AREAL GEOLOGY OF THE UPTON REGION, SUMMIT COUNTY, UTAH

By

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A thesis submitted to the faculty of the University of Utah in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Geology
University of Utah
June, 1953

Approved:

Supervisory Committee

Supervisory Committee

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ACKNOWLEDGMENTS

The author is deeply indebted to Dr. Norman C. Williams, at whose suggestion the problem was undertaken, for his invaluable counsel in the field and in the preparation of the manuscript; to Dr. A. J. Eardley for much valuable information and for his aid in editing the manuscript; to Dr. W. L. Stokes for helping edit the manuscript and for identifying the fossil collection; and finally to Mr. W. J. Wood for his help in measuring the stratigraphic section.

N.P.S.

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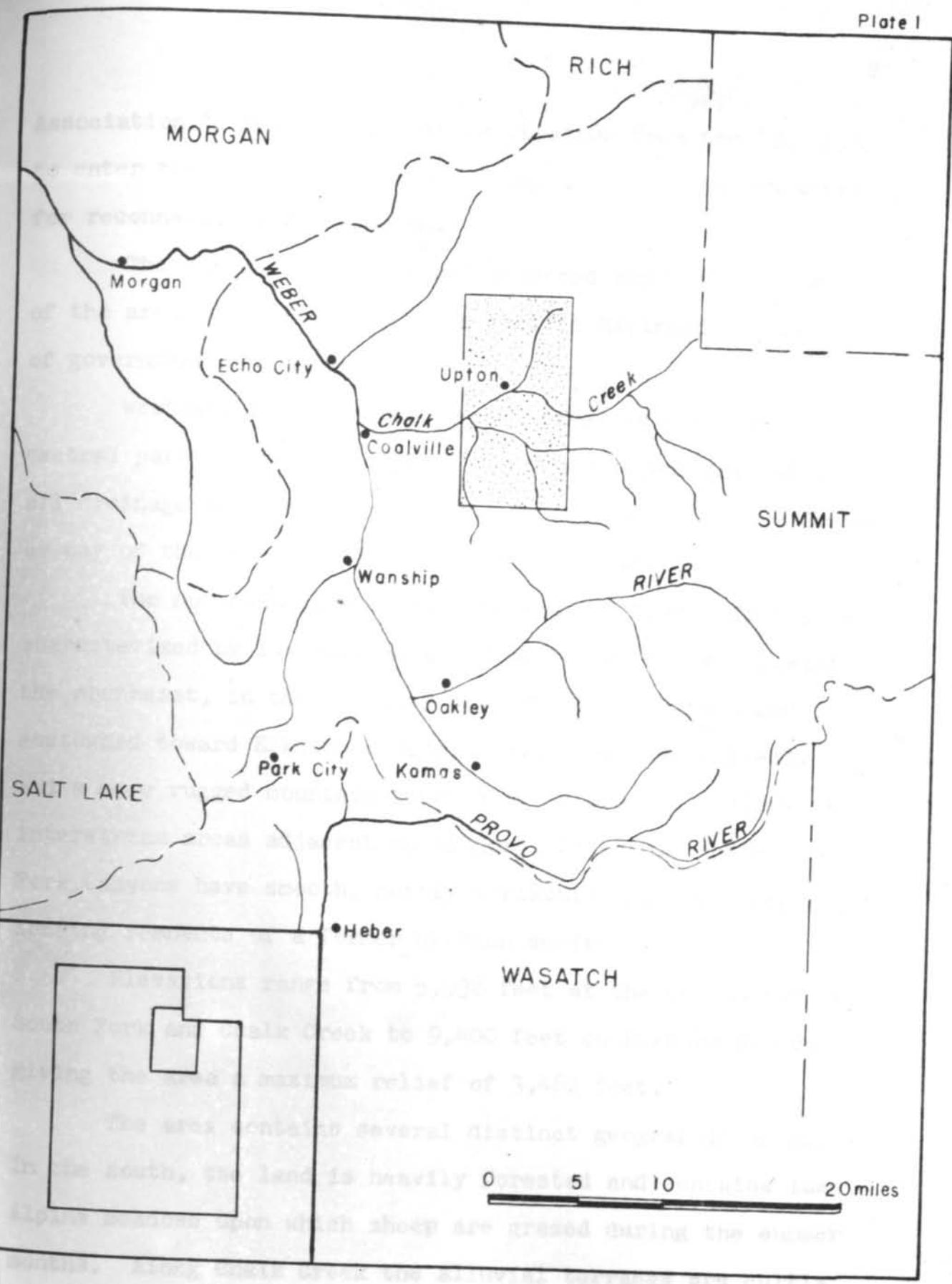
INTRODUCTION

General Statement

The area discussed in this paper is located in northeastern Utah. Upton, a small settlement twelve miles east of the city of Coalville, Summit County, is the approximate geographic center of the present study (Plate I). The area is part of the structural transition zone between the Uinta Mountains to the south, the Bridger Basin to the north and the Wasatch Mountains to the west, and comprises approximately 100 square miles. It includes all of T 2 N, parts of T 1 N, and T 3 N, R 6 E; parts of T 1 N, T 2 N, T 3 N, R 7 E, S. L. B. and M.

Utah State Highway 133 traverses the central part of the area from west to east. Roads which formerly extended from Highway 133 into the more remote parts of the area have, to a large extent, been made impassible by numerous landslides formed during the past few years. With the exception of the Clark Canyon road and parts of the South Fork and Meadow Creek Canyon roads, most of the area is accessible only by "jeep", horseback or foot.

Nearly all of the land surface rights are privately owned and the area is diligently patrolled by an owners cooperative formally titled the "Range Owners Protective



INDEX MAP — SHOWING LOCATION OF UPTON AREA, UTAH

Association." Permission must be obtained from the "R.O.P.A." to enter the South Fork, Meadow Creek and Clark Canyon areas for reconnaisance or research.

The mineral rights of odd numbered sections, in parts of the area, belong to the Union Pacific Railroad by virtue of government land grants.

