THE NOBACH FORMATION
OF
WESTERN WYOMING

by

Violet B. Siegler

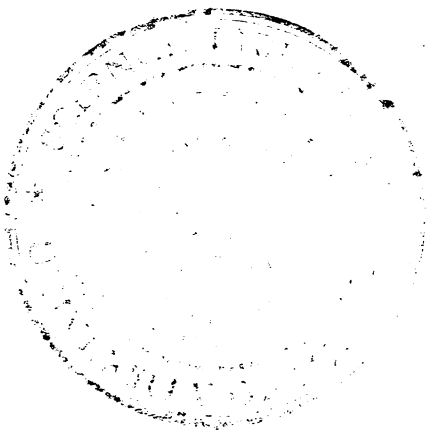

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Table of Contents

Geographic Distribution of the Hoback Formation 1

Earlier Investigations 1

Acknowledgments 2

Physiography 3

Regional Structure 3

Determination of Thickness 4

Lithology 6

Paleontological Analysis 8

Economic Deposits 11

Summary 11

Bibliography 12

List of Illustrations

1. County Map of Wyoming
2. Topographic Map of Hoback Canyon and Vicinity
3. Columnar Section along Granite Creek
4. Columnar Section along Shoal Creek
5. Plate I Pelecypods of Hoback Formation
6. Plate II Pelecypods of Hoback Formation
7. Plate III Gastropods of Hoback Formation
8. Plate IV Plant Remains of the Hoback Formation
9. Plate V Plant Remains of the Hoback Formation
10. Graphic Representation of Pebble Counts

