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Geology of the Southern Part of the Spanish Fork Peak Quadrangle, Utah

by

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GEOLOGY
OF THE SOUTHERN PART
OF THE SPANISH FORK PEAK QUADRANGLE,
UTAH

A Thesis

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Richard R. Rawson

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ABSTRACT

Rocks of Pennsylvanian, Permian, Triassic, Jurassic, Tertiary, and Quaternary Systems were mapped over an area of 23 square miles located south of Spanish Fork Canyon in the southern Wasatch Mountains. Paleozoic and Mesozoic beds were folded during the Larimide orogeny, developing a sharp anticline and syncline exposed in Pole Canyon. Tertiary formations, where present, lie upon Paleozoic and Mesozoic formations with marked angular unconformity. The Wasatch Fault and other normal faults of the Basin and Range type are found near the mouth of Spanish Fork Canyon. Water is the most important economic resource developed in the area. Although extensive prospecting has taken place in and around the Dream Mine, no ore has been produced.

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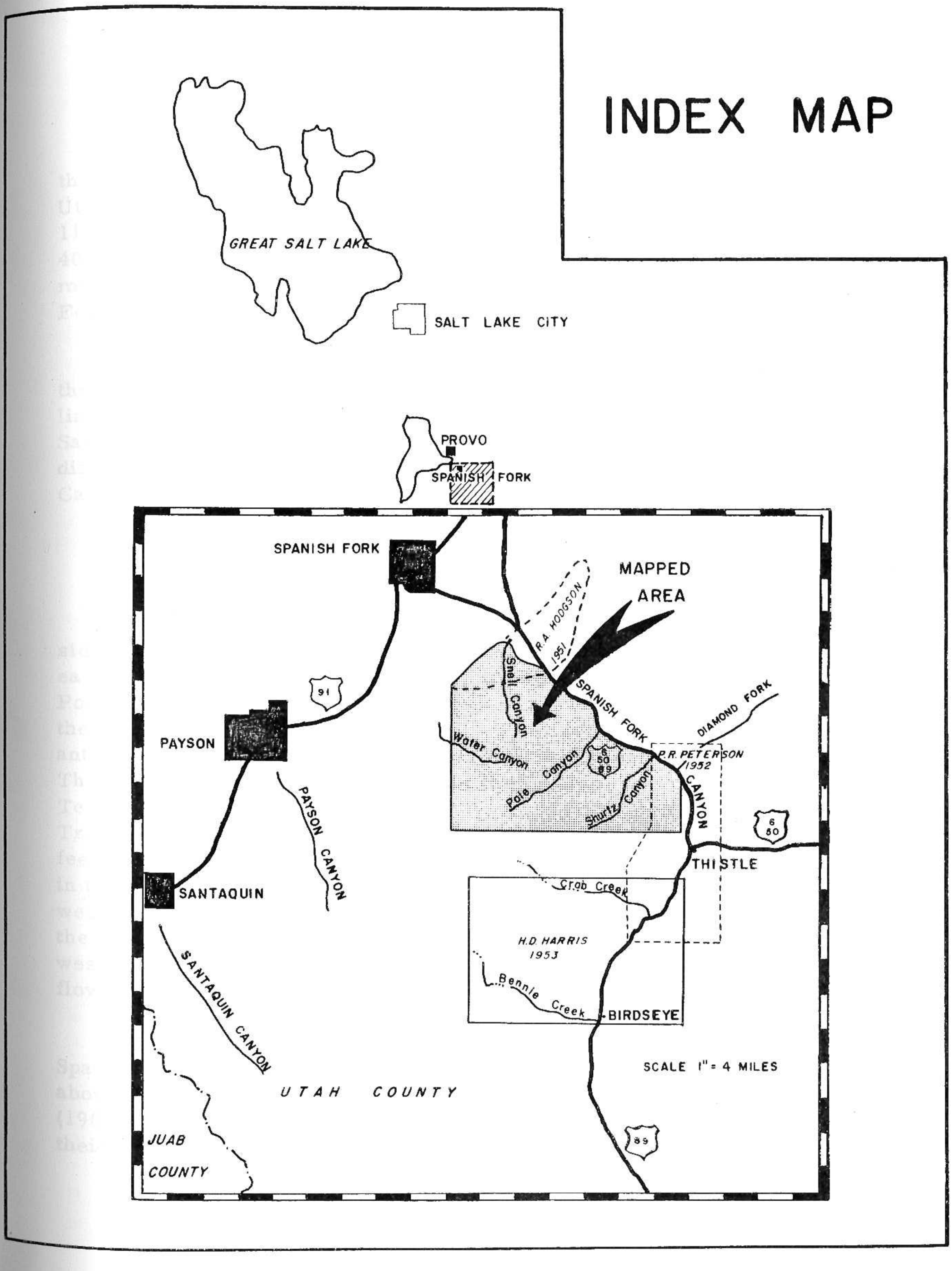


