clayey limestones and dolomites, and gray shales.
4	4	Chert, white to brownish gray, granular; irregular beds as much as 2 inches thick; hard; a few thin beds of limestone; some crystalline quartz in upper 1 foot.

Unit	*Thickness (in feet)*	*Lithologic Character*
3	2	Limestone, white, soft, granular; some hard irregular nodules of brownish gray crystalline limestone.
2	23	Covered interval; sporadic outcrops of light gray to white hard dolomite or dolomitic limestone; some soft very shaly tan dolomite or dolomitic shale; some white granular chert nodules as much as ½ inch in diameter.
1	3	Sandstone, light gray to creamy tan, fine-grained, soft; limestone and dolomite content increases progressively from bottom to top.
	242	Total thickness of Phosphoria formation.

Contact between Phosphoria formation and Tensleep sandstone.

	220+	Sandstone, gray, weathering buff to brown, fine-grained to medium-grained; many well rounded grains, hard and quartzitic on weathered surface but softer on fresh surface; porous; limy in part.

Base of measured section.

CROOKED CREEK-MILL CREEK COMPOSITE SECTION

This is a composite section as no continuous section can be measured because of poor exposures throughout much of the area, gentle dips that make outcrops broad, and minor amounts of squeezing of incompetent formations. The section extends from about four miles south of the village of Wind River to a point about 10 miles southwest of this village. It is on the Shoshone Indian Reservation 12 miles to 15 miles northwest of the town of Lander, Fremont County, Wyoming.

The section from the top of the Nugget sandstone to the top of the Frontier formation was measured along Mill Creek. Details of the Frontier formation were measured on the south side of Trout Creek. The thicknesses of the Mowry and Frontier formations are only approximate. The lower black shale member of the Thermopolis shale was measured on the north side of Crooked Creek, because sections farther south are apparently distorted. The section from the Tensleep sandstone to the top of the Nugget sandstone was measured along Crooked Creek. Plane table intervals of formations between the Bighorn dolomite and the top of the Tensleep sandstone were measured along the north side of Trout Creek Canyon, but no attempt was made to describe the lithologic composition of this part of the section in detail. Units are numbered consecutively from oldest to youngest.

Unit	*Thickness (in feet)*	*Lithologic Character*
Cody shale		
240	50+	Shale, gray, sandy, soft, poorly exposed.

Approximate contact between Cody shale and Frontier formation. Poor exposures and the nature of the contact make it impossible to pick a precise contact point. The contact is arbitrarily placed at the approximate point below which sandstones predominate and above which sandy shales predominate.

239	20±	Sandstone, brown, fine-grained; numerous dark grains; numerous gray to brown limy concretions and nodules containing an abundant fauna with both Carlile and Niobrara affinities (U.S.G.S. Loc. 19542): Bryozoan, *Inoceramus* aff. *I. fragilis* Hall and Meek, *Camptonectes* sp., *Liopistha* (*Psilomya*) *concentrica* Stanton, *Crassatellites* n. sp. *Cardium pauperculum* Meek, *Legumen* aff. *L. planulatum* Conrad, *Cadulus?* n. sp., *Gyrodes* cf. *G. depressa* Meek, *Anchura* cf. *A. ruida* White, *Baculites* sp., *Scaphites* n. sp., *Placenticeras* sp.
238	210	Covered interval, apparently underlain by gray sandy shale.

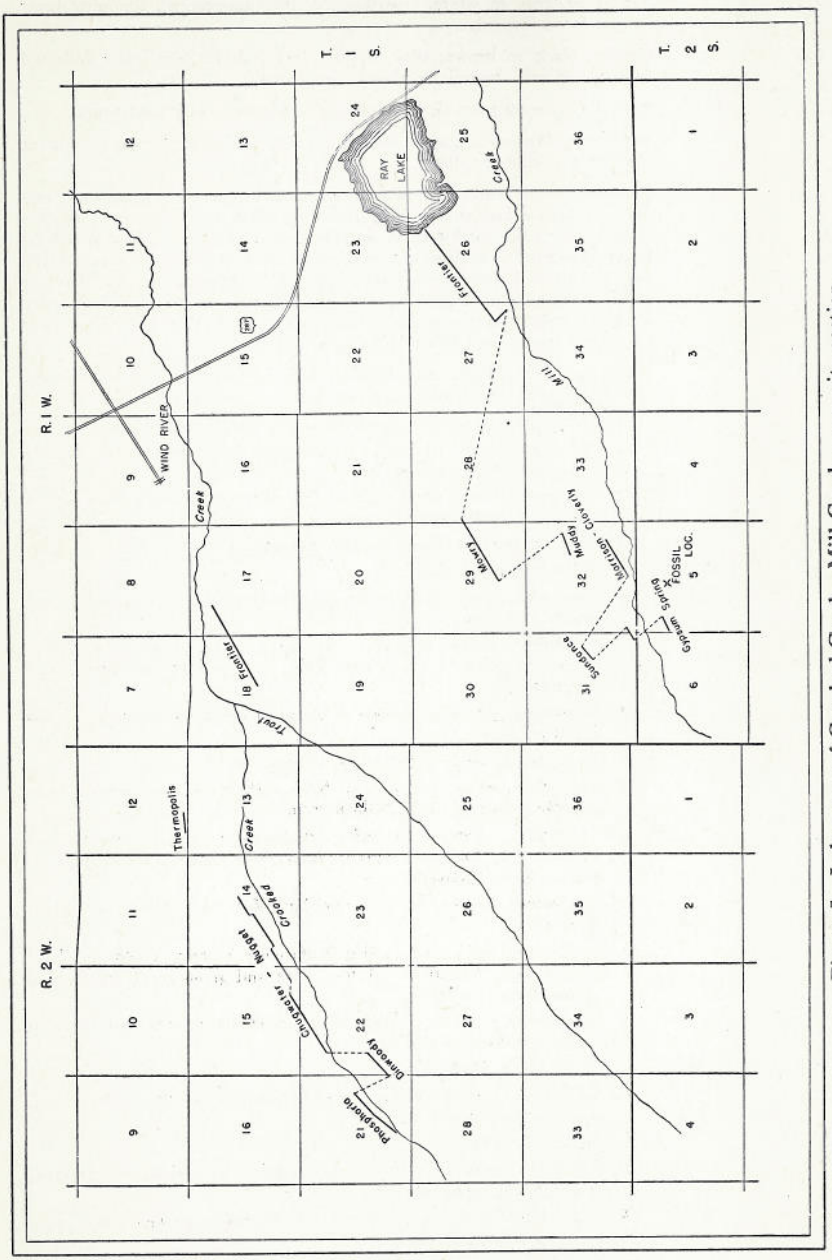

Figure 5. Index map of Crooked Creek—Mill Creek composite section, Fremont County, Wyoming.

Unit	*Thickness (in feet)*	*Lithologic Character*
237	7	Sandstone, gray to white, cross-bedded, medium-grained; limonitic layer at top; forms low ridge.
236	3	Lignite, black to brown, silty, friable, very impure; fern frond collected from top of unit one mile northwest along strike.
235	61	Partially covered interval; some outcrops of brown shaly sandstone.
234	15	Sandstone, brownish gray, medium-grained, limonitic; forms prominent ridge on east side of valley.
233	547	Partially covered interval; apparently underlain chiefly by gray shale and gray to brown sandstone. The following beds were measured in this interval four miles northwest, in sections 17 and 18, T. 1 S., R. 1 W., Wind River Meridian. The base of this supplementary section can be correlated with the main section of the base of the Frontier formation, but it is not at all certain whether the uppermost sandstone in the supplementary section correlates with any part of sandstone unit 234 or with some lower sandstone not exposed along Mill Creek.
	14	Sandstone, buff, cross-bedded, medium-grained; numerous black grains; overlying rocks not exposed.
	13	Shale, gray; some thin sandstone beds; poorly exposed.
	27	Sandstone, gray to buff, cross-bedded, medium-grained, slightly limy; numerous black grains.
	188	Covered interval; apparently underlain by gray sandy shale with a few brown and gray sandstones.
	50	Shale, gray; thin brown sandstone layers.
	1	Bentonite, gray, plastic.
	9	Sandstone, gray, medium-grained; poorly bedded; abundant black grains; numerous limonitic layers.
	15	Sandstone, yellow to brown, and gray, fine-grained; many black grains; limonitic; a 5-foot hard ledge near middle; thin ferruginous layer at top.
	16	Sandstone, yellowish brown to gray, fine-grained, limonitic; many black grains.
	27	Shale, black, silty; some sandy layers.
	8	Sandstone, white, greenish on fresh surface, medium-grained, sub-angular grains; abundant black grains.
	9	Sandstone, white, very soft; tuffaceous matrix, green on fresh surface; very fine quartz grains; black and green accessory mineral grains; forms badlands.
	1	Sandstone, brown, hard, limonitic; filled with wood and plant fragments.
	30	Sandstone, white, very soft; tuffaceous matrix, green on fresh surface; very fine quartz grains; black and green accessory mineral grains; forms badlands.
	1	Sandstone, gray to yellow, cross-bedded, laminated, fine-grained; some carbonaceous partings.
	2	Shale, black, fissile.
	1	Sandstone, gray to yellow, cross-bedded, laminated, fine-grained; some carbonaceous partings.
	2	Shale, black, fissile.
	2	Sandstone, gray to yellow, cross-bedded, laminated, fine-grained; some carbonaceous partings.
	66	Shale, black, fissile; a few thin black siltstone partings; a few limonitic sandstone partings.
	12	Sandstone, yellowish brown, medium-grained, cross-bedded in part; abundant black grains; near top are numerous black chert pebbles as much as ½ inch in diameter.
	5	Sandstone, yellowish brown, very thin-bedded, soft, medium-grained.

Unit	*Thickness (in feet)*	*Lithologic Character*
	20	Sandstone, yellowish brown, medium-grained, slightly limy; abundant black grains; forms cliff. The base of this sandstone is the base of the Frontier formation and correlates with the base of unit 232 in the section along Mill Creek.
232	15	Sandstone, gray, weathers yellowish brown, medium-grained; cross-bedded in part, slightly limy; numerous black grains.
	878	Approximate total thickness of Frontier formation.

Contact between Frontier formation and Mowry shale. This contact is exceptionally sharp and is well exposed throughout much of this area.

Offset 2 miles WNW to C east line section 29, T. 1 S., R. 1 W.

231	50	Shale, drab gray, carbonaceous, fissile, non-siliceous.
230	120	Shale, gray, weathering silvery gray, hard, siliceous; top of ridge 25 feet above base; remainder of unit on black slope and not too well exposed.
229	2	Siltstone, gray, weathering silvery gray to pinkish, siliceous, very hard.
228	130	Shale, dark gray, weathering silvery gray, hard; a few thin creamy white bentonites; some very hard layers.
227	145	Shale, dark gray, weathering silvery gray, siliceous, hard; silty in part; numerous creamy gray bentonitic layers comprising about 25% of unit.
226	135	Shale, dark gray, weathering silvery gray, hard, siliceous; silty in part; numerous fish scales; 3 feet of bentonite 38 feet above base; 5 feet of bentonite 63 feet above base; numerous thin bentonite beds and partings in upper half.
	582	Total thickness of interval between top of Mowry shale and top of Muddy sandstone member of the Thermopolis shale.

Contact between upper black shale member and Muddy sandstone member of Thermopolis formation is probably at this point.

Offset ¾ mile southeast to NE¼ sec. 32, T. 1 S., R. 1 W.

225	18	Partially covered interval; apparently underlain by sandstone, yellow to gray, moderately fine-grained; possibly some thin black shale beds.
224	15	Sandstone, yellow and gray; abundant black grains; some chalky chert(?) grains; cross-bedded in part; ferruginous; forms ridge.
223	10	Partially covered interval; apparently underlain by gray to black carbonaceous flaky shale.
222	38	Sandstone, gray, cross-bedded, fine-grained to coarse-grained; some chert grains; some small chert pebbles near top.
	81	Total thickness of Muddy sandstone member of Thermoloplis shale.

Contact between Muddy sandstone member and lower black shale member of Thermopolis shale.

Offset 4 miles northwest to SW¼ section 12 T. 1 S., R. 2 W.

221	204	Partially covered interval; some exposures of black fine-grained flaky fissile soft shale with some thin partings of yellowish white bentonite, some ferruginous concretions, and thin beds of fine-grained gray sandstone. This interval was measured in three places in the area and this seems to be the most reliable section.
	204	Total thickness of lower black shale member of Thermopolis shale.

Contact between Thermopolis shale and "Rusty beds" of Cloverly formation.

Offset 4½ miles southeast to SE¼ section 32, T. 1 S., R. 1 W.

220	40	Sandstone, rusty brown, fine-grained, limonitic; lower part massive, overlain by black soft shale about 5 feet thick; overlain by 8 feet of platy thin-bedded sandstone; poorly exposed.

