

Lithologic Description of Samples Submitted for Assay

Core samples of the Green River Formation from Brewer et al. Corehole No. 9-1 drilled in 1964 in C SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec 9, T 13 S, R 24 E, S 1 M, Uintah County, Utah (1980 ft S of N line and 1980 ft W of E line).

Described section: surface to 236 feet

Mahegan marker: 74.6 feet

Sampling appears to be invalid since the Mahegan bed is absent.

From	To	Description
0.0	1.0	Mudstone or tuff; orange-buff to rare tan (2.5 Y $\frac{8}{3}$ - $\frac{7}{3}$, rare $\frac{6}{3}$), very calcareous, faintly mottled. Irregular parting and fracture. Some limonite stains on parting and fracture surfaces.

Sample of mudstone or tuff from 0.5 foot:

X-ray - quartz, analcite, feldspar, illite.

1.0 7.0 Oil shale: medium brownish gray ($2.5 \times 5/2 - 7/2$; some slight olive tint). Faint smooth laminations. Very regular and rare irregular, thin to medium shaly parting; irregular to some ~~very~~ coarse hackly fracture. Some vertical fractures. Common earth coatings and some limonite stains of parting and fracture surfaces. Rare thin massive crystalline to silty-textured buff bands.

7.0 8.0 Oil shale: medium to dark brownish gray ($2.5 \times 7/2 - 7/2$, some $5/2$). Faint smooth laminations. Regular to some irregular, thin to medium shaly parting; slight to rare coarse hackly fracture. A $3/4$ -inch massive crystalline brown to brownish gray limonite-stained buff band at base.

8.0 9.0 Oil shale: medium to dark brownish gray and olive gray, very rare brownish black near top ($2.5 \times 4 \times 5 \times 7/2 - 3/2$, rare $7/2 - 7/2$ near top). Faint smooth laminations. Slightly irregular to very irregular, thick to medium and rare thin parting; irregular fracture. Rare very fine dark brownish gray crystalline streaks and stringers near top.

9.0 10.0 Oil shale: medium to dark brownish gray ($2.5 \times \frac{5}{2} - \frac{3}{2}$). Faint smooth laminations. Irregular to rare regular, thick to medium parting; very irregular fracture.

10.0 11.0 Oil shale: medium brownish gray ($2.5 \times \frac{5}{2} - \frac{4}{2}$; common very slight olive tint). Very faint smooth laminations and streaked bedding. Irregular to some regular, thick to medium parting; irregular to slightly conchoidal fracture. A diagonal fracture with slight limonite stains near top.

11.0 12.0 Oil shale: medium to dark brownish gray ($2.5 \times \frac{5}{2} - \frac{3}{2}$, rare $\frac{2}{2}$; some very slight olive tint). Faint smooth laminations. Regular to rare irregular, thin to thick shaly parting; irregular to conchoidal fracture. Very rare fine massive dark brownish gray crystalline streaks. Rare diagonal fractures and parting surfaces with slight yellowish green stains.

12.0 13.4 Oil shale: medium to dark brownish gray and olive gray ($2.5 \times \frac{5}{2} - \frac{4}{2}$, some $\frac{3}{2}$). Faint to very faint laminations and streaked bedding. Regular to some very irregular, thick to medium and rare thin parting;

irregular fracture. A 1-inch massive crystalline brownish gray to brownish black tuff or dolomite band with common fine disseminated pyrite at 12.5 feet. Some very fine pyrite blebs and streaks in lower part. Rare earthy buff coatings and limonite stains on parting surfaces.

13.4 15.5 Oil shale: medium to dark brownish gray ($2.5Y 5/2 - 3/2$, rare $2/2$). Faint smooth laminations. Very regular thin to medium and rare thick shaly parting; fairly smooth to irregular fracture. Rare fine dark brownish gray to brown massive crystalline stringers. Common buff earthy coatings and some limonite stains on parting surfaces - especially in middle part.

Section rearranged from 16.0 to 21.1 feet.

~~15.5 16.7 Oil shale: medium to dark brownish gray and rare brownish black, some medium to dark brown ($2.5Y 4/2 - 2/2$, some $5/3 - 3/3$, rare $1/2$).~~

15.5 16.5 Oil shale: dark to medium brownish gray and some brown, rare brownish black ($10YR 9.5Y 2/2 - 7/2$, some $3/3 - 4/3$, rare $1/2$). Faint smooth to slightly distorted laminations. Irregular to some very regular, thick to thin parting;

slightly to some finely smooth fracture. A thin yellowish tan silty tuff band with tarry coatings on one parting surface at 16.0 feet. Some very thin irregular brownish gray massive crystalline stringers in lower part.

16.5 19.0. Oil shale: medium to dark brown, some dark brownish gray in lower 0.4 foot (10YR 2.5Y $\frac{5}{3}$ - $\frac{3}{3}$, some $\frac{3}{1}$ - $\frac{2}{1}$ lower part). Faint smooth laminations. Irregular thin to thick parting; irregular and some coarse hackly fracture. Very rare thin to fine massive crystalline stringers.

Upper wavy bed, oil stained
19.0 20.7 Tuff: medium brown and brownish gray (5Y 2.5Y $\frac{4}{3}$ & $\frac{4}{2}$ - $\frac{5}{2}$), light gray in lower 0.1 foot (8-9N). Massive to some faintly streaked. Irregular parting; slightly irregular fracture. Sharp very wavy contact with oil shale at top; no matching contact with gray tuff at base (part may be missing).

Sample of brown tuff from 19.4 feet:

X-ray - quartz, analcite, feldspar, biotite.

Very light gray tuff from 20.6 feet:

X-ray quartz, analcite, feldspar, biotite.

20.7 22.2 Oil shale: medium to dark brown and brownish gray, some brownish black in lower part (10 yr $\frac{1}{2}$ to $\frac{3}{2}$, some $\frac{1}{2}$). Faint to moderately distinct, smooth and rare slightly distorted laminations. Irregular to some very smooth, medium to thick parting; very irregular to slightly conchoidal fracture.

22.2 24.5 Oil shale: medium to dark olive gray and brownish gray (5 yr $\frac{1}{2}$ to $\frac{3}{2}$, some $\frac{1}{2}$). Faint smooth laminations. Regular to irregular medium to thick parting; fairly smooth to conchoidal fracture. Rare very fine disseminated pyrite and very fine dark gray pyritic streaks.

24.5 26.6 Oil shale: medium to dark brownish gray (2.5 yr $\frac{1}{2}$ to $\frac{3}{2}$, rare $\frac{1}{2}$). Faint smooth to some very slightly irregular and distorted laminations. Irregular to some regular, thick to medium parting; irregular fracture.

26.6 27.6 Oil shale: medium to dark olive gray (5 yr $\frac{1}{2}$ to $\frac{3}{2}$). Very faint smooth laminations and streaks. Irregular thick to medium parting; irregular fracture. Common very fine disseminated pyrite.

27.6 28.6 Oil shale: medium to dark olive gray
($5\gamma \frac{1}{2} \pm \frac{1}{4}$ - $\frac{3}{2} \pm \frac{1}{4}$, some $\frac{2}{1}$). Faint smooth laminations.
Irregular to rare regular, thick to medium parting;
irregular fracture. Some very fine disseminated
pyrite and rare fine gray pyritic streaks and stringers.

28.6 29.6 Oil shale: medium to dark olive gray and
brownish gray ($5\gamma \pm 2.5\gamma \frac{1}{2}$ - $\frac{3}{2}$, rare $\frac{5}{2} \pm \frac{1}{2}$). Faint smooth
laminations. Regular to irregular, thick to medium
parting; irregular fracture. Rare very fine disseminated
pyrite in upper part.

