THE GEOLOGICAL SURVEY OF WYOMING

HORACE D. THOMAS, STATE GEOLOGIST

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STRATIGRAPHIC SECTIONS OF JURASSIC AND CRETACEOUS ROCKS IN THE JACKSON HOLE AREA, NORTHWESTERN WYOMING

BY

J. D. Love, D. C. Duncan, H. R. Bergquist, and R. K. Hose

UNIVERSITY OF WYOMING

Laramie, Wyoming

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ABSTRACT

Four detailed sections of Cretaceous rocks and two partial sections of Upper Jurassic rocks are recorded. The Lower Cretaceous and nonmarine Upper Jurassic rocks have a total thickness of about 850 feet and the Upper Cretaceous rocks have a maximum thickness of more than 10,200 feet. The facies of the Cretaceous rocks in the Jackson Hole area, northwestern Wyoming are intermediate between thin facies in central Wyoming and thick facies in eastern Idaho. Most of the lithologic units recognized are not identified with established formation names and have not yet been named, but one thick sequence of marine sandstone, which is the youngest marine unit in the Cretaceous of northwestern Wyoming is here named the Bacon Ridge sandstone. The measured sections record many coal beds and bentonite beds. One thin distinctive bentonite and carbonaceous shale zone in the Bacon Ridge sandstone is here called the pearl gray marker zone. This zone, which is about 4,000 feet above the base of the Upper Cretaceous rocks, is widespread and is useful as a key bed in mapping structure.

STRATIGRAPHIC SECTIONS OF JURASSIC AND CRETACEOUS ROCKS IN THE SOUTHEASTERN PART OF THE JACKSON HOLE AREA, NORTHWESTERN WYOMING[1]

By

J. D. Love, D. C. Duncan, H. R. Bergquist, and R. K. Hose[2]

INTRODUCTION

Detailed stratigraphic sections of Jurassic and Cretaceous rocks were measured in the part of the Jackson Hole area, northwestern Wyoming, that lies east and northeast of the Gros Ventre River in T. 40 N., R. 111 W., T. 41 N., R. 111 W., and T. 42 N., Rs. 111, 112, and 113 W., as a part of the program of oil and gas investigations in Wyoming by the Geological Survey, U. S. Department of the Interior.

Four detailed sections of Cretaceous rocks and two partial sections of Upper Jurassic rocks are recorded in this report. The locations at which the sections were measured are shown on the accompanying index map.

This study was undertaken because of the recent interest in oil and gas possibilities of the region and because of the need for basic geologic data bearing on the possibilities of commercial production of oil, gas, and coal, and to a lesser extent of bentonite and gold. Such data are urgently needed in arriving at equitable solutions of problems arising in the management and disposition of federal and state lands on which these deposits occur. It is hoped that this and additional studies now in progress will supply some of the data needed.

Very little information has been published heretofore on the detailed stratigraphy, thickness, fossils, and correlation of the Cretaceous rocks in this region, and the lack of such studies has handicapped the structural interpretation and evaluation of possible oil- and gas-bearing areas.

Helen L. Foster[3] published a section of the Jurassic and Cretaceous rocks along the Gros Ventre River, in the vicinity of the Upper Slide Lake section recorded here. Neely[4] published a section of Jurassic rocks measured in the same locality. Unpublished geological studies in this region have also been made by A. M. Morgan, Eliot Blackwelder, F. A. Swenson, and H. H. Gray.

As the facies of the Upper Cretaceous rocks present in the Jackson Hole area are intermediate between the thin facies in central Wyoming and the thick facies in eastern Idaho, the correlation of mappable units with named and well-established units both to the east and to the west of the Jackson Hole area is difficult. The Upper Jurassic and Lower Cretaceous strata can be correlated satisfactorily with formations in central Wyoming and with formations along the Idaho-Wyoming state line. However, a comparison of lithologic units of Upper Cretaceous rocks in the Jackson Hole area with formations in similar stratigraphic positions in central Wyoming and along the Wyoming-Idaho state line indicates some major problems in terminology, lithologic

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1Published under cooperative arrangement between the Geological Survey of Wyoming and the U. S. Geological Survey. Published with the permission of the Director, Geological Survey, U. S. Department of the Interior.

2Geologists, U. S. Geological Survey.

3Foster, Helen L., Paleozoic and Mesozoic stratigraphy of northern Gros Ventre Mountains and Mount Leidy highlands, Teton County, Wyoming: *Am. Assoc. Petrol. Geol. Bull.*, vol. 31, no. 9, pp. 1537-1593, 1947.

4Neely, Joseph, Stratigraphy of Sundance formation and related Jurassic rocks in Wyoming and their petroleum aspects: *Am. Assoc. Petrol. Geol. Bull.*, vol. 21, no. 6, pp. 715-770, 1937.


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significant microfossils would be found and could be used for zoning and correlating the thick mass of nondescript, sparsely fossiliferous shales in which there are no conspicuous key beds. Units are numbered consecutively from oldest to youngest.

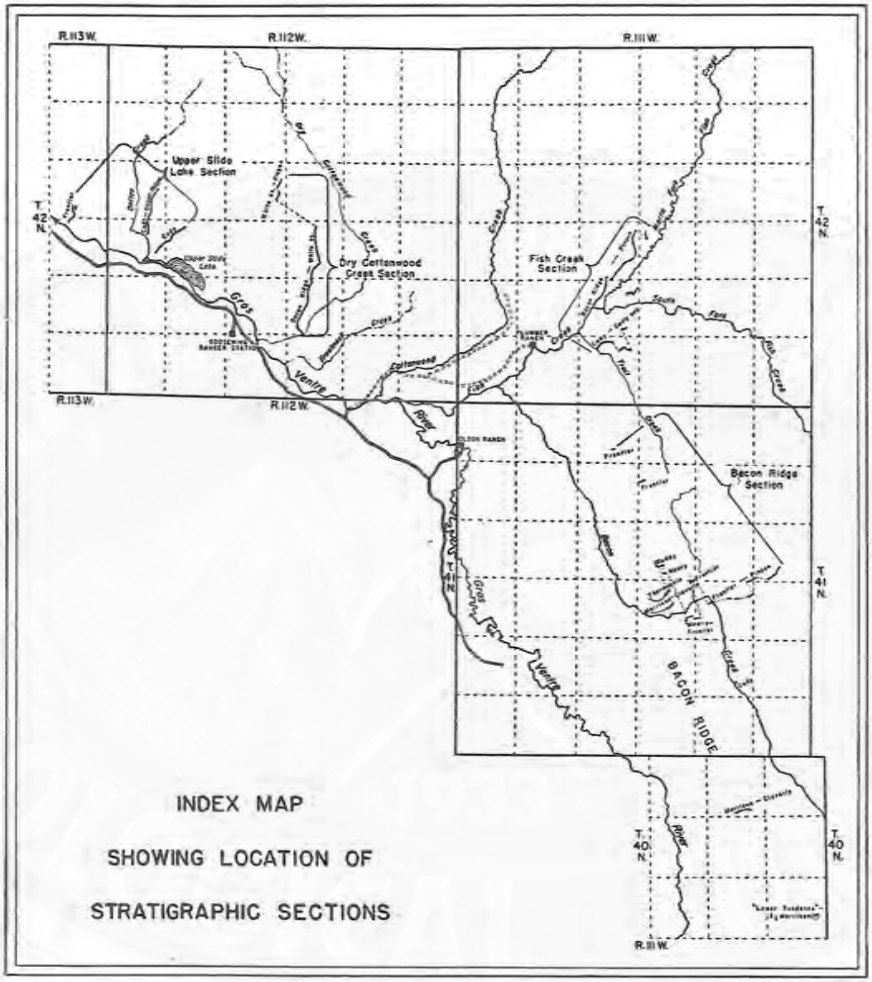

FIGURE 2. INDEX MAP SHOWING LOCATION OF STRATIGRAPHIC SECTIONS

Unit No.	*Thickness (in feet)*	*Lithologic Character*
Bacon Ridge sandstone (top not exposed)		
258	2	Sandstone, gray; forms ledge. Overlying rocks are covered.
257	15	Shale, gray, sandy, poorly exposed.
256	3	Shale, dark brownish-gray, soft, fissile, carbonaceous; some microfossils. Units 252 to 256, inclusive, were combined in one channel sample.
255	0.5	Coquina of small poorly preserved shells.
254	1	Shale, black, fissile.
253	0.2	Sandstone, gray, fine-grained.
252	0.5	Shale, greenish-gray, bentonitic.
251	1.7	Sandstone and shale, gray to tan, silty.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
250	1	Sandstone, brown, hard, nodular, limy; numerous dark grains; abundant oysters and other pelecypods.
249	52	Sandstone, gray, fine-grained, massive, soft, friable; numerous dark grains; a few scattered hard nodules; 1 foot of brown shaly sandstone 3 feet below top.

Top of pearl-gray marker zone. This zone can be recognized as a precise stratigraphic marker throughout the region.

248	17	Shale, gray, bentonitic, plastic; darker in color, less bentonitic, and more flaky near top.
247	0.4	Sandstone or tuff, gray, fine-grained, siliceous; looks like porcellanite; bronze mica flakes; sparse leaves.
246	8	Bentonite and bentonitic shale, gray to white; forms conspicuous bed.
245	0.2	Shale, brown, carbonaceous.
244	1	Coal, black, soft.
243	0.5	Shale, brown, carbonaceous; units 243, 244, and 245 form a persistent marker bed.
	27.1	Total thickness of pearl-grey marker zone.

Base of pearl-gray marker zone.

242	2	Sandstone, brown, fine-grained, carbonaceous.
241	7	Sandstone, tan, friable, fine-grained; 3 inches of brown shale in middle.
240	19	Sandstone, gray, fine-grained to medium-grained; top forms ledge; abundant oysters and other mollusks in top 2 feet.
239	2	Shale, olive-gray; a few thin silty layers; channel sample taken for microfossil study.
238	10	Sandstone, gray, soft, silty; minor amount of shale; abundant gastropods at top.
237	21	Sandstone, gray, massive, fine-grained to medium-grained; abundant molluscan fauna 5 feet and 15 feet above base.
236	1	Shale, olive-drab, silty; abundant small poorly preserved mollusks.
235	1	Shale, brown, carbonaceous; partings of black coal.
234	8	Siltstone, gray to tan; 1 foot gray shale at top; grades down into underlying unit.
233	6	Shale, dark-gray, smooth, fine-grained; a few silty layers; channel sample taken for microfossil study from upper 3 feet.
232	8	Sandstone, gray, medium-grained to fine-grained; a few thin limy sandstone lenses weathering to brown ledges; remainder of unit is friable and forms slopes.
231	3	Sandstone, gray, limy, fine-grained, soft.
230	3	Shale, olive-gray, plastic, fissile.
229	5	Shale, olive-gray, plastic, fissile; channel sample taken for microfossil study.
228	10	Partially covered interval; probably gray shale.
227	9	Sandstone, gray, weathering tan, soft; forms slope; oyster bed at top, from which collection was made.
226	23	Sandstone, gray, medium-grained; forms cliff; 2 thin platy limy zones forming ledges and containing oysters.
225	55	Sandstone, dark-gray, friable, soft, massive, porous; weathers rusty in part; forms slope.
224	21	Sandstone, dark-gray, weathering rusty in part, fine-grained, massive, porous; numerous dark grains; forms ledge; abundant poorly preserved fauna of large and small pelecypods, large gastropods, and sparse ammonites in basal 3 feet.
	318	Total measured part of Bacon Ridge sandstone.

Cody shale.

223	3	Shale, gray, interbedded with tan siltstone.
222	6	Claystone and shale, gray; shale is flaky and fissile; thin fine-grained sandstone partings; poorly preserved pelecypods present but not collected. Channel sample taken for microfossil study.
221	36	Shale and claystone, gray; forms slope.
220	10	Sandstone, gray, fine-grained, thin-bedded, platy; minor amount of silty shale in middle; top and basal parts form ledges. Channel sample taken for microfossil study.


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Unit No.	*Thickness (in feet)*	*Lithologic Character*
142	7	Sandstone, light-gray, interbedded with lesser amount of dark-gray shale. Channel sample taken for microfossil study.
141	27	Sandstone, gray, interbedded with gray shale; forms slope.
140	7	Sandstone, gray, fine-grained; numerous dark grains; lower 3 feet shaly. Channel sample taken for microfossil study.
139	34	Shale, dark-gray, interbedded with minor amount of silty shale and fine-grained gray sandstone. Channel sample of lower 7 feet taken for microfossil study.
138	35	Shale, gray; sparse gray sandstone partings; forms slope. Channel sample of lower 7 feet taken for microfossil study.
137	36	Shale, dark-gray; forms slope. Channel sample of lower 8 feet taken for microfossil study.
136	32	Shale, gray; forms slope.
135	40	Shale and sandstone, gray, soft, in about equal amounts; forms slope; *Inoceramus* prisms. Channel sample of top 8 feet taken for microfossil study.
134	8	Sandstone, light-gray, friable, alternating with dark-gray shale. Channel sample taken for microfossil study.
133	40	Sandstone, gray, friable, interbedded with lesser amount of dark-gray shale; *Inoceramus* prisms present; forms slope. Channel sample of lower 8 feet taken for microfossil study.
132	1	Bentonite, bluish-gray, fine-grained, sandy, micaceous, impure.
131	31	Sandstone, gray, fine-grained, friable, interbedded with minor amount of fine-grained gray shale.
130	7	Sandstone, light-gray; abundant dark-gray shale partings; ammonites and pelecypods were found in sandstone float on this unit. Channel sample taken for microfossil study.
129	34	Shale, dark-gray, interbedded with lesser amount of light-gray friable sandstone in beds ½ inch to 2 inches thick; numerous *Inoceramus* fragments. Channel sample of lower 7 feet taken for microfossil study.
128	20	Shale, gray.
127	7	Sandstone, gray, friable; 1 foot hard sandstone forming ledge at top.
126	8	Sandstone, gray, shaly near top; basal 1 foot hard sandstone ledge containing ammonites, gastropods, pelecypods. Channel sample taken of entire unit for microfossil study.
125	39	Shale, dark-gray. Channel sample of lower 8 feet taken for microfossil study.
124	38	Shale, dark-gray, silty; forms slope. Channel sample of lower 7 feet taken for microfossil study.
123	34	Shale, dark-gray, silty; forms slope. Channel sample of lower 7 feet taken for microfossil study.
122	420	Covered interval; chiefly gray shale in poor exposures about a mile east and southeast.
121	7	Shale, gray to tan, silty; weathered shell fragments.
	2211	Total thickness of Cody shale.

Contact between Cody shale and Frontier formation. This contact is established in conformity with the U. S. Geological Survey classification and common usage for central Wyoming. In the type area of the Frontier formation, however, this contact may come well down within the Frontier. The contact is arbitrarily placed at the approximate point below which sandstones predominate and above which sandy shales predominate. This contact is gradational within an interval of approximately 20 feet.

Frontier formation.