INDEX MAP
GREAT SALT LAKE
SALT LAKE CITY
PROVO
SPANISH FORK
SPANISH FORK
MAPPED
AREA
R.A. HODGSON
1951
Snell Canyon
SPANISH FORK
DIAMOND FORK
91
PAYSON
Water Canyon
Pole Canyon
6
50
89
P.R. PETERSON
1952
CANYON
Shurtz Canyon
PAYSON CANYON
6
50
THISTLE
SANTAQUIN
Crab Creek
H.D. HARRIS
1953
Bennie Creek
BIRDSEYE
SANTAQUIN CANYON
SCALE 1" = 4 MILES
UTAH COUNTY
89
JUAB
COUNTY

INTRODUCTION

LOCATION

The area under consideration is located in the northern part of the Southern Wasatch Mountains in the southern part of Utah County, Utah. The mapped area is bounded on the east and west by meridians 111° 30' and 111° 37' 30" west longitude, on the south by parallel 40° 00' north latitude, and by Spanish Fork Canyon on the north. The mouth of Spanish Fork Canyon is located 3 miles southeast from Spanish Fork, Utah (See Index Map).

The area is accessible both from the west, via Spanish Fork, and the east, via Thistle, on combined U. S. Highways 50, 6, 89. The main line of the Denver Rio Grande Western Railroad between Denver and Salt Lake City passes through Spanish Fork Canyon. Three unimproved dirt roads enter the area and extend part way up Water Canyon, Pole Canyon, and Shurtz Canyon.

PHYSICAL FEATURES

The mapped area is rugged and has high relief. On the west side, the Wasatch Mountains rise abruptly out of the valley floor, and east-dipping beds form a prominent hogback known as Loafer Ridge. Pole Canyon, which is formed in the trough of a syncline, makes up the central part of the mapped area. The east-dipping limb of an anticline, to the east of Pole Canyon, forms Shurtz Canyon Ridge. The Pasture area, to the east of Shurtz Canyon, is formed by slumped Tertiary sediments unconformably lying on truncated east-dipping Triassic formations. The relief in the area is approximately 4,600 feet, the highest point being Loafer Ridge (9,400 feet) and the lowest in the mouth of Spanish Fork Canyon (4,800 feet). The drainage is westward into Utah Valley on the west side of Loafer Ridge and on the east side is northward toward Spanish Fork Canyon and thence west to Utah Valley. The only perennial stream, Spanish Fork River, flows westward through Spanish Fork Canyon into Utah Valley.

Several prominent faceted spurs are located near the mouth of Spanish Fork Canyon. The faceted spurs rise more than 1500 feet above the valley floor and dip steeply 38-40° toward the west. Davis (1906), Hodgson (1951), and others have written extensively concerning their origin and relationship to the Wasatch Fault.

Slumping is common on steeper hillsides, particularly in Spanish Fork Canyon and the railroad cut directly north of Thistle. West of the railroad cut, Tertiary sediments fill an ancient drainage channel in the Nugget sandstone (See Plate II). During periods of heavy rains, slumping presents recurring problems of railroad clearance.

Springs are locally abundant in The Pasture, but are rather sparse elsewhere. No springs are known in the drainage area of Pole Canyon. Several lakes are formed in The Pasture area by the slumping of Tertiary sediments.