Unit	Thickness (in feet)	Lithologic Character
Contact between "Rusty bed:" and variegated claystone member of Cloverly formation.		
219	65	Claystone, grayish purple, soft; zone of limestone nodules as much as 6 inches in diameter 5 feet above base and another one 30 feet above base.
218	20	Claystone, greenish gray, blocky, soft.
217	1	Limestone nodules, gray; knobby on surface; sublithographic.
216	16	Claystone, olive green in basal 5 feet, pale green in upper part, blocky, soft.
215	4	Claystone, green, soft, blocky, with zone of gray knobby sublithographic limestone nodules at base; zone of creamy white non-calcareous claystone nodules at top.
214	5	Claystone, green and maroon, soft, blocky.
213	42	Sandstone, gray, sparkly; thin green shale partings; cross-bedded in part; forms ridge.
212	8	Sandstone or sandy siltstone, yellowish gray; very fine quartz grains in finer-grained matrix; sporadic coarse quartz grains.
211	19	Claystone, green, sandy.
210	9	Sandstone, buff to yellow, green at top, fine-grained.
209	26	Claystone, purple and maroon, soft, blocky.
208	2	Sandstone, gray, stained purple, fine-grained, limonitic.
207	13	Claystone, green, sandy; some maroon and gray zones.
206	2	Sandstone, yellow, friable, fine-grained; sparse red grains.
205	4	Claystone, maroon; sporadic polished pebbles.
204	1	Limestone, white, sandy. This unit grades laterally to a fine-grained limy sandstone with abundant red and black mineral grains 75 feet north of measured section.
203	12	Claystone, maroon and green, sandy; an emerald green very sandy and limy parting 4 feet below top.
202	2	Sandstone, white with greenish tint, thin-bedded, fissile, limy; some chert grains.
201	1	Limestone nodules, creamy white, moderately pure.
200	25	Partially covered interval; apparently sandstone, drab to tan; some drab shale; uppermost bed is yellowish medium-grained sandstone.
199	45	Sandstone and conglomerate, buff to yellow; coarse-grained sparkling sandstone with abundant quartz crystal facets, clean, cross-bedded, numerous chert grains; intertongues with large and small lenses of chert pebble conglomerate in which pebbles are commonly less than an inch in diameter but which in places are as much as 4 inches in diameter.
Base of quartz crystal sandstone and conglomerate zone, possibly marking contact between Cloverly and Morrison formations. There is a sharp lithologic change at this point and underlying sandstones are less sparkly, contain more interstitial clay, and conglomerates are absent. Claystones contain more silty material and colors are dull below this point.		
198	29	Sandstone, yellowish brown, cross-bedded, medium-grained; central part poorly exposed; upper 5 feet poorly exposed; forms cliffs. Along strike where contact with overlying unit is exposed, conglomerates have cut conspicuous channels in the soft uppermost sandstone of this unit.
197	25	Partially covered interval; some exposures of greenish gray shale and claystone interbedded with soft fissile greenish gray shaly sandstone.
196	37	Sandstone, buff to brown, medium-grained; massive in part; cross-bedded in part; some green shale pebbles; forms cliff.
195	12	Sandstone, white to greenish, medium-grained; thin irregular bedding; numerous pale green and sparse bright green grains; some soft green shale pebbles.
	465	Total thickness of Cloverly and Morrison formations, undivided.
Contact between Morrison formation and "upper Sundance".		
Offset ¾ mile northwest to E½E½ section 31, T. 1 S., R. 1 W.		
194	5	Shale, green, fissile, non-glauconitic.

Unit	*Thickness (in feet)*	*Lithologic Character*
193	29	Sandstone, greenish yellow, fissile, soft; some fine-grained shaly layers in lower 15 feet; upper 8 feet massive, medium-bedded, coarse-grained, glauconitic; at base 7 inches of limestone, white, weathering yellow, crystalline, with abundant glauconite and chert grains as much as one-eighth inch in diameter, and abundant pelecypod fragments.
192	28	Sandstone, greenish yellow, poorly bedded; cross-bedded in part; highly glauconitic, limy; numerous yellow and black grains; shaly and dark gray in upper 3 feet.
191	2	Limestone, gray, weathering yellow, medium crystalline, glauconitic; contains large pelecypods.
190	51	Sandstone, dark grayish green, silty and shaly, thin-bedded, friable, limy; lower part fine-grained; upper part medium-grained; abundant glauconite; numerous black grains.
189	7	Shale, dark olive green, very sandy with shaly sandstone layers near base; abundant glauconite; numerous black grains; gray crystalline glauconitic limestone at base containing yellow chert grains as much as one-eighth inch in diameter and abundant *Camptonectes*.
188	2	Limestone, gray, weathering yellowish brown, finely crystalline, glauconitic, oolitic; abundant small brown and yellow pebbles; numerous "*Belemnites*".
187	10	Shale, olive green, sandy, limy, glauconitic, soft, friable; contains gray finely crystalline glauconitic fossiliferous limestone beds as much as 2 inches thick; numerous pelecypods and "*Belemnites*".
186	5	Shale, brown, with green partings, sandy; forms soft ledge.
Contact between "upper Sundance" and "lower Sundance" marked by a very sharp lithologic change.		
185	1	Sandstone, white, fine-grained; rounded grains; non-glauconitic.
184	10	Siltstone, brownish red, fissile; a thin green parting at top.
183	4	Sandstone, white, yellow, and green, massive, soft, fine-grained, limy; abundant red, black, and yellow grains; slightly shaly in upper 6 inches.
182	9	Covered interval; apparently underlain by gray and reddish sandstones and siltstones.
181	2	Limestone, gray, thin-bedded; tiny oolites; abundant *Pentacrinus* and pelecypods including *Gryphaea* and *Ostrea*.
180	13	Sandstone, yellow, fine-grained, limy, friable, soft, non-glauconitic.
179	22	Claystone, grayish brown, limy; sporadic quartz grains.
178	7	Covered interval; apparently underlain by gray claystone or shale.
177	2	Sandstone, gray, limy, oolitic; fine quartz grains and oolites in about equal amounts; abundant shell fragments; tiny yellow and black grains.
176	6	Covered interval, apparently underlain by oolitic sandstone.
175	2	Oolitic limestone, grayish yellow, slabby; sparse green grains.
174	3	Sandstone, yellow, very fine-grained; slightly larger yellow and brown grains; upper contact gradational with overlying unit.
173	1	Marl, yellow, earthy.
172	1	Limestone, gray, oolitic; contains *Ostrea* and other pelecypod fragments.
171	2	Marl, yellow, earthy.
170	4	Marl, olive green, oolitic; sparse pelecypod fragments; 6 inches of gray oolitic limestone containing pelecypod fragments forms ledge at top of unit. Units 170 to 173 yielded the following Upper Jurassic fossils (U.S. G.S. Loc. 19366): *Pentacrinus asteriscus* Meek and Hayden, *Isognomon* sp., *Mytilus* cf. *M. whitei* Whitfield. One mile southeast along strike this zone yielded the following Upper Jurassic fossils (U.S.G.S. Loc. 19367 and 19368): *Cadoceras?* sp., *Ostrea strigilecula* White, *Pleuromya* cf. *P. newtoni* Whitfield, *Pleuromya* sp., *Cardinia?* cf. *C. praecisa* White, *Trigonia quadrangularis* Whitfield, naticoid gastropod.
169	4	Limestone, gray, hard, poorly bedded; earthy partings; 6 inches of yellowish green dolomitic marl at base.
168	1	Shale, green, limy, with 3 inches of calcite nodules at base. Nodules are white and red and have rough geodal appearance. This zone is widespread and distinctive in this area.

Unit	*Thickness (in feet)*	*Lithologic Character*
167	2	Bentonite (?), gray, plastic, waxy, slightly limy. This zone is widespread and distinctive throughout this area.
166	3	Limestone, gray, oolitic; abundant pelecypod fragments.
165	6	Marl, gray, earthy; numerous small brown calcite plates that may be shell fragments.
	105	Total thickness of "lower Sundance".
Contact between "lower Sundance" and Gypsum Spring formation.		
164	3	Marl, maroon and brown, hard in upper 6 inches; sparse pelecypod fragments.
163	1	Marl, gray, earthy.
162	8	Siltstone, reddish brown, limy.
161	2	Limestone, gray, massive, porous, highly fossiliferous; 6 inches of chert, dark gray, weathering pinkish yellow, brittle, not continuously present along strike. One-half mile southeast of section this limestone bed yielded the following Middle Jurassic fauna (U.S.G.S. Loc. 19357); *Lucina* n. sp., *Trigonia* aff. *T. packardi* (Crickmay), *Trigonia* n. sp., *Astarte* n. sp. a, *Astarte* n. sp. b, *Parallelodon* (*Beushausenia*) sp. a (similar to *P. simillima* (Whiteaves)), *Parallelodon* (*Beushausenia*) sp. b, *Opis* (*Trigonopis*) n. sp., *Pteroperna* n. sp., *Pteroperna?* n. sp., *Placunopsis* sp., *Protocardia* n. sp., *Pinna* sp., *Grammatodon?* sp., *Isocyprina?* n. sp., *Tancredia* n. sp., Tancredia n. sp., aff. *T. corbuliformis* Whitfield, *Cardinia?* sp., *Dosina?* n. sp., aff. *D. jurassica* Whitfield, *Quenstedtia* n. sp., *Arctica?* n. sp., *Cardinia* n. sp. aff. *C. praecisa* White, *Procerithium* (*Rhabdocolpus*) n. sp. a, *Procerithium* (*Rhabdocolpus*) n. sp. b, *Nerinea* n. spp. a, b, c, and d, *Ampullospira* n. sp. (similar to *A. pyramidata* (Morris and Lycett) from the Bathonian of England), *Nododelphinula* n. sp., *Serpula* sp., *Pseudodiadema?* sp.
160	1	Dolomite, gray, marly, poorly bedded, soft; thin green shale parting near middle.
Offset ¼ mile southeast to south side of Mill Creek, in SW¼ NW¼ section 5, T. 2 S., R. 1 W.		
159	4	Dolomite, gray, thin-bedded, finely crystalline, hard; forms top of ridge.
158	3	Shale and claystone, yellowish green, gray and maroon, blocky; 6 inches of gypsum near middle.
157	9	Gypsum, white, pure.
156	19	Siltstone, maroon to brownish red; nodules and partings of white gypsum; green partings a few inches thick every 3 to 4 feet throughout sequence.
155	3	Gypsum, white; contains some gray dolomite partings.
154	4	Claystone, reddish maroon, dolomitic; thin gray dolomite partings near middle and at top.
153	3	Dolomite, gray, marly; friable at base; grades up into thin-bedded platy limy dolomite.
152	8	Gypsum, white, soft.
151	4	Gypsum, white, interbedded with reddish brown clayey siltstone.
150	1	Claystone, reddish brown, silty.
149	1	Dolomite, greenish gray, blocky.
148	2	Claystone, reddish brown, slightly limy.
147	1	Dolomite, gray, very fine-grained, brittle.
146	2	Siltstone, brick red to brown, friable; some nodules of white gypsum.
145	1	Marl, purple with greenish gray mottling, dolomitic blocky, brittle.
144	3	Shale, purple and lavender, limy, silty, blocky.
143	2	Limestone, dark gray; contains abundant small flattened limestone nodules as much as ½ inch in diameter; friable and earthy in upper 6 inches.
142	4	Shale and siltstone, brownish red, friable, blocky; 6 inches of greenish gray earthy marl in lower part.
141	6	Shale, maroon, purple, green, and lavender, limy, fissile in part; earthy in part; thin purple and greenish fine-grained dolomite layer at top and another near middle.

Unit	*Thickness (in feet)*	*Lithologic Character*
140	3	Limestone, gray, platy, finely crystalline.
139	4	Siltstone, green and mauve, hard, limy near top.
138	8	Siltstone, red, blocky.
137	9	Siltstone, red, in beds about 3 feet thick, interbedded with white gypsum in beds 3 to 6 inches thick.
136	1	Siltstone, green.
135	4	Siltstone, red; white gypsum partings at top.
134	2	Gypsum, white.
133	2	Siltstone, red; some white gypsum partings.
132	12	Gypsum, white, soft.
131	2	Shale, red; a gray platy crystalline dolomite 3 inches thick at top.
130	8	Gypsum, white.
129	1	Dolomite, gray, platy, finely crystalline.
128	1	Shale, red.
127	2	Gypsum, white.
126	1	Shale, red, fissile.
125	6	Gypsum, white.
124	1	Dolomite, gray, platy; a thin red and green shale parting at base.
123	32	Gypsum, white, finely crystalline, poorly bedded; some thin red shale partings; forms cliff.
122	2	Siltstone, red.
121	3	Gypsum, white.
120	1	Siltstone, red; green parting at top.
119	3	Gypsum, white, massive.
118	2	Siltstone, red, blocky; a thin green siltstone parting at top; 6 inches gray laminated dolomite at base.
117	18	Siltstone, red; a few fine-grained green sandstone layers; sparse gypsum stringers.
	224	Total thickness of Gypsum Spring formation.

Contact between Gypsum Spring formation and Nugget sandstone.

The Nugget sandstone, not measured here, contains 1½ feet of gray to purple finely crystalline slabby hard slightly sandy limestone with abundant compressed ovoid masses of gray, red, and brown chert, 50 feet below the top of the formation. A similar cherty limestone was observed about 14 feet below top of Nugget sandstone on the Sage Creek Dome, 8 miles northeast. Offset 4 miles northwest, to center of section 14, T. 1 S., R. 2 W.

116	21	Sandstone, buff, massive in lower part; soft and friable in upper part; coarse-grained to fine-grained.
115	13	Sandstone, yellow to buff, medium-grained, some rounded and frosted grains; inconspicuous bedding; forms smooth cliff.
114	44	Sandstone, brown; irregular thin cross-bedding; pitted weathered surface; medium-grained.
113	1	Sandstone, red, medium-grained, frosted grains; conspicuous red zone.
112	38	Sandstone, buff, with faint red stain, medium-grained to coarse-grained; large rounded frosted grains; cross-bedded in part; massive in part.
111	1	Siltstone, red, very fine-grained; makes a dark red band on cliff.
110	2	Sandstone, pale red to buff; some large rounded frosted grains in a finer matrix; 6 inches of brick red hard quartzitic siltstone at base.
109	47	Sandstone, pale red to buff, massive in part; fine-grained to medium-grained; some obscure cross-bedding; forms cliff.
108	83	Sandstone, pale red to buff, fine-grained; thin regular bedding; poorly exposed in part.
107	28	Sandstone, red, fine-grained with large rounded frosted grains; obscure bedding; thin-bedded near top; forms conspicuous cliff; calcite geodes scattered along cliff face.