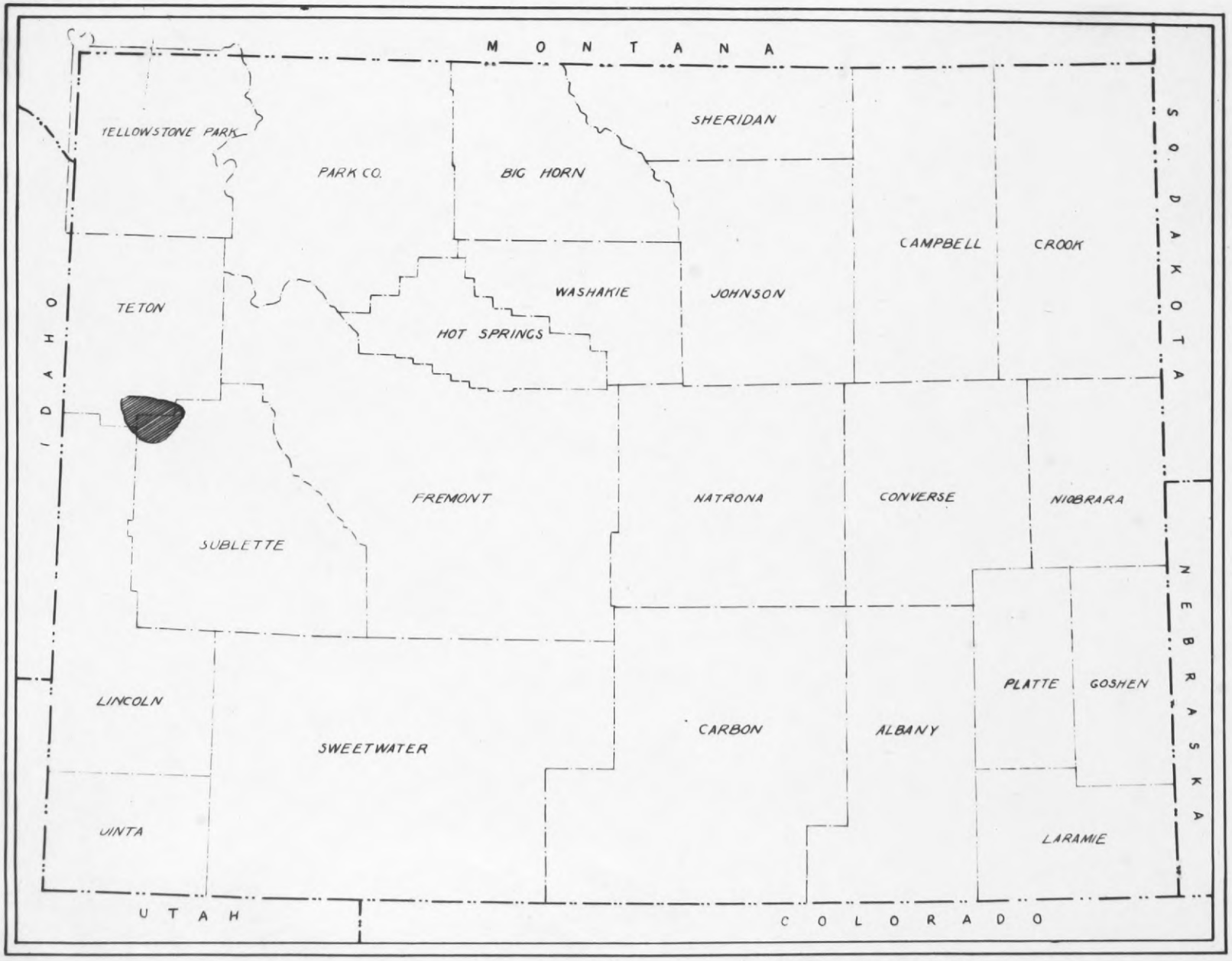

Figure 1

COUNTY MAP OF WYOMING
WYOMING, AMERICAN GUIDE SERIES

THE HOBACK FORMATION OF WESTERN WYOMING

Geographic Distribution of the Hoback Formation

The western boundary of the Hoback Formation occurs seven miles east of Camp Davis in Hoback Canyon which extends south from Teton to Sublette County, Wyoming. It covers an area twenty miles long, trending northwest to southeast, and ten miles wide with an approximate expanse of one hundred square miles.

The formation which is distributed over the entire western part of the Hoback Basin is bordered to the north and east by the Gros Ventre Range and to the west by the Hoback Range. In the southeastern part of the basin, which is covered by the Pass Peak Formation, a low divide is formed by the gradual diminishing in elevation of these ranges (See Figure 2).

The Hoback River traverses the area from east to west dividing it into approximately equal parts.

This portion of Wyoming has an elevation ranging from 6200 feet above sea level on the floor of Hoback Basin to approximately 12,000 feet in some of the higher peaks of the Gros Ventre Range. It is primarily a basin with low ridges and shallow valleys marked by high marginal boundaries. The valleys were glaciated in Pleistocene time and are filled with glacial outwash and moraine; the ridges are composed of early Tertiary sediments which are frequently partially masked by pre-Pinedale glacial deposits.

Earlier Investigations

Some of the first work of a geologic nature done in this area was carried

on by Clarence King (1878), Arthur Clifford Veatch (1907), and Alfred Reginald Schultze (1914). In their reports sediments now referred to the Hoback were mapped as Evanston Formation.

The earliest undertaking was mainly surveying and mapping, both geologic and topographic. Veatch was the first to define the Evanston Formation while studying coal bearing beds just north of Evanston, Wyoming. He also concerned himself with the lithology and paleontology of the formation. Schultze's paper contains material on the overall general character of the sediments. However, he was unable to determine the age of the formation and writes of it as "Cretaceous or Tertiary." Of late, some work has been done by members of the Camp Davis faculty and a number of graduate students.[1] The name Hoback has been used by the members of the University of Michigan parties working in this area in lieu of Evanston since 1943 as evidence is too meagre to correlate it with the latter.

This paper is the result of work undertaken at Camp Davis, University of Michigan, Rocky Mountain Field Station during July and August of 1945. The purpose of this investigation was threefold; (1) to determine the age of the sediments by means of paleontological evidence, (2) to measure the thickness of the formation, and (3) to find the source of the clastic material.

Acknowledgments

The author would like to express her appreciation to Doctors Lewis B. Kellum and Kenneth K. Landes and Mr. Marion V. Denny for the assistance they have given her, and especially to Doctor Ralph L. Belknap under whose helpful direction the field work was carried on, and this thesis prepared.

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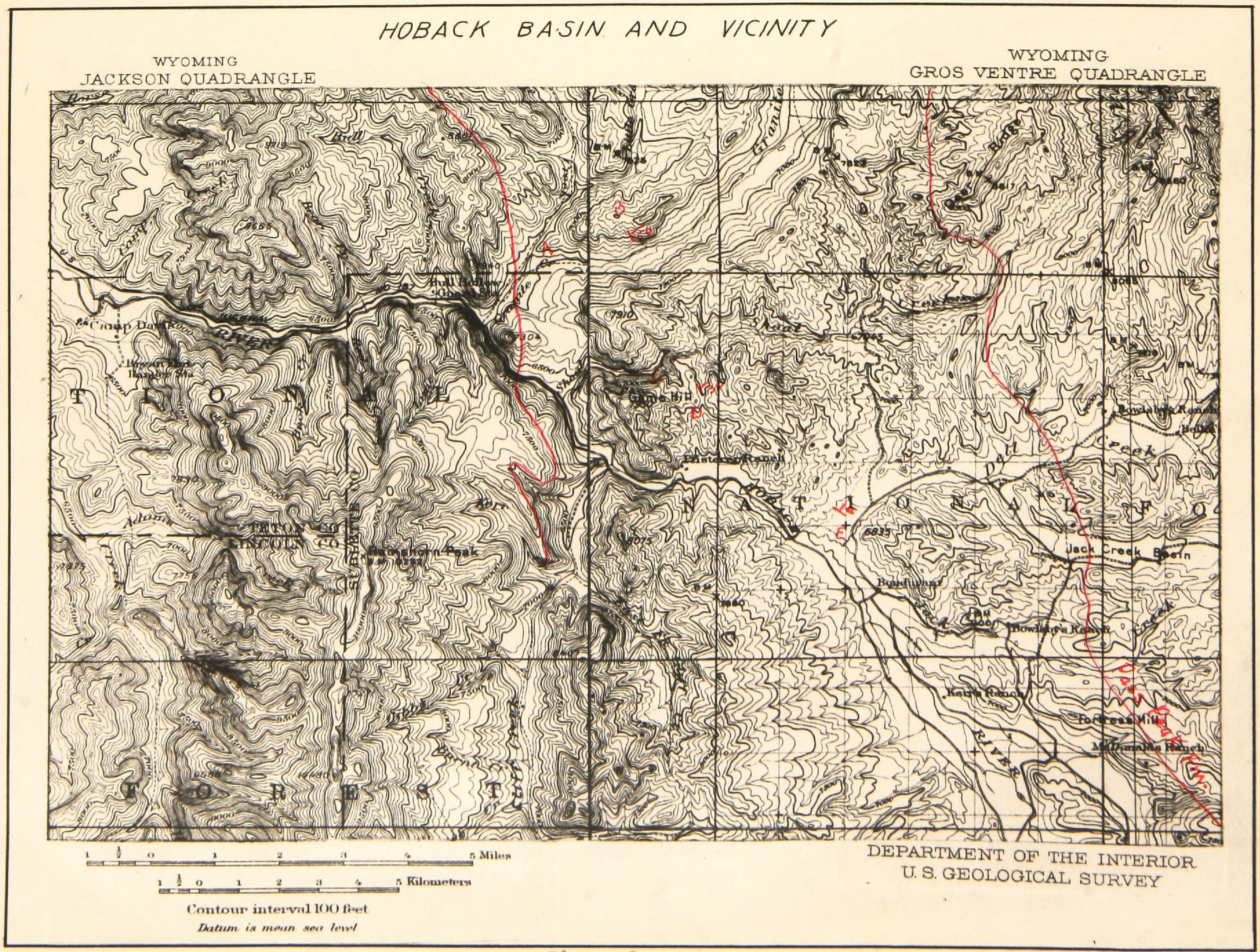