Near the mouth of Pole Canyon, nine circular depressions have been formed that are 20-40 feet in diameter and 15-40 feet deep (See Plate I). The sides dip 45-55^{o} into a flat bottom. The flat bottoms give evidence of having been filled by slope wash, and several of the depressions have large trees growing in them. The depressions appear to undergo periodic deepening as indicated by recent slumping observed in the bottom of one of the craters after a rainstorm. Schneider (1937) concluded the depressions were formed by the explosion of a meteorite near the mouth of Pole Canyon. The writer believes these depressions are the result of solution cavities or collapsed caverns that have been formed in the Kirkman limestone by ground water activity. (See fig. 2)

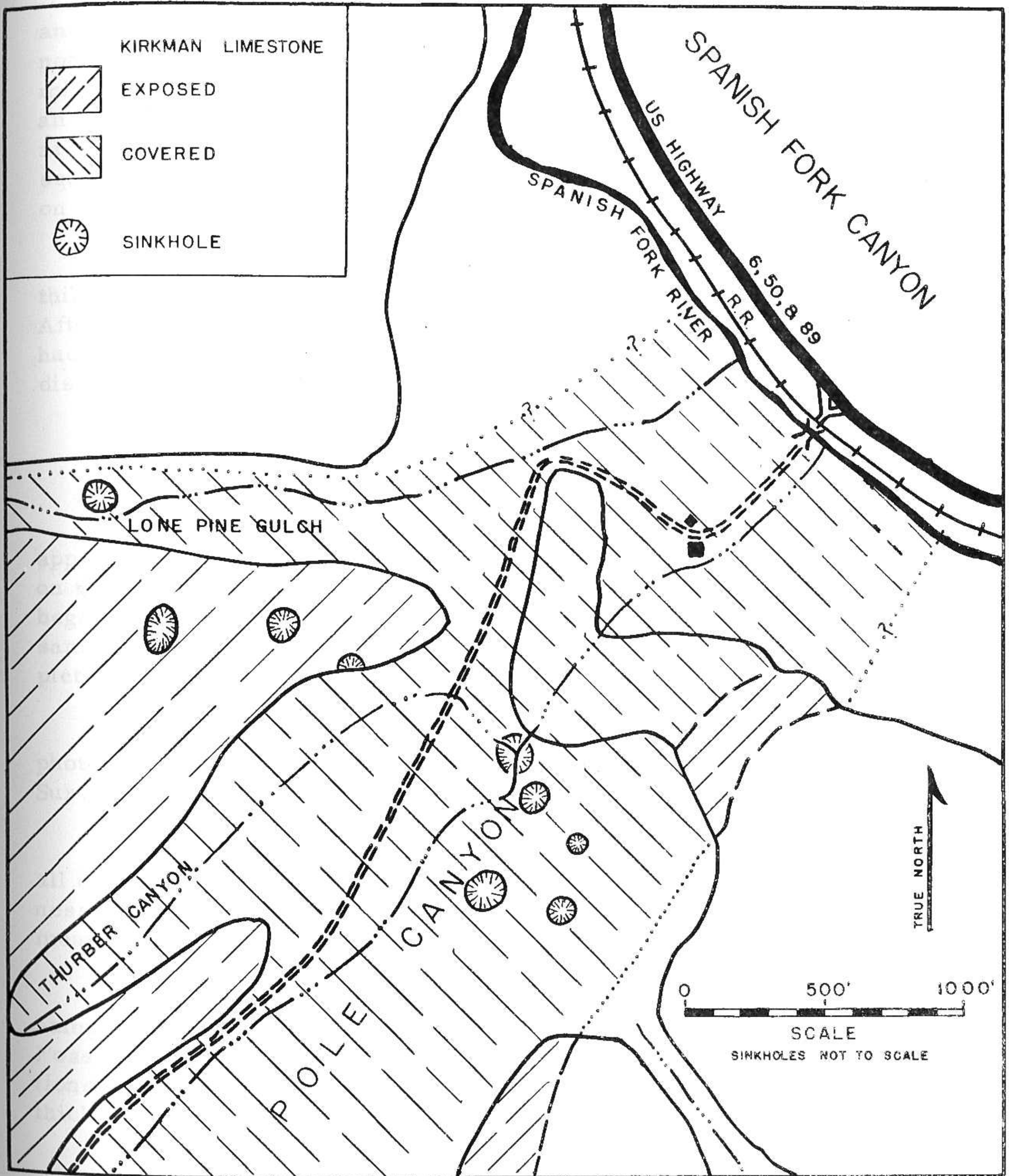
A prominent terrace near the mouth of Spanish Fork Canyon rises 300 feet above the valley floor (See Plate II). The wave built terrace was formed by Lake Bonneville during the Pliestocene epoch (Hodgson, 1951).

