

# The Foote Creek and Dutton Creek Formations, Two New Formations in the North Part of the Laramie Basin, Wyoming

By HAROLD J. HYDEN, HARRY McANDREWS, and ROBERT H. TSCHUDY

CONTRIBUTIONS TO STRATIGRAPHY

---

GEOLOGICAL SURVEY BULLETIN 1194-K



**UNITED STATES DEPARTMENT OF THE INTERIOR**

**STEWART L. UDALL, *Secretary***

**GEOLOGICAL SURVEY**

**Thomas B. Nolan, *Director***

The U.S. Geological Survey Library catalog card for this publication appears on page K12.

United States Government Printing Office, Washington: 1965

---

For sale by the Superintendent of Documents, U.S. Government Printing Office  
Washington, D.C., 20402 - Price 10 cents

## CONTENTS

---

	Page
Abstract.....	<b>K1</b>
Introduction.....	1
Foote Creek Formation.....	3
Dutton Creek Formation.....	8
References cited.....	12

---

## ILLUSTRATION

---

	Page
FIGURE 1. Map of southeast Wyoming.....	<b>K2</b>

100  
101  
102  
103  
104

100  
101  
102  
103  
104

105

105

## CONTRIBUTIONS TO STRATIGRAPHY

---

# THE FOOTE CREEK AND DUTTON CREEK FORMATIONS, TWO NEW FORMATIONS IN THE NORTH PART OF THE LARAMIE BASIN, WYOMING

---

By HAROLD J. HYDEN, HARRY McANDREWS, and ROBERT H. TSCHUDY

---

### ABSTRACT

The names Foote Creek Formation and Dutton Creek Formation are introduced here for rock units in the north part of the Laramie basin, Wyoming, and a small area to the west, including a part of the Carbon basin. The Foote Creek, of Late Cretaceous and Paleocene age, lies on the Lewis Shale. The Dutton Creek, of Paleocene age, overlies the Foote Creek Formation and is overlain by the Wind River Formation. The two new formation names are introduced for rocks shown as Medicine Bow Formation and Hanna Formation on the current State geologic map. The last two formations were named for exposures in the Hanna basin and the names have been extended into the Carbon and Laramie basins. In mapping the Laramie basin, we found the Hanna basin names to be inappropriate because the beds cannot be traced from basin to basin to establish a definite correlation.

The Foote Creek Formation consists essentially of beds of fine-grained sandstone interbedded with carbonaceous shale, carbonaceous siltstone, and coal beds. It ranges from 0 to about 350 feet in thickness. The Foote Creek is conformable on the Lewis Shale in most of the area but locally is unconformable.

The Dutton Creek Formation consists essentially of beds of coarse-grained locally conglomeratic sandstone, interbedded mudstone, carbonaceous shale, fine-grained sandstone, conglomerate, and coal. The thickness of the Dutton Creek is estimated to range from about 200 to 500 feet. The contact of the Dutton Creek Formation with the underlying Foote Creek Formation is a disconformity; locally the Foote Creek Formation has been removed by erosion and the Dutton Creek rests on the Lewis Shale.

### INTRODUCTION

The rocks between the Lewis Shale (Late Cretaceous) and the Wind River Formation (Eocene) in the northern part of the Laramie basin are 500 to 800 feet thick. They consist mainly of sandstone, conglomerate, and shale, and include minor coal. The rocks are poorly ex-

posed, but can be divided into two mappable units. These two units are shown as Medicine Bow Formation and Hanna Formation on the current State geologic map (Love and others, 1955). The last two formations were named for exposures in the Hanna basin (Bowen, 1918, p. 228-231), and usage of the names has been extended into the Carbon and Laramie basins. In mapping the part of the Laramie basin indicated on figure 1, however, we found the Hanna basin names to be inappropriate in the Laramie basin. The beds cannot be traced