HOBACK BASIN AND VICINITY
WYOMING
JACKSON QUADRANGLE
WYOMING
GROS VENTRE QUADRANGLE
Camp Davis
RIVER
T O N
N A T I O N A L F O
F O R E S T
Game Hill
Jack Creek Basin
Fortress Mill
McDonald's Ranch
Kerr's Ranch
RIVER
Bowlsby's Ranch
Pass Peak Fm.
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
5 Miles
5 Kilometers
Contour interval 100 feet
Datum is mean sea level

Figure 2

Physiography

As previously noted, the Hoback Basin forms a completely enclosed depression bounded on three sides by high mountains; only to the southeast is there a low divide which separates it and the adjoining Green River Basin.

A reconstruction of the physiographic history of the basin indicates that its size and shape at the beginning of the Tertiary was quite similar to its present day form. In the early Cenozoic, the sediments were derived largely from the mountains to the east and transported by streams into the shallow lake waters which filled the central depression.

The geomorphological appearance of the basin at present is characterized by a succession of ridges and intervening valleys. These valleys have been cut by tributaries of the Hoback. For the most part the river is in the youthful stage of the erosion cycle, although in one place along its course it has taken on the appearance of early maturity. In Hoback Canyon resistant beds are holding up erosion temporarily and thus to the east the stream has assumed the characteristics of maturity.

The master stream has cut three distinct terrace levels by lateral planation; the two upper flats are veneered with glacial outwash.

Regional Structure

The principal structural features of the region are associated with the Gros Ventre and Hoback Mountains which are the result of late Cretaceous orogenic movements (See Figure 2). These ranges are the product of folding and thrust faulting. The main structural trends extend north and south along the western side of the basin. The Cache Thrust marks the western boundary of the Gros Ventre Range, with Pre-Cambrian, Paleozoic and Mesozoic rocks

being overthrust on the Tertiary Hoback and Pass Peak Formations. On the west side of the basin the Game Thrust forms the margin, with Mesozoic rocks thrusted on the Tertiary deposits. Small cross faults are found within the basin itself.

Throughout the basin the dip is to the east which may indicate an elevatory movement on the western boundary later than that of the other surrounding mountains. Thus, the sediments dip into the basin at varying degrees of declivity (50°E to 11°E) from northwest to southeast.

As a result of the thrust faulting, the contact between the Hoback and its underlying and overlying beds is more commonly that of a fault plane rather than the usual unconformable surface.

Determination of Thickness

The strata were heretofore believed to be fifteen thousand feet thick. According to measurements taken during the summer of 1945, the true vertical extent seems to be more nearly thirteen thousand feet. The cumulative thickness from the Hoback Range east to Dell Creek is a result of composit sections as the thickest single section is slightly over 3,600 feet (ridge east of Granite Creek).

The procedure used in calculating the thickness of the formation is as follows: At Granite Creek (point A on the topographic map) a 3,600 foot section dipping east at 50°, was measured (terminating at point B). Similarly at Shoal Creek (point D on the map) a 1,000 foot section, with a 30° dip east, was measured up the slope (to point C on the map). Finally a dip of 11° was recorded at the mouth of Dell Creek (point E on the map).