Scrub oak is fairly abundant and proved to be a hindrance to detailed geologic work. Only in a few localities could an outcrop be traced for more than a few hundred feet.

PREVIOUS WORK

The earliest published literature concerning the geology of this area is the "Report of the Geographical and Geological Explorations and Surveys West of the 100th Meridian," made under the direction of G. M. Wheeler. Howell (1875), a geologist with the survey, briefly mentions features in and near Spanish Fork Canyon. Gilbert (1890), Emmons (1893), and Davis (1903) described various features of faulting and structure in the general area of Spanish Fork Canyon.

Campbell (1922) described the geology through Spanish Fork Canyon and published a reconnaissance map with a scale of 1:500,000. He briefly outlined the stratigraphy as consisting of Carboniferous, Triassic, Jurassic, and Lake Bonneville sediments. Schneider and Perkes (1937) attributed the craters found in Pole Canyon to meteoric origin.



RELATIONSHIP OF SINKHOLES TO THE KIRKMAN LIMESTONE

Baker (1947) measured a section just north of the present area, and has mapped the area north of Spanish Fork Canyon, but his map is not yet published. Hodgson (1951) mapped approximately five square miles in the mouth of Spanish Fork Canyon. Peterson (1952) mapped an area covering 10 square miles predominantly east of the present area, that included part of The Pasture. Harris (1954) mapped 24 square miles located 2 miles to the south of the present area, as shown on index map (figure 1).

When the present study was undertaken, it was believed, by this writer, that only reconnaissance work had been done in the area. After the field work was completed, it was discovered that the area had been mapped by Metter (1955) as part of a larger area for a Ph. D. dissertation from Ohio State University.

PRESENT WORK

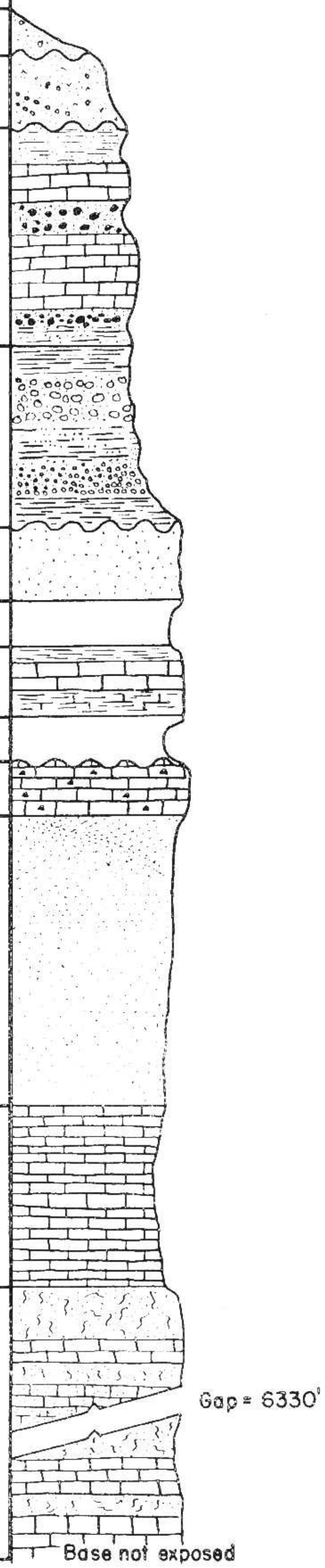
The present investigation consisted of mapping the geology of approximately 23 square miles located south of Spanish Fork Canyon on the Spanish Fork Peak Quadrangle topographic map. Field work began during July of 1956, and was completed by September of the same year. Twenty-seven actual working days were needed to complete the mapping.