Unit	*Thickness (in feet)*	*Lithologic Character*
106	4	Siltstone and sandstone, red, platy, shaly, ripple-marked; red sandstone in middle.
105	26	Sandstone, buff, with red staining, fine-grained; some large rounded frosted grains; regular but obscure bedding; forms cliff.
104	5	Siltstone, red and green, shaly, fissile; a buff fine-grained platy soft sandstone at top.
103	4	Sandstone, buff, stained red, thin-bedded, fine-grained; a few green grains and biotite flakes; at base a purple, green, and red siltstone 6 inches thick.
	317	Total thickness of Nugget sandstone.
Contact between Nugget sandstone and Popo Agie member of Chugwater formation.		
102	34	Claystone, ocher, with some red staining, nodular, limy; calcite-filled geodes; white siliceous oolites.
101	19	Partially covered interval; apparently chiefly ocher claystone.
100	15	Claystone, ocher, with some green and drab beds, thin-bedded; an irregular layer of large siliceous nodules as much as 1½ feet in diameter about 5 feet above base; abundant plant remains.
99	6	Claystone, ocher, blocky, oolitic; large ovoid concretions carrying plant remains at top; small ferruginous concretions at top.
98	11	Claystone, purple, pale green, red, and ocher, blocky, oolitic; some indurated zones apparently transect bedding; abundant plant remains in indurated zones, chiefly wood fragments, plant stems, and reeds.
97	1	Claystone, ocher, oolitic, hard; contains numerous plant stems and reeds as much as 2 feet in length.
96	24	Partially covered interval, apparently underlain by lavender and red claystone.
95	1	Sandstone, buff to gray, platy, fine-grained.
94	4	Shale, red and purple.
93	2	Conglomerates; gray limestone and ocher claystone pebbles as much as 3 inches in diameter embedded in lavender limestone matrix.
92	4	Claystone, lavender, blocky, interbedded with greenish buff platy fine-grained sandstone.
91	1	Sandstone, buff, weathering gray, platy, cross-bedded, fine-grained.
90	4	Shale, purple with thin green fine-grained platy sandstone parting in middle.
89	1	Conglomerate; limestone pebbles in lavender and orange claystone matrix.
88	3	Shale, purple to lavender, fissile; a red platy fine-grained sandstone near middle.
87	2	Conglomerate; limestone pebbles in lavender and orange claystone matrix; many calcite veins.
86	9	Siltstone, red; a few greenish buff fine-grained sandstone layers; an ocher blocky claystone at top.
85	13	Siltstone, lavender, interbedded with irregular lenses of buff sandstone.
84	11	Sandstone, brownish red, with some ocher layers, fine-grained, silty.
83	2	Sandstone, greenish buff, fine-grained, friable, soft; a red and purple shale parting at top.
82	1	Shale, purple.
81	2	Sandstone, white, weathering buff, cross-bedded, slabby, fine-grained to medium-grained; rounded grains; black and red grains present.
80	8	Siltstone, brick red, shaly.
79	4	Sandstone, red to buff, with purplish cast, fine-grained; contains sandstone pebbles as much as ¾ inch in diameter with same lithology.
78	2	Shale, purple.
77	29	Sandstone, reddish brown, with many green flecks, fine-grained, soft; a purple shale parting 9 feet above base.
76	10	Siltstone, reddish brown; obscure bedding.

Unit	*Thickness (in feet)*	*Lithologic Character*
75	2	Sandstone, buff to brown, thin-bedded, fine-grained.
74	4	Shale or claystone, purple, blocky.
73	5	Sandstone, buff to reddish brown, cross-bedded, fine-grained.
72	4	Shale, siltstone, and fine-grained sandstone, reddish brown; in about equal amounts; shale at base, sandstone in middle.
71	15	Sandstone, buff, slabby, fine-grained; some brownish red layers.
70	20	Siltstone and sandstone, reddish brown, interbedded in about equal amounts, each in beds about 2 feet thick; purple siltstone at base.
69	16	Sandstone, reddish brown, very fine-grained; some red shale pebbles; some lenticular green layers; a persistent green layer 6 inches thick at top.
68	4	Siltstone, red to brown.
67	2	Shale, red; paper thin laminae.
66	13	Sandstone, light reddish brown, massive to poorly bedded, fine-grained at base, medium-grained in upper part; numerous large rounded frosted quartz grains; forms irregular ledges.
65	1	Sandstone, light reddish brown, fine-grained; contains limestone pebbles as much as ¾ inch in diameter and a few sandstone pebbles; grades into overlying unit.
Top of Alcova limestone member of Chugwater formation.		
64	4	Limestone, dark gray, weathering white; lower part smooth and finely crystalline; upper part sucrose; upper part has crumpled bedding that is conspicuous on weathered surface; thickness ranges from 2 feet to 4 feet.
Contact between Alcova limestone member and Red Peak member of Chugwater formation.		
63	20	Siltstone, red; 1 foot of fine-grained reddish brown sandstone at top.
62	8	Sandstone, reddish brown, massive to thin-bedded.
61	16	Siltstone, red; 1 foot of fine-grained brownish red sandstone near middle.
60	53	Sandstone, reddish brown, massive to thin-bedded, fine-grained; thin shaly siltstone beds that form reentrants in cliff; some green sandstone and siltstone layers.
59	65	Siltstone, red to brown, poorly bedded.
58	11	Sandstone, reddish brown, fine-grained, massive.
57	23	Siltstone, red.
56	17	Sandstone, reddish brown, very fine-grained, massive.
55	5	Siltstone, red.
54	2	Shale, red to purple, fissile; a green fine-grained sandstone parting at base.
53	41	Siltstone, red; a green and purple limy shale parting 6 feet above base.
52	3	Sandstone, red, fine-grained; forms massive ledge.
51	2	Siltstone, red, fissile, soft; some green shaly layers.
50	7	Sandstone, red, fine-grained; forms massive ledge.
49	65	Siltstone, red, thin-bedded in part.
48	1	Sandstone, red, fine-grained.
47	3	Siltstone, red, soft.
46	7	Sandstone, red, fine-grained; forms cliff.
45	13	Siltstone, red, hard in lower part; some red shale partings and lenses.
44	4	Siltstone, red, soft, very shaly; forms reentrant.
43	7	Sandstone, red, fine-grained, slightly micaceous; sparse thin green layers.
42	41	Siltstone, reddish brown; some hard and soft layers a few shaly layers less than 1 foot thick.
41	8	Sandstone, red, fine-grained, slightly micaceous; forms massive rounded ledge.
40	24	Siltstone, reddish brown; some buff to brown hard layers.
Offset ¼ mile south to south side of Crooked Creek, SW¼ section 22, T. 1 S., R. 2 W.		
39	147	Siltstone, red to reddish brown; some buff to brown hard layers; poorly exposed in part.

Unit	*Thickness (in feet)*	*Lithologic Character*
38	29	Siltstone, red, hard and soft; some green laminae in upper part.
37	6	Siltstone, red, hard; some shale partings; numerous ripple marks; forms prominent ridge.
36	10	Siltstone, red, soft.
35	5	Siltstone, reddish brown, hard, cross-bedded, channeled into underlying unit; a few red shale lenses; shale pebbles along bedding planes in siltstone; numerous ripple marks.
34	75	Siltstone, red to reddish brown, soft, poorly exposed.
33	1	Siltstone, greenish gray.
32	3	Siltstone, red, soft, blocky.
31	1	Siltstone or sandstone, red, fine-grained, hard; forms ledge with green partings.
30	41	Siltstone, red, blocky, micaceous near base; some green partings and irregular masses.
29	37	Mudstone, greenish yellow, fissile to blocky; poorly exposed; lithology like that in Chugwater, except for color.
	1114	Total thickness of Chugwater formation.

Approximate contact between Chugwater and Dinwoody formations. Exact contact doubtful because of poor exposures.

28	8	Dolomite, gray to yellow, sucrose, spongy; small vugs filled with calcite, parallel to bedding; forms dip slope.
27	18	Mudstone or very fine-grained sandstone, gray, weathering dark brown to rusty brown, dolomitic, slightly limy, slabby, cross-bedded in part; forms ledges.
26	44	Covered interval, apparently underlain by soft gray shale or gray shaly very soft fine-grained sandstone.
	70	Total thickness of Dinwoody formation.

Approximate contact between Dinwoody and Phosphoria formations. Exact contact doubtful because of poor exposures.

25	14	Dolomite, gray, fossiliferous; contains reworked dolomite pebbles and chert nodules; forms cliff.
24	65	Partially covered interval; much greenish gray limy shale, gray limestone, and dolomite in float.
23	18	Limestone, purplish gray at base, yellow in upper part; massive in lower part; dolomitic in upper half; cherty throughout; very fossiliferous, containing bryozoans, spiriferids, crinoid stems, and productids.
22	3	Covered interval; apparently underlain by soft greenish shale or marl.
21	5	Dolomite, gray, massive; sparse chert nodules and brachiopod shells.
20	8	Covered interval; apparently underlain by soft gray shale or marl.
19	10	Dolomite, gray, weathering yellow, finely crystalline to medium crystalline, massive; chert lenses as much as 30 feet long; forms cliff.
18	7	Limestone, gray, weathering yellowish, dolomitic, nodular, concretionary; 6 inches of white chert in discontinuous bed at top; 6 inches of purple and yellowish chert at base.
17	4	Limestone, marl, mudstone, and shale, gray, fine-grained, interbedded in about equal amounts.
16	10	Marl, gray, fissile; bright green coating locally present.
15	52	Covered interval; gray and lavender dolomite and lesser amounts of gray shale in float.
14	4	Limestone, brownish gray to greenish yellow, platy, soft, dolomitic.
13	6	Dolomite, yellow, sucrose; contains irregular white and yellow chert lenses; sparse shell fragments; white chert breccia in lower 8 inches.
12	10	Covered interval; apparently underlain by gray sandy limy siltstone.
11	2	Limestone, lavender gray, coarsely crystalline, very fossiliferous, containing productids and spiriferids.

Unit	*Thickness (in feet)*	*Lithologic Character*
10	4	Covered interval; apparently underlain by gray shale or siltstone.
9	16	Dolomite, yellow, thick-bedded, slightly silty; vugs as much as 3 inches across filled with calcite; numerous brachiopod fragments.
8	9	Limestone, grayish green, dolomitic, silty; scattered sand grains; poorly bedded; numerous fossil shell fragments.
7	55	Covered interval; apparently underlain by grayish green shale and platy yellow siltstone or mudstone; possibly a ledge of sandy limestone about 35 feet above base.
	302	Total thickness of Phosphoria formation.

Approximate contact between Phosphoria formation and Tensleep sandstone. Exact contact doubtful because of poor exposures.

The underlying section was not measured in detail but major lithologic units were measured by plane table method on the north side of Trout Creek canyon along the road to Dickinson Park, in sections 4 and 5, T. 2 S., R. 2 W., and sections 32 and 33, T. 1 S., R. 2 W.

6	340	Sandstone, gray, weathering tan, medium-grained, coarsely bedded, cross-bedded in part, hard, moderately porous; stands in vertical spectacular cliff.
5	180	Partially covered interval; apparently lower 50 feet is red and green dolomitic sandy shale, grading up into about 150 feet of hard cherty dolomites interbedded with red and green shales, thin limestones, and quartzitic sandstones. This interval probably includes the contact between the Amsden formation and Tensleep sandstone, but exposures are too poor to pick it.

Top of Darwin sandstone member of Amsden formation.

4	80	Sandstone, gray to buff, massive in part, medium-grained, moderately porous; very similar to Tensleep sandstone; forms cliff; rests on irregular cavernous surface cut in underlying Madison limestone, with as much as 10 feet of relief in a horizontal distance of 20 feet; a basal conglomerate of Madison limestone blocks embedded in sandstone.
	600	Total thickness of Tensleep and Amsden formations, undivided.

Contact between Darwin sandstone member of Amsden formation and Madison limestone.

3	535	Limestone, bluish gray, massive to thick-bedded; numerous oolite beds; numerous chert beds; several porous and cavernous zones; forms conspicuous cliffs.
	535	Total thickness of Madison limestone.

Contact between Madison limestone and Darby formation.

2	20	Partially covered interval; apparently underlain by greenish gray shale thin limy sandstone, and fetid brown dolomite.
	20	Total thickness of Darby formation.

Contact between Darby formation and Bighorn dolomite.

1	200±	Dolomite, buff and gray, massive, siliceous; weathered surface rough and pitted; forms conspicuous cliff.

Base of measured section.

DERBY DOME SECTION

The following section was measured on the northeast flank of Derby Dome, a producing oil field about 13 miles southeast of Lander, Fremont County, Wyoming.

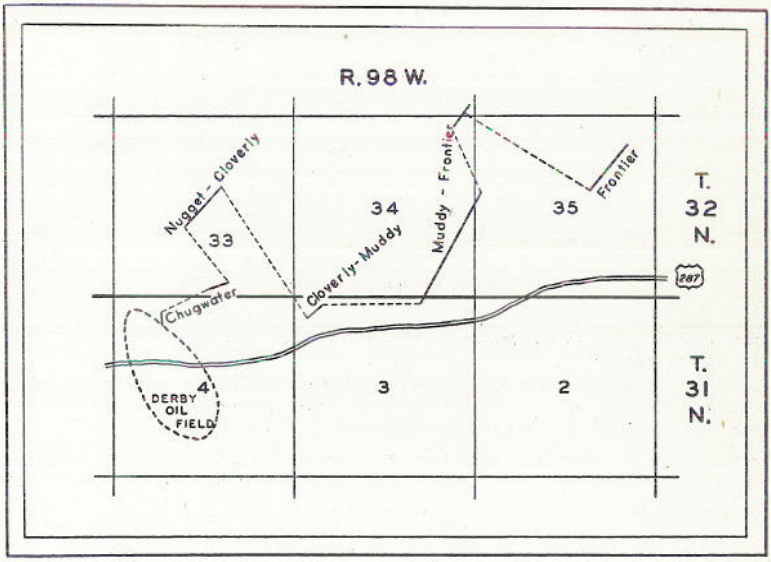

Figure 6. Index map of Derby Dome section, Fremont County, Wyoming.

The section from the top of the Frontier formation to a point about 175 feet below the Alcova limestone member of the Chugwater formation is moderately well exposed. The Alcova limestone and other Triassic and Jurassic rocks are duplicated by a normal fault on the northeast side of the dome. With this exception, there are no structural complications in the area where the section was measured. Units are numbered consecutively from oldest to youngest.

Unit	*Thickness (in feet)*	*Lithologic Character*
Cody shale		
158		Shale, gray, soft, sandy, poorly exposed.

Contact between Cody shale and Frontier formation. The contact is probably gradational from sandstone below to sandy shale above, but exposures are so poor that the point of greatest lithologic change cannot be picked within 50 feet.

157	61	Sandstone, gray to yellowish brown, medium-grained to coarse-grained many dark colored mineral grains; some glauconite; irregular masses of dark gray interstitial clay; irregularly bedded; hard and soft layers weathering to smooth slope with weak slabby ledges; one persistent ledge 3 feet thick, 20 feet below top; top bed is a 2-foot hard slabby sandstone containing plant stem molds and casts and the following lower Niobrara fossils (U.S.G.S. Locs. 19530 and 18942): *Inoceramus deformis* Meek, *Ostrea congesta* Conrad, *Anatina lineata* Stanton, *Camptonectes* cf. *C. platessa* White, *Crassatellites* sp., unnamed, *Gyrodes* sp., *Eutrephoceras* sp., *Scaphites ventricosus* Meek and Hayden.