120	14	Sandstone, gray to tan, shaly, soft; forms slope.
119	48	Sandstone, gray to tan, medium-grained, friable, massive; forms ledges in part, numerous dark grains; brown limy fossiliferous sandstone lenses 20, 35, and 45 feet above base; most abundant fossils are oysters.
118	1	Sandstone, gray, coarse-grained, limy; brown, black, and gray chert pebbles as much as 1½ inches in diameter; shark teeth and some oyster shell fragments noted.
117	13	Sandstone, dark-gray, shaly, forms slope; three evenly spaced gray limestone concretion layers containing pelecypods and gastropods.
116	9	Sandstone, gray, medium-grained; ledge at base; numerous dark grains; sparse gray shale partings.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
115	3	Sandstone, gray, weathering brown, limy, medium-grained to coarse-grained; numerous dark grains; abundant gastropods and pelecypods.
114	10	Sandstone, gray to tan, medium-grained, friable; forms slope.
113	12	Sandstone, gray to tan, massive to thin-bedded and platy, medium-grained; numerous dark grains; forms ledge; abundant well preserved pelecypods and gastropods.
112	8	Shale, gray, silty; grades upward to friable shaly sandstone in top 2 feet.
111	10	Sandstone, gray, shaly, friable; forms slope.
110	3	Shale, gray, silty.
109	15	Shale, brown, sandy; thin ocher-colored sandstone layers about 2 inches thick in lower 3 feet; carbonaceous and weathers to brown slope bare of vegetation.
108	7	Shale, dark-gray, grading up to tan sandstone in top 1 foot; 2-inch bed of shell fragments 4 feet above base.
107	15	Sandstone, light-gray, shaly, soft; forms slope.
106	42	Sandstone, light-gray to tan; forms cliff; sparse dark-gray shale partings in lower 25 feet; oysters and other mollusks in upper part.
105	12	Shale, dark-gray, interbedded with light-gray to tan fine-grained sandstone, in beds 2 inches to 4 inches thick; fibrous gypsum layers in upper part.
104	50	Sandstone, gray, medium-grained, massive; forms cliff with reentrant 4 feet to 15 feet below top; sparse oysters at top.
103	11.4	Shale, gray to tan, sandy at base; 0.6 feet carbonaceous black shale with partings of coal 0.8 feet below top.
102	19	Sandstone, tan, fine-grained, friable; forms slope.
101	18	Sandstone, light-gray, massive, medium-grained; forms cliff.
100	14	Sandstone, gray, hard to soft, shaly in part, with beds and lenses of shale as much as 6 inches thick; top locally is base of cliff; petrified log in lower 2 feet.
99	8	Sandstone, gray to brown, friable; limy near base.
98	1	Shale, grayish-green.
97	2	Sandstone, gray, hard, medium-grained.
96	6	Shale, gray to brown.
95	21	Sandstone, light-gray to tan, fine-grained, friable; forms slope.
94	3	Shale, grayish-green, sandy in upper part.
93	10.5	Shale, dark-gray; upper 6 inches black on fresh surface, weathering purplish-gray.
92	2	Bentonite (?), yellow, sandy; weathers with chippy fracture.
91	4.7	Shale, gray to purplish-gray; blocky in lower part; fissile near top.
90	1.5	Sandstone, yellow, shaly, friable.
89	8.7	Shale, gray to greenish-gray; fissile near base; sporadic limonite nodules throughout; blocky in upper part; green sandstone parting 6 inches thick near top.
88	3.5	Shale, tan to lavender-gray, blocky.
87	2	Bentonite, tan; weathers to small particles.
86	7.5	Shale, tan and sandy in lower half, dark-gray in upper half; bentonitic, plastic, swells on weathered surface.
85	1	Shale, dark-gray; abundant carbonized plant fragments; a thin gray sandstone layer contains black carbonaceous partings and carbonized plant fragments.
84	6	Shale, tan, sandy, bentonitic; swells on weathered surface.
83	2	Shale, black carbonaceous.
82	1.6	Shale, gray, plastic.
81	80	Sandstone, gray, weathering tan, massive, medium-grained; sporadic limy sandstone concretions weathering brown.
80	35	Sandstone, light-gray, fine-grained; alternating massive and slabby beds 2 feet to 6 feet thick; 2 feet of brown limy sandstone 18 feet above base; sporadic concretions in lower part; no fossils observed.
79	32	Sandstone, light-gray, fine-grained, platy, in beds 1-16 inch to ½ inch thick; contains sparse thin shale beds as much as 6 inches thick; 18 feet above base is brown limy sandstone 1 foot thick, containing abundant mollusks; at top is 1 foot of brown limy sandstone, the upper part of which grades to a gray, fine-grained, sandy limestone.
78	2	Shale, gray, sandy, lenticular.
77	12	Sandstone, gray to greenish-gray, fine-grained, thin-bedded, shaly; thin partings of brown shale in middle.
76	1.2	Shale, brown.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
75	3	Sandstone, gray, fine-grained, soft, thinly laminated.
74	12	Shale, gray, soft.
73	1.7	Shale, black, carbonaceous, with 6 inches of dirty black coal at top.
72	1	Sandstone, gray, medium-grained.
71	3.5	Shale, dark-gray to black; fissile and brittle near top.
70	13	Mudstone, tan, sandy, blocky; poorly exposed.
69	8	Shale, gray to black, sandy in lower part; thin gray bentonite near top.
68	3	Sandstone, tan, fine-grained, friable.
67	2	Shale, dark-gray, fissile.
66	12	Sandstone, gray to tan, fine-grained, friable; forms slope.
65	1.5	Shale, black at base, gray at top, with a tan friable sandstone bed in middle.
64	8.5	Sandstone, tan friable, shaly near top.
63	9	Shale, dark-gray to black, bentonitic; 1 foot brown bentonitic shale 2 feet below top.
62	1.3	Bentonite, tan and yellow, flaky, smooth.
61	5	Bentonite, greenish-gray, plastic, poor in quality.
60	1	Bentonite, black, weathering purple, impure.
59	2.5	Shale, tan, bentonitic, sandy.
58	1	Sandstone, greenish-gray, fine-grained, platy.
57	5	Shale, dark-gray, bentonitic, plastic, fissile.
56	13	Shale, gray to tan, thin-bedded, in beds 2 inches to 10 inches thick, interbedded with sandy shale and shaly sandstone.
55	42	Sandstone, white to pale-tan, medium-grained to coarse-grained, chiefly massive, friable to hard, sparse large concretions; forms dirty white cliff and slope.
54	10	Shale, black to gray in upper part, olive-drab in lower part, bentonitic; blocky in lower part; sandy near top.
53	28	Sandstone, gray, massive to cross-bedded, fine-grained to coarse-grained; numerous dark grains; sparse carbonaceous shale partings in middle 10 feet; ledges at top and bottom; sparse brown sandstone nodules and lenses about 10 feet below top; dark-green, hard, fine-grained sandstone 1 foot thick forming topmost ledge.
52	7	Shale, dark-gray; grades up to green sandy shale in top 2 feet.
51	1	Sandstone, green to tan, fine-grained.
50	4	Bentonite, yellow-green; looks fairly pure.
49	9.6	Shale, light-gray in lower part, dark-gray near top, bentonitic; pink tuffaceous sandstone parting 3.5 feet below top.
48	7	Shale, gray, sandy; abundant carbonized plant fragments.
47	2.5	Sandstone, grayish-green, fine-grained, cross-bedded; lower half shaly.
46	2	Shale, gray, laminated.
45	1	Sandstone, gray, fine-grained, silty.
44	4	Shale, gray, laminated, hard, fissile.
43	6	Sandstone, light-gray, thin-bedded, silty; partings of finely laminated, hard shale; unit weathers light gray with brown nodules and layers.
42	10	Shale, dark-gray to black, fissile, bentonitic in lower part.
41	3.3	Shale, gray, bentonitic; thin hard pink porcellanites at top and base.
40	7.5	Shale, gray, bentonitic; interbedded with light-gray, blocky, sandy claystone in equal amounts; black carbonaceous shale 6 inches thick at base.
39	0.7	Sandstone, gray, weathering green, fine-grained; contains plant fragments; pink tuffaceous parting at base.
38	1	Shale, gray, bentonitic.
37	12	Porcellanite and tuff, white, light-gray, red, and brown; constitutes most conspicuous porcellanite zone which forms white and pink cliff in a generally dull-gray slope; hard beds of porcellanite and tuff alternate with about equal amounts of pale, yellowish-green, bentonitic sandstone that weathers white.
36	1.6	Bentonite, white and light-green; looks fairly pure.
35	0.6	Sandstone, dark-gray, fine-grained; irregular masses of red mineral.
34	4	Shale, gray, blocky, sandy.
33	2.3	Sandstone, greenish-gray, shaly, soft, fine-grained; uppermost bed cross-laminated and forms ledge.
32	4	Shale, gray, bentonitic.
31	1	Sandstone, light-brown, soft.
30	2.5	Shale, dark-gray to black, fissile.
29	0.7	Sandstone, green, fine-grained.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
28	7	Shale, dark-gray, bentonitic.
27	2	Sandstone, greenish-gray, hard, thin-bedded; 6 inches sandy shale in middle.
26	3	Shale, dark-gray and brown, carbonaceous, bentonitic.
25	3	Shale, gray and cream-colored; pink in lower 2 inches; ocher in middle; bentonitic.
24	1.2	Tuff, gray, hard, massive, clayey, siliceous; forms ledge.
23	3	Bentonite, light greenish-gray.
22	17	Tuff, bentonite, and claystone; tuff is pale pink and forms hard ledges 1 inch to 4 inches thick, interbedded with softer light-gray to greenish bentonite and dark-gray to black, very hard, massive, siliceous claystone, in about equal amounts in lower half; bentonite more abundant and other beds thicker in upper half; some poorly preserved plant stems.
21	2.5	Bentonite, pale yellowish-green, soft, micaceous.
20	5.7	Shale, dark-gray to black; dull-green at top; hard, brittle; fractures filled with bright-red mineral; softer, more flaky, and bentonitic in upper part; top 6 inches hard, brittle, and massive.
19	8.5	Sandstone, gray, coarse-grained; numerous dark grains in lower part; olive-drab, finer-grained, and with fewer dark grains near top; soft, porous, and almost unconsolidated near top.
18	11.5	Claystone, dark-gray in lower part; olive-drab in middle; sulfurous yellowish-green in top 3 feet; top 6 inches dark-gray; sequence is hard, brittle, tuffaceous; abundant biotite; looks like a tuff that has been only partly altered to bentonite.
17	4.5	Sandstone, siltstone, and shale; sandstone is gray, in beds 1 foot thick, at top and bottom; lead-gray, fissile, silty shale and siltstone in middle.
16	10.5	Shale and claystone, dark lead-gray, soft, poorly exposed; some fine-grained, sandy layers near middle.
15	2.5	Porcellanite, white, fine-grained, hard; middle 6 inches has abundant pisolitic structures; beds are paper-thin to 4 inches in thickness; sequence forms ledge; poorly preserved leaves in lower part.
14	3.5	Bentonite, pink, pale-green, white and yellow; contains black mica, red grains, and other impurities.
13	8	Shale, dark-brown to black in upper part, dull-green in lower part; carbonaceous and sandy near top.
12	2	Bentonite, yellow to tan.
11	6	Shale, dark-gray, fissile in part; blocky in part.
10	10	Sandstone, gray, medium-grained; numerous dark grains.
9	30	Shale, dark-gray, plastic; hard siliceous layers as much as 3 inches thick scattered through the sequence.
8	20	Sandstone, gray, weathering brown, massive, hard, siliceous in part, medium-grained to coarse-grained; numerous dark grains; sparse plant fragments.
	1032.3	Total thickness of Frontier formation.
Mowry shale.		
7	3	Shale, dark-gray, interbedded with hard sandy shale.
6	35	Partly covered interval; chiefly shale like that directly below.
5	20	Shale, dark-gray, with white layers, hard, siliceous; thin friable sandstone beds in upper 3 feet.
4	15	Shale, gray, sandy; fissile in part; blocky in part.
3	13	Tuff and sandstone, gray, hard, siliceous; abundant dark grains, limy; black, mottled, fine-grained tuff in middle; siliceous shale partings in upper 2 feet.
2	19	Sandstone, gray, weathering brown, fine-grained, friable in part, thinly laminated; poorly exposed here, for only top 2 feet and bottom 2 feet is visible; laterally entire sequence is sandstone.
1	75	Shale, gray, thinly laminated; alternates with ½-inch to 6-inch beds of hard siliceous sandstone; shales are sandy in part and some contain plant fragments; top 3 feet very sandy.

Base of exposures and base of measured section.

DRY COTTONWOOD CREEK SECTION

This section was measured about two miles east of Upper Slide Lake along the high drainage divide directly west of Dry Cottonwood Creek which flows southward to the Gros Ventre River. The section is moderately well exposed, dips are gentle and comparatively uniform, and there are no structural complications. Units are numbered consecutively from oldest to youngest.

Pinyon formation (Paleocene)
Conglomerate member

394	16	Conglomerate, brown; roundstones of quartzite and volcanic rocks; abundant conspicuous percussion marks. Overlying this unit here is light-tan sandy loess soil about 10 feet thick, capping the knife-edged high ridge. One quarter mile east there is 30 feet of loess. One quarter mile west there is probably 100 feet more of conglomerate above unit 394.
393	27	Claystone and sandstone; 3 feet tan, medium-grained, soft sandstone at base; remainder is claystone, greenish-gray to dark-gray, very soft, plastic to finely blocky.
392	157	Conglomerate, brown; roundstones of quartzite and volcanic rocks; abundant conspicuous percussion marks.
391	16	Claystone and siltstone, brownish-gray to greenish-drab, blocky, soft; some sandy layers; appears to have considerable lateral continuity.
390	164	Conglomerate, brown, roundstones of quartzite comprise about 75 percent of the conglomerate and porphyritic volcanic rocks about 25 percent; some roundstones as much as 1 foot in diameter but average size is 2 inches to 3 inches; imbricate structure indicates current came from north; a 3-foot brown sandstone 60 feet above base and 5 feet of brown sandstone with twisted leaves and carbonized wood fragments 108 feet above base.
	380	Total measured part of conglomerate member of Pinyon formation.

Contact between conglomerate member and coal member of Pinyon formation.

This contact was followed for three miles to the northwest and for three miles to the east. The contact is sharp but there is no conspicuous evidence of extensive channeling. Quartzite boulders as much as 1 foot in diameter directly overlie the soft shale and claystone of unit 389.

Coal member

389	3	Shale and claystone, dark bluish-gray, with rusty layers; fine-grained, soft.
388	1	Coal, black, impure, interbedded with coaly shale.
387	6	Claystone, lead-gray, soft; contains small fragile gastropods and pelecypods.
386	5.4	Sandstone, ocher to gray, thin-bedded, very soft, interbedded with lesser amount of gray shale and claystone; sandstone is fine-grained and not at all like sandstones below coal member.
385	7.2	Shale and claystone, lead-gray, very soft; some coal fragments.
384	0.3	Coal, black, shiny.
383	1.4	Shale, black, coaly; numerous shiny coal layers 1 inch thick.
382	1.1	Coal, black, shiny, hard, gypsiferous.
381	1.7	Shale, dark-gray, carbonaceous, soft.
380	0.5	Coal, black, shiny.
379	1.5	Shale, black, coaly, plastic; shiny laminae of coal.
378	2.8	Coal, black, shiny; 3 inches of black shale in middle.
377	1.6	Claystone, light-gray, soft, silty, micaceous; weathers to a conspicuous white band on a black slope and is used as a marker bed. On this bed strike is N. 30°, W., dip 7° NE.
376	4	Coal, black, shiny; looks somewhat shaly; 6 inches of plastic black shale 6 inches below top.
375	2	Shale, black, coaly, plastic, soft; thin layers of coal.
374	2.5	Coal, black, shiny; looks fairly good.
373	7.7	Shale, black, coaly, interbedded with coal; 6 inches of black, shiny, sandy, impure, shaly coal at base and several 3-inch to 6-inch shaly coals in middle; remainder is black, plastic, coaly shale.
	49.7	Total thickness of coal member of Pinyon formation.
	429.7	Total measured part of Pinyon formation.

Unit No.	*Thickness (in feet)*	*Lithologic Character*

Contact between coal member of Pinyon formation and conglomeratic sandstone sequence in Upper Cretaceous. There is about 15° angular unconformity between the Cretaceous and Tertiary rocks, although the strike is essentially the same. Three miles east there is more than 100 feet of typical Pinyon conglomerate between the coal member and the Upper Cretaceous rocks, but three miles northwest the coal member rests directly on Cretaceous strata, as it does here.

Conglomeratic sandstone sequence

372	5	Sandstone, gray, medium-grained, impure, soft, porous; abundant carbonized plant fragments; so stained with carbonized wash that it is hard to tell what the rock really looks like.
371	0.5	Claystone, gray, firm, plastic, non-bentonitic, slightly gritty; a very unique bed, somewhat resembling an underclay.
370	3	Sandstone, dark-gray to light-gray; resembles unit 368; some bright-colored grains; poorly bedded, medium-grained, soft, porous; some carbonaceous material; some ocher ferruginous staining at top.
369	0–3	Conglomerate with white sandstone matrix; roundstones chiefly of Paleozoic chert, quartzite, and sandstone; sparse roundstones of pre-Cambrian quartzite; numerous fragments of petrified coniferous wood; fusulines present in some chert fragments; maximum roundstone size about 4 inches, average about 1 inch; a lenticular channel deposit grading into overlying and underlying units.
368	38	Sandstone, chalky, brilliant white, medium-grained to coarse-grained, cross-bedded to massive, porous; numerous dark grains; abundant pinhead-size ferruginous grains that are inert in acid; looks tuffaceous; chalky white matrix; contains numerous white pellets throughout.
	49.5	Total thickness of conglomeratic sandstone sequence.

Contact between conglomeratic sandstone sequence and white sandstone sequence. The sandstones below this contact are white but not as brilliant white as those above, and are not conglomeratic.

White sandstone sequence

367	16	Shale and claystone, lead-gray, soft, fine-grained; ferruginous clay balls in top 4 feet; a conspicuous ocher zone beginning about 5 feet below top and grading up to clay ball zone; color bright and irregularly mottled with pale green.
366	5	Sandstone, yellow, slabby, conspicuous because of color in lower part; grades to gray, soft, massive sandstone at top.
365	18	Claystone and shale, gray to slightly rusty in upper half; in lower half, claystone, siltstone, and fine-grained rusty nodular sandstone, interbedded. The following fossils were identified: *Sphaerium* sp., *Lioplacodes*? sp., *Gyraulus* sp., *Viviparus* sp., *Unio* aff. *U. priscus* Meek and Hayden, gastropod opercula, ostracode valve, abundant charophyte oogonia, seeds of a pond weed.
364	2	Sandstone, drab, very soft, porous, fine-grained, massive; silty near top.
363	10.5	Claystone and siltstone, dull-gray, soft, blocky; siltstone is nodular and ferruginous in part.
362	6.6	Sandstone and siltstone, with minor amount of claystone, dull-gray, soft, blocky in part; some ferruginous concretions.
361	1.7	Shale, dark-gray, carbonaceous, soft, silty, in lower half; upper half is coal, black, shiny, hard.
360	15	Sandstone, light-gray, massive, soft, medium-grained; bright-colored grains; numerous dark grains; some white kaolinitic or tuffaceous matrix; forms weak ledge.
359	20	Shale and claystone, light-gray to olive-gray, fine-grained, soft, finely blocky; some silty layers.
358	6.3	Sandstone and siltstone, gray, weathering tan in part, soft, laminated and interbedded in part; blocky siltstone in upper half; lower half weathers to brown sandstone ledge which contains an abundant and remarkably well preserved flora. The following leaves were identified by R. W. Brown and are considered by him to be of Late Cretaceous, probably Laramie age: *Anemia perplexa* Hollick, *Sequoia brevifolia* Heer, *Laurus* sp., *Cissus* sp., other dicotyledons, undetermined.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
357	14	Shale and claystone, light greenish-gray, finely blocky in part, soft, fine-grained; a black carbonaceous layer 1 foot thick 10 feet above base.
356	88	Sandstone, light-gray, massive, soft, medium-grained to coarse-grained, porous; bright-colored grains; numerous dark grains; abundant gray limestone and clay pebbles in lower half; gray limestone concretions as much as 6 inches in diameter 5 feet below top; massive to poorly bedded, with some cross bedding; some hard finer-grained ferruginous lenses; upper 11 feet very soft and forms slope; remainder forms the main conspicuous white cliff in the area.
	203.1	Total thickness of white sandstone sequence.

Contact between white sandstone sequence and lenticular sandstone and shale sequence arbitrarily placed at this horizon. Below this point the sandstones tend to be brown or darker gray and are much more lenticular and thinner than the sandstones above. This may or may not be a genuine contact that can be followed laterally.