Mapping was done on Department of Agriculture (1946) aerial photos having a scale of 1:20,000 and on the United States Geological Survey 7.5 minute quadrangle of the Spanish Fork Peak.

Because of the poor outcrops, it was not possible to walk out all of the contacts, and many, of necessity, had to be inferred. Thicknesses of several of the formations were computed by trigonometric means from the contacts on the geologic map.

The laboratory work consisted of making thin sections of rock samples that were taken from several of the formations in the area. Fossil collections were made in the Oquirrh formation, and thin sections were cut in order to determine the age of the fusulinids of this thick unit. These collecting localities are designated on the map.

ERA	PER.	FORMATION	THICKNESS
CENOZOIC	Q	Alluvium	
	TERTIARY	Pyroclastic Sediments	200'
		Flagstaff limestone	600'
		North Horn formation	400-500'
MESOZOIC	JURA	Nugget sandstone	200'+
	TRIASSIC	Triassic undifferentiated	concealed
		Thaynes limestone	200'+
		Woodside sh.	concealed
PALEOZOIC	PERMIAN	Park City formation	150'+
		Diamond Creek sandstone	800'
		Kirkman limestone	500'
	PENNSYLVANIAN	Oquirrh formation	7000'



COLUMNAR SECTION

STRATIGRAPHY

GENERAL STATEMENT

The rocks of the area range in age from Pennsylvanian to Recent, as shown in fig. 3. Paleozoic rocks are represented by the Oquirrh formation, Kirkman limestone, Diamond Creek sandstone, and the Park City formation. The Woodside shale, Thaynes limestone, Ankareh shale, and Nugget sandstone make up the Mesozoic rocks. The Tertiary rocks consist of the North Horn formation, Flagstaff limestone, and volcanic conglomerate. Lake Bonneville and Recent sediments represent the Quaternary System.

The Tertiary formations overlie, with marked angular unconformity, the steep east-dipping Paleozoic and Mesozoic formations.

PENNSYLVANIAN AND PERMIAN SYSTEMS (UNDIVIDED)

Oquirrh formation

The upper part of the Oquirrh formation crops out in the western part of the mapped area. The west face of the Wasatch Mountains, in the area under consideration, is composed of the Oquirrh formation. Several disconnected outcrops of the formation are also found in Pole Canyon. The Oquirrh formation forms the highest topographic features in the mapped area. The formation generally dips 25-35° to the east and strikes in a north-south direction.

The lithology of the Oquirrh formation characteristically alternates between limestone and quartzite, with only a few shale beds. The limestone is light blue-gray to dark gray, fine-grained crystalline. Abundant fossiliferous horizons are composed of crinoids, fusulinids, and bryozoans. In the upper part of the formation, the limestones are sandy and have a quartzitic appearance on a weathered surface. The quartzite beds become thicker and predominate over the limestone beds in the upper 3,000 feet of the formation. The quartzites are gray-brown to buff, fine-grained and well cemented, with no appreciable porosity. (See measured section by J. R. Bushman in appendix.) The bedding thickness ranges from a few inches to more than 20 feet. Two well developed joint systems, formed nearly at right angles to each other and to the bedding planes, cause the outcrops to have a blocky angular appearance.

The Kirkman limestone conformably overlies the Oquirrh formation. The Oquirrh formation is sandy near the contact, and appears as a fine-grained, buff to red sandstone. The base of the Kirkman is marked by fine-grained, laminated and brecciated, dark gray limestone.

