Measured Sections of the Montana Group and Equivalent Rocks From Montana and Wyoming

By

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79-1143

CONTENTS

This is a report to put into open files the detailed measured sections by Gill[1/] and others, used in Geological Survey Professional Paper 776. Stratigraphy and Geologic History of the Montana Group and Equivalent Rocks, Montana, Wyoming and North & South Dakota (Gill, J. R. and Cobban, W. R., 1973,: U.S. Geological Survey Professional Paper 776, 37 p.) Those Sections that do not appear here have been published in the following reports:

Mosby Section

Cobban, W. A., 1953, An Upper Cretaceous section near Mosby, Montana, in Billings Geological Society Guidebook 4th Annual Field Conference, Little Rocky Mountains, Montana-Southwestern Saskatchewan, 1953: p. 98-101.

Mosby Section

Johnson, W. D., Jr., and Smith, H. R., 1964, Geology of the Winnett-Mosby area, Petroleum. Garfield, Rosebud, and Fergus Counties, Montana: U.S. Geological Survey Bulletin 1149, 91 p.

Porcupine Dome Section

Gill, J. R., Cobban, W. A., and Schultz, L. G., 1972, Correlation, ammonite zonation, and a reference section for the Montana Group, central Montana: Montana Geological Society Guidebook 21st Annual Field Conference, Crazy Mountains Basin, 1972, p. 91-97.

Hardin Section

Richards, P. W., 1955, Geology of the Bighorn Canyon-Hardin area, Montana and Wyoming: U.S. Geol. Survey Bull. 1026, 93 p. (1956).

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Elgin Creek Section

Hose, R. K., 1955, Geology of the Crazy Woman Creek area, Johnson County, Wyoming: U.S. Geological Survey Bulletin 1027-B, p. 33-118, (1956).

Lower part of Seminoe Dam Section

Gill, J. R., Merewether, E. A., and Cobban, W. A., 1970, Stratigraphy and nomenclature of some Upper Cretaceous and lower Tertiary rocks in south-central Wyoming: U.S. Geological Survey Professional Paper 667, 50 p.

Red Bird Section

Gill, J. R., and Cobban, W. A., 1966, The Red Bird section of the Upper Cretaceous Pierre Shale in Wyoming, with a section on A new echinoid from the Cretaceous Pierre Shale of eastern Wyoming, by P. M. Kier: U.S. Geological Suvery Professional Paper 393-A, 73 p.

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Hewett, 1926, Geology and oil and coal resources of the oregon Basin, Meeteetse and Grass Creek Basin quadrangles, Wyoming: U.S. Geol. Survey, Prof. Paper 145, 111 pp., 10 figs., 32 pls.

Stanton and Hatcher, 1905, Geology and plaeontology of the Judith River beds. USGS, B 257: 128 pp.

Fossils were identified by W. A. Cobban. These collections have U.S. Geological Survey Mesozoic locality number, such as D3278, and are kept at the Federal Center, Denver, Colo.

(No page 3 or 4)

Section 1

Section of St. Mary River Formations Montana Group (Two Medicine, Virgelle, and Telegraph Creek Formations) and Marias River Shale exposed along Montana State Highway 20 near crossing of Dearborn River about 6 miles west of Bowmans Corners. Section measured by L. G. Schultz and J. R. Gill in 1961 by plane table and Jacobs Staff starting in the Marias River Shale in about the SE1/4 NE1/4 SE1/4 sec. 16 and continuing westward along the highway ending in the lower part of the St. Mary River Formation in about the NE1/4 SW 1/4 SW 1/4 sec. 21, T. 17 N., R. 5 W., Lewis and Clark County, Mont.

		Thickness
St. Mary River Formation (part):		Ft
41	Claystone, greenish- to olive-gray; sandy----------	105.0
40	Sandstone, light-greenish-gray; fine- to medium-grained; calcareous; crossbedded; fragments of carbonaceous material on bedding planes----------	3.0
39	Claystone, greenish- to olive-gray; sandy; limy; 1.3-ft-thick bentonite 13 ft above base; two thin beds of green sandstone at 31 and 28 ft above base; contains numerous Crassostrea subtrigonalis and Corbicula----------	45.0

Loc. D3630:

Crassostrea subtrigonalis (Evans and Shumard)

Corbicula sp.

(No page 3 or 4)

		Thickness
St. Mary River Formation (part)--Continued		Ft
38	Covered; weathers to a frothy green surface; apparently unit consists of sandy greenish-gray limy claystone----------	135.0
	Total St. Mary River Formation measured--------	288.0
Two Medicine Formation:		
37	Tuff, silicified, light-greenish-gray with some red mottling in upper part; thin bedded; biotitic----------	5.0
36	Claystone, greenish-gray; sandy; very limy---------	15.0
35	Tuff, silicified, very light greenish gray---------	1.0
34	Volcanic sandstone, very light greenish gray to dark-greenish-gray; medium-grained with lenses and layers of fine, coarse, and conglomeratic volcanic material; limy; hard ridge former; crossbedded; contains small grains of red heulandite----------	70.0
33	Volcanic claystone, light-olive-gray; silty; weakly calcareous; some heulandite; becomes dark greenish gray and sandy in upper 30 ft; forms saddle between adjacent units----------	120.0
32	Volcanic sandstone, alternating layers of green and maroon; medium-grained; clayey; capped by 2-ft-thick bed of clayey conglomeratic sandstone----------	70.0
31	Tuff, light-brown; bentonitic; thin-bedded; several thin layers of silicified tuff; forms conspicuous light-brown band on outcrop----------	12.0

		Thickness
Two Medicine Formation--Continued:		Ft
30	Volcanic sandstone, greenish-gray with some maroon layers; coarse-grained; clayey; calcareous; a 4-ft-thick bed of conglomeratic volcanic sandstone at 9 ft above base and an 8-ft-thick bed 37 ft above base; a 2-ft-thick bed of light-greenish-gray medium-grained sandstone 78 ft above base----------	90.0
29	Bentonite and tuff interbedded, white; bentonite, gritty and limy; tuff, silicified, dominant in upper part, thin-bedded----------	15.0
28	Poorly exposed; apparently fine-grained green and maroon volcanic sandstone with thin beds of conglomeratic sandstone containing pebbles of volcanic rock at base and 45 ft above base; unit contains some beds of very sandy volcanic claystone----------	185.0
27	Tuff, very light gray; silicified; thin-bedded with some soft layers of bentonite----------	12.0
26	Volcanic sandstone, dark-gray to dark-purple; coarse-grained; abundant volcanic pebbles; abundant red grains of heulandite; crossbedded; middle part of unit contains some fine-grained clayey sandstone---------	60.0

		Thickness
Two Medicine Formation--Continued		Ft
25	Volcanic sandstone, dark-olive-gray with several reddish bands; fine- to medium-grained with some layers of volcanic siltstone; argillaceous; abundant red grains of heulandite; unit weathers to form saddle with several small ridges in lower 30 ft; contains two prominent coarse-grained ridge-forming sandstone beds in middle----------	265.0
24	Volcanic sandstone, dark-olive; fine- to medium-grained; generally hard with thin beds of soft clayey sandstone; lower 7 ft coarse-grained and conglomeratic containing abundant red grains of heulandite; coarse-grained heulanditic sandstone with abundant green clay pebbles 60 ft above base; a 2-ft-thick bright-green sandstone at top; unit weathers to form several bare dark ridges---------	170.0
23	Partly covered; unit appears to consist of brownish-black to dark-green silty volcanic claystone; the upper 10 ft is exposed and consists of green silty claystone. South of the highway, 25 ft of brownish-black silty volcanic claystone is exposed in lower part of unit-	120.0

		Thickness
Two Medicine Formation--Continued		Ft
22	Volcanic sandstone; interbedded maroon and green, soft, fine-grained, clayey sandstone and medium-grained green and buff sandstone; brown hard sandstone concretions are abundant; red grains of heulandite common----------	155.0
21	Volcanic sandstone, very dusky reddish purple with local green mottling; fine-grained; limy; a 4-ft-thick bed of coarse-grained crossbedded conglomeratic volcanic sandstone at base; an 11-ft-thick bed at 70 ft and a 5-ft-thick bed a 93 ft above base; conglomerate pebbles of volcanic rock and claystone; unit forms conspicuous dark-maroon outcrop----------	130.0
20	Volcanic claystone interbedded with minor amounts of volcanic sandstone; claystone, dusky-reddish-purple with some green, sandy; sandstone, fine-grained, locally coarse-grained, ledge forming----------	130.0
19	Poorly exposed; includes both green and maroon volcanic-rich sandy claystone and some thin beds of ledge-forming sandstone----------	85.0
18	Tuff, greenish-gray; sandy; soft, appears ashy; calcareous----------	45.0

		Thickness
Two Medicine Formation--Continued		Ft
17	Tuff, grayish-yellow-green; limy; fine- to medium-grained; some pumice fragments; top exposed at northwest bridge abuttment over Dearborn River; middle and lower parts poorly exposed; base exposed south of highway at water level on east side of river----------	85.0
16	Tuff, greenish-gray; limy; very hard; silicified; forms prominent brownish-gray weathering ridge north and south of line of section----------	65.0
15	Tuff, pale-green; fragmental; limy; abundant large pumice fragments; forms bight-green outcrop south of highway; very clayey----------	25.0
14	Covered; small outcrops in lower part show very sandy brownish-gray volcanic-rich claystone and one thin bentonite. North of road, the upper part of this unit consists of coarse-grained limy grayish-red volcanic sandstone that contains pebbles to cobbles of angular to subrounded fragments of greensih-gray welded tuff, and light-greenish-gray, red, and reddish-brown fragments of porphyritic volcanic rock----------	145.0

		Thickness
Two Medicine Formation--Continued		Ft
13	Sill, rhyolite, light-gray; calcareous; columnar jointing; forms white cliff; slightly discordant with bedding and apparently crops out in the upper part of unit 14 north of road (thickness not included in thickness of formation)----------	25.0
12	Volcanic sandstone, brownish-gray to grayish-red; fine- to coarse-grained; limy----------	55.0
11	Poorly exposed; lowerpart contains green and brownish-gray limy sandy claystone and sandstone and upper part contains greenish-gray silty claystone----------	70.0
Two Medicine Formation (nonvolcanic-rich part):		
10	Sandstone, light-yellowish-gray; fine- to medium-grained; thin-bedded to crossbedded; limy; moderately hard; weathers light brownish gray to brownish gray; forms ridge; first unit exposed on north side of highway east of bridge----------	55.0
9	Claystone and sandstone interbedded; claystone, silty, greenish-gray and slightly limy; sandstone, greenish-gray, fine-grained, limy in beds from 1- to 2-ft-thick, some buff-weathering crossbedded tuffaceous sandstone; some dark-gray slightly carbonaceous shale in lower 70 ft of unit----------	330.0

		Thickness
Two Medicine Formation (nonvolcanic-rich part)--Continued		Ft
8	Shale, claystone, and sandstone interbedded; shale, medium- to dark-gray, silty; claystone, greenish-gray; sandstone, greenish-gray and very fine grained; a few thin impure beds of coal and carbonaceous shale in lower 15 ft; several thin, 0.05- to 0.3-ft-thick beds of light-brown gritty bentonite in lower part; unit is fossiliferous----------	60.0
	Loc. D763:	
	Corbula n. sp.	
	Total Two Medicine Formation----------	2670.0
Virgelle Sandstone:		
7	Sandstone, light-greenish- to yellowish-gray; medium-grained; limy; crossbedded; weathers buff; at top of unit, a 1- to 2-ft-thick bed of magnetite-rich hard sandstone that forms a dark-brown weathering caprock; upper part of unit is fossiliferous-----	38.0
	Loc. D3629 (top of unit):	
	Inoceramus lundbreckensis McLearn	
6	Shale, claystone, and sandstone interbedded; shale, medium- to dark-gray, silty with carbonaceous layers; claystone, greenish-gray; sandstone in medium-grained thin beds that weather buff; a 0.5-ft-thick bed of black coaly shale 26 ft above base----------	30.0

	Thickness
Virgelle Sandstone--Continued	Ft
5 Sandstone, light-greenish-gray to yellowish-gray; medium-grained; limy; biotitic; medium-bedded; locally crossbedded, weathers buff----------	60.0
5b Shale and sandstone interlaminated; shale, dark-gray, sandy; sandstone, light-gray, subordinate to shale and in thin beds less than 0.1 ft thick----------	5.0
5a Sandstone, light-gray, fine- to medium-grained; thin- to massive-bedded; a few shaly partings; lower part poorly exposed----------	65.0
Total Virgelle Sandstone----------	198.0
Telegraph Creek Formation:	
4 Sandstone and shale interlaminated; sandstone, very fine grained, very light olive gray, limy, biotitic, thin-bedded; shale, medium-olive-gray, very silty, limy, small carbonaceous flecks on bedding planes; a 0.3-ft-thick bentonite bed 55 ft above base----------	160.0
Total Telegraph Creek Formation----------	160.0
Marias River Shale (part):	
3 Shale, olive-gray, very silty; micaceous; slightly limy; contains thin laminae of very fine grained sandstone; lower part poorly exposed; a 0.5-ft-thick limy bentonite 50 ft below top----------	160.0

	Thickness
Marias River Shale (part)--Continued	Ft
2 Tuff, light-gray; silicified; biotitic; ridge former----------	5.0
1 Shale, like unit 3; poorly exposed; not measured----	____
Marias River Shale measured----------	165.0

Section 2

Composite section of rocks of the Miner Creek Formation and the underlying Montana Group measured by J. R. Gill and W. R. Vaughn in the vicinity of Loweth and Bruno siding on the Milwaukee, St. Paul and Pacific Railroad, Meagher County, Mont. Section of the Lennep Sandstone and Bearpaw Shale measured in the SW 1/4 SW 1/4 and NE 1/4 SW 1/4 sec. 15, T. 7 N., R. 8 E., and section of upper part of Eagle Sandstone, Claggett Shale, and Judith River Formation measured from the SW 1/4 NW 1/4 to the NE 1/4 NE 1/4 sec. 17, T. 7 N., R. 9 E. A supplemental section of the Claggett Shale was measured in the SE 1/4 NE 1/4 sec. 14, T. 6 N., R. 8 E.

		Thickness Ft
Miner Creek Formation:		
102	Claystone and volcanic sandstone; claystone, grayish-green, sandy; sandstone, grayish-yellow-green, coarse-grained; contains abundant red grains of heulandite; not measured in detail, approximate thickness----------	785.0
Lennep Sandstone:		
101	Volcanic sandstone, olive-gray, fine- to medium-grained with local lenses of andesite pebble conglomerate; thin-bedded; weathers into small tan fragments; slope former----------	75.0
100	Volcanic sandstone, greenish-gray; fine-grained; weathers dark yellowish brown, hard----------	5.0

		Thickness
Lennep Sandstone--Continued		Ft
99	Volcanic sandstone and siltstone interbedded; greenish-gray; locally mottled with patches of gray-weathering analcite cement; weathers to small pale-yellowish-brown angular fragments; contains a layer of gray- to brown-weathering-fossiliferous sandy limestone concretions at 10 ft above base----------	70.0
Loc. D4172:		
	Phelopteria linguaeformis (Evans and Shumard)	
	Cymella montanensis (Henderson)	
	Baculites sp.	
	Placenticeras meeki Boehm	
98	Volcanic sandstone, brown, fine- to medium-grained, forms prominent dark-brown weathering ridge-----	25.0
97	Volcanic sandstone, pale-yellowish-brown, thin-bedded; weathers to moderate yellowish-brown thin plates; contains an 8-ft-thick bed of hard sandstone at base----------	96.0
96	Volcanic sandstone and siltstone interbedded; banded, pale-yellowish-brown and moderate yellowish-brown; contains a 1-ft-thick bed of grayish-orange sandy claystone at 25 ft above base and a 1-ft-thick bed of bentonite at 10 ft above base----------	130.0

		Thickness
Lennep Sandstone--Continued		Ft
95	Bentonite, grayish-yellow, highly swelling---------	1.0
94	Siltstone, claystone and volcanic sandstone interbedded, olive-green to greenish-brown; contains a few layers of sandy limestone concretions in lower part----------	118.0
	Thickness Lennep Sandstone----------	520.0
Bearpaw Shale:		
93	Shale, medium-dark-gray, silty to sandy; contains a layer of dark-gray limestone concretions about 15 ft below top----------	30.0
92	Bentonite, grayish-yellow to pale-olive, poorly swelling----------	1.0
91	Shale, medium-dark-gray, silty----------	5.0
90	Bentonite, dark-yellowish-orange, nonswelling------	0.5
89	Shale, olive-gray, silty; contains a layer of limestone concretions about 10 ft below top----------	18.0
88	Bentonite, grayish-yellow to dark-yellowish-orange, nonswelling, granular texture----------	2.8
87	Shale, olive-gray, silty----------	31.0
86	Bentonite, dark-yellowish-orange, nonswelling------	0.6
85	Shale, like unit 87	27.0
84	Bentonite, grayish-yellow, nonswelling----------	2.1

		Thickness
Bearpaw Shale--Continued		Ft
83	Shale, line unit 87; contains a layer of limestone concretions about 15 ft above base----------	59.0
82	Bentonite, line unit 84----------	1.6
81	Shale, line unit 87----------	8.0
80	Bentonite, like unit 86----------	0.3
79	Shale, like unit 87----------	27.0
78	Bentonite, like unit 86----------	0.2
77	Shale, like unit 87----------	5.5
76	Volcanic ash, yellowish-gray, medium-grained, partly altered to bentonite----------	0.5
75	Shale, like unit 87----------	8.0
74	Bentonite, like unit 84----------	0.8
73	Shale, like unit 87----------	2.8
72	Bentonite, like unit 84----------	2.0
71	Shale, dark-gray, silty; contains a few limestone concretions----------	38.5
70	Bentonite, pale-yellowish-gray, gritty, biotitic---	9.5
69	Shale, dark-gray; silty to sandy----------	38.0
68	Shale, olive-gray, silty, lower 30 ft poorly exposed	60.0
	Thickness of Bearpaw Shale----------	379.7

The following section was measured south of Bruno rail siding from SW 1/4 NW 1/4 to the NE 1/4 NE 1/4 sec. 17, T. 7 N., R. 9 E., Meagher County, Mont.

		Thickness
Judith River Formation;		Ft
67	Bentonite, yellowish-brown, waxy, nonswelling------	3.0
66	Claystone, olive-green, silty to sandy, volcanic-rich----------	4.0
65	Bentonite, pale-yellowish-gray, very ashy, nonswelling----------	6.0
64	Claystone, like unit 66----------	25.0
63	Bentonite, pale-yellowish-green at base, brown and impure at top, nonswelling----------	2.8
62	Claystone, like unit 66----------	16.2
61	Volcanic ash, pale-yellowish-brown, biotitic, highly altered----------	1.0
60	Claystone like unit 66----------	15.0
59	Bentonite, pale-yellowish-gray, nonswelling--------	5.0
58	Claystone, olive-green in lower part grading up into dusky-yellowish-green in upper part; silty to sandy, weathers to a soft granular textured slope----------	50.0
57	Bentonite, pale-yellowish-brown, nonswelling, granular----------	3.7

		Thickness
Judith River Formation--Continued		Ft
56	Claystone, olive-green, volcanic-rich, abundant red grains of heulandite; contains thin lenses of olive-green fine-grained volcanic sandstone---	90.0
55	Ash, silicified, pale-green to light-gray, interbedded with thin layers of pale-yellowish-gray biotitic bentonites; ridge former----------	5.2
54	Claystone, dark-olive-green, volcanic-rich; contains 4 thin lenses of olive-green volcanic sandstone--	60.0
53	Bentonite, pale-yellowish-green, nonswelling; contains abundant pink to red grains of heulandite----------	0.7
52	Claystone, dark-greenish-gray, silty to sandy; grades up into dark-green volcanic-rich siltstone that contains abundant red grains of heulandite----------	85.0
51	Bentonite, olive-gray at base grading up into moderate-pink at top; contains abundant grains of heulandite----------	1.2
50	Claystone, greenish-gray, silty, volcanic-rich, and volcanic-rich siltstone; contains 8-ft-thick bed of medium-grained, greenish-gray volcanic sandstone 10 ft below top----------	55.0
49	Bentonite, dark-gray, impure, nonswelling----------	1.3

		Thickness
Judith River Formation--Continued		Ft
48	Claystone, greenish-gray----------	1.3
47	Bentonite, light-yellowish-gray, nonswelling-------	1.3
46	Claystone, greenish-gray, sandy----------	8.0
45	Sill, 12 ft thick, thickness not included in measured section----------	
44	Claystone, like unit 46----------	11.0
43	Bentonite, light-olive-gray, granular texture, nonswelling----------	9.0
42	Claystone, siltstone and fine-grained lenticular sandstone, volcanic rich; ranges in color from dusky yellow green to greenish black; contains a few thin soft beds of light-olive-gray to grayish-yellow bentonite----------	40.0
41	Sandstone, dark-green, medium grained to pebbly; volcanic-rich, lenticluar, hard; contains coatings of reddish-brown heulandite on fractures, weathers brown----------	8.0
40	Claystone, green, sandy, volcanic rich----------	12.0
39	Sanadstone, like unit 41----------	8.0

		Thickness
Judith River Formation--Continued		Ft
38	Claystone and siltstone, volcanic rich; weathers much darker than underlying unit; claystone in lower part is dusky yellowish brown with some thin beds of grayish-olive-green, sandy mudstone; a 2-ft-thick bed of green volcanic claystone near middle of unit; upper part contains red and green volcanic claystone with a few lenses of gray volcanic-rich coarse-grained sandstone; reddish-brown grains of heulandite abundant throughout; unit forms valley----------	200.0
37	Shale and sandstone interbedded; unit much less volcanic rich and lighter in color than overlying rocks; sandstone in beds 1 ft to 2.5 ft thick, light gray, fine-grained, hard, limy; shales are light olive gray to dark gray, sandy, and weather yellowish gray; sandstones in middle of unit contain more volcanic material than those in lower and upper parts----------	230.0
36	Covered, appears to consist of dark-gray, soft sandy shale----------	110.0

		Thickness
Judith River Formation--Continued		Ft
35	Shale and sandstone, like unit 37 except thin beds of sandstone are medium to coarse grained, pale olive to grayish olive, volcanic-rich and weather light brown; contains some sandy claystone in upper part----------	140.0
34	Bentonite, yellowish-orange, granular texture, nonswelling, uppermost unit in a 183 ft thick sequence light- and dark-banded beds of probably brackish-water origin----------	2.5
33	Shale, dusky-yellow, sandy and silty; contains layer of brown-weathering limy siltstone concretions----------	4.5
32	Shale, grayish-brown to dark-gray, silty to sandy--	11.0
31	Volcanic ash, grayish-orange, bentonitic----------	3.0
30	Shale, dusky-yellow, silty to sandy----------	9.5
29	Shale, like unit 32----------	8.0
28	Shale, like unit 30----------	9.5
27	Shale, like unit 32 except for a 1.5-ft thick bed of siltstone at top----------	9.0
26	Shale, like unit 30----------	5.0
25	Shale, like unit 32 except for 0.8-ft thick bed of sandstone at top----------	3.5

		Thickness
Judith River Formation--Continued		Ft
24	Shale, like unit 30 except for thin bed of sandstone at top----------	4.5
23	Shale, like unit 32----------	16.5
22	Shale, like unit 30----------	8.0
21	Claystone, dark gray, sandy----------	9.5
20	Claystone, dusky yellow, sandy----------	6.0
19	Sandstone, pale-yellowish-brown, fine- to medium-grained, tuffaceous----------	6.5
18	Shale, dark-brown to reddish-brown, carbonaceous, contains 3 beds of dark-gray noncalcareous shale-	13.5
17	Shale, dark-brown grading up into black carbonaceous shale at top----------	10.0
16	Shale, like unit 30----------	7.5
15	Sandstone, light-olive-gray, very fine grained; weathers pale olive, hard----------	15.0
14	Shale, weathers grayish orange; 1.5-ft thick fine grained, light-olive-gray sandstone 3 ft below top; unit contains brackish-water fossils; collected in 1957 by H. A. Tourtelot----------	8.8

Loc. D1607:

Crassostrea subtrigonalis (Evans and Shumard)?

Anomia micronema Meek?