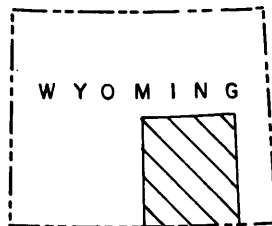
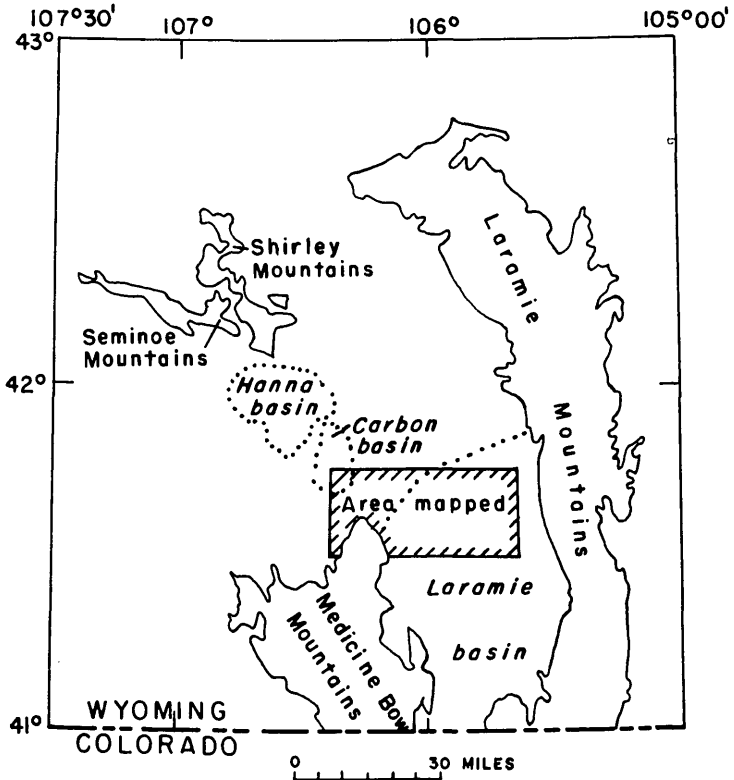


FIGURE 1.—Map of southeast Wyoming showing area in which Foote Creek and Dutton Creek Formations have been named and mapped. Outline of mountain ranges shown coincides with outcrop of Precambrian rocks.

from basin to basin to establish a definite correlation. The introduction of new names for the rocks exposed in the Laramie basin is desirable because of the great difference in thickness (as much as 20,000 feet in the Hanna basin versus about 800 feet in the north part of the Laramie basin), probable differences in source areas, and an indicated slight age difference in specific units.

The names Foote Creek Formation and Dutton Creek Formation are introduced here for the rock units in the north part of the Laramie basin, Wyoming, and a small area to the west, including a part of the Carbon basin (fig. 1). The Foote Creek, the older of the two formations, lies on the Lewis Shale. The Dutton Creek Formation overlies the Foote Creek Formation and is overlain by the Wind River Formation.

Very few megascopic fossils were found in the Foote Creek and Dutton Creek Formations exposed in the map area in the Laramie basin. Carbonaceous material in the formations, however, yielded spores and pollen that furnished data needed to establish the age of the formations. Samples for palynological study were collected in the Hanna basin as well as in our map area. Tschudy supervised the collecting and made the identifications of pollen and spores. The palynologic data indicate that the Foote Creek Formation is both Late Cretaceous and Paleocene in age and that the Dutton Creek Formation is Paleocene in age. In addition, our data confirmed presently accepted ages for two Hanna basin units: a Late Cretaceous age for the Medicine Bow Formation and the basal conglomeratic zone of the Ferris Formation, and a Paleocene age for the upper part of the Ferris Formation.