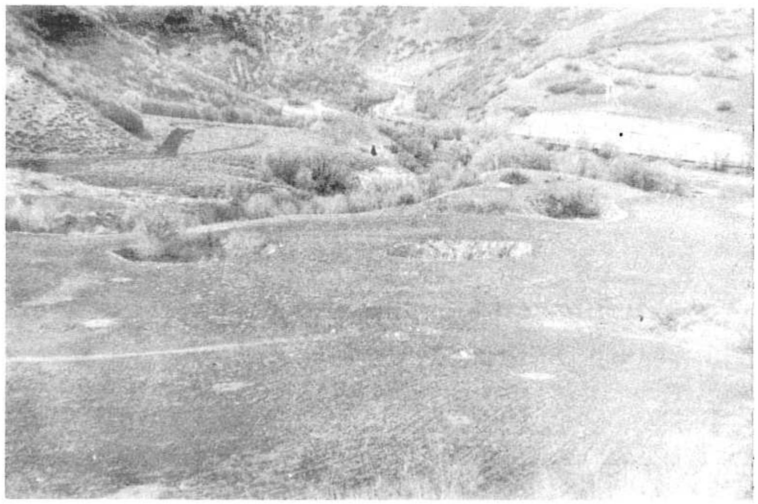
The type locality for the Oquirrh formation is in the Oquirrh Mountains, approximately 50 miles northwest of the mapped area. Gilluly (1932) named the formation and measured 17,000 feet in the type locality. Baker (1947) measured 26,000 feet of the Oquirrh formation in the central Wasatch Mountains. Bushman (1950) measured a section in Water Canyon, within the mapped area, and found that the oldest exposures of the formation are Atokan. He measured 3,005 feet of the Oquirrh formation from the Atokan through the Missourian age. The outcrops are very poor above Bushman's highest measured unit. The writer has computed, from the geologic map, a thickness of approximately 4,000 feet of the Oquirrh formation above the section measured by Bushman. The combined thickness of the measured and computed section in Water Canyon is approximately 7,000 feet.

The following fusulinids were collected from the Oquirrh formation by the writer and identified by H. J. Bissell: (Field collecting localities are shown on the geologic map)

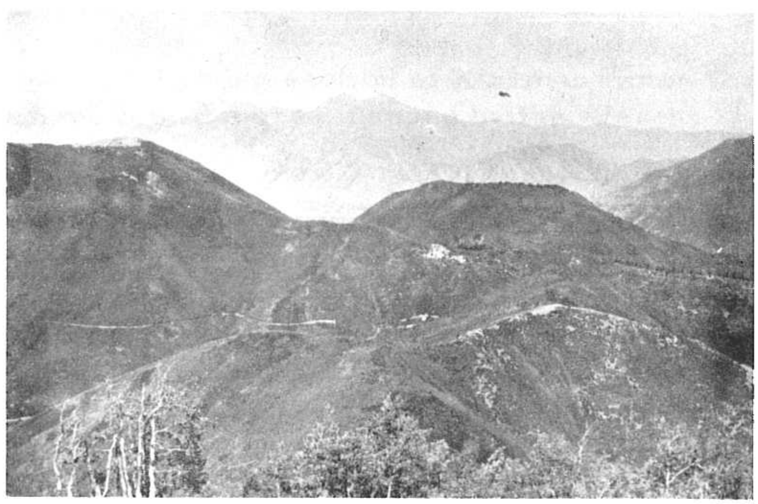
Fusulinid	Field Location	BYU #
Permian (Wolfcampian)		
Schwagerina sp.	RR-37	10965
	RR-36	10964
	RR-35	10963
	RR-34	10962
	RR-30	10959
Schwagerina wellsensis (?)	RR-33	10961
Dunbarinella(?) sp.	RR-35	10963
	RR-33	10961
Oketaella (?) sp.	RR-36	10964
Schubertella (?) sp.	RR-36	10964
Pseudoschwagerina (?) sp.	RR-31	10960

Plate I

A. Sinkhole near mouth of Pole Canyon.



B. Group of Sinkholes near mouth of Pole Canyon. Spanish Fork Canyon in background.



C. Loafer Ridge looking north toward Utah Valley. East dipping Oquirrh and Kirkman fms. form the ridge.

Fusulinid	Field Location	BYU #
Penn. - Perm. (?)		
Triticites sp.	RR-15	10958
	RR-10	10957
Pennsylvanian		
Triticites sp.	RR-2	10956
	RR-1	10955

PERMIAN SYSTEM

Kirkman limestone

The Kirkman limestone overlies the Oquirrh formation in apparent conformity. It extends in a belt, trending northeast-southwest, from the right fork of Shurtz Canyon through Pole Canyon to Spanish Fork Canyon and continues an unknown distance up Joe's Canyon north of the highway. The Kirkman limestone forms a prominent hogback along Loafer Ridge for about two miles where it dips eastward into Pole Canyon at about 30-35^{o} (See Plate I). The formation is exposed on both sides of Pole Canyon where it forms a northward plunging syncline. A thickness of 500 feet for Kirkman limestone has been calculated from the geologic map. The contact of the Oquirrh and the Kirkman is present in the right fork of Shurtz Canyon.