Lenticular sandstone and shale sequence

355	54	Sandstone, shale, claystone, and siltstone; lower 14 feet is chiefly fine-grained, gray, very soft, silty sandstone; overlain by 1 foot of purplish-gray claystone; remainder is gray siltstone, claystone, and shale, interbedded; a black carbonaceous shale 1 foot thick 5 feet below top; other thin, gray and greenish, soft layers interbedded with gray shale and claystone.
354	29	Sandstone, light-gray, weathering buff in part, medium-grained; bright-colored grains; numerous dark grains; forms massive cliff but is thin-bedded in part; some clay pellets in local lenses.
353	41	Shale and sandstone; shale is lead-gray to light-gray; sandstone is light-gray, fine-grained, soft, abundant bright-colored grains; both shale and sandstone form slopes.
352	7	Sandstone, gray, weathering buff, fine-grained, hard, poorly bedded; numerous bright-colored grains; forms single brown ledge.
351	80	Sandstone and shale interbedded in about equal amounts; sandstone is gray, fine-grained, soft; numerous dark grains; forms gray slope; 1 foot brown slabby sandstone 22 feet above base; shale is lead-gray, with some almost black and some light-gray zones; 1 foot coal and coaly shale 49 feet above base.
350	36	Sandstone, light-gray, massive, soft, porous; abundant bright-colored grains; abundant dark grains; forms lowest conspicuous smooth white cliff; 1-foot ledge of hard buff sandstone at top. This unit is 15 feet thick ¼ mile east and 8 feet thick ¾ mile east.
Offset on base of unit 350 ¾ mile east-southeast.		
349	50	Shale, gray to tan, sandy; 2 feet brown limy sandstone 22 feet above base; fine-grained, gray, limy sandstone weathering brown, forming ledges 1 foot thick 35 feet and 46 feet above base.
348	43	Shale, gray to dark-gray; minor amount of tan sandy shale 21 feet and 39 feet above base; several brown sandstone ledges 1 foot thick; 1 foot of carbonaceous shale 10 feet above base.
347	7	Sandstone, gray, weathering brown, hard, cross-bedded, fine-grained to medium-grained; abundant bright-colored grains; petroliferous odor on fresh fracture; forms conspicuous ledge where it crosses stream divide.
346	19	Sandstone, gray, shaly, soft, friable.
345	19	Shale, gray; at top is limy gray sandstone containing sparse leaves identified as *Araucarites longifolia* (Lesquereux) Dorf, and fragments of ferns and dicotyledons. R. W. Brown considers these probably of Late Mesaverde age.
344	2	Marlstone, yellow on weathered surface, gray on fresh surface, fine-grained, compact.
343	2	Shale, gray.
342	3	Sandstone, gray; lower 2 feet weathers to a brown ledge.
341	7	Shale, gray.
340	31	Sandstone, gray to tan, shaly near top and bottom; middle part forms ledge.
339	16	Shale, gray, interbedded with tan sandy shale.
338	3	Sandstone, gray, lenticular; forms ledge.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
337	11	Shale, gray, interbedded with 2-foot to 4-foot beds of fine-grained friable sandstone.
336	1	Coal, black, 8 inches thick; 3 inches of carbonaceous shale at base and gray shale parting at top.
335	8	Sandstone, gray, shaly, interbedded with an equal amount of dark-gray shale.
334	1.6	Coal, black, 14 inches thick; 4 inches gray and brown shale at base and 1 inch gray shale at top.
333	21	Sandstone, gray, fine-grained, friable; two limy sandstone ledges, each about 1 foot thick; minor amount of gray shale in lower part.
332	3	Shale, gray, sandy.
331	3	Sandstone, gray, friable, fine-grained; lower 2 feet weathers to brown ledge.
330	2	Shale, gray.
329	0.5	Coal, black.
328	5	Sandstone and shale, gray, interbedded in beds about 1 foot thick.
327	7	Sandstone, gray to tan, friable.
326	20	Shale, gray; 2 feet of limy brown sandstone 9 feet above base.
325	0.5	Shale, black, carbonaceous, with partings of coal.
324	5	Shale, gray to tan, sandy.
323	6	Sandstone, light-gray, friable.
322	32	Shale, gray, interbedded at 2-foot to 6-foot intervals with friable shaly sandstone; 16 feet above base is a 2-foot brown limy sandstone.
321	19	Sandstone, gray, friable; 1-foot thin-bedded ledge at base and another 17 feet above base.
320	41	Shale, gray to tan, sandy; thin platy sandstone ledges 1-foot thick 24 feet, 30 feet, and 38 feet above base; reptile bone found in float 19 feet above base; well preserved leaves at top. The following leaves were identified by R. W. Brown and are considered by him to be of Late Cretaceous, probably late Mesaverde age: *Anemia perplexa* Hollick, *Araucarites longifolia* (Lesquereux) Dorf, *Sequoia brevifolia* Heer, *Myrtophyllum torreyi* (Lesquereux) Dorf, *Cercidiphyllum ellipticum* (Newberry) Brown, palm fragment.
319	4	Sandstone, gray; forms ledge.
318	21	Shale, gray to tan, interbedded with fine-grained gray to brown limy sandstone.
317	8	Sandstone, light-gray, medium-grained, lenticular.
316	1.6	Coal, black, 16 inches thick; 3 inches of brown carbonaceous shale at base; gray shaly sandstone parting at top.
315	33	Shale, light-gray to dark-gray, sandy; 1 foot brown limy sandstone.
314	24	Sandstone, light-gray, massive, lenticular; numerous dark grains; sparse bright-colored grains; poorly preserved plant fragments in brown bed at top.
313	45	Shale, gray, sandy; some friable fine-grained sandstone with brown limy sandstone concretions.
312	4	Shale, gray, sandy.
311	5	Sandstone, gray, fine-grained; ledge 1 foot thick in middle.
310	34	Shale, gray; sandy in upper half; 1 foot of brown limy sandstone 10 feet and 17 feet above base.
309	9	Sandstone, gray, massive, soft, friable; forms slope.
308	14	Sandstone, gray, massive, lenticular; sparse clay balls and ferruginous concretions; forms cliff.
307	9	Sandstone, gray, soft, friable, interbedded with lesser amount of gray shale.
306	1.3	Coal, 8 inches thick; 2 inches carbonaceous shale at base and 6 inches gray shale at top.
305	29	Shale, gray, interbedded with fine-grained, friable, gray sandstone.
304	40	Sandstone, light-gray, massive, lenticular; forms cliff.
303	42	Shale, gray, interbedded with fine-grained gray sandstone; one 6-inch bed of carbonaceous shale and 1 foot of brown limy sandstone.
302	11	Sandstone, gray, massive; forms slope.
301	10	Sandstone, gray, massive, lenticular; locally forms ledge.
300	24	Shale, gray, sandy in part.
299	11	Sandstone, gray, massive, lenticular; locally forms cliff.
298	1	Shale, carbonaceous; contains coal partings.
297	11	Sandstone, gray, shaly; 6 inches of gray shale at top.
296	1	Coal, 8 inches thick; 4 inches of carbonaceous shale at base.
295	17	Sandstone, gray, fine-grained; sparse gray shale partings.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
294	29	Sandstone, light-gray, massive to thin-bedded, medium-grained, numerous dark grains.
293	45	Shale, gray, interbedded with 2-foot to 4-foot beds of fine-grained, friable, light-gray sandstone.
292	17	Sandstone, gray, massive to thin-bedded, medium-grained, lenticular; numerous dark grains.
291	45	Sandstone, gray, fine-grained, shaly, interbedded with dark-gray shale; 3 feet of sandy shale weathering yellow, at base; 2-foot ledge of sandstone 36 feet above base; pelecypods in shale 20 feet above base.
290	8	Sandstone, gray, fine-grained; ledge 2 feet thick at top.
289	4	Shale, gray.
288	14	Sandstone, gray, fine-grained, friable; ledge of thin-bedded sandstone at base
287	8	Shale, gray, interbedded with fine-grained friable gray sandstone.
286	1	Shale, carbonaceous.
285	3	Shale, gray.
284	27	Sandstone, gray, fine-grained to medium-grained, lenticular, cross-bedded in part, massive in part, friable; numerous dark grains.
283	15	Sandstone, gray, friable, fine-grained.
282	1	Shale, gray.
281	17	Sandstone, gray, fine-grained to medium-grained, friable; ledge 2 feet thick near middle.
280	3	Shale, gray.
279	42	Sandstone, gray, fine-grained to medium-grained, friable; 2 feet of gray shale 13 feet above base.
278	16	Shale, gray to tan; 1 foot of sandy shale near middle
277	2	Sandstone, gray, friable.
276	16	Shale, gray, sandy near top.
275	2	Sandstone, gray, fine-grained, thin-bedded; forms ledge.
274	109	Shale, gray, interbedded with light-gray sandstone; poorly exposed; lower half chiefly sandstone; upper half chiefly gray shale; 3 inches of carbonaceous shale at top.
273	1	Sandstone, gray, medium-grained to fine-grained, thin-bedded; forms ledge.
272	66	Shale, gray, interbedded with a lesser amount of tan to white sandstone which is shaly in part.
271	151	Covered interval in saddle on ridge top; probably shale with a minor amount of shaly sandstone.
Base of light grayish-tan slopes and top of banded gray, white and ocher-yellow slopes.		
270	5	Sandstone, white, friable.
269	15	Shale, gray to tan, sandy in part.
268	1	Sandstone, gray, fine-grained; forms ledge; basal part is thin marlstone.
267	21	Shale, gray and tan, sandy in upper 16 feet; yellowish-brown and blocky in lower 5 feet.
266	30	Shale, gray; 6 inches of carbonaceous shale 10 feet above base; 1 foot tan sandy shale 17 feet above base; 1 foot gray marlstone weathering yellow 21 feet above base; leaves and gastropods present.
265	7	Sandstone, gray, medium-grained; numerous dark grains; locally forms ledge.
264	11	Shale, gray; 1 foot tan shaly sandstone 8 feet above base.
263	1	Marlstone, gray, weathering yellow to tan; sparse leaves and gastropods. The following leaves were identified by R. W. Brown and are considered by him to be of Late Cretaceous, probably Late Mesaverde age: *Araucarites longifolia* (Lesquereux), *Equisetum* sp., fern, fragments of dicotyledonous leaves.
262	2	Shale, gray.
261	23	Sandstone, light-gray, massive, lenticular; sparse clay pellets; upper part forms ledge; lowest conspicuous channel sandstone.
260	78	Shale, gray, interbedded with 2-foot to 6-foot layers of yellow to tan shaly sandstone.
259	2	Marlstone, yellow; thin gray limy sandstone at base; forms ledge.
258	47	Shale, gray, interbedded with gray to tan friable sandstone.
257	1	Sandstone, gray, thin-bedded, hard; forms ledge.
256	38	Shale, gray, interbedded with gray to tan friable sandstone.
255	5	Shale, dark-gray.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
254	52	Partly covered interval; chiefly shale and shaly sandstone.
253	1	Marlstone, gray, weathering yellow, hard.
252	16	Shale, gray to tan, sandy near base.
251	13	Sandstone, light-gray, fine-grained, thin-bedded; ledge 3 feet thick 5 feet above base.
250	32	Shale, gray; sparse layers of tan sandy shale 1 foot thick; 1 foot of fine-grained sandstone 20 feet above base.
249	0.5	Shale, carbonaceous.
248	12	Shale, gray; sparse layers of tan sandy shale.
247	2	Sandstone, gray, friable, fine-grained.
246	20	Shale, gray; sparse layers of tan sandy shale.
245	2	Sandstone, gray, thin-bedded, platy.
244	9	Shale, gray.
243	1	Marlstone, gray, weathering yellowish tan, fine-grained; sparse gastropods, pelecypods, and leaves. The leaves were identified as *Trapa? microphylla* Lesquereux by R. W. Brown.
242	10	Shale, gray to tan, sandy in part.
241	12	Sandstone, gray, fine-grained, friable.
240	2	Shale, gray.
239	4	Sandstone, light-gray, thin-bedded, platy.
238	6	Shale, gray.
237	1	Marlstone, gray, weathering yellow.
236	5	Shale, gray to tan, sandy in part.
235	2	Sandstone, gray, fine-grained, thin-bedded, platy; forms ledge; poorly preserved plant fragments.
234	1	Shale, carbonaceous.
233	21	Shale, gray, interbedded with 1-foot to 2-foot beds of tan to gray friable sandstone.
232	2	Sandstone, gray, fine-grained, thin-bedded; forms ledge.
231	1	Marlstone, yellow.
230	6	Shale, gray.
229	6	Sandstone, light-gray, friable.
228	6	Shale, gray.
227	30	Sandstone, gray, medium-grained to fine-grained, cross-bedded in part, massive in part; lower 12 feet of sandstone forms ledge.
226	1.2	Coal, black, 10 inches thick, underlain by 3 inches carbonaceous shale and overlain by 2 inches of carbonaceous sandstone.
225	4	Shale, gray, interbedded with friable fine-grained sandstone.
224	18	Sandstone, gray, thin-bedded to massive, medium-grained to fine-grained; numerous dark grains; locally forms cliff; is lowest massive sandstone in this part of section.
	2273.2	Total thickness of lenticular sandstone and shale sequence.

Contact between the lenticular sandstone and shale sequence and the coaly sequence arbitrarily placed at this horizon. The coaly sequence outcrops as light-gray, dark-gray, and brown banded slopes with only sparse sandstone ledges.

Coaly sequence

223	22	Shale, gray, with minor amount of tan shaly sandstone.
222	1	Bentonite, tan.
221	2	Shale, dark-gray, bentonitic, swelling, fissile; weathers to dark-gray slope; white fibrous gypsum.
220	15	Shale, gray; upper 6 feet is sandy and grades laterally to a sandstone ledge.
219	4	Sandstone, gray, friable; top and base form ledges; middle is shaly.
218	2	Shale, gray.
217	1	Marlstone, light-brown, weathering gray.
216	3	Shale, gray.
215	8	Sandstone, gray; locally forms ledge.
214	20	Shale, gray, interbedded with a lesser amount of gray, fine-grained, friable sandstone.
213	8	Sandstone, gray, friable; ledge 1 foot thick at top.
212	9	Shale, dark gray.
211	2	Sandstone, gray, weathering yellow, limy; grades up to marlstone; forms ledge.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
210	45	Shale, gray to tan; 1-foot beds of fine-grained, thin-bedded sandstone 4 feet and 23 feet above base; sparse thin beds of tan sandy shale.
209	2.6	Coal and shale beds, detailed as follows:
		Top: Shale, brown, sericitic — 3 inches Coal — 3 inches Siltstone, buff — 1 inch Coal — 7 inches Shale, brown, carbonaceous — 1 inch Base: Coal — 16 inches
208	19	Shale, gray, plastic.
207	0.5	Marlstone, gray, weathering brown.
206	80	Shale, gray.
205	0.5	Coal, black.
204	46	Shale, gray.
203	1	Coal, black.
202	10	Shale, gray. Units 202 to 206, inclusive, are poorly exposed in saddle on top of drainage divide.
201	16	Sandstone, light-gray, friable.
200	3	Shale, gray.
199	2	Sandstone, light-gray, friable.
198	25	Shale, gray, bentonitic; forms dip slope.
197	4	Sandstone, light-gray, shaly in part.
196	2.2	Coal and shale beds, detailed as follows:
		Top: Shale, tan, sericitic — 3 inches Coal — 5 inches Coal bone, weathering white — 2 inches Coal — 7 inches Shale, brown, sericitic — 2 inches Coal — 6 inches Shale, brown, carbonaceous — 2 inches
195	4.1	Sandstone, gray, interbedded with gray shale; poorly exposed; thin carbonaceous shale parting at base.
194	10	Sandstone, gray, fine-grained, friable; interbedded with gray shale; poorly exposed.
193	8	Sandstone, gray, fine-grained, thin-bedded near top; tan and shaly in lower part; 6 inches of yellow marl at top.
192	3	Shale, gray.
191	1	Shale, carbonaceous.
190	5	Sandstone, gray, fine-grained, shaly.
189	9.5	Shale, dark-gray; carbonaceous in basal 6 inches.
188	3	Sandstone, gray, fine-grained, friable.
187	7	Shale, gray, interbedded with fine-grained sandstone.
186	5	Shale, gray.
185	23	Sandstone, light-gray, fine-grained, friable; forms slope.
184	9	Shale, gray.
183	1	Coal and carbonaceous shale.
182	8	Sandstone, gray, friable, interbedded with lesser amount of gray shale.
181	3	Marlstone, yellow, forming lower part; platy limy sandstone forming upper part; weathers to lenticular ledge.
180	14	Shale, dark-gray, interbedded with lesser amount of fine-grained friable sandstone.
179	13	Sandstone, light-gray, friable; 2 inches of carbonaceous shale in middle.
178	12	Shale, gray.
177	2	Sandstone, gray, limy, thin-bedded; forms ledge.
176	1	Shale, gray.
175	3	Sandstone, light-gray, friable.
174	2	Shale, gray.
173	3.5	Coal and shale beds, detailed as follows:
		Top: Shale, carbonaceous — 4 inches Coal — 20 inches Coal bone, weathering white — 3 inches Coal — 5 inches Clay, yellow, sericitic — 4 inches Base: Coal — 6 inches