#### FOOTE CREEK FORMATION

The Foote Creek Formation is named for exposures near Foote Creek in the NE $\frac{1}{4}$  sec. 13, T. 20 N., R. 79 W., and the NW $\frac{1}{4}$  sec. 18, T. 20 N., R. 78 W., Carbon County, Wyo. At the type section, the Foote Creek Formation is 227.8 feet thick, and in the north part of the Laramie basin it ranges from 0 to about 400 feet in thickness. The Foote Creek consists of fine- and medium-grained sandstone, dark shale, siltstone, and coal. The sandstone is light gray to white, and locally ocher-stained on the outcrop; it occurs in lenticular beds, and grades locally to siltstone. Carbonized plant fragments and small fragments of coal are present in the sandstone and siltstone. The shale and siltstone are gradational and interlaminated. Carbonaceous material is abundant in some of the shale and siltstone beds; the carbonaceous shale and siltstone beds characteristically weather dark brown. The coal beds locally grade into carbonaceous shale or siltstone and are lenticular.

Calcareous ironstone concretions are present in zones or beds interbedded with carbonaceous siltstone and shale; they range from grayish purple to dusky blue and some have ocherous red or yellow rinds.

The Foote Creek seems to have been deposited in a lagoonal shoreline environment at the edge of the retreating Lewis sea. The fauna, flora, and type of sedimentary rocks are indicative of such an environment. Fresh- or brackish-water pelecypods and gastropods are locally concentrated in the formation. Fossil wood fragments are common, and molds or casts of leaves are present although less common. The shoreline environment of deposition is also reflected in the heavy mineral content of the sandstones; the resistant minerals zircon and tourmaline are most common, and labile minerals are rare.

A local unconformity at the base of the Foote Creek Formation is present a few miles southwest of the type section where a coal bed in the Foote Creek rests on the lowermost part of the Lewis Shale. The unconformity was not observed elsewhere in the map area; moreover, the contact of the Foote Creek and Lewis Shale seems to be gradational at most of the outcrops. Where the beds are conformable, the boundary between the two formations was drawn below the lowest coal bed and the beds directly below it that appear to be associated with the coal. The Foote Creek is unconformably overlain by the Dutton Creek Formation; this contact is marked by the presence of conglomerate or conglomeratic sandstone in the overlying Dutton Creek Formation. The contact is a disconformity; its irregular or channeled aspect is displayed at the type locality, but in most of the mapped area the contact is obscured by cover.

Macrofossils, collected from outcrops of the Foote Creek Formation, were identified by W. A. Cobban (written commun., 1961):

*Ostrea glabra* (USGS Mes. loc. D3836)

*subtrigonalis* (USGS Mes. loc. D3131)

*Corbicula fracta* (USGS Mes. loc. D3131)

*Cassiopella turricula* (USGS Mes. loc. D3132)

*Campeloma multilineata* (USGS Mes. loc. D3132)

*Tulotomops thompsoni* (USGS Mes. loc. D3132)

These fossils are common in Upper Cretaceous rocks in Wyoming.

Tschudy studied spores and pollen from samples of coal and carbonaceous shale from the type section of the Foote Creek Formation. Many of the specimens are poorly preserved, and only the lowest coal yielded an assemblage of chronological value. The assemblage (USGS Paleobot. loc. D3162) indicates a Late Cretaceous age for the rocks. The following forms were identified:



*Aquilapollenites* sp.*Beaupreacidites* (*Proteacidites* of some authors) 2 sp.*Kurtzipites* sp.*Liliacidites* cf. *L. leei* Anderson, 1960*Tricolpites* sp.*Tiliaepollenites* sp.

All the above genera except *Tiliaepollenites* are common in the Hell Creek and Lance Formations of Late Cretaceous age. The species of *Tiliaepollenites* found in this assemblage was found also in the lowermost coal from the Medicine Bow Formation near its type locality.

A core drill penetrated the Foote Creek Formation in sec. 32, T. 19 N., R. 77 W., and samples from this core yielded excellent palynologic specimens (USGS Paleobot. loc. D3194). The genera *Pistillipollenites* Rouse, 1962 and *Caryapollenites* Raatz, 1937 were found in all beds sampled in the cores. These genera indicate a Paleocene age for the Foote Creek Formation at this locality. Thus, the Foote Creek Formation is of Late Cretaceous and Paleocene age.