Westward flowing Chalk Creek traverses the north central part of the area and is the trunk stream into which all drainage from north and south empties. Chalk Creek drains, by way of the Weber River, into the Great Basin.

The northern part of the area, along Meadow Creek, is characterized by low cuestas and flat-topped hills. Toward the northeast, in the vicinity of Porcupine Mountain and southward toward Elkhorn Divide, elevations rise markedly and a more rugged mountain topography is present. Elevated interstream areas adjacent to Elkhorn, Lodgepole and South Fork Canyons have smooth, nearly horizontal surfaces representing remnants of a former erosion surface.

Elevations range from 5,938 feet at the confluence of South Fork and Chalk Creek to 9,400 feet on Elkhorn Divide, giving the area a maximum relief of 3,462 feet.

The area contains several distinct geographic units. In the south, the land is heavily forested and contains lush alpine meadows upon which sheep are grazed during the summer months. Along Chalk Creek the alluvial terraces are cultivated and produce some vegetable and hay crops. North of

Chalk Creek semi-desert conditions prevail. Vegetation is sparse and consists chiefly of brush and hardy grasses. Water is scarce and, except for limited grazing, the land has little value.

Purpose and Scope

This investigation is one of a series of studies being conducted, in the Coalville and Hayden Peak Quadrangles, by the University of Utah, under the direction of Dr. Norman C. Williams. Information contributed by these studies will, in the near future, be combined into a more comprehensive report on the Coalville Quadrangle.

The purpose of this paper is to describe the geology, stratigraphy, structure and economic importance of the Upton area and, it is hoped, contribute to the knowledge of Laramide and post-Laramide history insofar as these are revealed by the exposed rocks.

Field work was accomplished during the summer and fall of 1952. Mapping was done on aerial photographs of the Soil Conservation Service at a scale of two inches per mile. The geologic data were transferred to a base map prepared from Soil Conservation Planimetric maps 47, 48, 59 and 60, Utah.

Previous Geologic Work

The Uinta Mountains and immediately adjacent areas

have long been a source of interest to geologists. J. W. Powell (1876) and Clarence King (1876) did the first geology in the Uinta Mountains. This information was augmented and expanded by C. P. Berkey (1905), F. B. Weeks (1907), W. C. Knight (1907), S. F. Emmons (1907), A. C. Veatch (1907), W. W. Atwood (1909), C. H. Wegemann (1913) and A. R. Schultz (1918). Later and more detailed knowledge of the area has been contributed by W. A. Bradley (1934-35), J. D. Forrester (1937), A. J. Eardley (1944) and N. C. Williams (1953).

Unpublished data, amassed as part of the Coalville Project by the Department of Geology, University of Utah, was made available to the writer.

STRATIGRAPHY

General Statement

Along Chalk Creek and its tributaries, erosion has cut through the extensive and nearly horizontal Tertiary formations to expose folded and truncated Cretaceous strata.

The exposed Cretaceous rocks were deposited during Coloradoan and Montanan time and consist of ridge making sandstones, shales and some interbedded coal seams. The fossil remains indicate a transition from marine environment in Coloradoan time to a terrestrial environment in late Montanan time. The Tertiary strata, which represent deposition during parts of Paleocene, Eocene and Oligocene time, are composed principally of conglomerates with some interbedded sands and shales.

Upper Cretaceous Rocks

Frontier formation. The name Frontier was given by Knight (1902, p. 721) to a formation which occurs throughout western Wyoming and southern Montana. At the type section, at Frontier Wyoming, it is described as:

> . . . a sandstone formation in which there is a thick stratum of evenly bedded light brown

> sandstone. Above and below this there are several seams of coal and there are also beds of clay and shale. The thickness of this formation has not been taken; but it will approximate 2,000 feet. These beds can be absolutely determined by the presence of Ostrea soleniscus . . .

A similar thick sequence of ridge-forming sandstones containing several seams of coal and numerous units of shale overlie the Aspen shale in the Coalville area. This sequence has been studied by many geologists including Stanton (1893), Veatch (1907) and Wegemann (1915). As a result of his investigation, Knight (1907) correlated these beds with the Frontier formation of southwestern Wyoming.

Along Chalk Creek, immediately east of the Narrows, a sequence of gray to buff colored, ridge-making sandstones is exposed and this is continuous eastward, along strike, into the area discussed in this paper. This sequence of beds conformably overlies the Aspen shale on the southeast flank of the Coalville anticline. The beds consist of massive sandstones interbedded with gray and black shales and lenses of sub-bituminous coal. The sandstone is calcareous, and, on the whole, very friable.

Another exposure of the upper part of this sequence is found near the head of Right-Hand Canyon. Specimens of Chemnitzia(?) coalvillensis, Turitella micronema, and Ostrea congesta were taken from the top sandstone of this second exposure. Ostrea congesta is typical of the Niobrara formation of the type Colorado group. These beds have been assigned

to the Frontier formation of Coloradoan age.

Amother small exposure of the Frontier occurs along Chalk Creek east of Upton. This outcrop exposes the Wasatch Coal bed described by Wegemann (1915, p. 183). The Black Hawk coal mine is now operating at the site of this exposure.

The section along Chalk Creek has been cut by the East Flank fault and only 660 feet of Frontier beds are present. Along Right-Hand Canyon only the top 280 feet of the formation are exposed.

Measured Section along Right-Hand Canyon

	Feet
Non-resistant sandstone and shale masked by detritus from overlying beds	248
Argillaceous sandstone, easily weathered, contains Chemnitzia(?) coalvillensis, Turitella micronema and Ostrea congesta . . .	10
Resistant sandstone cliff, light gray to buff color, cross-bedded.	22
Dark gray shale	(?)
Total	280

Wanship formation. The name Wanship has been applied to a series of gray and brown sandstones which crop out south of Cherry Canyon in the vicinity of Wanship, Utah. This formation, which rests with from 10 to 90° angular discordance upon the Frontier sandstone in the type section at Wanship, Utah, is also unconformable on the Frontier in the Upton area although the unconformity is not so conspicuous.