Corbula aff. *C. undifera* Meek

		Thickness
Judith River Formation--Continued		Ft
	Corbicula sp.	
	Dircella? sp.	
	Thickness of Judith River Formation----------	1,380.0
Parkman Sandstone:		
13	Sandstone, light-gray, salt and pepper with dark mineral grains concentrated at base of low-angle crossbeds; fine- to medium-grained; locally contains placer-like accumulations of dark heavy mineral grains; contains Ophiomorpha-------	50.0
12	Sandstone and shale interbedded, sandstone in thin beds, light-gray, fine grained; shale, medium-dark-gray, nonsandy; gradational with overlying sandstone----------	70.0
	Thickness of Parkman Sandstone----------	120.0
Claggett Shale:		
11	Covered; a few miles to the south in the SE 1/4 NE 1/4 sec. 16, T. 6 N., R. 8 E., about 65 ft of medium-gray marine shale containing thin layers of pale-yellowish-gray soft sandstone is exposed in this interval; sandstone contain abundant borings, worm trails and Ohpiomorpha; unit contains several layers of dark-gray to brown-weathering nonfossiliferous limestone concretion----------	65.0

		Thickness
Claggett Shale--Continued		Ft
	Loc. D4200, from sandstone in upper part of unit: *Cymbophora* sp.	
	Inferred thickness of Claggett Shale----------	65.0
Eagle Sandstone:		
10	Covered; to the south this interval contains dark-yellowish-orange-weathering sandy claystone and shale with at least two beds of grayish-olive-green volcanic-rich sandstone----------	85.0
9	Poorly exposed; consists of grayish-orange to olive-green silty and sandy claystone containing thin beds of fine-grained volcanic-rich sandstone; a 1-ft-thick bed of dark-brown to black carbonaceous shale in middle of unit; weathers to a moderate yellowish-brown outcrop----------	278.0
8	Clay, black, lignitic----------	2.0
7	Sandstone, pale-olive to light-gray, fine- to medium-grained, soft; contains 4 hard layers of dark brown weathering concretionary sandstone; capped by a 3-ft-thick white sandstone----------	73.0

		Thickness
Eagle Sandstone--Continued		Ft
6	Sandstone and shale interbedded; sandstone is moderate yellowish brown with much limonite stain, fine grained and in thin discontinuous beds; shale is grayish brown and slightly carbonaceous, dominant lithology in lower 12 ft; a bed of brackish-water fossils at 12 and 17 ft above base; unit is capped by a thin layer of small claystone and rounded chert pebbles----------	26.0
	Loc. D4174, 12 and 17 ft above base:	
	Crassostrea sp.	
	Corbula subtrigonalis Meek and Hayden	
	Dircella? sp.	
	Remarks: Brackish-water assemblage	
5	Shale, black, carbonaceous----------	0.6
4	Sandstone, light-gray, fine-grained, clayey, soft----------	20.0

		Thickness
		Ft
Eagle Sandstone--Continued		
Virgelle Sandstone Member:		
3	Sandstone, light-gray, fine-grained, massive; contains thin lenses of olive green andesitic sandstone that weathers brown; unit capped by a 5.5-ft-thick bed of greenish-brown-weathering sandstone that is rich in magnetite; unit contains limy irregular masses and concretions of brown-weathering sandstone----------	120.0
	Thickness of Virgelle Sandstone Member---------	120.0
	Thickness of Eagle Sandstone----------	604.6
Telegraph Creek Formation:		
2	Sandstone and shale interbedded; light-olive-gray, fine-grained, thin-bedded; abundant worm trails; upper part poorly exposed----------	160.0
1	Sandstone, siltstone and shale interlaminated; pale-yellowish-gray, sandstone are very fine grained and weather to thin plates that litter the outcrop; unit contains two layers of dark-gray limestone concretions near middle and several thin beds of grayish-olive andesitic sandstone about 25 ft above base; upper part of unit is very soft and poorly exposed----------	610.0
Loc. D4175, at base:		
	Inoceramus platinus Logan	

	Thickness
Telegraph Creek Formation--Continued	Ft
Ostrea sp.	
Baculites codyensis Reeside (late form)	
Clioscaphites vermiformis (Meek and Hayden)	
Loc. D4176, 250 ft above base:	
Inoceramus platinus Logan	
Ostrea sp.	
Baculites cf. *B. asper* Morton	
Clioscaphites choteauensis Cobban?	
Thickness of Telegraph Creek Formation measured----------	770.0

Section 3

Composite section measured by J. R. Gill and L. G. Schultz in 1961 on the south side of Shawmut anticline and big Elk Dome, Wheatland County, Mont. Part of Hell Creek Formation and Lennep Sandstone measured in NE 1/4 SW 1/4 sec. 15, T. 6 N., R. 16 E., Wheatland County, Mont. The Colorado Shale is not part of the Montana Group.

		Thickness Ft
Hell Creek Formation (part):		
	Covered----------	
55	Sandstone, pale-yellowish-gray, fine-grained, arkosic, clayey, crossbedded, lenticular; contains a layer of 1.5-ft-diameter brown-weathering calcareous sandstone concretions 2 ft above base----------	18.0
54	Claystone, olive-gray to medium-dark-gray; weathers to pale yellowish gray, light greenish gray and light gray with rare streaks of red; forms badlands-	36.0
53	Claystone, dusky-yellow, contains discontinuous lenses of fine-grained sandstone; a 2-ft-thick bed of dark-brown to black bentonitic claystone at 8 ft above base----------	70.0
52	Sandstone, greenish-gray, coarse-grained at base, fine-grained at top, crossbedded, local ridge former----------	15.0
51	Claystone, dusky-yellow, sandy; contains a few thin lenticular beds of sandstone----------	89.0

		Thickness
Hell Creek Formation (part)--Continued		Ft
50	Bentonite, olive-gray, highly swelling, weathers to a deep frothy surface, has a hard siliceous base----------	3.0
49	Volcanic claystone, siltstone and discontinuous lenses of sandstone, yellowish-gray, dusky-yellow and greenish-gray; red grains of heulandite are abundant; a 5-ft-thick coarse-grained channel sandstone containing dinosaur bones occurs 38 ft above base----------	50.0
48	Claystone, medium-dark, bentonitic; weathers to a frothy surface----------	1.0
47	Shale, reddish-brown, carbonaceous----------	5.0
	Thickness of Hell Creek Formation measured----	287.0
Lennep Sandstone:		
46	Sandstone and shale interbedded, light-olive-gray; sandstone, medium-grained, hard, contains abundant worm trails and a few Ophiomorpha-------	12.0
45	Sandstone, light-olive-gray, fine- to medium-grained, calcareous, thin-bedded, ledge-former; contains Ophiomorpha----------	2.0
44	Claystone, grayish-olive in lower part, olive-gray in upper part; silty to sandy----------	52.0

	Thickness
Lennep Sandstone--Continued	Ft
43 Volcanic sandstone; grayish-olive, fine-grained; clayey, thin-bedded; contains several layers of moderate brown-weathering sandstone concretions in upper part; capped by a 0.5-ft-thick bed of moderate-brown-weathering hard sandstone; contains abundant Ophiomorpha----------	12.0
42 Sandstone, pale-yellowish-gray, fine- to medium-grained, thin-bedded to massive with low-angle crossbeds; weathers light-gray; contains abundant Ophiomorpha; ledge former----------	34.0
Thickness of Lennep Sandstone----------	112.0

Following section measured near the center of sec. 23, T. 6 N., R. 15 E., Wheatland County, Mont.

Bearpaw Shale:

41 Shale, dark- to medium-gray, silty; weathers dark gray to brownish gray; numerous thin beds of tan-weathering very fine grained sandstone in upper 25 ft; three layers of sparsely fossiliferous dark-gray to brown-weathering calcareous siltstone concretions at 235, 170, and 100 ft above base---------- 330.0

Loc. D3628, 170 ft above base:

Baculites eliasi Cobban?

		Thickness
Bearpaw Shale--Continued		Ft
	Loc. D3627, 100 ft above base:	
	Nymphalucina occidentalis (Morton)	
40	Covered in stream valley; probably like unit 41----	75.0
39	Shale, dark-gray to black, flaky; numerous layers of dark-gray fossiliferous tan-weathering septarian limestone concretions; a few thin beds of light-gray orange-weathering bentonite. A thin lens of light-brown-weathering fine- to medium-grained sandstone about 40 ft above base, and a 0.3-ft-thick hard bed of light-gray fine- to medium-grained unaltered ash at 35 ft above base----------	75.0
	Loc. D3626, upper 10 ft of unit:	
	Baculites cuneatus Cobban	
	Placenticeras meeki Boehm	
38	Shale, similar to unit 39, with numerous beds of orange-weathering ashy bentonite, and gray- and brown-weathering sparsely fossiliferous septarian limestone concretions; a 2.5-ft-thick bed of light-gray bentonite about 75 ft above base, and a 3-ft-thick bed at the base----------	110.0
	Loc. D3625, 100 ft above base:	
	Baculites compressus Say subsp. *robinsoni* Cobban	

		Thickness
Bearpaw Shale--Continued		Ft
	Hoploscaphites sp.	
	Placenticeras meeki Boehm	
	Loc. D3624, 5 to 25 ft above base:	
	Baculites compressus Say subsp. robinsoni Cobban	
	Placenticeras meeki Boehm	
37	Shale, similar to unit 39, poorly exposed along line of section. Contains a few layers of gray- to brown-weathering septarian limestone concretions----------	150.0
36	Shale, similar to unit 39; contains numerous beds of pale-olive-gray bentonite associated with thin beds of light-gray bentonite shale; 1.5- and 4-ft-thick bentonite beds at base and at 7 ft above base; 1-, 1.5- 2,- and 1-ft-thick bentonite beds at 60, 76, and 90 ft above base and at top of unit; five other beds, less than 0.5 ft in thickness, are present in upper 40 ft of unit. Large oval 3- by 5-ft reddish-brown weathering silty septarian limestone concretions occur at 55 ft above base--	100.0
	Thickness of Bearpaw Shale----------	840.0

		Thickness
Judith River Formation:		Ft
35	Volcanic siltstone, claystone and sandstone interbedded, greenish-gray; about 12 layers of ridge-forming greenish-gray volcanic sandstone less than 2 ft thick; several beds of dark-reddish-brown carbonaceous shale in upper part; unit poorly exposed----------	430.0

Lower part of section measured near the Cen. sec. 18, T. 6 N., R. 16 E., Wheatland County, Mont.

34	Sandstone, fine- to medium-grained, greenish-gray, calcareous, thin- and crossbedded, forms two ridges in upper and middle part; rest of unit is softer greenish clayey sandstone and sandy claystone; contains dinosaur bone fragments; sandstones form a series of fairly prominent parallel ridges----------	30.0
33	Sandstone, fine-grained, light-greenish-gray, calcareous, crossbedded, forms three ridges separated by greenish-gray argillaceous siltstone; uppermost sandstone forms prominent dark-brown dip slope---	65.0
32	Shale, silty, carbonaceous, black plant fragments with some medium-gray claystone in upper part----	30.0
	Thickness Judith River Formation----------	555.0

		Thickness
Parkman Sandstone:		Ft
31	Sandstone, yellowish-gray, fine- to medium-grained, calcareous, soft, poorly exposed----------	55.0
30	Sandstone, yellowish-gray, fine-grained, calcareous massive, crossbedded; contains Ophiomorpha-------	30.0
29	Sandstone, yellowish-gray, fine-grained, calcareous, thin-bedded, ripple marked; contains thin beds of silty shale in upper part; rare limestone concretions in middle; lower 2 ft forms persistent ledge-----	50.0
	Thickness of Parkman Sandstone----------	135.0
Claggett Shale:		
28	Poorly exposed; seems to be thin beds of shale and soft fine-grained sandstone----------	65.0
27	Sandstone, light-olive-gray, fine- to medium-grained, very calcareous, soft; few iron-cemented layers form minor ridges----------	25.0
26	Sandstone and shale interbedded, light-olive-gray, very fine grained, thin-bedded, calcareous-------	35.0
25	Sandstone, fine-grained, light-olive-gray, calcareous-	5.0
24	Shale, light-olive-gray to olive-gray, very silty, calcareous, interbedded with a few thin very fine grained sandstone beds. Contains a few poorly preserved shells of Inoceramus----------	60.0

	Thickness
Claggett Shale--Continued	Ft
23 Shale and sandstone interbedded, light-olive-gray; sandstone very fine grained and thin-bedded-------	55.0

Following part of section measured in the NW 1/4 NW 1/4 sec. 13, T. 6 N., R. 15 E., Wheatland County, Mont.

22 Shale, olive-gray; weathers flaky; poorly exposed. Contains a 1.6-ft-thick pale yellowish-gray bentonite bed 7 ft above base; thin silty and sandy layers in upper 5 ft and rare iron-stained limestone concretions in upper part----------	55.0
21 Shale, gray, silty to sandy, interbedded with thin hard layers of tan- to buff-weathering very fine-grained sandstone and siltstone in beds ranging from 0.1 to 0.5 ft in thickness; unit capped by a 5-ft-thick bed of sandstone, the upper 3 ft of which is soft, the lower part forms persistent ridge----------	56.0
Thickness of Claggett Shale----------	356.0
Eagle Sandstone:	
20 Sandstone, pale-yellowish-gray, medium- to coarse-grained; thin-bedded, hard ridge-former; weathers tan; contains a few small tan-weathering clay pebbles----------	10.0
19 Claystone, silty, medium- to olive-gray, soft, calcareous----------	28.0

		Thickness
Eagle Sandstone--Continued		Ft
18	Siltstone, light-gray, soft, argillaceous, calcareous----------	9.0
17	Claystone, dark-olive-gray, bentonitic, slightly carbonaceous, soft; weathers brown----------	15.0
16	Sandstone, light-gray, fine-grained, thin-bedded; locally crossbedded; hard ridge former----------	15.0
15	Covered; consists of dark-gray sandy shale---------	27.0
14	Sandstone, similar to unit 16; upper 16 ft and lower 7 ft are hard and ridge-forming, middle 10 ft is covered; probably consists of soft sandstone and thin beds of sandy shale----------	33.0
13	Poorly exposed; upper 6 ft consists of soft light-gray sandstone and the lower 19 ft consists of brown-weathering dark-olive-gray bentonitic claystone that contains a 1-ft-thick bed of pale-yellowish-gray bentonite at the top---------	25.0
12A	Sandstone, greenish- to olive-gray, fine- to medium-grained; a scattering of tan clay pebbles, a few borings and fossils in upper part; weathers to form a hard light-brown presistent ridge------	12.0

Loc. D3623:

Nuculana sp.

Modiolus? sp.

		Thickness
Eagle Sandstone--Continued		Ft
	Cymbophora? sp.	
	Placenticeras sp.	

The following part of the section was measured in the NE 1/4 sec. 14, T. 6 N., R. 15 E. Units 7 through 12 are rarely exposed; they are described from trenched outcrop.

12	Sandstone and shale interbedded; soft, poorly exposed----------	8.0
11	Claystone, dark-gray to light-olive-gray, soft, bentonitic; upper 2 ft is black and very carbonaceous----------	17.0
10	Bentonite, pale-olive-gray, biotitic----------	2.0
9	Claystone, similar to unit 11, but without carbonaceous shale----------	7.0
8	Sandstone, yellowish-gray, clayey, bentonitic; weathers buff to light orange brown----------	17.0
7	Claystone, dark-brown to black, sandy, bentonitic; contains a 2-ft-thick bed of impure black lignite at base----------	11.0

Virgelle Sandstone Member:

6	Sandstone, white in upper part to light olive gray in lower part, fine- to medium-grained, non-calcareous; thin to medium even bedded; contains abundant borings and _Ophiomorpha_; appears andesitic in part----------	73.0
	Thickness of Eagle Sandstone----------	309.0

		Thickness Ft
	Measured in the N 1/2 of the SE 1/4 sec. 8, T. 6 N., R. 16 E., Wheatland County, Mont.	
Telegraph Creek Formation:		
5	Shale, dark-gray, silty, rarely exposed----------	32.0
4	Sandstone, pale-yellowish-gray, fine-grained; upper part weathers brown and is massive, the lower is white and thin bedded----------	30.0
3	Poorly exposed; probably mostly sandy shale and thin beds of soft sandstone; a 6-ft-thick thin bedded light-gray sandstone occurs about 100 ft above the base, and two thin layers of light-gray calcareous septarian siltstone concretions occur about 75 ft above base; the rest of the unit is covered-	120.0
2	Sandstone, light-gray, very fine to fine-grained, very thin bedded; some low-angle crossbedding present in the middle of unit----------	60.0
	Loc. D4215:	
	starfish?	
	Terebrimya? sp.	
	Baculites cf. B. haresi Reeside	
	Total Telegraph Creek Formation----------	242.0

		Thickness
Colorado Shale:		Ft
1	Shale, dark-gray, poorly exposed; contains gray septarian limestone concretions in upper part and dark-orange-brown-weathering septarian limestone concretions; several thick beds of bentonite are present. Lower part of unit consists of about 145 ft of greenish-brown sandy claystone and thin beds of fossiliferous brown-weathering fine- to coarse-grained glauconitic andesitic sandstone, one of which contains phosphatic and dark chert pebbles to 1/2 in. diameter-------	730.0

Loc. D3622, about 145 ft above base:

Inoceramus sp.

Pleuriocardia n. sp.

Baculites asper Morton

Pinna sp.

Inoceramus cf. I. involutus Sowerby

Inoceramus stantoni Sokolow

Gryphaea n. sp.

Pholadomya papyracea Meek and Hayden

Crassatella sp.

Legumen sp.

Turritella sp.

Baculites codyensis Reeside

Remarks: Zone of Scaphites depressus

Colorado Shale--Continued

Loc. D4214, same level in SW 1/4 sec. 11, T. 6 N., R. 16 E.

Inoceramus sp.

Pholadomya papyracea Meek and Hayden

Crassatella andrewsi Henderson

Baculites codyensis Reeside

Baculites asper Morton

Scaphites sp.

Remarks: Probably from Range Zone of *Scaphites depressus*.

Section 4

Hell Creek Formation, Lennep Sandstone, and uppermost part of the Bearpaw Shale measured south of Lavina in the SE 1/4 sec. 23, T. 6 N., R. 22 E. The remainder of the section was measured by J. R. Gill and L. G. Schultz on the south flank of Woman's Pocket anticline, Golden Valley County, Mont.

		Thickness Ft
Hell Creek Formation (part):		
75	Sandstone and sandy mudstone interbedded, light-olive-brown; sandstone medium- to coarse-grained; contains 2-ft-thick by 6-ft-diameter sandstone concretions that weather with concentric shells--	20.0
74	Mudstone, reddish-brown, carbonaceous----------	18.0
73	Claystone, pale-yellowish-gray, weathers light gray----------	0.5
72	Lignite, black, impure----------	1.0
71	Mudstone, reddish-brown, carbonaceous----------	2.0
70	Mudstone, olive-gray, sandy; contains thin streaks of sandstone and carbonaceous shale----------	18.0
	Thickness Hell Creek Formation measured--------	59.5
Lennep Sandstone:		
69	Sandstone, pale-yellowish-gray, medium- to coarse-grained, crossbedded, hard ledge former----------	1.5

	Thickness
Lennep Sandstone--Continued	Ft
68 Sandstone, pale-yellowish-gray, very fine grained; thin bedded, ripple marked; contains abundant Ophiomorpha----------	15.0
67 Sandstone and shale interlaminated, medium-light-gray; weathers tan, soft slope former----------	40.0
Thickness Lennep Sandstone----------	56.5
Bearpaw Shale:	
66 Shale, medium-dark-gray, sandy; contains a 1-ft-thick by 20-ft in diameter layer of sandy limestone concretions at 30 ft above base and a layer of small, brown-weathering sandy limestone concretions at 70 ft above base----------	95.0
Loc. D4219, 70 ft above base: Ostrea sp. Cymbophora warrenana (Meek and Hayden)	
65 Volcanic ash, light-greenish-gray, biotitic, fine-grained, soft----------	1.5

		Thickness
Bearpaw Shale--Continued		Ft
64	Shale, medium-dark-gray to olive-gray, silty to finely sandy, weathers to a light-olive-gray surface; contains numerous layers of gray limestone concretions that weather yellowish gray to moderate brown; contains at base a layer of 0.8-ft-thick by 8-ft-diameter limestone concretions and a layer of brown limestone concretions at 20 ft above base, a layer of gray limestone concretions at 38 ft and a layer of dark-brown-weathering limestone concretions at 68 ft above base--------	70.0

Loc. D4217, 38 ft above base:

Yoldia cupressensis Landes

Nucula (Pectinucula) sp.

Protocardia rara (Evans and Shumard)

Hoploscaphites sp.

Remarks: The abundance of *Protocardia* and *Yoldia* suggests either the zone of *Baculites baculus* or that of *B. grandis*.

Loc. D4218, 68 ft above base:

Baculites grandis Hall and Meek

Following part of Bearpaw Shale measured in the SW 1/4 sec. 25, T. 8 N., R. 20 E., Golden Valley County, Mont.

		Thickness
Bearpaw Shale--Continued		Ft
63	Shale, gray, silty to sandy; contains a thick persistent ridge-forming layer of silty septarian limestone concretions at top of unit and gray- and light-brown-weathering limestone concretions at 11, 22, and 52 ft above base of unit----------	82.0
62	Bentonite, orange, nonswelling----------	0.3
61	Shale, gray, silty to sandy; contains a presistent layer of gray limestone concretions at base and 51 ft above base and a thin bed of bentonite 27 ft above base of unit----------	71.0
60	Poorly exposed; contains at least one thin bed of bentonite and two layers of limestone concretions----------	37.0
59	Bentonite, yellowish-orange, nonswelling----------	0.4

	Thickness
Bearpaw Shale--Continued	Ft
58 Shale, gray, silty to sandy; contains gray septarian and brown fossiliferous limestone concretions at 7, 22, and 29 ft above base of unit----------	33.0
Loc. D3606, at 22 ft above base of unit: bryozoan *Nymphalucina* sp. *Baculites cuneatus* Cobban	
Loc. D3605, at 7 ft above base of unit: bryozoan *Phelopteria linguaeformis* (Evans and Shumard) *Baculites cunetus* Cobban *Hoploscaphites* sp.	
57 Sandstone, gray, fine-grained; locally grades into rusty-weathering siltstone----------	0.4
56 Shale, gray, silty to sandy; contains brown-weathering fossiliferous limestone concretions at 2 ft above base and a thin layer of brown-weathering slabby siltstone at 15 ft above base--	25.0
Loc. D3604, 9 ft above base of unit: *Phelopteria linguaeformis* (Evans and Shumard) *Baculites cuneatus* Cobban	

		Thickness
Bearpaw Shale--Continued		Ft
55	Shale, medium-gray, silty; contains limestone concretion layers at 1, 4, 26, 44 ft above base and top of unit----------	57.0
	Loc. D3603, at top of unit: *Phelopteria linguaeformis* (Evans and Shumard) *Baculites cuneatus* Cobban	
	Loc. D3602, at 4 ft above base of unit: *Baculites compressus* Say subsp. *robinsoni* Cobban *Hoploscaphites nodosus* (Owen)	
	Loc. D3601, at 1 ft above base of unit: *Baculites compressus* Say subsp. *robinsoni* Cobban	
54	Bentonite, yellowish-orange----------	0.6
53	Shale, medium-gray, silty----------	10.4
52	Bentonite, yellowish-orange, nonswelling----------	1.0

		Thickness
Bearpaw Shale--Continued		Ft
51	Shale, gray, silty; contains limestone concretion layers at 5, 14, and 24 ft above base----------	26.0
	Loc. D3600, 24 ft above base:	
	Inoceramus sp.	
	Drepanochilus sp.	
	Baculites compressus Say subsp. *robinsoni* Cobban	
	Hoploscaphites nodosus (Owen)	
	Loc. D3599, 14 ft above base:	
	Inoceramus sagensis Owen	
	Ostrea sp.	
	Varicorbula crassimarginata (Meek and Hayden)	
	Baculites compressus Say subsp. *robinsoni* Cobban	
50	Bentonite, greenish-gray, nonswelling----------	0.4
49	Shale, medium-gray; contains a layer of fossiliferous limestone concretions 2 ft above base----	15.0
48	Bentonite, greenish-gray----------	0.2
47	Shale, gray, silty, contains layer of red-weathering limestone concretions at 2 and 9 ft above base---	19.0
46	Bentonite, pale-greenish-gray, nonswelling---------	2.0
45	Shale, medium-gray, silty; contains a thin layer of brown slabby weathering siltstone at 6 ft above base----------	19.0

		Thickness
Bearpaw Shale--Continued		Ft
44	Bentonite, greenish-gray----------	0.2
43	Shale, medium-gray; contains a layer of sparse limestone concretions at 12 ft above base--------	15.0
42	Bentonite, greenish-gray, nonswelling----------	3.0
41	Shale, medium-gray, silty, layers of limestone concretions at 4, 8, and 28 ft above base--------	29.0
40	Bentonite, yellowish-orange, nonswelling----------	0.3
	Shale, medium-gray, silty; contains a layer of light-brown-weathering sparsely fossiliferous limestone concretions at base and 8, 20 and 23 ft above base of unit----------	34.0

Loc. D3598, 23 ft above base:

Placenticeras meeki Boehm

Loc. D3597, at base:

Inoceramus sp.

Drepanochilus sp.

Ellipsoscapha sp.

Baculites compressus Say subsp. *robinsoni* Cobban

Placenticeras meeki Boehm

Placenticeras cf. *P. intercalare* Meek

	Thickness
Bearpaw Shale--Continued	Ft
39 Shale, medium-dark-gray, bentonitic; weathers to soft gray crust, becomes silty in upper part; sparse gray limestone concretions at base and dark-gray-, gray-, and brown-weathering septarian limestone concretions at 35, 27, 16, and 8 ft above base; 1 and 1.8 -ft-thick beds of light-gray bentonite at 25 and 38 ft above base--------	50.0

Loc. D3596, 8 to 35 ft above base:

Nuculana sp.

Inoceramus sagensis Owen

Phelopteria linguaeformis (Evans and Shumard)

Ostrea sp.

Modiolus sp.