A detailed section of the Foote Creek Formation and overlying formations at the type locality and a description of the Foote Creek Formation obtained by core drilling follow:

*Section of the Foote Creek Formation and overlying Dutton Creek Formation, exposed at the type locality of the Foote Creek, NE¼ sec. 13, T. 20 N., R. 79 W., and NW¼ sec. 18, T. 20 N., R. 78 W.*

[Measured by H. J. Hyden and H. McAndrews]

	<i>Thickness (feet)</i>
Terrace gravel bed:	
33. Gravel: unconsolidated cobbles and pebbles of quartzite, amphibolite, and chert. Rests on eroded surface of the underlying Dutton Creek Formation.....	10
Dutton Creek Formation:	
32. Sandstone, light yellowish-gray, medium- and coarse-grained; scattered pebble zones; pebbles 0.5-3 in. in diameter; soft, poorly cemented; more resistant zones form small iron-stained ledges (1-3 in. thick); cross-stratified.....	45
31. Sandstone, light-gray, medium- and coarse-grained; calcareous cement; weathered light brown; forms ridge; cross-stratified..	5
30. Sandstone, light yellowish-gray, medium- and coarse-grained; soft, poorly cemented.....	29.5
29. Concealed.....	17.5
28. Sandstone, light-gray, coarse-grained, conglomeratic; pebbles of shale and sandstone as much as 2 in. in diameter; pebbles irregularly distributed, but abundant at base; leached clayey cement. Matrix is fine- and medium-grained sandstone composed of quartz, feldspars, and both light- and dark-colored chert grains. Unit rests on channeled surface.....	15
Total measured thickness of Dutton Creek Formation.....	112

Section of the Foote Creek Formation and overlying Dutton Creek Formation, exposed at the type locality of the Foote Creek, NE $\frac{1}{4}$  sec. 13, T. 20 N., R. 79 W., and NW $\frac{1}{4}$  sec. 18, T. 20 N., R. 78 W.—Continued

Foote Creek Formation:	Thickness (feet)
27. Coal.....	5
26. Shale, medium-gray; upper 1 ft is brown and very carbonaceous.....	9
25. Sandstone, light-gray, very fine to fine-grained; leached calcareous cement; weathered grayish yellow with limonitic boxwork in upper 3 in., irregular iron-stained laminae in remainder.....	12
24. Shale, medium-gray, soft and fissile; carbonaceous zones 1 ft thick at base and 10 ft above base; thin interbeds of medium-gray siltstone; scattered 0.3-1-in. veinlets of white fibrous gypsum.....	41
23. Sandstone, light-gray, very fine grained, noncalcareous; intricate pattern of yellow iron staining crosses bedding and also parallels bedding; jointed.....	7.5
22. Shale, medium-gray, soft, weathered.....	8
21. Sandstone, light-gray, very fine grained, noncalcareous.....	7.5
20. Shale, medium-gray, soft, fissile; medium brown and carbonaceous in upper 10 in.....	6.5
19. Sandstone, light-gray to white, very fine grained, iron-stained.....	3
18. Shale, medium-gray, soft, fissile; brownish-gray ironstone concretions.....	9
17. Coal; contains bed of brown carbonaceous siltstone 6 in. thick near top.....	6
16. Shale, medium-brown, very carbonaceous.....	.3
15. Sandstone, light-gray, very fine grained; contains ferruginous concretions 0.3 in.-0.5 in. in diameter.....	5
14. Concealed.....	20
13. Ironstone, grayish-purple to dusky-blue; contains fossils including <i>Ostrea glabra</i> Meek and Hayden (USGS Mes. loc. D3836).....	2
12. Concealed.....	5.5
11. Shale, medium-brown, carbonaceous; in part silty.....	4.5
10. Sandstone, very light gray to white, fine-grained, noncalcareous, friable, cross-laminated.....	2.5
9. Shale, dark-gray to black, hard, fissile.....	12
8. Sandstone, very light gray to white, fine-grained, noncalcareous; forms small white bluff with iron-stained upper surface.....	45
7. Shale, dark-gray, carbonaceous; interlaminated medium-gray clayey siltstone.....	3
6. Sandstone, light-gray, very fine grained, noncalcareous, cross-laminated.....	4.5
5. Coal; USGS Paleobot. loc. D3162.....	2.2
4. Siltstone, light-brown, very carbonaceous; weathers medium gray.....	2.3
3. Sandstone, light-gray, very fine grained, noncalcareous, friable, soft, iron-stained; contains scattered mica flakes.....	4.5
Total thickness of Foote Creek Formation.....	227.8