An average variation in dip of four degrees per approximately one mile has been assumed. Thus at points B and C dips of 46° and 34° have been used in determining the average dips between points A and B, B and C, and C and D. In this way an average dip of 48° was used in the determination of the first partial thickness, 38° in the second and 32° in the third. In evolving the fourth thickness an average dip of 20.5° was used.

Since the distances from points B and C and D and E were not measured in the field, they were scaled off the map. The former being 12,300 feet and the latter 16,600 feet.

Thus four partial thicknesses were arrived at:

$$t_1 = 3600' \cdot \sin\left(\frac{50^\circ - 46^\circ}{2}\right) = 3600 \cdot \sin 48^\circ = 2{,}670'$$

$$t_2 = 12300' \cdot \tan\left(\frac{46^\circ - 30^\circ}{2}\right) = 12300 \cdot \tan 38^\circ = 9{,}600'$$

$$t_3 = 1000' \cdot \sin\left(\frac{34^\circ - 30^\circ}{2}\right) = 1000 \cdot \sin 32^\circ = 520'$$

$$t_4 = 16600' \cdot \tan\left(\frac{30^\circ - 11^\circ}{2}\right) = 2\ 16600 \cdot \tan 20.5^\circ = 620'$$

$$13{,}410'$$

According to these computations the thickness is found to be 13,410 feet. Since the slopes change rapidly the values of the dips used are slightly in excess of the true thickness. A final value of 13,000 feet is thus more acceptable.

Lithology

The Hoback Formation is of fresh water origin. It is composed largely of gray, medium grained sandstone with interbedded shale layers. Beds of impure limestone are located near the top of the section measured in the vicinity of Dell Creek. A few conglomeratic lenses are also to be found in the sediments. Pebble counts taken on these conglomerates aid in ascertaining their source. (See Figure 10). Interbedded diverse types of sedimentary rocks denote variations in conditions of deposition from time to time; the limestone and shale point to lacustrine deposition, the conglomerate to a fluvial environment. During periods of increased orogenic activity the streams carried coarser debris and distributed it more widely in the basin.

The sandstone units of the formation are relatively homogeneous. (See Figures 3 and 4). One stratigraphic section near the base of the formation was measured a few thousand feet east of Battle Mountain on Granite Creek. Another section, representing a somewhat higher interval in the lower half of the formation, was measured about four thousand feet to the east. In general, the Hoback Formation is characterized by gray color on the fresh surface--weathering tan. The bedding is massive. A few ripple marked surfaces were noted. Quartz is the dominant constituent of the sandstone but magnetite grains are usually present; the quartz particles are rounded and frequently colored by limonite stain.

In a section approximately thirty-five feet thick at the confluence of Dell Creek and the Hoback River, where the Eocene gastropods (See Figure 7) were collected, the outcrop of the Hoback Formation consists of limestone

and other sedimentary strata including some carbonaceous layers.[2] The limestones are impure argillaceous beds one and a half to two and a half feet in thickness. The outcrop is medium grey on the fresh surface and weathers brown. It contains numerous veins of crystalline calcite.

The conglomeratic lenses are exceedingly thick and of limited extent. They cannot be traced for more than four hundred feet from the point of outcrop. Their peculiar character leads one to speculate on their origin. They were probably formed by streams around the margins of the Hoback Basin during periods of increased orogenic activity.

Pebble counts were made in three localities: the first two along U.S. Highway 187 just west of V Bar V Ranch (the first at the level of the highway and the second three hundred feet above the highway), and the third four miles above the junction of Cliff Creek and the Hoback River.

In both cases the counts were made from pebbles found in the conglomeratic lenses. An area roughly three feet long and two feet wide was blocked off and the pebbles removed from within this enclosure. The size of the pebbles varied from one-fourth of an inch to two inches in diameter. In each case the pebbles were embedded in a medium grained tan sandstone. The percentage of the matrix varied, however, between the two localities; it constituted slightly more of the lens along Cliff Creek (See Figure 10).

The quartzites were mainly of boulder size and more nearly rounded than any of the other types of rocks present. The limestone pebbles showed pitted surfaces and solution marks due to weathering. Some of the other pebbles were irregular in shape, although for the most part they were rounded.

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2. Personal communication with Miss Helen Foster.

Almost all of the older formations in the area appear to be represented in the conglomerate with the predominance of early Paleozoic strata (See Figure 10). The Flathead quartzite of Cambrian age accounted for twenty-two to twenty-eight percent of the pebbles present. Along with other Paleozoic strata between fifty and sixty-five percent of the conglomerate can be identified as derived from an ancient crystalline land mass. This source can be associated with the Gros Ventre Mountain Range (to the north and northeast). These mountains are composed in part of crystalline rocks in contrast to the Hoback Range which is predominantly Mesozoic and contains a sedimentary sequence.

The deposition of the conglomerate was the result of increased erosional activity due to the uplift of the Gros Ventre Range. The pebbles were carried into the basin by streams which had probably been rejuvenated by this uplift.