The formation, where exposed in Shurtz Canyon, is fine/ to medium-grained, finely laminated limestone near the contact, but grades upward into a recemented breccia with fragments from 1/2 inch to 24 inches. Fine lamination, wavy contortions, strong fetid odor on a fresh fracture, are the key identifying features of the Kirkman limestone. It is medium/to dark gray, with white calcite veinlets running perpendicular to the bedding plane in some beds.

Harris (1954) measured the following section of Kirkman limestone approximately two miles south of the area mapped by the present writer.

Bed	Description	Thickness (feet)
3	Limestone: dark gray, weathers dark gray, consists of recemented, angular fragments of laminated limestone; fetid.	47

Bed	Description	Thickness (feet)
2	Limestone: medium gray, weathers buff to gray; thin bedded (1/2"-3"); arenaceous.	10
1	Limestone: light gray, weathers medium light gray; laminated (some laminations have a wavy and contorted structure); fetid. Contains some shale partings; contains fusulinids, crinoid stems, etc.	148
	Total thickness of measured section	205

The name Kirkman limestone was proposed by Baker and Williams (1940). The type locality is in Kirkman Hollow, a tributary to the right fork of Hobble Creek Canyon, located approximately 12 miles north of the mapped area. Baker measured 1,590 feet of Kirkman limestone in the type area, but the formation apparently thins both north and south from the type locality as indicated in published works (Bissell, 1952; Harris, 1954).

No fossils were found by the present writer in the Kirkman limestone, but Baker (1947) reported fossils were locally abundant. Harris (1954) reported the following fauna collected from the Kirkman limestone in the Birdseye area:

Triticites
Schwagerina
Pseudoschwagerina
Aulosteges wolfcampensis King
Dictyoclostus sp.
Heritschia sp.

The Kirkman limestone was dated as Wolfcampian by Harris from the above collection. The present writer has no evidence to sustain or reject his findings.

Diamond Creek sandstone

The Diamond Creek sandstone conformably overlies the Kirkman limestone. It crops out on both sides of the right fork of Pole Canyon, forming a more or less continuous belt that trends northeastward from the right fork of Shurtz Canyon to Castilla, where it crosses the highway and continues for an unknown distance northward. A small, sharply folded anticline that is formed in the Diamond Creek sandstone can be seen north of the highway near Castilla Springs. Shurtz Canyon ridge forms the eastward dipping limb of this north-plunging anticline. The Diamond Creek sandstone also crops out in the mouth of Snell Canyon, where it has been down faulted against the Oquirrh formation.

A section was not measured in this area because the contacts and exposures are poor. An approximate thickness of 800 feet for the formation was calculated from the map contacts. The best exposure of the contact between the Kirkman limestone and the Diamond Creek sandstone was observed in the right fork of Shurtz Canyon, where it is somewhat gradational. The Kirkman limestone becomes quite sandy with fewer laminations, and gradually grades into a buff to yellow sandstone with numerous calcite veinlets. These calcite veinlets are characteristic near the contact of the Kirkman limestone and the Diamond Creek sandstone. On the ridge between the right fork and left fork of Pole Canyon, scalenohedral calcite crystals have formed in what appears to be ancient mud cracks in the Diamond Creek sandstone. The quartzose sandstone is generally medium/to coarse-grained, white to buff to yellow with occasional red streaks. Bedding ranges from fine to massive, with cross-bedding observed in most outcrops. Jointing is not as well defined as that found in the Oquirrh formation. The sandstone weathers quite easily to form pitted, cavernous exposures in the lower part of the formation. Near the top of the formation, the sandstone becomes quartzitic.