FOOTE CREEK, DUTTON CREEK FORMATIONS, WYOMING K7

*Section of the Foote Creek Formation and overlying Dutton Creek Formation, exposed at the type locality of the Foote Creek, NE¼ sec. 13, T. 20 N., R. 79 W., and NW¼ sec. 18, T. 20 N., R. 78 W.—Continued*

	<i>Thickness (feet)</i>
Lewis Shale:	
2. Shale, olive-gray, soft, platy; contains clay-ironstone concretions as much as 0.5 in. maximum diameter; weathered yellow and orange.....	9.9
1. Sandstone in thin parallel beds, very light gray to white, very fine grained.....	2.5
Total measured thickness of Lewis Shale.....	12.4

*Partial section of Foote Creek Formation described from core obtained from drill hole in SE¼ sec. 32, T. 19 N., R. 77 W., Albany County, Wyo.*

[Described by H. J. Hyden]

	<i>Estimated thickness<sup>1</sup> (feet)</i>	<i>Depth (feet)</i>
Foote Creek Formation:		
33. Shale, dark-gray.....	0.9	249.0
32. Sandstone, light-gray, fine- and medium-grained, micaceous, silty; calcareous cement; carbonaceous flakes..	16.0	250.0
31. Shale, dark-gray, silty.....	1.4	267.0
30. Sandstone, light-gray, medium-grained; some scattered coarse grains and quartzite granules.....	1.4	268.5
29. Shale, dark-gray, carbonaceous; 0.1-ft coal bed.....	9.9	270.0
28. Sandstone, medium-gray, fine-grained, silty, micaceous; abundant carbonaceous flakes.....	.9	280.5
27. Siltstone, dark-gray, carbonaceous.....	1.4	281.5
26. Shale, dark-gray, carbonaceous.....	.9	283.0
25. Sandstone, light-gray, fine- and medium-grained; calcareous cement.....	5.6	284.0
24. Siltstone, dark-gray, carbonaceous; scattered pyrite crystals.....	4.7	290.0
23. Shale, dark-gray, silty, carbonaceous; blocky fracture; three interbedded coals, 2 in., 2 in., and 3 in. thick....	17.8	295.0
22. Coal bed.....	1.1	314.0
21. Shale, dark-gray to black, carbonaceous; contains two 10-in. boney coal zones; interbedded coaly siltstone..	8.5	315.3
20. Coal.....	.7	324.3
19. Shale, dark-gray to black; coal laminae.....	2.7	325.1
18. Shale, dark-gray to black; USGS Paleobot. loc. D3194A..	3.8	328.0
17. Coal and interbedded dark-gray carbonaceous shale; coal beds are 3 in., 1.1 ft, 5 in., 10 in., and 9.5 in. thick; USGS Paleobot. loc. D3194B.....	6.1	332.0
16. Shale, dark-gray to black.....	4.7	338.5
15. Coal.....	3.1	343.5
14. Shale, dark-gray to black, carbonaceous.....	1.9	346.8
13. Sandstone, light-gray, fine-grained; scattered medium grains; slightly calcareous cement. Unit contains very finely crystalline pyrite.....	2.1	348.8
12. Shale, dark-gray, carbonaceous; USGS Paleobot. loc. D3194C.....	2.1	351.0

See footnote at end of section.