29.6 30.7 Oil shale: medium to ^{very} rare dark olive gray
and brownish gray ($5\gamma \pm 2.5\gamma \frac{5}{2}$ - $\frac{7}{2}$, rare $\frac{3}{2}$). Faint smooth
laminations. Regular to rare irregular, thick to
medium parting; smooth to slightly irregular and conchoidal fracture.

30.7 32.0 Oil shale: medium to dark brownish gray
and rare brownish black ($2.5\gamma \pm 10\gamma \frac{7}{2}$ - $\frac{3}{2}$, rare $\frac{1}{2}$). Faint
to moderately distinct smooth laminations. Regular to
some irregular thick parting; slightly conchoidal and
some irregular fracture.

32.0 34.5 Oil shale: medium to dark olive gray and brownish gray, rare black ($5\% \pm 2.5\%$ $1/2 - 3/2$, some $1/2$, rare 2). Faint to moderately distinct smooth laminations. Irregular to regular, medium to thick parting; irregular and conchoidal to some smooth fracture. Very rare ~~very~~ fine dark gray silty-textured streaks (some fine brittle flakes near streaks in X-ray sample).

Sample of shale with fine gray streaks from 32.7 feet:
X-ray - feldspar (sanidine, albite), illite, quartz, dolomite, calcite.

34.5 35.6 Oil shale: dark brownish gray to brownish black ($2.5\% \pm 10\%$ $1/2 - 3/2$, rare $3/2$). common resinous luster in middle part. Very faint slightly distorted to smooth streaked bedding and some faint smooth laminations. Irregular to regular, thick to rare thin parting; slight hackly to conchoidal and some smooth fracture.

35.6 38.0 Oil shale: dark to medium and some light brownish gray and olive gray, rare brownish black ($5\% \pm 2.5\%$ $1/2 - 4/2$, some $3/2 - 4/2$, rare $1/2$). Faint to moderate distinct smooth laminations. Regular to irregular, thick to medium parting; slightly conchoidal to some irregular fracture. Some fine pyrite blebs and rare fine gray

to buff silty stringers in lower part.

38.0 40.2 Oil shale: medium to dark brownish gray, rare buff and brownish black ($2.5 \times \frac{1}{2} - 10 \times \frac{5}{2} - \frac{3}{2}$, rare $\frac{6}{2} - \frac{7}{2}$ & $\frac{1}{2}$). Moderately distinct to some very distinct, smooth to slightly irregular and distorted laminations; very common small loop structure and displacements. Regular to rare irregular, medium to thick parting; slightly irregular to slightly conchoidal fracture. Rare fine buff silty stringers in upper part.

40.2 40.8 Oil shale: dark brownish gray to brownish black ($2.5 \times \frac{3}{2} - \frac{1}{2}$, rare $\frac{3}{2}$); common resinous to some waxy luster. Very faint to faint, distorted to fairly smooth laminations and streaked bedding. Slightly irregular thick parting; irregular to hackly fracture. Some very fine pyrite blebs and streaks. Some very irregular thin to fine, medium to dark brownish gray silty-textured buff stringers (rarely bitumen impregnated).

40.8 41.8 Oil shale: medium to dark brownish gray ($2.5 \times \frac{4}{2} - \frac{3}{2}$, rare $\frac{3}{2}$). Faint to moderately distinct smooth laminations. Irregular to slightly irregular thick parting; smooth to irregular fracture.

41.8 42.7 Oil shale: medium to dark brownish gray ($2.5 \times \frac{1}{2} - \frac{3}{2}$, rare $\frac{1}{2}$). Moderately distinct smooth laminations. Irregular thick to medium parting; irregular to conchoidal fracture. Some very fine pyrite streaks and blebs in lower part.

42.7 43.4 Oil shale: buff to light and some dark brownish gray ($2.5 \times \frac{1}{2} - \frac{4}{2}$, some $\frac{3}{2}$, rare $\frac{1}{2}$). Very distinct smooth laminations. Irregular to some regular, thick to medium parting; slightly conchoidal to smooth fracture. Rare fine pyrite streaks and blebs.

43.4 44.3 Oil shale: dark and rare medium brownish gray to brownish black ($2.5 \times \frac{3}{2} - \frac{1}{2}$, rare $\frac{1}{2}$); common resinous and rare waxy luster. Moderately distinct to faint smooth to slightly irregular and distorted lamination and streaked bedding; some small loop structures. Regular to some irregular, thick to thin shaly and rare papery parting; slightly irregular to hackly fracture. Some very fine pyrite blebs and streaks. A smooth pinch light to dark brownish gray silty-textured buff band at 43.6 feet. A very thin irregular pinched-out silty to argillaceous slightly oil-stained buff at base.

44.3 45.3 Oil shale: medium to dark and rare light brownish gray ($2.5 \times \frac{1}{2} - \frac{3}{2}$, some $\frac{5}{2}$, rare $\frac{6}{2}$ & $\frac{7}{2}$). Faint to some moderately distinct, slightly irregular and distorted to smooth laminations; some to very common small loop structures. Irregular thick parting; irregular to slightly conchoidal fracture. Some to common very fine disseminated pyrite. Rare very thin buff lenses near top.

Top A-groove

45.3 47.3 Oil shale: light to medium and very rare dark brownish gray and olive gray ($2.5 \times \frac{1}{2} \text{ to } \frac{5}{2}$, some $\frac{4}{2}$, rare $\frac{3}{2}$). Faint to some fairly distinct, smooth to slightly irregular and distorted laminations; very common small loop structures and displacements. Irregular thick parting; conchoidal to irregular fracture. Common very fine dark gray to black specks and some pyrite blebs.
 Sample of shale with fine dark specks from 46.7 feet:
 X-ray - quartz, dolomite, calcite, feldspar, illite.

47.3 48.9 Oil shale and marlstone: light and some medium brownish gray and olive gray to very light buff ($2.5 \times \frac{1}{2} - \frac{7}{2}$, some $\frac{5}{2}$, rare $\frac{6}{2}$). Moderately distinct to very faint smooth laminations; some small loop structures in upper part. Regular to slightly irregular thick parting; smooth to slightly irregular fracture.

48.9 49.9 Oil shale: buff to medium brownish gray and some medium to dark brown and rare brownish black ($2.5 \times \frac{1}{2} - \frac{5}{8}$, some $\frac{1}{3} - \frac{3}{8}$, rare $\frac{3}{2} - \frac{1}{2}$). Moderately distinct smooth to slightly irregular and distorted lamination; common very small large structures. Regular to some irregular thick parting; slightly irregular fracture. Some very fine buff to white crystal specks - especially in some darker zones. A slightly irregular fine dark gray (almost neutral) silty-textured crystalline stringer with some pyrite near top. A $\frac{3}{4}$ inch very dark rich shale band at 49.6 feet.

Sample of buff to dark brown oil shale with fine disseminated crystals from 49.2 feet.

X-ray - dolomite, quartz, calcite, feldspar.

49.9 50.9 Oil shale and marlstone: buff and tan to rare medium and dark brown ($2.5 \times \frac{3}{2} - \frac{6}{3}$, rare $\frac{5}{3} - \frac{3}{3}$), some light olive gray in middle part ($5 \times \frac{1}{1} - \frac{6}{1}$). Faint to some moderately distinct smooth lamination and some very faintly bedded bands. Regular to some irregular thick parting; irregular to conchoidal fracture.