Cymella montanensis Henderson

Cuspidaria variabilis Warren

Tenea circularis (Meek and Hayden)

Cymbophora holmesi (Meek)

Varicorbula crassimarginata (Meek and Hayden)

Acmaea occidentalis (Meek and Hayden)

Drepanochilus sp

Baculites compressus Say subsp. robinsoni Cobban

Placenticeras meeki Boehm

		Thickness
Bearpaw Shale--Continued		Ft
	Loc. D3619, at base:	
	Inoceramus sp. (discarded)	
	Baculites compressus Say subsp. *robinsoni* Cobban	
38	Shale, medium-dark-gray; weathers to flaky brownish-gray crust; at 10 ft above base is a 0.5 ft-thick bentonite bed, and a 0.6 ft-thick bentonite bed at top of unit; in upper 35 ft are 9 layers of dark-reddish-brown limestone concretions, some of which have dark-gray-tan-weathering limestone concretions----------	47.0
	Loc. D3620, 3 ft above base:	
	Inoceramus sagensis Owen	
	Baculites compressus Say subsp. *robinsoni* Cobban	
	Placenticeras meeki Boehm	

		Thickness
Bearpaw Shale--Continued		Ft
37	Shale, medium-gray, silty; weathers to flaky brownish-gray crust; poorly exposed; contains two layers of small reddish-brown-weathering siderite concretions and a layer of gray limestone concretions in lower 30 ft; at 32 ft above base is a layer of closely spaced 1 by 8 ft gray to reddish-brown-weathering silty septarian limestone concretions that contain some colorless quartz crystals in fractures, sparsely fossiliferous. At the top is a 0.3 ft-thick bentonite bed and at 77 ft above base if a 1-ft-thick bed of pale yellowish-gray bentonite; two layers of limestone concretions occur in uppermost 10 ft of unit-----	87.0
	Loc. D3595, 32 ft above base:	
	Inoceramus sagensis Owen	
	Baculites compressus Say subsp. *robinsoni* Cobban	
	Placenticeras meeki Boehm	
36	Bentonite, calcareous, pale-yellowish-gray, abundant plates of fibrous calcite; at base is a 0.2-ft-thick bed of very fine-grained gray ripple-marked sandstone; poorly swelling----------	4.0
	Loc. D3594, from sandstone:	
	Crassatella sp.	

		Thickness
Bearpaw Shale--Continued		Ft
35	Shale, dark-gray, soft, fossiliferous; contains *Ostrea patina* Meek and Hayden----------	17.0
34	Bentonite, pale-olive-gray, deeply weathered; forms light-gray frothy outcrop, very biotitic---	5.0
33	Shale, medium-gray, silty at base; contains sparse 3 by 6 ft gray-, tan-, and brown-weathering-septarian concretions 33 ft above base; septa formed by 1/16 to 1/4 in. layers of colorless quartz crystals, some of which have a coating of white calcite crystals, are rarely fossiliferous--	50.0
	Loc. D3593, 33 ft above base: *Cymella montanensis* Henderson *Placenticeras Meeki* Boehm	
32	Shale, gray, very sandy to silty, with thin layers of reddish-brown-weathering fine-grained sandstone; sparse 4 by 6 ft light-orange-weathering septarian siltstone concretions at top, a few have septa of milky white chalcedony; poorly exposed----------	45.0
	Thickness of Bearpaw Shale----------	952.7

		Thickness
Judith River Formation		Ft
31	Poorly exposed; appears to be largely carbonaceous shale interbedded with light-gray clayey sandstone, and green and gray claystone with minor buff sandstone and brown ironstained sandstone concretions. Top of unit and top of Judith River Formation placed at top of uppermost carbonaceous shale; oysters 5 ft above base in tuffaceous sandstone----------	80.0
	Loc. D3592, 5 ft above base:	
	Crassostrea subtrigonalis (Evans and Shumard)	
30	Sandstone, light-brownish-gray, fine-grained, thin-bedded, calcareous, seems andesitic; weathers to minor ridge strewn with brown and reddish-brown sandstone chips----------	5.0
29	Shale, carbonaceous, silty, brownish-gray, noncalcareous, with abundant plant fragments and minor amounts of dark-gray bentonitic claystone; contains several thin layers of coal and a 6-ft-thick coal bed 40 ft above base; minor white-weathering carbonaceous sandstone, soft gray claystone, and argillaceous sandstone; silicified log 1 ft in diameter found near top; brown calcareous siderite concretions, one formed around a piece of carbonized wood----------	60.0

		Thickness
Judith River Formation--Continued		Ft
28	Carbonaceous shale, sandstone, and claystone, similar to unit 28 in lower 20 ft. Upper part light olive gray, fine-grained, argillaceous sandstone and gray claystone. Locally two lenticular fine-grained thin-bedded limy sandstone beds at 32 and 21 ft above base form minor ridges; brown ferruginous sandstone at 22 ft above base----------	35.0
27	Sandstone, light-brownish-gray, fine-grained, thin wavy bedding, very calcareous; forms prominent ridge----------	1.0
26	Shale, brownish-gray, silty, carbonaceous, contains abundant plant fragments and minor dark gray bentonitic claystone; weathers to dark band above unit 24; some dark-brown calcareous carbonaceous sandy concretions and minor thin coal streaks----------	25.0
25	Sandstone, light-olive-gray, fine-grained, clayey, greenish-gray argillaceous siltstone, and gray claystone; local thin beds of calcareous brown-weathering sandstone----------	40.0

		Thickness
Judith River Formation--Continued		Ft
24	Sandstone, light-olive-gray, fine-grained, cross-bedded and ripple marked; cemented hard with calcite and iron; seems andesitic; forms the lower of the two most prominent and persistent ridges in the upper part of the Judith River Formation----------	3.0
23	Mostly light-greenish-gray and light-gray-silty claystone and lesser argillaceous sandstone with 10 harder sandy tuffaceous layers indurated with calcite or iron that form minor ridges in slope; one sandstone ledge 49 ft above base contains abundant leaf and twig impressions and bond fragments; some sandstone ripple marked; minor carbonaceous shale in upper part; some siderite concretions----------	125.0
22	Sandstone, yellowish- to greenish-gray, medium-grained, calcareous; numerous claystone and some volcanic pebbles; crossbedded; appears very andesitic; lower part coarse-grained and lighter colored; upper part weathers to minor dark ledge-	30.0
	Thickness of Judith River Formation----------	404.0

		Thickness
Parkman Sandstone:		Ft
21	Sandstone, yellowish-gray, calcareous, micaceous; mostly thick bedded to massive, crossbedded; borings in lower part; clay pebble conglomerate at top----------	70.0
20	Sandstone, yellowish-gray, fine-grained, thin- to medium-bedded, crossbedded, calcareous; interbedded with olive-gray shale and soft clayey sandstone; forms saddle between units 18 and 20----------	30.0
19	Sandstone, fine-grained, yellowish-gray, calcareous, micaceous; mostly thick-bedded to massive, crossbedded; lower part thin bedded with shaly partings; rare borings; honeycomb weathering; forms basal cliff----------	50.0
	Thickness of Parkman Sandstone----------	150.0
Claggett Shale:		
18	Shale, olive-gray, silty, slightly micaceous; tan-weathering silty limestone concretions at 55, 25, 18, and 5 ft above base; upper 20 ft covered by debris from cliff above----------	80.0

Loc. D3616, 55 ft below top of this interval in SE 1/4 sec. 33, T. 8 N., R. 22 E.:

Baculites perplexus Cobban

		Thickness
Claggett Shale--Continued		Ft
	Loc. D3618, 60 ft below top if this interval in NW 1/4 sec. 26, T. 7 N., R. 22 E.:	
	Inoceramus subcompressus Meek and Hayden	
	Baculites perplexus Cobban	
17	Covered; dark shale with numerous iron stained limestone concretions in nearby areas----------	200.0
	Loc. D3617, about middle of this unit in NW 1/4 sec. 26, T. 7 N., R. 20 E.:	
	Inoceramus subcompressus Meek and Hayden	
	Baculites sp.	
16	Shale, olive-gray, noncalcareous; fragments of iron limestone concretions on surface----------	5.0
15	Covered; bentonitic shale and bentonite in lower part; shale and iron limestone concretions in upper part in nearby areas----------	180.0
	Loc. D3615, near base of this interval in SW 1/4 sec. 33, T. 8 N., R. 22 E.:	
	Baculites obtusus Meek	
	Thickness of Claggett Shale----------	465.0
Eagle Sandstone:		
14	Shale, silty, olive gray, noncalcareous, minor plant fragments on bedding----------	30.0

		Thickness
Eagle Sandstone--Continued		Ft
13	Sandstone, yellowish gray, fine-grained, calcareous, slightly micaceous, thin, poorly bedded in lower 10 ft, massive crossbedded 10 to 20 ft above base (thins laterally), and thin wavy bedding in upper part (most common around the anticline); top 1 to 2 ft cemented with calcite and iron forming hard cap with scattered black chert pebbles at top; pelecepods at top and bottom	40.0
	Loc. D3613, at top:	
	Ethmocardium whitei Dall	
	Legumen sp.	
	Cymbophora sp.	
	Loc. D3614, base of unit:	
	Ethmocardium whitei Dall	
12	Siltstone, light-olive-gray, very argillaceous, slightly micaceous, noncalcareous; calcareous sandstone concretion layers at 50, 46, 23, and 11 ft above base; very sandy in upper part grading into unit above----------	90.0
11	Covered, Possibly soft, clayey sandstone or siltstone as in adjacent units----------	140.0
10	Sandstone, very clayey, dark-greenish-gray; poorly exposed----------	10.0

		Thickness
Eagle Sandstone--Continued		Ft
9	Sandstone, yellowish- to greenish-gray, fine- to medium-grained, thin-bedded, crossbedded and ripple marked; locally carbonaceous fragments on bedding; partly calcareous; abundant worm trails and borings, and rare Ophiomorpha; forms prominent brown cliff----------	30.0
8	Sandstone, dark-greenish-gray, very clayey, poorly bedded, slightly micaceous, noncalcareous; weathers to light-green slope; appears andesitic; slightly carbonaceous in upper 2 ft----------	15.0
7	Sandstone, mottled brownish-gray, light-gray; very carbonaceous, some carbonaceous shale; mostly covered by debris from cliff above----------	7.0
Virgelle Sandstone Member		
6	Sandstone, very light gray, fine- to medium-grained, crossbedded, iron stained in upper few feet; top forms small ridge in saddle between units 4 and 8-	75.0
5	Sandstone, yellowish-gray, fine-grained, calcareous, micaceous, mostly thin bedded, some medium bedded, minor silty partings, locally abundant borings and trails; forms prominent cliff----------	60.0
	Thickness of Eagle Sandstone----------	497.0

Telegraph Creek Formation measured in SW 1/4 sec. 5, T. 7 N., R. 22 E.

		Thickness
Telegraph Creek Formation:		Ft
4	Shale, dark-gray, very sandy, forms reentrant, soft, shaly fractures; weathers to grayish-tan surface; locally with thin beds of nonpersistent sandstone, becomes very sandy in upper part------	24.0
3	Sandstone, gray, very fine grained, thin-bedded, clayey; weathers tan; abundant borings; soft; uppermost 5 ft forms persistent ledge----------	28.0
2	Shale, dark-gray, with thin layers of soft muddled sandstone; forms smooth dark-gray slope; becomes increasingly sandy in upper 20 ft; sandy calcareous concretions at 55, 47, and 25 ft above base------	82.0
1	Sandstone, siltstone, and shale, interlaminated; shale, medium-gray, sandy; sandstone, light-gray, very fine grained with abundant dark mineral grains, calcareous forming hard discontinuous lenses to 1 in. thick, weathers to a light-yellowish-gray smooth plate-littered slope. Three layers of light-gray calcareous septarian siltstone concretions at top and at 78 and 75 ft above base, with septa of white barite----------	80.0
	Base covered.	
	Thickness of Telegraph Creek Formation measured	214.0

Section 5

Section of the upper part of the Claggett Shale, the Parkman Sandstone, and the lower part of the Judith River Formation measured by J. R. Gill along the south side of a small tributary to Dog Creek starting in about the cen. NE 1/4 sec. 31 and continuing up a steep ridge to the top of a flat-topped hill that occupies the central part of the SE 1/4 sec. 31, T. 23 N., R. 17 E., Fergus County, Mont.

		Thickness Ft
Judith River Formation (part):		
17	Poorly exposed, probably consists dominantly of soft sandstone----------	30.0
16	Sandstone, pale-yellowish-gray; contains hard ledge-forming bed of limy sandstone at 25 ft above base and layer of large brown-weathering limy sandstone concretions at 20 ft above base----------	27.0
15	Claystone, pale-yellowish-gray, soft, bentonitic, silty to sandy; has a bed of bentonite 2 ft thick in upper part; weathers light gray to white------	38.0
14	Sandstone, medium- to light-gray, medium-grained, crossbedded, contains abundant dark mineral grains and local hard lenses of limy sandstone; weathers tan to buff contrasting with lighter-colored over- and underlying beds----------	14.0
13	Claystone, similar to unit 15; grades laterally into clayey sandstone----------	20.0

		Thickness
Judith River Formation (part)--Continued		Ft
12	Claystone and shale interbedded, olive-gray, silty to sandy, bentonitic; weathers pale greenish gray, becoming very bentonitic in upper 15 ft; poorly exposed; thin streaks of brown carbonaceous shale at 53, 42, 28, and 15 ft above base----------	65.0
11	Sandstone, light-gray, fine- to medium-grained, argillaceous, soft; contains abundant reddish-brown streaks of carbonaceous sandstone and makes light band that contrasts with darker underlying sandstone----------	13.0
	Total Judith River Formation measured---------	207.0
Parkman Sandstone:		
10	Sandstone, light-gray, very fine grained; weathers gray to buff; has a medium- to coarse-grained iron-cemented ledge-forming bed at top of unit; at 24 ft above base is a lense of brown hard limy sandstone; lower 12 ft clayey and soft, with sparse layers of limonite-cemented brown sandstone near base ----------	28.0
9	Shale, siltstone, and sandstone interbedded; medium- to browish-gray; weathers pale brown----------	15.0

		Thickness
Parkman Sandstone--Continued		Ft
8	Sandstone, yellowish-gray, clayey, fine-grained, soft, weathers pale yellowish brown----------	10.0
7	Poorly exposed; seems to consist chiefly of soft, bentonitic, silty shale or clayey siltstone with a few streaks of brown carbonaceous shale; a layer of dark-gray to brown-weathering septarian limestone concretions near top. Unit weathers light brown----------	25.0
6	Sandstone, pale-yellowish-gray, soft, clayey, very fine grained, crossbedded; contains lenses of hard orange-brown, tan, and gray-weathering limy sandstone; contains sparse chert pebbles and rounded bond fragments in upper part and a few gray sandy limestone concretions throughout; weathers to buff and light brown----------	53.0
5	Shale, sandy, bentonitic, soft, deeply weathered; poorly exposed; sparse brown-weathering limestone concretions at 30 and 18 ft above base; weathers tan to light brown----------	55.0
4	Sandstone, pale-yellowish-gray, very fine grained, soft; interbedded with soft sandy claystone------	28.0

	Thickness
Parkman Sandstone--Continued	Ft
3 Sandstone, similar to unit 4; very thin bedded, fossiliferous; has 1 to 2 ft thick ledge-forming limy layers at 30, 12, 7, and 2 ft above base; weathers tan to very light brown----------	30.0
Loc. D 3284:	
Pholadomya subventricosa Meek and Hayden	
Cymella montanensis Henderson	
Euspira subcrassum (Meek and Hayden)	
Baculites asperiformis Meek	
2 Sandstone, fine-grained, medium-dark-gray to gray, soft, clayey; weathers light gray to yellowish gray----------	6.0
Total Parkman Sandstone----------	250.0
Claggett Shale (part):	
1 Shale, medium-dark-gray, bentonitic, soft; weathers to a medium-brownish-gray crust; contains a few sparse layers of dark-brown- to orange-brown-weathering septarian limestone concretions-------	50.0+

Section measured by L. G. Schultz in a tilted fault block in the NW 1/4 NW 1/4 sec. 13, T. 22 N., R. 17 E., Fergus County, Mont.

		Thickness Ft
Eagle Sandstone:		
22	Sandstone, light-gray, very fine grained, very clayey in all but the lower 10 ft; two beds of black and brown chert granules and pebbles, one at 4 to 4.5 ft above base and the other 9.5 to 10 ft above base. Unit contains light-brown-weathering limestone concretions with gypsum crusts scattered throughout; capped by 1-ft to 2-ft-thick layer of closely spaced brown-weathering sandy limestone concretions containing scattered dark chert granules. Forms a long dip slope below the overlying soft Claggett Shale; unit forms slope above cliff of unit 21----------	38.0

Loc. D3271, lower part of this unit in SE 1/4 NW 1/4 sec. 31, T. 23 N., R. 17 E.:

Ethmocardium whitei Dall

Tellina equilateralis Meek and Hayden

Cymbophora alta Meek and Hayden

		Thickness
Eagle Sandstone--Continued		Ft
21	Sandstone, yellowish-gray, fine-grained, crossbedded, appears tuffaceous; lower 2 ft of unit medium-grained, crossbedded, and contains numerous flat polished black and brown chert pebbles; abundant shale pebbles in lower 8 ft; unit forms prominent light-gray to white cliffs; sandy limestone concretions at top contain crushed fossils----------	20.0
20	Sandstone, yellowish-gray, fine-grained; contains thin beds of gray shale; 1 ft carbonaceous shale at base----------	13.0
19	Sandstone, light-olive-gray, fine-grained, micaceous, soft, friable; forms light-brown slope; bedding poorly developed----------	15.0
18	Sandstone, muddled with olive-gray shale----------	20.0
17	Sandstone, similar to unit 19----------	8.0
16	Sandstone, medium-brown, fine-grained, friable, interbedded with shale; 0.05-ft-thick cone-in-cone limestone layer and a 0.2-ft-thick red-weathering sideritic clay layer in middle of unit----------	5.0
	Loc. D3270 at this level in SE 1/4 NW 1/4 sec. 13, T. 23 N., R. 17 E.:	
	Corbula sp. (phosphatic casts)	
	Bits of bones and crabs	

		Thickness
Eagle Sandstone--Continued		Ft
15	Coal, black, impure, attrital----------	0.8
14	Mudstone, olive-black, with thin layers of siltstone, contains abundant jarosite----------	7.0
13	Sandstone, clayey, medium-brown, muddled with olive-gray shale; forms dark band with overlying unit-------	8.0
12	Coal, black, impure; all but lower 0.1 ft is shaly--	1.0
11	Sandstone, light-gray, fine-grained, clayey, friable; contains thin carbonaceous partings and weathers to white band; 0.5 ft bed of carbonaceous shale at top	3.0
10	Sandstone, similar to unit 19----------	17.0
9	Shale, olive-black, slightly carbonaceous, bentonitic; three yellowish-gray bentonite beds 0.15 ft, 0.5 ft, and 0.25 ft thick at 1, 2, and 3 ft above base; unit forms dark band----------	10.0
8	Coal, black, attrital, with thin carbonaceous shale partings----------	7.0
7	Sandstone, dark-brown, carbonaceous and silty black shale; middle and lower part of unit more shaly---------	5.0

		Thickness
Eagle Sandstone--Continued		Ft
Virgelle Sandstone Member:		
6	Sandstone, very light gray, fine-grained, biotitic; lower few feet contain irregular shaped pebbles and slabs of bentonitic sandy carbonaceous shale; borings in lower part; borings or root impressions in upper part; upper 2 ft is carbonaceous; weathers to white ledge of cliff----------	42.0
5	Sandstone, clayey, light-brownish-gray, fine-grained, poorly bedded; contains plant fragments and abundant limonite and jarosite; upper part shaly. Iron-stained limestone concretions in upper part contain plant impressions; sandstone gradational with underlying unit----------	12.0
4	Sandstone, olive-gray, clayey, soft; forms slope----	37.0
3	Sandstone, buff, fine-grained, clayey, muddled with small amounts of silty shale; rusty-weathering siderite concretions at top----------	20.0

Loc. 21568:

Nucula (Pectinucula) sp.

Nemodon sp.

Inoceramus lundbeckensis Mclearn

Phelopteria cf. P. linguaeformis (Evans and Shumard)

Ostrea sp.

Anomia sp.

		Thickness
Eagle Sandstone--Continued		Ft
Virgelle Sandstone Member--Continued		
	Periploma? sp.	
	Crenella sp.	
	Pholadomya n. sp.	
	Laternula aff. L. virgata Stephenson	
	Legumen n. sp.	
	Leptosolen sp.	
	Cymbophora sp.	
	Oligoptycha cf. O. concinna (Meek and Hayden)	
	Anchura? sp.	
	Dentalium pauperculum Meek and Hayden	
	Eutrephoceras sp.	
	Baculites thomi Reeside	
	Scaphites cf. S. hippocrepis (DeKay) (coarse early form)	
	Placenticeras planum Hyatt	
2	Sandstone, yellowish-gray, fine-grained, slightly clayey, with thin partings of shale; mostly soft, friable, upper 8 ft is lime-cemented and forms ledge of thin-bedded crossbedded sandstone with numerous borings; unit contains limonite nodules 1 in. in diameter which probably were originally pyrite----------	30.0
	Thickness of Virgelle Sandstone Member--------	141.0
	Thickness of Eagle Sandstone----------	318.8

		Thickness
Telegraph Creek Formation (part):		Ft
1	Shale, dark-gray, very silty, nonlimy, muddled with fine-grained buff sandstone; shale dominant in lower part, sandstone at top; scattered light-brown weathering sandy limestone concretions; borings visible in concretions----------	80.0
	Loc. D3269:	
	Nucula (Pectinucula) sp.	
	Pholadomya n. sp.	
	Thickness of Telegraph Creek Formation measured	80.0

Section 6

Section of upper part of Claggett Shale, the Parkman Sandstone, and lower part of Judith River Formation measured by J. R. Gill southeastward along a northwest-trending ridge of Claggett Hill from the SE 1/4 sec. 35, to the SW 1/4 SW 1/4 sec. 36, T. 23 N., R. 16 E., Fergus County, Mont.

		Thickness
		Ft
Judith River Formation (part):		
14	Claystone, bentonitic, and soft very fine grained bentonitic sandstone; medium-light-gray; weathers very light gray; upper part poorly exposed to top of hill---------	78.0
	Total Judith River Formation measured---------	78.0
Parkman Sandstone:		
13	Sandstone, yellowish-gray, very fine to fine grained, even-bedded; weathers buff with numerous hard lenses and concretionary masses of dark-brown weathering ledge-forming limy sandstone. Probably of marine origin----------	46.0
12	Shale interlaminated with very fine grained gray sandstone, thinly and evenly bedded; contains thin layers of light-gray limy sandstone concretions containing abundant borings and trails; weathers olive gray----------	14.0

		Thickness
Parkman Sandstone--Continued		Ft
11	Sandstone, pale-yellowish-gray, clayey; with thin beds of shale that contain abundant pyrite nodules; unit weathers pale yellowish brown to light brown; a bed of fossiliferous soft sandstone containing abundant broken shells and fish teeth near top of unit; irregularly shaped gray limy sandstone concretions occur at 12 ft above base; and at 10 ft above base is a thin layer of light-gray silty limestone concretions----------	16.0
	Loc. D3283, near top of unit:	
	Euspira subcrassum Meek and Hayden	
10	Sandstone and siltstone interbedded, pale-yellowish-gray, bentonitic, very clayey and soft; 12 ft above base is a 5-ft-thick bed of fossiliferous soft sandstone that contains abundant pyrite nodules and a layer of small limestone concretions; lower 5 ft contains some sandy shale; weathers gray to tan----------	25.0
	Loc. D3282, 12 ft above base:	
	Ostrea sp.	
	Tancredia americana Meek and Hayden	
	Cymbophora formosa Meek and Hayden	
	Fish bones and shark teeth	

		Thickness
Parkman Sandstone--Continued		Ft
9	Sandstone, pale-yellowish-gray, very fine grained, clayey, soft; contains occasional lense of hard limy sandstone and a few lenticular beds of sandy shale----------	18.0
8	Sandstone, pale-yellowish-gray, fine- to medium-grained, weathers light gray in lower 2 ft, remainder weathers buff with numerous large limy sandstone concretions and lenses of hard dark-brown-weathering limy sandstone; thin-bedded with some low-angle crossbeds; contains lenses of iron-cemented claystone pebbles and bone fragments, a few pyrite nodules throughout; also contains Ophiomorpha and a few fossils. Unit forms cliff----------	35.0

Loc. D3281:

Tancredia americana Meek and Hayden

Ophiomorpha major (Lesquereux)

		Thickness
Parkman Sandstone--Continued		Ft
7	Shale, dark-gray, flaky, with a few thin beds of soft sandstone in upper part; unit weathers brownish gray. On long exposure, weathers to a gray soft bentonitic surface. A layer of iron-stained septarian limestone concretions at 15 ft above base and a layer of sparsely fossiliferous limestone concretions at 25 ft above base; thin layers of light-gray cone-in-cone limestone are associated with thin sandstone beds in upper part of unit----------	48.0
	Loc. D3280, 25 ft above base:	
	Cymbophora sp	
	Cymella montanensis Henderson	
	Baculites sp.	
6	Sandstone and sandy siltstone, medium-gray to light-brown, slightly carbonaceous, very fine grained, soft; a local 1.5-ft-thick hard lens of buff and moderate-brown-weathering limy sandstone 8 ft above base; a thin layer of phosphatic pebbles and bone fragments occur at top----------	15.0

		Thickness
Parkman Sandstone--Continued		Ft
5	Sandstone, pale-yellowish-gray, very fine grained, soft, thin bedded in part; weathers tan to buff; contains thin local lenses of hard limy sandstone at top and near base. Locally is very fossilferous at base; probably one of the Tancredia sandstones of Stanton and Hatcher (1905)----------	6.0
	Loc. D3279:	
	Tancredia americana Meek and Hayden (large coll.)	
	Ethmocardium sp.	
	Callista owenana (Meek and Hayden)	
	Euspira subcrassum (Meek and Hayden)	
4	Sandstone, pale-yellowish-gray, very fine grained, fossiliferous, soft except for local hard limy layers at 30, 24, and 12 ft above base and at base; unit is dominantly soft and weathers to a deep soft bentonitic grayish-brown frothy surface; upper part of unit consists of interlaminated siltstone and sandstone with muddled bedding-----	54.0
	Loc. D3278, 24 ft above base:	
	Tellinimera aquilateralis (Meek and Hayden)	
	Cymbophora formosa Meek and Hayden	
	Euspira sp.	

