THE GEOLOGICAL SURVEY OF WYOMING

HORACE D. THOMAS, State Geologist

PRELIMINARY REPORT NO. 6

Gravity Thrusting in the Bradley Peak Seminoe Dam Quadrangles, Carbon County, Wyoming, and the Relationship to the Seminoe Iron Deposits

by

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CONTENTS

ILLUSTRATIONS

GRAVITY THRUSTING IN THE BRADLEY PEAK–SEMINOE DAM QUADRANGLES, CARBON COUNTY, WYOMING, AND THE RELATIONSHIP TO THE SEMINOE IRON DEPOSITS

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D. L. Blackstone, Jr.*

INTRODUCTION

The area discussed in this report includes the entire U. S. Geological Survey Bradley Peak topographic quadrangle and the southwest corner of the Seminoe Dam quadrangle. The geologic map covers parts of Tps. 25 and 26 N., Rs. 85 and 86 W. on the southwest flank of the Seminoe Mountains. These mountains are one of the separate ranges along the southern flank of the Sweetwater anticline or arch (Hares, 1916). Access to the area is easiest by way of the Seminoe Dam road that extends northward from U. S. Highway No. 30 at Sinclair, Wyoming (Fig. 1).

Published results of geologic investigations dealing with this quadrangle include papers by Erdlich (1879), Aughey (1886), Veatch (1907), Fath and Moulton (1924), Lovering (1929), Heisey (1951), Carpenter and Cooper (1951), Veronda (1951), and Blackstone (1962).

Unpublished results of geologic investigations included work by Carpenter, Cooper, Heisey, Lawson and Weimer.

The investigation of this area has been carried out at scattered intervals over a period of years beginning in 1957. Mapping has been done on vertical aerial photographs at a scale of 1:33, 000 and on a topographic base at a scale of 1:24, 000. The original investigation sought to define the relationship of the Ferris and Seminoe Mountains and to delimit the nature of the Seminoe thrust fault. The geologic mapping has revealed new information that has economic significance concerning the extent of the iron bearing Seminoe formation.

The writer wishes to acknowledge data obtained from former graduate students of the Department of Geology of the University of Wyoming--Leo C. Carpenter and Herschel T. Cooper. The writer also is grateful for discussions with J. D. Love. R. S. Houston, and George Veronda, concerning the structural interpretation of the area.

GEOLOGY

Stratigraphy

The exposed rocks within the area of the quadrangle represent all geologic eras, as shown by Table I.

The essential information concerning the stratigraphy is presented in the form of a table. The data have been collected from published and unpublished sources, supplemented by examination of well logs, and personal observation in the outcrop areas. No attempt is made to review or discuss the problems of regional correlation of the rock units. Exposures are good, and mappable units for the most part can be readily distinguished. The major stratigraphic problem involves proper subdivision of, and terminology for the late Cretaceous rock units.

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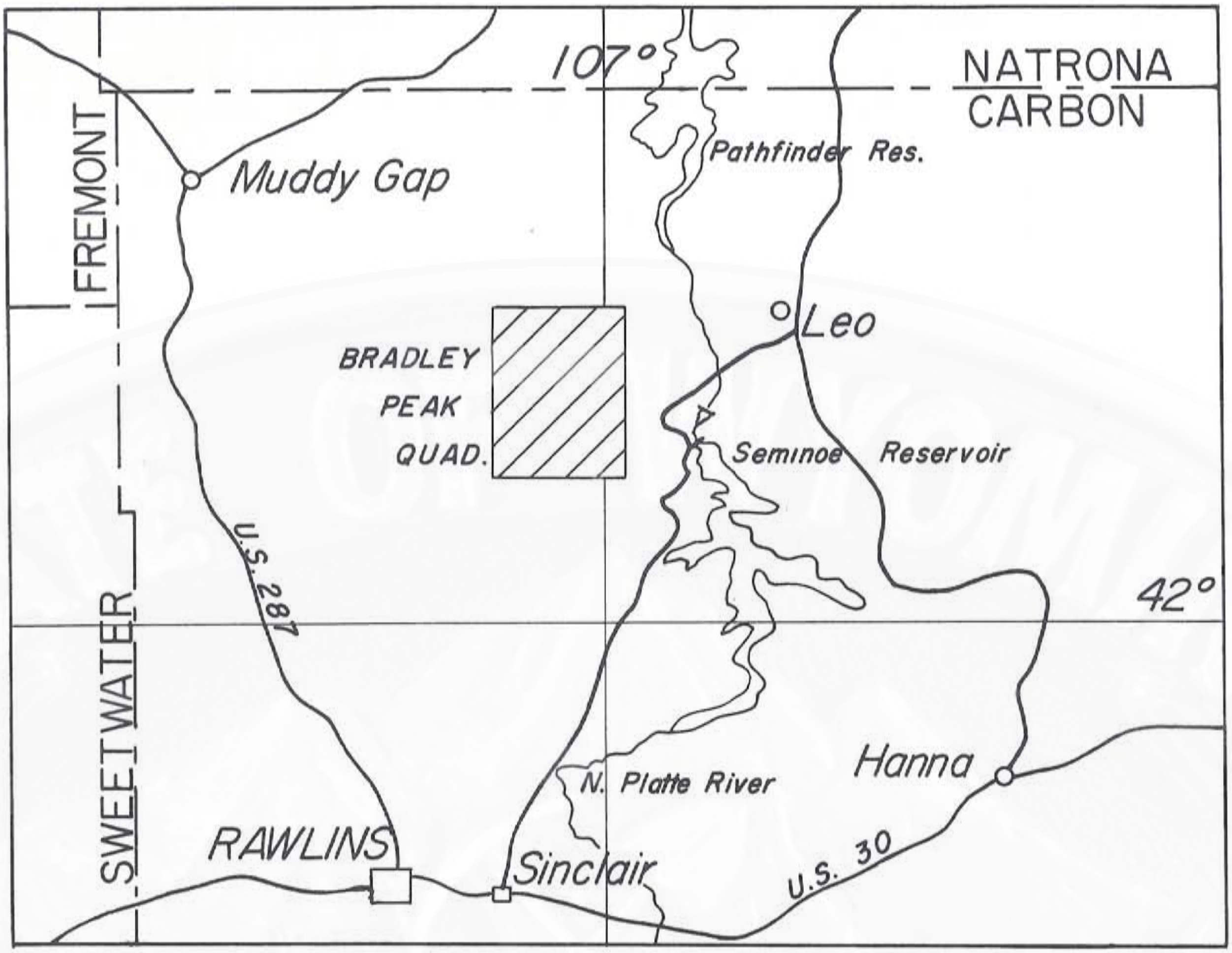