The Hoback Formation rests in part unconformably on late Mesozoic sediments, and is overlain in the same manner by the Pass Peak conglomerate (Middle Eocene). The Mesozoic strata consist of light colored shales, sandstones and limestones. The overlying Pass Peak Formation comprises red and grey coarse conglomerates that grade into sandstone. The pebbles of the Pass Peak conglomerate are similar to those of the Eocene Pinyon conglomerate of the Gros Ventre region, and may represent a reworking of these earlier deposits.

Paleontological Analysis

In the investigation carried on during the summer of 1945 fossils were collected at two localities in the Hoback Basin; (1) a few thousand feet east

of Battle Mountain between Granite Creek and Shoal Creek, and (2) at the junction of Dell Creek and the Hoback River. At the first site the fossils were found embedded in a matrix of extremely coarse grained (virtually) conglomeratic sandstone. They were poorly preserved and therefore difficult to identify. The assemblage consists of a few pelecypods, a gastropod and some plant remains. The pelecypods have all been referred to the genus Unio. Although they seem to be more closely related to forms described from the Cretaceous their poor state of preservation, the small number of specimens collected and the fact that no two specimens can be referred to the same species makes any inference based on them in regard to the age of this part of the Hoback Formation extremely uncertain. The single gastropod referred to the genus Gyrodes, although a poorly preserved internal mold, is somewhat more significant than the Unios as the genus is confined to the Cretaceous in western North America. If the specimen is correctly identified, it implies that the lower part of the Hoback Formation is Cretaceous. A determination of the age of these strata, however, must await the collection of better preserved material and greater variety of species.

Faunal List

Granite Creek - Just South of Battle Mountain

Pelecypoda

Unio species cfr. Unio cryptorhynchus White (Plate II - Fig. 6)

Unio species cfr. Unio danai Meek and Hayden (Plate I - Fig. 5)

Unio species cfr. Unio endlichi White (Plate II - Fig. 6)

Unio species cfr. Unio subspatulatus Meek and Hayden (Plate I - Fig. 5)

Unio species

Gastropoda

Gyrodes species cfr. depressa Meek (Plate III - Fig. 7)

Plant Remains

The plant remains are fragments of dicotyledonous leaves (See Figures 8 and 9) which are too poorly preserved to be accurately identified.

The second location at Dell Creek is near the top of the Hoback Formation. The fossils were better preserved than those from the older horizon.[3] The entire assemblage consisted of fresh water gastropods. Accurate identification of the species was made in all but one case. The age of these fossils was established as Eocene.

Faunal List

Dell Creek - At Junction of Hoback River

Gastropoda

Oreohelix grangeri Cockerell and Henderson (Plate III - Fig. 7)

Physa bridgerensis Meek (Plate III - Fig. 7)

Planorbis planoconvexus Meek and Hayden (Plate III - Fig. 7)

Viviparus ledyi formosus Meek (Plate III - Fig. 7)

Since one of the intents of this paper is to determine the age of the Hoback Formation, a discussion of the stratigraphic significance of the fossils is pertinent. Let us note the relative position in the stratigraphic column of these fossil bearing strata. The conglomeratic sandstone yielding the Unios and Gyrodes is roughly 12,500 feet lower in the section than the gastropod-bearing limestone. Thus the fossiliferous beds virtually mark the upper and lower extent of the formation.

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3. Other collections of fossils similar to those made by the author have been gathered by Dr. A. J. Eardley and Miss Helen Foster. These collections are described in an unpublished manuscript.

The fossils in the Granite Creek area may be the result of secondary deposition; that is, they may have escaped destruction during the post-Cretaceous erosional cycle and been redeposited in Eocene sediments. Then too, there may be an unrecognized unconformity within the Hoback Formation that marks the boundary between the Tertiary and Cretaceous strata. Possibly the lowermost portion of the formation is Cretaceous and the upper portion Tertiary. Since the Unios and Gyrodes were found in fragments in a conglomeratic sandstone near the base of the formation they have little bearing on the age of the overlying strata comprising most of the formation. The age of the higher beds must be based on the Gastropods from the mouth of Dell Creek. This fauna has been determined to be of Eocene age.

Economic Deposits

The only portion of the formation which is of economic value is a thin coal seam found near the base two miles up Little Granite Creek. It varies in thickness from a few inches to approximately three feet. The coal is characterized by many shale partings and is of sub-bituminous type. It is used locally.

Summary

Field and later laboratory work described in this report records certain observations on the Hoback Formation. Stratigraphically the formation consists of thirteen thousand feet of fresh water sediments--consisting mainly of interbedded sandstone and shale with some limestone and coal found at the upper and lower extremeties. Careful study of the fossiliferous strata indicate early Eocene as the probable time of deposition. These beds were laid down in an enclosed basin. The probable source of the sediments has been determined through pebble counts, to be the crystalline rocks of the Gros Ventre Mountains.