		Thickness
		Ft
Parkman Sandstone--Continued		
	Loc. D3277, at base:	
	Thracia? *prouti* (Meek and Hayden)	
	Pholadomya subventricosa Meek and Hayden	
	Clisocolus sp.	
	Nymphalucina n. sp.	
	Spironema? sp.	
	Thickness of Parkman Sandstone----------	277.0
Claggett Shale:		
3	Shale, dark-gray, bentonitic; weathers to a soft frothy crust; a layer of sparse dark-gray brown-weathering septarian limestone concretions at 5 ft above base, and two layers in upper 20 ft of unit----------	87.0
2	Shale, medium-dark-gray to olive-gray, somewhat bentonitic; weathers to a dark-brownish-gray soft crust; contains a 0.3-ft-thick bed of orange-weathering bentonite at base and layers of tan- to brown-weathering septarian limestone concretions at 80, 60, 45, 36, 27, 15, and 3 ft above base----------	80.0

	Thickness
Claggett Shale--Continued	Ft
1 Shale, similar to unit 2, but not bentonitic; weathers to a moderately hard flaky surface, numerous plates of gypsum and gypsum-replaced baculites. Gray cone-in-cone limestone lense at 5 ft above base and slabby-weathering limestone concretions with crusts of cone-in-cone at 20 ft above base. At top of unit and below bentonite of unit 2, is a layer of 3 by 6 ft orange-brown-weathering septarian concretions of dense limestone. These concretions are shaped like inverted mushrooms and have a saucer-like depression on their upper surface that locally contains a thin lens of cone-in-cone. These concretions do not break down rapidly upon weathering and often accumlate as large boulder-appearing masses at the base of the slopes----------	30.0
Thickness of Claggett Shale measured----------	197.0

Section 7

Reference section of Claggett Shale measured by J. R. Gill in fault block in NE 1/4 SW 1/4 sec. 12, T. 22 N., R. 17 E., Fergus County, Mont. Beds dip easterly at 38 to 42 degrees; lower part of section trenched.

		Thickness
Parkman Sandstone (not measured):		Ft
31	Sandstone, pale-yellowish-gray, soft, very fine grained; has 0.1-ft-thick orange-weathering bed of hard limy sandstone 5 ft above base----------	
	Level of Loc. D3276 collected in NW /14 SE 1/4 sec. 36, T. 23 N., R. 16 E.:	
	Solemya n. sp	
	Oxytoma cf. *O. haydeni* (Meek and Hayden)	
	Cymella montanensis Henderson	
	Tancredia americana Meek and Hayden	
	Thracia? *Prouti* (Meek and Hayden)	
	Cymbophora formosa Meek and Hayden	
	Euspira sp.	
	Vanikoropsis tuomeyana (Meek and Hayden)	
	Baculites asperiformis Meek	
Claggett Shale:		
30	Shale, medium-gray, soft, bentonitic; upper part poorly exposed; weathers brownish gray; has four layers of sparsely scattered light-brown-weathering septarian limestone concretions; a 0.3-ft-thick bed of orange-weathering bentonite 20 ft above base--	135.0

		Thickness
Claggett Shale--Continued		Ft
29	Shale, light-olive-gray to dark-gray, weathers dark brownish gray, hard; has hackly fracture; abundant dark-brown iron stain on fractures and bedding planes; has 7 thin beds of bentonite ranging in thickness from 0.1 to 0.8 ft in the lower 35 ft. Six layers of dark-gray brown-weathering septarian limestone concretions at 115, 92, 80, 60, 40, and 26 ft above base; three upper layers have thin crusts of gray-weathering cone-in-cone----------	120.0
	Loc. D3866, 40 ft above base of unit in SW 1/4 SE 1/4 NW 1/4 sec. 14, T. 22 N., R. 16 E.:	
	Protocardia sp.	
	Nymphalucina subundata (Hall and Meek)	
	Baculites mclearni Landes	
	Hoploscaphites n. sp.	
	Trachyscaphites sp.	
	Euspira rectilabrum (Conrad) (coquina of immature forms)	
	Graphidula sp.	
28	Bentonite, pale-yellowish-green; poorly swelling; biotitic; weathers pale orange----------	2.8
27	Shale, olive-gray, soft----------	0.8
26	Bentonite, similar to unit 29----------	0.4
25	Shale, similar to unit 28----------	1.2

		Thickness
Claggett	Shale--Continued	Ft
24	Bentonite, similar to unit 29----------	0.7
23	Shale, similar to unit 28----------	2.0
22	Bentonite, similar to unit 29----------	0.9
21	Shale, similar to unit 28----------	4.1
20	Bentonite, similar to unit 29, except for a 0.4-ft-thick shale parting 0.2 ft above base----------	1.3
19	Shale, similar to unit 28----------	2.2
18	Bentonite, similar to unit 29----------	0.5
17	Shale, similar to unit 28, except for a layer of dark-gray brown-weathering fossiliferous septarian limestone concretion 9 ft above base----------	11.0
16	Bentonite, similar to unit 29----------	1.4
15	Shale, similar to unit 28----------	2.8
14	Bentonite, similar to unit 29----------	2.0
13	Shale, similar to unit 28----------	2.5
12	Bentonite, similar to unit 29----------	0.8
11	Shale, medium-light-gray; with a layer of 1 by 3 ft dark-gray brown-weathering septarian limestone concretions at 5 ft above base; septa of brown fibrous calcite--	10.0
10	Bentonite, pale-yellowish-gray, biotitic, less swelling than unit 6; weathers creamy yellow to pale yellow-	2.6

		Thickness
Claggett Shale--Continued		Ft
9	Shale, olive-gray, soft, bentonitic, flaky; weathers to light brownish gray crust; has layer of sparse septarian fossiliferous limestone concretions in upper part----------	22.4
	Loc. D3273; this level in SE 1/4 NW 1/4 sec. 31, T. 23 N., R. 17 E.:	
	Baculites obtusus Meek (typical form)	
8	Bentonite, pale-yellowish-gray, gypsiferous; weathers to dark-brownish-gray soft frothy surface--------	0.8
7	Shale, similar to unit 9----------	0.7
6	Bentonite, similar to unit 8----------	2.6
5	Shale, medium-light-gray, bentonitic, soft, flaky; weathers to light-brownish-gray soft crust; locally contains brown-weathering limestone concretions--	5.0
	Loc. D3272; this level in SE 1/4 NW 1/4 sec. 31, T. 23 N., R. 17 E.:	
	Baculites obtusus Meek (early form)	
	Total Claggett Shale----------	336.5
Eagle Sandstone (part):		
4	Sandstone, pale-yellowish-gray, very fine grained, soft, clayey; contains sparse scattered polished black and gray chert granules----------	2.0

		Thickness
Eagle Sandstone (part):--Continued		Ft
3	Poorly exposed; probably soft sandstone at base grading up into gray silty shale at top. Small sample at top-	8.0
2	Sandstone, light-gray, clayey, soft; weathers tan; contains sparse scattered small black, brown, and gray polished chert pebbles throughout with abundant chert pebbles concentrated in lenses in the lower 5 ft. Abundant casts of Ophiomorpha in upper part; one layer of small gray sand limestone concretions 15 ft above base; unit is capped by a 1- to 3-ft-thick bed of hard light-brown nodular-weathering limy sandstone----------	28.0
1	Sandstone, light-gray to white, fine- to medium-grained, massive; unit is capped by a hard 1- to 5-ft-thick bed of crossbedded sandstone containing lenses of 1/16 to 2 in. in diameter flattened black, brown, and gray polished chert pebbles.	
	Total Eagle Sandstone measured----------	38.0

Section 8

Partial section of rocks of Montana age measured by J. R. Gill, W. A. Cobban and R. E. Burkholder, September 1963. Measured with planetable along the banks of Columbus Creek on the Sheeley and Mock Ranches in the N 1/2 sec. 13, T. 57 N., R. 87 W., and in the N 1/2 of NW 1/4 sec. 19, T. 57 N., R. 86 W., Sheridan County, Wyo.

		Thickness Ft
Lance Formation:		
34	Sandstone, dusky-yellow to yellowish-gray, fine-grained; contains discontinuous lenses of moderate olive-brown sandy claystone; numerous elongate and irregular shaped dark-yellowish-brown weathering sandstone concretions; massive to crossbedded; best exposed where north-south road crosses Columbus Creek in NE 1/4 NW 1/4 sec. 19; thickness not measured----------	
Fox Hills Sandstone:		
33	Sandstone, pale-yellow and light-gray to white; very fine grained, soft, clayey, very micaceous, thin-bedded; locally 1 by 2 ft thin-bedded sandstone concretions near base that contain Ophiomorpha----------	28.0

	Thickness
Fox Hills Sandstone--Continued	Ft
32 Sandstone, siltstone and sandy shale interlaminated; pale-yellowish-gray, soft; contains 3 thin layers of limonite-cemented sandstone and abundant thin plates of limonitic siltstone and jarosite; best exposed a few feet west of the road along the east bank of Columbus Creek in E 1/2 sec. 13----------	35.0
Total Fox Hills Sandstone----------	63.0
Bearpaw Shale:	
31 Shale, olive-black, weathers light olive gray; a few fragments of phosphatized baculites too poorly preserved to identify; upper 20 ft of unit is sandy, only upper 60 ft exposed along east bank of Columbus Creek in NW 1/4 SE 1/4 NE 1/4 sec. 12----------	60.0
30 Covered, this interval probably largely comprised of soft Bearpaw Shale. Thickness of exposed shale and covered interval determined by the difference in overlap in the north and south planetable traverses------	90.0
Maximum thickness Bearpaw Shale----------	150.0

		Thickness
Mesaverde Formation:		Ft
Teapot Sandstone Member and unnamed member, undivided (Measured in the NE 1/4 NW 1/4 sec. 19)		
29	Shale and sandy claystone, brownish-black, carbonaceous; contains thin lenses of impure coal and coaly shale; locally lenticular masses of white kaolinitic(?) fine-grained sandstone as much as 5 ft thick. Contact with overlying Bearpaw Shale not exposed---------	25.0
28	Sandstone, light-gray to white, very fine grained, hard. Apparently the same bed mentioned by Darton as being quarried on the east side of the railroad 1/4 mile south of the town of Parkman----------	1.0
27	Bentonite, very pale orange, lower 0.5 ft ashy, highly swelling weathering to a light-gray frothy surface; sharp undulatory contact with underlying claystone----------	3.5
26	Claystone, carbonaceous, olive-black weathering olive gray; abundant coaly fragments, hard-------	2.8
25	Bentonite; grayish-olive becoming light olive gray and slightly carbonaceous in upper 0.5 ft----------	2.0

Mesaverde Formation--Continued		Thickness
Teapot Sandstone Member and unnamed member, undivided--continued		Ft
24	Coal, black, impure, thin-to medium-banded; contains some thin lenses of light-gray sandy claystone----------	0.6
23	Claystone, brownish-gray, becomes dark-brown carbonaceous claystone in upper 1 ft----------	5.0
22	Claystone, brownish-black; abundant macerated plant fragments----------	5.0
21	Poorly exp osed; appears to consist of dark-brown carbonaceous claystones with thin lenticular beds of black coal interbedded with about equal thickness of soft light-gray to white fine-grained sandstone----------	85.0
20	Sandstone, very light gray to white; very fine grained, soft, top not exposed----------	5.0
19	Claystone, carbonaceous; ranges from brownish-gray through dark reddish brown; lower 5 ft very silty to sandy----------	10.0
18	Sandstone, light-greenish-gray, fine- to medium-grained; contains abundant dark mineral grains and macerated plant fragments; massive crossbedded channel cuts into underlying unit----------	60.0

Mesaverde Formation--Continued	Thickness
Teapot Sandstone Member and unnamed member, undivided--continued	Ft
17 Sandstone, yellowish-gray, fine-grained, soft, crossbedded; contains thin layers of dark-gray sandy shale; base not exposed----------	60.0
16 Covered, interval probably contains soft sandstone and possibly some sandy shale; unit forms valley; not exposed on either traverse----------	85.0
Thickness Teapot Sandstone Member and unnamed member, undivided----------	349.9

Following units to base of section are described from exposures on the north traverse located on the north and south sides of Columbus Creek in the north 1/2 sec. 13.

Parkman Sandstone Member:

15 Sandstone, pale-yellowish-gray; very fine grained, soft, contains a few thin beds of gray sandy shale and two layers of dark-brown slabby-weathering sandstone concretions in upper part; upper concretion layer contains small Ophiomorpha; upper part of unit poorly exposed--- 75.0

Mesaverde Formation--Continued	Thickness
Parkman Sandstone Member--Continued	Ft
14 Sandstone, pale-yellowish-gray, very fine grained, thin-bedded; contains three less than 1-ft-thick interlaminated shale and sandstone units 20 ft above base; ridge-forming 2-ft-thick by 10-ft diameter dark-brown-weathering limy sandstone concretions at top and 1.5-ft-thick by 3 ft in diameter cannonball-like brown-weathering fossiliferous sandstone concretions at base----------	35.0
Loc. D4276:	
Pinna sp.	
Oxytoma haydeni (Hall and Meek)	
Cymella montanensis (Henderson)	
Cymbophora sp.	
fish scale	
13 Sandstone, pale-yellowish-gray, very fine grained, soft, weathers blocky; 1.5 ft; unit of interbedded sandstone and dark-gray shale at top----------	15.0
12 Sandstone, dusky-yellow, fine-grained, massive soft in lower 1.5 ft----------	5.0

Mesaverde Formation--Continued		Thickness
Parkman Sandstone Member--Continued		Ft
11	Sandstone and shale interlaminated, sandstone, dusky yellow; shale, medium-light-gray to olive-gray in beds less than 0.1 ft thick--------	9.0
10	Sandstone, dusky-yellow, very fine grained, soft, lower part poorly exposed----------	31.0
9	Shale, dusky-yellow at base becoming yellowish-gray in upper part; silty to sandy; small baculite found in shale from gopher hole 25 ft below top----------	40.0
	Loc. D4298:	
	Baculites sp.	
	Remarks: This juvenile baculite has rather strong flank ribs; it could be B. perplexus.	
8	Sandstone, dusky-yellow becoming gray at top; fine-grained, soft----------	40.0
7	Shale, light-gray, bentonitic, sandy----------	10.0

Mesaverde Formation--Continued	Thickness
Parkman Sandstone Member--Continued	Ft
6 Sandstone, light-gray, fine-grained, soft, a few thin shale partings, a thin tabular bed of yellowish-gray limestone 5 ft above base; a 2-ft-thick bed of hard brown-weathering ledge-forming concretionary sandstone with abundant Ophiomorpha at 75 ft and a 1-ft-thick ledge-forming bed of brown sandstone 85 ft above base----------	116.0
5 Sandstone, dusky-yellow, to dark-yellowish-orange, very fine grained, soft; contains 2-ft-diameter fossiliferous brown-weathering cannonball-like concretions 7 ft above base------	14.0
Loc. D4275, from 7 ft above base:	
Inoceramus sp.	
Ostrea sp.	
Cymella montanensis (Henderson)	
Ethmocardium ursaniense Landes	
Tellina sp.	
Cymbophora formosa (Meek and Hayden)	
Baculites sp.	
4 Sandstone, pale-yellowish-gray weathering dark brown, limy, hard; first of ledge formers; contains a few Ophiomorpha----------	3.5

Mesaverde Formation--Continued	Thickness
Parkman Sandstone Member--Conintued	Ft
3 Sandstone, yellowish-gray; fine to very fine grained, massive; contains large brown-weathering calcareous sandstone concretions at 7, 15, 20, 35, and 40 ft above base; a layer of small gray limestone concretions 2 ft above base and a 1 ft brown-weathering limestone concretions 8 ft below top----------	55.0

Loc. D4270, from upper part of unit in NE 1/4 sec. 26, T. 8 S., R. 35 E., Big Horn County, Mont.:

Inoceramus cf. I. ovatus Dobrov
Ostrea russelli Landss
Ostrea cf. O. albertensis Landes
Anisomyon aff. A sexsulcatus Meek and Hayden
Baculites perplexus Cobban
Placenticeras cf. P. intercalare Meek

2 Shale and sandstone interlaminated; yellowish-gray, shales are silty to sandy; sandstone is fine grained and soft, becomes more sandy towards top; lower part poorly exposed----------	75.0

Loc. D4268, from upper part of unit in SW 1/4 SE 1/4 sec. 13, T. 9 S., R. 35 E., Big Horn County, Mont.:

Mesaverde Formation--Continued	Thickness
Parkman Sandstone Member--Continued	Ft
Nucula (Pectinucula) sp.	
Nuculana sp.	
Inoceramus cf. *I. ovatus* Dobrov	
Phelopteria sp.	
Loc. D4267, from lower part of unit at above locality:	
Baculites perplexus Cobban	
Thickness Parkman Sandstone Member----------	523.5
Thickness Mesaverde Formation----------	873.4
Cody Shale (not measured)	
Shale, dark gray, silty----------	

Section 9

Section of the lower part of the Medicine Bow Formation, Fox Hills Sandstone, Lewis Shale, Almond Formation and Pine Ridge Sandstone of Mesaverde Group and upper part of the Steele Shale all of Montana age. Measured by A. D. Zapp and modified by J. R. Gill in the SE 1/4 sec. 2 and NE 1/4 sec. 11, T. 24 N., R. 84 W., sec. 36, T. 25 N., R. 84 W., and sec. 1, T. 24 N., F. 84 W., Carbon County, Wyoming.

		Thickness Ft
Medicine Bow Formation (part):		
88	Sandstone, siltstone and shale interbedded, grayish orange, yellowish orange and yellowish gray; contains several beds of reddish brown weathering carbonaceous----------	125.0
87	Sandstone, yellowish gray, fine grained, crossbedded; contains Ophiomorpha burrows and oysters---------	35.0
86	Sandstone and carbonaceous shale interbedded; a 0.4 ft thick coal bed at top; unit is nonmarine------	55.0
85	Sandstone, yellowish gray, medium grained----------	27.0
84	Sandstone and carbonaceous shale interbedded-------	45.0
83	Sandstone, yellowish gray, fine grained, massive; contains oysters near base and Ophiomorpha burrows at top-	25.0
82	Sandstone and carbonaceous shale interbedded, soft-	30.0
81	Sandstone, grayish orange, medium grained, weathers light brown and forms a ridge----------	8.0
80	Sandstone and carbonaceous shale interbedded; sandstone contains some 1-2 in thick iron cemented layers--	40.0

		Thickness
Medicine Bow Formation--Continued		Ft
79	Sandstone, soft, fine-to-medium-grained, and interbedded carbonaceous shale with jarosite sandstone; contains--thin (1 to 2 in.) ferruginous beds. Freshwater clams in upper part ----------	85.0
78	Coal and carbonaceous shale----------	1.5
77	Sandstone, marine, massive, cross-bedded, resistant, ridge-forming, yellowish-gray, medium-grained---	20.0
76	Shale, silty, olive-brown, interbedded sandstone 5 ft yellowish-gray silty sandstone at base with oysters----------	20.0
75	Shale, carbonaceous, yellowish-gray sandstone 1 in., ferruginous and coaly: 2 ft carbonaceous shale and coal at base; 10 ft sandstone; 3-ft coal and 2-ft carbonaceous shale, with jarosite at top---------	17.0
74	Sandstone, massive, soft, cross-bedded, yellowish-gray, medium-grained, with resistant ridge-forming 3- to 5-ft ferruginous concretionary bed about 10 ft above base. Large oysters in sandstone about 10 ft below the top ----------	45.0
73	Sandstone, soft, yellowish-gray, medium-grained, with scattered interbedded, brownish-gray 1- to 2-ft carbonaceous shale. Two 1- to 2-ft coalbeds in upper part. Scattered 1- to 2-in. ferruginous layers. Jarosite in carbonaceous shales-	60.0

		Thickness
Medicine Bow Formation--Continued		Ft
72	Sandstone, massive, crossbedded, medium-grained, yellowish-gray, with small oysters at top ------	25.0
71	Shale, carbonacoues with large oysters----------	10.0
70	Sandstone, interbedded, yellowish-gray, medium grained; light olive-gray, silty sandstone and olive-gray sandy shale. 10 ft carbonaceous shale in lower part, which intertongues with sandstone to the east. Sandstone with 1/2 to 1 in. ferruginous beds. Oysters near top ----------	75.0
69	Shale, yellowish-gray- to black, with large oysters----------	20.0
	Total thickness of measured Medicine Bow Formation----------	768.5
Fox Hills Sandstone:		
68	Sandstone, massive, ridge forming, yellowish-gray, crossbedded, medium-grained, with Ophiomorpha----	25.0
67	Sandstone and siltstone, poorly exposed, interbedded, soft and fine-grained, yellowish-gray. Partly covered in lower part. Upper part contains oysters ----------	85.0

		Thickness
Fox Hills Sandstone--Continued		Ft
66	Sandstone, massive, fine grained, nonresistant, top marine?----------	22.0
65	Shale and shaly siltstone, with a couple of thin beds of very fine sandstone----------	52.0
64	Sandstone, fine grained, laminar and mostly friable, but with resistant, brown weathering calcareous indurations----------	60.0
63	Sandstone, massive and yellow-gray above, increasingly thin bedded below. Transitional into underlying shale----------	43.0
62	Shale, dark gray, marine (tongue of Lewis)---------	100.0
61	Sandstone, massive, big "cannonball" concretions, marine----------	45.0
60	Shale, silty, dark gray (tongue of Lewis)----------	12.0
59	Sandstone, massive, thin bedded toward base. Ornate clams collected from lower 20 ft----------	50.0
	Total Thickness of Fox Hills Sandstone--------	494.0
	Loc. D3329, base of Fox Hills Sandstone: *Pholadomya* n. sp.	
Lewis Shale:		
58	Concealed-presumbly shale----------	510.0

		Thickness
Lewis Shale--Continued		Ft
57	Interlaminated and interbedded silty shale; very fine sandstone, platy to papery. Near top are platy beds of calcareous sandstone as much as 1 ft thick----	25.0
56	Shale and sandstone; silty banded shale with a massive 2 ft sandstone bed at base and a 4 ft one at top. The sandstones are fine grained; rough-textured; form ridges locally----------	36.0
55	Shale, gray to dark gray; many thin rusty bands in upper part. 2 ft below top is row of rusty concretions about 8 in. x 1-2 ft that are remarkably regularly exposed about 6-8 ft apart. Small collection ammonites, etc. from gray limestone concretions 65 ft above base ----------	140.0

Loc. D3328

Tenuipteria fibrosa (Meek and Hayden)

Baculites clinolobatus Elias

Hoploscaphites n. sp.

Thickness upper part of Lewis Shale---------- 711.0

Lewis shale: Dad Sandstone Member

54	Sandstone, very fine to fine grained; argillaceous to shaly in lower 25 ft; massive above. Lower 45 ft concretionary and ridge forming, expecially the level 45 ft up. Upper part nonresistant to weathering. Ophiomorpha and poorly preserved clams, etc.----------	75.0

		Thickness
Lewis Shale; Dad Sandstone Member--Continued		Ft
53	Silty shale and mudstone, dark-gray. Thin bentonites 3 ft and 48 ft above base. Just below the lower bentonite the shale is very black----------	80.0
52	Sandstone, very fine grained, with some siltstone. All papery to platy, except 1-ft-thick massive bed 25 ft above base and 2-ft-thick very calcareous dark-brown-weathering ledge 6 ft from top. Forms low ridge, with either the 1-ft-thick massive sandstone or the top brown beds forming crest. (This is the most pronounced ridge in Lewis valley. Farther west, the sandstone in upper part forms the crest of the ridge)----------	52.0
51	Shale and mudstone, gray; thin layer rich with Turritella 35 ft below top and a very fossiliferous small concretion was found (west of line of section) at a level 55 ft below top of unit. ----------	115.0

Loc. D3326:

Nuculana evansi (Meek and Hayden)

Anomia sp.

Crenella sp.

Baculites sp.

Discoscaphites sp.