Unit No.	*Thickness (in feet)*	*Lithologic Character*
172	5	Shale, gray.
171	1	Shale, carbonaceous.
170	18	Shale, gray; tan shaly sandstone beds 12 feet and 15 feet above base.
169	1	Sandstone, gray, limy, platy.
168	3	Shale, dark-gray.
167	2	Marlstone, gray, weathering yellowish-tan, fine-grained.
166	7	Sandstone, gray to tan, fine-grained, friable; two 6-inch beds of gray shale.
165	1.5	Shale, gray.
164	6	Coal and shale beds, including coal bed that was once mined commercially in adjacent coal mine, detailed as follows:
		Top: Shale, carbonaceous — 6 inches
		Coal — 4 inches
		Siltstone, brown — 4 inches
		Coal — 12 inches
		Siltstone, brown, micaceous — 5 inches
		Coal — 20 inches
		Siltstone, brown, sericitic — 1 inch
		Base: Coal — 20 inches
163	2.5	Shale, gray.
162	3	Sandstone, gray, fine-grained, thin-bedded; forms slope.
161	0.7	Coal, impure.
160	3	Sandstone, gray, shaly.
159	1.5	Marlstone, gray, tan, and yellow; appears fairly continuous.
158	2	Shale, gray.
157	5	Sandstone, gray to tan, cross-bedded, lenticular; forms ledge.
156	9.2	Coal, sandstone, and shale beds, detailed as follows:
		Top: Coal — 6 inches
		Shale, carbonaceous — 12 inches
		Sandstone, gray — 12 inches
		Shale, gray — 18 inches
		Coal — 24 inches
		Coal bone, with plant fragments, weathers white — 2 inches
		Coal — 20 inches
		Sandstone, gray — 8 inches
		Coal — 7 inches
		Base: Shale, carbonaceous — 2 inches
155	9	Shale, gray.
154	1	Shale, black, carbonaceous, numerous coal partings.
153	6	Shale, gray, sandy.
152	1	Sandstone, gray, thin-bedded, limy; forms ledge.
151	4	Shale, gray; 6 inches of shaly sandstone in middle; brown marlstone nodules 2 feet below top.
150	1	Coal, black; 2 inches of carbonaceous shale at top and base.
149	6	Shale, gray; sparse shaly sandstone partings.
148	6	Sandstone, gray, shaly.
147	6	Shale, gray.
146	2	Marlstone, yellow; weathers gray; fine-grained.
145	9	Sandstone, gray in lower part, tan near top, medium-grained, friable; two 3-inch partings of carbonaceous shale; 3-foot ledge at top.
144	10.5	Shale, dark-gray, fissile.
143	2	Sandstone, gray, fine-grained.
142	0.5	Coal.
141	0.5	Shale, brown, sandy.
140	2	Sandstone, light-gray, fine-grained.
139	17.5	Shale, dark-gray; lower 7 feet plastic, remainder fissile; sparse thin marlstone layers.
138	1	Sandstone, gray to brown, fine-grained, shaly.
137	1	Coal and shale beds, detailed as follows:
		Top: Coal — 3 inches
		Shale, brown, carbonaceous — 2 inches
		Base: Coal — 7 inches

Unit No.	*Thickness (in feet)*	*Lithologic Character*
136	4	Shale, gray, sandy at base.
135	9	Sandstone, gray in upper half, tan and thin-bedded in lower half; fine-grained to medium-grained, friable.
134	26	Shale, gray; sparse siderite and marlstone concretions; lower 3 feet sandy; upper half is about one-third bentonitic shale.
133	6	Sandstone, gray, fine-grained, platy; forms ledge.
132	7	Shale, gray.
131	1.5	Coal, 14 inches thick; 2 inches of carbonaceous shale at top and base.
130	6	Shale, gray; 3 inches of carbonaceous shale 1 foot above base and layer of marlstone nodules in middle.
129	4	Sandstone, gray to tan, fine-grained to medium-grained; forms ledge.
128	6	Shale, gray; parting of sandy shale at top; 6 inches of carbonaceous shale 1 foot above base.
127	1.5	Sandstone, light-gray, fine-grained.
126	1	Marlstone, yellowish-brown.
125	3	Shale, gray.
124	4	Sandstone, gray, fine-grained.
123	1.8	Coal, 13 inches thick, underlain by 8 inches of brown carbonaceous shale.
122	2	Shale, gray.
121	14	Sandstone, light-gray, friable; sparse partings of shale; forms slope except for 1-foot ledge 10 feet above base.
120	1.5	Shale, carbonaceous; 6 inches of coal at top.
119	3	Sandstone, gray, friable, fine-grained.
118	0.4	Coal, 4 inches thick, underlain by 1 inch brown carbonaceous shale.
117	2	Shale, gray.
116	7	Sandstone, gray, friable, interbedded with 2-inch to 6-inch beds of bentonitic shale; sparse marlstone nodules.
115	5	Shale, gray.
114	3.2	Coal and shale beds, detailed as follows: Top: Shale, carbonaceous — 1 inch Coal — 8 inches Coal bone — 2 inches Coal — 13 inches Coal bone with plant fragments, weathers white — 2 inches Coal — 10 inches Base: Shale, carbonaceous — 2 inches
113	10	Shale, gray to brownish, sandy.
112	8	Sandstone, light-gray, fine-grained to medium-grained; at top is 1-foot brown siderite and marlstone concretion zone.
111	2	Shale, gray; sparse nodules and thin layers of brown marlstone.
110	0.5	Shale, carbonaceous.
109	0.5	Bentonite, greenish-tan.
108	2	Sandstone, gray, fine-grained, friable.
107	6	Bentonite, black to dark-gray, impure.
106	6	Sandstone, gray, friable, fine-grained, interbedded with gray bentonitic shale.
105	1.5	Marlstone, brown to yellowish-brown.
104	2.5	Bentonite, dark-gray to black, impure.
103	2	Sandstone, tan, fine-grained, friable.
102	1.2	Shale, gray.
101	1.5	Sandstone, gray, thin-bedded, fine-grained, platy; 6 inches of gray shale in middle.
100	3	Shale, gray to tan, sandy.
99	1.5	Sandstone, gray, fine-grained, thin-bedded.
98	0.5	Marlstone, brown.
97	6	Shale, dark-gray, bentonitic.
96	2.5	Sandstone, gray, fine-grained, shaly, thin-bedded; 6 inches of brown marlstone 6 inches above base.
95	4.5	Shale, gray.

Unit No.	*Thickness (in feet)*	*Lithologic Character*	
94	4.7	Coal, shale, and sandstone beds, detailed as follows:	
		Top: Shale, brown, carbonaceous	4 inches
		Coal	6 inches
		Coal bone, black, weathers white; abundant wood fragments	4 inches
		Coal, impure	2 inches
		Sandstone, gray, clayey, fine-grained	4 inches
		Coal	15 inches
		Shale, brown, carbonaceous, micaceous	2 inches
		Coal	2 inches
		Shale, brown, carbonaceous	4 inches
		Coal	9 inches
		Base: Shale, brown, carbonaceous	4 inches
93	1	Shale, gray.	
92	1	Sandstone, gray, shaly.	
91	1.8	Coal, shale, and sandstone beds, detailed as follows:	
		Top: Shale, brown	4 inches
		Coal	8 inches
		Sandstone, brown, fine-grained	4 inches
		Coal, black, shaly cleavage	4 inches
		Base: Shale, brown, carbonaceous	2 inches
90	2	Shale, gray.	
89	8	Sandstone, gray to tan, fine-grained, thin-bedded, soft; limy in part; shaly near top.	
88	2	Shale, gray.	
87	1	Marlstone, gray, weathering yellow-brown; lenticular.	
86	1	Shale, gray.	
85	3	Coal, shale, and sandstone beds, detailed as follows:	
		Top: Shale, brown, carbonaceous	12 inches
		Sandstone, gray, fine-grained	4 inches
		Coal	10 inches
		Coal bone	2 inches
		Coal	6 inches
		Base: Shale, carbonaceous	2 inches
84	7	Shale, gray; contains sporadic nodules of brown marlstone.	
83	1	Shale, brown, carbonaceous.	
82	15	Sandstone, gray, fine-grained, thin-bedded, platy.	
81	2	Shale, carbonaceous.	
80	15	Shale, gray to brown; 2-inch bed of brown marlstone nodules 6 feet above base.	
79	8.1	Coal and shale beds, detailed as follows:	
		Top: Shale, carbonaceous; laminae of coal	18 inches
		Coal	30 inches
		Shale, carbonaceous	1 inch
		Coal	18 inches
		Shale, brown, carbonaceous	3 inches
		Claystone, gray, sandy	16 inches
		Base: Coal	12 inches
	915.5	Total thickness of coaly sequence.	

Contact between coaly sequence and Bacon Ridge sandstone arbitrarily placed at this point. Offset 0.4 mile west on base of coal, to north side of ravine.

Bacon Ridge sandstone

78	29	Sandstone, gray, medium-grained to fine-grained, massive; abundant dark grains; two 1-foot ledges in upper part; remainder friable and forms slope.
77	1.5	Shale, brown, carbonaceous.
76	4	Sandstone, gray, friable.
75	3.5	Shale, gray, fissile; 6 inches black carbonaceous shale 1 foot below top; 3 inches brown carbonaceous shale at base.
74	7	Shale, gray, bentonitic; 2 inches of bentonite at top.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
73	37	Sandstone, gray, weathering brown in part, fine-grained to medium-grained, soft, porous, massive; numerous dark grains; locally forms cliffs; 0.4 mile east there is 3.5 feet of fine-grained, lead-gray shale 9 feet below top.
72	1	Coal, 6 inches thick, underlain by 6 inches carbonaceous shale.
71	6.5	Shale, gray, blocky in part; abundant, poorly preserved plant fragments.
70	5	Bentonite, gray, interbedded with fine-grained tuffaceous thin-bedded sandstone; about 1 foot below top is a two-inch layer containing small, thin-shelled pelecypods and high-spired gastropods, excellently preserved but very fragile. This thin zone was followed for a distance of four miles to the southeast. It is probable that this zone and associated bentonitic beds may constitute an excellent marker zone. This is the highest stratigraphic occurrence of marine fossils discovered in this section.
69	7	Shale, dove-gray, bentonitic.
68	11	Sandstone, gray, fine-grained to medium-grained, massive.
67	0.9	Coal and carbonaceous shale.
66	3	Sandstone, gray, clayey and bentonitic.
65	5.7	Coal and shale beds, detailed as follows:

Top:	Coal	4 inches
	Shale, carbonaceous	4 inches
	Coal bone	6 inches
	Coal	32 inches
	Coal, interbedded with coal bone	8 inches
	Coal	10 inches
Base:	Shale, carbonaceous	4 inches

64	5	Sandstone, gray, fine-grained, thin-bedded.
63	1	Shale, brown, carbonaceous.
62	2.2	Coal, 22 inches thick, underlain by 4 inches of carbonaceous shale.
61	1	Sandstone, gray, friable.
60	3	Shale, gray, bentonitic.
59	5	Shale, dark-brown, silty, carbonaceous.
58	7	Sandstone, light-tan, fine-grained, friable.
57	8	Shale, dark-brown, silty, carbonaceous; weathers to brown slope.
56	5	Sandstone, gray, medium-grained; thin-bedded ledge at base; ocher-yellow layer at top.
55	20	Sandstone, gray, massive, friable; forms slope; 0.1 mile east are gastropods and pelecypods, including oysters.
Offset 0.1 mile east.		
54	38	Sandstone, gray, massive; forms cliff; cannonball concretions as much as 3 feet across; numerous dark grains.
53	15	Sandstone, gray, massive, friable, medium-grained; ledge 2 feet thick near middle.
52	2.2	Shale, dark-gray; carbonaceous and interlaminated with coal in lower half.
51	9	Sandstone, gray, fine-grained, thin-bedded.
50	10	Shale, gray.
49	5	Shale, brown, with 2 feet of gray shale in middle.
48	1	Claystone, yellowish-gray, bentonitic.
47	0.8	Coal.
46	6	Shale, brown; carbonaceous near top; sandy near base.
45	1	Sandstone, gray, fine-grained, thin-bedded.
44	1	Shale, gray.
Offset 0.25 mile southeast to top of ridge.		
43	1.5	Sandstone, brown, very limy, hard; forms ragged ledge at top of spur; contains abundant well-preserved gastropods and pelecypods.
42	8	Sandstone, gray, massive, very soft; numerous dark grains; forms slope.
41	24	Shale, dark-gray, soft, fine-grained, fissile; 1 foot of gray slabby sandstone 4 feet above base; shale is very fossiliferous, with small pelecypods and gastropods between 10 and 15 feet above base; giant oysters as much as 1 foot long and 1½ inches thick 15 feet above base; chiefly concentrated in a 1-foot zone; mollusk coquina 5 feet below top.
40	1.7	Sandstone, gray, thin-bedded, fine-grained, hard; forms ledge.
39	6.6	Shale, dark-gray, fissile, moderately fine-grained; some sandy zones in upper part.
38	0.5	Coal, black, impure, soft, sandy.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
37	16	Sandstone, gray in lower part; becomes progressively rusty and then carbonaceous and brown near top; very soft, porous; numerous dark grains; forms slope.
36	47	Sandstone, light-gray, chiefly massive; a few rough bedding planes; cross-bedded in part; medium-grained to coarse-grained, soft, porous; forms uppermost conspicuous white cliff on hill; abundant dark grains; sparse green and red grains but not bright-colored; numerous oyster and petrified wood fragments.
35	7	Sandstone, dark-gray, weathering brown, fine-grained, petroliferous in part, cross-bedded, limy; numerous dark grains; top 2 feet forms hard smooth conspicuous brown ledge which weathers bluish and contains abundant gastropods, pelecypods, and sparse ammonites.
34	10	Sandstone, gray, soft; lower 1 foot hard, fine-grained, slabby, slightly cross-bedded, and forms ledge; upper part softer and forms slope.
33	1.2	Shale, gray, fine-grained, fissile, flaky, soft.
32	4	Sandstone, gray, fine-grained to medium-grained, very soft; numerous dark grains.
31	1.5	Sandstone, gray, weathering brown, hard, limy, fine-grained; numerous dark grains; at base are abundant well-preserved pelecypods, including oysters as much as 6 inches long and ½-inch thick, and gastropods.
30	5.6	Sandstone, gray, very soft, porous, medium-grained, massive to poorly bedded.
29	1.7	Shale, brown, carbonaceous, silty and sandy; 4 inches of black, soft, crumbly coal in middle.
28	1.5	Sandstone, gray, fine-grained, cross-bedded; forms ledge.
27	12	Shale, dark-gray to nearly black, very fine-grained, fissile, soft; sparse olive silty layers near top and base; poorly preserved fossils near base.
26	3	Sandstone, brown, silty and shaly; softer than underlying sandstone; very limy; numerous dark grains; abundant poorly preserved pelecypods.
25	5	Sandstone, gray; numerous dark grains; forms weak cross-bedded ledge; limy, medium-grained; abundant large and small pelecypods.
24	28	Shale and siltstone, dark-gray, sandy, soft, poorly bedded in part; fissile in part; highly fossiliferous in upper 10 feet.
23	15	Sandstone, dull yellowish-gray to gray, fine-grained to medium-grained, silty and shaly, very soft; forms slope; numerous poorly preserved pelecypods in cross-bedded soft sandstone 4 feet below top; grades up into overlying unit.
22	35	Sandstone, gray, porous, clean; lower 18 feet is hard and forms the middle ragged prominent cliff on spur; numerous dark grains; numerous large *Inoceramus* shell fragments and oysters; upper half softer and forms slope broken by discontinuous ledges; 1-inch to 4-inch coal layers in upper 3 feet; top 1 foot of sandstone contains poorly preserved leaves.
21	35	Sandstone, gray, very soft, medium-grained, porous; numerous dark grains; forms gray slope; a dark-gray shale 1 foot thick 15 feet above base; a thinner similar shale parting 26 feet above base.
20	7	Shale, dark-gray, silty, soft. Channel sample taken for microfossil study.
19	8	Sandstone, dark-gray, very soft, porous; abundant black grains; lower part forms slope; top 2 feet hard, limy, thin-bedded, slabby, rusty, and forms conspicuous brown discontinuous ledge; abundant but unevenly distributed fauna of large and small gastropods, pelecypods, and sparse ammonites.
18	2.5	Sandstone, brownish-gray; upper part has contorted solifluction-type of bedding; top 1 foot of sandstone forms a brown ledge; lower part soft; abundant fauna of gastropods and pelecypods.
17	1.2	Sandstone, gray, weathering buff, hard, fine-grained to medium-grained; forms lowest conspicuous brown ledge above gray slope; numerous poorly preserved gastropods and pelecypods.
16	7	Sandstone, dark-gray because of abundance of dark grains, very soft, medium-grained, moderately clean.
15	7	Shale, and claystone, drab, very sandy, very soft; lenses of sandstone.
14	2	Sandstone, dark greenish-gray, fine-grained to medium-grained, soft, clayey; numerous dark grains.
13	14	Shale and claystone, dark olive-gray, soft, silty and sandy.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
12	11	Sandstone, dark-gray to olive-gray, soft, clayey and silty; two 3-inch carbonaceous shale layers, one about 1 foot above the base and the other 6 feet above the base.
11	16	Sandstone, bluish-gray, very soft, clean; abundant dark grains; 2 feet of thin-bedded, slabby, hard sandstone forming rusty ledge at top; poorly exposed in part.
10	1	Sandstone, gray, weathering brown, medium-grained, angular; abundant dark grains; forms weak ragged ledge.
9	25	Sandstone, light bluish-gray; numerous dark grains; remarkably clean, soft, porous; forms slopes that look like gray shale slopes.

Top of pearl-gray marker zone. This zone can be recognized as a precise stratigraphic marker throughout the region.

8	2	Coal, black, soft, impure, weathering to finely divided fragments; clayey in lower 6 inches.
7	7	Bentonite and bentonitic claystone, pearl-gray to rusty-yellow, soft, plastic, swelling, impure, sandy; top poorly exposed.
6	1.5	Coal and coaly shale, black, shiny to dull; slacks to small particles; some fragments and stumps of petrified wood that weather bluish white.
	10.5	Total thickness of pearl-gray marker zone.

Base of pearl-gray marker zone.