Fig. 1. Index map showing location of the Bradley Peak Quadrangle.

Structural Geology

The dominant structural element of central Wyoming is the broad northwest trending structural arch named by Hares (1916) the Sweetwater anticline or arch that extends southeastward from the vicinity of the southern Wind River Mountains to the Freezeout Hills north of Medicine Bow, Wyoming. The northeast corner of the uplifted area is near Alcova, Wyoming. Crystalline rocks of Precambrian age outcrop extensively in the central part of the uplift and are surrounded by low dipping late Tertiary sediments (Love, 1961). The bold granite knobs and domes located along the axial portion of this arch are collectively known as the Granite Mountains (Hares, 1916).

The southwest margin of the uplift is marked by folded and faulted sedimentary rocks which are designated from west to east Crooks Mountain, Green Mountain, Ferris Mountains, Seminoe Mountains, Shirley Mountains and Freezeout Hills. The Bradley Peak quadrangle delimits an area at the western end of the Seminoe Mountains (Pl. 1). The present erosion surface that is developed on the Precambrian rocks reaches an elevation of 9, 000 feet and the subsedimentary erosion surface must have reached much higher elevation. In comparison the surface of the Precambrian in the deeper part of the Hanna Basin to the south lies at a minus sea level elevation of approximately 28, 000 feet. This figure is based on unpublished seismic data combined with surface geology. Within the Bradley Peak and Seminoe Dam quadrangles the relationship between the uplift and the adjacent basin is reasonably well exposed.

The general structural relationships are shown on Figure 2. Details of the geologic structure are shown on the geologic map, Plate 1. The interpretation of the geologic structure is shown on two cross sections,

TABLE 1. GEOLOGIC FORMATIONS IN THE BRADLEY PEAK-SEMINOE DAM QUADRANGLES

Standard Time			Formation	Lithology and significant characteristics	Thickness
CENOZOIC	Quaternary	Pleistocene		Dune sand, playa lake deposits, landslides, and pediment gravels.	
	Tertiary	Miocene	Split Rock formation (?)	Sandstone, fine grained, light gray, and tuffaceous beds. Local basal conglomerate. Major unconformity	2000'+
MESOZOIC	Upper Cretaceous		Medicine Bow formation	Sandstones, drab claystones, coal. Partial section in Camp Creek syncline. Complete section in Hanna Basin. See description in U.S. Geological Survey Bull. 804, pp. 23-24.	4000'+
			Lewis shale	Shale, dark gray, marine. Weathers light gray to pale buff. Concretionary sandstone zones weather yellow. Basal sandstone in sec. 11, T. 25 N., R. 86 W. contains heavy shelled pelecypods in abundance.	3000'
			Mesaverde formation	Three fold division. Upper sandstones with coal; middle shaley unit with no coals; lower sandstone unit with local coals. Characterized by prominent hogback ridges, underlain by thick sandstones.	1700' - 1900'
			Steele shale	Shale, gray, marine, monotonous sequence. Thickness not accurately determined but interpretation of electric logs indicates a thickness of approximately 3200 feet. The upper part (400') of the Steele sh. contains beds of very glauconitic sandstone up to 40 feet thick. Glauconite is dull green, soft, and imparts a brown limonitic coloration to the weathered sandstone.	3200' - 3400'
			Niobrara-Carlile shale	Shale, dark gray, thinly laminated calcareous. Basal contact with sandstone sharp. Upper contact gradational and marked by thin yellowish brown sandy layers. Calcareous zones or "chalks" form minor ridges, and may weather to pale orange tint.	1370' - 1425'
			Frontier formation	Sandstones, gray, black chert grains, sparsely glauconitic interbedded with dark gray shales. 540'. Some bentonites. Shale, black, basal zone contains large manganiferous septarian concretions 415'.	955'