Eardley (1944, p. 840) designated a sequence of sandstone and shale beds in the vicinity of Henefer, and another group just north of the railroad in Grass Creek Valley as the Henefer formation. This formation he believed to be equivalent of part or all of the Hilliard, Adaville and Evanston formations. These three formations occur in southwest Wyoming and lie between the Frontier and the Wasatch group. The Hilliard is a marine shale, but both the Adaville and Evanston are fresh water deposits.

In a restudy of the type Wasatch, Eardley (1951) concluded that the Almy was conformable on the Henefer and therefore the Henefer was probably a lower member of the Almy.

The beds near Wanship and the outcrops north of the railroad in Grass Creek Valley, in the Coalville area, have been shown to be equivalent by Lankford (1951) on the basis microfauna. N. C. Williams has proposed the name Wanship for these beds and A. J. Eardley (1952) concurs with Williams in this designation.

The Wanship, in the Upton area, is exposed along the north side of Chalk Creek Valley. The formation is very similar in lithology and physical character to the Frontier which it overlies.

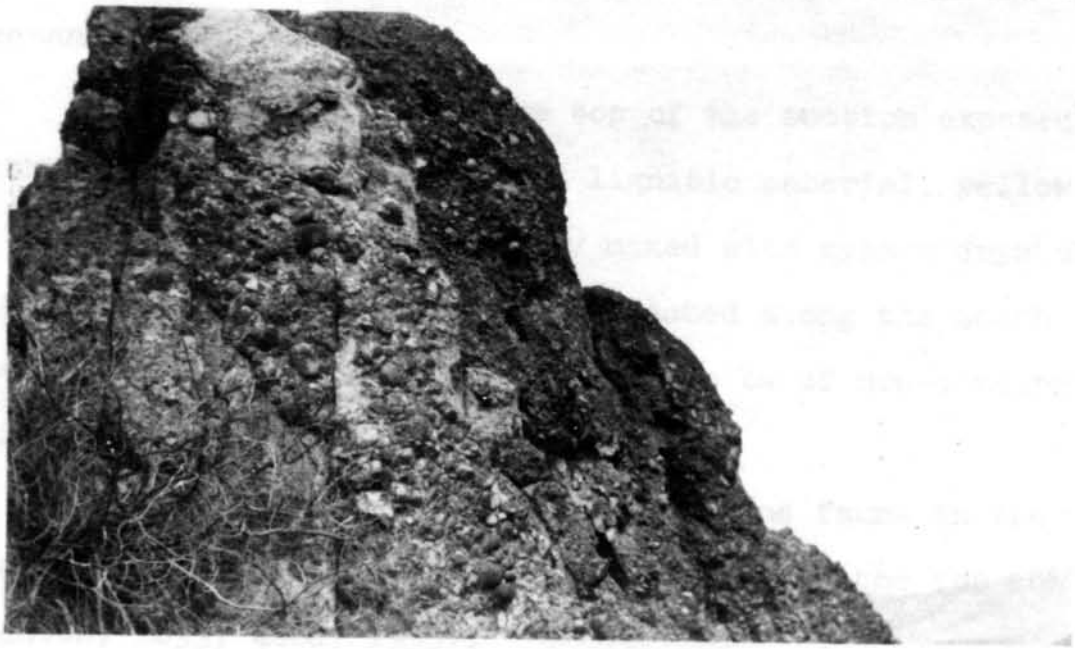
The sandstone occurs in massive beds and forms cliffs and cuestas in Meadow Creek Valley. Locally the sandstone lenses are calcareous, contain limonite concretions and are

very friable. Gray to black shale is interbedded with the sandstone, and at least two horizons contain seams of lignitic material. The soft shale beds are almost everywhere masked by detritus from the overlying sandstones.

The whole of the Wanship formation is very fossiliferous and nearly every sand member contains some invertebrate forms. Fossils were successfully collected from only four horizons. These specimens were identified by Dr. W. L. Stokes as: Ostrea patina(?), Ostrea sp., Corbula sutrigonalis(?), Gyroides conradi, Inoceramus sp., Cardium sp.

The sandstones and shales are underlain by a basal conglomerate unit, which in this area, is composed of pebble to cobble sized fragments of sandstone, limestone and quartzite. Further west Larson (1951) and Wood (1953) describe the same conglomerate as being composed of considerably larger cobble and boulder sizes. The decrease in fragment size suggests a greater distance from the source rocks than the previously cited areas to the west. The conglomerate averages about 41 feet in thickness in the Upton area. This conglomerate marks the unconformity between the Wanship and the Frontier formations.

A coal seam occurs 1177 feet above the basal conglomerate. In the past, this coal seam has been prospected at several points in Meadow Creek Valley. Immediately above the coal is an oyster bed about 18 feet thick. The bed is composed primarily of the remains of Ostrea patina(?). The



A. Basal Wanship Conglomerate east of Chalk Creek Narrows.

B. Inoceramus sp. in Wanship formation at the mouth of Right-Hand Canyon.

coal bed appears to be the Dry Hollow coal bed described by Wegemann (1915, p. 182).

In a shale bed, near the top of the section exposed in this area, there is a lens of lignitic material, yellow to black in color, and intimately mixed with gypsum crystals. This lignitic deposit has been prospected along the north side of Chalk Creek Valley but proved to be of non-commercial quality.

The Wanship formation exhibits marine fauna in the lower part and contains fresh water forms near the top (Stanton, 1893; Wood, 1953).

The age of this formation has long been in question. Stanton (1893) originally thought the beds 100 feet below the coal mined at Coalville to the conglomerate 1,000 feet above (basal Wanship conglomerate) belonged to a single fauna of Coloradoan age (present Frontier formation). Later he came to believe that beds 1,000 feet above the conglomerate were of Coloradoan age. This belief was strengthened by a fossil collection made by Veatch in southwestern Wyoming who found Inoceramus exogyroides (typical of Colorado fauna) at a point which would be 3,980 feet above the position of the conglomerate in the Coalville section. Fossil leaves collected by Stanton above the highest coal in the Coalville area (above the conglomerate) were identified by Knowlton as Montanan in age. This information seems to confirm Stanton's original idea that all beds below the conglomerate are of

Coloradoan age.