		Thickness
Lewis Shale, Dad Sandstone Member--Continued		Ft
	Loc. D3327:	
	Turritella aff. T. hilgardi Stoll	
50	Sandstone, very fine to fine grained, soft, weathers like shale. Many brown sandstone concretions indurations. Poorly preserved fossils, including Baculites----------	120.0
	Total Thickness Dad Sandstone Member----------	442.0
Lewis Shale:		
49	Shale and mudstone with much very fine grained, very thin bedded sandstone 65-90 ft above base. 3-ft-thick bentonite at base----------	200.0
48	Shale, gray, sandy in upper part. Row of barren concretions 85 ft above base and 1-2 ft below a thin bentonite. Very fossilferous concretions 140-170 ft above base Capped by very dark finely sandy limestone that makes prominent, though discontinuous, low ridge----------	192.0
	Loc. D3325:	
	Nucula cancellata Meek and Hayden	
	Nuculana evansi (Meek and Hayden)	
	Inoceramus typicus (Whitfield)	
	Anomia sp.	
	Clisocolus moreauensis (Meek and Hayden)	

		Thickness
Lewis Shale--Continued		Ft
	Loc. D3325--Continued	
	Baculites grandis Hall and Meek	
	Hoploscaphites n. sp.	
	Discoscaphites n. sp.	
	Sphenodiscus (Coahuilites) pleurisepta (Conrad)	
47	Sandstone, massive, yellow-gray, fine grained. Contains Inoceramus near base. This is a very strong ledge, whose dip slope borders the "terrace" above main Lewis valley in this area----------	35.0
46	Shale and silt. Mostly gray shale in lower one third; silt and very fine sand in middle; very dark gray to black shale at top. ---------- ----------	162.0
45	Sandstone, great massive beds, light-gray, fine-grained. Abundant oysters 55-58 ft above base. Upper part has some of the most spectacular displays of Ophiomorpha I've seen. At one place in upper surface of unit are small ferruginous knots of small fossils----------	130.0
44	Black shale and gray mudstone ----------	95.0
43	Sandstone, soft and friable, fine-grained, light-gray. Brown calcareous indurations near base. Contains Ophiomorpha ----------	43.0

		Thickness
Lewis Shale--Continued		Ft
42	Black shale and gray mudstone. Shale contains small ironstone concretions and thin bands. Sandy zone with brown calcareous indurations 85 ft above base----------	135.0
41	Mostly sandstone, soft, friable, very fine to fine grained. Many Ophiomorpha near top. 10-12 ft of dark shale ± 12 ft below top----------	70.0
40	Shale and mudstone, very dark, at most black to brownish gray. Many small ironstone concretions in lower part; 1 ft bentonite bed 50 ft above base--------	95.0
39	Sandstone, light gray, fine grained, massive. No Ophiomorpha observed, but has general appearance of a marine sandstone. Quite persistant and uniform. Upper 6 ft has many small ironstone concretions and large brown calcareous indurations. (Rather abrupt change in slope at this level--most geologists would probably draw top of Mesaverde at top of unit 39----------	76.0
	Thickness of lower part of Lewis Shale--------	1233.0
Almond Formation		
38	Carbonaceous shale and silty-shale, with thin coals 45 ft above base and 2 ft below top----------	78.0
37	Sandstone, very fine grained to fine grained, thin bedded below to massive at top. Ophiomorphain upper 6 ft----------	25.0

	Thickness
Almond Formation--Continued	Ft
36 Mostly carbonaceous shale, with several 1-2-ft-thick very fine sandstone beds; a thicker one in lower 8 ft. At least two sizeable coals, including one at top that is more than 3 ft thick----------	155.0
Thickness of Almond Formation----------	258.0
Pine Ridge Sandstone (approx.)	
35 Sandstone, fine grained, very resistant. Irregular bedding and gnarly weathering ----------	180.0

Other fossil collections

Loc. D3322 (sandstone in Steele-Mesaverde transition 3177 ft above D3320)

Inoceramus sp.

Ostrea sp.

Baculites asperiformis Meek

Loc. D3323 (tongue of Steele Shale in Mesaverde Group)

Inoceramus subcompressus Meek and Hayden

Ethmocardium sp.

Baculites perplexus Cobban

Placenticeras cf. P. intercalare Meek

Loc. D3324 (concs. 1375, 1400 ft below top of Lewis shale)

Nucula cancellata Meek and Hayden

Nuculana evansi (Meek and Hayden)

Inoceramus cf. I. balchii Meek and Hayden

Anomia sp.

Clisocolus moreauensis (Meek and Hayden)

Loc. D3324--Continued

Dosiniopsis? deweyi (Meek and Hayden)

Legumen ellipticum Conrad

Baculites grandis Hall and Meek

Hoploscaphites n. sp.

Discoscaphites n. sp.

Section 10

Composite section of rocks of Montana age measured by J. R. Gill and C. R. Givens on Cottonwood Creek in the NE 1/4 sec. 26, T. 45 N., R. 97 W., and in the Grass Creek oil field in the NW 1/4 sec. 16, T. 46 N., R. 98 W., Hot Springs County, Wyo. Description of Meeteetse Formation from Hewett (1926, p. 22-23, 26).

	Thickness Ft
Lance Formation:	
35 Sandstone and shale, not meausred----------	
Meeteetse Formation:	
34 Alternating beds of gray and brown clay and sandy clay (20 percent), gray to white sand and clayey sand (75 percent), brown shale, coal (2 percent), and bentonite (3 percent)----------	900.0
Mesaverde Formation:	
Teapot Sandstone Member:	
33 Shale and sandstone interbedded; shale, light-gray, sandy, soft; sandstone, light-gray to yellowish-orange, fine- to medium-grained; contains abundant thin layers of platy weathering ironstone; unit capped by 35-ft-thick white sandstone that is overlain by a soft sandy bed that contains 2 layers of reddish-brown-weathering sandstone concretions----------	91.0

		Thickness
Teapot Sandstone Member--Continued		Ft
32	Sandstone, light-gray to white, upper part yellowish-gray, fine-grained; lenticular masses of crossbedded sandstone and thin layers of light-gray sandy shale; forms striking light-colored cliff contrasting sharply with darker beds below----------	242.0
	Thickness of Teapot Sandstone Member---------	333.0
Mesaverde Formation (upper part):		
31	Sandstone and shale interbedded; sandstone beds are lenticular, fine to medium grained and weather yellowish brown; shales are light gray to white and contain lens-like beds of light-gray siltstone----------	53.0
30	Sandstone, pale-yellowish-brown, medium-grained, lenticular; cliff former----------	22.0
29	Shale, reddish-brown, carbonaceous; contains a few thin layers of carbonaceous sandstone----------	23.0
28	Sandstone, pale-yellowish-brown, medium-grained, clayey, lenticular----------	16.0
Ardmore(?) Bentonite Bed:		
27	Bentonite, light-gray to greenish-gray, slightly swelling----------	2.0
26	Shale, dark-brown to black, carbonaceous----------	1.0

		Thickness
		Ft
Mesaeverde Formation (upper part)--Continued		
Ardmore(?) Bentonite Bed:--Continued		
25	Shale, light-gray to light-bluish-gray; bentonitic, weathers to a soft frothy surface in part--------	6.0
24	Shale, dark-brown to black, carbonaceous----------	1.5
23	Shale and sandstone interbedded; shale, dark-brown to black, carbonaceous; sandstone, light-gray to white, clayey, soft; contains a 5-ft-thick bed of reddish-brown carbonaceous shale 20 ft above base and thin beds of light-gray sandy shale and soft sandstone in upper 10 ft; unit is capped by a 3-ft-thick lenticular bed of sandstone----------	64.5
	Thickness Mesaverde Formation (upper part) including Ardmore(?) Bentonite Bed----------	189.0
Sussex Sandstone Member Cody Shale:		
22	Sandstone, pale yellowish gray at base grading to light gray in upper part, fine- to medium-grained; thin bedded in lower part, massive in upper part; contains thin layers of limonite replaced shale pebbles, abundant impressions of plant fragments and Ophiomorpha. At 5 ft above base is a layer of shale-pebble conglomerate that contains a few scattered pebbles to cobbles of gray, red and black quartzite and a few fossils----------	48.0

		Thickness
		Ft
Sussex Sandstone Member of Cody Shale--Continued		
	Loc. D4702:	
	Serpula sp.	
	Crassostrea cf. *C. glabra* (Meek and Hayden)	
	Protocardi sp.	
	Ethmocardium sp.	
	Protodonax exaquilius Vokes	
	Baculites sp.	
21	Sandstone and shale interbedded; sandstone weathers dusky yellow to grayish orange, fine grained, thin bedded; shale subordinate to sandstone, olive gray, sandy----------	21.0
	Thickness of Sussex Sandstone Member of Cody Shale----------	69.0
Tongue of Cody Shale:		
20	Shale, medium-gray, sandy; locally contains large concretionary masses of fine-grained sandstone----------	16.0
19	Siltstone, dark-gray, weathers to highly fractured dusky-yellow to yellowish-gray ovate masses 2.0 ft thick by 15.0 ft in diameter----------	2.0

		Thickness
Tongue of Cody Shale--Continued		Ft
18	Shale and sandstone interbedded; shale, medium-gray, sandy; sandstone, pale-yellowish-brown, fine-grained, thin-bedded; locally lime cemented forming low ridges; some layers show contorted bedding-------	41.5
17	Sandstone, dusky-yellow, fine-grained, thin bedded, ledge former----------	1.5
16	Shale, medium-gray, sandy; contains a few thin beds of soft sandstone; slope former----------	12.0
15	Sandstone, yellowish-gray, fine-grained, soft; a 0.1-ft-thick layer of limonite-cemented fossiliferous sandstone at top; unit thicknens to south of line of section----------	1.0
	Loc. D4703:	
	Ostrea albertensis Landes? (bored)	
	Thickness of tongue of Cody Shale----------	74.0

		Thickness
Mesaverde Formation (lower part)		Ft
14	Sandstone and shale interbedded; not measured in detail; sandstones, pale-brown to grayish-orange, fine- to medium-grained containing abundant small pyrite nodules, thin- to massive-bedded, lenticular; shale, light- to dark-gray, sandy, contains abundant plant fragments. Lower one-third of unit contains numerous reddish-brown to black layers of carbonaceous to lignitic shale----------	605.0
Mesaverde Fromation (lower part) continued: (measured in NW 1/4 sec. 16, T. 46 N., R. 98 W., Hot Springs County, Wyo.)		
13	Sandstone, reddish-brown to black, fine-grained, hard, abundant dark mineral grains; a beach placer deposit----------	4.0
12	Sandstone, medium-gray, fine- to medium-grained; weathers yellowish-brown; lacks abundant dark mineral grains of overlying and underlying units-	4.5
11	Sandstone, reddish-brown to black, very fine grained, thin-bedded, hard; contains abundant dark mineral grains----------	2.0

		Thickness
Mesaverde Formation (lower part)--Continued		Ft
10	Sandstone, yellowish-gray, fine-grained, cliff former, massive, thin bedded in upper 8 ft; contains a few layers of dark-brown-weathering sandstone concretions----------	110.0
9	Sandstone, yellowish-gray, clayey, thin bedded at base and gradational into overlying cliff-forming sandstone----------	75.0
8	Sandstone and shale interlaminated, weathers yellowish gray, slope former; locally upper 25 ft forms cliff; contains a .4-ft-thick bed of highly fractured yellowish-gray siltstone at 50 ft above base----------	98.0
	Thickness of Mesaverde Formation (lower Part)-	698.5
Cody Shale (part):		
7	Shale, medium-dark-gray, soft----------	135.0
6	Shale, medium-dark-gray, sandy; contains a few thin soft beds of yellowish-gray-weathering sandstone----------	60.0
5	Sandstone and shale interlaminated, soft; weathers yellowish gray----------	22.0

		Thickness
Cody Shale (part)--Continued		Ft
4	Sandstone, light-brown, fine-grained, hard, ledge former----------	1.0
3	Shale, medium-dark-gray, sandy----------	4.0
2	Sandstone, yellowish-gray, fine- to medium-grained, thin-bedded; contains a few small shale pebbles; forms small cliff----------	17.0
1	Shale, medium-dark-gray; contains a layer of light-gray to yellowish-gray septarian limestone concretions near base and 5 ft below top---------	50.0

Loc. D4706, 5 ft below top:

Inoceramus sp.

Baculites sp.

Placenticeras sp.

Thickness of Cody Shale measured---------- 289.0

Section 11

Partial section of rocks of Montana age measured by J. R. Gill and C. R. Givens in the vicinity of the Roncco Coal Mine in the NE 1/4 SE 1/4 sec. 17, T. 44 N., R. 95 W., Hot Springs County, Wyo.

		Thickness Ft
Mesaverde Formation (upper part) undivided:		
47	Shale, reddish-brown, carbonaceous----------	11.0
	Sandstone, pale-yellowish-brown to moderate-yellowish-brown, fine- to medium-grained; contains thin limonite cemented layers and a few thin lenses of clay pebbles; cliff former----------	78.0
46	Shale, reddish-brown, carbonaceous----------	4.0
45	Sandstone, dusky yellow in lower 20 ft, light gray in upper 35 ft, medium-grained; thin lens of shale pebble conglomerate at top; massive, light gray sandstone, contains Ophiomorpha----------	55.0
44	Sandstone, dusky-yellow, fine-grained, thin-bedded, soft----------	23.0
43	Sandstone, dusky-yellow, fine-grained, massive, ridge former----------	35.0
42	Sandstone, moderate-yellowish-brown with thin beds of gray sandy shale; locally sandstone forms small ledges----------	25.0

	Thickness
Mesaverde Formation (upper part) undivided--Continued	Ft
41 Shale, gray, sandy, soft; contains a few thin beds of soft sandstone----------	18.0
40 Sandstone and shale interbedded, pale-yellowish-brown, thin-bedded; a 4 ft-thick layer of limy sandstone concretions at top of unit forms small ledge----------	37.0
Thickness of Mesaverde Formation (upper part) undivided----------	286.0
Tongue of Cody Shale:	
39 Shale, olive-gray, sandy; contains thin beds of concretionary weathering sandstone at 12, 61, 70, 8, 115, and 120 ft above base; a resistant layer of sandstone concretions at top of unit----------	125.0
Thickness of tongue of Cody Shale----------	125.0
Mesaverde Formation (lower part) undivided:	
38 Sandstone, yellowish-gray to dusky-yellow, fine-grained, thick-bedded to massive; lower 50 ft more massive and resistant than upper part; several resistant layers of oval to botryoidal sandstone concretions in upper part; locally Ophiomorpha is abundant----------	130.0
37 Sandstone, dusky-yellow to yellowish-gray, fine-grained, soft, medium- to thin-bedded----------	50.0

		Thickness
Mesaverde Formation (lower part) undivided--Continued		Ft
36	Shale, gray, sandy----------	2.0
35	Sandstone, lower part dusky yellow, upper part very light gray, fine-grained, massive; contains Ophiomorpha and a layer of 1 ft to 2 ft diameter sandstone concretions at top----------	50.0
34	Shale, dark-reddish-brown, carbonaceous, lenticular-	6.0
33	Shale, and sandstone interbedded, soft; shale, light-gray; sandstone, pale-yellowish-brown; contains thin layer cemented with limonite----------	6.0
32	Shale, reddish-brown, carbonaceous----------	3.0
31	Sandstone and shale, like unit above----------	20.0
30	Coal, black, attrital----------	0.6
29	Shale, reddish-brown, carbonaceous----------	0.6
28	Coal, black, attrital----------	2.0
27	Shale, reddish-brown, carbonaceous----------	2.0
26	Sandstone and shale, interbedded----------	15.0
25	Shale, reddish-brown, carbonaceous----------	2.5
24	Shale, black, coaly----------	1.0
23	Shale, light-brown, slightly carbonaceous----------	3.0
22	Coal, black, domintantly attrital, thickness to north-	5.5
21	Shale, brown, carbonaceous----------	0.4
20	Coal, black, attrital----------	1.5
19	Shale, reddish-brown, carbonaceous----------	2.0

		Thickness
Mesaverde Formation (lower part) undivided--Continued		Ft
18	Sandstone, pale-brown, fine grained----------	7.0
17	Coal, black, attrital----------	1.0
16	Shale, reddish-brown, carbonaceous----------	3.0
15	Sandstone, white, fine-grained, soft, clayey, locally cemented with limonite----------	6.0
14	Sandstone, light-brown to pale-yellowish-brown; thin even bedded to crossbedded, appears to be comprised of several thick bodies of channel sandstone with local thin lenses of gray sandy shale and brown carbonaceous shale----------	97.0
13	Shale, dark-reddish-brown, carbonaceous; contains a 1-ft-thick bed of impure coal 2 ft above base; unit weathers bluish gray----------	12.0
12	Sandstone, moderate-yellowish-brown, light gray at top; fine- to medium-grained, thin-bedded to massive; contains a thin hard layer of orange-brown iron-cemented sandstone at top----------	70.0
11	Sandstone, moderate-yellowish-brown, medium-grained, lenticular, high-angle cross beds----------	45.0
10	Coal and carbonaceous shale interbedded, black to reddish-brown----------	6.0
9	Sandstone and shale interbedded, pale-brown, channels into underlying marine sandstone----------	25.0

		Thickness
Mesaverde Formation (lower part) undivided--Continued		Ft
8	Sandstone, light-gray, fine-grained, cliff former; locally cut out by channeling of overlying nonmarine beds; ranges from 0 to 60 ft thick----------	22.0
7	Sandstone and shale interbedded, pale-yellowish-brown; sandstone beds 1 ft to 2 ft thick alternate with thin beds of gray sandy shale----------	68.0
6	Shale, medium-gray, sandy; contains some thin beds of soft sandstone; slope former----------	52.0
5	Sandstone and shale; like unit above except sandstones are soft; unit forms low ridge----------	98.0
	Thickness of Mesaverde Formation (lower part)-	815.0
Cody Shale (part):		
4	Shale, gray, sandy; contains a few thin beds of soft sandstone; at 65 ft above base is a 1 ft thick bed of dark-gray-weathering bentonitic shale; scattered quartzite pebbles and cobbles found loose on outcrop at this level----------	95.0
3	Shale, medium-dark-gray, silty to sandy; contains platy weathering thin ironstone concretions------	175.0
2	Sandstone, pale-yellowish-gray, fine-grained, glauconitic; locally contains lime-cemented masses of fossiliferous sandstone----------	15.0

		Thickness
Cody Shale (part)--Continued		Ft
	Loc. D4699:	
	Inoceramus quadrans Whitfield	
	Phelopteria aff. *P. linguaeformis* (Evans and Shumard)	
	Eutrephoceras sp. (discarded)	
	Baculites aquilaensis Reeside	
	Scaphites hippocrepis (DeKay) (early form)	
	Placenticeras sp. (discarded)	
1	Shale, medium-dark-gray, soft; contains a layer of pale-yellowish-brown septarian limestone concretions at 50 ft below top and at top--------	100.0
	Loc. D4698, at top in SW 1/4 NE 1/4 SW 1/4 sec. 2, T. 44 N., R. 96 W.:	
	Inoceramus quadrans Whitfield	
	Phelopteria aff. *P. linguaeformis* (Evans and Shumard)	
	Ostrea cf. *O. inornata* Meek and Hayden	
	Nymphalucina sp.	
	Xylophagella sp. (wood-boring clam)	
	Loc. D4697, 50 ft above base:	
	Baculites haresi Reeside	
	Thickness Cody Shale (lower part) measured----	385.0

Section 12

Composite section of rocks of Montana age measured by J. R. Gill and C. R. Givens in the vicinity of Cedar Mountain located about 5 1/2 miles northeast of Lucerne, Hot Springs County, Wyo.

Basal part of the Lance Formation and the Meeteetse Formation measured by planetable from the SE 1/4 NE 1/4 NW 1/4 sec. 7 to the SW 1/4 NE 1/4 SW 1/4 sec. 6, T. 44 N., R. 93 W., Hot Springs County, Wyo.

	Thickness Ft
Lance Formation:	
46 Sandstone and shale interbedded; sandstone is medium grained, lenticular and weathers brown; shale is gray and sandy with some layers of reddish brown weathering carbonaceous shale near base. Thickness not measured----------	
Meeteetse Formation:	
45 Shale and sandstone interbedded; shale are dark gray to reddish brown, sandy and bentonitic; sandstones are light gray, fine to medium grained, thin bedded and lenticular; unit contains numerous discontinuous layers of impure coal and black lignitic shale and thin beds of bentonite. Unit is soft and poorly exposed. Not measured in detail----------	540.0
Thickness Meeteetse Formation----------	540.0

Following section measured by Jacob's staff in the NE 1/4 sec. 13, T. 44 N., R. 94 W., Hot Springs County, Wyo.

Mesaverde Formation:	Thickness
Teapot Sandston Member:	Ft
44 Sandstone, light-gray to white, fine- to medium-grained; soft at base grading up into massive cliff former; high angle crossbeds; upper 70 ft poorly exposed-	167.0
Shale, reddish-brown, carbonaceous----------	1.0
Sandstone and siltstone interbedded; white, fine-grained, soft; contains a few local lens-like beds of channel sandstone----------	45.0
43 Sandstone, light-gray to white, medium- to coarse-grained; several lens-like layers of strongly crossbedded shale pebble conglomerate; alternating beds of soft and hard sandstone result in tred and riser outcrop-------	81.0
42 Sandstone, light-gray, medium-grained, soft, slope former; contains abundant thin layers of iron-cemented sandstone that weather yellow, orange brown and dusky red--	38.0
41 Sandstone, pale-yellowish-gray, fine- to medium-grained, cliff former----------	15.0
40 Shale, light-brown, carbonaceous; weathers bluish gray	5.0
39 Sandstone, pale-yellowish-gray, fine- to medium-grained, cliff former----------	20.0
Thickness Teapot Sandstone Member----------	372.0

		Thickness
Mesaverde Formation (upper part) undivided:		Ft
38	Shale, siltstone and sandstone; most of shale beds are carbonaceous and weather reddish brown to pinkish gray; siltstone beds are highly cemented with limonite and weather orange brown to dark brown; sandstone beds are fine to medium grained, lenticular channel deposits that range from 5 ft to 25 ft in thickness-------	202.0
37	Sandstone, medium- to light-gray, fine- to medium-grained; soft at base grading up into massive cliff former; polygonal joints are well developed in upper 30 ft of unit, a local lens-like 3 ft-thick layer of slightly carbonaceous shale 37 ft below top. Unit contains abundant worm trails and Ophiomorpha----------	92.0
36	Sandstone, yellowish-gray, fine-grained, soft; a few hard sandstone concretion layers that contain Ophiomorpha----------	29.0
35	Shale, medium-gray, sandy, soft----------	17.0
34	Sandstone, yellowish-gray, fine-grained; abundant small sandstone concretions; unit forms low cliff------	23.0
33	Sandstone, pale-yellowish-gray, fine-grained, thin-bedded, slope former----------	7.0

		Thickness
Mesaverde Formation (upper part) undivided--Continued		Ft
32	Shale, reddish-brown, carbonaceous, lenticular-----	0.6
31	Sandstone, dusky-yellow, fine-grained; upper 3 ft weathers white and contains polygonal joints only where overlain by carbonaceous shale----------	49.0
30	Shale and sandstone interbedded, pale-yellowish-gray, soft; grades up into overlying massive sandstone-------	59.0
29	Sandstone, dusky-yellow, fine-grained; contains a few hard layers----------	26.0
	Thickness Mesaverde Formation (upper part) undivided----------	504.6

Following unit measured in the NE 1/4 sec. 23, T. 44 N., R. 94 W.

Upper tongue of Cody Shale:

28	Shale, medium-gray, very sandy; poorly exposed; one or more layers of pale-yellowish-gray silty limestone concretions at 20 ft to 30 ft above base-	270.0
	Thickness upper tongue of Cody Shale----------	270.0

Following part of the section measured in the center SE 1/4 sec. 23 and center NW 1/4 sec. 26, T. 44 N., R. 94 W.

Tongues of Mesaverde Formation and tongues of Cody Shale undivided:

27	Sandstone, gray, medium-grained, moderately hard; appears marine----------	1.0

		Thickness
Tongues of Mesaverde Formation and tongues of Cody Shale undivided--Continued		Ft
26	Sandstone and shale interbedded; yellowish-gray soft sandstone and gray and reddish-brown carbonaceous shale; appears to be nonmarine----------	23.0
25	Coal, black, attrital, impure, highly weathered----	4.0
24	Shale, dark-reddish-brown, carbonaceous; weathers bluish gray----------	2.0
23	Sandstone and shale interbedded, soft, poorly exposed-	10.0
22	Shale and sandstone interbedded; light-gray, soft, poorly exposed; upper 10 ft appears to be light-yellowish-gray sandstone capped by a 1 ft-thick concretionary layer of hard, dark-brown-weathering sandstone----------	22.0
21	Sandstone, nonmarine, yellowish-gray, fine-grained, cliff former; channels into underlying units, appears to pinch out eastward; contains a few oysters----	21.0
20	Shale, light-gray, sandy----------	14.0
19	Sandstone, marine, dusky-yellowish-green, fine-grained, soft; contains a layer of 5 ft diameter sandstone concretions 15 to 30 ft above base----------	40.0
	Loc. D4696, from concretions:	
	Nucula (Pectinucula) sp.	
	Ethmocardium sp.	
	Tellina sp.	

		Thickness
Tongues of Mesaverde Formation and tongues of Cody Shale undivided--Continued		Ft
	Cymbophora sp.	
	Bits of turtle bones and shark teeth	
18	Sandstone, light-yellowish-gray, fine-grained, soft, clayey----------	18.0
17	Sandstone, pale-yellowish-gray, fine-grained, massive, soft at base to cliff forming at top; at 47 ft above base is a 1 ft thick layer of highly fractured, light-yellow limy siltstone and a soft sandstone that divides the unit into an upper and lower bench; local development of large concretionary masses of sandstone in upper bench; unit is capped by a 1-ft-thick bed of coarse-grained sandstone that contains abundant Ophiomorpha; a few quartzite pebbles to cobbles strewn about on upper surface of this sand----------	90.0
16	Shale and sandstone interbedded; soft, slope former- Loc. D4695, float on this unit:	40.0
	Baculites sp.	
15	Sandstone, pale-yellowish-gray, fine-grained, lower 8 ft moderately hard and massive; upper part thin bedded and soft; contains 1 ft-thick by 1.5 ft diameter concretion layer near base----------	29.0
14	Coal, black, attrital----------	0.6

		Thickness
Tongues of Mesaverde Formation and tongues of Cody Shale undivided--Continued		Ft
13	Sandstone, reddish-brown, carbonaceous, medium-grained-	4.0
12	Coal, black, attrital----------	0.5
11	Sandstone, lower part dark yellowish orange grading up to light yellowish gray and light gray at top; fine- to medium-grained, massive cliff former, a 0.4-ft-thick dark-green glauconitic layer 8 ft above base and a 1 ft-thick dark-brown carbonaceous sandstone at top----------	40.0
10	Shale, brownish-gray, flakey; weathers darker than over or underlying units, non-sandy----------	32.0
9	Sandstone, pale-brown, soft, clayey; weathers pale yellowish gray; contains a few limonite-cemented layers near top-	10.0
8	Sandstone, yellowish-gray, very fine grained; thin-bedded, soft; weathers similar to shale except for local development of more resistant layers; thin hard layers at top and base and 24 and 48 ft above base------	61.0
7	Shale and sandstone, soft, poorly exposed----------	24.0
6	Sandstone, pale-brown, fine-grained, local ledge former----------	3.0
5	Shale, medium-dark-gray, soft, slope former; sandy in upper 30 ft----------	50.0

		Thickness
Tongues of Mesaverde Formation and tof Cody Shale undivided--Continued		Ft
4	Sandstone and sandy shale interbedded, medium-gray; sandstone, fine-grained, in beds 1 ft - 2 ft thick interbedded with sandy shale beds 0.1 ft to 0.5 ft thick; capped by massive cliff forming sandstone 10 ft thick----------	63.0
3	Shale, medium-gray, largely covered by slope wash from above; sandy in upper 20 ft; at about 30 ft above base there appears to be one or more beds of bentonite at least 0.5 ft thick----------	135.0
2	Shale, dark-gray, bentonitic, soft, abundant selenite crystals----------	15.0
1	Sandstone, dusky-greenish-yellow, glauconitic, concretionary weathering at top; contains a few hematite nodules with a few fossils; base not exposed-----	25.0

Loc. D4694:

Inoceramus sp.