Standard Time		Formation	Lithology and significant characteristics	Thickness
MESOZOIC	Lower Cretaceous	Mowry shale	Shale, siliceous in part, weathers as silvery gray. Characterized by fish scales on many bedding planes. Some thin bentonites 1" - 6" thick.	270'
		Muddy sandstone	Sandstone, fine grained, flaggy. Weathers light buff.	1-20'
		Thermopolis shale	Shale, black, hard. Thin sandy lenses with worm castings. Sandstones and siltstones weather to a dull olive green color.	110'
		Cloverly formation	Sandstone, thinly bedded, limonitic yellow brown in color. Pink hematitic siltstone. Sandstone, light colored, cross-bedded, with local chert pebble conglomerates.	100' - 150'
	Jurassic	Morrison formation	Claystone, variegated (purple, pink, green). Sandstone white, cross laminated, locally developed.	180' - 200'
		Sundance--Nugget(?) formation	Sandstone, cross-bedded, glauconitic; dark green fossiliferous shales; gypsiferous shales, red and pink fine-grained sandstones.	230'
			Sandstone, white to buff, cross-bedded, medium grained.	100'
	Triassic	Chugwater formation	Siltstone, sandstone, shale, red, white and yellow in color. Prominent white sandstone 4' thick, 100' below top.	370'
			Alcova ls. member. Limestone, gray to lavender, thinly laminated, much internal brecciation, crops out as a prominent ledge or ridge.	20'
			Siltstone, fine grained sandstone, and shale red in color.	500'
PALEOZOIC	Permian	Goose Egg formation	Limestone, gray, finely crystalline alternating with soft red shales and gray to buff sandstones. Gypsum occurs locally in shales.	250' - 300'
		Tensleep sandstone	Sandstone, buff, tan, white, cross-bedded. Includes two thin beds of gray crystalline limestone in lower 90 feet.	540'
	Pennsylvanian	Amsden formation	Sandstones, shale, limestone resting on a karst topography of Madison ls. Upper part comprised of limestone and shale. Lower part bright red sandstones and shales.	112' - 200'
	Mississippian	Madison limestone	Limestone, gray, moderately well bedded, crystalline, fine grained.	270'
	Cambrian	Flathead sandstone	Sandstone, maroon to dark brown, coarse to medium grained. Glauconitic, green sandy shales in upper part. Basal unit conglomeratic. Uppermost unit usually a quartzite.	340'
Precambrian			Iron formation, gneiss, amphibolite, quartzite.	

Figures 3 and 4. The location of the cross sections is given on the geologic map, Plate 1.

Individual structural features are described below.

Camp Creek syncline. The Camp Creek syncline was defined by Fath and Moulton (1924, Pl. 1, and p. 44) and is a major fold extending eastward from Muddy Gap at least as far as the North Platte River--a distance of over 25 miles. The surface axis of this fold in the quadrangle extends from near the center of sec. 20, T. 25 N., R. 85 W. in a direction N 35° W to the west line of T. 25 N., where the syncline bifurcates. The northern branch of the syncline trends N 25° W and is a minor fold which loses identity as it approaches Bear Mountain. The southwestern branch is the Camp Creek syncline proper, and continues westward beyond the boundaries of the quadrangle.

The Camp Creek syncline is well exposed at the surface just west of, and parallel to Coal Creek in the southeastern part of the quadrangle. The dip of the strata in the west limb of the syncline ranges from 15° to 27° E. with the strike relatively constant at about N 50° W. The strata in the northeast limb of the syncline are overturned, strike N 50° W, and dip rather consistently 40° to 45° NE. The plunge of the synclinal axis is generally to the southeast at a low angle. The plunge varies along the trend of the fold so that northwest plunge may occur.

The youngest rocks exposed in the trough of the syncline are a part of the lower coal bearing units of the Medicine Bow formation of Upper Cretaceous age. The Medicine Bow formation has only a limited area of outcrop in the syncline due to a reversal of plunge of the axis near the east line of sec. 35, T. 25 N., R. 85 W. (Cooper, 1951). The underlying Lewis shale, Mesaverde formation, and Steele shale outcrop extensively throughout the area of synclinal folding.

The subsidiary syncline which branches to the north from the Camp Creek syncline is poorly defined in the southeast quarter of T. 26 N., R. 86 W. Sand dunes cover much of the bed rock. The limited exposures by which the syncline can be delimited are largely those of resistant rock units such as the Cloverly formation, Wall Creek sandstone member of the Frontier formation, and the Alcova limestone. These units strike N 50° W., are overturned and dip 45° to 50° NE in the ridges paralleling Junk Hill and Bear Mountain. The western limb of the syncline is expressed in the Steele shale, and dips are approximately 13° to 19° SE.

G. P. anticline. The fold known as G. P. Dome described by Fath and Moulton (1924, p. 46-47) lies southwest of, and parallel to, the Camp Creek syncline. The axis of the fold crosses T. 25 N., R. 86 W., from the southeast corner of section nine to the southeast corner of section 13, and in this sector trends N 75° W. Southeast of the latter point the trend of the fold becomes N 40° W and closely parallels the deeper portion of the Camp Creek syncline.

Strictly speaking the term "dome" should not be used to describe the anticlinal fold since there appears to be no reversal of dip to the northwest. The southeast plunge of the fold is clearly outlined by the prominent hogbacks in the sandstones of the Mesaverde formation. Dips on the south limb of the fold range from 8° to 15° southeast.

Several wells were drilled for oil and/or gas in this fold. Those which lie within the map area are shown on Plate 1. Such production as was obtained was derived from a sandstone approximately 1500 feet above the base of the Steele shale which has been called locally the "G. P. sandstone"

Big Sandy fold. Veronda (1951, pp. 119-121) described the geology of a plunging anticline in T. 26 N., R. 86 and 87 W. The fold was not given a name but was discussed under the title--Big Sandy area. It seems appropriate to refer to this anticline as the Big Sandy fold. The continuation of this fold crosses the Bradley Peak quadrangle in the vicinity of the old Boot Ranch (NE$\frac{1}{4}$ sec. 34, T. 26 N., R. 86 W.), and occupies a position between the Camp Creek syncline proper and its northern branch. The northern half of the fold is obscured by sand dunes but it can be outlined by scattered outcrops of sandy beds within the Steele shale. Dips ranging from 8° to 15° were obtained in these scattered outcrops.