Langford (1952) upon correlation of microfossils with the microfauna of the Gulf Coast assigned a Cretaceous-Tertiary age to the Wanship.

A dinosaur ungal was found by W. Sadlick in the Wanship formation of Cherry Canyon 1,946 feet above the base of the formation. The ungal was identified by W. L. Stokes who believes it could not have been reworked from older sediments.

Fossil leaves found by Wood (1953), near the Almy contact west of Echo City, have been dated as Paleocene, but are not definitely from the Wanship. Other leaves found in the Cherry Canyon-Moffat Pass area indicate a Cretaceous age.

Exact dating of the Wanship awaits further extensive paleontologic work. Until the exact age is determined, the Wanship formation in this area has been assigned tenatively to the Montanan epoch.

A complete section of Wanship is not exposed in the area, but a composite section of 4676 feet was measured along Chalk Creek and Right-Hand Canyon.

Measured Section of Right-Hand Canyon-Chalk Creek

	Feet
Gray to buff calcareous sandstones with interbedded shales. Sandstones fine to medium grained, even to cross bedded form ledges 4 to 14 feet thick	702
Dark gray shale bed containing lignitic seam brown to yellowish-brown in color and intimately mixed with gypsum crystals.	12

Shales and sandstone ledges. Sandstones gray to buff and friable	755
Series of sandstone ledges and shale capped by a sandstone ledge containing *Cardium* sp.	145
Shales and sandstones capped by a six foot fossil-bearing sandstone ledge containing *Corbule sutrigonalis* and *Gyroides conradi*	1105
Massive gray sandstone cliff containing *Ostrea* sp.	97
White fine-grained sandstone cliff containing large specimens of *Inoceramus* sp.	95
Dark gray shales masked by sandy detritis contains one sandstone ledge with specimens of *Inoceramus* sp.	163
Shales and sandstones capped by a massive buff colored ninety foot sandstone cliff	168
Marker bed composed entirely of pelecypod shells, principally *Ostrea* patina.	18
Shales interbedded with massive sandstone ledges. Sandstones are gray to buff even to cross--bedded and calcareous. This sequence is capped by a massive sandstone ledge, at the base of which occurs the Dry Hollow coal seam.	1315
Coarse grit which grades upward into a medium grained greyish sandstone	72
Pebble to cobble sized conglomerate grades upward into a coarse grit	41
Total	4676

Tertiary Formations

Almy formation. The almy was described at its type section in southwestern Wyoming by Veatch (1907, p. 89) as:

> . . . yellow and reddish-yellow sandy clays with irregularly bedded sandstones and near the base pronounced conglomerate beds.

The Almy is the oldest of the three Tertiary formations (Almy, Fowkes and Knight) which make up the Wasatch group.

Eardley (1944, pp. 842-3) found, in the Almy formation of Lost Creek Canyon and Toone Canyon, near Henefer, Utah, beds of low rank bituminous coal which contain much "bone" and are overlain by a blue clay containing fossil plants. One thousand feet of these beds are exposed near Echo City and another 1000 feet are indicated in the trough of the Stevenson Canyon syncline.

In the Upton area, extending from upper Meadow Creek across the head of Dry Canyon to where they finally pass under the terrace gravels of Chalk Creek, a series of beds containing sandstone layers, shales and grits is exposed. These beds yielded no fossils. They are so similar lithologically to the Knight that the contact can be drawn only on the basis of the discordant dips of the two formations. The unconformable relationship of the two formations can best be seen in the mountain rising to the north of Meadow Creek Valley.

These beds have been designated as Almy because they are continuous with beds to the east, so designated by Randall (1952).

The upper and lower contacts are so poorly exposed that accurate measurement of thickness is difficult. The estimated thickness of the exposure in this area is 1910 feet.

Fowkes formation. Veatch (1907, p. 90) gave the name Fowkes to:

> . . . a thick series of light colored beds composed largely to rhyolitic ash and containing thin layers of white limestones.

These he thought were conformable on the Almy formation.

A formation above the Echo Canyon conglomerate "consisting of 800 feet of friable gray grit and sandstone and poorly indurated shale," has been correlated by Eardley (1944, p. 844) with the Fowkes.

Although the Fowkes is not clearly present in the Upton area, Randall (1952, p. 17) describes 300 feet of non-fossiliferous white and pink rhyolitic tuff and ash which he believes to be Fowkes three miles to the east, in Porcupine Canyon.

Knight formation. The Knight formation was named from Knight station on the Union Pacific Railroad near which the first vertebrate fossils were recovered from the Wasatch beds. At the type locality it consists of:

> . . . yellow and reddish-yellow sandy clays, with irregularly bedded sandstones and occasional

> thin layers of fresh water limestones in its upper portion. (Veatch, 1907, p. 92).

Eardley (1944, p. 844) correlates beds in Morgan Valley which occupy a similar stratigraphic position with the Knight formation of southwestern Wyoming. In Morgan Valley the formation has the same red color but is more conglomeratic and contains no limestone. The Knight beds are also observed to have steeper dips in the Morgan Valley area than in southwestern Wyoming.

The greater part of the Upton area is covered by gently dipping beds of the Knight formation, which can be traced from the Echo Canyon section.

The lithology varies geographically in the area. To the north, the beds are composed of variegated sandstones and shales. Southward this lithology gives way to unconsolidated debris consisting of tan and purple quartzite boulders. In South Fork and to some extent along the south side of Chalk Creek Valley, well consolidated beds of tan quartzitic conglomerate have weathered to produce monuments and conical pinnacles.