*Partial section of Foote Creek Formation described from core obtained from drill hole in SE $\frac{1}{4}$  sec. CB, T. 19 N., R. 77 W., Albany County, Wyo.—Continued*

Foote Creek Formation—Continued		Estimated thickness <sup>1</sup> (feet)	Depth (feet)
11.	Sandstone, light-gray, very fine grained, silty, slightly calcareous; interbedded with dark-gray shale.....	2.6	353.2
10.	Sandstone, light-gray, fine-grained; scattered medium grains; contains laminae with abundant carbonaceous flakes; interbedded carbonaceous siltstone and shale..	8.9	356.0
9.	Shale, dark-gray, carbonaceous; interbedded with dark-gray carbonaceous siltstone.....	12.2	365.5
8.	Shale, dark-gray, coaly with four coal beds, 6 in., 1.3 ft, 7.5 in., and 2 in. thick.....	16.4	378.5
7.	Coal; USGS Paleobot. loc. D3194D.....	7.0	396.0
6.	Shale, dark-gray, carbonaceous; interbedded with carbonaceous siltstone and a 6-in. coal bed; USGS Paleobot. loc. D3194E.....	3.3	403.5
5.	Siltstone, medium- and dark-gray, clayey; some carbonaceous limestone.....	7.0	407.0
4.	Sandstone, light-gray, very fine grained, silty, micaceous; scattered clay flakes.....	8.0	414.5
Total estimated thickness Foote Creek Formation..		163.1	

Lewis Shale:

3.	Sandstone, light-gray, very fine grained, silty, glauconitic; contains clay flakes and clay laminae.....	10.3	423.0
2.	Siltstone, medium-gray, sandy, glauconitic.....	2.8	434.0
1.	Sandstone, light- and medium-gray, very fine grained, silty, glauconitic.....	12.2	437.0
Bottom of hole.....			450.0

<sup>1</sup> The exact dips of these beds is unknown because the beds are obscured by surficial cover. The estimated thicknesses are based on an assumed 20° dip. Corrections for errors in thickness, due to core loss during drilling, were made by use of an electric log.

### DUTTON CREEK FORMATION

The Dutton Creek Formation is underlain by the Foote Creek Formation and is overlain by the Wind River Formation. The type area of the formation is designated as near where Dutton Creek crosses the Albany-Carbon County boundary in secs. 32 and 33, T. 19 N., R. 77 W. The surface section of the Dutton Creek could not be measured at the type locality because of surficial cover, but its thickness is estimated to range from 200 to 500 feet in the mapped area. The Dutton Creek Formation consists essentially of beds of coarse-grained locally conglomeratic sandstone, interbedded mudstone, carbonaceous shale, fine-grained sandstone, conglomerate, and coal. A partial section from core was obtained from a hole drilled in the type area:

FOOTE CREEK, DUTTON CREEK FORMATIONS, WYOMING K9

*Partial section of Dutton Creek Formation described from core obtained from hole drilled, SE¼ sec. 32, T. 19 N., R. 77 W., Albany County, Wyo.*

[Described by H. J. Hyden]