Seminoe Thrust fault. Fath and Moulton (1924, Pl. 1) used the name Seminoe thrust fault on a map of the Lost Soldier-Ferris district. The fault however, had been recognized earlier and appears on a map by Veatch (1907) but without a specific name. Veatch's reference to the fault states:

> At Knapp the beds are overthrust by iron bearing metamorphic pre-Cambrian rocks,

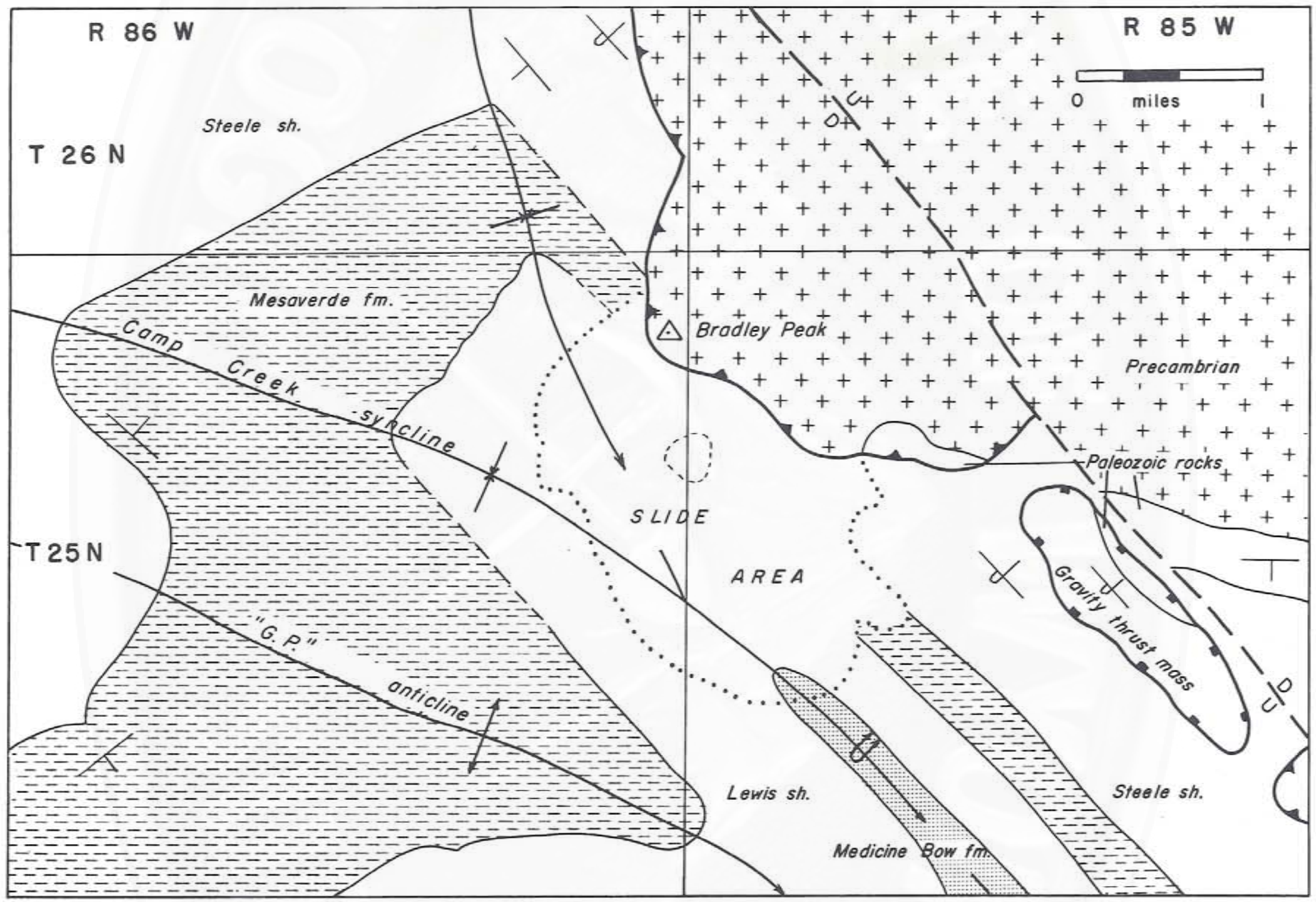

Fig. 2. Generalized geologic map of the Bradley Peak area.

and the Seminoe hematite deposits are thus underlain by coal. The beds here occur in a syncline, the north limb of which is overturned and dips at angles of 110° - 150° NE. The south limb is comparatively flat, dipping from 10° to 15° (Pl. XIV).

This major thrust fault is an important element of the regional structural pattern. The Ferris Mountains and the Seminoe Mountains are very similar in general aspect, but are offset about five miles. The offset arrangement of the ranges was not caused by the movement on the Bradley Peak thrust fault, but rather the fault is the expression of a major line of basement control which localized the ranges. Continued deformation produced fault movement of thrust character along this line.

The Seminoe thrust fault is the major structural feature within the Bradley Peak quadrangle and extends in a southeasterly direction from the mouth of Sand Creek canyon to Hurt Creek. Neither the northwest nor the southeast terminations of the fault lie within the map area.