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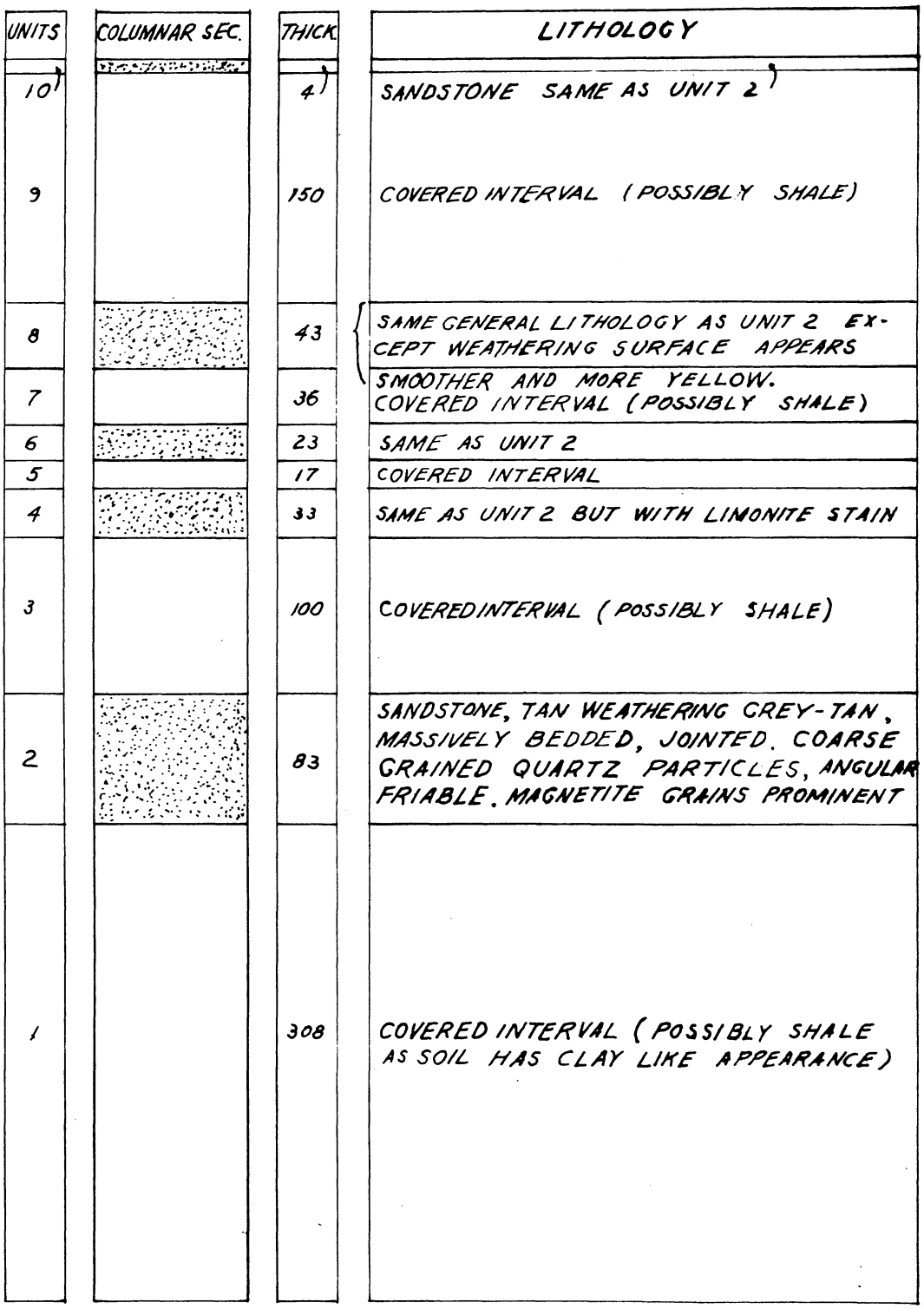
HOBACK FORMATION (TERTIARY) OF WESTERN WYOMING GRANITE CREEK SECTION



SCALE 1"=100'