5	10	Sandstone, gray; forms ledge; top is marked by a sharp rough surface above which is an abrupt change in lithology.
4	26	Sandstone, gray, massive to thick-bedded, medium-grained, moderately soft and porous; abundant dark grains; some green and sparse red grains but not the bright-colored type; forms prominent rounded cliff; 1 foot below the top the sandstone is dark olive brown, medium-grained, angular, porous, massive; top 1 foot is gray, hard, slabby sandstone forming a ledge; numerous large oyster shells, large *Inoceramus* shells, other pelecypods, and gastropods.
3	2	Sandstone, brownish-gray, medium-grained, limy, moderately hard; forms ledge; thin irregular bedding; abundant gastropods and pelecypods and sparse ammonites.
2	20	Sandstone, gray, weathering slightly rusty, medium-grained, soft, porous, angular; numerous dark grains; massive to poorly bedded; forms lowest conspicuous cliff just above Dry Cottonwood Creek; numerous *Inoceramus* and other pelecypod fragments.
1	5	Sandstone, bluish-gray, fine-grained to medium-grained, angular, soft, poorly bedded; numerous poorly preserved fossil fragments; numerous black grains.
	714.3	Total measured part of Bacon Ridge sandstone.

Base of exposures and base of measured section.

FISH CREEK SECTION

This is a composite section consisting of a major section measured on the northwest side of the north fork of Fish Creek, supplemented by an additional section between the forks of Fish Creek, and another section between the south fork of Fish Creek and Trail Creek. The rocks are exposed on the crest and northeast flank of the Bacon Ridge anticline, and dips range from nearly horizontal to 60°. No faulting of consequence was found. There are many covered intervals so supplementary sections were measured wherever possible to fill in the missing parts. Units are numbered consecutively from oldest to youngest.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
Pinyon formation (Paleocene)		
293	200	Conglomerate, brown; roundstones of quartzite and volcanic rocks; abundant conspicuous percussion marks; highly rounded rock fragments; maximum size 1 foot in diameter; average size 2 inches to 3 inches; many roundstones are so smooth they have a slight sheen; brown, coarse-grained sandstone matrix; many roundstones are sheared and crushed and all are very brittle; no locally derived Paleozoic or Mesozoic rock fragments observed; sparse, thin, lenticular brown sandstone beds. No evidence was found here of the coal member of the Pinyon formation measured in the Dry Cottonwood Creek section.
292	37	Gravel debris. This may all be conglomerate of the Pinyon formation, or the contact between the conglomerate and the underlying Upper Cretaceous rocks may be concealed within the interval. There are no exposures that will indicate exactly where the contact is.
	237	Total measured part of Pinyon formation.

Approximate contact between the Pinyon formation and the conglomeratic sandstone sequence. This contact is the boundary between Paleocene rocks and an Upper Cretaceous sequence that has not been satisfactorily correlated with better known sections in adjacent areas. This section shows the thickest development of the conglomeratic sandstone sequence in the area. Although the actual contact is covered and there are no good bedding planes in the lower part of the Pinyon, on which dips can be obtained, the areal distribution of the conglomeratic sandstone sequence and the Pinyon indicate that a major angular unconformity exists between them.

Conglomeratic sandstone sequence (Upper Cretaceous)		
291	28	Sandstone, gray, fine-grained, friable, poorly exposed.
290	2	Sandstone, gray, fine-grained, thin-bedded; weathers to a platy ledge.
289	16	Sandstone, tan, fine-grained, friable; bright-colored grains.
288	2	Conglomeratic sandstone, brown, limy; roundstones are as much as 1 inch in diameter and consist of Paleozoic and Mesozoic sandstone, Paleozoic chert, hard shale; sporadic elongated angular sand grains; carbonized plant fragments; numerous vari-colored grains.
287	64	Sandstone, tan, shaly; interbedded with minor amount of gray shale.
286	72	Sandstone, gray, fine-grained, friable; poorly exposed.
285	50	Shale, dark-gray; plastic at base; fissile near top.
284	24	Sandstone, gray, friable, fine-grained; bright-colored grains; poorly exposed.
283	4	Shale, gray, sandy.
282	10	Sandstone, gray, friable.
281	10	Shale, gray, sandy; sulfur spring issues from this bed where section was measured.
280	60	Covered interval.
Offset 0.25 mile to the northwest, to crest of ridge.		
279	20–6	Conglomerate and conglomeratic sandstone, brown, lenticular; roundstones range from ¾-inch to 3 inches and average 1 inch in diameter, are well-rounded to subangular and consist of Paleozoic and Mesozoic sandstone, chert, sparse granite, and abundant petrified wood fragments, some resembling *Tempskya* which occurs in the Aspen-Frontier section to the west

Unit No.	*Thickness (in feet)*	*Lithologic Character*
278	22	Sandstone, tan, fine-grained, friable; 6 inches of pebble conglomerate 6 feet below top.
277	10	Shale, dark-gray; some carbonaceous partings.
276	1	Sandstone, gray, weathering brown, fine-grained, lenticular; thickens laterally to 4 feet; some cone-in-cone structure.
275	14	Covered interval; probably shaly sandstone.
274	1	Sandstone, gray, limy, fine-grained.
273	92	Covered interval; probably sandy shale.
272	34	Covered interval; laterally this unit is gray and tan sandy shale.
271	18	Sandstone, gray to tan, medium-grained, massive; sand grains rounded to subangular, bright-colored grains; forms slope.
270	81	Covered interval; probably shaly sandstone or sandy shale.
269	11	Sandstone, gray; top beds form thin ledge.
268	37	Sandstone, gray, medium-grained to coarse-grained; soft and very porous; scattered thin lenses of pebble conglomerate in which the roundstones are ¼-inch to 1 inch in diameter and consist chiefly of dark-gray to light-gray sandstone and chert; sand grains subangular to rounded; abundant red, orange, and green grains; top 6 feet of sandstone is stained red; unit forms conspicuous cliff.
267	95	Sandstone, gray to tan, friable, soft, very porous; forms slope.
266	6	Sandstone, gray, hard; forms ledge.
265	15	Sandstone, yellowish brown, medium-grained; forms ledge.
264	25	Sandstone, gray, massive, porous, medium-grained; scattered lenses of pebble conglomerate in which roundstones consist chiefly of Paleozoic and Mesozoic sandstone and chert, in lower part; 3 feet of clay pellet conglomerate near top; sand grains rounded to subangular; pink and orange grains very abundant; unit forms cliff.
263	35	Sandstone, light-gray, medium-grained, massive; 6-inch beds of brown, thin-bedded, fine-grained sandstone at base and in middle; siderite concretions at top; forms slope.
262	10	Sandstone, rusty-brown, medium-grained; contains sporadic iron-stained concretions; sand grains chiefly black and gray; unit forms cliff.
	869	Total thickness of conglomeratic sandstone sequence.

Contact between conglomeratic sandstone sequence and white sandstone sequence arbitrarily placed at this horizon. The sandstones below this horizon are not conglomeratic. The white sandstone sequence is 779 feet thicker in the Fish Creek section than in the Dry Cottonwood Creek section, suggesting that a major unconformity is present within the Cretaceous at the base of the conglomeratic sandstone sequence.

White sandstone sequence

261	13	Sandstone, tan, friable, interbedded with gray shale in beds about 2 feet thick.
260	40	Sandstone, tan, shaly, friable.
259	16	Shale, gray.
258	14	Sandstone, tan, friable.
257	23	Shale, gray; siderite concretions abundant 3 feet above base.
256	34	Sandstone, tan to cream-colored, friable; shaly in part.
255	21	Shale, gray, sandy in part; sporadic siderite concretions 7 feet above base.
254	14	Sandstone, brown, massive.
253	69	Covered interval; laterally this unit is a friable gray sandstone with thin-bedded ledge 10 feet above base.
252	80	Covered interval; probably friable sandstone with minor amount of shale.
251	16	Sandstone, tan to gray, massive; top 2 feet of sandstone forms ledge.
250	20	Shale, gray.
249	1	Bentonite, tan to gray.
248	2	Shale, tan, bentonitic.
247	26	Shale, gray.
246	125	Sandstone, gray; sparse ironstone concretions.
245	8	Shale, gray; 6 inches of brown shale near top.
244	167	Sandstone, gray, friable; sparse ledges weather out on a gray slope; sparse thin shale beds.
243	3	Sandstone, tan, friable.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
242	4.5	Coal and shale beds, detailed as follows: Top: Coal, sooty — 18 inches Shale, gray — 24 inches Base: Coal, sooty — 12 inches
241	10	Shale, gray, sandy at base.
240	4	Shale, tan, weathering light yellowish brown, sandy.
239	113	Sandstone, gray, massive, medium-grained.
238	15	Sandstone, gray; sparse thin shale beds; poorly exposed.
237	2	Shale, gray.
236	33	Sandstone gray to tan friable; 1-foot ledge at base.
235	23	Shale, gray, smooth, fine-grained; sparse thin beds of brown marlstone.
234	52	Sandstone, light-gray to white, massive, friable; numerous dark grains, some are red, but most are white or gray and rounded.
233	26	Sandstone, white, friable, soft, poorly exposed.
232	8	Sandy soil, white; probably underlain by soft white sandstone.
	982.5	Total thickness of white sandstone sequence.

Approximate contact between white sandstone sequence and lenticular sandstone and shale sequence. The actual contact between these two sequences is not exposed. Below this horizon the sandstones are thinner, more lenticular, not as abundant, and tend to be tan to brown in color.

Lenticular sandstone and shale sequence

231	269	Covered interval.
230	108	Shale, gray, interbedded with tan shaly sandstone; thin bed of limy sandstone and marlstone 90 feet above base; float of marlstone near this bed contains sparse dicotyledonous leaf fragments.
229	3	Sandstone, gray, weathering brown, thin-bedded.
228	52	Shale, gray, interbedded with tan shaly sandstone.
227	2	Sandstone, brown; forms ledge.
226	30	Shale, gray, interbedded with tan shaly sandstone.
225	20	Sandstone, gray, massive; some thin-bedded layers that weather brown.
224	204	Covered interval.
223	13	Shale, gray to tan, silty to fine-grained and smooth; sporadic indurated layers.
222	1	Sandstone, tan, fine-grained, thin-bedded; shaly along strike; outcrops as a tan band on hillside.
221	14	Shale, gray to tan, fine-grained in part; silty in part; some indurated layers.
220	2	Sandstone, tan, fine-grained, lenticular; forms ledge.
219	12	Shale, gray to tan, fine-grained in part; silty in part; sporadic indurated layers.
218	3	Sandstone, gray to tan, fine-grained, lenticular; forms ledge; sparse leaf imprints identified as *Anemia perplexa* Hollick.
217	26	Shale, gray to tan, fine-grained in part; silty in part; scattered indurated layers; carbonaceous shale 14.4 feet above base, overlain by 4 inches of coal, which is overlain by a thin buff siltstone.
216	162	Covered interval.
215	3	Sandstone, gray to tan, fine-grained, thin-bedded, cross-bedded in part; forms ledge.
214	71	Covered interval.
213	26	Sandstone, gray to tan, fine-grained, thin-bedded to massive.
212	31	Shale, gray to tan, fine-grained in part; sandy in part; occasional thin layers of siltstone and fine-grained sandstone; 6 inches of carbonaceous shale 21 feet above base; sparse carbonized plant fragments.
211	5	Sandstone, gray, fine-grained, lenticular; massive in lower part; cross-bedded in upper part; sporadic clay pebbles in lower 2 feet; sparse poorly preserved leaf fragments.
210	42	Shale, gray to tan, fine-grained to sandy; thin, fine-grained, gray sandstone layers interbedded with shale; limonite nodules 33 feet above base.
209	2	Sandstone, gray, fine-grained; massive to thin-bedded.
208	69	Covered interval.
207	3	Sandstone, gray, fine-grained, massive to cross-bedded.
206	257	Covered interval in valley.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
143	2	Shale, gray.
142	2	Sandstone, gray, interbedded with gray shale.
141	11	Sandstone, gray, fine-grained, friable; 1 foot of brown limy sandstone in middle.
140	4	Shale, gray.
139	1.1	Coal and shale beds, detailed as follows: Top: Coal — 3 inches Shale, carbonaceous — 4 inches Base: Coal — 6 inches
138	1	Shale, brown, carbonaceous; laminae of coal.
137	1	Shale, gray.
136	1	Sandstone, gray, fine-grained.
135	1	Coal, inpure.
134	1	Sandstone, gray, shaly.
133	3	Shale, gray.
132	1	Sandstone, gray, fine-grained, platy.
131	5	Shale, gray, sandy.
130	5.8	Coal and shale beds, detailed as follows: Top: Shale, brown — 2 inches Coal — 6 inches Shale, carbonaceous, and coal bone — 14 inches Coal — 45 inches Base: Shale, brown — 2 inches
129	4	Shale, gray.
128	6	Sandstone, gray, fine-grained to medium-grained; ledge 2 feet thick at base.
127	2	Shale, gray; 2 inches of brown marlstone at top.
126	3	Sandstone, gray, friable.
125	9	Shale, gray; partings of sandy shale; sparse pelecypods.
124	4	Shale, brown to black, carbonaceous.
123	3	Sandstone, gray, friable; sparse shale partings.
122	12	Shale, dark-gray.
121	2	Shale, black to brown, carbonaceous; partings of coal.
120	5	Shale, gray.
119	1	Marlstone, brown.
118	3	Shale, gray.
117	1.8	Coal and shale beds, detailed as follows: Top: Coal — 16 inches Base: Shale, brown, carbonaceous — 6 inches
116	8	Sandstone, gray, fine-grained, interbedded with gray shale.
115	6	Sandstone, light-gray, friable.
114	6	Shale, gray; 6 inches of carbonaceous shale at top.
113	8	Sandstone, gray and tan, massive; locally forms cliff.
112	2	Shale, gray.
111	2.5	Coal and shale beds, detailed as follows: Top: Shale, brown — 3 inches Coal, with partings of carbonaceous shale — 21 inches Base: Shale, carbonaceous — 6 inches
110	3	Shale, gray, interbedded with sandstone.
109	15	Sandstone, gray, massive; locally forms cliff.
108	4	Shale, gray.
107	1	Shale, brown; abundant carbonized plant fragments and poorly preserved pelecypods.
106	5	Shale, gray.
105	4	Sandstone, tan, thin-bedded, limy; forms ledge.
104	3	Marlstone, tan, hard.
103	12	Shale, gray, interbedded with tan shaly sandstone.
102	4	Sandstone, gray, limy; forms ledge.
101	2	Shale, gray to tan.
100	1	Shale, carbonaceous; partings of coal.
99	4	Sandstone, tan, shaly; 6 inches of gray shale at base.
98	2.5	Coal and shale beds, detailed as follows: Top: Shale, brown, carbonaceous — 3 inches Base: Coal — 27 inches

Unit No.	*Thickness (in feet)*	*Lithologic Character*
242	4.5	Coal and shale beds, detailed as follows: Top: Coal, sooty — 18 inches Shale, gray — 24 inches Base: Coal, sooty — 12 inches
241	10	Shale, gray, sandy at base.
240	4	Shale, tan, weathering light yellowish brown, sandy.
239	113	Sandstone, gray, massive, medium-grained.
238	15	Sandstone, gray; sparse thin shale beds; poorly exposed.
237	2	Shale, gray.
236	33	Sandstone gray to tan friable; 1-foot ledge at base.
235	23	Shale, gray, smooth, fine-grained; sparse thin beds of brown marlstone.
234	52	Sandstone, light-gray to white, massive, friable; numerous dark grains, some are red, but most are white or gray and rounded.
233	26	Sandstone, white, friable, soft, poorly exposed.
232	8	Sandy soil, white; probably underlain by soft white sandstone.
	982.5	Total thickness of white sandstone sequence.

Approximate contact between white sandstone sequence and lenticular sandstone and shale sequence. The actual contact between these two sequences is not exposed. Below this horizon the sandstones are thinner, more lenticular, not as abundant, and tend to be tan to brown in color.

Lenticular sandstone and shale sequence

231	269	Covered interval.
230	108	Shale, gray, interbedded with tan shaly sandstone; thin bed of limy sandstone and marlstone 90 feet above base; float of marlstone near this bed contains sparse dicotyledonous leaf fragments.
229	3	Sandstone, gray, weathering brown, thin-bedded.
228	52	Shale, gray, interbedded with tan shaly sandstone.
227	2	Sandstone, brown; forms ledge.
226	30	Shale, gray, interbedded with tan shaly sandstone.
225	20	Sandstone, gray, massive; some thin-bedded layers that weather brown.
224	204	Covered interval.
223	13	Shale, gray to tan, silty to fine-grained and smooth; sporadic indurated layers.
222	1	Sandstone, tan, fine-grained, thin-bedded; shaly along strike; outcrops as a tan band on hillside.
221	14	Shale, gray to tan, fine-grained in part; silty in part; some indurated layers.
220	2	Sandstone, tan, fine-grained, lenticular; forms ledge.
219	12	Shale, gray to tan, fine-grained in part; silty in part; sporadic indurated layers.
218	3	Sandstone, gray to tan, fine-grained, lenticular; forms ledge; sparse leaf imprints identified as *Anemia perplexa* Hollick.
217	26	Shale, gray to tan, fine-grained in part; silty in part; scattered indurated layers; carbonaceous shale 14.4 feet above base, overlain by 4 inches of coal, which is overlain by a thin buff siltstone.
216	162	Covered interval.
215	3	Sandstone, gray to tan, fine-grained, thin-bedded, cross-bedded in part; forms ledge.
214	71	Covered interval.
213	26	Sandstone, gray to tan, fine-grained, thin-bedded to massive.
212	31	Shale, gray to tan, fine-grained in part; sandy in part; occasional thin layers of siltstone and fine-grained sandstone; 6 inches of carbonaceous shale 21 feet above base; sparse carbonized plant fragments.
211	5	Sandstone, gray, fine-grained, lenticular; massive in lower part; cross-bedded in upper part; sporadic clay pebbles in lower 2 feet; sparse poorly preserved leaf fragments.
210	42	Shale, gray to tan, fine-grained to sandy; thin, fine-grained, gray sandstone layers interbedded with shale; limonite nodules 33 feet above base.
209	2	Sandstone, gray, fine-grained; massive to thin-bedded.
208	69	Covered interval.
207	3	Sandstone, gray, fine-grained, massive to cross-bedded.
206	257	Covered interval in valley.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
205	5	Sandstone, gray to tan, fine-grained, soft, friable; some carbonaceous partings.
204	2	Shale, gray to tan, smooth and fine-grained in part; silty in part.
203	1	Sandstone, gray, weathering tan, fine-grained, thin-bedded and cross-bedded in part.
202	90	Shale, gray to tan, sandy in part; thin layers of carbonaceous shale 40.5 feet and 60 feet above base.
201	249	Covered interval.
200	23	Shale, gray to tan, sandy in part; interbedded with thin layers of fine-grained, gray sandstone.
199	3	Sandstone, gray, fine-grained, thin-bedded.
198	24	Shale, gray; fine-grained, sandy in part.
197	2	Sandstone, gray, fine-grained, cross-bedded; limy pebbles in lower 8 inches. This bed is believed to correlate with the top sandstone of unit 2 in the supplementary section half a mile to the southeast.
196	65	Shale, gray to tan, sandy in part; interbedded with thin layers of fine-grained gray sandstone.
195	6	Sandstone, gray, fine-grained, thin-bedded; numerous black grains.
194	9	Shale, gray to tan, smooth and fine-grained in part; sandy in part.
193	249	Covered interval.
192	18	Sandstone, tan, friable.
191	230	Shale, gray, interbedded with fine-grained sandstone beds forming ledges; 2 feet of sandstone 18 feet above base; 3 feet of sandstone 30 feet above base; 2 feet of sandstone 95 feet above base; 3 feet of sandstone 112 feet above base; 1 foot of brown marlstone 150 feet above base.
190	9–2	Sandstone, gray, massive, fine-grained to medium-grained, lenticular; forms cliff.
	2415	Total thickness of lenticular sandstone and shale sequence.