Distance from base of bed 157 to top of bed 146 is 176 feet, with intervening interval largely covered. Section offset on top of bed 146 one mile to the northwest to the SE corner sec. 27 and the NE corner sec. 34, T. 32 N., R. 98 W. Section resumed at a point 187 feet above bed 146 along which offset was made. Probably parts of units 156 and 155 are equivalent to the lower part of unit 157, but no exact correlations can be made. The section above unit 156 is not exposed.

156	2	Sandstone, dark gray, weathering brown, fine-grained, many dark grains, glauconitic; scattered masses of dark gray clay; well-sorted; limy matrix; *Inoceramus* fragments.
155	35	Sandstone, dark gray and greenish brown, weathering light grayish brown fine-grained, very clayey; weathers into smooth slope.

Unit	*Thickness (in feet)*	*Lithologic Character*
154	2	Sandstone, dark gray, weathering brown, fine-grained; many dark colored grains; clayey; some carbonaceous masses; limy matrix; contains the following fossils that may be of Carlile age or transitional between Carlile and Niobrara ages (U.S.G.S. Loc. 18941): *Inoceramus* aff. *I. stantoni* Sokolow, *Scaphites* sp., unnamed (associated in some places with upper Carlile fossils), and borings of an undetermined organism.
153	6	Sandstone, dark gray with some olive green layers, weathering brownish gray, fine-grained to medium-grained, clayey, indurated; weathers to smooth slope.
152	5	Sandstone, dark gray, weathering brown, clayey, limy, soft; many dark mineral grains; contains the following fossils that are typical long-ranging forms common in a sandy environment, but which are believed to be of Carlile age (U.S.G.S. Loc. 18942): *Inoceramus "fragilis* Hall and Meek," *Cardium pauperculum* Meek, *Corbula nematophora* Meek, *Aporrhais* (*Tessarolex*) *hitzi* (White), "*Fusus*" sp., *Baculites* sp.
151	34	Partially covered interval. Some outcrops of sandstone and shale, dark gray, soft, fine-grained.
150	2	Sandstone, gray, weathering brown, coarse-grained; many black and green grains; very hard, very limy; a few stem-like molds and casts.
149	47	Partially covered. Some outcrops of sandstone and sandy shale, dark gray, soft, fine-grained.
148	6	Sandstone, dark gray, weathering brown, fine-grained, carbonaceous, hard and soft; contains the following fossils, probably of Carlile age (U.S.G.S. Loc. 18943): *Inoceramus "fragilis* Hall and Meek", and an undetermined boring.
147	48	Covered interval, probably underlain by soft gray sandstones and gray sandy shales.
146	28	Sandstone, gray, weathering grayish brown, fine-grained, soft, clayey, carbonaceous; forms discontinuous ledges.
145	4	Sandstone, yellowish brown, coarse-grained; coarser grains near base; many black, pink, and white grains; well bedded, some cross-bedding, non-calcareous; forms prominent ridge; sharp contact at base.
144	23	Sandstone, dark gray, weathering brown, fine-grained, many black grains and some white grains; clayey, non-calcareous, moderately soft; massive in part.
143	47	Covered interval, probably underlain by soft gray sandstones and gray sandy shales.
142	3	Sandstone, yellowish brown, weathering gray to dark brown, medium-grained, many black and white grains, slabby, irregularly bedded, hard.
141	20	Covered interval. *Inoceramus* fragments in float, possibly coming from this interval or from overlying unit 142.
140	3	Sandstone, tan, weathering yellowish brown, fine-grained, some black mineral grains, slabby, hard and soft, limy.
139	7	Covered interval.
138	9	Sandstone, gray, weathering yellowish brown; many limonite stains; fine-grained to medium-grained; many black and white grains; slabby, moderately hard, poorly exposed.
137	19	Covered interval.
136	28	Sandstone, gray, locally stained yellowish brown, fine-grained to medium-grained; many dark and white grains; massive to cross-bedded and slabby; hard to moderately soft and friable. About ¼ mile northwest, this sandstone is yellow, cross-bedding is prominent, and the cliff has a slabby appearance.
135	6	Covered interval, probably underlain by gray sandy shale and carbonaceous shaly sandstones.
134	25	Sandstone, gray to greenish gray, weathering brown, fine-grained, many black and white grains; forms conspicuous cliff; shaly and thin-bedded near base; cliff disappears to northwest and zone becomes more shaly.
133	17	Covered interval, probably underlain by gray shale and sandstone.

Unit	*Thickness (in feet)*	*Lithologic Character*
132	13	Sandstone, gray, weathering yellowish brown, fine-grained to medium-grained; many black and white grains; forms conspicuous cliff; limonitic near top; carbonaceous near base.
131	130	Covered interval, probably underlain by gray sandy shale.
130	49	Sandstone, yellow in lower part, gray in upper part; limonite stains on joint planes; fine-grained; numerous black and white grains; soft, friable, cross-bedded in part; many limonite nodules near base; basal contact sharp.
129	4	Shale, black, weathering dark gray, silty; some fine-grained sandstone layers.
128	8	Sandstone, light gray, weathering nearly white, fine-grained; many black grains; soft, friable; grades down into underlying unit.
127	3	Shale, dark gray, very sandy, with thin beds of fine-grained sandstone.
126	5	Sandstone, olive green, weathering to ashy gray, very fine-grained, silty and shaly, with laminae of silty black and dark gray shale.
125	33	Shale, black, weathering gray, silty; contains thin partings of fine-grained gray sandstone.
124	62	Covered interval.
123	7	Shale, black, silty; some fine-grained sandstone; one bluish gray mottled fine-grained to medium-grained sandstone 1 foot thick at top.
122	20	Sandstone, tan and white, weathering light yellowish brown, fine-grained to medium-grained; many black grains; well bedded; localized cross-bedding; non-calcareous
121	89	Covered interval.
120	46	Shale, black, weathering silvery gray, silty; some fine-grained sandstone in fissile laminated beds as much as 3 inches thick; sparse fish scales.
119	8	Bentonite, creamy yellow, impure, silty, very limy.
118	3	Sandstone, gray; irregular thin bluish gray shaly beds weathering rusty brown; fine-grained, silty; many black grains; very hard, quartzitic; forms ledge.
	956	Total thickness of composite section of Frontier formation, including bed 157 plus the interval of 176 feet between the base of bed 157 and the top of bed 146, and excluding beds 156 to 147, inclusive.

Contact between Frontier formation and Mowry shale.

117	44	Shale, black, soft; contains thin partings of fine-grained gray sandstone; sandier and thinner-bedded near top.
116	202	Shale, black, weathering silvery gray, very siliceous, hard, brittle, outcrops form smooth bare ridges; silty; gray to brown quartzitic sandstone in prominent beds as much as 1 foot thick; sparse fish scales.
115	207	Covered interval, probably underlain by soft black and gray shale. Contact between Mowry and Thermopolis shales is concealed by this covered interval.
	453	Total thickness of interval between top of Mowry shale and top of Muddy sandstone member of the Thermopolis shale.

Contact between upper black shale member and Muddy sandstone member of Thermopolis shale is probably at this point.

114	2	Sandstone, gray, weathering greenish tan, medium-grained to coarse-grained; many black minerals; rounded grains; small masses of opaque calcite give sandstone a milky appearance; hard; many plant fragments; very limy; some shaly layers.
113	12	Covered interval.
112	1	Sandstone, gray, weathering brown and greenish brown, fine-grained to medium-grained; hard, bedded; many dark grains.
111	20	Covered interval, probably underlain by sandstone and sandy shale.

Unit	*Thickness (in feet)*	*Lithologic Character*
110	25	Sandstone, tan to buff, massive to cross-bedded, coarse-grained to finely conglomeratic near middle; finer-grained near base and top; gray chert granule conglomerate locally present at base; gray to white grains abundant in middle; hard; forms cliff and ridge.
	60	Total thickness of Muddy sandstone member of the Thermopolis shale.

Contact between Muddy sandstone member and lower black shale member of Thermopolis shale.

The underlying beds were measured ½ mile to the west in the NW corner sec. 3, T. 31 N., R. 98 W. Section offset along base of Muddy sandstone member of the Thermopolis shale which forms a conspicuous escarpment.

109	167	Shale, black to gray, soft, fissile, flaky; thin partings of limonitic silty sandstone at a few horizons; thin white bentonite near top; poorly exposed.
	167	Total thickness of lower black shale member of Thermopolis shale.

Contact between Thermopolis shale and "Rusty beds" of Cloverly formation.

108	1	Sandstone, brown, weathering bluish black, very fine-grained, hard; forms ledge.
107	15	Shale, light gray to dark gray, limonitic; contains thin partings of hard gray siltstone.
106	15	Sandstone, gray, very fine-grained, silty, thin-bedded; lower part soft and upper part hard; carbonaceous.
105	11	Sandstone, gray to tan, very fine-grained, silty, carbonaceous, micaceous, shaly, thin-bedded.
104	12	Partially covered interval; lower part probably sandstone; upper part gray fine-grained silty shaly sandstone.
103	17	Sandstone, gray to buff, fine-grained; some bright red grains; irregularly bedded, limonitic. Basal bed is very coarse-grained sandstone with pebbles as much as ¼ inch in diameter; grains rounded and frosted to angular and regrown with sparkling quartz crystal facets.

Contact between "Rusty beds" and variegated claystone member of Cloverly formation.

Offset on base of "Rusty beds" 1 mile northwest to the SW¼ NE¼ section 33, T. 32 N., R. 98 W.

102	41	Partially covered interval, apparently underlain by dark reddish purple fine-grained sandy claystone.
101	6	Claystone, reddish purple, sandy, soft.
100	2	Sandstone, cream-colored, soft.
99	50	Claystone, violet, maroon, grayish green, brownish violet; silty, especially in lower part; limy nodules; blocky and breaks into small angular fragments.
98	32	Sandstone and claystone, dark gray, reddish to purple, green; some limy concretionary masses; many concretions with radial crystal structure.
97	7	Sandstone, cream to yellow, stained brown, soft, friable, medium-grained at base; fine-grained and more shaly near top; quartz grains sparkly with crystal facets.
96	32	Partially covered interval. Poor exposures of fine-grained soft shaly sandstone, greenish in lower part, dark gray to brown in upper part.
95	2	Sandstone, gray and greenish gray, fine-grained; numerous tiny pale green clay fragments.
94	9	Partially covered interval. Poor outcrops of green very fine-grained shaly soft sandstone.
93	13	Sandstone, greenish gray to tan, coarse-grained to fine-grained, irregularly bedded; many quartz crystal facets on grains; many pinkish orange grains; many fragments of underlying green claystone and siltstone reworked in basal part of sandstone; one fragment of a dinosaur bone observed; thickness of bed is variable.
92	121	Partially covered interval. Poor exposures of soft dark brownish red claystone and siltstone and some gray silty fine-grained sandstone. The upper 20 feet is mottled to solid bluish green to grayish green and harder than below.

Unit	*Thickness (in feet)*	*Lithologic Character*
91	11	Sandstone, gray to greenish gray, fine-grained to medium-grained; lower part cross-bedded; softer and more pronounced green near top; numerous pink and green grains; most grains angular but some very well rounded and frosted.
	397	Approximate thickness of Cloverly and Morrison formations, undivided.

Approximate contact between Morrison formation and "upper Sundance". Exposures are so poor that it is not possible to determine whether the contact is at the base of sandstone bed 91 or within the 20-foot covered interval below it. On the basis of comparison with two adjacent sections, the contact is tentatively put at the base of the exposed sandstone bed 91.

90	20	Covered interval.
89	1	Limestone, greenish gray, highly oolitic, hard, fine-grained.
88	7	Partially covered interval, apparently underlain in part by slabby limestone.
87	6	Limestone, gray to brown, glauconitic, coarsely crystalline; very oolitic in finer portions; hard, fossiliferous.
86	4	Covered interval.
85	2	Limestone, gray to brown, coarsely crystalline, sparsely glauconitic; finer-grained part is oolitic and contains a rectangular crystalline black mineral.
84	16	Covered interval.
83	2	Limestone, gray, coarsely crystalline, fossiliferous, glauconitic, slabby, very oolitic.
82	2	Covered interval.
81	1	Limestone, gray, coarsely crystalline, fossiliferous, glauconitic; some green shale fragments.
80	4	Covered interval, apparently underlain by dark gray fine-grained shaly sandstone.
79	1	Limestone, grayish brown, fossiliferous, oolitic, crystalline; forms ledge.
78	8	Sandstone, greenish gray, soft, medium-grained, glauconitic, limy; nodular at top; grades up into limestone.
77	7	Covered interval, apparently underlain by soft glauconitic sandstone.
76	2	Limestone, bluish gray, oolitic, glauconitic; contains thin gray shale lenses; forms ledge.
75	3	Covered interval, apparently underlain by gray sandstone.
74	4	Limestone, brownish gray, fossiliferous, glauconitic, crystalline, poorly bedded; oolitic near middle; sandy near top; contains large *Camptonectes*.
73	6	Shale, dark gray to brown, soft, plastic, fissile.
72	2	Limestone, grayish brown, sandy, slightly glauconitic; forms ledge; contains pelecypods and brachipod *Kallirhyncia*.
71	6	Sandstone, green to brown, shaly, slightly glauconitic.
70	4	Limestone, brownish gray to purplish brown, hard, poorly bedded; contains abundant fauna of pelecypods and "*Belemnites*".
69	22	Shale and sandstone, interbedded. Shales are greenish gray, glauconitic; sandstones are greenish gray, soft, shaly. Sequence is poorly exposed.
68	1	Limestone, brown, coarsely crystalline, hard, glauconitic; contains abundant pelecypods.
67	40	Sandstone, greenish gray, very shaly; so glauconitic that it is almost a green sand; soft; sparsely fossiliferous; poorly exposed.
	171	Total thickness of "upper Sundance".

Contact between "upper Sundance" and "lower Sundance".