The Seminoe thrust fault trends N. 50° W. and dips 20 NE. in the vicinity of Bradley Peak where the fault trace is best exposed and where the fault plane has the lowest dip. In the vicinity of Turkey Creek and Sand Creek in the northwest corner of the quadrangle the fault has a steep dip, perhaps as great as 60° NE., and the stratigraphic separation is small--in the order of 300 to 400 feet. Displacement on the fault increases to the southwest and reaches a maximum near Bradley Peak where rocks of Precambrian age rest upon overturned Upper Cretaceous Lewis shale, the latter forming the northeast limb of the Camp Creek syncline (Fig. 2). The stratigraphic separation here must be a minimum of 10,000 feet, and may be slightly greater. Southeast of Bradley Peak in the NW$\frac{1}{4}$ of sec. 8, T. 25 N., R. 85 W., the Cambrian Flathead sandstone unconformably overlies the Precambrian basement in the hanging wall of the fault plate, and is in fault contact with Upper Cretaceous Steele shale in the footwall. The minimum stratigraphic separation here must be 9,000 feet. Actual movement or slip on the fault plane probably exceeds this amount because the rocks in the footwall are overturned.

Elevations taken on the fault trace in the vicinity of Bradley Peak indicate that the strike of the fault plane there is N. 40° W., and that the thrust dips N. 20° E. Dip of the fault plane probably steepens at depth. Actual dip values of the fault plane are somewhat more problematical southeast of Hurt Creek beyond the map area, but appear to steepen.

The Seminoe thrust fault continues southeastward into the Seminoe Dam SW quadrangle but cannot be traced east of the Seminoe Dam highway near the I. D. Ranch (sec. 30, T. 25 N., R. 84 W.). Near the eastern termination, the fault is located in an outcrop area of Steele shale lacking in marker beds so that actual displacement is difficult to establish.

The fault is well defined in sec. 15, T. 25 N., R. 85 W. along Windy Ridge. The Alcova limestone member of the Chugwater and the Cloverly formation in the hanging wall strike almost due east-west; dip about 35° to the south; and lie almost at right angles to the overturned Cretaceous beds in the footwall. The fault trace near Windy Ridge is offset by the Deweese Creek fault in a manner similar to that shown in the SW$\frac{1}{4}$ of section five, west of Hurt Creek.

Lovering (1932, p. 658) cited the Seminoe thrust fault as an example of an overthrust and set up criteria for distinguishing the active and passive parts of a fault situation. He states:

> The swing in the direction of the beds as they approach the thrust mass suggests the drag of an active hanging wall block as it was thrust southward over a relatively passive foot wall. The eastern limit of the thrust fault is marked by a tear fault striking nearly north and south. The relative movement along this tear fault is clearly indicated by the marked southward drag of the vertical and overturned lower Paleozoic beds bordering the tear fault on the east. They have apparently been pulled southward by the active hanging wall of the thrust fault.

The interpretation offered by Lovering is incorrect. The existence of a tear fault cannot be demonstrated. The strata described as swinging into the tear fault in the footwall of the fault are in actuality on the toe of the hanging wall, and owe their change in strike to differential movement of the overthrust plate. The present writer believes that the hanging wall was the active block but for a different reason than that proposed by Lovering. The evidence for this conclusion is that the synclinal axes in the footwall adjacent to the Bradley Peak thrust fault show no evidence of being bent or bowed in and under the thrust plate. Such distortion of the trend of the synclines would be necessary if there were underthrusting.

Normal faults. Several normal faults of small displacement have been mapped in the footwall of the major thrust. Such faults displace the Alcova limestone immediately northwest of the mouth of Sand Creek canyon. Similar faults exist near the north end of Junk Hill and displace the Chugwater and the Cloverly formations. The faults are nearly vertical, and the displacements are of the order of magnitude of a hundred feet.

Gravity thrust masses. Patterson Basin * - Elkhorn Stage Station area:

The present mapping indicates that the interpretations made by Lovering (1929, 1932) and Carpenter and Cooper (1951) concerning the nature of the faulting is open to question. The present mapping indicates that the actual trace of the Seminoe thrust fault (line on the map separating Precambrian rocks in place from underlying sediments) passes close to the common corner of Ts. 25 and 26 N., Rs. 85 and 86 W. at an elevation of about 8700 feet. The fault can be traced eastward and passes through the springs in the N$\frac{1}{4}$ sec. 8, T. 25 N., R. 85 W., at an elevation of 7700 feet. The trace of the fault then continues to the head of the valley of the north branch of Indian Creek, where it is concealed by the Split Rock (?) formation, and is offset by the Deweese Creek normal fault (Pl. 1).

Precambrian iron bearing rock is distributed over an area of three square miles southwest of, and at a lower elevation than the actual fault trace. The outer boundary of this area is indicated on the map by a dashed line which passes through the old Elkhorn stage station on Salteel** Creek. The characteristics of this area include very hummocky topography, numerous undrained depressions with emphemeral ponds, (sag ponds) slump scars, local areas of outcrop of Cretaceous Lewis shale and numerous springs along the southern edge.

The interpretation is here offered that the outlined area contains rocks which have moved down slope under the influence of gravity as large landslide-like masses. The term gravity thrust has been used to describe such features. If this mass actually is an integral part of the upper plate of the Seminoe thrust fault it has been folded down to the southwest to reach the elevation of 7200 feet at the southern and lowermost edge as compared to the 8700 foot elevation of the fault trace on the west side of Bradley Peak. Such a possibility is considered unlikely.