Contact between lenticular sandstone and shale sequence and coaly sequence placed arbitrarily at this point. The underlying rocks are softer and contain few conspicuous sandstones.

Coaly sequence

189	21	Shale, gray.
188	2	Sandstone, gray, fine-grained, thin-bedded, platy.
187	14	Shale, gray; sparse thin marlstone beds in upper part weathering ocher.
186	2	Sandstone, gray, fine-grained, platy, thin-bedded; forms ledge.
185	15	Shale, gray, fissile.
184	5	Sandstone, gray, fine-grained; ledge 2 feet thick at top.
183	31	Shale, gray; sparse thin beds of light-gray sandy shale and fine-grained sandstone.
182	4	Shale, gray, weathering dark gray, bentonitic; has flowed down hillside, covering the upper 10 feet of the underlying unit; forms conspicuous dark-gray band on outcrop.
181	75	Shale, dark-gray, in layers 2 feet to 6 feet thick, interbedded with light-gray sandy shale; sparse thin platy sandstone beds; 1 foot of carbonaceous shale 55 feet above base; 1 foot sandstone 64 feet above base.
180	35	Shale, gray, sandy.
179	14	Shale, gray, bentonitic; weathers to form a conspicuous outcrop.
178	1	Shale, gray to brown; carbonized plant fragments.
177	1.5	Coal and shale beds, detailed as follows:
		Top: Shale, brown, limy — 5 inches
		Coal, black — 11 inches
		Base: Shale, brown, carbonaceous — 2 inches
176	24	Shale, gray, sandy in part.
175	1	Sandstone, gray, thin-bedded, platy; forms ledge.
174	94	Shale, gray; sparse thin beds of sandy shale near top; 1 foot of ocher-colored marlstone 20 feet above base.
173	4	Sandstone, gray, fine-grained, platy.
172	9	Shale, gray.
171	1	Coal and shale beds, detailed as follows:
		Top: Shale, carbonaceous — 3 inches
		Coal — 6 inches
		Base: Shale, carbonaceous — 3 inches

Unit No.	*Thickness (in feet)*	*Lithologic Character*
170	4	Sandstone, gray, shaly; 1 foot of gray shale at top.
169	2	Shale, gray.
168	2.5	Coal and shale beds, detailed as follows:
		Top: Shale, brown — 3 inches
		Coal — 10 inches
		Shale, gray — 3 inches
		Base: Coal — 14 inches
167	34	Shale, gray; sparse thin layers of sandy shale; sporadic siderite nodules.
166	2	Sandstone, gray, shaly, interbedded with about an equal amount of ocher marlstone.
165	4	Shale, gray; sparse layers of sandstone.
164	5	Sandstone, light-gray, shaly.
163	3.8	Coal and shale beds, detailed as follows:
		Top: Coal — 6 inches
		Siltstone — 1 inch
		Coal — 11 inches
		Shale, gray — 4 inches
		Coal — 4 inches
		Siltstone, brown — 2 inches
		Base: Coal, with ¼-inch sandstone parting in middle — 17 inches
162	10	Shale, gray, sandy in part; sparse siderite nodules and concretionary masses as much as 2 feet in diameter in middle.
161	1.3	Coal, sandstone, and shale beds, detailed as follows:
		Top: Shale, carbonaceous — 2 inches
		Coal — 3 inches
		Sandstone, brown — 1 inch
		Base: Coal — 10 inches
160	6	Sandstone, gray, weathering tan, shaly; sparse nodules of siderite, constituting the lowest occurrence of siderite observed in this section; petrified log present.
159	3	Shale, gray, bentonite; partings of carbonaceous shale.
158	14	Sandstone, gray, fine-grained, friable.
157	1	Shale, carbonaceous.
156	14	Shale, gray; 6 inches of marlstone near top.
155	7	Sandstone, tan, soft, shaly; 6 inches of thin-bedded hard sandstone in middle.
154	1	Marlstone, yellow, weathering brown.
153	5	Shale, gray.
152	3	Coal and shale beds, detailed as follows:
		Top: Shale, carbonaceous — 3 inches
		Coal — 7 inches
		Coal bone — 8 inches
		Coal — 8 inches
		Base: Shale, carbonaceous — 10 inches
151	23	Shale, gray, in beds about 4 feet thick alternating with tan sandy shales; sparse thin beds of sandstone and marlstone.
150	1	Shale, black, carbonaceous, and coal.
149	39	Shale, gray; sparse thin beds of brown marlstone and tan friable sandstone.
148	1	Sandstone, gray, fine-grained, thin-bedded, platy.
147	3	Shale, gray, interbedded with about an equal amount of brown marlstone.
146	1	Sandstone, gray, weathering brown, fine-grained, platy.
145	3	Shale, gray; sparse thin beds of brown marlstone.
144	6.7	Coal and shale beds, detailed as follows:
		Top: Shale, brown — 2 inches
		Coal — 8 inches
		Shale, carbonaceous — 17 inches
		Coal — 10 inches
		Shale, carbonaceous — 9 inches
		Coal — 12 inches
		Shale, brown, micaceous — 1 inch
		Base: Coal — 21 inches

Unit No.	*Thickness (in feet)*	*Lithologic Character*
143	2	Shale, gray.
142	2	Sandstone, gray, interbedded with gray shale.
141	11	Sandstone, gray, fine-grained, friable; 1 foot of brown limy sandstone in middle.
140	4	Shale, gray.
139	1.1	Coal and shale beds, detailed as follows:
		Top: Coal — 3 inches
		Shale, carbonaceous — 4 inches
		Base: Coal — 6 inches
138	1	Shale, brown, carbonaceous; laminae of coal.
137	1	Shale, gray.
136	1	Sandstone, gray, fine-grained.
135	1	Coal, inpure.
134	1	Sandstone, gray, shaly.
133	3	Shale, gray.
132	1	Sandstone, gray, fine-grained, platy.
131	5	Shale, gray, sandy.
130	5.8	Coal and shale beds, detailed as follows:
		Top: Shale, brown — 2 inches
		Coal — 6 inches
		Shale, carbonaceous, and coal bone — 14 inches
		Coal — 45 inches
		Base: Shale, brown — 2 inches
129	4	Shale, gray.
128	6	Sandstone, gray, fine-grained to medium-grained; ledge 2 feet thick at base.
127	2	Shale, gray; 2 inches of brown marlstone at top.
126	3	Sandstone, gray, friable.
125	9	Shale, gray; partings of sandy shale; sparse pelecypods.
124	4	Shale, brown to black, carbonaceous.
123	3	Sandstone, gray, friable; sparse shale partings.
122	12	Shale, dark-gray.
121	2	Shale, black to brown, carbonaceous; partings of coal.
120	5	Shale, gray.
119	1	Marlstone, brown.
118	3	Shale, gray.
117	1.8	Coal and shale beds, detailed as follows:
		Top: Coal — 16 inches
		Base: Shale, brown, carbonaceous — 6 inches
116	8	Sandstone, gray, fine-grained, interbedded with gray shale.
115	6	Sandstone, light-gray, friable.
114	6	Shale, gray; 6 inches of carbonaceous shale at top.
113	8	Sandstone, gray and tan, massive; locally forms cliff.
112	2	Shale, gray.
111	2.5	Coal and shale beds, detailed as follows:
		Top: Shale, brown — 3 inches
		Coal, with partings of carbonaceous shale — 21 inches
		Base: Shale, carbonaceous — 6 inches
110	3	Shale, gray, interbedded with sandstone.
109	15	Sandstone, gray, massive; locally forms cliff.
108	4	Shale, gray.
107	1	Shale, brown; abundant carbonized plant fragments and poorly preserved pelecypods.
106	5	Shale, gray.
105	4	Sandstone, tan, thin-bedded, limy; forms ledge.
104	3	Marlstone, tan, hard.
103	12	Shale, gray, interbedded with tan shaly sandstone.
102	4	Sandstone, gray, limy; forms ledge.
101	2	Shale, gray to tan.
100	1	Shale, carbonaceous; partings of coal.
99	4	Sandstone, tan, shaly; 6 inches of gray shale at base.
98	2.5	Coal and shale beds, detailed as follows:
		Top: Shale, brown, carbonaceous — 3 inches
		Base: Coal — 27 inches

Unit No.	*Thickness (in feet)*	*Lithologic Character*
97	2	Shale, gray, carbonaceous near top.
96	9	Shale, gray; sparse tan marlstone beds.
95	1	Shale, brown to black, carbonaceous.
94	2	Shale, gray.
93	5	Sandstone, gray, fine-grained, platy, limy; forms ledge.
92	9	Shale, gray, interbedded with fine-grained soft sandstone.
91	1.5	Coal and shale beds, detailed as follows:
		Top: Coal — 15 inches
		Base: Shale, brown, carbonaceous — 3 inches
90	13	Shale, gray.
89	6	Sandstone gray, fine-grained, limy; forms ledge.
88	6	Sandstone, tan, shaly.
87	4	Shale, gray.
86	2	Sandstone, gray, limy, fine-grained; forms ledge.
85	9	Shale, gray, interbedded with tan shaly sandstone.
84	5.1	Coal and shale beds, detailed as follows:
		Top: Shale, brown — 1 inch
		Coal — 38 inches
		Coal bone — 2 inches
		Coal — 18 inches
		Base: Shale, brown, carbonaceous — 2 inches
83	4	Shale, gray.
82	2	Sandstone, gray, weathering brown, limy.
81	2	Shale, gray.
80	1	Sandstone, gray, fine-grained.
79	1.2	Coal, black.
78	9	Sandstone, gray, massive, medium-grained, lenticular; forms cliff.
77	2	Marlstone, ocher-brown.
76	4	Shale, gray, sandy in upper part.
75	1.4	Coal and shale beds, detailed as follows:
		Top: Shale, brown — 1 inch
		Coal — 13 inches
		Base: Shale, brown, carbonaceous — 3 inches
74	1	Sandstone, gray, friable, soft.
73	19	Shale, gray, sandy near base, fissile near middle; 1 foot of brown marlstone near top.
72	10	Sandstone, gray, fine-grained, friable.
71	4	Shale, brown.
70	4.9	Coal, shale, and sandstone beds, detailed as follows:
		Top: Coal — 7 inches
		Shale, gray, sericitic — 2 inches
		Coal — 42 inches
		Sandstone, brown, coarse-grained — 3 inches
		Base: Coal — 5 inches
69	3	Shale, brown, carbonaceous.
68	2	Sandstone, ocher, silty.
67	2	Sandstone, gray, thin-bedded; forms ledge.
66	2	Marlstone, yellowish-brown, hard; forms ledge.
65	5	Shale, gray.
64	2.9	Coal, shale, and sandstone beds, detailed as follows:
		Top: Shale, brown, carbonaceous — 3 inches
		Coal — 12 inches
		Sandstone, brown, fine-grained, sericitic — 5 inches
		Coal — 3 inches
		Base: Shale, brown, carbonaceous — 12 inches
63	1	Sandstone, gray, friable.
62	4.5	Shale, gray.
61	4.5	Shale, black to brown; numerous coal partings; numerous plant remains; 6 inches of gray, sericitic, shaly sandstone at top.
60	1	Sandstone, gray, fine-grained, friable.
59	4	Marlstone, yellowish-brown.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
58	16	Shale, gray; 6 inches of marlstone and 1 foot of gray sandstone in upper part.
57	2	Marlstone, yellowish-brown; contains poorly preserved leaf imprints; weathers to slope; constitutes the lowest occurrence of marlstone in this section.
56	3	Sandstone, gray, fine-grained, friable; extends laterally to brown marlstone.
55	6	Shale, gray.
54	4	Sandstone, gray, fine-grained, thin-bedded, limy; forms ledge.
53	4	Shale, gray; sparse tan sandstone partings.
52	1	Sandstone, tan, fine-grained.
51	3	Shale, gray.
50	4.8	Coal and shale beds, detailed as follows: Top: Shale, brown, carbonaceous — 24 inches Coal — 32 inches Base: Shale, carbonaceous — 2 inches
49	1	Sandstone, gray, friable; contains clay cement.
48	1	Shale, brown, carbonaceous.
47	12	Sandstone, tan, fine-grained, friable; forms slope.
46	4-5	Shale, gray to tan, sandy.
45	3.4	Coal and shale beds, detailed as follows: Top: Shale, carbonaceous — 8 inches Coal — 31 inches Base: Shale, carbonaceous — 2 inches
44	4	Shale, brown, sandy; partings of carbonaceous shale.
43	13	Sandstone, gray to tan, fine-grained, friable; forms slope.
42	3	Shale, gray.
41	2.2	Coal and shale beds, detailed as follows: Top: Shale, brown, carbonaceous — 2 inches Coal, clean — 23 inches Base: Shale, brown, carbonaceous — 2 inches
40	2	Shale, brown, sandy.
	1004.4	Total thickness of coaly sequence.

Contact between coaly sequence and Bacon Ridge sandstone arbitrarily placed at this point.

Bacon Ridge sandstone

39	14	Sandstone, gray to tan, fine-grained to medium-grained; weathers to slope except for a ledge 2 feet thick near top.
38	3	Shale, gray, fissile.
37	3	Sandstone, gray to tan, friable.
36	4	Shale, brown, carbonaceous.
35	3	Sandstone, gray, fine-grained, friable.
34	4-5	Shale, gray.
33	2	Shale, gray to black, interbedded with a lesser amount of gray friable sandstone; thin sandstone near middle contains abundant oysters.
32	10	Sandstone, gray, massive, fine-grained to medium-grained.
31	208	Covered interval in valley.
30	20	Sandstone, gray, weathers white to tan, medium-grained to fine-grained, friable; contains poorly preserved pelecypods.
29	145	Covered interval.
28	70	Sandstone, light-gray, massive, medium-grained; numerous black grains; locally forms cliff.
27	12	Sandstone, brown to gray, medium-grained to fine-grained; massive and friable in part; platy in part.
26	18	Shale, dark-gray, fissile; poorly exposed.
25	1	Sandstone, light-gray, platy, fine-grained.
24	6	Shale, dark-gray, fissile.
23	5	Sandstone, gray, massive, friable.
22	12	Sandstone, brown, limy, thick-bedded to thin-bedded; abundantly fossiliferous, containing pelecypods, gastropods, shark teeth, and reptile bones.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
21	100	Sandstone, light-gray, massive, friable; 2 feet of brown, platy, limy sandstone at base, 20 feet above base, and 60 feet above base; sparse *Inoceramus* prisms, some carbonized wood, and poorly preserved mollusk shell fragments 70 feet above base.
20	30	Covered interval; sandy soil, probably underlain by friable sandstone.
19	45	Sandstone, light-gray, massive, friable.
18	2	Sandstone, brown, limy, platy; forms ledge.
Offset 0.3 mile west.		
17	40	Covered interval.
Approximate top of pearl-gray marker zone		
16	30	Shale, gray, interbedded with bentonitic shale; 1 foot of gray, thin-bedded, tuffaceous sandstone near middle.
	30	Total thickness of pearl-gray marker zone.

Base of pearl-gray marker zone.

Offset on base of pearl-gray marker zone one mile east-southeast to top of bare ridge about half way between Trail Creek and the south fork of Fish Creek. The following section duplicates the lower part of the coaly sequence and upper part of the Bacon Ridge sandstone, but is described here because it gives data on thicknesses and continuity of several important coal beds.