The Knight, in its areas of greatest exposure, can be divided, on the basis of color and lithology, into several units. The lowest unit, the base of which is not exposed, is a tan cobble to boulder conglomerate with lenses of tan sandstone. Above this tan conglomerate is a brick-red conglomerate containing lenses of sandstone and grading upward

into sandstones and limestones. Three hundred and fourteen feet of the tan conglomerate and 1266 feet of the red conglomerate are exposed in Elkhorn Canyon.

On the south side of Chalk Creek Valley, above the Black Hawk coal mine, the tan conglomerate is overlain by beds composed of white and red-tinted sandstones grading upward into reddish fresh-water limestones without the intervening red conglomerate of Elkhorn Canyon.

The Knight formation has long been considered as Eocene in age. The Almy has been classified as middle Paleocene and the Fowkes as upper Paleocene by Wood, et al, (1941, Pl. 1, p. 1). Eardley (1952, p. 54) now recognizes the Fowkes as lower Eocene.

Norwood tuff(?). A formation chiefly of volcanic derivation, "in the valley of the Weber River from Morgan City to Devil's Gate", was observed and named the Salt Lake group by Hayden (1869, p. 92).

Eardley (1944, p. 845) from an exposure in Norwood Canyon, named a distinct lithologic unit of the Salt Lake group the Norwood tuff. This formation, on the whole, is composed dominantly of light colored tuff with lenses of volcanic conglomerate which become more abundant toward the south. Vertebrate remains which definitely date the formation as early Oligocene have been found in some of the beds.

The isolated outcrops have not been correlated with

any similar exposures, but because of their unconformable relationship, stratigraphic position and lithologic character have been correlated by Eardley[1] with the Norwood tuff which he has mapped a few miles to the northeast.

Quaternary formations

Pleistocene. The Pleistocene is represented by the glacial deposits in the Sargent Lakes and Windy Ridge areas.

Recent. Deposits of alluvium are cultivated along Chalk Creek, Meadow Creek and South Fork.

Alluvial fans are present particularly in the upper Meadow Creek Valley and on the south side of Chalk Creek Valley near the Black Hawk mine.

Landslides, which here seem to be the predominant expression of mass wastage, are numerous.

1/ Eardley, A. J. Personal Communication.

STRUCTURE

Regional Structure

The Upton area is part of the structural transition zone between the Uinta Mountains on the south, the Wasatch Mountains on the west and the Bridger Basin on the north.

The Uinta Mountain uplift was named the Uinta Anticline by Schultz (1918, p. 55) who describes it as a "long, narrow, flat-topped east-west fold", consisting of "numerous secondary anticlines and synclines, some parallel to the main axis and some at right angles to it." The "Uinta Anticline" which separates the Green River Basin on the north from the Uinta Basin on the south, contains "numerous low, cross folds along the flanks of the major fold, expressed in undulations, local sags, and irregularities along both sides of the range."

Forrester (1937, p. 642) describes the Uinta Mountains as a "broad open anticline, somewhat overturned and arcuate to the north."

Cretaceous and Tertiary rocks, in general, dip northward off the north flank of the Uinta Mountains and continue into the Bridger Basin to the north.

The cross folds of the Central Wasatch Mountains (Eardley, 1944, p. 860) extend northeastward into southwestern

Wyoming.

The Upton area has been affected by both the cross folding of the Central Wasatch Mountains and the arching of the Uinta Mountains.

Folding

Clark Canyon syncline. Clark Canyon extends northward from Chalk Creek at a point one and one-half miles west of Upton. This canyon marks approximately the position of the axis of the Clark Canyon syncline. The west limb is slightly overturned to the east and the trough is located west of Clark Canyon. The axis of the Clark Canyon syncline strikes about N 20 E.

Beds of the Wanship formation which constitute the west limb of the syncline are nearly vertical in upper Clark Canyon. On the north side of Chalk Creek Valley, at the confluence of Chalk Creek and South Fork, the Wanship beds are overturned and dip from 78° to 89° northwest. In the mountainous area immediately east of the confluence of Chalk Creek and South Fork, the beds are again nearly vertical. Immediately adjacent to these overturned beds in Clark Canyon, Fewkes Canyon and east of the mouth of South Fork other Wanship beds dip gently to the northwest at an angle of about 15°. These gently dipping beds form the east limb of the Clark Canyon syncline.

Northward in Clark Canyon and to the south in Elkhorn Canyon the fold disappears beneath the Knight formation.

The Wanship beds which make up the east limb of the syncline exhibit a considerable change in strike from a point two miles up Meadow Creek southward to a point immediately west of Upton. Along Meadow Creek, north of Right-Hand Canyon, the beds strike N 15° W and dip 25° southwest. Immediately west of Upton the beds strike N 10° E and dip 20° northwest.

Several miles to the north of the area and somewhat to the east of the westward-dipping Wanship beds discussed in this paper, beds were observed at a distance which appear similar to the Wanship. These beds have a general northward strike and an eastward dip. It is possible these beds at one time connected with the westward dipping Wanship to form an anticline. No evidence of eastward dipping beds was found in the Upton area and hence the existence of such a structure is merely conjectural.

Post-Wasatch folding. Knight beds west and north of Meadow creek dip gently to the Northwest. South of Chalk Creek the Knight beds dip gently to the southeast. Morris (1953) has noted northward dips of the Knight formation in the vicinity of Elkhorn Divide. This gentle folding of the Knight can easily be observed from the head of Dry Canyon.

Faulting

Clark Canyon Fault. The presence of a fault in the Clark Canyon area cannot be demonstrated positively; however, a high angle reverse fault is thought to extend from Clark Canyon southwest between the mouth of Clark and Fewkes Canyons, across Chalk Creek and across South Fork to where it disappears beneath the Knight beds immediately west of Elkhorn Canyon.

A chaotic aggregation of sandstone ledges occurs immediately adjacent to vertical beds on the east wall of Fewkes Canyon near its juncture with Chalk Creek. A great number of divergent dips can be obtained from these ledges. On the north side of South Fork the vertical beds are adjacent to beds which dip gently to the northwest.