66	16	Sandstone, greenish gray, soft, fine-grained, non-glauconitic, poorly exposed.
65	26	Shale and sandstone, interbedded, reddish brown to maroon, soft, very fine-grained, limy; grades up into soft yellowish brown sandstone at top; constitutes "Sundance red" zone.
64	19	Shale and sandstone, interbedded. Shale is greenish gray and silty; sandstone is gray, very fine-grained, rounded grains; shaly, limy.

Unit	*Thickness (in feet)*	*Lithologic Character*
63	2	Sandstone, light brownish gray, limy, medium-grained, thin-bedded; forms ledge.
62	24	Shale, greenish gray at base, brownish gray at top; very pure, fissile, and flaky in lower part; sandy in upper part, grading to sandstone in uppermost 6 inches.
61	2	Sandstone, brown in lower part, gray in upper part, shaly, limy; 6 inches of brownish gray finely sandy very oolitic limestone at top.
60	3	Sandstone, light to dark brown, limy, oolitic, thin-bedded; contains shale pellets; forms ledge.
59	1	Conglomerate, brownish gray; limestone matrix containing angular to rounded fragments of sandstone and shale and a few polished irregular subrounded fragments of brownish gray chert as much as 3 inches in diameter, but commonly less than 1 inch.
	93	Total thickness of "lower Sundance".
Contact between "lower Sundance" and Gypsum Spring formation.		
58	35	Shale, maroon to brown, gray in top foot, silty, fissile in part, blocky in part; layers and nodules of sugary white gypsum except near top; uppermost 5 feet hard, massive, tan to brown, limy; thin gray limestone 6 inches below top.
57	6	Limestone, red to gray, shaly, laminated.
56	7	Gypsum, white, granular, soft, interbedded with red and maroon shale.
55	10	Shale, maroon to reddish brown, locally altered to gray shale; poorly exposed.
54	1	Limestone, gray, massive, dense, hard; forms ledge.
53	6	Shale, yellowish brown to chocolate brown, silty, fissile; 1 foot yellowish gray very fine-grained shaly sandstone at top.
52	3	Limestone, dull gray; contorted laminae in upper part; massive in lower part.
51	2	Limestone, white, chalky, irregularly bedded; abundant brown specks in lower part; laminated near middle.
50	12	Shale, red to maroon, silty, hard, brittle, blocky; grayish green at top.
49	52	Gypsum, white, soft, sugary, well bedded; sparse red shale partings.
48	7	Shale, dark purple to brown, silty, hard, brittle; 3 inches of grayish brown crystalline laminated limestone 1 foot below top.
	141	Total thickness of Gypsum Spring formation.
Contact between Gypsum Spring formation and Nugget sandstone.		
47	1	Sandstone, reddish brown, fine-grained, shaly.
46	342	Sandstone, light buff to brown and red, fine-grained to medium-grained; large rounded polished and frosted grains common throughout but most abundant in upper part; cross-bedded in upper 300 feet; hard to soft; some red sandy shale partings in lower 150 feet.
45	16	Covered interval, apparently underlain by red sandy shale or shaly sandstone.
44	2	Sandstone, reddish brown, medium-grained, soft, limy.
43	2	Shale, dark reddish brown, locally greenish gray, silty, finely sandy.
42	6	Sandstone, reddish brown, fine-grained, limy; abundant reddish brown clay balls; hard at top; shaly in part.
41	5	Covered interval, apparently underlain by red shaly sandstone.
40	7	Sandstone, reddish brown, fine-grained, limy, shaly.
39	2	Covered interval.
38	7	Sandstone, gray to reddish brown, fine-grained to medium-grained, very limy; large polished quartz grains in finer matrix; hard, slabby; many angular clay fragments in upper part; conspicuously ripple-marked.
37	2	Shale, brownish maroon, with greenish gray bedding and joint planes, silty; some fine-grained sandstone.

Unit	*Thickness (in feet)*	*Lithologic Character*
36	7	Sandstone, reddish brown to white, medium-grained to fine-grained; abundant large rounded polished quartz grains in upper half; limy; shaly in lower half.
35	2	Limestone, mauve, weathering gray, fine-grained, sandy, shaly; paper-thin laminae; rounded clay fragments on bedding planes at top; forms ledge.
34	7	Sandstone, dull reddish brown in lower part, bright red in upper part, fine-grained, irregularly bedded; forms ledge.
33	4	Shale, maroon to brown, fissile, silty; sandy near top; greenish gray limy bed at top.
32	8	Sandstone, light brownish red, fine-grained to coarse-grained; numerous rounded frosted grains; some shale partings; ripple-marked at top.
	420	Total thickness of Nugget sandstone.

Contact between Nugget sandstone and Popo Agie member of Chugwater formation.

Offset ½ mile southeast to SW¼ SE¼ section 33, T. 32 N., R. 98 W.

31	36	Siltstone and claystone, grayish purple, ocher in upper 3 feet; very hard in upper 20 feet; abundant white siliceous oolites; some large sand grains; more sandy in lower part; calcite geodes in upper 15 feet.
30	25	Claystone, maroon; upper part very silty; some gray layers.
29	5	Sandstone, white to olive green, fine-grained to medium-grained; some large frosted rounded grains.
28	9	Shale, reddish brown to maroon, silty.
27	15	Sandstone, brownish red, very fine-grained; greenish gray on joint planes; poorly bedded; softer near top.
26	196	Covered interval.

Top of Alcova limestone member of Chugwater formation.

25	9	Limestone, gray, fine-grained to medium-grained; finely laminated, with crinkled structure; basal contact sharp and slightly irregular; hard; forms conspicuous ledge.

Contact between Alcova limestone member and Red Peak member of Chugwater formation.

24	15	Sandstone, red, fine-grained, micaceous, silty, hard.
23	6	Shale, maroon; some thin layers of fine-grained sandstone.
22	3	Sandstone, red, very fine-grained, micaceous, hard; ripple-marked in part.
21	11	Shale, maroon, interbedded with thin layers of fine-grained red sandstone.
20	2	Sandstone, white to pink, fine-grained to medium-grained; many dark grains; thickness variable.
19	8	Sandstone, red, fine-grained, silty, micaceous, poorly bedded.
18	2	Shale, maroon; thin sandstone layers.
17	17	Sandstone, red, fine-grained, silty, micaceous; red shale partings.
16	3	Shale, maroon, silty; thin red sandstone layers.
15	6	Sandstone, red, fine-grained, silty, micaceous; slabby in upper part.
14	2	Shale, maroon, silty, sandy; thin red sandstone layers.
13	10	Sandstone, red, fine-grained, silty, micaceous; forms massive ledge.
12	2	Shale, maroon, silty.
11	7	Sandstone, red, fine-grained, silty, micaceous; slightly cross-bedded; forms ledge.
10	2	Shale, maroon, silty; some green blotches.
9	2	Sandstone, red, fine-grained, silty, shaly, micaceous; hard to soft.
8	2	Shale, maroon, silty.
7	3	Sandstone, red, fine-grained, silty, shaly; forms ledge.
6	4	Shale, maroon, silty, blocky; hard and soft.
5	4	Sandstone, red, fine-grained, silty, micaceous; forms ledge; grades down into underlying shale unit.

Unit	*Thickness (in feet)*	*Lithologic Character*
4	39	Shale and claystone, maroon, silty; thin green layer at top; some irregular hard sandstone partings.
3	7	Siltstone and shale, red, hard, micaceous, sandy.
2	30	Sandstone, red, fine-grained, micaceous; irregular greenish layers; some some red shale partings.
1	58	Covered interval from lowest outcrop to edge of oiled highway.

Base of measured section.

CONANT CREEK SECTION

The Conant Creek section was measured along the east side of the valley of Conant Creek, about 8 miles east of the Sand Draw oil and gas field, and about 25 miles southeast of Riverton, Fremont County, Wyoming.

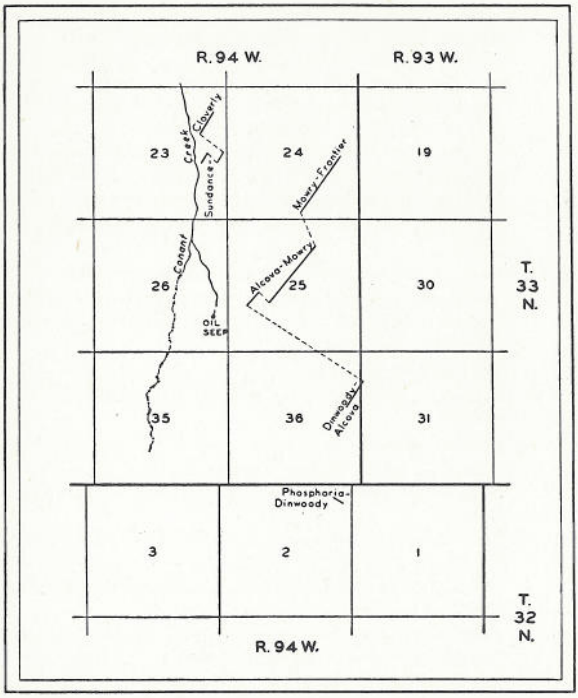

Figure 7. Index map of Conant Creek section, Fremont County, Wyoming.

The best exposures of the Mesozoic rocks are on the northeast flank of a sharp faulted fold that extends northwest from the Granite Mountains. Some parts of the section are poorly exposed but there are few structural complications along the lines of measurement. Units are numbered consecutively from oldest to youngest.

Unit	*Thickness (in feet)*	*Lithologic Character*
Cody shale		
190	50+	Shale, gray, sandy, soft, poorly exposed.

Approximate contact between Cody shale and Frontier formation. Poor exposures and the nature of the contact make it impossible to pick a precise contact point. The contact is arbitrarily placed

Unit	*Thickness (in feet)*	*Lithologic Character*
at the approximate point below which sandstones predominate and above which sandy shales predominate.		
189	5	Sandstone, grayish brown, weathering dark gray, medium-grained to coarse-grained, limy, hard; forms ledge; pebbles as much as ¼ inch in diameter of black chert.
188	25	Covered interval.
187	3	Sandstone, gray, weathering brown, coarse-grained, hard, limy; limonite balls; forms ledge; many chert pebbles as much as ½ inch in diameter.
186	5	Shale, black, flaky, soft.
185	1	Sandstone, grayish brown, medium-grained to coarse-grained, limy, hard; forms a single ledge; many dark colored grains.
184	15	Sandstone, grayish brown, fine-grained to medium-grained, very shaly, soft; weak ledge 5 feet above base; contains *Inoceramus* and a nautiloid cephalopod. A mile and a half northwest, in section 14, T. 33 N., R. 94 W., 50 yards north of the road, on the east side of Conant Creek, this same bed contains the following lower Niobrara fossils (U.S.G.S. Loc. 19531): *Inoceramus deformis* Meek, *Liopistha* n. sp., *Turritella* n. sp., *Volutoderma?* sp., *Anisomyon* n. sp., *Baculites* aff. *B. ovatus* Say, *Baculites* aff. *B. ovatus* var. *haresi* Reeside, *Scaphites* sp., *Placenticeras* aff. *P. planum* Hyatt, *Placenticeras* aff. *P. guadalupae* (Roemer).
183	10	Sandstone, gray, stained brown, medium-grained, soft, friable, well-bedded; many dark colored grains; forms 1 ledge with pitted surface.
182	22	Covered interval, apparently underlain by gray very sandy shale.
181	6	Sandstone, gray, fine-grained, soft, friable; forms ledge; many dark colored grains.
180	66	Covered interval, apparently underlain by gray shale.
179	11	Sandstone, gray, fine-grained to medium-grained; soft, friable, cross-bedded in part; many dark colored minerals; weathers to rounded knobs along ridge.
178	59	Covered interval.
177	6	Sandstone, gray, very fine-grained, thin-bedded, silty, slabby, hard to soft, shaly.
176	76	Covered interval.
175	11	Sandstone, gray, slightly ferruginous, fine-grained to medium-grained; many dark colored grains; soft, friable, well bedded; forms slabby outcrop on ridge.
174	121	Covered interval, apparently underlain chiefly by dark gray shales.
173	38	Sandstone, light grayish brown, weathering gray; iron stain at top; fine-grained in lower part; medium-grained in upper part; many dark grains; gray shale partings; well bedded; forms cliff.
172	6	Shale, black, soft, flaky; many gypsum crystals; becomes sandy near top and grades up into overlying sandstone.
171	4	Bentonite, creamy gray to light green, smooth, waxy, apparently rather pure.
170	117	Shale, dark gray to black, soft, flaky; poorly exposed; many gypsum crystals in upper part; 12 feet of bentonitic shale 29 feet above base.
169	7	Bentonite, creamy gray, crumbly and soft; basal 1 foot is hard and granular; numerous bundles of acicular non-calcareous crystals in middle.
168	3	Sandstone, gray, fine-grained; many dark colored grains; much interstitial clay; thin-bedded.
167	110	Shale, dark gray to black, soft, flaky; 6 inches of bentonite 25 feet above base; 6 inches dark olive gray fine-grained shaly sandstone at base.
166	2	Shale, dark gray to black, soft, flaky.
165	25	Sandstone, olive brown to gray, fine-grained; many dark colored grains; shaly; interbedded with dark gray sandy shale; forms low ridge; limy at top.
164	33	Shale, black, soft, flaky; sandy toward top.
163	2	Sandstone, dark olive gray, fine-grained, soft; limy; much interstitial clay; forms ledge.

Unit	*Thickness (in feet)*	*Lithologic Character*
162	75	Shale, dark gray to black, soft except for a few thin hard layers; veins of ferruginous calcite in upper 18 feet; 6 inches of bentonite 28 feet above base; 1.5 feet of bentonite 33 feet above base; 1.5 feet of bentonite 60 feet above base.
161	6	Bentonite, creamy gray, crumbly, impure.
160	10	Shale, dark gray, sandy; some thin-bedded sandstone layers.
159	15	Bentonite, creamy gray, locally stained orange, crumbly; impure in lower part.
158	6	Covered interval.
157	8	Sandstone, light gray, fine-grained; many dark grains; interbedded with about equal amounts of dark gray silty shale.
	909	Total thickness of Frontier formation.

Contact between Frontier formation and Mowry shale.