Cretaceous rocks belonging to the Lewis shale outcrop in Patterson* Basin, and in the scarp to the northwest. It was not possible to determine the strike and dip of the shales in these exposures as slumpage is common and the outcrops are discontinuous.

Indian Creek - Hurt Creek area:

A prominent ridge about two miles long lies between Indian Creek and Hurt Creek and extends from the NE$\frac{1}{4}$ of sec. 8 to the center of the SW$\frac{1}{4}$ of section 15, T. 25 N., R. 85 W. The main hogback is underlain by the Tensleep sandstone. Limited exposures of Amsden (?) formation parallel the ridge on the northeastern side. Younger formations up to and including the Mowry shale outcrop in an orderly fashion on the southwest side of the hogback, but terminate at Indian Creek. The Alcova limestone crops out in a well defined but less prominent ridge than the Madison limestone. Several faults of small displacement offset the formations. All strata cropping out in this area are overturned and dip 40° to 60° NE. The strike of the rocks is rather consistently N. 40° W. except on the west side of Indian Creek in SW$\frac{1}{4}$ sec. 15, T. 25 N., R. 85 W., where small scale contortion produces much local variation in strike.

Geological mapping reveals that Cretaceous rocks crop out on three sides of the ridge. Relationships are partially obscured on the eastern side due to a pediment surface and the overlying Tertiary Splitrock (?) formation. The older rocks outcropping in the ridge are interpreted to lie within a gravity thrust mass which has moved down, and to the southwest, from the hanging wall of the Seminoe thrust plate. The trace of the Seminoe thrust fault can not be observed in the valley of Hurt Creek. A combination of Tertiary Split Rock (?) formation, pediment gravels and colluvial material obscure much of the geologic detail. The most plausible explanation for the absence of the trace of the Seminoe thrust is that movement on the Deweese Creek normal fault has carried the trace below present ground level. The normal fault is either the southward extension of the Deweese Creek fault or a fault in the same series of fractures. (See discussion under fault of that name.)

Previous investigators have erroneously interpreted the distribution of formations in the Indian Creek area. Lovering (1929, 1932) interpreted the succession ranging from the Flathead sandstone to the Mowry as a regular undisturbed section in the footwall beneath the Seminoe thrust fault. Cooper (1951) likewise

*The spelling of the Bradley Peak quadrangle is incorrect, and should be Pattison.
**The original homestead entrant after whom the creek is named spelled his name Saltiel.

considered the rocks in the hogback ridge as part of the footwall of the Seminoe thrust fault sliced by three minor and subsidiary thrust faults.

These conclusions apparently resulted from a failure to recognize and properly interpret the Cretaceous rocks that crop out around the common corner of secs. 4, 5, 8, and 9, T. 25 N., R. 85 W., and in the west central part of section 15 north of Windy Ridge. In addition these investigators postulated the existence of a hypothetical and concealed thrust fault trending N. 45° W. across sec. 8, T. 25 N., R. 85 W. The existence of such a fault was considered necessary in order to explain the relative position of the Chugwater and younger formations along Indian Creek, as compared to the contact of the Steele shale and the Mesaverde formation about one mile to the west. Lovering and Cooper both concluded that there was not enough space between the two outcrops to accommodate a complete normal section of sedimentary formations if the Triassic and the Mesaverde were in normal position. Carpenter (1951) considered this same hypothetical fault to extend northwestward beyond Bradley Peak.

It is now apparent that the Triassic rocks in question lie a considerable distance west of their proper structural and stratigraphic position in the hanging wall of the Seminoe thrust fault, and that they lie upon an inverted section of Cretaceous rocks which are the true footwall of the Seminoe thrust fault. It is unnecessary to postulate a "hidden" thrust to explain the structural position of the units. Cross section B-B', Figure 4, is the writer's interpretation of the geological structure at this locality.

Kortes Fault (Pathfinder fault). The north flank of the Seminoe Mountains from Deweese Creek to southeastward beyond the North Platte River, northeast of Kortes Dam is remarkably straight and abrupt topographically. The abrupt rise in topography is developed upon a foliated sequence of Precambrian rocks forming the core of the mountain range. Rocks of the Split Rock (?) formation are in contact with the Precambrian units and underlie the land surface which slopes regularly northward to the North Platte River.

The sharp break in slope in conjunction with the extreme linearity, and the difference of rock types is interpreted as evidence of a fault on which relative movement has been down to the north. The fault strikes N. 70° W. and appears to dip northward at a steep angle. At present there is no data available to determine the exact amount of displacement on this fault, but it probably exceeds 1300 feet. Cooper (1951, p. 56) and Carpenter and Cooper (1951, p. 79) described this fault as well as others in a system of fractures on the north flank of the Seminoe and Ferris Mountains under the name Pathfinder fault zone. The name seems inappropriate since Pathfinder Dam is far removed from the fault system, and the reservoir created by the dam does not reach the fault zone.

No stream that might provide a name for the prominent normal fault in the Bradley Peak quadrangle parallels the fault, nor is there any prominent topographic feature which might lend its name to the fault. The Kortes Black Canyon ranch is located near where the fault crosses the North Platte River, approximately two and one-half miles northeast of the Bureau of Reclamation Kortes Dam in Black Canyon. It is here proposed that the fault be known as the Kortes fault, rather than as the Pathfinder fault as previously suggested. The fault is exposed in the Bradley Peak Quadrangle for a distance of approximately two and one-half miles across sections 17, 18, 20, and 21, T. 26 N., R. 85 W. southeastward from Deweese Creek.