If folding alone were involved in the deformation of such a thick sequence, it seems a number of dips transitional from one limb to the other would be observed, rather than the two divergent dips in such close proximity. Fault drag near a fault plane could produce vertical beds in contact with gently dipping beds such as those described.

The chaotic blocks of sandstone, north of Chalk Creek, although possibly produced by folding, suggest fault movement.

It is suggested, in view of this evidence, that to relieve compressional stresses imposed during the folding of the Wanship, the beds were sheared and the west limb of the

syncline moved up relative to the east limb, thus bringing vertical beds into contact with gently dipping strata.

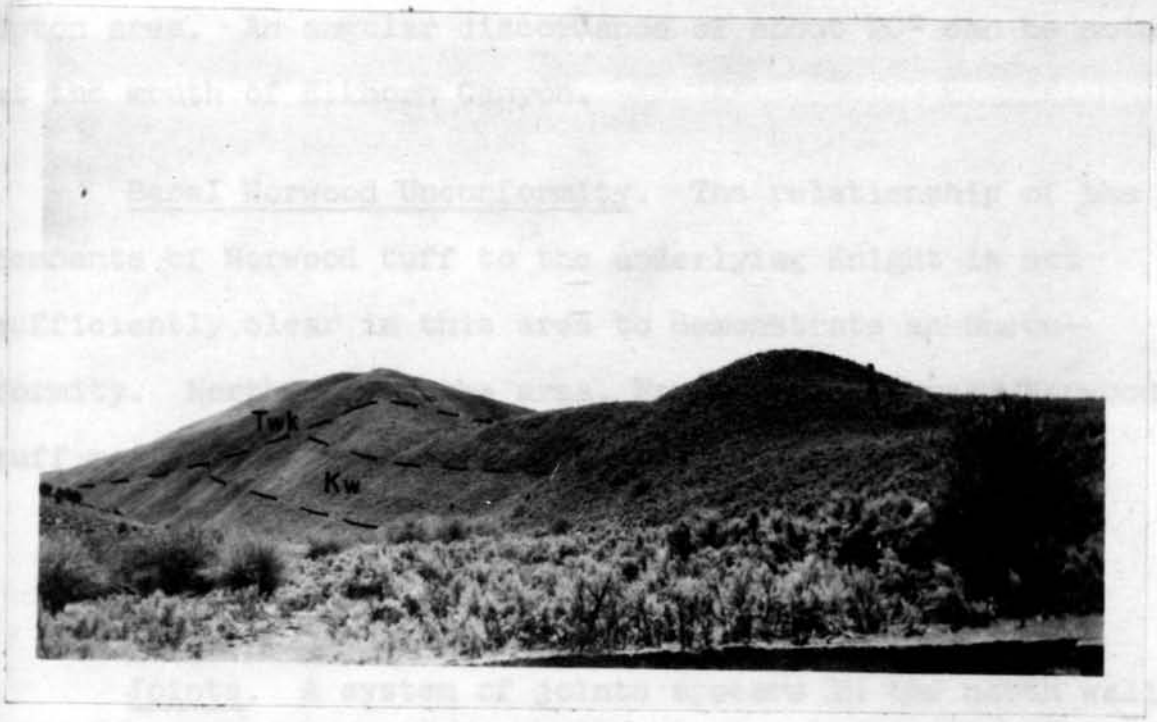
East Flank Fault. The East Flank fault is present in part in the extreme eastern part of the Upton area. This fault was named and discussed by Wood (1953).

Post-Wasatch Faulting. The lithology of the members of the Wasatch group is such that it is nearly impossible to trace faulting over any distance. Minor movements, a few inches to several feet, have been noted in the sandstone beds of the Knight formation. However, they are too small to map and cannot be traced more than a few feet. These offsets represent small local adjustments to the gentle folding rather than major crustal adjustments.

Unconformities

Basal Wanship Unconformity. The basal Wanship unconformity is marked by a conglomerate in this area as well as in areas to the south and west (Larson, 1951; Wood, 1953). The basal Wanship truncates the Frontier with only a 2-3° angular discordance in the Upton and Coalville areas, but rests with nearly 90° angularity of the Frontier and Kelvin beds of the Wanship area.

Basal Knight Unconformity. The Knight formation rests with angular relationship on the Wanship formation in the



A. Basal Knight Unconformity at the mouth of Elkhorn Canyon.

B. Wanship beds along strike of Clark Canyon fault in South Fork.

Upton area. An angular discordance of about 20° can be noted at the mouth of Elkhorn Canyon.

Basal Norwood Unconformity. The relationship of the remnants of Norwood tuff to the underlying Knight is not sufficiently clear in this area to demonstrate an unconformity. Northeast of the area, Eardley[2] has mapped Norwood tuff resting unconformably upon older formations.

Minor Structures

Joints. A system of joints appears in the north wall of South Fork Canyon about one and one-half miles east of the junction of South Fork and Chalk Creek. One set has a northeast-southwest orientation and the other a northwest-southeast orientation. The joints are cemented with calcite.

Other minor jointing is present in the Wanship beds and in the sandstone members of the Knight. Most of the joints have been filled with a calcite cement.

2/ Eardley, A. J. Personal Communication.

GEOMORPHOLOGY

General Statement

By Miocene time the Uinta Uplift had been eroded to form the Gilbert Peak erosion surface. Subsequent uplift rejuvinated the drainage and this surface was dissected to form the Bear Mountain surface (Bradley, 1934-35, p. 163). Pleistocene glaciation and subsequent erosion have modified or obliterated many of the former landforms. Much of the erosional history has been preserved in the modern geomorphic features of the Upton area.

Drainage

The drainage has the dominantly dendritic pattern characteristically developed in horizontal strata.

Meadow Creek and South Fork appear to be superposed streams whose courses were established on nearly horizontal rocks. They have incised channels through the Knight beds and maintained their courses while cutting across the structures of the underlying Cretaceous formations. In the vicinity of Upton, Chalk Creek has the characteristics of a superposed stream. However, to the east and to the west, structure has influenced the course of this stream.