Eutrephoceras sp.

Baculites aquilaensis Reeside

Glyptoxoceras novimexicanum (Reeside)

Placenticeras sp.

Thickness of tongues of Mesaverde Formation and tongues of Cody Shale measured----------	777.0
	(Rounded)

Section 13

Composite partial section of rocks of Montana age measured by J. R. Gill and C. R. Givens in the vicinity of Zimmerman Butte, Washakie County, Wyo. Measured in the SE 1/4 SE 1/4 sec. 15, T. 44 N., R. 92 W.

Mesaverde Formation:	Thickness
	Ft
Teapot Sandstone Member:	
Sandstone, light-gray, medium-grained, with thin laminae of reddish-brown carbonaceous shale; torrential type of crossbedding----------	40.0+
Thickness of Teapot Sandstone Member measured-	40.0
Mesaverde Formation (upper part) undivided:	
63 Sandstone, pale-yellowish-gray, fine-grained, soft; grades up into massive light-gray cliff-forming sandstone; low-angle crossbedding; polygonal jointing; at 30 ft above base is a layer of 3 ft thick by 5 ft diameter brown-weathering sandstone concretions with Ophiomorpha----------	41.0
62 Shale and sandstone; reddish-brown carbonaceous shale interbedded with lenticular beds of light-gray and dusky-yellow soft sandstone; carbonaceous shale is dominant lithology in unit----------	80.0
61 Sandstone, siltstone and shale; weathers yellowish gray with abundant limonite cement; a few erratic concretionary masses of dark-brown-weathering sandstone----------	30.0

		Thickness
Mesaverde Formation (upper part) undivided:		Ft
60	Sandstone, dusky-yellow, fine-grained, local lenses of shale pebble conglomerate; contains a thin layer of broken oyster shells in middle; lenticular; channels into underlying beds----------	30.0
	Loc. D4692:	
	Crassostrea cf. *C. glabra* (Meek and Hayden)	
59	Shale, gray, sandy; 0.5 ft thick lens of silty limestone 10 ft above base----------	20.0
58	Shale, reddish-brown, carbonaceous----------	4.5
57	Siltstone, light-gray, hard, yellow to orange iron stain on upper surface----------	2.0
56	Shale, reddish-brown, carbonaceous----------	4.5
55	Siltstone, as above----------	3.0
54	Shale, reddish-brown, carbonaceous----------	1.0
53	Sandstone, yellowish-gray, medium-grained, massive cliff former; lower part softer and eastward grades abruptly into lithology of underlying unit; polygonal jointed; contains *Ophiomorpha*----------	42.0
52	Sandstone, dusky-yellow to light-gray, fine-grained; 1-2 ft thick ledge-forming sandstones alternate with soft clayey sandstone; contains a few iron-stone concretions and *Ophiomorpha*; unit thickens to the east----------	36.0

		Thickness
Mesaverde Formation (upper part) undivided--Continued		Ft
51	Shale, gray, sandy, contains a few thin layers of soft sandstone----------	15.0
50	Sandstone, dusky-yellow to light-yellowish-gray, fine-grained; low-angle crossbedding; upper 2 ft lime cemented and weathers concretionary forming a resistant ledge; shale pebble conglomerate 5 ft below top contains a few fossils----------	19.0

Loc. D4690:

Inoceramus sp.

Ostrea russelli Landes

Cymella montanensis Henderson

Ethmocardium whitei Dall

Cymbophora formosa (Meek and Hayden)

Baculites mclearni Landes

Loc. D4691, in NW 1/4 sec. 19, T. 44 N., R. 92 W.:

Baculites mclearni Landes

49	Sandstone and shale interbedded; sandstone, dusky-yellow to light-yellowish-gray, fine-grained; thin-bedded with thin iron-cemented layers in lower one-third; medium-gray sandy shale dominant in middle one-third and thin to medium-bedded sandstone dominant in upper part; worm trails and borings present in upper part of unit--------	35.0

		Thickness
Mesaverde Formation (upper part) undivided--Continued		Ft
48	Shale and sandstone interbedded; shale, light-reddish-brown, carbonaceous; sandstone, pale-yellowish-gray, soft, lenticular----------	16.0
47	Shale, reddish-brown, carbonaceous----------	3.0
46	Shale, medium-gray; contains .2 ft thick sandstone bed in middle----------	3.0
45	Shale, reddish-brown, carbonaceous----------	2.0
44	Shale, medium-gray, sandy----------	5.0
43	Sandstone, light-olive-gray, slightly carbonaceous, lenticular----------	1.0
42	Shale, reddish-brown, carbonaceous----------	3.0
41	Sandstone and shale interbedded; yellowish-brown, soft sandstone with thin iron-cemented layers and medium-gray sandy shale----------	12.0

Following part of section measured from the Cen. sec. 25 to the NE 1/4 NE 1/4 sec. 25, T. 44 N., R. 93 W.

		Thickness
Mesaverde Formation (upper part) undivided--Continued		Ft
40	Sandstone, yellowish gray at base to light gray at top, fine- to medium-grained; upper part massive; lower part thin bedded and shaly, cliff former; locally contains 2 ft thick by 3 ft diameter brown-weathering sandstone concretions with Ophiomorpha. Unit thins and appears to grade into nonmarine beds within two or three miles to the west-------	60.0
	Thickness of Mesaverde Formation (upper part) undivided----------	468.0
Tongue of Cody Shale:		
39	Shale, medium- to light-gray, very sandy----------	40.0
38	Bentonite, light-gray, slightly swelling; contains thin plates of pale-yellowish-gray calcite-------	4.5
	Thickness tongue of Cody Shale----------	44.5
Cody Shale:		
Sussex Sandstone Member:		
37	Sandstone, dusky-yellow, fine- to medium-grained; lower part massive; upper 15 ft thin bedded; contains Ophiomorpha and abundant worm trails on bedding surfaces; a layer of large brown-weathering sandstone concretions and a few oyster shells in upper part of unit; forms massive cliff----------	50.0
Loc. D4693:		
Ostrea sp. (bored)		

Cody Shale--Continued:	Thickness
Sussex Sandstone Member--Continued	Ft
36 Sandstone, yellowish-gray, fine- to medium-grained, thin-bedded; grades up into overlying unit-------	15.0
Thickness of Sussex Sandstone Member of Cody Shale----------	65.0
Tongue of Cody Shale:	
35 Shale, medium-gray, silty to sandy; weathers to a yellowish gray slope; poorly exposed; contains two layers of orange-brown-weathering fossiliferous ironstone concretions about 200 ft above the base of unit----------	360.0
Loc. D4688:	
Baculites sp. (smooth to weakly ribbed)	
Loc. D4689, in NE 1/4 NW 1/4 sec. 22, T. 44 N., R. 92 W.:	
Baculites sp. (smooth)	
34 Sandstone, pale-yellowish-gray, fine-grained, clayey, soft----------	18.0
33 Shale, medium-gray, flakey; weathers to a yellowish-gray crust; becomes sandy in upper part----------	15.0

		Thickness
Tongue of Cody Shale--Continued		Ft
32	Sandstone, greenish-gray, fine- to medium-grained, glauconitic at top, locally cemented with iron; weathers bright orange brown; contains at top a layer of rounded bone fragments and black polished chert granules with a sparse scattering of gray, black and pink quartzite rounded cobbles that are as much as .4 ft thick by .5 ft in diameter------	10.0
31	Shale, medium-gray, very sandy, soft, poorly exposed; contains three beds of light-gray-sandy slightly swelling bentonite; a 0.4 ft thick bed at 32 ft above base; a 0.6 ft thick bed at 47 ft above base and an 0.5 ft thick bed at 57 ft above base; all contain thin translucent plates of pale-yellow calcite----------	65.0
	Thickness of tongue of Cody Shale----------	468.0
Tongues Mesaverde Formation and tongues of Cody Shale undivided:		
30	Sandstone, yellowish-gray, fine- to medium-grained, clayey; very thin even beds with minor amounts sandy shale; locally cliff forming; bedding in upper 60 ft is less uniform than in lower part; sandstone beds more firmly cemented and shale beds soft giving a tred and riser effect; unit capped by a 0.5 ft thick layer of brown-weathering hard sandstone that forms a long dip slope----------	180.0

		Thickness
Tongues of Mesaverde Formation and tongues of Cody Shale undivided-- Continued		Ft
29	Siltstone and silty shale interlaminated; greenish-gray, soft; unit more shaly in upper 30 ft; weathers to a yellowish-gray slope----------	100.0
28	Shale, reddish-brown, carbonaceous, lenticular-----	1.0
27	Sandstone, dusky yellow in lower part, light gray in upper part, fine-grained; massive cliff former; abundant Ophiomorpha----------	72.0
26	Sandstone, dusky-yellow-green, fine-grained; lower two-thirds of unit very thin bedded; upper part more massive; weathers to a low ridge----------	28.0

The following part of section measured in the NE 1/4 NE 1/4 sec. 26, T. 44 N., R 93 W.:

25	Shale, gray, sandy, a 1 ft-thick bed of soft sandstone 8 ft below top----------	65.0
24	Sandstone, dusky-yellow, medium-grained, thin-bedded; ridge former; contains Ophiomorpha----------	2.0
23	Shale, gray, sandy----------	3.0
22	Sandstone, dusky-yellow, fine-grained, soft; contains some thin beds of gray sandy shale----------	33.0
21	Sandstone, dusky-yellow, medium-grained, massive, cliff former----------	10.0
20	Sandstone and shale interbedded, soft----------	8.0

		Thickness
Tongues of Mesaverde Formation and tongues of Cody Shale undivided-- Continued		Ft
19	Sandstone, dusky-yellow, fine- to medium-grained, massive cliff former; contains 10 ft diameter sandstone concretions----------	18.0
18	Shale and sandstone interbedded; shale, gray and sandy; sandstone, dusky-yellow and clayey--------	8.0
17	Sandstone yellowish-gray, medium-grained, massive cliff former; contains Ophiomorpha----------	15.0
16	Shale and sandstone interbedded, soft----------	5.0
15	Sandstone, yellowish-gray, medium-grained, resistant-	8.0
14	Sandstone and shale interbedded; a thin iron-cemented sandstone layer at base----------	33.0
13	Shale, medium-gray, numerous layers of ironstone concretions and a few brown-weathering limestone concretions----------	130.0
	Loc. D4687, from limestone concretion 65 ft above base of unit: Baculites aquilaensis Reeside	
12	Sandstone, light-gray to greenish-gray, fine-grained; soft, glauconitic, contains a few iron-cemented thin layers; sparse Ophiomorpha----------	45.0
	Thickness of undivided tongues of Mesaverde Formation and tongeus of Cody Shale----------	764.0

		Thickness
Lower part of Cody Shale		Ft
11	Shale, medium-gray; contains numerous ironstone concretion layers----------	60.0
10	Sandstone, greenish-gray, glauconitic; contains a few fossils----------	0.5
	Loc. D4686:	
	Baculites haresi Reeside	
9	Shale, medium-gray, abundant ironstone concretions and a few scattered gray limestone concretions---	128.0
	Loc. D4684, 60 ft below top of unit:	
	Inoceramus sp.	
	Goniochasma sp. (wood-boring clam)	
	Loc. D4685, same level in Cen. sec. 23, T. 44 N., R. 93 W.:	
	Syncyclonema? sp.	
	Crenella sp.	
	Baculites aquilaensis Reeside	
	Scaphites hippocrepis (DeKay) (early form)	
	Loc. D4683, at base of unit:	
	Baculites aquilaensis Reeside	
8	Shale, as above but without concretions----------	35.0
7	Bentonite, yellowish-gray----------	0.9
6	Shale, gray, contains septarian limestone concretions	14.0
	Loc. D4682, in NE 1/4 SE 1/4 sec. 28, T. 44 N., R. 92 W.:	

		Thickness
Lower part of Cody Shale--Continued		Ft
	Eutrephoceras alcesense Reeside	
	Baculites haresi Reeside	
	Scaphites hippocrepis (DeKay) (early form)	
	Haresiceras montanaense (Reeside)	
5	Bentonite, yellowish-gray----------	0.5
4	Shale, as above----------	6.0
3	Bentonite, as above----------	0.2
2	Shale, medium-gray, limestone concretions rare------	97.0
1	Shale, as above; limestone concretions layer at top of unit contains a few fossils----------	80.0
	Loc. D4681:	
	Inoceramus sp.	
	Cryptorhytis? sp.	
	Baculites aquilaensis Reeside	
	Scaphites hippocrepis (DeKay) (early form)	
	Haresiceras montanaense (Reeside)	
	Remainder of section poorly exposed	
	Thickness of lower part of Cody measured----	422.1

Section 14

Section of rocks of Montana age measured in the vicinity of Nowater Creek by J. R. Gill and C. R. Givens by planetable and Jacobs staff in the NW 1/4 sec. 35, T. 44 N., R. 90 W., Washakie County, Wyo. Supplemental details on the Meeteetse and Lance Formations from G. W. Horn.

		Thickness Ft
Lance Formation:		
37	Sandstone and shale interbedded with thin beds of carbonaceous shale; contains a massive light-gray sandstone at base. Formation not measured-------	
Meeteetse Formation:		
36	Shale and sandstone interbedded; contains lenticular beds of impure coal, carbonacoues shale and bentonite; unit weathers to a soft, light- and dark-banded outcrop. Not measured in detail----------	190.0
	Thickness of Meeteetse Formation----------	190.0
Lewis Shale:		
35	Sandstone, light-gray, fine-grained, clayey, soft--	40.0
	Sandstone, yellowish-gray, fine-grained, thin-bedded; Contains several layers of light-brown-weathering sandstone concretions; worm trail impressions are abundant on bedding surfaces----------	30.0
	Loc. D4680:	
	Pseudobaculites natosini (Robinson)	

		Thickness
Lewis Shale--Continued:		Ft
34	Shale, medium-gray, sandy; weathers to a smooth yellowish-gray slope; contains a persistant layer of reddish-brown-weathering ironstone concretions--25.0	
33	Sandstone and shale interbedded, gray, weathering yellowish gray, locally forms small resistant ledge; worm tails impressions abundant on budding surfaces; contains a few moderately-resistant sandstone concretions----------	17.0
32	Shale, gray, sandy; weathers to smooth slope-------	75.0
	Loc. D4679, 5 ft above base of unit:	
	Baculites jenseni Cobban	
31	Shale, medium-gray, bentonitic; contains a 1 ft-thick bed of pale-yellowish-gray bentonite in middle; bentonite contains abundant plates of pale yellow translucent calcite----------	10.0
30	Shale and sandstone interbedded; gray to yellowish-gray; weathers to a smooth slope----------	23.0
	Thickness of Lewis Shale----------	220.0
Mesaverde Formation:		
Teapot Sandstone Member:		
29	Shale, dark-reddish-brown, carbonaceous, soft------	7.0

Mesaverde Formation:	Thickness
Teapot Sandstone Member--Continued	Ft
28 Sandstone, light-gray to white; fine- to medium-grained, soft, clayey, crossbedded; contains thin lenticular beds of reddish-brown carbonaceous shale----------	47.0
27 Sandstone, light-gray to white, fine- to medium-grained, strongly crossbedded----------	63.0
Thickness of Teapot Sandstone member----------	117.0
Mesaverde Formation (upper part):	
26 Sandstone, siltstone and shale interbedded; pale-yellowish-brown to pale-brown, thin lenticular beds locally cemented with moderate brown-weathering layers of limonite, soft; not well exposed----------	130.0
25 Shale, medium-light to dark-gray, sandy with lenticluar beds of reddish-brown carbonaceous shale---------	30.0
24 Sandstone, dusky-yellow, fine-grained, soft; contains a few dark-brown-weathering layers of concretionary sandstone; abundant thin layers cemented with limonite----------	85.0
23 Shale, siltstone and sandstone interlaminated; olive-gray to moderate-yellowish-brown; weathers to a smooth slope; at 15 ft above base is a .8 ft-thick by 6 ft in diameter distinctive layer of highly fractured pale-yellowish-brown-weathering limestone concretions----------	70.0

		Thickness
Mesaverde Formation (upper part)--Continued		Ft
22	Sandstone, pale-yellowish-brown, fine- to medium-grained, massive; contains some large brown-weathering sandstone concretions; at 1 ft above the base is a thin layer of thin-shelled oysters----------	40.0
21	Shale, dark-brown, carbonaceous----------	10.0
20	Sandstone, light-gray, fine-grained, soft; contains a thin bed of black lignitic shale----------	15.0
19	Sandstone, dusky-yellow, fine- to medium-grained, massive, cliff former; contains 3 layers of large dark-brown-weathering sandstone concretions with Ophiomorpha; top of unit is horizon of lens-like accumulations of black sand----------	95.0
18	Sandstone, siltstone, and shale interbedded, gray, forms slope; sandstone content increases in upper part-	40.0
17	Sandstone, dusky-yellow, fine-grained, soft, clayey; contains a 2 ft-thick by 6 ft in diameter layer of light-brown-weathering sandstone concretions at top----------	75.0
	Thickness of Mesaverde Formation (upper part)-	590.0

		Thickness
Tongue of Cody Shale		Ft
16	Shale and siltstone interbedded with a few thin layers of soft sandstone, medium-gray, poorly exposed----------	85.0
	Loc. D4678, 40 ft above base: *Baculites* cf. *B. mclearni* Landes Remarks: A single juvenile	
15	Sandstone, dusky-yellow, fine- to medium-grained, massive layer of phosphate pebbles and rounded bone fragments at top of unit----------	33.0
14	Shale and siltstone interlaminated with a few thin layers of soft sandstone, medium-gray, soft------	165.0
Ardmore(?) Bentonite Bed:		
13	Bentonite, dusky-yellow, poorly swelling, biotitic at base----------	1.5
12	Shale, gray, sandy----------	1.0
11	Bentonite, as above----------	0.7
10	Shale, gray, sandy----------	1.0
	Thickness of tongue of Cody Shale----------	287.1

Cody Shale: Thickness

Sussex(?) Sandstone Member: Ft

9 Sandstone, light-gray, very fine grained, soft with local thin beds of hard lime-cemented sandstone; low-angle crossbedding; several layers of hard sandstone concretions that contain Ophiomorpha; contains a .5 ft-thick bed of broken oyster shells 5 ft below top---------- 50.0

Loc. D4677, at top and 10 ft below top

Ostrea sp.

Ethmocardium sp.

Baculites cf. B. obtusus Meek

Thickness of Sussex(?) Sandstone Member of Cody Shale---------- 50.0

Cody Shale (part):

8 Shale, siltstone, and thin layers of soft sandstone interlaminated, light-olive-gray; layer of brown-weathering fossiliferous sandy limestone concretions at base; base of unit poorly exposed and very sandy and may be represented by a bed of soft sand about 1- ft thick---------- 200.0

Loc. D4676 and D4675, in SE 1/4 sec. 1, T. 44 N., R. 89 W.:

Baculites sp. (dominantly smooth)

		Thickness
Cody Shale (part)--Continued		Ft
7	Shale, siltstone, and sandstone, as above; soft, poorly exposed; local masses of concretionary sandstone----------	175.0
	Loc. D4673, 80 ft above base:	
	Baculites sp. (weak flank ribs)	
	Placenticeras syrtale (Morton)	
	Loc. D4674, in SE 1/4 sec. 1, T. 44 N., R. 89 W.:	
	Baculites sp. (weak flank ribs)	
6	Sandstone, light-olive-gray, medium- to coarse-grained; small dark chert and phosphate pebbles at top and graunles at base; glauconitic; middle part is fine grained and soft; capped by a 0.6-ft-thick orange-brown-weathering layer of hard sandstone---------	25.0
	Loc. D4672:	
	Inoceramus n. sp.	
	Modiolus sp.	
	Bacuiltes sp. (weak flank ribs)	
	Loc. D4671, from NE 1/4 sec. 36, T. 44 N., R. 90 W.:	
	Nucula sp.	
	Inoceramus n. sp.	
	Baculites sp. (weak flank ribs)	
	Placenticeras syrtale (Morton)	

		Thickness
Cody Shale (part)--Continued		Ft
	Loc. D4670, From SE 1/4 sec. 1., T. 44 N., R. 90 W.:	
	Inoceramus sp.	
	Cymbophora? sp.	
	Baculites sp.	
5	Shale, medium-gray, sandy----------	195.0
4	Bentonite, yellowish-gray, poorly swelling; weathers light gray and forms light band on outcrop-------	6.0
3	Shale, medium-gray, silty to sandy----------	100.0
2	Sandstone, dark-yellowish-green, glauconitic; contains a few chert granules; very soft and poorly exposed----------	10.0
1	Shale, medium-gray, silty, poorly exposed; contains a layer of fossiliferous limestone concretions 270 ft below top----------	320.0
	Loc. D4669:	
	Baculites sp.	
	Placenticeras sp.	
	Thickness of Cody Shale measured----------	1031.0

Section 15

Composite section of rocks of Montana age measured on the west side of the North Fork oil field near Kaycee, Wyo. and along the Powder River near the junction of the north and south forks. The lower part of the section measured by planetable by J. R. Gill, R. E. Burkholder and W. A. Cobban in 1963 and the upper part by J. R. Gill and C. R. Givens in 1964.

Section measured in the SE 1/4 NE 1/4 SE 1/4 sec. 23, T. 43 N., R. 81 W., Johnson County, Wyo,

		Thickness Ft
Lance Formation (part):		
72	Sandstone and carbonaceous shale interbedded, not measured----------	
71	Sandstone, dusky-yellow, medium-grained; contains large lime-cemented concretions----------	40.0
70	Shale, dark-brown, carbonaceous; contains 10- to 15-ft-thick lenticular masses of light-yellowish-gray channel sandstone in lower part----------	50.0
69	Sandstone, light-gray to dusky-yellow, fine- to medium-grained; contains layers of large sandstone concretions in middle and upper parts. A few thin carbonaceous shale in lower 40 ft----------	120.0
68	Coal and carbonaceous shale interbedded, black to dark-brown----------	5.0
67	Sandstone, yellowish-gray to dusky-yellow, medium-grained, soft; abundant carbonaceous fragments---	26.0
66	Sandstone, light-olive-gray to dusky-yellow, soft; contains thin beds of carbonaceous shale and layers of limonite-cemented sandstone----------	35.0
65	Shale, dark-brown, carbonaceous; contains 1 ft-thick bed of coaly shale at top----------	11.0
	Total Lance Formation measured----------	287.0

Section measured in the SE 1/4 NE 1/4 SE 1/4 sec. 23, T. 43 N., R. 81 W., Johnson County, Wyo,--Continued

		Thickness
		Ft
Fox Hills Sandstone:		
64	Sandstone, very light gray, fine- to medium-grained; massive; sandstone concretion layers at base and top; Ophiomorpha throughout---	37.0
63	Sandstone, moderate-olive-brown, glauconitic; fine-grained; concretionary weathering; contains Ophiomorpha----------	2.0
	Thickness of Fox Hills Sandstone----------	39.0

Upper part measured in the SE 1/4 NE 1/4 SE 1/4 sec. 24 and lower part measured in the SW 1/4 SE 1/4 sec. 24, T. 43 N., R. 81 W., Johnson County, Wyo.

		Thickness
Lewis Shale (part):		
62	Shale, medium-gray, silty to sandy, glauconitic near base; gradation into overlying sandstone----	111.0
61	Sandstone, olive-gray, fine-grained, soft----------	14.0
60	Mudstone, dark-greenish-gray, very sandy, gradational into overlying sandstone; contains a layer of sparse sandy limestone concretions 20 ft above base----------	60.0
	Loc. D5072:	
	Nucula sp.	
	Ostrea sp.	
	Tellinimera scitula (Meek and Hayden)	
	Baculites cf. B. grandis Hall and Meek	
59	Shale, medium-gray, sandy; interbedded with .05 to .1 ft-thick beds of greenish-gray, very fine grained sandstone; contains rare lens-like 1 ft-diameter by 1.5 ft-thick sandstone concretions in middle of unit----------	56.0

Upper part measured in the SE 1/4 NE 1/4 SE 1/4 sec. 24 and lower part measured in the SW 1/4 SE 1/4 sec. 24, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness Ft
Lewis Shale (part)--Continued;		
58	Sandstone, light-gray, fine-grained, soft; contains six layers of cannonball-like concretions that range in diameter from .5 ft to 1.5 ft; Ophiomorpha is abundant---------	31.0
57	Sandstone, olive-gray to brownish-gray, fine-grained, massive, soft; contains 4 layers of cannonball concretions with Ophiomorpha----------	34.0
56	Mudstone, dark-greenish-gray, very sandy, soft, muddled bedding----------	4.0
55	Sandstone, olive-gray to brownish-gray, fine-grained, thin- to medium-bedded with some thin shale partings near base; contains layer of 1.5 ft diameter sandstone concretions at top---------	44.0
	Loc. D5071 at top: Cymbophora sp.	
54	Shale, reddish-brown, carbonaceous----------	2.0
53	Shale, olive-gray, sandy; weathers bentonitic------	4.4

Upper part measured in the SE 1/4 NE 1/4 SE 1/4 sec. 24 and lower part measured in the SW 1/4 SE 1/4 sec. 24, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness Ft
Lewis Shale (part)--Continued:		
52	Sandstone, pale-yellowish-gray, very fine grained, soft; thin laminae of dark-gray shale----------	12.0
51	Coal, black, attrital, impure----------	1.6
50	Sandstone, light-gray to white, fine-grained, low-angle cross beds; Ophiomorpha abundant----------	72.0
49	Shale, dark-gray, sandy; one-half mile to the northwest a 1-ft-bed of coal crops out of this level----------	0.8
48	Sandstone, light-gray to white, fine-grained; layer of 1.5 ft thick by 3-ft-diameter concretions 10 ft above base----------	42.0
47	Sandstone, olive-brown, fine-grained, massive, cliff former; contains abundant 3-ft-diameter cannonball-like concretions containing Ophiomorpha-	58.0
46	Sandstone, olive-brown, fine-grained; in layers .1 ft to 3 ft thick interbedded with thin dark-gray shale laminae----------	45.0

Measured in the SE 1/4 SE 1/4 SE 1/4 sec. 23, T. 43 N., R. 81 W., Johnson County, Wyo.