Dutton Creek Formation:		Estimated thickness <sup>1</sup> (feet)	Depth (feet)
54.	Shale, dark-gray and dark brownish-gray, silty, micaceous-----	8.5	32.0
53.	Siltstone, medium-gray, clayey, micaceous, slightly sandy-----	3.9	41.0
52.	Sandstone, light-gray, fine-grained; abundant mica and carbonaceous flakes-----	4.5	45.2
51.	Sandstone, light- and medium-gray, coarse-grained to conglomeratic; contains quartzite granules and pebbles as much as 0.5 in. in diameter, and fragments of coal as much as 1 in. in long dimension-----	7.5	50.0
50.	Shale, dark-gray-----	1.9	58.0
49.	Sandstone, medium- and light-gray, fine-grained, silty, micaceous; carbonaceous flakes-----	3.2	60.0
48.	Shale, dark-gray-----	1.0	63.4
47.	Sandstone, light- and medium-gray; fine grained in upper 2 ft, medium and coarse grained in remainder; abundant quartzite pebbles as much as 0.5 in. in diameter in basal 5 ft; scattered coal flakes-----	8.9	64.5
46.	Shale, dark-gray, micaceous, silty-----	.9	74.0
45.	Conglomerate; quartzite pebbles as much as 0.5 in. in diameter; rare shale pebbles; fine- and medium-grained sandstone matrix; interbedded fine- and medium-grained sandstone-----	8.5	75.0
44.	Mudstone, dark-gray; mainly clay with scattered silt and sand grains-----	1.4	84.0
43.	Sandstone, medium-gray, fine- and medium-grained; interlaminated dark-gray shale; conglomeratic in basal 3 ft with abundant quartzite granules and pebbles as much as 0.3 in. in diameter-----	6.1	85.5
42.	Mudstone, dark-gray, very sandy; grades into clayey sandstone in part-----	12.2	92.0
41.	Sandstone, medium-gray, medium-grained, friable, non-calcareous; abundant carbonaceous flakes-----	18.8	105.0
40.	Sandstone, medium-gray, coarse-grained to conglomeratic; pebbles as much as 0.5 in. in diameter; scattered carbonaceous flakes-----	18.8	125.0
39.	Sandstone, medium-gray, medium- and fine-grained, friable, noncalcareous; scattered carbonaceous flakes; contains 2 ft of shaly carbonaceous pyritic siltstone....	30.1	145.0
38.	Sandstone, medium-gray, coarse-grained to conglomeratic; abundant granules and small pebbles as much as 0.4 in. in diameter; micaceous-----	12.2	177.0
37.	Conglomerate; granules and small pebbles in sandstone matrix-----	1.9	190.0
36.	Sandstone, light-gray, medium-grained; contains four coal laminae and interbedded dark-gray silty shale--	2.3	192.0

*Partial section of Dutton Creek Formation described from core obtained from hole drilled, SE $\frac{1}{4}$  sec. 32, T. 19 N., R. 77 W., Albany County, Wyo.—Continued*

	<i>Estimated thickness<sup>1</sup> (feet)</i>	<i>Depth (feet)</i>
<b>Dutton Creek Formation—Continued</b>		
35. Conglomerate; quartzite pebbles as much as 0.3 in. in diameter, shale pebbles as much as 1 in. in diameter..	1.4	194.5
34. Sandstone, light-gray, medium- and coarse-grained, granularitic; contains scattered pebbles and zones of pebble conglomerate with pebbles as much as 0.5 in. in diameter; interbedded light-gray fine-grained sandstone and sandy siltstones.....	49.8	196.0
Estimated thickness of partial section of Dutton Creek Formation.....		203.8

<sup>1</sup>The exact dips of these beds is unknown because the beds are obscured by surficial cover. The estimated thickness is based on an estimated dip of 20°. Corrections for errors in thickness, due to core loss during drilling, were made by use of an electric log.

Lenses of conglomerate are common at the base of the Dutton Creek Formation where they fill large channels; elsewhere coarse sandstone containing scattered pebbles commonly forms the basal bed. The basal or near-basal conglomerate contains pebbles of sandstone, shale, chert, and ironstone. Locally a few chips derived from the Cretaceous Mowry Shale have been noted. The conglomerate and conglomeratic sandstone beds are present in the western part of the mapped area, on the north and east flanks of the Medicine Bow Mountains. The Dutton Creek beds in the eastern part of the mapped area are markedly finer grained—they contain only scattered pebbles and these are less than one-half inch in diameter. The increase of grain size toward the Medicine Bow Mountains indicates that this range was the source of the sediments in the Dutton Creek.

Characteristically, the sandstone beds of the Dutton Creek Formation are very irregularly cross stratified and lenticular. The sandstone is poorly sorted and generally friable, but local zones have relatively good cementation. Green hornblende is the most common mineral in heavy mineral concentrates of sandstone in the Dutton Creek Formation. Precambrian amphibolites in the Medicine Bow Range are the probable source of most of this hornblende. Locally the sandstone grades into mudstone. The mudstone is greenish gray or olive on the outcrop; at depth it is medium to dark gray.