156	8	Shale, dark gray to black, flaky, siliceous; interbedded fine-grained sandstone in upper 1 foot; thin bed of light gray fine-grained shaly soft fissile sandstone containing many dark grains at base.
155	4	Shale, black and soft in upper half; gray, weathering white, very fine-grained, possibly tuffaceous, hard, brittle, siliceous, non-calcareous, in lower half.
154	101	Covered interval, apparently underlain by siliceous shale.
153	312	Shale, dark gray, weathering very light gray, platy, siliceous, hard, brittle; many fish scales; forms steep hogback; becomes lighter colored and thicker bedded about 15 feet below top.
152	110	Covered interval. Upper part apparently underlain by siliceous shale and lower part by soft black shale. Contact between Mowry and Thermopolis shales is concealed by this covered interval.
151	1	Shale, light gray, silty, siliceous, very hard, platy.
	536	Total thickness of interval between top of Mowry shale and top of Muddy sandstone member of the Thermopolis shale.

Contact between upper black shale member and Muddy sandstone member of Thermopolis shale.

150	8	Sandstone, dark olive gray, very fine-grained, very shaly; many lignite fragments; thin ledges at top; interbedded with black to dark gray shale.
	8	Total thickness of Muddy sandstone member of Thermopolis shale.

Contact between Muddy sandstone member and lower black shale member of Thermopolis shale.

149	50	Partially covered interval, apparently underlain by black shale containing thin partings of very fine-grained shaly olive brown fucoidal sandstone and siltstone; 5 inches of bentonite 11.5 feet below top.
148	40	Shale, black, flaky; lenticular partings of olive brown limonitic siltstone and very fine-grained very shaly limonitic fucoidal sandstone along which are many large limonite concretions that form an inconspicuous ridge.
147	13	Sandstone and shale. Central part of unit consists of dark brown to black silty shale containing thin partings of sandstone. At base is a 2-foot ledge of olive brown very fine-grained very shaly hard fucoidal sandstone. At top is a 2-foot ledge of similar type sandstone.
146	96	Partially covered interval, apparently underlain by dark brown to black silty soft flaky shale containing thin partings of very fine-grained shaly olive brown sandstone and black ironstone concretions.
	199	Total thickness of lower black shale member of Thermopolis shale.

Contact between Thermopolis shale and "Rusty beds" of Cloverly formation.

145	25	Shale, dark brown to black, silty; many beds of very fine-grained shaly olive brown sandstone; top of unit is a 6-inch bed of very slabby, very

Unit	*Thickness (in feet)*	*Lithologic Character*
		fine-grained, fucoidal olive brown shaly sandstone forming an inconspicuous ledge.
144	12	Sandstone, light gray, fine-grained to medium-grained, well-bedded, slightly limy, clean, hard; forms prominent ridge; softer near base.
143	1	Shale, dark gray, slightly sandy, non-calcareous, silty; some carbonaceous fragments.
142	39	Partially covered interval, apparently underlain by variegated shales containing limestone nodules and polished pebbles of chert, quartzite and quartz.
141	5	Sandstone, light gray to tan, weathering dark gray to brown, fine-grained, limy; local limestone breccia and thin layers of hard gray sandy limestone.
140	5	Sandstone, light gray, stained brown, very shaly, soft, massive, blocky, poorly exposed.
Offset one mile northwest to the NE¼ sec. 23, T. 33 N., R. 94 W.		
139	4	Claystone, bright red, slightly sandy.
138	6	Claystone, pinkish violet, limy, locally replaced by crystalline pinkish violet limestone that forms an irregularly rounded ledge.
137	1	Sandstone, bright green, fine-grained; scattered clay pebbles.
136	15	Claystone, green to black, waxy, silty in part, blocky, soft; some fine-grained sandstone.
135	33	Sandstone and sandy silty claystone, dark gray to greenish gray, soft, blocky.
134	10	Sandstone and conglomerate, gray, soft, limy; pebbles of bluish gray and black chert as much as ½ inch in diameter in a matrix of medium-grained to coarse-grained sandstone containing many chert grains; well bedded; some cross-bedding; unit is lenticular.
133	23	Claystone, dark bluish gray, slightly sandy, soft, blocky; apparently grades into unit 135 where unit 134 is absent.
132	9	Claystone, brownish red with some gray mottling, sandy in part, limy; scattered limestone nodules.
131	1	Limestone, light greenish gray, sublithographic, slightly sandy; some green clay masses.
130	2	Claystone, dark grayish green, slightly sandy, limy, blocky, soft.
129	1	Limestone, light gray, sublithographic, slightly sandy, underlain by about equal amount of sandstone, light olive gray, very fine-grained, very shaly, soft, blocky.
128	3	Claystone, light grayish green, very sandy, soft, limy, blocky.
127	24	Sandstone, light gray to greenish gray, weathering brown, fine-grained to coarse-grained, limy; a fairly persistent layer of limestone pebbles 1 to 2 feet thick at base and locally higher in sequence; a few sporadic chert pebbles; cross-bedded, hard, forms ledges; is markedly lenticular; maximum thickness is given here.
126	2	Claystone and limestone, light grayish violet, sandy, nodular, lenticular.
125	10	Claystone, brownish red mottled with gray, sandy; many nodules of sandy sublithographic limestone.
124	19	Claystone, brownish red in lower part, violet mottled with gray in upper part; sandy in lower part; limestone nodules in upper part.
Offset ¼ mile to the east.		
123	7	Sandstone, gray, very sparkly with quartz crystal facets; medium-grained, porous; forms ledge; lenticular, with thickness ranging from a wedge-edge to 18 feet; sparse chert pebbles; a very few unidentifiable pelecypod fragments.

Base of quartz crystal sandstone and conglomerate zone. Possible contact between Cloverly and Morrison formations. There is a marked lithologic change at this point and underlying sandstones are much more dull and contain more intersitial clay than those above.

122	3	Claystone, green and red, fine-grained, soft.

Unit	*Thickness (in feet)*	*Lithologic Character*
121	1	Limestone, gray, weathering brownish yellow, hard, fine-grained, very nodular.
120	20	Claystone, dull red, with green and purplish layers, fine-grained, soft; a few soft thin gray sandstone lenses; two polished chert pebbles observed, probably in place.
119	4	Sandstone, gray, weathering brown, fine-grained, hard, thin-bedded, ripple-marked; thickness varies locally.
118	34	Sandstone and claystone in about equal amounts. Sandstone is gray to dull red, fine-grained, soft, poorly exposed. Claystone is dull red, fine-grained, sandy, poorly exposed; conspicuous bed about 6 feet thick at top.
117	4	Sandstone, gray, medium-grained, porous; forms ledge; numerous large and small green shale inclusions.
116	8	Claystone, red, soft, and red flaky shale.
115	4	Sandstone, gray, slabby, medium-grained; abundant pink and pale green grains.
114	14	Sandstone and claystone, interbedded in about equal amounts. Sandstone is gray; claystone is red and comprises top and bottom units; poorly exposed.
113	12	Sandstone, light gray, soft, porous, medium-grained; forms rounded ledges; some clay pellets; numerous tiny pale green grains.
112	6	Shale, purplish red, soft, flaky.
111	2	Sandstone, gray and red, soft, slabby; traces of glauconite probably derived by erosion of "upper Sundance".
110	4	Shale, red, soft, fine-grained, micaceous, flaky.
109	6	Sandstone, light gray, very soft, moderately slabby, non-glauconitic.
	379	Total thickness of Cloverly and Morrison formations, undivided.

Contact between Morrison formation and "upper Sundance".

Offset one mile southeast to center of section 25, T. 33 N., R. 94 W.

108	10	Shale, dark greenish gray to black, limy; nodules of purplish gray sublithographic limestone near base; thin partings of very fine-grained fissile sandstone with abundant rounded grains of bright green glauconite.
107	1	Sandstone, dark greenish brown, fine-grained, highly glauconitic, very limy, thin-bedded, lenticular.
106	17	Shale, dark gray to greenish; some fine-grained glauconitic sandstone, soft; nodules of sublithographic grayish violet limestone near top.
105	2	Limestone, brownish violet, medium crystalline to coarsely crystalline, glauconitic; fossiliferous, with large *Camptonectes*; hard; forms prominent ledge.
104	7	Sandstone, dark gray to greenish gray, fine-grained, very shaly, glauconitic, platy, fissile, soft.
103	4	Limestone, grayish violet, coarsely crystalline, sparsely glauconitic, hard, thin-bedded; many black grains; some irregular masses of green clay; fossiliferous, with large *Camptonectes*; forms prominent ledge.

Offset 1 mile northwest to C E½ E½ section 23, T. 33 N., R. 94 W.

102	5	Greensand, dark green, fine-grained, soft, nodular; large proportion of rock consists of rounded bright green grains of glauconite.
101	5	Shale, dark green, flaky, fine-grained.
100	44	Greensand, dark green; very shaly in lower 15 feet; harder and less shaly in upper part; abundant round grains of lusterous emerald green glauconite; a limy sandstone ledge 1 foot thick 30 feet above base; a sandstone ledge 2 feet thick 38 feet above base; top foot of unit is nodular glauconitic sandstone; large and small "*Belemnites*" abundant throughout sequence.
	95	Approximate total thickness of "upper Sundance".

Unit	Thickness (in feet)	Lithologic Character
Contact between "upper Sundance" and "lower Sundance"; marked by a very sharp lithologic change.		
99	2	Sandstone, light gray, very fine-grained, soft, poorly bedded, limy, non-glauconitic.
98	4	Sandstone, pale red, fine-grained, soft, shaly.
97	2	Sandstone, pale green, very soft, almost flaky, shaly.
96	5	Sandstone, buff to light gray, fine-grained, moderately hard; two very limonitic zones.
95	5	Sandstone, red, soft, fine-grained, shaly.
94	8	Sandstone, pale green, soft, fine-grained, very shaly.
93	7	Sandstone, red, fine-grained, soft, very shaly.
92	34	Sandstone, pale greenish gray, very soft, fine-grained; some ledges as much as 1 foot thick; ledge near middle contains small smooth pelecypods; some soft greenish gray shales and claystones; ledge of sandstone 3 feet thick near top contains sparse very distinctive clusters of barite crystals in tabular form.
91	20	Sandstone, light gray, moderately hard, limy, thin-bedded, slightly cross-bedded in places, fine-grained; numerous tiny pink grains; forms ledges.
90	22	Shale and mudstone, greenish gray, blocky, moderately hard; more shaly near top.
89	3	Sandstone, gray, fine-grained, rounded grains, limy, soft; numerous pink grains.
Offset 1 mile southeast to center of section 25, T. 33 N., R. 94 W. Offset is on base of unit 89.		
88	13	Covered interval. Thickness estimated by subtracting combined thicknesses of units 89 and 90 from total measured thickness of interval between units 87 and 91.
87	1	Limestone, grayish brown, in thin platy beds, finely crystalline, interbedded with gray fine-grained limy sandstone.
86	1	Sandstone, light gray to white, fine-grained, limy; many rounded granules of bluish gray chert and quartz; some lenticular stringers of chert; much crystalline calcite at base.
	127	Approximate total thickness of "lower Sundance".
Contact between "lower Sundance" and Gypsum Spring formation.		
85	2	Sandstone, olive tan, very clayey, soft, blocky, limy, very fine-grained.
84	1	Limestone, brownish violet, finely crystalline to coarsely crystalline, hard, thin-bedded near base; forms ledge.
83	1	Sandstone, light greenish gray, fine-grained, slightly shaly, limy, soft, blocky.
82	1	Sandstone, brownish red, very fine-grained, very shaly, limy, blocky to fissile; sparse nodules of coarsely crystalline calcite near base.
81	3	Sandstone, grayish green, very fine-grained, very shaly, limy, blocky, fissile at top.
	8	Total thickness of Gypsum Spring formation.
Contact between Gypsum Spring formation and Nugget sandstone.		
80	2	Sandstone, yellowish tan, very fine-grained, very shaly, limy, soft, blocky.
79	10	Covered interval.
78	179	Sandstone, light gray to tan, weathering rusty brown, fine-grained to medium-grained, well-bedded in part; local concentrations of large rounded frosted and polished grains in a finer matrix; some parts of the unit highly cross-bedded, with steep angles of bedding planes; hard to soft and friable; forms prominent ridge; contains many limonite balls near top; some geodes of calcite; some knotty limy aggregates.

Unit	*Thickness (in feet)*	*Lithologic Character*
77	120	Sandstone, light gray to greenish gray, fine-grained, varying amounts of lime cement; varying amounts of greenish gray sandy shale interbedded with the sandstone; ripple-marked in part; slight amount of cross-bedding; some limonite nodules; some calcite geodes; thin dark brownish red soft limy silty shale parting at base.
76	8	Sandstone, drab to greenish gray, weathering tan, fine-grained, shaly, limy; numerous large rounded frosted or polished sand grains in finer matrix; numerous limonite balls near base; thin-bedded; some shale partings.
75	3	Shale and sandstone, brownish red in lower part, greenish gray in upper part, interbedded in beds as much as 6 inches thick; numerous limonite balls near top.
74	3	Sandstone, light gray, stained tan and pink, with some red layers in upper part, fine-grained, limy, thin-bedded; sparse large rounded frosted grains; some red and green clay balls; more shaly near top; forms ledge.
	325	Total thickness of Nugget sandstone.

Contact between Nugget sandstone and Popo Agie member of Chugwater formation.

73	20	Sandstone, dark brownish maroon to red, very fine-grained, very shaly, thin-bedded, platy, limy, soft; altered to greenish gray in upper 6 inches.
72	4	Sandstone, purplish red, locally leached light gray, very fine-grained, limy, massive, hard; forms ledge; abundant small pits developed on weathered surface.
71	24	Sandstone, light brownish red, darker near top, fine-grained, shaly, particularly near top, slightly limy; moderately thin-bedded and platy; moderately soft, but with a few hard ledges near base.
70	1	Limestone pellet conglomerate, greenish gray, hard; consists of rounded fragments of granular sandy limestone as much as ¼ inch in diameter embedded in a matrix of finely crystalline less sandy limestone; forms ledge.
69	8	Sandstone, brownish maroon, very fine-grained, very shaly, limy; irregular conchoidal fracture, soft; scattered large rounded to subangular sand grains.
68	62	Partially covered interval, apparently underlain by sandstone, light brownish red with some greenish gray splotches, soft; very shaly, especially near top.
67	40	Covered interval. Red soil.
66	75	Sandstone, light brownish red, with some irregular gray layers in lower part, fine-grained, shaly in part, thin-bedded; some thin ledges; upper 13 feet poorly exposed.
65	3	Sandstone, tan, fine-grained, limy, fairly clean, thin bedded, fairly hard; forms conspicuous ledge.
64	11	Sandstone, gray to tan in lower part, red and gray in upper part; more sandy in lower part; numerous sandy shales interbedded with sandstones in upper part.
63	6	Sandstone, gray to tan, fine-grained; fairly clean near top and bottom but shaly in middle part; friable; brownish red silty limy sandy shale 5 inches thick at base.
62	3	Sandstone, tan to greenish gray, fine-grained, limy; clean near base and shaly in upper part; forms ledge.
61	12	Partially covered interval. Poor exposures of sandstone, tan with some pink and red color in upper 3 feet; shaly near top; clean fine-grained sandstone near base.