A fault similar in character to the Kortes fault has its eastern termination in the north-central part of the Bradley Peak quadrangle. The fault trends N. 65° W.; and the hanging wall is relatively down to the north. The fault continues northwestward for at least four miles beyond the boundary of the present map and across the Buzzard Ranch quadrangle area.

Love (1961, Fig. 2) has used the name South Granite Mountains fault system to describe the regional normal fault system.

Deweese Creek Fault. Lowering (1929, Pl. 46 and 47) reported a tear fault trending north-south between secs. 5-6 and 7-8, T. 25 N., R. 85 W. The present mapping does not confirm the existence of such a fault and offers a different interpretation concerning the position of the trace of the Seminoe thrust fault.

Lovering (1929, Pl. 46 and p. 229) described a fault that determines the northwest course of Deweese Creek. The fault in the stretch along Deweese Creek is upthrown on the northeast side so that rocks of Precambrian age are in fault contact with the Split Rock (?) formation on the southwest. The fault trace passes across the low divide between Deweese Creek and a tributary of Hunt Creek, then continues S. 35° E. in the Hunt Creek Valley to the south edge of the map area. The fault is here called the Deweese Creek fault.

The displacement on the southerly three miles of the Deweese Creek fault is reversed from that in the north part. The fault appears to be nearly vertical in attitude and is downtown to the northeast so as to place strata of Paleozoic and Mesozoic age in contact with either Tertiary, or Cretaceous. Further depression of the block lying east of the Hurt Creek is accomplished by movement on the normal fault which trends northeastward across sections 11, 14, and 15.

The area along Hurt Creek valley through which the trace of the Deweese Creek fault must pass is one of very poor exposures. From the areal distribution of rock units it is apparent that a fault situation must exist. The most positive evidence is that seen in section 15 where the Deweese Creek fault ruptures the hanging wall block of the Seminoe thrust plate. The Alcova member of the Chugwater formation, and the Clov erly formation are exposed topographically as well defined hogbacks, and the strata strike approximately east-west and dip 35° south. Offset of these units is quite clear, and demonstrates that the east side is upthrown.

The "scissors" movement along the Deweese Creek system of fractures may indicate a rotation of the west end of the Seminoe Mountain block after the period of overthrusting.

The Seminoe thrust fault was used by Lovering (1932, Fig. 9, pp. 656-660) as an example of an overthrust fault on the basis of the relationship of the syncline in the footwall, and the relative movement on the presumed tear fault in the hanging wall. Despite the revision of the mapping presented here the conclusion offered by Lovering is still valid.

ECONOMIC SIGNIFICANCE OF THE GEOLOGIC STRUCTURE

Seminoe Iron Formation

The Seminoe iron-ore deposits have been studied and prospected since 1870 (Aughey, 1886). The U. S. Geological Survey published a report by Lovering in 1929 which included a topographic and geologic map of the iron bearing rocks in the vicinity of Bradley Peak. The report carries an adequate discussion of the nature of the iron bearing Seminoe formation, and a number of analyses. The reader is referred to this publication for a discussion of the genesis of the mineralization. Osterwald et al., (1959, p. 100-103) summarized development data on prospects in the area.

In general the iron bearing rocks are magnetite-banded iron formation. The banding is very striking and appears as a yellow and black striping consisting of layers of magnetite alternating with layers of yellow chert.

The development of any deposit of raw material depends upon knowledge of the extent, and mineral content of the deposit in question. In the case of the Seminoe iron deposits sporadic prospecting and sampling has gone on for over 70 years. No systematic appraisal of the extent of the deposits seems to have been made, though local bodies of high grade hematite have been reported. The present mapping contributes new information concerning the extent of the iron bearing rocks, but no new data concerning the mode of origin, or of the character of the deposits themselves.

Extent of Deposits

The iron bearing Seminoe formation is a part of the Precambrian basement complex that outcrops extensively in the region. These rocks normally underlie the sequence of sedimentary formations which are so strikingly exposed in the hogbacks and parallel valleys on the south flank of both the Ferris and Seminoe Mts. The Precambrian rocks are known to be locally iron bearing only at the western extremity of the Seminoe Mountains.

The Precambrian Seminoe formation is exposed for the most part immediately adjacent to the Seminoe thrust fault in the upper or hanging wall block of that fault situation. The fault plane dips 20° NE., but probably steepens at depth a short distance east of the outcrop. The fault plane is a break or rupture which cuts across the rock units, and has in the course of development cut across the Seminoe iron formation. Movement on the fault plane has elevated part of the Seminoe formation and moved it westward to the present position. The relative vertical movement has been approximately 7,000 feet, and the westward component of movement about 8,000 feet. These relationships are shown in cross sections A-A' and B-B', Figures 3 and 4.