Sample of faintly bedded very light buff marlstone band from 50.6 feet.

X-ray - dolomite, quartz, feldspar.

50.9 52.0 Oil shale and marlstone: light to medium olive gray ($5\frac{7}{16} \pm \frac{7}{16} - \frac{7}{16} \pm \frac{4}{16}$) and rare buff to brown ($2.5\frac{7}{16} - \frac{7}{16}$). Moderately distinct to faint smooth laminations; common very small loop structures. Slightly irregular thick parting; conchoidal to irregular fracture. Common fine dark pyritic specks and streaks in lower part.

52.0 54.0 Marlstone: gray-buff to rare medium brownish gray and olive gray ($2.5\frac{7}{16} \pm 5\frac{7}{16} - \frac{5}{16}$, rare $\frac{5}{16} - \frac{7}{16}$). Faint to ~~very faint~~ smooth laminations; common very small loop structures and displacements. Irregular to regular thick parting; irregular and conchoidal to smooth fracture. Very common fine dark pyritic specks and rare fine stringers.

54.0 55.0 Marlstone and rare oil shale: gray buff to some medium and rare dark olive gray ($5\frac{7}{16} \pm \frac{7}{16} - \frac{5}{16} \pm \frac{6}{16}$, some $\frac{5}{16} \pm \frac{5}{16} - \frac{4}{16} \pm \frac{4}{16}$, rare $\frac{3}{16}$). Faint to moderately distinct smooth laminations; common small loop structures and displacements. Irregular to some very regular, thick to medium parting; conchoidal fracture. Common fine dark pyritic specks.

(Break)

Bottom 2-2 groove

55.0 56.0 Oil shale: medium to dark olive gray and brownish gray ($2.5 \times \frac{1}{4} - \frac{3}{4}$, some $\frac{5}{8} - \frac{1}{2}$). Faint to very faint smooth laminations. Slightly irregular to irregular, thick to medium parting; irregular fracture. Some fine pyrite blebs and dark specks.

56.0 57.0 Oil shale: light to medium brownish gray and rare tan to buff ($2.5 \times \frac{1}{2} - \frac{3}{4}$, rare $\frac{1}{2} - \frac{3}{4}$; some very slight olive tint. Faint and rare moderately distinct smooth laminations; very common small loop structures. Regular to some irregular, thick to medium parting; slightly irregular fracture. Rare fine irregular dark brownish gray to brown crystalline stringers.

57.0 58.3 Oil shale: medium to dark brownish gray and some brownish black ($2.5 \times \frac{1}{2} - \frac{3}{4}$, some $\frac{1}{2}$, rare $\frac{5}{8}$); some resinous to waxy luster - especially in lower part. Faint slightly distorted streaked bedding in upper part; faint to some moderately distinct, smooth to irregular and distorted laminations with some moderately large loop structures in lower part. Irregular to slightly irregular, thick to rare thin parting; irregular slight hackly fracture. Some fine pyrite blebs. Rare fine dense brown crystalline streaks in upper part. A thin irregular reddish brown to

dark brownish gray silty-textured buff stringer at 57.6 feet. Some fine prismatic calcite streaks near base.

58.3 60.3 Oil shale: medium to dark brownish gray and olive gray ($2.5 \times \frac{5}{8} \pm \frac{5}{16} \pm \frac{5}{16} - \frac{3}{8}$, some $\frac{3}{8}$ upper part). Moderately distinct to faint, smooth to slightly irregular and distorted laminations; common small loop structures and displacements. Slightly irregular thick parting; fairly smooth to irregular fracture. (Common fine pyrite blebs and some dark gray pyritic streaks and stringers. Rare fine prismatic calcite stringers near top. A 0.1-foot irregular buff to gray earthy to sparry crystalline stringer at 59.1 feet.

60.3 61.8 Oil shale: buff and tan to dark brownish gray ($2.5 \times \frac{8}{16} \pm \frac{6}{16} - \frac{3}{8}$, rare $\frac{3}{8}$). Distinct smooth to slightly irregular and distorted laminations; common very small loop structures and displacements. Very regular to some irregular, thick to medium parting; slightly irregular and some very slight hackly fracture. Some thin to fine, buff to gray silty buff bands and stringers in lower part.

sections were turned around from 62.0 to 65.6 feet.

61.8 62.6 Oil shale: medium to dark brownish gray and rare brownish black ($2.5 \times \frac{3}{2} - \frac{1}{2}$, rare $\frac{1}{2}$). Fairly distinct to faintly smooth to some irregular, distorted laminations; some loop structures and displacements. Some of some irregular thick parting; smooth to conchoidal and some very slight hackly fracture. Some thin to fine brownish gray ^{fine} stringers and lenses with pyrite. A 3-inch tan to brownish gray fine granular tuff at base.

62.6 63.7 Oil shale: dark brownish gray to brownish black ($2.5 \times \frac{3}{2} - \frac{1}{2}$); common resinous luster. Faint irregular and distorted to some fairly smooth laminations; some loop structures and displacements. Irregular to slightly irregular, thick to medium parting; slightly irregular and rare very slight hackly fracture. Common very fine disseminated pyrite. Some ^{medium to} fine dark brownish gray tuff stringers and lenses. A very thin faintly bedded light brownish gray to buff silty-textured tuff near top. A $1\frac{1}{4}$ -inch dark brownish gray to black, silty- to fine sandy-textured, slightly oil-stained tuff at 63.0 feet.

63.7 65.3 Oil shale: medium to dark brownish gray and ^{very} rare brownish black ($2.5 \times \frac{1}{2} - \frac{3}{8}$, some $\frac{5}{8}$ to $\frac{3}{4}$, rare $\frac{1}{2}$). Moderately distinct to faint, fairly smooth to some irregular and distorted laminations; some irregular loop structures and displacements. Slightly irregular to some very regular, thick to medium parting; fairly smooth to slightly irregular and some slight hackly fracture. Some fine brownish gray silty-textured buff stringers and streaks with pyrite. Some very fine disseminated pyrite.

Sample of shale with fine pyritic streaks and stringers from 64.2 feet:

X-ray - calcite, dolomite, feldspar, quartz.

65.3 66.7 Oil shale: dark brownish gray to brownish black ($2.5 \times \frac{3}{8} - \frac{1}{2}$); common resinous and rare waxy luster. Very faint smooth to some distorted laminations and streaked bedding. Regular to some irregular, thick to medium parting; slight hackly fracture. Some fine disseminated pyrite. Some very thin to medium brownish gray buff stringers in lower part.

66.7 67.7 Oil shale: medium to dark brownish gray and brown, rare brownish black in upper part ($10 \times R \pm 2.5 \times \frac{1}{2} \pm \frac{1}{3} - \frac{3}{2}$, rare $\frac{1}{2} - \frac{1}{2}$). Faint to very faint smooth laminations and streaked bedding. Slightly irregular to irregular thick parting; slightly irregular fracture. A $\frac{1}{2}$ -inch dark reddish brown silty textured buff band at 66.9 feet. Some thin to fine irregular massive crystalline stringers in lower part.

67.7 69.2 Oil shale: medium to dark brownish gray and olive gray ($2.5 \times \pm 5 \times \frac{1}{2} - \frac{3}{2}$). Very faint smooth laminations and streaked bedding. Regular to slightly irregular thick parting; irregular fracture. Rare fine pyrite blebs and dark gray pyritic streaks.