Top of Alcova limestone member of Chugwater formation.

60	10	Limestone, gray, medium crystalline to sublithographic; laminated, with contorted and irregular laminae; sandy in part; scattered calcite geodes; purple and violet stains along bedding planes in lower part.

Unit	Thickness (in feet)	Lithologic Character
		Contact between Alcova limestone member and Red Peak member of Chugwater formation.
		Offset on base of Alcova limestone one mile southeast, to the NE¼ section 36, T. 33 N., R. 94 W.
59	13	Sandstone, red and gray, fine-grained, limy, irregularly bedded; weathers to vertical face below Alcova limestone.
58	12	Shale and siltstone, dark brownish maroon; soft and flaky in lower part; more silty in upper part; thin sandstone parting near middle.
57	33	Sandstone, light gray to tan, stained pink and red, fine-grained, clean, limy, hard, friable in part; many dark colored grains; limonite balls; local concentrations of brownish maroon siltstone and clay balls as much as ½ inch in diameter; forms prominent cliff.
56	7	Shale, dark brownish maroon, limy, silty, micaceous, flaky, soft.
55	112	Sandstone, dark reddish brown, fine-grained, micaceous, limy, shaly, blocky, soft; several lenticular beds of ripple-marked fine-grained sandstone; several conspicuous hard sandstone ledges in middle and upper parts.
54	8	Sandstone, light brownish red in lower part, reddish gray in upper part, fine-grained, limy; many dark colored minerals; thin-bedded in lower part, massive in upper part; forms prominent ledge.
53	6	Shale and sandy siltstone, dark brownish maroon, soft, limy, micaceous.
52	11	Sandstone, light brownish red, fine-grained, slightly micaceous, limy, irregularly thin-bedded; forms ledge.
51	20	Sandstone, light brownish red, very fine-grained, shaly, slightly micaceous, limy, thin-bedded in part, soft; thin red shale partings; local concentrations of large rounded sand grains.
50	7	Sandstone, orange brown, fine-grained to medium-grained, limy, cross-bedded, soft, friable; many dark colored grains, some red and white opaque grains, very well rounded grains; forms soft ledge.
49	1	Shale, dark brownish maroon, slightly micaceous, limy, platy, soft, silty.
48	2	Sandstone, light orange brown, fine-grained to medium-grained, limy, soft, friable; grains very well rounded, with numerous large well rounded frosted and polished grains; some dark colored grains; cross-bedded.
47	1	Shale, dark brownish maroon, soft, limy, platy, silty.
46	4	Sandstone, light brownish red, very fine-grained, limy; massive and forms ledge in lower part; thin-bedded in upper part.
45	4	Shale, dark brownish maroon, very fissile, silty, limy, sandy, soft.
44	54	Sandstone, light brownish red, fine-grained, slightly micaceous, limy, irregularly thin-bedded, soft; forms slope.
43	21	Sandstone, light brownish red, fine-grained, slightly micaceous, limy, thin-bedded, ripple-marked; forms rough prominent cliff.
42	27	Sandstone, light brownish red, fine-grained, slightly micaceous, limy, thin-bedded, slabby; some dark red shaly partings; some greenish gray partings; forms slope broken by slabby ledges.
41	14	Sandstone, light brownish red, fine-grained, slightly micaceous, limy, thin-bedded; forms two prominent ledges.
40	17	Sandstone, light reddish brown, very fine-grained, limy; thin-bedded, in beds as much as 4 inches thick, alternating with dark brownish sandy siltstone beds of about equal thickness.
39	9	Sandstone, light brownish red, fine-grained, slightly micaceous, limy, thin-bedded; forms ledge.
38	5	Siltstone, dark brownish maroon, sandy, limy, blocky, sandstone parting near middle.
37	6	Sandstone, light brownish red, fine-grained, slightly micaceous, limy; some shaly layers in lower part; forms ledge.
36	3	Siltstone, dark brownish maroon, limy, shaly, sandy, blocky, soft.
35	24	Sandstone, light brownish red; shaly partings near top; lower part chiefly red siltstone with red sandstone partings, in 3:1 ratio.
34	17	Sandstone, light brownish red, fine-grained, limy, irregularly thin-bedded; forms ledge.

Unit	*Thickness (in feet)*	*Lithologic Character*
33	206	Sandstone, siltstone, and shale; a heterogeneous unit consisting of 6-inch to 1-foot layers of fine-grained light brownish red limy sandstone alternating with 2 to 8-foot beds of soft dark brownish maroon sandy silty shale and sandy siltstone; some soft beds of light reddish brown fine-grained sandstone; some thin greenish gray very limy partings; less sandstone in upper part.
32	7	Sandstone, light brownish red, fine-grained, limy, thin-bedded; forms ledge.
31	24	Sandstone and silty shale, light brownish red; fine-grained shaly limy sandstone in thin beds alternating with about equal amounts of brownish maroon sandy blocky silty shale; some sandstone beds locally greenish gray.
30	8	Sandstone, light brownish red, fine-grained, slightly micaceous limy; massive near base, thin-bedded near top; forms ledges.
29	55	Sandstone, light brownish red, fine-grained, limy; some partings of red silty sandy shale; sequence moderately soft but with a few harder layers forming ledges.
28	230	Covered interval, apparently underlain by brownish red soft silty shales or very fine-grained soft red sandstones.
27	2	Siltstone, brownish red, shaly, micaceous, blocky, hard, limy; finely sandy in part.
	1249	Total thickness of Chugwater formation.

Approximate contact between Chugwater and Dinwoody formations. Exact contact doubtful because of poor exposures.

26	24	Shale and sandy siltstone, light grayish tan, weathering gray, limy; loose sandy siltstone in lower part, grading up to soft sandy silty shale; poorly exposed.
25	4	Sandstone, grayish brown, locally stained black with oil, fine-grained, shaly, soft, poorly exposed; a few calcite geodes filled with asphaltic residue.
24	1	Limestone, violet brown with ocher partings, crystalline; laminated with shaly partings; some asphaltic particles; forms a weak ledge.
23	3	Shale, grayish tan, silty, platy; so limy that it is almost a shaly silty limestone.

Offset ¾ mile south to the NE corner section 2, T. 32 N., R. 94 W.

22	13	Sandstone, yellowish brown, weathering dark brown, iron stained, very dolomitic, silty, fine-grained, very thin-bedded; forms ragged slabby ledge; contact with underlying bed is gradational.
21	8	Sandstone, light brownish gray, very fine-grained, shaly, dolomitic, soft, irregularly bedded; blocky in part.
20	9	Shale, ocher brown, dolomitic; several partings of soft earthy dolomite about an inch thick near base; layers of gypsum as much as ½ inch thick near base.
	62	Total thickness of Dinwoody formation.

Contact between Dinwoody and Phosphoria formations. Contact is sharp.

19	56	Dolomite and dolomitic limestone, gray, weathering tan to brown, granular to finely crystalline; many calcite geodes, nodules, and shell fragments; lower third hard, massive, obscurely bedded and forms vertical cliff; upper part softer and has chalky appearance.
18	2	Dolomite, light gray, weathering buff, soft, earthy.
17	17	Limestone, grayish tan, weathering gray, dolomitic; sparsely fossiliferous; lower third principally chert which becomes less abundant higher in unit; upper half contains lenses of greenish shaly material in which are many bryozoans, crinoid stems, and shell fragments; calcite geodes and limonitic concretions in upper part.
16	9	Limestone, gray, weathering brown, dolomitic, thin-bedded, slabby; a few small chert nodules in upper 5 feet.

Unit	*Thickness (in feet)*	*Lithologic Character*
15	5	Dolomite and dolomitic limestone, gray, weathering brown, thin-bedded, slabby; irregular nodules of bluish black oolitic fetid limy phosphate.
14	10	Dolomite and dolomitic limestone, light gray, weathering white, very finely crystalline; scattered calcite crystals as much as ½ inch in diameter in lower part of unit; calcite crystals smaller and more abundant near top.
13	7	Dolomite, gray, weathering light gray to white, with some brown stains; microcrystalline to sublithographic, massive, hard; many masses of large calcite crystals in lower part.
12	4	Dolomite, olive brown, weathering light brown, irregularly bedded; shaly near top; forms ledge.
11	2	Dolomite, light tan, very fine-grained, obscurely bedded; upper half contains thin partings of crystalline material that is more resistant to weathering; weathered surface conspicuously pitted.
10	8	Limestone, gray to light violet brown, weathering gray to rusty brown, dolomitic, granular to finely crystalline, very thin-bedded; weathers to prominent ledge; sparse calcite geodes as much as an inch in diameter.
9	7	Dolomite, gray, very fine-grained, moderately well bedded, hard, locally oil stained; many calcite geodes as much as 5 inches in diameter, most of which contain asphaltic residue; irregular tabular masses as much as 1 foot thick containing calcite and granular chert with asphaltic residue in porous parts; lower 2 feet contains productids, other brachiopods, small pelecypods, and several bellerophontid type gastropods.
8	2	Dolomite, light tan, weathering light gray, irregularly thin-bedded, laminated in part, siliceous.
7	1	Dolomite, violet brown, weathering gray, very hard, laminated; smal irregular masses of asphaltic residue.
6	2	Siltstone, light violet brown, dolomitic, thin-bedded, locally oil-stained.
5	3	Dolomite, gray, very sandy; locally as much as 50% sand; fairly hard, massive; weathers to irregular rounded forms; locally near top has porous siliceous masses filled with asphaltic residue.
4	85	Dolomitic siltstone and very fine-grained sandstone, gray, weathering tan; thin-bedded in part; contains scattered small pyrite cubes; many tiny black particles; forms steep slopes.
3	22	Sandstone, gray, weathering tan, very fine-grained, shaly, dolomitic, fairly hard; massive in part; somewhat distorted so thickness is approximate.
2	2	Dolomite, gray, weathering tan, very shaly, hard; some fine-grained sandstone.
1	4	Dolomite, gray, weathering tan, very fine-grained to sublithographic, hard; nodules of calcite as much as 4 inches in diameter, some of which contain small pyrite cubes; small rounded nodules of granular white chert.

Underlying section is too much distorted by sharp folding and faulting to be measured accurately at this locality. Tensleep sandstone exposed 20 to 30 feet below the base of unit 1, but this may not be the correct interval.

Base of measured section.

DUTTON BASIN SECTION

The Dutton Basin section was measured on the northeast and southwest flanks of the Dutton Basin anticline, a sharp fold trending northwest from the northern margin of the Granite Mountains.

The locality is approximately 12 miles east of the Muskrat gas field and 23 miles south southeast of Moneta, Fremont County, Wyoming. Sharp folding, minor faulting, and poor exposures tend to reduce the accuracy of the section from the Alcova limestone member of the Chugwater formation to the top of the Cloverly formation. Units are numbered consecutively from oldest to youngest.

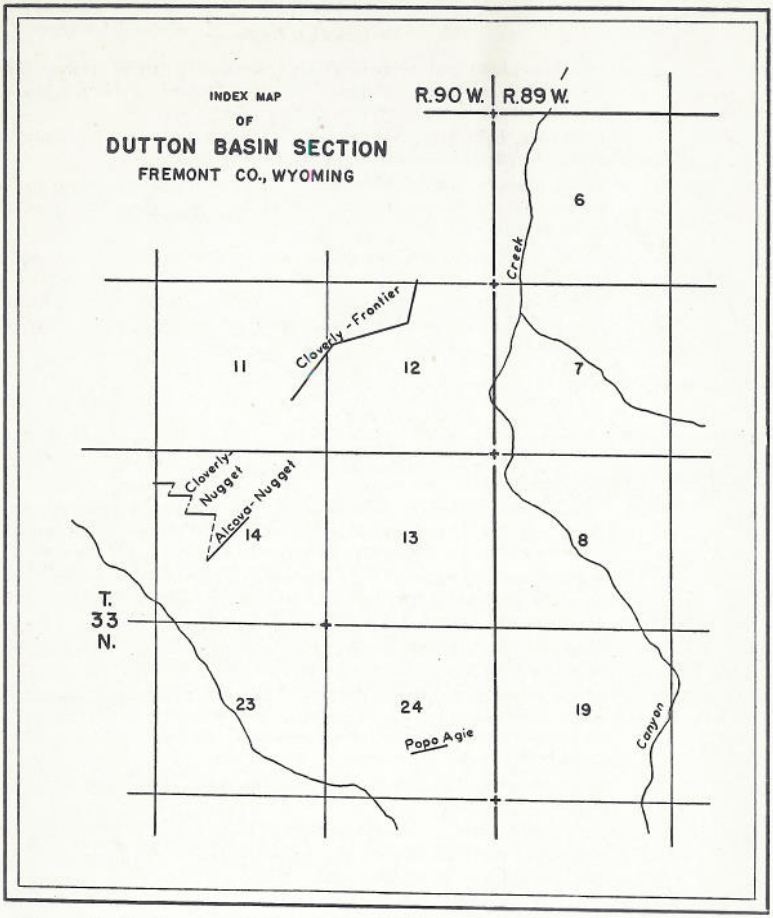

Figure 8. Index map of Dutton Basin section, Fremont County, Wyoming.

Unit	*Thickness (in feet)*	*Lithologic Character*
Cody shale		
75	50+	Shale, gray, sandy, soft.

Contact between Cody shale and Frontier formation. The contact is arbitrarily placed at the approximate point below which sandstones predominate and above which sandy shales predominate.