VIOLET B. SIEGLER

Figure 3

HOBACK FORMATION (TERTIARY) OF A PORTION OF WESTERN WYOMING

SHOAL CREEK SECTION

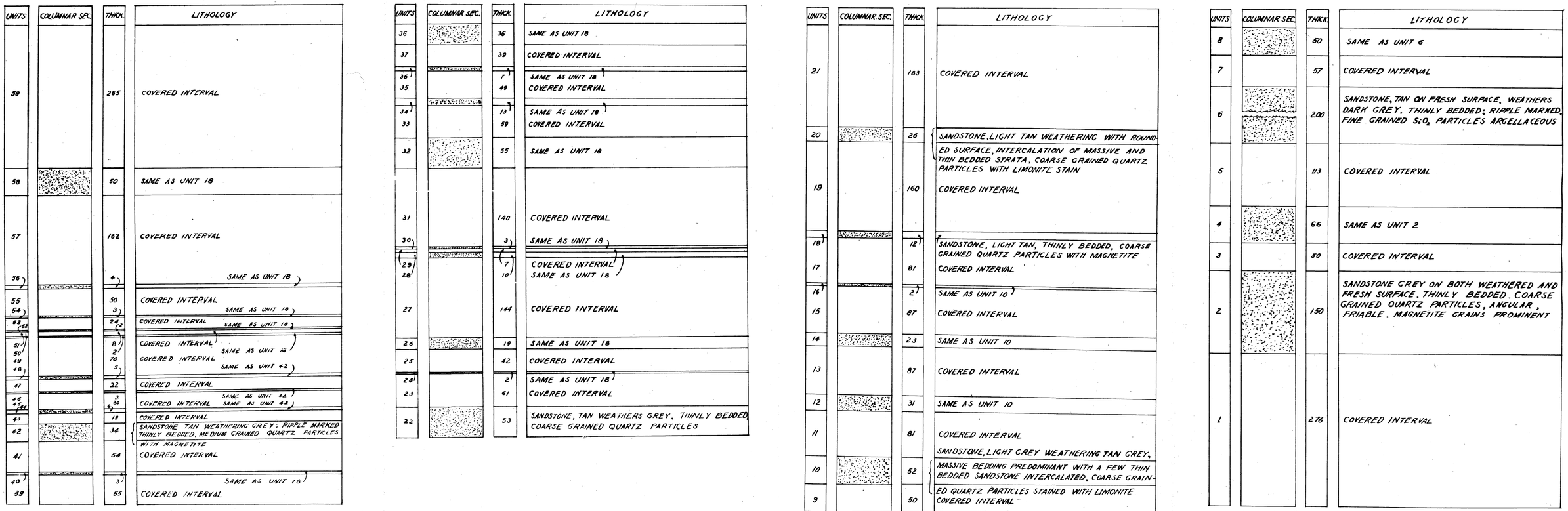


Figure 4

PLATE I

1

Unio species cfr. Unio subspatulatus
Meek and Hayden

2

Unio species cfr. Unio danai
Meek and Hayden

Figure 5

PLATE II

1

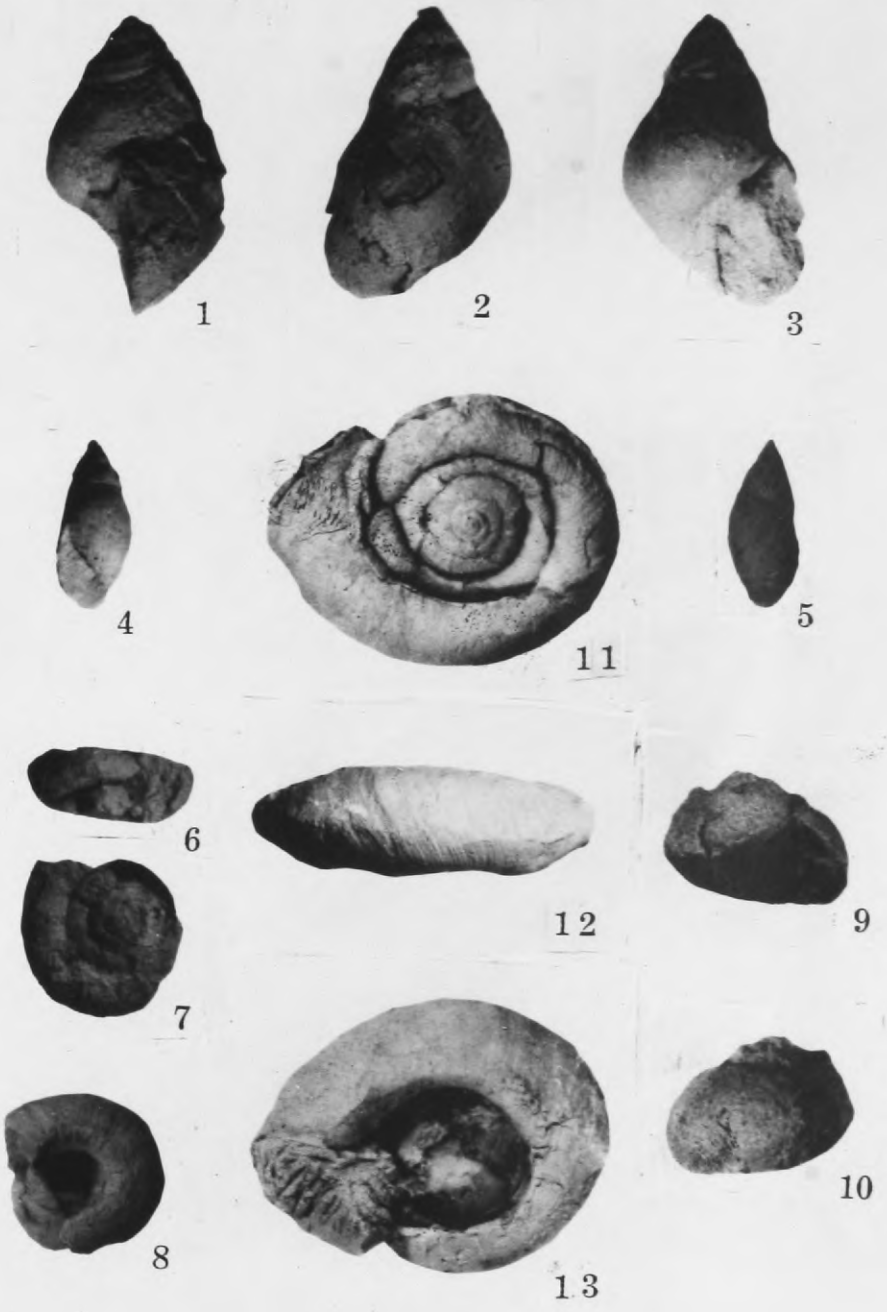
Unio species cfr. Unio cryptorhynchus
White