69.2 70.5 Oil shale: medium to rare dark olive gray ($5 \times \frac{1}{2} - \frac{1}{2}$, rare $\frac{3}{2}$). Very faint smooth laminations. Regular to slightly irregular thick parting; slightly conchoidal to irregular fracture. Rare very fine disseminated pyrite and dark gray pyritic streaks.

70.5 71.6 Oil shale: medium to dark brownish gray ($2.5 \times \frac{1}{2} - \frac{2}{2}$, rare $\frac{5}{2}$). Very faint smooth laminations and streaked bedding. Irregular thick to medium parting;

slightly irregular and rare slight blocky fracture.
Rare very fine disseminated pyrite.

71.6 72.6 Oil shale: medium to dark and rare light brownish gray ($2.5 \times \frac{5}{2} - \frac{3}{2}$, rare $\frac{4}{2} \times \frac{3}{2}$). Very faint to rare moderately distinct smooth laminations; some small loop structures. Irregular to some very smooth thick parting; smooth to some irregular fracture. Very rare fine dark gray pyritic stringers.

72.6 - 73.6 Oil shale: medium to dark and some light brownish gray and olive gray ($2.5 \times \frac{5}{2} \times \frac{5}{2} - \frac{3}{2} \times \frac{3}{2}$, some $\frac{4}{2} - \frac{3}{2}$). Faint and some distinct smooth laminations and streaked bedding; some loop structures and displacements. Regular to irregular, thick to medium parting; smooth to some irregular and conchoidal fracture. Rare fine disseminated pyrite and pyritic streaks. A very irregular very thin dark gray stringer with some pyrite at 72.9 feet.

73.6 74.6 Oil shale: medium to dark brownish gray and olive gray ($2.5 \times \frac{5}{2} \times \frac{4}{2} - \frac{3}{2} \times \frac{3}{2}$, some $\frac{5}{2}$). Very faint to faint smooth laminations; some very small loop structures. Irregular to slightly irregular, thick to medium parting; irregular to slightly conchoidal fracture. Some fine

disseminated ^{fine} pyrite and gray to brownish gray massive crystalline stringers in lower part. A thin light brownish gray massive dolomite band at 73.9 feet.

Mahogany marker

74.6 75.0 Tuff: tan to some dark brownish gray ($2.5 \times \frac{1}{3} - \frac{5}{3}$, some $\frac{4}{2} - \frac{7}{1}$). Massive with some irregular stringers. Common fine disseminated pyrite. Slightly oil stained. Smooth contact at top; slightly irregular contact at base.

75.0 76.4 Oil shale: medium to dark olive gray and rare light brownish gray to buff ($5 \times \frac{5}{1} - \frac{3}{1}$, rare $2.5 \times \frac{1}{2} - \frac{7}{2}$). Faint to very faint, irregular and distorted to smooth laminations; some very small loop structures and displacements. Regular to some irregular, thick to medium parting; irregular to conchoidal fracture. Common very fine disseminated pyrite and some very fine dark gray pyritic streaks. Some thin light brownish gray to buff massive dolomite bands, ~~in upper part~~. A black woody plant fossil on parting surface at base.

76.4 77.6 Oil shale: medium to some dark olive gray and brownish gray ($5 \times \frac{1}{2} - 2.5 \times \frac{5}{1} - \frac{5}{2} - \frac{3}{1} - \frac{3}{1}$, some $\frac{3}{1}$). Faint

slightly irregular and distorted to smooth laminations.

Regular to some irregular thick parting; irregular to conchoidal fracture. Common very fine disseminated pyrite and some fine pyritic streaks.

77.6 78.6 Oil shale: medium to dark brownish gray ($2.5Y 5/1, 5/2 - 3/1, 3/2$, rare $3/2$). Faint to some moderately distinct smooth laminations. Regular to rare irregular, thick to medium parting; smooth to slightly conchoidal fracture. Common very fine disseminated pyrite.

78.6 79.2 Oil shale: medium to dark brownish gray and brown ($2.5Y 5/10YR 5/2, 5/3 - 3/2$). Distinct to very faint smooth laminations; rare small displacements. Slightly irregular thick parting; fairly smooth fracture. A very thin pinched-out dark brownish gray pyritic stringer near top. A thin irregular brownish black tar-impregnated buff stringer at 79.0 feet.

79.2 80.4 Oil shale: dark brownish gray to brownish black ($10YR 3/2 - 1/2$, some $3/2$); common resinous to waxy luster. Very faint smooth laminations and streaked bedding. Regular to irregular, thick to medium parting; slightly irregular fracture. A fine siliceous black organic seam at 79.7 feet.

80.4 81.6 Oil shale: medium and rare light to dark brownish gray, some brownish black in upper part ($2.5 \times \frac{5}{2} - \frac{3}{2}$, some $\frac{3}{2} \times \frac{1}{2}$ to $\frac{1}{2}$). Moderately distinct smooth laminations. Slightly irregular thick to medium parting; slightly irregular fracture. Rare fine pyrite stringers and very small lenses.

81.6 83.5 Oil shale: medium to dark and rare light brownish gray ($2.5 \times \frac{5}{2} - \frac{3}{2}$, rare $\frac{6}{2}$). Moderately distinct to faint smooth laminations; some faint streaked bedding near base. Slightly irregular to some very smooth. Thick parting; slightly irregular to slightly conchoidal fracture. Some fine dark brownish gray pyritic streaks and lenses.

83.5 84.7 Oil shale: medium to light brownish gray and rare buff ($2.5 \times \frac{4}{2} - \frac{6}{2}$, rare $\frac{7}{2}$). Very faint to some moderately distinct, ^{slightly} distorted and some displaced streaked bedding. Irregular thick to medium parting; slightly conchoidal to some very irregular fracture.

84.7 86.4 Oil shale: medium to light and rare dark brownish gray and brown ($2.5 \times \frac{5}{2} \pm \frac{5}{3} - \frac{6}{2} \pm \frac{5}{3}$, some $\frac{4}{3} - \frac{7}{2}$ lower part). Very faint to some moderately distinct smooth

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laminations and streaked bedding. Irregular to regular thick parting; smooth to slightly conchoidal and some irregular fracture.

86.4 88.6 Oil shale: dark and some medium brownish gray to brownish black ($2.5 \times \frac{3}{2} - \frac{1}{2}$, some $\frac{1}{2}$, rare $\frac{5}{2} - \frac{6}{3} \frac{7}{2}$); some resinous luster. Very faint to faint very distorted to some smooth streaks and stringers; a 2-inch unconformable ^{laminated} lean oil shale band with common small loop structures and displacements at 87.9 feet. Very irregular to some slightly irregular thick parting. Slightly irregular to some very slight hackly fracture. Rare very thin brownish gray, silty textured to massive crystalline streaks and stringers. (Possible break at 87.0 feet)

88.6 89.4 Oil shale: light to dark brownish gray and some brownish black ($2.5 \times \frac{6}{2} - \frac{3}{2}$, some $\frac{2}{2} - \frac{1}{2}$); some resinous to waxy stringers. Faint to moderately distinct, contorted and displaced laminations and stringers; several very discordant unconformities. Irregular thick to medium parting; slightly irregular to conchoidal fracture. Some very small buff to dark gray pyritic lenses, blebs and streaks.

89.4 90.6 Oil shale: medium brownish gray and brown to brownish black and rare tan ($2.5 \times \frac{5}{2} \div \frac{5}{3} - \frac{1}{2}$, rare $\frac{1}{3}$); some resinous and rare waxy luster. Faint to distinct, distorted to smooth streaks, stringers and laminations; rare small loop structures and displacements in lower part. Slightly irregular thick parting; slightly irregular fracture. Rare very small brownish gray pyritic blebs and streaks in upper part. Some thin medium to dark brownish gray massive to faintly bedded stringers and lenses near base.