74	114	Sandstone, gray, locally iron-stained, fine-grained to medium-grained; some coarser-grained portions; many dark colored grains; non-calcareous, well-bedded, cross-bedded in part; some sandy shale in upper fourth; lower 15 feet forms prominent ledge; fragments of underlying bed in lower 1 foot.
73	104	Shale, dark brownish gray, silty, slightly sandy in central part; darker colored, more fissile, and somewhat carbonaceous near top; locally contains lignite fragments.
72	122	Shale, dark gray, weathering light gray to grayish brown; bentonitic throughout but no beds of pure bentonite; a discontinuous ledge of sandstone near middle; soft; many gypsum crystals.
71	115	Shale, black, breaking into minute flakes; many gypsum crystals; some of upper beds very soft and possibly bentonitic.
70	35	Covered interval. Lower 5 feet probably a continuation of underlying unit, and upper part probably a black shale.

Unit	*Thickness (in feet)*	*Lithologic Character*
69	4	Sandstone, light gray to greenish gray, weathering tan to greenish brown fine-grained to medium-grained, limy, thin-bedded; slabby; many dark mineral grains; forms ledge.
68	6	Sandstone, light gray, fine-grained to medium-grained, very shaly, soft, limy; many lenses and partings of black silty shale.
67	75	Shale, black to olive brown, sandy, soft; ferruginous concretions; thin beds of olive drab fine-grained to medium-grained shaly limy sandstone; many gypsum crystals.
66	4	Shale, black to brown and gray, soft, bentonitic, flaky; many gypsum crystals.
65	2	Tuff(?) or bentonite, creamy gray to olive, hard, waxy; some black mica; thin bed of light bluish gray fine-grained to medium-grained shaly sandstone at base.
	581	Total thickness of Frontier formation.

Possible contact between Frontier formation and Mowry shale. This contact is picked more on a basis of regional relationships of underlying and overlying sequences of strata than on any sharp break at this point in this section.

64	76	Shale, black to dark gray, soft, silty, more blocky than flaky; irregular ferruginous concretions and nodules; two thin beds of hard waxy ferruginous bentonite 41 and 45 feet above base.
63	10	Partially covered interval; some exposures of light bluish gray hard tuffaceous shale grading up into dark gray to black silty shale; much distorted by expansion and slumping of underlying bed.
62	8	Bentonite, tan to gray, slightly silty, slightly sandy, waxy in part; thickness approximate because of expansion and slumping of bed.
61	14	Shale, bluish gray in lower part; dark gray in upper part; brittle, flaky, hard, siliceous; numerous fish scales; thin bentonite 6 feet above base; lenticular fine-grained to medium-grained sandstone containing many chert grains 12 feet above base.
60	6	Shale, brownish gray, slightly bluish at base, silty, soft; flaky in part; thin bentonite bed at top.
59	1	Sandstone, white to light bluish gray, fine-grained to medium-grained, shaly; thin partings of bluish gray silty shale.
58	10	Shale, dark gray to brownish gray, flaky, soft, silty; thin bentonite bed 1 foot below top.
57	13	Shale, light bluish gray, siliceous, brittle, hard.
56	14	Covered interval.
55	221	Shale, light to dark gray, weathering white to light bluish gray, hard, siliceous, platy; many fish scales; sparse *Inoceramus* fragments; blocky in upper part; forms ridge.
54	11	Shale and bentonite; 4 beds of micaceous bentonite ranging in thickness from 6 inches to 1½ feet interbedded with dark gray to black micaceous siliceous tuffaceous shale; along strike to the east this zone carries ferruginous and limy cone-in-cone concretions that give a brownish appearance to the unit.
53	87	Shale, black, soft, fissile, platy; many gypsum crystals; 1.5 feet of bentonite 16 feet above base; 1 foot of bentonite 26 feet above base; 3 feet of bentonite 31 feet above base; 6 inches of bentonite 56 feet above base; above highest bentonite the soft shale grades to a black brittle siliceous tuffaceous shale in uppermost 5 feet. Arbitrary contact between Mowry shale and Thermopolis shale may be at or slightly above or below the top of this unit.
	471	Total thickness of interval between top of Mowry shale and top of Muddy sandstone member of the Thermopolis shale.

Contact between upper black shale member and Muddy sandstone member of Thermopolis shale.

52	28	Sandstone, light gray to drab, fine-grained near base and medium-grained near top; interbedded with sandy silty gray shale.

Unit	*Thickness (in feet)*	*Lithologic Character*
51	3	Sandstone, light gray, fine-grained, shaly; in two ledges separated by dark gray, possibly tuffaceous sandy shale with a thin parting of bentonite; lignite fragments and poorly preserved leaves; thin parting of creamy gray flaky to nodular soft tuff at base.
50	1	Sandstone, gray, fine-grained to medium-grained, soft; irregular lenses of black flaky shale; some ferruginous partings; lignite fragments.
	32	Total thickness of Muddy sandstone member of the Thermopolis shale.

Contact between Muddy sandstone member and lower black shale member of Thermopolis shale.

49	79	Shale, black, brown near top, soft, flaky, fissile; some olive drab fucoidal very fine-grained soft shaly sandstone partings; some small ferruginous concretions.
48	12	Shale and sandstone; a persistent zone of lenticular partings of olive drab very fine-grained very shaly fucoidal sandstone interbedded with black fine-grained soft flaky shale; six soft sandstone ledges in unit.
47	59	Shale, black, weathering gray in lower half and rusty in upper half; lower 2 feet contains much fine-grained to coarse-grained sand; some partings of fine-grained shaly fucoidal sandstone; very fissile in lower half; numerous gypsum crystals.
	150	Total thickness of lower black shale member of Thermopolis shale.

Contact between Thermopolis shale and "Rusty beds" of Cloverly formation.

46	3	Sandstone, light gray, weathering rusty brown, fine-grained to coarse-grained; scattered chert pebbles as much as ¼ inch in diameter; strongly ripple-marked; many fucoidal markings; non-calcareous, hard; sparkles with quartz crystal facets; forms ledge.
45	13	Partially covered interval; some outcrops of very fine-grained soft light gray sandstone; some lignite fragments; possibly some gray shale in central part.
44	2	Sandstone, gray, weathering rusty brown, fine-grained to medium-grained, very porous, non-calcareous, hard; forms ledge; sparkles with quartz crystal facets.
43	23	Partially covered interval; probably sandstone in lowest 3 feet; central 15 feet probably dark shale with thin partings of very fine-grained sandstone; upper 5 feet is probably gray ferruginous fine-grained soft sandstone.
42	5	Sandstone, gray to tan, stained pink to black, fine-grained to coarse-grained; scattered chert pebbles as much as ½ inch in diameter; hard, ferruginous, non-calcareous; slabby in part.
41	10	Partially covered interval; some exposures of sandstone, grayish tan, weathering brown, fine-grained to medium-grained; scattered chert pebbles; hard, massive in part; non-calcareous to slightly calcareous.

Offset 1 mile southwest to NW¼ sec. 14, T. 33 N., R. 90 W.

40	23	Conglomerate, gray, weathering brown; composed of gray to black highly rounded chert pebbles with average size about ½ inch and maximum size 2 inches; massive, cliff-forming; lenses laterally into buff sparkling sandstone; sharp contact at base and top.
39	83	Claystone, pale green in lower part, purplish near top, soft; breaks into fine blocky fragments; abundant pink to gray limestone nodules in middle and lower parts.
38	12	Sandstone, greenish gray, coarse-grained to fine-grained, hard, lenticular; sparkles with abundant quartz crystal facets; forms ledge; some shaly sandstone zones.

Base of quartz crystal sandstone and conglomerate zone. Possible contact between Cloverly and Morrison formations. There is a marked lithologic change at this point and underlying sandstones are less sparkly and contain more intersititial clay; claystones have more silty material and colors are duller below this point.

37	23	Claystone, red, green, gray, purple, soft, poorly exposed in part.
36	5	Limestone, white to pinkish, nodular; interbedded with purplish claystone.

Unit	*Thickness (in feet)*	*Lithologic Character*
35	27	Partially covered interval; some exposures of red and green soft claystone.
34	47	Claystone, brick red; fine-grained in middle and upper parts; lower 10 feet interbedded with slabby gray sandstones.
33	17	Sandstone, gray, medium-grained, porous, coarsely bedded to massive; forms ledge; clay pellets in basal 1 foot.
	293	Total thickness of Cloverly and Morrison formations, undivided.

Contact between Morrison formation and "upper Sundance".

32	35	Sandstone and shale; lowest 3 feet is green fissile flaky shale grading up into very thin-bedded fissile fine-grained glauconitic sandstone about 20 feet thick; upper third of unit consists of interbedded fissile flaky green shale and thin-bedded glauconitic sandstone; uppermost 3 feet is flaky green shale.
31	31	Limestone, brown, soft; some shale beds; highly glauconitic, sandy; a mass of fossils, chiefly oysters and *Camptonectes*.
30	55	Greensand, dark green, highly glauconitic, in lower half, grading up to shale, green, fissile, flaky, soft, in upper half; abundant "*Belemnites*" in both shale and greensand.
	121	Total thickness of "upper Sundance".

Contact between "upper Sundance" and "lower Sundance"; marked by a very sharp lithologic change.

29	6	Sandstone, gray, very fine-grained, limy, shaly, non-glauconitic; forms ledge.
28	15	Sandstone, red in lower 2 feet, green and shaly in next 6 feet, red in top 7 feet; typical "Sundance red" zone; very fine-grained, limy soft.
27	40	Shale, pale green, waxy to sandy; interbedded with extremely fine-grained sandstone in lower part; upper part interbedded buff to pale green very fine-grained sandstone and sandy shale; soft sequence.
26	15	Sandstone, buff, hard, limy, very fine-grained; rounded grains; forms ledge.
25	40	Shale, pale green, fine-grained; remarkably fissile and flaky.
	116	Total thickness of "lower Sundance".

Contact between "lower Sundance" and Nugget sandstone. Gypsum Spring formation is absent. Sandstone unit 24 is arbitrarily placed in the Nugget, although there is some possibility that it belongs in the "lower Sundance".

24	11	Sandstone, white, massive, fine-grained, sporadic large rounded frosted grains; conspicuous and widespread unit; looks somewhat like "lower Sundance" type of sandstone.
23	64	Sandstone and shaly sandstone, gray; softer, more sandy, and more ferruginous than underlying unit; abundant sandstone balls about the size of marbles; a persistent unit of greenish shaly sandstone 5 feet thick at top; numerous rounded frosted sand grains.
22	47	Sandstone and shaly sandstone in about equal amounts; sandstone is gray, fine-grained to medium-grained, hard, and forms ledges; shaly sandstone is pale greenish gray, soft; uppermost sandstone contains abundant limy round sandstone balls about ½ inch in diameter; unit forms ridge.
21	32	Sandstone, gray, fine-grained to medium-grained, porous, shaly in upper part; forms ledges.
20	5	Shale, pale greenish gray, fissile, fine-grained.
19	14	Sandstone, gray, medium-grained, porous; inconspicuous rounded grains; upper part contains pale gypsiferous silty shale; forms ledge.
18	9	Sandstone, gray, fine-grained, soft, shaly, poorly exposed.

Contact between Nugget sandstone and Popo Agie member of Chugwater formation.

Offset ¼ mile southeast to C sec. 14, T. 33 N., R. 90 W., for total interval between base of Nugget sandstone and top of Alcova limestone member of the Chugwater formation. This interval is completely covered so details of upper part of Popo Agie member are taken from a section exposed 1½ miles southeast in W½ SE¼ sec. 24, T. 33 N., R. 90 W.

Unit	*Thickness (in feet)*	*Lithologic Character*
17	18	Shale and claystone, red, with purplish and greenish layers, soft, very fine-grained in part; moderately silty and finely sandy in part; weathers to soft red slopes.
16	2	Shale, purple to lilac, coarse-grained, silty, nodular; irregular greenish gray siliceous nodules.
15	5	Limestone pellet conglomerate, purplish, irregular to rounded pellets and fragments of limestone as much as 8 inches in diameter embedded in a light-colored silty limestone matrix; unit is very lenticular, but reappears at the same horizon over a distance of more than half a mile.
14	3	Sandstone, red and white, mottled, fine-grained, moderately soft.
13	11	Sandstone, red and greenish white, mottled, soft, poorly bedded, very fine-grained, nodular; a 6-inch limestone pellet conglomerate, reddish brown, nodular, very irregular, with sparse limestone pebbles in a limestone matrix at base of sequence.
12	3	Sandstone, gray, hard, fine-grained, massive; a few large rounded frosted sand grains; forms ledge.
11	4	Sandstone, mottled red and greenish white, fine-grained, moderately soft, shaly.
10	27	Shale, claystone, very fine-grained sandstone, and mudstone, red, with a few green zones; beds are hard and nodular in part; shales are silty, siliceous, hard; beds near top are red fine-grained shaly sandstones with red silty limestone pellet conglomerate lenses.
9	227	Covered interval. The thickness of this interval is derived by subtracting the total thickness of units 10 to 17, inclusive, from the total measured covered interval between the Alcova limestone member and top of the Popo Agie member near the center of section 14, T. 33 N., R. 90 W. The thickness of this interval is approximate, for there are changes of dip and strike above and below this covered interval and some minor faulting that may or may not extend under the alluvium.
Top of Alcova limestone member of Chugwater formation.		
8	5	Limestone, gray, fine-grained, hard; crinkled ribbon-like laminae conspicuous; thickness ranges from 2 to 5 feet; forms conspicuous dip slope.
Contact between Alcova limestone member and Red Peak member of Chugwater formation.		
7	23	Mudstone and sandstone in about equal amounts, gray, very soft, fine-grained.
6	24	Sandstone, gray, fine-grained, very limy, ripple-marked; forms ledges; some of beds look almost like limestones; upper half softer with about equal amounts of shaly mudstone and sandstone.
5	14	Shale, red, silty; a few slabby fine-grained sandstones.
4	2	Sandstone, gray, fine-grained, hard; forms ledge.
3	9	Shale, chiefly red, with some greenish gray beds, soft, silty.
2	8	Sandstone, gray to reddish, blotchy, fine-grained, silty, poorly bedded; forms ledges.
1	10	Shale, red, moderately coarse-grained, silty. This is the lowest bed exposed on the Dutton Basin anticline.

Base of measured section.