Landforms

Two types of topography are evident in the area. One type is characteristic of the nearly horizontal Tertiary formations, the other of the folded Cretaceous.

The resistant members of the Cretaceous rocks form cliffs and, in Meadow Creek Valley, hold up cuestas. Sheer sandstone cliffs 100 feet high are found on the steep sides of some of these cuestas.

Conglomerates of the Knight formation form sheer cliffs such as are found in Elkhorn Canyon. In advanced stage of erosion, the Knight forms a typical badland topography, in which monuments and conical pinnacles are left as erosional remnants.

Throughout the Upton area and in those parts of the Coalville area that were observed by the writer, a topographic break was noted at the contact of the Knight and underlying Cretaceous beds. When viewed from a distance, this topographic break has a nearly horizontal attitude which can be projected from mountain to mountain and is suggestive of a peneplained surface. Undoubtedly this break represents an old erosion surface developed on the Cretaceous strata before the Knight was deposited. In areas where the contact between Knight and Wanship is obscured this topographic feature was used to define the contact.

The high flat interstream areas between Elkhorn, Lodgepole and South Fork Canyons represent remnants of an old

erosion surface. Another remnant of the same surface was observed near the head of South Fork. These remnants are at an average elevation of 7500 feet. No attempt was made to correlate these surfaces with those preserved in adjacent areas, but it is probable they are remnants of the Gilbert Peak or Herd Mountain surface (Eardley, 1944, p. 874).

Terraces were noted along Chalk Creek and in Meadow Creek Valley and South Fork, which although lower than the high erosion surfaces are still higher than the alluvial terraces of the Chalk Creek floodplain. The age of these terraces and their relationship to the drainage of the Weber River is not known.

Alpine glaciation, which affected the Uinta Mountain area two or three times (Atwood, 1907; Bradley, 1934-35) is represented by the morainal deposits of the Sargent Lakes area.

GEOLOGIC HISTORY

General Statement

The geologic history of this area is closely allied with that of the central Wasatch Mountains as described by Eardley (1944) and of the Uinta Mountains described by Forrester (1937), Mount (1952) and others.

The Paleozoic and early Mesozoic rocks record a history of quiet sedimentation uninterrupted by orogenic manifestations until the deposition of the Kelvin, which marks "the first major crustal disturbance of the general Sierran-Laramide revolution in the North Central Wasatch area." (Eardley, 1944, p. 859).

During the Laramide orogeny periods of folding, faulting, and uplift, punctuated by erosional episodes, affected the area. Epeirogenic uplift followed the Laramide Orogeny and continued late into the Tertiary.

Cretaceous History

Late Coloradoan. The Frontier formation was deposited during late Coloradoan time near the fluctuating shoreline of the widespread Cretaceous sea which encroached from the east. Sediments from a western low-lying upland were

deposited in a thick basinlike sequence (Eardley, 1944, p. 861).

Early Montanan. Shortly after the deposition of the Frontier formation, the area was subjected to the compressive forces which mark the early Laramide orogeny. The Cottonwood Uplift and the Northern Utah Highland were elevated and the cross folds of the Central Wasatch Mountains were formed at this time (Eardley, 1944, p. 865). The north flank of the Uinta Mountains was folded and the area of the Coalville anticline received its initial, but slight, deformation.

The Dry Canyon anticline (Larson, 1951), Rockport, Silver Creek and Snyderville synclines (Mount, 1952) are nearby folds which also have been demonstrated to be representative of the early Laramide stage of cross folding of the Wasatch.

The few small outcrops of Frontier in the Upton area furnish only meager evidence of the Early Laramide deformation. A small angular discordance, one to two degrees, was noted between the Frontier and Wanship formations in Right-Hand Canyon. This discordance in dip may represent deformation by the Early Laramide Orogeny, or may only be a local anomaly in the later overlying Wanship structure.

The nearly concordant nature of the two formations indicates deformation in this area was slight and probably occurred in an area marginal to the main cross folds.

A period of faulting, contemporaneous with, or shortly after the cross folding of the Wasatch, is indicated by the Crandall Canyon and Dry Canyon faults of the Wanship area (Mount, 1952, p. 27).

Middle Montanan. The local highlands which were created by the cross folding of the Wasatch served as a source for the basal conglomerate of the Wanship formation. The lithologic similarity of the Wanship and Frontier formations suggests that the Frontier beds were in large part the source of material for the Wanship. These formations were deposited in similar environments but the transition to continental environment in the Upper Wanship suggests a regression of the Cretaceous sea in Middle Montanan time.

Late Montanan-Early Paleocene. The Cretaceous sea oscillated and withdrew from the area during late Wanship time and the land was subjected to a period of erosion. Lankford (1952) believes the transition from Cretaceous to Paleocene time occurred during the deposition of the Wanship formation.

Tertiary History

Paleocene. In very late Montanan or early Paleocene time highlands were again created to the west.

During middle Paleocene time, as the result of extensive erosion of the western highlands, the Almy formation

was deposited (Eardley, 1951, p. 331).

Wanship and Almy beds are not observed in contact in the Upton area and no evidence can be offered to indicate whether or not the Almy is conformable, or is separated by an erosional or angular unconformity from the Wanship formation. However, the conformable relationship of the Almy and Wanship beds in Carruth Canyon as described by Wood (1953) and a less certain but seemingly similar relationship noted by Morris (1953) in the upper Weber River Canyon east of Oakley suggests only an erosional unconformity.

During late Paleocene time the most intense deformation in the history of the area occurred. The Almy and Wanship beds were folded and the Coalville anticline attained its present structural form. The Clark Canyon syncline and the Clark Canyon fault, of the Upton area, were formed at this time.

The folding of the Almy and Wanship beds was probably contemporaneous with the crustal unrest in southwestern Wyoming represented by the Absaroka and Darby thrusts (Eardley, 1951, p. 323).