		Thickness Ft
Lewis Shale (part)--Continued:		
45	Shale, medium-dark-gray, sandy----------	30.0
44	Sandstone, dark-greenish-gray, fine-grained; contains a few sandstone concretions; ridge former----------	30.0
43	Mudstone, medium-gray, very sandy; locally contains some poorly cemented lenses of concretionary sandstone----------	125.0
	Loc. D4668, 65 ft below top: *Baculites eliasi* Cobban	
42	Sandstone, olive-gray, fine-grained, clayey; contains some thin lime-cemented beds that form a low ridge----------	40.0
41	Shale, medium-gray, sandy, soft. Locally a thin glauconitic sandstone is present at base that contains nodules of phosphate-cemented sandstone and phosphatic casts of baculites----------	60.0
	Loc. D3445, base of unit in SW 1/4 sec. 32, T. 44 N., R. 81 W., Johnson Coutny, Wyo.: *Baculites reesidei* Elias *Hoploscaphites nodosus* (Owen)	
	Thickness Lewis Shale----------	877.0

Measured in the NE 1/4 NE 1/4 NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.

		Thickness Ft
Mesaverde Formation (part):		
Teapot Sandstone Member:		
40	Sandstone and siltstone interbedded; sandstone is white, very fine grained and soft; unit poorly exposed; appears to contain 5 to 7 ft thick units of dark-brown carbonaceous shale in lower, middle and upper parts. Some of the better exposed sandstone units are strongly crossbedded and contain an abundance of carbonaceous fragments----------	125.0
	Thickness Teapot Sandstone Member----------	125.0
Marine shale member:		
39	Sandstone, pale-yellowish-gray, very fine grained, clayey, soft; contains numerous thin plates of limonite-cemented sandstone; weathers yellowish-orange----------	88.0
38	Shale, medium-gray, sandy, grades up into overlying unit----------	87.0
37	Sandstone, greenish-gray, medium-grained, glauconitic; locally cemented with iron; contains low-angle cross beds----------	5.0
	Loc. D4667, base of sandstone: Inoceramus sublaevis Hall and Meek Oxytoma haydeni (Hall and Meek) Baculites scotti Cobban	
	Thickness marine shale member measured---------	180.0

Section measured in the cen NE 1/4 sec. 26, R. 43 N., R. 81 W., Johnson County, Wyo

		Thickness
	Measverde Formation (part):	Ft
	Parkman Sandstone Member:	
36	Shale, medium- to light-gray, sandy, poorly exposed; contains a layer of highly fractured light-gray-weathering limestone concretions in lower part and a few layers of dark-orange-brown-weathering ironstone concretions in upper part----------	20.0
35	Shale, light-gray, pale-yellow and dark-brown, sandy, soft; contains some soft lenticular beds of pale-yellowish-gray sandstone; numerous thin layers and lenses of dark-orange-brown weathering limonite; unit is capped by 1 ft-thick bed of brown lime-cemented sandstone----------	113.0
34	Shale, dark-brown, carbonaceous, sandy----------	5.0
33	Sandstone, pale-yellowish-gray, fine grained, lenticular locally contains thin beds of carbonaceous shale; sandstone in upper part of unit contains abundant shale pebbles replaced by limonite----------	53.0
32	Shale, dark-brown, carbonaceous; contains a few thin sandstone partings----------	5.0

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness Ft
Mesaverde Formation (part)--Continued:		
Parkman Sandstone Member--Continued		
31	Sandstone, yellowish-gray, fine-grained; forms massive cliff; upper 5 ft thin bedded and locally cemented with irons; weathers brownish-red-------	80.0
30	Sandstone and shale interbedded, soft; locally contains concretionary masses of yellowish-gray sandstone----------	6.0
29	Sandstone, yellowish-gray, fine-grained; massive cliff former; contains some shale pebbles replaced by limonite----------	15.0
28	Sandstone, yellowish-gray, fine-grained, thin-bedded, soft; locally contains dark-brown-weathering hard lenses of sandstone----------	6.0
27	Sandstone, pale-yellowish-gray, fine-grained; massive cliff former; contains 1.5 ft thick layer of soft clayey sandstone in middle----------	12.0
26	Sandstone as before but thin bedded; beds range from .4 to 1 ft thick containing some thin interbeds of dark-gray sandy shale; softer than over or underlying units----------	15.0
25	Sandstone, pale-yellowish-gray, fine-grained, hard; contains small shale pebbles replaced by limonite-	10.0

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

	Thickness Ft
Mesaverde Formation (part)--Continued:	
Parkman Sandstone Member--Continued:	
24 Sandstone, as above but with thin interbeds of sandy shale; contains local concretionary masses of sandstone with shale pebbles; unit forms slope----------	75.0

Basal part of Parkman Sandstone Member and underlying units measured on the west side of the North Fork oil field starting at the contact of the Niobrara Member of Cody Shale in the NE 1/4 NE 1/4 sec. 27 and ending in the Parkman Sandstone Member in the NW 1/4 NE 1/4 sec. 25, T. 44 N., R. 82 W., Johnson County, Wyo.

23 Sandstone and shale interlaminated, unit medium dark gray, weathering grayish orange, grades up into soft clayey sandstone; contains several layers of lime-cemented, highly fractured sandstone concretions that weather light brown----------	105.0
Thickness Parkman Sandstone Member----------	520.0

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

	Thickness Ft
Cody Shale (upper part):	
22 Shale, medium-gray, weathering gray; silty becoming slightly sandy in upper part; upper 10 ft of unit weathers yellowish brown; contains many layers of dark-gray moderate-brown-weathering fossiliferous limestone concretions----------	132.0

Loc. D4264, in upper part of unit:

Inoceramus cf. *I. ovatus* Dobrov

Anomia sp.

Baculites perplexus Cobban

Hoploscaphites sp.

Placenticeras intercalare Meek

Loc. D4263, 85 ft below top:

pyriporid bryozoan

Lingula cf. *L. nitida* Meek and Hayden

Baculites perplexus Cobban

Loc. D4262, 115 ft below top:

pyriporid bryozoan

Inoceramus cf. *I. ovatus* Dobrov

Baculites perplexus Cobban

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R 81 W., Johnson County, Wyo.--Continued

		Thickness Ft
Cody Shale (upper part)--Continued:		
21	Shale, medium-gray weathering brownish gray to pale yellowish brown; upper part weathers light gray; silty to sandy; a few light-brown-weathering slabby limestone concretions in lower part; a persistant layer of grayish-orange to light-brown-weathering fossiliferous septarian limestone concretions 40 ft below top. Top of unit is marked by a 1 ft-thick bed of yellow nonswelling bentonite that contains abundant fragments of translucent yellow calcite----------	160.0

Loc. D4261, fossiliferous concretions 10 ft below top:

Inoceramus cf. *I. ovatus* Dobrov

Baculites sp. (smooth)

Baculites asperiformis Meek

Hoploscaphites n. sp.

Loc. D4260, fossiliferous concretions 20 ft below top:

Baculites sp. (smooth)

Hoploscaphites n. sp.

Loc. D4259, fossiliferous concretions 40 ft below top:

Inoceramus sp.

Baculites asperiformis Meek

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness
	Cody Shale (upper part)--Continued:	Ft
20	Sandstone, pale-yellow-gray; fine- to medium-grained with thin lenses of coarse-grained sandstone, phosphate pebbles, fish teeth and rounded bone fragments at base; thin-bedded locally cemented with lime and iron; forms low hogback----------	20.0
19	Shale, medium-gray weathering gray; thin local lenses of very fine grained soft sandstone; concretions rare in lower part; a layer of highly fractured brown-weathering fossiliferous sandy limestone concretions 10 ft below top----------	120.0

Loc. D4258, 10 ft below top:

Cymbophora emmonsi (Meek)

Baculites mclearni Landes

Hoploscaphites n. sp.

Loc. D4257, at base:

Baculites sp.

Remarks: Numerous initial coils and fragments of two crushed young adults that have weak flank ribs.

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness
		Ft
Cody Shale (upper part)--Continued:		
Ardmore Bentonite Bed:		
18	Bentonite, medium-light-gray, highly swelling----------	4.5

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness
		Ft
Cody Shale (upper part)--Continued;		
17	Shale, medium-gray weathering light gray; sandy, has several persistant layers of dark-brown-weathering silty limestone concretions which contain a few fossils----------	260.0

Loc. D4256, 5 ft below top:

pyriporid bryozoan

Baculites sp. (weak flank ribs)

Loc. D4255, 40 ft below top:

Nuculana sp.

Ostrea sp.

Nymphalucina subundata (Hall and Meek)

Baculites sp. (weak flank ribs)

Placenticeras aff. P. syrtale (Morton)

Loc. D4254, 100 ft below top:

Inoceramus sp.

Baculites sp. (weak flank ribs)

Loc. D4253, 150 ft below top:

pyriporid bryozoan

Inoceramus n. sp.

Ostrea

Tenea? sp.

Baculites sp. (weak flank ribs)

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

	Thickness
Cody Shale (upper part)--Continued	Ft
16 Shale, medium-dark-gray; slightly silty; contains several persistant beds of bentonite; 1.2 ft greenish-gray moderately swelling bentonite with abundant white to pale-yellow fibrous calcite at base; a 0.6-ft orange-weathering bentonite at 8 ft below top and a 1.5-ft greenish-gray bentonite at top of unit; a few small gray limestone concretions near top and base of unit----------	50.0
15 Shale, medium-dark-gray, silty to sandy; a few thin lenses of very fine grained gray sandstone and a few small limestones----------	30.0
Thickness upper part of Cody Shale----------	770.0

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness
		Ft
Cody Shale (part)--Continued		
Shannon Sandstone Member:		
14	Sandstone, dark-greenish-gray, glauconitic, fine-grained, clayey, soft; local concretionary masses of weakly lime-cemented sandstone near base, and moderately hard thin crossbedded sandstone in middle part; upper part soft and clayey----------	80.0
	Thickness of Shannon Sandstone Member---------	80.0
Cody Shale (lower part):		
13	Mudstone, dark-gray, very sandy; a few limy sandstone concretions near base; gradational with overlying sandstone----------	40.0
	Loc. D4266 near base:	
	Baculites sp. (smooth)	
	Hoploscaphites? n. sp.	

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness
		Ft
Cody Shale (lower part)--Continued		
12	Bentonite, dark-olive-green, poorly swelling; biotitic in lower part; locally some small clayey concretions----------	2.8
11	Shale, medium-dark-gray weathering medium-light gray, silty; yellowish-gray-weathering slabby limestone concretions and a few scattered red-weathering ironstone concretions at and near base; at 70 ft above base a layer of dark-gray septarian limestone concretions with distinctive dark-brown fibrous calcite septa which weather into small angular fragments and at 267 ft below top red and brown-weathering sandy limestone concretions. At 117 ft below top a 0.6 ft bed of orange-weathering bentonite that contains abundant yellow fibrous calcite----------	347.0

Loc. D4265, 15 ft below top:

Baculites sp. (smooth)

Loc. D4252, 112 ft below top:

Baculites sp. (smooth)

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness
	Cody Shale (lower part)--Continued	Ft
	Loc. D4251, 267 ft below top:	
	Inoceramus cf. *I. balticus* Boehm	
	Baculites sp.	
	Haresiceras natronense Reeside?	
	Loc. D4250, 277 ft below top:	
	pyriporid bryozoan	
	Inoceramus sp.	
	Cymbophora sp.	
	Baculites aquilaensis Reeside	
	Placenticeras sp.	
	Loc. D4249 at base:	
	Cymbophora sp.	
	Baculites aquilaensis Reeside	
	Scaphites hippocrepis (DeKay)	
	Haresiceras sp.	
10	Shale, medium-dark-gray, bentonitic, weathers to a light-gray alkali outcrop; red-weathering ironstone concretions abundant----------	150.0

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness
Cody Shale (lower part)--Continued		Ft
9	Shale, medium-dark-gray, interlaminated with soft light-gray siltstone; and a fine-grained sandstone weathers darker than over or underlying units; contains abundant silty shaly red-weathering ironstones and thin layers of yellowish-gray to brown-weathering siltstone concretions; a few light-gray-weathering laminated silty limestone concretions at top of unit----------	20.0
	Loc. D4248 at top of unit:	
	Inoceramus cf. *I. balticus* Boehm	
	Baculites aquilaensis Reeside	
	Scaphites hippocrepis (DeKay)	
8	Shale, medium-dark-gray weathering brownish-gray; contains light-brown-weathering limestone concretions; a 0.1-ft-thick orange bentonite near base; a 1-ft-thick greenish-yellow bentonite 60 ft below top--	200.0
	Loc. D4247, 5 ft below top:	
	pyriporid bryozoan	
	Baculites aquilaensis Reeside	
	Placenticeras sp.	

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness
		Ft
Cody Shale (lower part)--Continued		
	Loc. D4246, 152 ft below top:	
	pyriporid bryozoan	
	Baculites aquilaensis Reeside	
7	Bentonite, orange, poorly swelling----------	1.6
6	Shale, medium-gray, very bentonitic at base grading unward into light-gray very sandy shale, contains in upper part several layers of 1.5 ft by 2 ft-thick orange-brown-weathering septarian limestone concretions with septa of yellow crystalline calcite; in upper 10 ft are numerous irregular shaped tan-weathering septarian limestone concretions; 0.1-ft-thick beds of bentonite 5 and 10 ft below top----------	60.0
	Loc. D4245 in upper 10 ft:	
	Goniochasma sp. (wood-boring mollusk)	
	Baculites aquilaensis Reeside	

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

	Thickness
Cody Shale (part)--Continued	Ft
5 Shale, medium-dark-gray weathering brownish gray; very silty to sandy; contains large septarian limestone concretions with septa of orange calcite----------	100.0
4 Shale, medium-dark-gray weathering gray; a few silty limestone concretions; 1.5-ft-thick bentonite at 150 ft below top; 0.5-ft-thick bentonite at 105 ft below top and a 0.3-ft-thick orange bentonite at top----------	200.0

Loc. D4244 at top:

Baculites aquilaensis Reeside

Loc. D4243 at base:

Nemodon sp.

Inoceramus lundbreckensis McLearn

Inoceramus cf. *I. balticus* Boehm

Eutrephoceras alcesense Reeside

Baculites aquilaensis Reeside

Scaphites hippocrepis (DeKay)

Haresiceras montanaense (Reeside)

Scaphites aquisgranensis Schlüter

Remarks: The *Haresiceras* is the late form of the species.

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness
Cody Shale (lower part)--Continued		Ft
3	Shale, medium-gray weathering light gray to grayish yellow; interlaminated with soft silt and very fine grained sand; thin discontinuous lenses of hard gray to reddish-brown fine-grained sandstone abundant; lower 20 ft of unit less sandy and somewhat bentonitic----------	480.0

Loc. D4242, 305 ft below top:

Inoceramus lingua Goldfuss?

Baculites sp.

Scaphites sp.

Immature gastropods:

Drepanocheilus? sp. (nuculear and first teloconoch whorl)

Euspira? sp.

Calliomphalus? sp.

Loc. D4241, 415 ft below top:

Inoceramus sp.

Baculites sp.

Scaphites hippocrepis (DeKay) (coarse-ribbed)

Haresiceras sp.

Thickness of lower part of Cody Shale--------- 1,601.4

Section measured in the Cen NE 1/4 sec. 26, T. 43 N., R. 81 W., Johnson County, Wyo.--Continued

		Thickness Ft
Cody Shale:		
Niobrara Shale Member:		
2	Shale, bluish-gray weathering yellowish orange, very calcareous; contains 2 layers of highly fractured light-gray laminated limestone concretions at top and base----------	5.0
1	Shale, brownish-gray, calcareous----------	20.0
	Thickness of Niobrara Shale Member measured---	25.0

Section 16

Composite section of rocks of Montana age exposed in the vicinity of the Salt Creek and Teapot Dome oil fields, Natrona County, Wyo. Section measured by planetable and Jacob's staff by J. R. Gill and L. G. Schultz, July 1961.

Lower part of Lance Formation, Fox Hills Sandstone, Lewis Shale, Mesaverde Formation and tongues of Pierre Shale measured in the N 1/2 NE 1/4 sec. 24, T. 39 N., R. 78 W., Natrona County, Wyo.

		Thickness
	Lance Formation (part):	Ft
86	Shale, brown, carbonaceous, with thin black coaly layers interbedded with lenticular masses of light-gray to tan, crossbedded, soft sandstone; sandstones in upper part contain large, brown-weathering calcareous sandstone concretions----------	150.0
85	Sandstone, buff, massive; weathers light brown with lenses of dark-brown nodular calcite-cemented sandstone; becomes softer and lighter colored in top; base channels into underlying unit----------	50.0
	Total Lance Formation measured----------	200.0

Lower part of Lance Formation, Fox Hills Sandstone and tongues of Pierre Shale measured in the N 1/2 NE 1/4 sec. 24, T. 39 N., R. 78 W., Natrona County, Wyo.--Continued

		Thickness
		Ft
Fox Hills Sandstone:		
84	Sandstone, buff, massive, slightly calcareous, weathers brown with large hard brown calcareous sandstone concretions----------	40.0
83	Siltstone, very fine grained sandstone, and shale interbedded, medium- to light-gray; weathers tan; calcareous; mostly soft with a few hard calcite-cemented layers----------	90.0
82	Shale, carbonaceous, dark-gray-brown and black; 0.1-ft-thick coal bed at base of unit; few thin layers of tan to light-brown sandstone----------	20.0
81	Shale and sandstone interbedded; shale, medium-gray; sandstone, buff, calcareous with few rusty-weathering silty limestone concretions; soft unit; some pyrite in sandstone----------	30.0
80	Sandstone, yellowish-gray, fine-grained, massive, slightly calcareous, cliff forming; nodular and tabular brown-weathering calcite-cemented sandstone masses, particularly at top of unit----	30.0
	Thickness of Fox Hills Sandstone----------	210.0

Lower part of Lance Formation, Fox Hills Sandstone and Tongue of Pierre Shale measured in the N 1/2 NE 1/4 sec. 24 T. 39 N., R. 78 W., Natrona County, Wyo.--Continued

		Thickness
		Ft
Lewis Shale (part):		
79	Shale, silty, and siltstone, medium-gray, soft, locally with lenses of sandstone as much as 3 ft thick; light-gray, sparsely fossiliferous limestone concretions at 260 ft above base-------	410.0

Loc. D3233:

Nucula cancellata Meek and Hayden

Nuculana evansi (Meek and Hayden)

Tenuipteria cf. *T. fibrosa* (Meek and Hayden)

Cymbophora holmesi (Meek)

Baculites cf. *B. clinolobatus* Elias

Hoploscaphites sp.

Following section measured in the SW 1/4 and SW 1/4 SE 1/4 sec. 24, T. 39 N., R. 78 W., Converse County Wyo.

		Thickness Ft
Lewis Shale:		
78	Sandstone, greenish-gray, fine- to medium-grained with small lenses of coarse-grained sandstone; soft, weathers yellowish-gray; at 5 ft above base is a 3 ft-thick layer of hard calcareous dark-brown nodular weathering sandstone; upper 8 ft of unit contains some thin beds of light-brown and gray shale; Ophiomorpha abundant throughout sandstone----------	45.0
77	Sandstone, greenish-gray, fine-grained; interbedded with thin layers of medium-gray siltstone and sandy shale; a few thin layers of hard lime-cemented sandstone and a 1 ft-thick thin-bedded slabby sandstone at base that locally forms prominent ridge----------	40.0
76	Covered; exposures at this level nearby (NE 1/4 NE 1/4 sec. 36, T. 39 N., R. 78 W.) indicate that soft carbonaceous shale and sandstone of brackish-water or nonmarine origin occupy this position---	20.0
75	Sandstone, greenish-gray, fine- to medium-grained; stained brown with iron; contains large brown sandstone concretions with abundant Ophiomorpha--	25.0

Following section measured in the SW 1/4 and SW 1/4 SE 1/4 sec. 24, T. 39 N., R. 78 W., Converse County, Wyo.--Continued

		Thickness Ft
Lewis Shale (part):		
74	Sandstone, yellowish-gray, medium- to coarse-grained; weathers borwn; abundant dark heavy mineral grains that are locally concentrated into placer-like deposits; large inoceramids are abundant---------	1.0
	Loc. D3232 and D5070: *Inoceramus oblongus* White s.l. (less inflated)	
	Loc. D5070: *Inoceramus* aff. *I. oblongus* White; *Inoceramus* sp.	
73	Sandstone, fine- to medium-grained, buff, soft-----	5.0
72	Covered, probably soft sandstone and sandy shale---	60.0
71	Sandstone, fine- to medium-grained, calcareous, lower two-thirds of unit is buff and locally cliff forming; upper one-third of unit is white; lower part contains shale fragments, borings, and *Ophiomorpha*; upper part contains large tabular brown concretionary masses; locally at top of unit is a very hard sandstone with abundant dark minerals----------	115.0

Following section measured in the SW 1/4 SW 1/4 sec. 24, T. 39 N., R. 78 W., Natrona County, Wyo.

		Thickness Ft
Lewis Shale (part):		
70	Shale, gray, very silty, to clayey siltstone, noncalcareous, limestone concretion layers at several horizons, most prominent at 40 ft and 180 ft below top----------	240.0
	Loc. D3231, 55 ft below top: *Hoploscaphites plenus* (Meek and Hayden)	
69	Sandstone, medium-gray, soft, very fine grained, clayey. Two or three layers of hard, lime-cemented glauconitic sandstone that forms prominent hogback; basal part has small irregular tan-weathering limestone concretions----------	95.0
68	Shale, medium-dark-gray, silty to sandy with thin beds of fine sand; prominent layer of 0.4-ft-thick by 2-ft-diameter fossiliferous limestone concretions at top----------	65.0
	Loc. D3230: *Baculites eliasi* Cobban *Hoploscaphites* n. sp.	

Following section measured in the SW 1/4 SW 1/4 sec. 24, T. 39 N., R. 78 W., Natrona County, Wyo.--Continued

		Thickness Ft
Lewis Shale (part);		
67	Sandstone, medium-gray fine- to medium-grained, mostly soft, noncalcareous with few lenticular hard lime-cemented sandstone layers at top-------	40.0
	Loc. D3229, 20 ft Below top:	
	Baculites eliasi Cobban	
	Hoploscaphites n. sp.	
66	Shale, medium-dark-gray, silty, noncalcareous; prominent layers of limestone concretions 12, 45, and 50 ft above base; four thin sandy bentonites in interval 20 to 35 ft above base----------	140.0
	Loc. D3228, 50 ft above base:	
	Anisomyon centrale Meek	
	Baculites jenseni Cobban	
	Rhaeboceras halli Meek	
	Loc. D3227, 12 ft above base:	
	byrozoan	
	Nucula cf. N. nacatochana Stephenson	
	Nuculana cf. N. corbetensis Stephenson	
	Nuculana sp.	
	Inoceramus incurvatus Meek and Hayden	
	Inoceramus cf. I. barabini Morton	

Following section measured in the SW 1/4 SW 1/4 sec. 24, T. 39 N., R. 78 W., Natrona County, Wyo.--Continued

	Thickness Ft
Lewis Shale (part):	
Loc. D3227, 12 ft above base--Continued	
Periploma sp.	
Cymbophora holmesi (Meek)	
Cryptorhytis cheyennensis (Meek and Hayden)	
Anisomyon centrale Meek	
Baculites reesidei Elias	
Hoploscaphites nodosus (Owen)	
Nostoceras cf. *N. colubriformis* Stephenson	

Following section measured in the SW 1/4 SW 1/4 sec. 24, T. 39 N., R. 78 W., Natrona County, Wyo.--Continued

		Thickness Ft
Lewis Shale (part):		
65	Sandstone, grayish-green, fine- to medium-grained, glauconitic; rusty-weathering calcareous sandstone concretions 0.3 ft by 0.8 ft near top and bottom of unit----------	10.0
	Loc. D3226, 1.5 ft above base:	
	Baculites sp.	
	Hoploscaphites sp.	
	Thickness of Lewis Shale----------	1311.0

The following section measured in the Cen. NW 1/4 sec. 25, T. 39 N., R. 78 W., Natrona County, Wyo.