2

Unio species cfr. Unio endlichi
White

Figure 6

PLATE III



1,2,3 - Viviparus ledyi formosus Meek
4,5 - Physa bridgerensis Meek
6,7,8 - Planorbis planoconvexus Meek and Hayden
9,10 - Gyrodes species cfr. depressa Meek
11,12,13 - Oreohelix grangeri Cockerell and Henderson

Figure 7

PLATE IV

1

2

Dicotyledonous Leaves

Figure 8

PLATE V

1

2

Dicotyledonous Leaves

Figure 9

GRAPHIC REPRESENTATION OF PEBBLE COUNTS

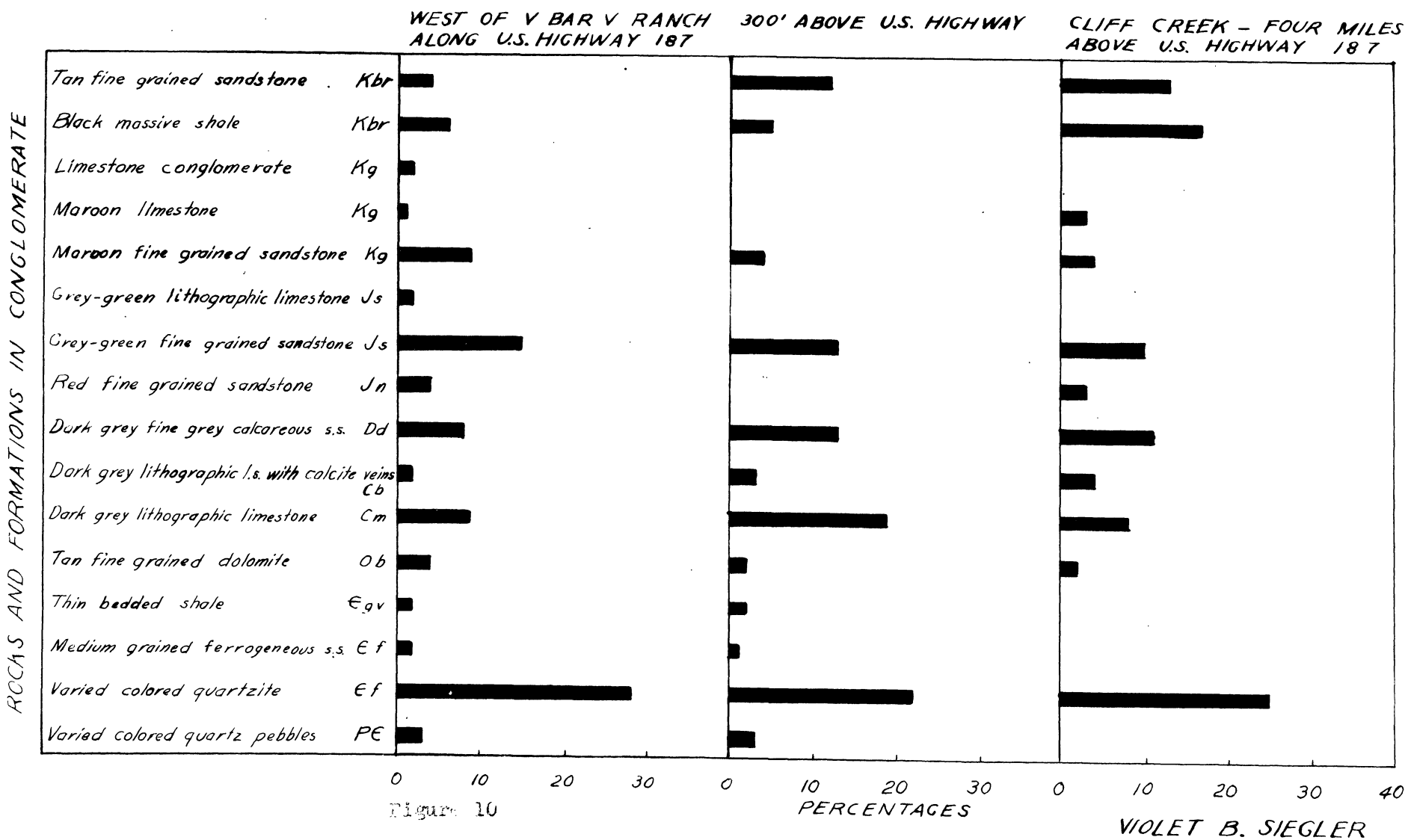


Figure 10

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