Sample of medium to dark brownish gray lens from 90.6 feet:

X-ray - quartz, trace dolomite.

90.6 91.8 Oil shale: dark brownish gray to brownish black ($10 \times R \frac{3}{2} - \frac{1}{2}$); very common resinous luster. Very faint slightly distorted to smooth streaked bedding and some laminations. Irregular to rare regular medium to thick parting; slight hackly to slightly irregular fracture. A very irregular 1-inch brownish gray to yellowish tan silt to sandy stuff with some fine bitumen coated vertical fractures at 91.6 feet. (Possible break at 90.7 feet)

91.8 92.8 Oil shale: medium brownish gray to brownish black ($2.5Y\frac{5}{2}-\frac{1}{2}$). Very faint to distinct smooth laminations; some small loop structures and displacements. Irregular to some regular, thick to medium parting; irregular to conchoidal fracture. Some fine to thin light colored pyrite streaks and lenses in upper part. A very thin irregular light brownish gray to light gray silty textured crystalline shinger with some pyrite at 92.3 feet.

92.8 94.3 Oil shale: medium to dark and rare light brownish gray ($2.5Y\frac{5}{2}-\frac{3}{2}$, rare $\frac{6}{2} \& \frac{7}{2}$). Distinct smooth laminations; common very small loop structures and displacements. Very regular to some irregular thick parting; slightly conchoidal to very conchoidal fracture.

94.3 95.3 Oil shale: dark brownish gray to brownish black ($10YR\frac{3}{2}-\frac{1}{2}$); common resinous and some waxy luster. Very faint to faint, smooth to some distorted laminations and streaked bedding. Irregular thick to medium parting; slightly conchoidal to slightly irregular fracture. Some very thin dark gray silt streaks near base.

95.3 96.4 Oil shale: medium to dark and rare light brownish gray and brown ($2.5 \times \frac{5}{16} \text{ to } \frac{7}{8} - \frac{3}{2}$, rare $\frac{1}{2} \text{ to } \frac{3}{2}$). Distinct to some faint smooth laminations; common small loop structures and displacements. Very regular and rare irregular thick parting; smooth to slightly conchoidal fracture.

96.4 97.8 Oil shale: tan and rare buff to dark brownish gray and very rare brownish black ($2.5 \times \frac{1}{3} - \frac{3}{2}$, rare $\frac{1}{2} \text{ to } \frac{3}{2} - \frac{1}{2}$). Moderately distinct to very distinct smooth laminations; very common small loop structures and displacements. Very regular to slightly irregular thick parting; very smooth to some conchoidal fracture. A very thin pinched out buff-white silty-textured stringer with some fine pyrite flebs at 96.8 feet. Very rare fine buff earthy to silty streaks. Some very small gray pyritic lenses at 97.1 feet.

97.8 98.7 Oil shale: dark brownish gray to brownish black ($10 \times R \frac{1}{2} - \frac{1}{2}$, rare $\frac{3}{2}$); common very slight resinous luster. Faint distorted and displaced to smooth laminations near top; very faint smooth streaked bedding in other parts. Irregular thick to medium parting; slightly irregular and rare hackly fracture.

98.7 99.3 Oil shale: medium to dark brownish gray ($2.5 \times \frac{1}{2} - \frac{3}{2}$); some very slight resinous luster. Very faint smooth to slightly distorted streaked bedding and rare laminations. Smooth to irregular, thick to thin parting; slightly irregular and some hackly fracture. A $\frac{3}{4}$ -inch reddish brown silty tuff band at 99.0 feet with some fine stringers extending into shale below. (Possible break at 98.9 feet)

99.3 100.0 Oil shale: dark brownish gray to brownish black ($10 \times \frac{1}{2} - \frac{1}{2}$, rare $\frac{3}{2}$); very common resinous luster. Very faint smooth streaked bedding. Regular to some irregular thick parting; smooth and some very fine to coarse hackly fracture. Rare very fine disseminated pyrite. (Possible break at 99.5 feet)

100.0 101.7 Oil shale: medium to rare dark brownish gray ($2.5 \times \frac{1}{2} - \frac{1}{2}$, rare $\frac{3}{2}$). Faint smooth laminations. Regular to some irregular thick parting; slightly conchoidal fracture. A thin dark brownish gray silty textured tuff with common light colored pyrite at 100.2 feet.

101.7 102.7 Oil shale: medium to dark brownish gray and some brownish black ($2.5 \times \frac{1}{2} - \frac{3}{2}$, some $\frac{1}{2}$); rare resinous luster. Faint to very faint, smooth to rare slightly distorted laminations and streaked bedding. Slightly irregular to irregular thick parting; slightly irregular and rare slight hackly fracture. A thin irregular dark brownish gray silty textured tuff with some fine pyrite blebs at 102.4 feet.

102.7 104.9 Oil shale: buff to medium and some dark brownish gray, very rare brownish black ($10 \times 2.5 \times \frac{1}{2} - \frac{4}{2}$, some $\frac{3}{2}$, rare $\frac{2}{2} - \frac{1}{2}$). Distinct to some faint smooth laminations; common small loop structures and displacements. Irregular to rare smooth thick parting; conchoidal fracture. A very thin irregular dark brownish gray tuff at 102.9 feet. Some very thin irregular light gray silty-textured tuff stringers at 103.6 feet. A 1-inch band of dark shale with some resinous luster at 103.9 feet.

104.9 106.2 Oil shale: dark and rare medium brownish gray to brownish black ($10 \times 2.5 \times \frac{3}{2} - \frac{1}{2}$, rare $\frac{1}{2}$); very common resinous to waxy luster. Very faint to faint, smooth to some ~~very~~ distorted laminations and streaked

bedding. Slightly irregular to irregular thick parting; conchoidal to slightly irregular fracture. Some very irregular, thin medium to dark brownish gray tuff ^(stringers and lenses) with fine disseminated pyrite in middle part. A very thin slightly sparry gray pyritic stringer at base.

106.2 107.2 Oil shale: light to dark brownish gray and rare buff ($2.5 \times \frac{1}{2} - \frac{3}{2}$, rare $\frac{1}{2}$). Faint to distinct fairly smooth laminations; common small loop structures and displacements. Irregular to regular thick parting; irregular to conchoidal fracture. Common very fine dark pyrite blebs.

107.2 108.4 Oil shale and some marlstone: buff to medium and rare dark brownish gray and brown ($2.5 \times \frac{3}{2} - \frac{4}{2} + \frac{4}{3}$, rare $\frac{3}{2}$). Fairly distinct to some faint, smooth to slightly irregular and distorted laminations; common very small loop structures and displacements. Irregular to some slightly irregular, thick to medium parting; conchoidal to irregular fracture. Some very fine pyrite blebs and gray silty-textured pyritic streaks in upper part.

108.4 109.4 Oil shale: light brownish gray and tan to some dark brownish gray and very rare brownish black ($2.5 \times \frac{1}{2} - \frac{3}{2}$, some $\frac{3}{2} - \frac{5}{2}$, rare $\frac{1}{2}$); rare fine resinous streaks in upper part. Faint to very faint, slightly distorted and displaced to smooth laminations and some streaked bedding. Irregular to some regular, thick to medium parting; irregular and conchoidal to fairly smooth fracture.