As Lovering (1929, p. 232-233) pointed out, the outcropping iron deposits lie above the fault plane and

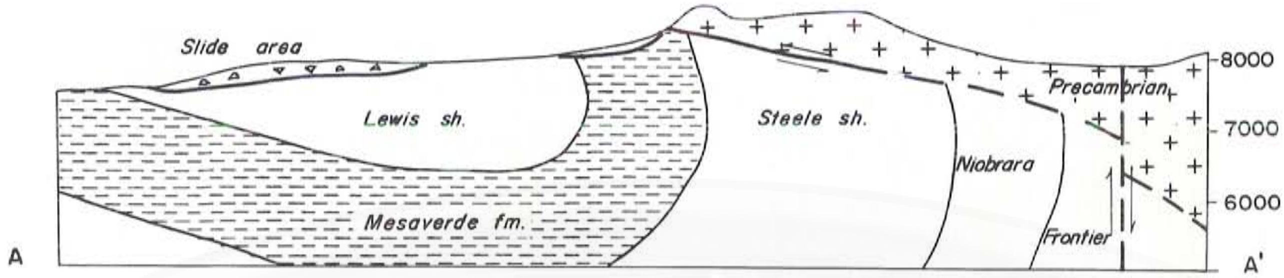

Fig. 3. Geologic structure section A-A', to accompany geologic map (Pl. 1).

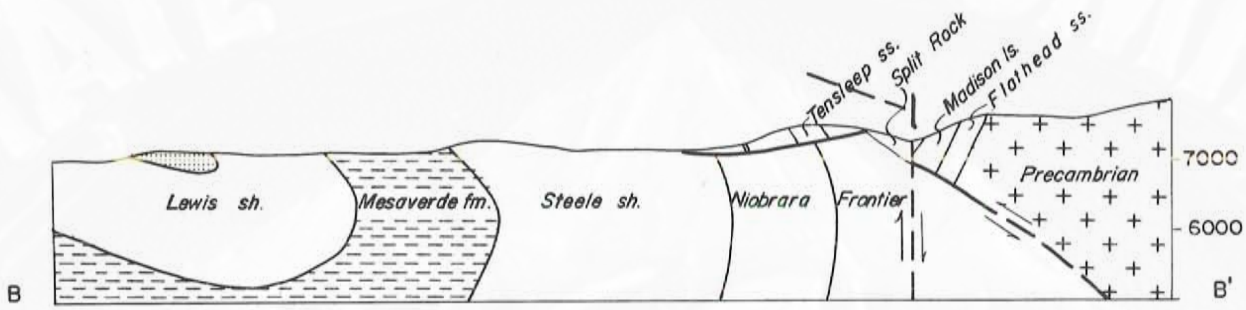

Fig. 4. Geologic structure section B-B', to accompany geologic map (Pl. 1).

cannot extend to any great depth. This observation applies to the deposits east and northwest of Bradley Peak, but not to deposits east of the Deweese Creek fault.

The conditions governing the extent of the iron deposits lying southwest of Bradley Peak and west of the fault trace of the Bradley Peak thrust plane are quite different than those prevailing east of the fault trace. In the three mile square area delimited on the map southwest of Bradley Peak as a gravity thrust mass the vertical extent of the Precambrian rocks is extremely limited.

Erosion of the soft sedimentary shales in the footwall of the Bradley Peak thrust fault caused large masses of Precambrian rock to creep, and move down slope because of lack of underlying support. This movement is independent of the fault displacement and is always down slope to the west and south of the trace of the Bradley Peak thrust fault. As a result of this movement a thin veneer of iron bearing Precambrian rocks has been spread out over the sediments. Figure 5, shows the extent of a part of this gravity thrust. Another result has been the disruption of individual iron deposits into many smaller masses, and to jumble masses of barren ground with the iron bearing rocks. Extent of individual bodies of iron therefore are small, and preclude the possibility of operating extensive pits for mining.

Cretaceous shales crop out among the jumble of blocks of Precambrian rock further documenting the limited vertical extent to which the Precambrian rocks extend. The base of the Precambrian is probably not over three hundred feet below surface; and for the most part of the area is at a depth of less than one hundred feet.

Any prospecting, or drilling in the area of the Seminoe iron district should consider the structural situation carefully. The local structure governs the extent and depth of the iron deposits, and in general tends to limit their extent.

Fig. 5. Panoramic view generally west from $NW\frac{1}{4}$ sec. 9, T. 25 N., R. 85 W. Bradley Peak on the skyline. Deadwood, Madison and Amsden formations center right are the hanging wall of the Seminoe thrust. Area of gravity thrust mass containing Precambrian iron formation outlined at left of photograph by dashed line.

Fig. 6. View southward from $NW\frac{1}{4}$ sec. 35, T. 26 N., R. 86 W., toward Bradley Peak. Dashed line is the trace of the Seminoe thrust.

The position of any extension of the Seminoe iron formation in the footwall of the Seminoe thrust fault can only be approximated from a map of the surface geology. The interpretation made in the cross sections (Figs. 3 and 4) indicates that the continuation of the Seminoe formation would be at a depth of approximately 4000 feet, which would probably make mining costs excessive.

CONCLUSIONS

Movement upon the Seminoe thrust fault in the vicinity of Bradley Peak, Wyoming has displaced the Precambrian basement complex upward and to the southwest. In the process the Seminoe iron formation has been offset on the fault plane. The extension of the iron formation at depth beneath the fault plane is controlled by the attitude (dip) of the fault plane at depth. This dip can only be approximated from the surface mapping. A dip for the fault plane of 45° or more to the northeast is anticipated.

Two gravity emplaced thrust masses occur southwest of, and at a lower elevation than the trace of the Seminoe thrust fault. One of these masses is composed of Seminoe iron formation, and the other of Mesozoic and Paleozoic sedimentary rocks. Much prospecting has been done for iron in the gravity emplaced thrust mass. The iron deposits cannot extend to any great depth, and the evaluation of reserves should carefully consider the structural aspects of the occurence.

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