The carbonaceous shale weathers dark brown and contains coaly laminae. Small lenses of coal with a maximum thickness of about 1 foot are interbedded with the carbonaceous shale; many coal lenses consist mainly of coalified pieces of tree trunks or limbs. Medium-

gray bentonitic shale that contains many selenite crystals crops out at one locality.

Silicified wood fragments and molds and casts of leaves are present, but none of the specimens collected proved to be diagnostic for age determination. Diagnostic pollen forms, however, were obtained from the carbonaceous material. The following fossil pollen genera from core samples of the Dutton Creek Formation were identified (USGS Paleobot. loc. D3199) :

*Caryapollenites* sp.

*Engelhardtioipollenites* sp.

*Pterocaryapollenites* sp.

*Tricolpites* 2 sp.

*Tiliaepollenites* (a species different from that found in the Foote Creek Formation)

These genera have been found in the Fort Union Formation at several localities in the Rocky Mountains and are indicative of a late Paleocene age.

The contact of the Dutton Creek Formation with the underlying Foote Creek is an irregularly channeled surface. The Foote Creek Formation has been removed by erosion at some localities and Dutton Creek beds rest directly on Lewis Shale. A topographic feature known as the Chimney Rocks in sec. 17, T. 20 N., R. 79 W., on the west side of the mapped area (fig. 1) displays a typical channel that cuts through coal beds of the Foote Creek and into sandstone of the Lewis Shale. Tectonic uplift of the Medicine Bow Mountains must have followed deposition of the Foote Creek beds. Streams originating in the newly risen mountains eroded the Foote Creek beds and deposited the Dutton Creek beds on this channeled surface.

The boundary between the Dutton Creek Formation and the overlying Wind River Formation is concealed everywhere in the map area. The two units are lithologically similar and both are poorly exposed. Where exposed, the Wind River Formation seems to be flat lying and unconformable with the Dutton Creek Formation, but the poor exposures make the structural relations of these two units somewhat speculative. The Foote Creek and Dutton Creek beds have been folded in the mapped area at the Medicine Bow dome and at the Dutton Creek anticline. The Wind River Formation probably overlapped these structures, but erosion has removed the evidence. McGrew (1953) assigned the Wind River Formation in the mapped area to the Eocene on the basis of a mammalian fauna.

## REFERENCES CITED

- Bowen, C. F., 1918, Stratigraphy of the Hanna basin, Wyoming: U.S. Geol. Survey Prof. Paper 108, p. 227-235.
- Love, J. D., Weitz, J. L., and Hose, R. K., 1955, Geologic map of Wyoming: U.S. Geol. Survey.
- McGrew, P.O., 1953, Tertiary deposits of southeastern Wyoming, *in* Wyo. Geol. Assoc. Guidebook, 8th Ann. Field Conf., Laramie Basin and North Park: p. 61-64.

The U.S. Geological Survey Library has catalogued this publication as follows:

**Hyden, Harold Julius, 1922-**

The Foote Creek and Dutton Creek Formations; two new formations in the north part of the Laramie basin, Wyoming, by Harold J. Hyden, Harry McAndrews, and Robert H. Tschudy. [Washington, U.S. Govt. Print. Off., 1965].

iii, 15 p. map. 24 cm. (U.S. Geological Survey. Bulletin 1194-K)  
Contributions to stratigraphy.  
Bibliography: p. 12.

(Continued on next card)

**Hyden, Harold Julius, 1922-** The Foote Creek and Dutton Creek Formations. [1965] (Card 2)

1. Geology—Wyoming. 2. Geology, Stratigraphic. 3. Borings—Wyoming. I. McAndrews, Harry, 1926- joint author. II. Tschudy, Robert Haydn, 1908- joint author. III. Title. IV. Title: Laramie basin, Wyoming. (Series)