109.4 110.4 Oil shale: dark brownish gray and rare brownish black ($2.5 \times \frac{2}{5} - \frac{3}{5}$, rare $\frac{1}{2}$), some very slight resinous luster. Very faint smooth to slightly distorted streaked bedding and rare laminations. Irregular to slightly irregular thick parting; slightly irregular to rare slight hackly fracture. A very thin black massive crystalline stringer with some pyrite near base.

110.4 113.4 Oil shale: medium to dark brownish gray and rare brownish black ($0.4 \times 2.5 \times \frac{1}{2} - \frac{3}{2}$, some $\frac{2}{2}$, rare $\frac{5}{2} - \frac{1}{2}$); rare very slight resinous luster. Faint to some moderately distinct, smooth to slightly irregular and distorted laminations; some loop structures and displacement - especially in middle part. Slightly irregular to irregular, thick to rare medium parting;

slightly conchoidal to rare slight hackl. fracture.
Rare very fine disseminated pyrite. A $\frac{1}{2}$ -inch dark to medium brownish gray and rare tan, slightly oil-stained tuff at 111.5 feet. A thin irregular dense brownish gray shinger at 112.5 feet.

113.4 114.4 Oil shale: dark to light brownish gray, very rare brownish black in upper part ($10YR\ 2.5Y\ \frac{3}{2}-\frac{6}{2}$, rare $\frac{3}{2}-\frac{1}{2}$). Fairly distinct to faint, smooth to slightly irregular and distorted laminations and some very faint streaked bedding; some to common very small loop structures and displacements. Slightly irregular to irregular, thick to medium parting; irregular fracture. Some very fine gray pyritic streaks. Some fine ^{dark} brown crystalline calcite streaks and blebs with pyrite at 114.2 feet.

114.4 117.6 Oil shale and some marlstone in middle part: light to rare dark brownish gray, some very light buff in middle part ($2.5Y\ \frac{6}{2}-\frac{7}{2}$, some $\frac{7}{2}-\frac{8}{2} \pm \frac{8}{1}$, rare $\frac{3}{2}-\frac{2}{2}$). Distinct to some faint smooth laminations; very common small loop structures and displacements. Very smooth to some irregular thick parting; slightly conchoidal to some irregular fracture. Some very thin irregular

light to medium gray stringers and lenses at 116.0 and 116.8 feet.

117.6 118.4 Oil shale: dark and rare medium brownish gray to brownish black ($2.5 \times 10^9 R^{3/2-1/2}$, rare $7/2$). common resinous luster. Faint to very faint, slightly distorted to smooth laminations and some streaked bedding; some irregular loop structures and displacements. Slightly irregular to irregular thick parting; irregular fracture. A $1/2$ -inch irregular and pinched out tar-impregnated (bleeding) tuff at 118.2 feet; a very thin tar-impregnated tuff stringer at base.

118.4 119.2 Oil shale: medium to some dark and rare light brownish gray ($2.5 \times 10^9 5/1, 5/2-7/1, 4/2$, some $3/2$, rare $6/2$). Faint fairly smooth laminations; rare loop structures and displacements. Slightly irregular to irregular, thick to some medium parting; slightly concoidal to irregular fracture. Rare fine to thin brownish gray very pyritic streaks and lenses.

119.2 122.4 Marlstone and oil shale: buff and gray-buff to medium and very rare dark brownish gray ($2.5 \times 10^9 8/2, 7/1-3/2$, rare $4/2-7/2$). Very distinct to some very faint, very smooth and

rare slightly irregular laminations. Very smooth and some irregular thick parting; conchoidal to smooth fracture. Some very fine dark specks and black pyritic streaks in middle part. Some small dark gray pyritic lenses in conformable laminar at 121.1 feet.

122.4 123.5 Oil shale: medium to dark brown and brownish gray, rare tan and brownish black ($10YR\ 2.5Y\ 5/2\ \&\ 5/3 - 3/2$, some $2/2$, rare $6/3\ \&\ 1/2$); rare slight resinous luster. Faint to moderately distinct very smooth laminations. Very smooth to irregular, thick to medium parting; conchoidal to slightly irregular fracture. Very rare fine dark gray to brownish gray pyritic streaks in upper part. A very thin massive to silty textured brown crystalline band at 123.0 feet. Rare very fine disseminated pyrite in lower part.

123.5 124.7 Marlstone and oil shale: light to rare dark olive gray and buff ($5Y\ 6/2\ \&\ 6/1 - 5/2\ \&\ 5/1$, rare $7/1 - 3/1\ \&\ 7/2 - 8/2$). Faint smooth laminations. Smooth to very irregular thick to medium parting; conchoidal to irregular fracture. Common very fine dark pyrite specks. A very thin very pyritic dark gray silty-textured band at 123.7 feet. A very thick light to medium gray and brownish gray buff with

common very fine dark specks and chiseled points at 124.1 to 124.5 feet.

124.7 126.1 Oil shale: dark brownish gray to brownish black, some medium brownish gray to tan in upper 0.3 foot ($2.5 \times 10 \times R^{3/2-1/2}$, some $1/2-2/3$ upper part); common resinous luster. Fairly distinct smooth to very distorted laminations in upper 0.3 foot; faint smooth laminations and some streaked bedding in lower part. Regular to some irregular, thick to medium parting; slightly irregular and conchoidal fracture. Some thin to medium tan to dark brownish gray, massive to silty-textured, oil-stained tufts in conformable laminations at 124.9 to 125.0 feet. Common fine dark brownish gray to brown massive to silty-textured streaks and stringers in middle part. Some thin gray to brownish gray pyritic stringers and lenses at 125.7 feet. Some to common fine pyrite blebs in lower part.

126.1 128.1 Oil shale: light to dark brownish, rare buff in lower part ($2.5 \times 10 \times R^{1/2-3/2}$, rare $1/2$ upper part, rare $1/2$ lower part; some almost neutral gray). Moderately distinct smooth laminations; some small loop structures and displacements in upper part. Regular to some irregular thick parting; irregular to

conchoidal fracture. Very common fine dark pyrite blebs. A very thin gray to rare buff and tan-spotted very pyritic band 126.3 feet. A very thin buff to gray pyritic band at base.

128.1 129.3 Oil shale: medium to dark brownish gray and rare brownish black ($2.5 \times \frac{5}{2} \pm \frac{5}{1} - \frac{3}{2}$ in upper part, $10 \times \frac{4}{2} - \frac{3}{2}$, rare $\frac{1}{2}$ in lower part); some very slight resinous luster in lower part. Moderately distinct to very faint, smooth to slightly irregular and distorted laminations and some streaked bedding; some loop structures and displacements. Regular to slightly irregular thick parting (some very thin shaly to papery parting at base); slightly irregular and rare slight hackly fracture. Common fine pyrite blebs in upper part. Some thin to fine medium to dark brown tuff stringers near base. Sharp smooth conformable contact with ^{dolomite} marlstone at base.

129.3 130.5 Marlstone and oil shale: buff-white to some medium and rare dark olive gray ($5 \times \frac{9}{2} - \frac{6}{2} \pm \frac{5}{1}$, some $\frac{5}{2} - \frac{5}{1}$, rare $\frac{4}{2} - \frac{3}{2}$; rare slight brown tint. Faint to some very distinct, smooth to some slightly irregular, distorted and displaced laminations. Regular to some irregular, thick to medium and rare thin parting; conchoidal to irregular fracture. A 2-inch band of dense massive light brownish gray dolomite

with very fine smooth dark seams at top. A fine green
silty-textured crystalline stringer at 130.5 feet.

Sample of light brownish gray dolomite from 129.4 feet:
X-ray - dolomite, trace quartz.