		Thickness
Mesaverde Formation:		Ft
Teapot Sandstone Member:		
64	Shale, carbonaceous, brown, interbedded with light-gray sandstone----------	1.5
63	Sandstone, light-gray, even bedded with thin films of carbonaceous material----------	2.5
62	Shale, carbonaceous, dark-brown, hard, with thin sandy layers; weathers light gray----------	3.8
61	Sandstone, light-gray, weathers white, fine- to medium-grained, abundant dark grains give a salt- and pepper effect; soft; irregularly bedded with numerous thin carbonaceous shale layers----------	24.0
60	Coal, attrital, impure, black with thin lenses of coalified wood----------	0.8
59	Shale, sandy, carbonaceous, brown----------	0.7
58	Sandstone, light-gray, fine-grained, interbedded with shale; 1-ft-thick bed of sandstone at top of unit-	3.7
57	Shale, sandy, carbonaceous, dark- to medium-brown; lower 1 ft most carbonaceous containing thin lenses of coalified wood----------	5.5
56	Sandstone, fine-grained, crossbedded(?), light-gray, soft----------	7.3

The following section measured in the Cen. NW 1/4 sec. 25, T. 39 N., R. 78 W., Natrona County, Wyo.--Continued

Measverde Formation--Continued:	Thickness
Teapot Sandstone Member--Continued:	Ft
55 Sandstone, yellowish-gray mottled; abundant carbonaceous trash and borings; becomes grayish-brown with carbonaceous material in upper 3 ft; iron-stained concretions in lower 2 ft; tidal flat deposit(?)----------	8.5
54 Sandstone, medium-grained, crossbedded(?), light-gray; weathers tan----------	2.1
53 Sandstone, fine-grained, thin-bedded, gray with some thin sandy shale layers----------	1.9
Thickness of the Teapot Sandstone Member---------	62.3

Following section measured from the NW 1/4 SW 1/4 to Cen. NW 1/4 sec. 25, T. 39 N., R. 78 W. Supplemental fossil collections and stratigraphic details for lower part of section obtained in NW 1/4 SE 1/4 sec. 8, T. 38 N., R. 78 W., Natrona County, Wyo.

Mesaverde Formation--Continued:	Thickness
Marine shale member:	Ft
52 Sandstone, light-greenish-gray, fine-grained, massive, soft; abundant *Ophiomorpha* contains tuberous hematite-cemented sandstone concretions--	155.0
51 Siltstone and shale interbedded, pale-yellowish-gray, soft----------	10.0
50 Shale, medium-gray weathering yellowish gray; silty to sandy; contains 12 layers of medium-gray-weathering dense limestone concretions. Loc. D3225 at base and D5069 at top. D5068 occurs at level of D3225 at nearby locality----------	25.0

loc. D3225 at base:

Inoceramus aff. *I. vanuxemi* Meek and Hayden

Ostrea sp.

Baculites sp.

Following section measured from the NW 1/4 SW 1/4 to Cen. NW 1/4 sec. 25, T. 39 N., R. 78 W. Supplemental fossil collections and stratigraphic details for lower part of section obtained in NW 1/4 SE 1/4 sec. 8, T. 38 N., R. 78 W., Natrona County, Wyo.--Continued

Mesaverde Formation--Continued: Thickness

Marine shale member: Ft

Loc. D5068:

Nuculana cf. *N. evansi* (Meek and Hayden)

Inoceramus cf. *I. pertenuis* Meek and Hayden

Oxytoma sp.

Cymella montanensis Henderson

Baculites sp. (probably new)

Didymoceras nebrascense (Meek and Hayden)

Loc. D5069 at top:

Solemya sp.

Inoceramus sp.

Oxytoma sp.

Baculites pseudovatus Elias

Baculites sp.

Hoploscaphites n. sp.

Remarks: Probably zone of *Didymoceras nebrascense*

Following section measured from the NW 1/4 SW 1/4 to Cen. NW 1/4 sec. 25, T. 39 N., R. 78 W. Supplemental fossil collections and stratigraphic details for lower part of section obtained in NW 1/4 SE 1/4 sec. 8, T. 38 N., R. 78 W., Natrona County, Wyo.--Continued

Mesaverde Formation--Continued:	Thickness
Marine shale member:	Ft
49 Shale, medium-light-gray, silty to sandy, weathers to soft bentonitic crust; poorly exposed; contains a few scattered limestone concretions and thin beds of soft sandstone----------	110.0

Loc. D3224, 25 ft above base:

Solemya sp.

Phelopteria cf. *P. linguaeformis* (Evans and Shumard)

Oxytoma aff. *O. nebrascana* (Evans and Shumard)

Nymphalucina occidentalis (Morton)

Ellipsoscapha occidentalis (Meek and Hayden)

Baculites scotti Cobban

Loc. D5064-D5066, 30 to 48 ft above base at nearby localities

Loc. D5066:

Anapachydiscus complexus (Hall and Meek)

Placenticeras sp.

Loc. D5065 and D5064:

Baculites scotti Cobban

Thickness of marine shale member of Mesaverde Formation----------	300.0

The following section measured from the NW 1/4 SW 1/4 sec. 3 to the SW 1/4 SE 1/4 sec. 4, T. 38 N., R. 78 W., Natrona County, Wyo.

Mesaverde Formation--Continued:	Thickness
Parkman Sandstone Member:	Ft
48 Sandstone, light-grayish-yellow; weathers buff; very fine grained, cliff forming; lower part formed of channel sandstone deposits that contain thin lenses of ironstone pebbles, wood, and bone fragments; upper part is soft containing lime-cemented sandstone concretions 2 ft thick by 4 ft in diameter. Nonmarine fossils locally abundant at top of unit. Loc. D5063 from this stratigraphic level in NW 1/4 SW 1/4 sec. 26----------	42.0
Loc. D5063:	
Fusconaia? danae (Meek and Hayden)	
Campeloma sp.	
Viviparus sp.	
Remarks: fresh-water clam and gastropods.	
47 Sandstone and shale interbedded, gray, soft, with a few thin layers of ironstone and dark-brown to black carbonaceous to coaly shale. About 45 ft above base is the level of pronounced but local channel sandstone deposit----------	87.0
46 Shale, black, coaly, interbedded with dark-brown, light-gray weathering sandy carbonaceous shale and limonite concretions----------	43.0

The following section measured from the NW 1/4 SW 1/4 sec. 3 to the SW 1/4 SE 1/4 sec. 4, T. 38 N., R. 78 W., Natrona County, Wyo.-- Continued

Mesaverde Formation--Continued:	Thickness
Parkman Sandstone Member--Continued:	Ft
45 Sandstone, light-yellowish-gray; weathers buff, shaly, soft; several thin layers of limonite concretions containing large bone fragments abundant plant impressions----------	17.0
44 Shale, carbonaceous, dark-brown weathering light gray; interbedded with black coaly shale---	27.0
43 Sandstone, light-gray, very fine grained, massive; thin lenses of iron-cemented sandstone near base; cliff former----------	22.0
42 Sandstone, light-yellowish-gray, very fine grained; weathers buff; upper 4 ft crossbedded, cliff former-	34.0
41 Sandstone, light-yellowish-gray, very fine grained, soft; interbedded with thin beds of sandy shale; a few poorly preserved plant impressions; unit forms slope----------	23.0
40 Sandstone, light-yellowish-gray, very fine grained, thin bedded at base and massive in upper part; weathers buff; cliff former----------	98.0
Loc. D3264 from lower part of unit in NW 1/4 NW 1/4 sec. 4 *Cymella montanensis* Henderson	

The following section measured from the NW 1/4 SW 1/4 sec. 3, to the SW 1/4 SE 1/4 sec. 4, T. 38 N., R. 78 W., Natrona County, Wyo.--Continued

Mesaverde Formation--Continued	Thickness Ft
Parkman Sandstone Member--Continued:	
39 Shale and sandstone interbedded, yellowish-gray; weathers buff; sandstone form hard layers in soft shale and are more abundant in upper part of unit-	65.0
Loc. D3263 from middle of unit in NW 1/4 NW 1/4 sec. 4:	
Ostrea sp.	
Nymphalucina sp.	
Baculites gilberti Cobban? (two specimens)	
38 Shale, gray, sandy with thin layers of sandstone---	25.0
Loc. D3262 from middle of unit in NW 1/4 NW 1/4 sec. 4:	
Inoceramus subcompressus Meek and Hayden	
Baculites gilberti Cobban	
37 Shale, yellowish-gray with thin layers of sandstone; unit weathers to buff ridge----------	15.0
Thickness of Parkman Sandstone Member of Mesaverde Formation:----------	498.0

The following section measured from the NW 1/4 SW 1/4 sec. 3, to the SW 1/4 SE 1/4 sec. 4, T. 38 N., R. 78 W., Natrona County, Wyo.--Continued

		Thickness
	Pierre Shale (part):	Ft
36	Shale, gray; weathers light yellowish gray; silty with an occasional thin sandy layer. Silty tan and rusty-weathering limestone concretions are abundant throughout the unit. An 0.8-ft-thick bed of bentonite occurs 270 ft above base of unit-- and a few thin beds of sandstone containing chert granules occur 250 ft above base	700.0

Loc. D3223, 75 ft below top of unit:

Baculites perplexus Cobban

Loc. D3222 and D3261 in NW 1/4 NW 1/4 sec. 4, 215 ft below top

Loc. D3222:

Baculites perplexus Cobban

Loc. D3261:

Nucula cf. *N. planimarginata* Meek and Hayden

Inoceramus subcompressus Meek and Hayden

Baculites perplexus Cobban (very large coll.)

Hoploscaphites gilli (Cobban and Jeletzky)

Exiteloceras n. sp.

Pachydiscus sp.

Placenticeras sp.

The following section measured from the NW 1/4 SW 1/4 sec. 3 to the SW 1/4 SE 1/4 sec. 4, T. 38 N., R. 78 W., Natrona County, Wyo.--Continued

		Thickness
	Pierre Shale (part)--Continued	Ft
	Loc. D3221, 315 ft below top:	
	Inoceramus subcompressus Meek and Hayden	
	Phelopteria cf. *P. linguaeformis* (Evans and Shumard)	
	Baculites aff. *B. asperiformis* Meek	
	Loc. D4294, 450 ft below top:	
	Inoceramus sp.	
	Cymbophora emmonsi (Meek)	
	Baculites mclearni Landes	
	Trachyscaphites spinigeri (Schluter)	
	Loc. D3220, 550 ft below top:	
	Baculites sp.	
35	Shale, sandy, dusky-yellow, with thin layers of lime- and iron-cemented sandstone. A 1-ft-thick sandstone at base of unit contains a few fossils--	50.0
	Loc. D3219:	
	Baculites obtusus Meek?	
34	Shale, medium-dark-gray, silty; weathers medium light gray, poorly exposed; contains a few layers of gray sparsely fossiliferous limestone--	70.0

The following section measured from the NW 1/4 SW 1/4 sec. 3 to the SW 1/4 SE 1/4 sec. 4, T. 38 N., R. 78 W., Natrona County, Wyo.--Continued

		THickness Ft
Pierre Shale (part)--Continued		
33	Bentonite, pale-greenish-yellow, sandy, shaly fracture; weathers to a deep frothy surface------	1.0
	Shale, gray, silty to sandy; dark-gray 0.6 ft by 1 ft limestone layer at top----------	17.0
32	Bentonite, like above----------	1.0
31	Limestone concretion, 1.5 ft by 8 ft, dark-gray, weathers medium-gray, silty. White translucent chalcedony coats fractures. Some of the smaller concretions in this layer are abundantly fossiliferous----------	1.5
	Loc. D3218:	
	Baculites obtusus Meek (typical form)	
30	Shale, dark-gray, slightly silty, poorly exposed---	10.0
29	Bentonite, poorly exposed----------	3.5
28	Shale, dark-gray, poorly exposed; thin fossiliferous limestone concretion 4 ft above base----------	12.0
	Loc. D3217:	
	Inoceramus sp.	
	Baculites obtusus Meek (early form)	
27	Bentonite, poorly exposed----------	0.5

The following section measured from the NW 1/4 SW 1/4 sec. 3, to the SW 1/4 SE 1/4 sec. 4, T. 38 N., R. 78 W., Natrona County, Wyo.--Continued

	Thickness Ft
Pierre Shale (part)--Continued	
26 Shale, dark-gray, poorly exposed; gray to light-brown weathering; fossiliferous shaly siltstone concretion layer at base----------	16.0
Loc. D3216: *Inoceramus* sp. *Baculites obtusus* Meek (early form)	
25 Bentonite, poorly exposed, weathers to frothy surface----------	3.0
24 Shale, like unit above with limestone concretion layer at top----------	9.5
23 Bentonite, deeply weathered, forms light-gray frothy surface----------	8.0
22 Shale, medium-gray to dark-gray, sandy at base becoming silty upwards; weathers light gray, Ardmore Bentonite Bed----------	35.0

The following section measured from the NW 1/4 SW 1/4 sec. 3 to the SW 1/4 SE 1/4 sec. 4, T. 38 N., R. 78., Natrona County, Wyo.--Continued

		Thickness
	Pierre Shale (part)--Continued	Ft
21	Bentonite, creamy-yellow, weathers light gray, frothy surface, thin lenses of silicified sandstone at top. Silicified baculites collected from middle of unit, Loc. D3214, and from sandstone at top Loc. D3215----------	8.0
	Loc. D3215 top of unit:	
	Inoceramus sp.	
	Baculites obtusus Meek (early form)	
	Loc. D3214 middle of unit:	
	Baculites sp. (weak flank ribs)	
	Thickness upper Pierre Shale----------	946.0

The following section measured from the NW 1/4 SW 1/4 sec. 3 to the SW 1/4 SE 1/4 sec. 4, T. 38 N., R. 78 W., Natrona County, Wyo.--Continued

	Pierre Shale (part)--Continued	Thickness Ft
	Sussex Sandstone Member:	
20	Sandstone, medium-dark-gray, very fine grained, soft, clayey, glauconitic; weathers light medium gray (N6); light-brown-weathering sandy sparsely fossiliferous limestone concretions near top. Uppermost part of bed contains sandstone casts of baculites----------	9.0
	Loc. D3213:	
	Baculites sp. (weak flank ribs)	
19	Bentonite, like Ardmore Bed described above; small plates of translucent calcite at the base and shaly tan limestone concretions at top----------	1.2
18	Sandstone, gray, weathers yellowish gray, very fine grained, thin-bedded, soft in lower and upper parts; 2.8-ft-thick hard lime-cemented layer 8 ft above base; Several layers of dark-yellowish-orange-weathering fossiliferous sandstone concretions occur at 10 to 24 ft above base----------	32.4
	Loc. D3212:	
	Baculites sp. (smooth to weakly ribbed)	
	Thickness Sussex Sandstone Member of Pierre Shale----------	42.6

Following section measured in SW 1/4 SE 1/4 and SE 1/4 SW 1/4 sec. 3, T. 39 N., R. 79 W., Natrona County, Wyo.

		Thickness Ft
Pierre Shale (part)--Continued:		
17	Shale, dark-gray; silty to sandy; weathers to yellowish-gray soft slope; .5 ft thick by 1 to 2 ft in diameter limestone concretions abundant throughout unit----------	180.0
16	Shale, dark-gray, silty; without concretions-------	145.0
15	Shale, dark-gray; weathers yellowish-gray; contains .8-ft-thick ironstained bentonite at top and .5-ft-thick bentonite 8 ft below top. Persistent layer of limestone concretions 13 ft below top----------	50.0
	Thickness middle tongue of Pierre Shale-------	375.0

Following section measured in SW 1/4 SE 1/4 and SE 1/4 SW 1/4 sec. 3, T. 39 N., R. 79 W., Natrona County, Wyo.--Continued

Pierre Shale (part)--Continued:	Thickness
Shannon Sandstone Member:	Ft
14 Sandstone, yellowish-gray, fine- to medium-grained; cliff former; several layers of rusty weathering concretions----------	40.0
Loc. D5005, 35 ft below top: *Baculites* sp. (smooth)	
13 Sandstone, yellowish-gray, glauconitic, fine- to medium-grained, local coarse-grained clayey bedding is muddled and mottled with grayish-yellow sandstone and streaks of medium-gray shale; unit is soft forming slope between upper and lower cliff forming parts of Shannon; 3-ft-thick by 5 ft in diameter sandstone concretions crop out 15 ft below top----------	45.0
Loc. D3246 from NE 1/4 sec. 1, T. 40 N., R. 80 W.: *Inoceramus* sp. *Cymbophora* cf. *C. holmesi* (Meek) *Baculites* sp. (smooth) *Placenticeras* sp.	

Following section measured in SW 1/4 SE 1/4 and SE 1/4 SW 1/4 sec. 3, T. 39 N., R. 79 W., Natrona County, Wyo.--Continued

Pierre Shale (part)--Continued:	Thickness
Shannon Sandstone Tongue (part)--Continued	Ft
12 Sandstone, yellowish-gray, medium-grained; slightly glauconitic; numerous thin clayey streaks; cliff-forming except for soft interval 5 to 15 ft above base----------	30.0
11 Sandstone, olive-gray, clayey, muddled bedding; weathers to a smooth yellowish-gray slope--------	30.0

Loc. D3245 from NE 1/4 sec. 1, T. 40 N., R. 80 W.:

Baculites sp. (smooth)

Thickness Shannon Sandstone Member of Pierre Shale---------- 145.0

Following section measured in SW 1/4 SE 1/4 and SE 1/4 SW 1/4 sec. 3, T. 39 N., R. 79 W., Natrona County, Wyo.--Continued

		Thickness Ft
Pierre Shale (part)--Continued:		
10	Shale, sandy, becoming progressively more sandy upward and grading into overlying sandstones; shaly parts are dark gray; sandy lenses are yellowish gray, slightly calcareous; unit weathers to a light-yellowish-gray slope; contains a few ironstone and limestone concretions----------	100.0
9	Shale, in part silty, thin fine-grained sandstone lenses, particularly near top; medium-dark to dark-gray, weathering to yellowish-gray slightly cracked surface; several layers of 0.5 ft thick by 2 to 3 ft in diameter, medium-gray limestone concretions weather to grayish yellow with zone of ironstone concretions 125 to 145 ft above base----------	275.0

Loc. D3202 from ironstone concretion 150 ft below top:

Baculites sp. (weak flank ribs)

Loc. D3201 from limestone concretions 165 ft below top:

Baculites sp. (weak flank ribs)

Loc. D3200 from limestone concretions 310 ft below top:

Baculites sp. (weak flank ribs)

Scaphites hippocrepis (DeKay)

Following section measured in SW 1/4 SE 1/4 and SE 1/4 SW 1/4 sec. 3, T. 39 N., R. 79 W., Natrona County, Wyo.--Continued

		Thickness Ft
Pierre Shale (part)--Continued		
8	Shale, medium-dark-gray; contains abundant small rusty-weathering ironstone concretions throughout----------	125.0
	Loc. D3199, 25 ft below top: *Glyptoxoceras rubeyi* (Reeside)	
	Loc. D3198, 80 ft below top: *Glyptoxoceras rubeyi* (Reeside)	
7	Shale, silty, medium-dark-gray, weathers to yellowish-gray slightly cracked surface; no concretions----------	110.0
6	Shale, very sandy, dark-gray, noncalcareous, interbedded with thin layers of light-gray hard slightly limy fine-grained sandstone; sandstone most abundant near base. Shale weathers to a deep loose soil with plates of sandstone on surface; ironstone concretions abundant throughout unit; a layer of limestone concretions at top of unit----	80.0
	Loc. D3197 from limestone concretions at top of unit: *Inoceramus proximus* Tuomey	
	Baculites aquilaensis Reeside	
	Scaphites hippocrepis (DeKay)	
	Scaphites aquilaensis Reeside	

Following section measured in SW 1/4 SE 1/4 and SE 1/4 SW 1/4 sec. 3, T. 39 N., R. 79 W., Natrona County, Wyo.--Continued

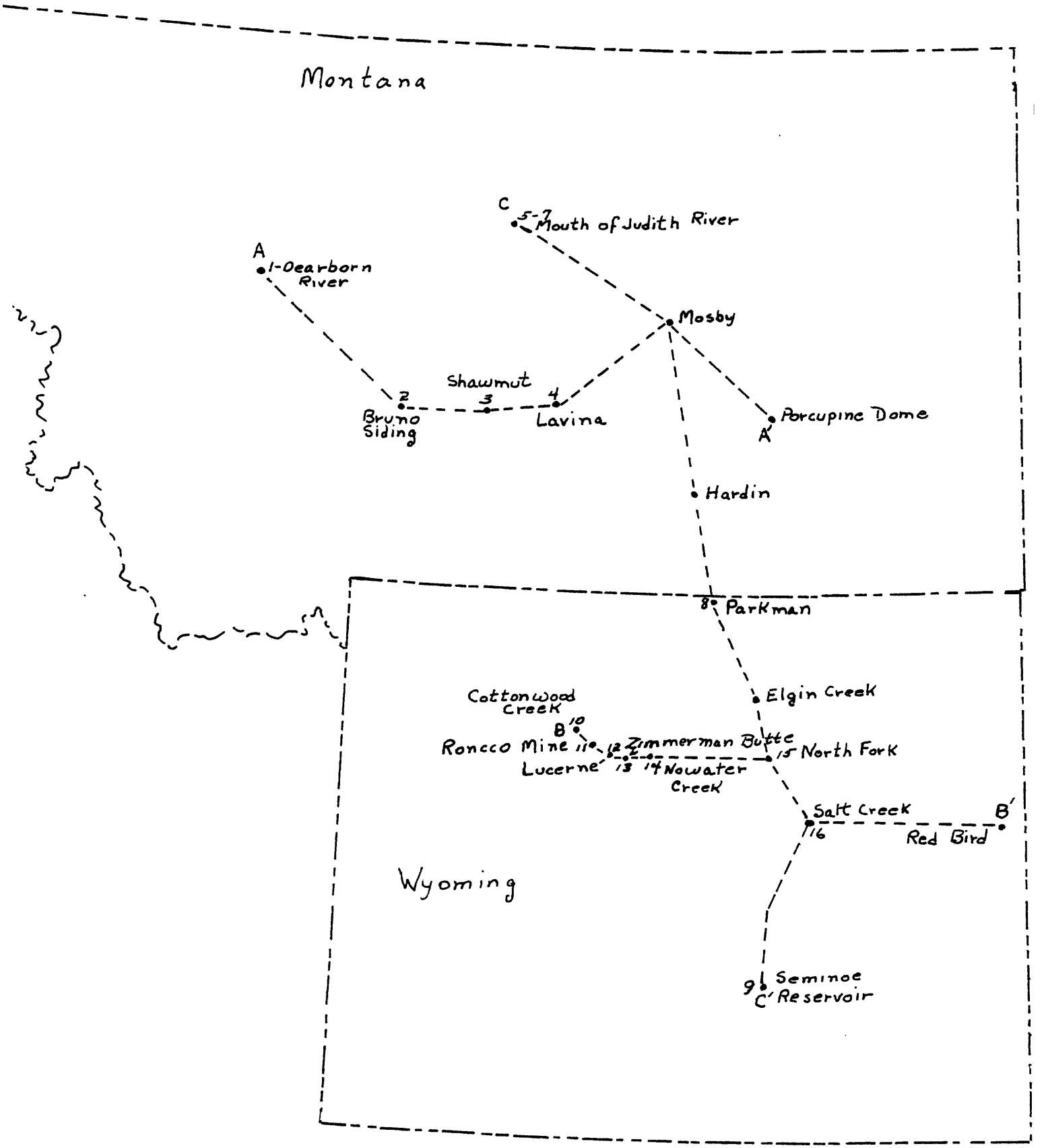
		Thickness
	Pierre Shale (part)--Continued	Ft
	Unnamed sandstone tongue (Fishtooth sandstone of Wegemann)	
5	Sandstone, pale-yellowish-gray cemented with hematite; weathers moderate brown; medium- to coarse-grained with abundant fish teeth, dark chert granules and locally chert and clay pebbles; ledge former-----	15.0
4	Sandstone and shale interlaminated; sandstone, yellowish-gray, fine-grained; shale, dark-gray and very sandy; contains a few scattered chert granules----------	20.0
3	Shale, medium-dark-gray, noncalcareous; weathers to yellowish gray, slightly cracked surface; abundant moderate brown-weathering ironstone concretions abundant and a few scattered limestone concretions----------	105.0
	Loc. D5004 from limestone concretions 35 ft below top:	
	Inoceramus sp.	
	Baculites aquilaensis Reeside	
	Scaphites hippocrepis (DeKay)	

Following section measured in SW 1/4 SE 1/4 and SE 1/4 SW 1/4 sec. 3, T. 39 N., R. 79 W., Natrona County, Wyo.--Continued

		Thickness
Pierre Shale (part)--Continued		Ft
2	Shale, dark-gray, noncalcareous, weathers to a smooth yellowish-gray slope; contains numerous yellowish-gray weathering limestone concretions instead of the ironstone concretions above and below----------	70.0
	Loc. D3196, 25 ft below top:	
	Inoceramus sp.	
	Baculites aquilaensis Reeside	
1	Shale, dark-gray, noncalcareous, weathering to yellowish-gray slightly cracked surface; few sandy layers; numerous small (1 in. by 2 in. diameter) olive-gray calcareous ironstone concretions that weather moderate brown.	
	Base of exposure----------	285.0
	Exposed thickness of lower tongue of the Pierre Shale----------	1185.0

Measured sections to the west of the Salt Creek oil field indicate that about 130 ft of Gammon is present between the base of the exposed section and the top of the Niobrara Member of the Cody Shale.

Total thickness of the lower part of lower tongue of the Pierre Shale is estimated to be---------- 590.0



Index map showing location of sections in Montana and Wyoming