Large valleys were eroded subsequent to this episode of crustal deformation, and the Almy formation was locally removed.

Eocene. Eardley (1952, p. 55) states that a center of volcanism appeared in southwestern Wyoming in early Eocene

time, and that great quantities of volcanic material were washed into this area and filled the valleys previously eroded in the Almy formation. These volcanic sediments constitute the Fowkes formation.

Middle Eocene time was marked by the deposition of great volumes of Knight conglomerate which was contributed from the Wasatch and Uinta Mountains. This flood of conglomerate buried all former structures and topographic features.

The Uinta Mountains were vertically uplifted along their present position, accompanied by large scale faulting in late Eocene time (Forrester, 1937, p. 469; Walton, 1944).

The Knight formation was gently folded along north-south axes by the Late Laramide Orogeny (Eardley, 1944, p. 864). This gently folded surface was subjected to erosion and deep wide valleys were formed.

Upon this eroded surface the volcanically derived Norwood tuff was deposited in latest Eocene time.

Post-Laramide. The Norwood tuff and the Knight formation together were affected by gentle folding as demonstrated in the Morgan Valley syncline (Eardley, 1944, p. 862).

The Absarokan orogeny of Oligocene time (Eardley, 1951, p. 332) which was marked by volcanic activity in the Park City area was also recorded in deformation of Eocene beds near the fault and flexure of the north flank of the Uinta

Mountains (Bradley, 1936, p. 167). Walton (1944) noted an uplift of the Uinta Mountains in post-Duchesne River time which corresponds to the Norwood folding.

The folding of Almy beds prior to deposition of the Knight can be demonstrated by the conspicuous angular unconformity in Echo Canyon five miles east of Echo City. The gentle folding of the Knight can readily be observed in the Upton area.

The late Eocene uplift of the Uinta Mountains suffered a long period of erosion and by Miocene time a pediment had been formed. This pediment was named the Gilbert Peak surface by Bradley (1935-36). This surface is correlative with the Heard Mountain surface (Eardley, 1952).

High, flat areas between Elkhorn, Lodgepole and South Fork Canyons, as well as a terraced area near the head of South Fork, have been designated as remnants of the Gilbert Peak surface.

After a short period of quiescence, the streams were rejuvinated and the Bear Mountain, or Weber Valley surface was formed in Pliocene time (Eardley, 1944, p. 874).

Quaternary History

Basin and Range faulting interrupted the formation of the Bear Mountain surface and rejuvinated the erosion cycle.

Pleistocene alpine glaciation of the Uinta Mountains

was followed by fluvial erosion and mass wastage which has continued to the present.

ECONOMIC GEOLOGY

General Statement

Beginning, in 1859, with the reconnaisance of Captain J. H. Simpson, the Upton and Coalville areas have been the subject of a number of mineral resource investigations. The goal of these investigations was to effect the commercial production of coal and to test the oil potential of the region.

Coal. Exploitation of the coal-bearing formations in the region began soon after they were discovered, and in 1915 Wegemann reported a thriving community supported by coal mining in the Coalville area.

Coal from the area generally has high heating value, ranging from 11,039 to 11,799 British Thermal Units, but it also has a high moisture content and when exposed to air and sunlight crumbles and slacks. The high slacking index renders the coal unsuitable for even short periods of storage. The coal has been classified by Wegemann (1915, p. 174) as subbituminous. The coal is satisfactory as a domestic fuel, for stationary engines and for manufacturing establishments where extraordinary heat is not required.

The following data presented by Wegemann (1915) and arranged as Proximate, Ultimate and Calorific Analyses by

the writer, shows the nature of the coal taken from the Wasatch bed:

Sample A - Analyzed exactly as mined.

Sample B - Analyzed after being dried at a temperature slightly above normal.

Proximate Analyses

	Sample A	Sample B
Moisture	12.2%	8.0%
Volatile matter	42.2%	44.2%
Fixed Carbon	42.2%	44.2%
Ash	3.39%	3.55%
Total	99.99%	99.95%

Ultimate Analyses

	Sample A	Sample B
Sulphur	1.90%	1.99%
Hydrogen	5.80%	5.55%
Carbon	63.77%	66.77%
Nitrogen	1.27%	1.33%
Oxygen	23.5%	20.81%
Total	95.34%	96.45%

Calorific Analyses

	Sample A	Sample B
Calories	6,255	6,550
B. T. U.	11,260	11,790

Development of modern heating methods and access to better sources of coal and hydrocarbon fuels elsewhere in the states of Utah and Wyoming have virtually eliminated the production of coal in the Upton-Coalville region.

The Black Hawk mine, located in NW¼, sec. 36, T 2 N, R 6 E is the only producing mine in the Upton area. At this mine coal is being produced from the Wasatch coal bed which is about eight feet thick at this point. The Black Hawk mine is producing only a small output, equated to the limited local demand.

A second coal bed, the Dry Hollow coal, is situated 2,000 feet stratigraphically above the Wasatch coal bed. The Dry Hollow coal, although extensively prospected, has been found unsuitable for general use because of its low grade and occurrence in discontinuous thin beds.

Although considerable reserves of coal are present in the Upton area, production will probably remain at its present low figure reflecting only the local demand.

Oil. Geologists have long speculated on the possibility of oil production from the Coalville anticline to the west of Upton. During the period from 1924 to 1944, four wells were drilled on the structure. The wells, which range from 3,197 to 5,538 feet in depth, penetrated no oil horizons and were abandoned. No rocks older than Kelvin(?) have been tested in the Coalville structure.

No wells have been drilled in the Upton area, but current exploration activity attests to the high interest which the area still holds. The Porcupine anticline to the east of the Upton area has been under lease for a number of years, and at present one of the major oil companies has undertaken to investigate and map the region.

Although no wells have been drilled in the Upton area, and despite the apparent absence of oil in the Coalville region, it remains possible that careful mapping plus correct interpretation of the structure will lead to the discovery of oil.

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