130.5 131.5 Oil shale: light to dark brownish gray, some
brownish black in lower part ($2.5 \times \frac{1}{2} - \frac{3}{2}$, some $\frac{1}{2} - \frac{1}{2}$ lower
part; some slight olive tint in upper part); some very slight
resinous luster in lower part. Moderately distinct to faint
smooth laminations; some small loop structures and
displacements. Irregular to some very smooth, thick
to medium parting; fairly smooth to irregular and
rare hackly fracture. Some very thin to medium
dense brownish gray dolomite bands in lower part.
Sharp wavy conformable (?) contact with tuff at base.

131.5 132.5 Tuff: buff and tan to medium and rare dark
brownish gray ($2.5 \times \frac{1}{1} - \frac{5}{3} \pm \frac{1}{2}$, rare $\frac{1}{1} - \frac{2}{1}$), some white in lower
part (9N). Contorted fine oil shale stringers and streaks
to some mottled. Irregular parting and fracture. Some
fine lacy gray stringers in white parts. Irregular slight
interfingering contact with shale at base. (Lower wavy bed?).

132.5 133.4 Oil shale and marlstone: Dark brownish gray and some brownish black to tan and some buff (2.5 \times $\frac{1}{2}$ - $\frac{2}{3}$, some $\frac{1}{2}$ upper part, rare $\frac{1}{2}$ lower part; some slight to moderate olive tint); some resinous luster near top. Very faint to very distinct, irregular and distorted laminations; some very faint streaked bedding near top. Irregular medium to thin parting; irregular fracture. A $\frac{1}{2}$ -inch brownish black massive crystalline stringer and some very thin tan to brownish gray stringers near top. A very thin irregular very light gray-buff stringer with some fine black specks at 133.0 feet. Some buff to medium brownish gray and olive gray massive crystalline dolomite laminae and bands in lower part. Some vertical fractures with slight brown varnish-like coatings in lower part.

Sample of brownish black stringer from 132.5 feet:
X-ray - quartz; trace dolomite.

133.4 135.7 Marlstone and oil shale: Buff to medium and some dark olive gray (5 \times $\frac{1}{2}$ - $\frac{5}{2}$ \pm $\frac{5}{1}$, some $\frac{4}{2}$ - $\frac{2}{2}$ and $\frac{3}{2}$ - $\frac{2}{2}$), some medium to light brownish gray in lower part (2.5 \times $\frac{1}{2}$ - $\frac{1}{2}$). Faint to very distinct, smooth to some irregular and distorted laminations. Irregular to some regular thick parting; conchoidal to slightly irregular fracture. Some dense massive

crystalline, light to medium olive gray and brownish gray dolomite
 laminae and bands in upper part. Common fine dark
 pyritic specks, streaks and bluish aggregates in lower part.
 (tar impregnated)

135.7 137.1 Limestone (?) light brownish gray and tan to
 brownish black ($2.5 \times \frac{1}{2}$ to $\frac{2}{3}$ - $\frac{1}{2}$); silty and ^{some} fragmental to
 fine granular. Contorted and broken stringers to massive.
 Irregular parting and fracture. Some fine to thin buff
 to gray marlstone stringers.

137.1 138.4 Marlstone: very light to light olive gray
 in upper part ($5 \times \frac{1}{1}$ - $\frac{6}{1}$), light brownish gray to yellowish buff
 in lower part ($2.5 \times \frac{1}{2}$ - $\frac{2}{3}$). Very faint smooth to distorted and
 brecciated laminations. Irregular thick parting; conchoidal
 to irregular fracture. Some fine gray silty textured streaks
 and fine dark pyritic specks in lower part.

138.4 139.3 Oil shale: tan to dark brownish gray and
 rare brownish black ($2.5 \times \frac{1}{3}$ - $\frac{2}{3}$, rare $\frac{1}{2}$; some slight olive tint
 upper part). Moderately distinct to faint, fairly smooth to
 some contorted laminations; some cross-laminated inclusions (?)
 near base. Regular to irregular, medium to thick parting,
 irregular fracture. Common irregular tan to brown and brownish
 gray buff stringers.

139.3 140.8 Oil shale: light to dark brownish gray, some tan to buff in lower part (2.5' $\frac{1}{2}$ - $\frac{3}{16}$ $\frac{3}{2}$, some $\frac{1}{8}$ - $\frac{1}{2}$). Moderately distinct to some very distinct very smooth laminations. Regular thick parting; slightly irregular to slightly conchoidal fracture. Very common fine dark pyrite (?) specks. A fine irregular vertical pyrite stringer in upper 1 inch.

140.8 141.7 Oil shale: light to dark brownish gray, some brownish black and tan to buff in middle part (2.5' $\frac{1}{4}$ 10' $\frac{1}{2}$ - $\frac{3}{2}$, some $\frac{3}{2}$ - $\frac{1}{2}$ $\frac{1}{3}$ - $\frac{3}{4}$ in middle part); some resinous to waxy luster in middle part. Moderately distinct and some very distinct to faint, smooth to slightly irregular and distorted laminations. Slightly irregular to irregular, thick to medium parting; slightly conchoidal to irregular fracture. Some very fine pyrite blebs and streaks. A 1-inch irregular gray to brownish gray silty-textured tuff with some fine lacy orange-buff stringer at 141.6 feet (some fine interfingering shale stringers at top).

141.7 143.3 Oil shale and marlstone: very light buff to dark brownish gray (2.5' $\frac{1}{2}$ - $\frac{3}{2}$; some slight chert in). Very distinct smooth and rare slightly distorted laminations.

Very smooth and rare irregular, thick to medium and rare thin parting; irregular to some fine small fracture. A 0.2-foot white to dark buff at top. A 0.1-foot white buff with some fine irregular gray stringers or fracture fillings 142.1 foot. Some thin to fine gray tuffs in middle part. A 0.2-foot light gray faintly bedded buff at base.

143.3 144.0 Oil shale: medium to dark brownish gray and olive-gray, some light brownish gray to buff in upper and lower parts ($2.5 \times 5 \times \frac{5}{2} - \frac{3}{2}$, some $\frac{1}{2} \times \frac{1}{2}$, rare $\frac{3}{2}$). Distinct smooth laminations. Regular to irregular, thick to thin parting; smooth to concoidal and some irregular fracture. Some thin buff limestone bands in lower part.

144.0 146.0 Marble and some oil shale: buff and gray buff to medium and rare dark brownish gray and olive gray ($2.5 \times 5 \times \frac{8}{2} \pm \frac{3}{1} - \frac{5}{2} \pm \frac{5}{1}$, some $\frac{7}{3}$, $\frac{4}{1} - \frac{3}{2}$). Distinct irregular and distorted to smooth laminations. Irregular to some regular thick to medium parting; irregular to concoidal fracture. Some thin buff limestone bands in upper part. A 0.1-foot light brownish gray to yellowish buff limestone and marble breccia band at top. A 0.1-foot

buff-white silty to earthy buff(?) at 144.2 feet
Rare thin to fine gray limestone, streaks and lenses in
~~middle part~~. A $\frac{3}{4}$ -inch white buff with some fine
gray stringers or ductile fillings at 145.1 feet.
Some fine vertical fractures in lower part.

146.0 147.3 Oil shale; light to dark olive gray ($5Y\frac{6}{10}\frac{2}{2}-$
 $\frac{3}{1}\frac{3}{2}$) and some buff and tan to dark brownish gray
($2.5Y\frac{7}{2}\frac{6}{3}-\frac{2}{2}$). Distinct fairly smooth to some irregular
distorted laminations. Irregular to some regular, thick to
thin parting; slightly irregular to some ^{very} irregular
coarse hackly fracture. Rare thin to fine gray
buff stringers. A $1\frac{1}{2}$ -inch light gray buff at
146.6 feet. Some thin limestone bands in lower part.
Some short light vertical fractures with rare orange-
brown varnish-like coatings in lower part.