4	Sandstone, gray, limy, fine-grained; top of exposed section of coaly sequence.
6	Shale, gray, interbedded with fine-grained sandstone.
2	Sandstone, gray, fine-grained, limy; forms ledge.
2	Shale, gray.
3	Marlstone, gray, weathers yellow.
2	Shale, gray.
10	Sandstone, gray, fine-grained, limy; forms ledge.
5	Shale, gray, interbedded with sandy shale.
3	Marlstone, gray, weathering yellowish brown.
4	Shale, gray; veinlets of fibrous gypsum at base.
1.3	Shale, gray to brown, carbonaceous near top; 4 inches of coal at top.
3	Sandstone, light-gray, fine-grained, soft.
5	Shale, gray; 3 inches of brown shale at base; 2 inches of gray marlstone, which weathers brown, at top.
1.2	Coal.
1	Shale, gray; 3 inches of carbonaceous shale at top.
2	Sandstone, gray, fine-grained.
5	Shale, gray; partings of brown shale at base.
2	Shale, gray and brown; 6 inches of coal at top.
5	Sandstone, gray to brown, fine-grained, massive to thin-bedded.
4	Shale, gray; some partings of carbonaceous shale near base.
5	Shale, brown to black, carbonaceous.
14	Shale, gray; sparse partings of fine-grained light-gray sandstone.
2	Sandstone, gray, fine-grained, limy; weathers to a brown ledge.
3	Shale, gray.
1	Siltstone, gray, very limy; sparse poorly preserved leaf imprints.
7	Shale, gray; partings of tan fine-grained sandstone.
16.1	Coal and shale beds, detailed as follows:

Top:	Shale, brown	4 inches
	Coal	5 inches
	Shale, brown, carbonaceous	8 inches
	Coal	3 inches
	Coal, impure, shaly	5 inches
	Coal	20 inches
	Shale, carbonaceous	4 inches
	Siltstone, gray to ocher-brown	24 inches
	Shale, brown	2 inches
	Coal	1 inch
	Shale, brown	3 inches
	Siltstone, gray	5 inches
	Shale, gray	5 inches

Unit No.	*Thickness (in feet)*	*Lithologic Character*
		Coal, clean; small blebs of amber; looks like very good grade coal — 88 inches
		Siltstone, brown, sericitic — 1 inch
		Coal — 12 inches
		Base: Shale, carbonaceous — 3 inches
	1	Shale, gray.
	12	Sandstone gray to tan, fine-grained to medium-grained, friable, limy near base; contains sparse plant fragments near base.
	8	Sandstone, tan, friable, fine-grained; forms slope.
	3.5	Shale, gray; 2 inches of fine-grained, gray, sericitic sandstone at base.
	4	Coal, clean, black, conchoidal fracture; ½-inch blebs of amber in upper 6 inches of bed.
	2.5	Shale, dark-gray, fissile; brown carbonaceous shale 6 inches thick at top.
	149.6	Total thickness of measured part of coaly sequence.

Contact between coaly sequence and Bacon Ridge sandstone arbitrarily placed at this horizon.

Bacon Ridge sandstone

	3	Sandstone, tan, friable.
	340	Covered interval.

Offset 0.4 mile south on top of 240-foot sandstone, the next unit below the following 110-foot shale.

	110	Shale, gray, interbedded with sandy shale; limy concretions 30 feet above base; 2 feet of fine-grained gray sandstone 45 feet above base; 6 inches of gray sandstone 64 feet above base, and a similar sandstone 68 feet above base.
	240	Sandstone, light-gray, friable, massive except for platy, limy, brown sandstones 50 feet, 143 feet, and 219 feet above base; abundant marine molluscan fauna 188 feet above base; abundant marine molluscan fauna 219 feet above base.

Top of pearl-gray marker zone.

	30	Shale, gray, poorly exposed.
	7	Sandstone, gray, fine-grained, thin-bedded, platy; contains a molluscan fauna.
	14	Shale, pearl-gray, bentonitic; forms a distinctive pearl-gray weathered slope.
	51	Total thickness of pearl-gray marker zone.

Base of pearl-gray marker zone. The underlying section is continued at this locality, but is added to the main section measured on the north side of the north fork of Fish Creek. The section is offset one mile southeast from the section on Fish Creek on the base of the pearl-gray marker zone.

15	7	Sandstone, light-gray, fine-grained, platy.
14	11	Shale, tan, sandy.
13	10	Sandstone, gray, massive; numerous black grains.
12	20	Sandstone, gray, thin-bedded, platy; forms ledge; abundant marine fossils.
11	90	Sandstone, gray, massive; numerous dark grains; two layers of *Inoceramus* shells in basal 3 feet.
	925.5	Total thickness of Bacon Ridge sandstone.

Cody shale.

10	450	Shale, sandy in part; poorly exposed; *Inoceramus* shells 20 feet to 30 feet above base.
9	38	Sandstone, gray, medium-grained, limy; numerous dark grains; forms ledges; contains large *Inoceramus* shells and oysters.
8	427	Shale, dark-gray; several 2-foot to 4-foot beds of gray bentonitic shale in upper half.
7	42	Shale, gray; thin partings of sandstone; at top is 8 inches of thin, platy limy, medium-grained sandstone with numerous dark grains.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
6	8	Shale, gray to tan, bentonitic.
5	163	Shale, dark-gray, fissile; sparse partings of fine-grained sandstone.
4	46	Shale, dark-gray, interbedded with sandstone, gray, thin-bedded, medium-grained, limy.
3	18	Shale, dark-gray; partings of gray fine-grained sandstone.
2	29	Shale, dark-gray; sparse thin partings of fine-grained gray sandstone.
1	134	Shale, dark-gray, poorly exposed near base.
	1355	Total measured part of Cody shale.

Base of exposures and base of measured section.

A supplementary section of the lenticular sandstone and shale sequence was measured on the west end of the high spur between the north and south forks of Fish Creek. This section is presented because it indicates the lithology of many of the soft units that are covered or only poorly exposed in the section along the west side of the north fork of Fish Creek, half a mile northwest; and also because the conglomerate facies of the Pinyon formation, in a distance of a mile from north to south, has overlapped 869 feet of the conglomeratic sandstone sequence, 982 feet of the white sandstone sequence, and approximately 850 feet of the lenticular sandstone and shale sequence. Because nearly all the beds in this sequence are lenticular, it is difficult to correlate any of the major or minor units between the main section and the supplementary section. However it is believed that the top bed of unit 2 in the supplementary section is approximately equivalent to unit 197 in the section on the west side of the north fork of Fish Creek. The supplementary section is completely exposed and there are no structural complications. Units are numbered consecutively from oldest to youngest.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
Pinyon formation (Paleocene)		
65	100	Conglomerate, brown; composed of highly rounded fragments of quartzite and volcanic rocks; abundant conspicuous percussion marks; maximum size about 6 inches in diameter; average size 2 inches; many roundstones are so smooth they have a slight sheen; brown coarse-grained sandstone matrix; many roundstones sheared and crushed and all are brittle; no locally derived Paleozoic or Mesozoic rock fragments observed.
	100	Total measured part of Pinyon formation.

Contact between Pinyon formation and lenticular sandstone and shale sequence. This contact is sharp and areal relationships indicate that there is an angular uniformity between these two sequences of rock, but the amount of angularity cannot be determined because no good bedding planes were observed in the Pinyon.

Lenticular sandstone and shale sequence			
64	29	Shale, gray.	
63	1	Coal and shale beds, detailed as follows:	
		Top: Coal, black	10 inches
		Base: Shale, carbonaceous	2 inches
62	16	Shale, gray; sparse partings of sandy shale.	
61	3.5	Coal and shale beds, detailed as follows:	
		Top: Shale, brown	4 inches
		Coal	36 inches
		Base: Shale, carbonaceous	2 inches
60	50	Shale, gray; partings of shaly sandstone and sandy shale.	
59	0.5	Coal, black.	
58	58	Shale, gray.	

Unit No.	*Thickness (in feet)*	*Lithologic Character*
57	6	Sandstone, gray, weathering tan, thin-bedded, platy.
56	23	Shale, gray.
55	0.5	Shale, brown, carbonaceous.
54	15	Shale, gray.
53	4	Shale, gray, sandy.
52	1.7	Coal and shale beds, detailed as follows: Top: Coal — 18 inches Base: Shale, carbonaceous — 2 inches
51	22	Shale, gray; sparse thin beds of sandy shale.
50	1	Sandstone, gray, fine-grained; weathers to brown ledge.
49	19	Shale, gray; sparse thin beds of sandy shale.
48	2	Sandstone, gray, fine-grained, thin-bedded, platy.
47	17	Shale, gray; sparse thin beds of shaly sandstone; scattered marlstone nodules.
46	2	Sandstone, gray, fine-grained, platy; forms ledge.
45	45	Shale, gray; 3 inches of coal at base.
44	8	Sandstone, gray, shaly.
43	42	Sandstone, gray, massive, fine-grained to medium-grained, lenticular; forms ledge.
42	15	Shale, gray; sparse *Unio* shells too poorly preserved to collect.
41	2.9	Coal and shale beds, detailed as follows: Top: Coal — 29 inches Base: Shale, carbonaceous — 6 inches
40	20	Shale, gray.
39	2	Sandstone, gray, thin-bedded; forms ledge.
38	48	Shale, gray; 3 inches carbonaceous shale 2 feet below top; 1 foot tan sandy shale 30 feet above base.
37	2	Sandstone, gray, platy; forms ledge.
36	24	Shale, gray, sandy.
35	0.8	Shale, carbonaceous, underlain by 4 inches of coal.
34	9	Shale, gray.
33	23	Sandstone, gray, massive, lenticular.
32	113	Shale, gray, interbedded with sporadic layers of friable fine-grained sandstone and sandy shale 2 feet to 3 feet thick; 8 inches of carbonaceous shale in middle; sparse concretions of brown marlstone.
31	2	Sandstone, gray, fine-grained, hard, thin-bedded; forms ledge.
30	12	Shale, gray.
29	1	Shale, brown to black, carbonaceous.
28	13	Sandstone, gray to tan, fine-grained, cross-bedded; forms ledge.
27	77	Shale, gray; layers of shaly sandstone 1 foot to 2 feet thick at approximately 4-foot to 8-foot intervals; 1 foot of white friable sandstone 25 feet above base.
26	4	Sandstone, gray, fine-grained to medium-grained, cross-bedded to massive; forms lenticular ledge.
25	36	Sandstone, tan, friable; sparse shale partings near top; ledge about 8 feet above base.
24	6	Shale, gray to tan.
23	6	Sandstone, gray, weathering tan, fine-grained, interbedded with an equal amount of gray shale.
22	3	Shale, gray.
21	0.8	Coal bed 6 inches thick, underlain by 4 inches of brown shale.
20	11	Shale, light-gray to tan, sandy; sparse siderite nodules.
19	9	Shale, gray.
18	14	Sandstone, tan, gray near base, fine-grained; sparse shale partings; 6 inches of carbonaceous shale just above middle.
17	4	Shale, gray to tan.
16	2	Sandstone, gray, thin-bedded, fine-grained, platy.
15	6	Shale, gray to tan.
14	2	Sandstone, gray, fine-grained, thin-bedded, platy.
13	16	Shale, gray.
12	4	Sandstone, gray, massive, lenticular; weathers into weird pinnacle and pothole shapes.
11	2	Shale, gray; sparse concentrically ribbed pelecypods at base.
10	6.5	Shale, gray; 1 foot of light-gray sandstone in middle; 6 inches of carbonaceous shale at top.
9	6	Sandstone, gray to tan, fine-grained; ledge 2 feet thick locally at base.
8	1	Shale, brown to black, carbonaceous.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
7	2	Shale, gray.
6	20	Sandstone, tan, friable; sparse carbonized plant fragments; sparse gray shale partings.
5	17	Shale, gray, interbedded with sandy shale.
4	4	Sandstone, light-gray, platy.
3	54	Shale, gray, interbedded with lesser amount of tan shaly sandstone.
2	10	Sandstone, gray, massive, lenticular; forms ledge. The top bed of this unit is believed to be the same as unit 197 in the section on the west side of the north fork of Fish Creek.
1	27	Sandstone, gray, massive near base; some gray shale partings in upper half.
	1004.2	Total measured part of lenticular sandstone and shale sequence.

Base of exposures and base of measured supplementary section.

BACON RIDGE SECTION

This is a composite section consisting of a major section measured eastward from the core of the Bacon Ridge anticline where Bacon Creek has cut through Bacon Ridge, supplemented by numerous short sections of various formations measured on both flanks of the Bacon Ridge anticline from a point three miles northwest of the canyon to five miles south of the canyon. Exposures are poor, dips are steep, and there are numerous structural complications so the supplementary sections are used to check the principal section. Units are numbered consecutively from oldest to youngest.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
Pinyon formation (Paleocene)		
314	50	Conglomerate, brown; composed of highly rounded fragments of quartzite and volcanic rocks; abundant conspicuous percussion marks; average size 2 inches; many roundstones sheared and crushed and all are brittle; no locally derived Paleozoic or Mesozoic rock fragments observed; brown, coarse-grained, sandstone matrix.
313	10	Sandstone, tan, medium-grained, interbedded with limestone-pellet conglomerate which is highly lenticular; limestone pellets are gray and of unknown origin.
312	50	Sandstone, yellow, medium-grained, soft, porous, highly cross-bedded; numerous lenses of greenish limestone-pellet conglomerate as much as 1 foot thick; one unidentifiable fragment of bone observed.
311	5	Shale, gray, fissile, soft, fine-grained, smooth, slightly carbonaceous; no fossils found.
310	2	Sandstone, tan, medium-grained, soft, porous, cross-bedded.
309	100	Conglomerate, brown; composed of highly rounded fragments of quartzite and volcanic rocks; abundant conspicuous percussion marks on roundstones; average size 2 inches; many roundstones are crushed and sheared, and all are brittle; no locally derived Paleozoic or Mesozoic rock fragments observed; brown, coarse-grained, sandstone matrix; lower part poorly exposed.
	217	Total measured part of Pinyon formation.

Contact between the Pinyon formation and the lenticular sandstone and shale sequence or the coaly sequence arbitrarily placed at this point. The contact is placed at the top of 3 feet of sandstone that resembles the underlying Cretaceous sandstones, and which is overlain by conglomerate of the Pinyon formation. The contact is irregular, with about 1 foot of relief in 3 feet of lateral exposure. However, below this 3-foot sandstone is 515 feet of covered interval, and some of the sandstones of the Pinyon resemble those in the underlying Cretaceous. No good dip is obtainable here. Dips in Pinyon above and in Cretaceous below are almost exactly the same in this area.

Coaly sequence (possibly including some of the lenticular sandstone and shale sequence)		
308	515	Covered interval; chiefly talus from overlying conglomerate.
307	36	Shale, gray.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
306	15	Sandstone, gray, medium-grained, friable.
305	2	Shale, gray to brown, sandy.
304	17	Sandstone, gray to ocher, friable.
303	4	Shale, gray.
302	5	Sandstone, gray, friable.
301	10	Shale, gray.
300	13	Sandstone, gray, fine-grained, friable.
299	28	Shale, gray to tan.
298	2.5	Shale, brown, carbonaceous.
297	21	Shale, gray.
296	0.8	Shale, carbonaceous, interbedded with coal.
295	2.2	Coal.
294	11	Shale, gray.
293	1	Sandstone, gray, limy, thin-bedded; forms ledge.
292	29	Shale, gray; partings of darker-colored shale.
291	7.2	Coal, shale, and sandstone beds, detailed as follows: Top: Coal, impure — 8 inches Sandstone, shaly — 2 inches Coal — 39 inches Shale, brown, plastic — 2 inches Coal — 28 inches Shale, brown — 2 inches Base: Coal. — 6 inches
290	0.7	Shale, brown to gray.
289	10	Sandstone, tan to gray, fine-grained, friable.
288	9	Shale, gray.
287	1	Sandstone, gray, fine-grained, thin-bedded, soft.
286	7	Shale, gray.
285	14	Sandstone, gray, medium-grained, friable.
284	2.6	Coal.
283	12	Shale, gray.
282	4	Sandstone, gray, thin-bedded, friable, limy.
281	2.5	Coal and shale beds, detailed as follows: Top: Coal — 8 inches Shale, brown — 2 inches Base: Coal — 20 inches
280	3	Shale, gray.
279	3	Sandstone, gray, friable.
278	1	Claystone, gray, nodular; grades into underlying unit.
277	11	Shale, gray.
276	7	Sandstone, gray, medium-grained, massive, limy.
275	25	Shale, tan to gray; sporadic tan claystone nodules; sparse partings of carbonaceous shale; 1 foot of carbonaceous shale at top.
274	6	Sandstone, gray, shaly near top; limy, thin-bedded; lower part forms ledge.
273	14	Shale, gray, sandy; 17 inches of brown to black carbonaceous shale 17 inches above base.
272	12	Sandstone, gray, medium-grained, soft and friable near top; hard and forms ledge near middle; soft and carbonaceous near base.
271	13	Shale, gray to tan; 17 inches of nodular tan claystone at top.
270	11.2	Coal, shale, and sandstone beds, detailed as follows: Top: Coal — 2 inches Shale, gray — 17 inches Coal — 22 inches Shale, tan — 1 inch Coal — 6 inches Sandstone, brown — ½ inch Coal — 17 inches Shale, brown — 1 inch Coal — 10 inches Sandstone — 1 inch Coal — 9 inches Shale, brown, interbedded with sandstone — 8 inches Coal — 23 inches Base: Shale, carbonaceous — 17 inches

Unit No.	*Thickness (in feet)*	*Lithologic Character*
269	2	Shale, gray.
268	1	Sandstone, gray, limy; contains plant fragments.
267	22	Shale, tan to gray, sandy in lower part, carbonaceous in upper part.
266	2	Sandstone, gray, medium-grained, thin-bedded, limy; forms ledge.
265	6	Shale, gray, sandy near base.
264	4.4	Coal and shale beds, detailed as follows:
		Top: Shale, carbonaceous, interbedded with coal — 5 inches
		Coal — 12 inches
		Shale, brown — 6 inches
		Coal and carbonaceous shale — 4 inches
		Siltstone, brown, hard — 2 inches
		Coal — 16 inches
		Base: Shale, carbonaceous — 8 inches
263	15	Shale, gray to tan.
262	2	Shale, brown, carbonaceous.
261	4	Shale, gray.
260	16	Sandstone, gray, friable in upper and lower parts; limy and forms ledge near middle.
259	6	Shale, gray.
258	6	Coal, shale, and sandstone beds, detailed as follows:
		Top: Shale, carbonaceous — 10 inches
		Coal — 30 inches
		Sandstone, shaly — 6 inches
		Base: Coal — 26 inches
257	26	Shale, gray to brown; 3 inches of yellow sericitized sandstone 1 foot above base.
256	39	Sandstone, tan to gray, friable; ledge 2 feet thick at top.
255	7	Shale, gray; 6 inches of limy sandstone in middle.
254	4	Sandstone, tan to gray, limy; ledges at bottom and top.
253	2	Shale, gray.
252	4	Sandstone, gray, friable.
251	4	Shale, gray.
250	1	Sandstone, gray, medium-grained, thin-bedded.
249	16	Shale, gray.
248	1	Shale, carbonaceous; contains coal partings.
247	3	Shale, gray.
246	1	Sandstone, gray, fine-grained.
245	3	Shale, gray.
244	1	Shale, black to brown, carbonaceous.
243	1	Shale, gray.
242	6	Sandstone, gray, medium-grained, friable.
241	6	Shale, gray.
240	2	Sandstone, gray, medium-grained, limy.
239	12	Shale, gray.
238	5.5	Coal and shale beds, detailed as follows:
		Top: Shale, brown, interbedded with coal — 6 inches
		Coal — 48 inches
		Base: Shale, black, carbonaceous — 12 inches
237	3	Shale, brown to dark-gray.
236	10	Shale, light-gray to tan.
235	2	Sandstone, gray in upper part, brown near base, limy, fine-grained to medium-grained, friable.
234	4	Shale, brown to gray.
233	3	Coal.
232	3	Shale, gray.
231	6	Shale, ocher to tan, sandy.
230	6	Shale, gray.
229	6	Shale, black to brown, carbonaceous.
	1162.6	Total thickness of coaly sequence (may possibly include a small amount of the lenticular sandstone and shale sequence).