147.3 149.3 Oil shale and marlstone; buff and tan to
medium and some dark brown and brownish gray ($2.5Y\frac{8}{2}\frac{7}{4}-$
 $\frac{5}{2}\frac{5}{3}$, some $\frac{4}{3}-\frac{3}{2}$, rare $\frac{2}{2}$), some light to rare dark olive
gray in middle part ($5Y\frac{6}{10}\frac{2}{2}-\frac{4}{1}\frac{4}{2}$, rare $\frac{3}{1}$). Very distinct
to some faint, slightly irregular, distorted and distorted
to fairly smooth laminations. Irregular to some very
regular thick to medium parting; very irregular coarse

buff.

hackly fracture. Some siliceous limestones and bands especially in lower part. Some thin to fine gray silty buff stringers. Some vertical fractures with orange-brown varnish-like coatings in lower part.

149.3 149.8 Tuff: light gray (8-7N, rare 6N). Massive to some speckled and spotted. Irregular parting and fracture. Some very fine gray intersecting stringers or fracture fillings. Sharp slightly irregular contacts at top and bottom with rare fine short irregular stringers extending into adjacent beds.

Sample of tuff from 149.5 feet:

X-ray - feldspar (sanidine, albite), pyrite.

149.8 152.1 Oil shale: buff and tan to some dark brownish gray and olive gray, rare brownish black (2.5Y 4.5Y 7.5Y 8-9, some 7.5Y 8, rare 7.5Y 8), rare resinous luster. Distinct fairly smooth to some irregular, distorted and displaced laminations. Slightly irregular to very irregular, thick to some thin parting; slightly irregular to very irregular coarse hackly fracture. Some vertical fractures with brown to yellowish green coatings. Some massive crystalline limestone laminae and bands.
(over)

U 3-inch buff-white to light gray buff with very common fine bluish (massive?) gray stringers or fracture fillings at 150.8 feet. Some thin to fine gray buff stringers in lower part.

152.1 155.1 Limestone: light brownish gray and gray-buff to buff and some tan (2.5% , $8\frac{1}{2}-8\frac{1}{3}$, $8\frac{1}{2}$, some $8\frac{1}{3}-7\frac{1}{3}$), very oolitic. Massive and some mottled to faintly bedded. Irregular parting and fracture. Medium brownish gray and brown faintly streaked oil shale with very common buff calcareous oolites and fine blebs from 153.9 to 154.2 feet. Thin to medium irregular dark brown dense massive crystalline bands at 154.3 and 154.4 feet. Tan to buff massive to silty crystalline limestone with common curved and folded dark oil shale laminae in lower 0.2 foot.

Sample of dense dark brown crystalline stinger from 154.4 feet. X-ray - quartz; trace dolomite.

155.1 156.3 Limestone and marlstone: light gray and buff in upper part ($8-7N$ & 2.5% $\frac{1}{2}-\frac{1}{2}$), buff-white to orange-buff in lower part (2.5% $\frac{1}{2}-\frac{1}{3}$ & $8\frac{1}{3}$). Faint contorted and broken stringers to wavy and crumpled bands (algal structure) in upper part; contorted and broken stringers and laminations in lower part. Very

irregular parting and fracture. Some fine distinct
tan to brown oil shale laminae and stringers in
lower part.

156.3 157.1 Oil shale: medium brown and brownish
gray to brownish black, some tan to buff ($2.5Y^5 \frac{1}{3} \frac{1}{2} - \frac{1}{2}$,
some $\frac{4}{3} - \frac{7}{2}$). Very faint distorted streaked bedding to
fairly distinct fine very slightly distorted laminations.
Irregular to some very regular, thick to medium
parting; irregular to conchoidal fracture. Very common
fine tan to buff calcareous oolites, flecks and streaks. Some
fine vermiform buff marly limestone stringers near top.
A very thin irregular yellowish gray to gray buff stringer
with some very fine black flecks at 156.8 feet.
tar impregnated

157.1 158.2 Limestone (?) medium to dark brownish
gray and brown ($2.5Y \frac{1}{2} 10YR \frac{7}{3} \frac{1}{3} - \frac{7}{2}$). Fairly mottled.
Irregular parting and fracture. Some very thin broken
buff marlstone stringers near base.

158.2 158.5 Marlstone and oil shale: light to rare dark
brownish gray ($2.5Y \frac{1}{2} 10YR \frac{6}{3} - \frac{7}{2} \frac{1}{3}$, rare $\frac{3}{2}$). Faint broadly
curved laminations and streaked bedding in some part. A very
irregular thin oil stained buff (?) stringer in middle. Very faint

fairly smooth streaked bedding with common fine buff limestone blebs and streaks and some fine bituminous black organic streaks in lower part. A $1\frac{1}{2}$ -inch band of brittle vitreous black organic material at base.

158.5 - 168.8 Marlstone, mudstone and siltstone: pale greenish gray marlstone and mudstone; brownish gray to brownish black tar-impregnated siltstones at 158.5-159.2, 160.3-162.9, 163.6-163.7, 164.0-164.5 and 166.7-168.0 feet; rare thin tar impregnated siltstone stringers in other parts. Some cross-bedding in siltstones.

168.8 - 179.1 Siltstone and sandstone, tar impregnated: dark brown to black. Massive with some thin to fine pale greenish gray marlstone and mudstone stringers.

179.1 - 199.7 Mudstone: pale greenish gray and rare light to medium olive gray. Massive to faintly bedded with rare fine light brownish gray streaks, stringers and laminae. A $1\frac{1}{2}$ -inch buff limestone band with some ^{very pyritic} gray streaks stringers and blebs at 198.9 feet. Faintly laminated marlstone in lower 0.2 feet.

199.7 201.5 Limestone, slightly tar impregnated in lower part: buff to medium brown and brownish gray, very oolitic. Massive to speckled.

201.5 208.0 Limestone, tar impregnated: dark to medium brown and some buff to gray white. Very common algal structures throughout (very irregular concentric ^{laminae} ^{of} ^{stippled} tubes and blebs and some wavy to crinkled banding).

208.0 220.3 Mudstone: pale greenish gray and some very light green to almost neutral light gray. Buff-white to light brownish gray, oolitic to blebby limestone from 215.6 to 216.5 feet.

220.3 222.1 Limestone, slightly tar impregnated in lower part: very light buff to some medium brown, very oolitic. Massive to mottled and variegated.

222.1 225.8 Limestone, tar impregnated: medium to dark brown, some very light buff clean bands in upper part; very oolitic. Massive with common buff speckles and some fine buff streaks and stringers.

225.8 - 227.1 Limestone, tar impregnated: dark brown to brownish black, very oolitic. Massive with common buff speckles.

227.1 - 228.1 Sandstone, tar impregnated: dark brown to some brownish black. Mottled with common very irregular fine to thin, light brownish gray to buff marlstone streaks and stringers.

228.1 - 236.0 Mudstone and siltstone: pale to rare medium greenish gray. Faintly bedded and streaked to massive; rare irregular cross-bedding. Dark brownish gray to black tar impregnated sandstone at 232.0 - 232.8 and 233.7 - 233.9 feet; rare irregular slightly impregnated brownish gray silty stringers and patches in other parts.

Bottom of core.