Unit No.	*Thickness (in feet)*	*Lithologic Character*

Contact between coaly sequence and Bacon Ridge sandstone arbitrarily placed at this horizon. The sandstone of unit 228 is like the Bacon Ridge sandstone but more data are needed in order to determine whether this sandstone and underlying units 214 to 227, inclusive, should be placed in the coaly sequence or in the Bacon Ridge sandstone.

Bacon Ridge sandstone

228	51	Sandstone, light-gray with some tan layers, soft, friable, fine-grained to medium-grained; forms poorly exposed slopes.
227	3.5	Shale, gray, with 6 inches of brown shale at base.
226	2	Coal.
225	1	Shale, gray, interbedded with carbonaceous shale; some plant fragments.
224	3	Sandstone, tan to gray, medium-grained, friable.
223	3	Shale, gray.
222	1	Shale, carbonaceous, interbedded with coal.
221	2	Shale, gray.
220	4	Sandstone, gray, friable.
219	7	Shale, gray.
218	3	Shale, brown to black, carbonaceous.
217	6	Shale, gray; 1 foot of shaly sandstone at top; 6 inches of brown to black carbonaceous shale at base.
216	20	Shale, gray.
215	4	Shale, brown, carbonaceous.
214	2	Coal and shale beds, detailed as follows: Top: Coal — 16 inches Base: Shale, brown, carbonaceous — 8 inches
213	145	Sandstone, gray, fine-grained to medium-grained, massive in part; coarsely bedded in part; some shale partings; grades down into underlying unit; lower 35 feet of sandstone forms conspicuous cliff; upper part softer and poorly exposed; some brown oil staining; oysters and other mollusks present 50 feet above base.

Offset on base of sandstone 1000 feet northwest.

212	18	Covered interval; probably underlain by soft, sandy, gray shale and sandstone.
211	1	Sandstone, gray, fine-grained, thin-bedded; numerous dark grains.
210	16	Shale, gray, fine-grained in part; sandy in part; carbonized plant remains in sandy layers.
209	1	Sandstone, gray, fine-grained, thin-bedded; numerous dark grains.
208	193	Covered interval.
207	30	Shale, gray; sandy in part; thin layers of sandstone, some with carbonized plant remains; thin sandstone at top.
206	2	Sandstone, gray, fine-grained, thin-bedded; numerous dark grains; forms ledge.
205	19	Shale, gray, fine-grained to silty; thin layers of fine-grained sandstone containing carbonized plant fragments.
204	1	Sandstone, gray, fine-grained, thin-bedded; numerous dark grains; forms ledge.
203	8	Shale, gray, fine-grained to sandy; some sandy layers containing carbonized plant fragments.
202	100	Covered interval.

Offset 1500 feet southeast. As there are no key beds on which to offset, the thickness of the covered interval, unit 202, is calculated on the assumption of constant strike and dip of beds in the interval between the base of unit 203 and the top of unit 201.

201	72	Sandstone, gray, shaly, interbedded with gray sandy shale, soft, poorly exposed.
200	4	Sandstone, gray, hard; shaly near middle.
199	50	Shale, gray, sandy; poorly exposed.
198	5	Sandstone, gray, limy, fine-grained, concretionary.
197	30	Sandstone, gray, shaly, interbedded with shale; poorly exposed.
196	4	Sandstone, gray, fine-grained; numerous dark grains.
195	60	Partly covered interval; apparently underlain by gray shale and shaly sandstone. The top of the pearl-gray marker zone is probably concealed in this interval.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
Pearl-gray marker zone.		Neither top nor base of this zone is exposed.
194	2	Bentonite and shale, gray, soft, swelling.
193	80	Covered interval. Basal contact of pearl-gray marker zone is concealed in this interval.
192	2	Sandstone, gray, fine-grained to medium-grained; numerous dark grains; forms conspicuous ledge; giant *Inoceramus* shells in massed aggregates; individual shells 8 inches to 12 inches long and 7 inches wide.
	955.5	Approximate total thickness of Bacon Ridge sandstone.

Contact between Bacon Ridge sandstone and Cody shale is believed to be approximately at the base of unit 192. This checks well with regional relationships and the outcrop pattern of the Bacon Ridge sandstone.

Cody shale

191	480	Covered interval; probably underlain by gray shale.
190	22	Sandstone, gray, fine-grained to medium-grained, thin-bedded; numerous dark grains; top and bottom parts form ledge; one poorly preserved specimen of *Inoceramus* found.
189	410	Covered interval; probably underlain by gray shale.
188	3	Sandstone, gray, medium-grained to coarse-grained; numerous dark grains; forms ledge; contains sparse poorly preserved shell fragments.
187	1150	Covered interval; lateral exposures are chiefly of gray shale with some thin soft gray sandstone.
	2065	Total thickness of Cody shale.

Contact between Cody shale and Frontier formation approximately at this point. Although the actual contact is covered, the areal outcrop pattern of the Frontier and Cody formations indicates that the top of the uppermost Frontier sandstone outcrop is essentially the top of the formation. Offset 0.5 mile northwest to high hill on north side of Bacon Creek.

Frontier formation

186	50	Sandstone, gray, soft, friable; 5 feet of brown limy concretionary sandstone in middle; thickness only approximate.
185	32	Sandstone, gray to tan, medium-grained, massive; forms cliff; abundant *Inoceramus* sp., oysters, and other pelecypods.
184	2	Sandstone, gray, limy; almost an oyster coquina.
183	17	Sandstone, gray to tan, medium-grained, massive; forms cliff.
182	39	Sandstone, gray, shaly, soft; poorly exposed.
181	1	Sandstone, brown, limy, nodular, highly fossiliferous.
180	21	Sandstone, gray, shaly, soft; 1 foot ledge in middle contains sparse fossils.
179	2	Shale, dark-gray, sandy.
178	18	Sandstone, gray to tan, medium-grained, massive to thin-bedded; forms cliff; abundant pelecypods, gastropods and some ammonites at base.
177	8	Shale, gray.
176	1	Sandstone, gray.
175	11	Shale, gray and brown, sandy.
174	2	Sandstone, gray to brown, limy; abundantly fossiliferous.
173	10	Shale, gray to tan.
172	9	Shale, brown.
171	5	Sandstone, gray, shaly; poorly exposed.
170	7	Sandstone, gray, thick-bedded to thin-bedded; sparse shale partings.
169	7	Shale, gray, interbedded with thin-bedded sandstone.
168	5	Shale, brown to black, carbonaceous; numerous coal partings.
167	5	Sandstone, gray, interbedded with brown shale.
166	29	Shale, black to dark-gray, weathering brown; upper part poorly exposed.
165	7	Sandstone, gray to tan, fine-grained to medium-grained, limy; numerous dark grains.
164	13	Shale, gray, sandy.
163	2	Sandstone, tan, medium-grained.
162	23	Shale, dark-gray.
161	1	Shale, brown, carbonaceous.
160	8	Sandstone, gray to brown, medium-grained; lower part thin-bedded; upper part massive; some carbonaceous material.


STATE OF WYOMING
1933
GEOLOGICAL SURVEY


STATE OF WYOMING
1933
GEOLOGICAL SURVEY

Unit No.	*Thickness (in feet)*	*Lithologic Character*
Thermopolis shale		
Muddy sandstone member		
Offset 0.15 mile north-northwest.		
71	2	Sandstone and claystone, dark-green, weathering rusty, very hard, poorly bedded except near middle; sandstones are at base and top; highly siliceous; a conspicuous bed recognized over a wide area.
70	6	Shale, gray; about 1 foot of bentonite in lower middle; sandy near top; same bed 1 mile south-southeast, on the south side of Bacon Creek contains fish and reptile bones.
69	14	Sandstone, greenish-gray, interbedded with a lesser amount of dark-gray silty shale; sandstone is in thin irregular beds; moderately hard and forms low ridge; capped by 1 foot of very hard very fine-grained dull-green sandstone that breaks into thin, hard, laminated plates and forms a conspicuous bed.
68	5	Shale, black, fissile, silty, ferruginous.
67	1.4	Bentonite, pale-green, gritty; looks like "pepper and salt" sandstone because of abundance of biotite; a very unusual rock.
66	13	Shale, dark-gray to black, soft, fissile, flaky; numerous partings of cream-colored to slightly greenish bentonite as much as 3 inches thick; some siliceous and sandy layers; some hard blocky black shale.
65	1	Sandstone, greenish-black, hard, blocky, siliceous, possibly tuffaceous; forms ledge.
64	6	Shale, dark-gray, bentonitic and plastic in lower two-thirds; sandy and silty in upper one-third.
63	3.5	Shale, black, both hard and soft, moderately coarse-grained, ferruginous in part; numerous *Lingula* fragments in lower 1 foot; other fossils that may be spores or foraminifera.
62	3	Sandstone and shale, dark-drab to black, hard; forms ledge; fine angular quartz grains; very impure and appears tuffaceous; 2 inches of cream-colored bentonite at top.
61	0.8	Bentonite, cream-colored, smooth, slightly ferruginous; gray and impure near top.
60	16	Sandstone, drab to rusty-gray, very fine-grained, clayey and silty, soft; angular grains; numerous dark grains; conspicuous yellow mica flakes; interbedded with lesser amount of black to olive-drab soft silty and sandy shale.
	71.7	Total thickness of Muddy sandstone member.
Black shale member.		
59	1	Shale, black, weathering rusty, coarse-grained, tuffaceous, very hard; forms ledge; possibly slightly sandy or silty.
58	2	Bentonite, light greenish-gray, flaky, translucent, slightly impure.
57	7	Shale, dark-gray, fissile in part, blocky in part, moderately soft; looks slightly tuffaceous.
Offset 0.5 mile south-southeast to top of west-facing escarpment on crest of high hill at top of Bacon Ridge anticline.		
56	207	Shale, black, weathering dark gray in part, soft, fine-grained, fissile; sparse ferruginous nodules in upper 50 feet; thin partings of sandstone and siltstone 60 to 100 feet above base.
	217	Total thickness of lower black shale member.
	288.7	Total thickness of Thermopolis shale.
Cloverly formation		
"Rusty beds"		
55	35	Sandstone, gray to greenish-gray, weathering tan, shaly, hard, fine-grained; thin but irregular bedding; abundant plant stem impressions and fucoidal markings.
54	31	Shale, dark-gray, laminated; interbedded with thin irregular layers of gray fine-grained sandstone; soft and weathers to slope.
53	11	Shale, dark-gray, interbedded with sparse sandstone layers; poorly exposed.

Unit No.	*Thickness (in feet)*	*Lithologic Character*
52	10	Sandstone, gray to tan; massive in part; cross-bedded in part.
51	7	Shale, gray, poorly exposed.
50	4	Sandstone, tan to gray, medium-grained.
	98	Total thickness of "Rusty beds" of Cloverly formation.

Contact between "Rusty beds" and lower part of Cloverly formation. In the western Wyoming-southeastern Idaho terminology, this is the contact between the Bear River formation and the Gannett group.

The underlying beds here are described as a supplementary section. The main section is offset on the base of the "Rusty beds" 3.7 miles south-southeast, to the west flank of the Bacon Ridge anticline where the section is better exposed, more complete, and fossiliferous.

21	Covered interval; probably underlain by shale or claystone.
48	Claystone, dark-gray, bentonitic; 1 foot of gray fine-grained limestone in middle.
1	Limestone, gray, hard.
6	Claystone, gray, plastic, swelling.
3	Limestone, gray, hard.
72	Claystone, gray, plastic, swelling.
6	Marlstone, white to light-gray, fine-grained.
9	Claystone, gray, soft.
1	Limestone, gray; weathers into rounded concretion-like masses.
6	Claystone, gray, plastic, swelling.
1	Limestone, gray; weathers into rounded concretion-like masses.
8	Claystone, gray, plastic, swelling.
10	Claystone, gray, weathering lavender; thin limestone bed 3 feet above base. The beds between the base of this unit and the base of the "Rusty beds" weather to a very distinctive lilac-colored slope. This lilac-colored zone is recognizable throughout much of central and northwestern Wyoming, where it likewise directly underlies the "Rusty beds".
4	Claystone, red.
1	Limestone, gray; weathers into rounded concretion-like masses.
13	Claystone, red; contains sporadic polished pebbles.
5	Sandstone, gray, fine-grained, limy; cross-bedded in part; massive in part; appears to be a lens about 200 feet long.
4	Shale or claystone, red.
7	Sandstone, light-gray, limy, lenticular.
15	Shale or claystone, red and maroon, sandy.
5	Sandstone, white, fine-grained, limy, lenticular.
9	Shale or claystone, red, sandy.
36	Shale or claystone, purplish-gray in upper part; gray, yellow, and red in lower part.
5	Shale or claystone, purplish-gray, sandy.
29	Sandstone, gray to tan, medium-grained, lenticular; forms ledge; shaly at top.
8	Shale or claystone, gray, weathering purplish gray; sandy.
23	Shale or claystone, red and orange, sandy.
	Base of exposed beds in core of Bacon Ridge anticline where Bacon Creek cuts through Bacon Ridge.

Offset 3.7 miles south-southeast on base of unit 50, the base of the "Rusty beds", to the west flank of the Bacon Ridge anticline.

Lower part of Cloverly formation and Morrison (?) formation, undivided.

49	37	Partly covered interval; shale, gray, hard, interbedded with claystone, siltstone, and slabby hard sandstone; apparently a transition zone between lilac claystone and "Rusty beds".
48	10	Claystone, grayish-lilac, soft, waxy, swelling.
47	9	Claystone, pale-lilac in lower half; upper half contains abundant white limestone nodules.
46	12	Limestone nodules, white, embedded in a pale, lilac-gray, limy, claystone matrix.


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Unit No.	*Thickness (in feet)*	*Lithologic Character*
8	2	Sandstone, dark bluish-gray, fine-grained, shaly, highly glauconitic; weathers with "onion skin" type of exfoliation; forms conspicuous re-entrant.
7	3	Sandstone, greenish-gray, weathering tan, very fine-grained, limy, hard; abundant bright-green glauconite grains and bright-red grains; forms lowest conspicuous ledge in outcrop.
6	17	Sandstone and shale sequence; basal 1.5 feet is dark-gray, soft, porous, clayey, oolitic conglomerate with grain size ¼-inch to 1/10-inch; some large round sand grains and bright-green glauconite grains as large as bird shot; this bed grades up to fine-grained, dark-gray, slightly glauconitic shale which in turn grades up to 1.5 feet of dark-gray to black clayey limestone forming a ledge which is a coquina of crinoid fragments and pelecypods in a coarse-grained oolite. The following fossils were collected from this bed, which is 5 feet above the base of the unit: *Eumicrotis curta* Hall, *Pentacrinus asteriscus* Meek and Hayden. Above this bed is dark lead-gray sandstone, shaly in part, medium-grained to coarse-grained with abundant fossil fragments and bright-green glauconite.
	96	Total thickness of "upper Sundance". This is almost certainly the eastern equivalent to the Stump formation of westernmost Wyoming and southeastern Idaho.

Contact between the "upper Sundance" and "lower Sundance". This contact is marked by a sharp lithologic change from gray, very fine-grained, blocky, nonglauconitic clay-stone below to oolitic glauconitic conglomerate above.

"Lower Sundance"

5	4	Claystone, gray, blocky, soft, very fine-grained, non-glauconitic; no fossils observed.
4	8	Sandstone, gray, weathering pale tan, very fine-grained, very hard, very limy, massive except at top; forms ledge on slope; typical "lower Sundance" type of sandstone containing the characteristic scattered red grains; no fossils observed. This sandstone has considerable lateral extent, forms a conspicuous unit, and may be the eastern remnant of the Preuss sandstone.
3	25	Shale, gray, soft, fissile, very fine-grained, limy; contains abundant *Gryphaea nebrascensis*.
2	1	Limestone coquina, gray, weathering rusty, blocky; consists chiefly of *Gryphaea nebrascensis* as much as 1½ inches long. The following fossils were identified: *Gryphaea nebrascensis* Meek and Hayden, *Panope*? sp., *Camptonectes* sp., and *Pleuromya* sp.
1	99	Shale, gray, soft, fissile, very fine-grained, limy; contains abundant *Gryphaea* throughout.
	137	Total thickness of exposed part of "lower Sundance".

Base of exposures and base of measured section.

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