Harris (1954) measured the following section of the Diamond Creek sandstone:

Bed	Description	Thickness (feet)
1	Sandstone: grayish white to white, locally buff to grayish yellow; weathers lighter in color, fine to medium, well rounded quartz grains; slightly calcareous and of medium compaction in lower half of unit becoming more calcareous and friable in upper portions; cross-bedding and laminations commonly and well displayed.	621
	Total thickness of measured section	621

Baker proposed the name Diamond Creek sandstone in 1940. The type locality for the sandstone is located about five miles northeast of the present area in Little Diamond Creek, a tributary of Diamond Fork. In the type locality, the Diamond Creek sandstone reaches a thickness of approximately 1,000 feet. The formation thins both to the north and south, according to other writers (Bissell, 1952; Muessig, 1951).

To the present writer's knowledge, no fossils have ever been collected from the Diamond Creek sandstone. Because of its stratigraphic position beneath the Park City formation, which contains a Kaibab fauna, the Diamond Creek sandstone has been correlated with the Coconino sandstone of the San Rafel Swell (Baker and Williams, 1940; Baker, 1947; Baker, Huddle, and Kinney, 1949).

Park City formation

The Park City formation conformably overlies the Diamond Creek sandstone. The basal part of the formation crops out along the southern portion of Shurtz Canyon ridge, where it forms a dip slope eastward into Shurtz Canyon. It is buried beneath the Tertiary formations to the east. Small, isolated outcrops of the Park City formation are also found along the northern part of Shurtz Canyon ridge. The Park City formation crops out east of Creer Hollow, north of Spanish Fork Canyon, and continues northward for an unknown distance.

Not more than 150 feet of the formation is present in the area. The contact of the Diamond Creek sandstone and the Park City formation is gradational within a 50 foot zone. The Diamond Creek sandstone is a buff to yellow, soft quartz sandstone near the contact, that exhibits numerous small holes which give it a rotten appearance. The Park City formation near the contact is a fine-grained limestone; light-gray to white, with numerous white chert fragments 1/4 to 1/2 inch in diameter that weather out to form an angular gravel. The joint system is perpendicular to the bedding planes and forms blocky, angular outcrops. The bedding ranges from a few inches to six feet, with bedded chert developed locally.

The Park City formation in this area is not as thick as it has been measured to the north and south of the mapped area (Baker, 1947; Harris, 1954). Baker has noted that only the lower unit is present beneath the Woodside shale north of Spanish Fork Canyon. Apparently the Park City formation was beveled by erosion before the Woodside shale and succeeding sediments were deposited (Baker, 1947; Peterson, 1952).

A few poorly preserved, unidentifiable brachiopods were found in the exposures of the Park City formation. Harris (1954) collected the following fauna in the area that he mapped:

Ambocoelia guadalupensis Girty
Martina wolfcampensis (?) King
Composita subulita (Hall)
Aulosteges guadalupensis (?) Shumard

The Park City formation is considered to be Leonardian from the Kaibab faunas taken from it (Baker and Williams, 1940).

TRIASSIC SYSTEM

Five Triassic formations, the Woodside shale, the Thaynes limestone, Ankareh shale, Shinarump conglomerate, and the Chinle formation, occur in and adjacent to the mapped area. Only the Thaynes limestone crops out within the area mapped. The other formations are undoubtedly present beneath the Tertiary sediments.

Woodside shale

The Woodside shale unconformably overlies the Park City formation. It does not crop out in the mapped area, but poor exposures can be found east of Creer's Hollow, just north of Spanish Fork Canyon. The formation consists of thin regularly-bedded siltstone, shale, and fine-grained red sandstone. Baker (1947) measured 150 feet of Woodside shale north of Spanish Fork Canyon.

Thaynes limestone

The Thaynes limestone conformably overlies the Woodside shale. The only exposure of the formation in the mapped area occurs approximately 1/4 mile west of Diamond Fork, where it crops out for about 200 feet in a railroad cut. The formation consists of pink to greenish-gray sandy limestone and sandstone with interbedded variegated shale. Baker (1947) measured more than 1300 feet of the formation near the mouth of Diamond Fork.

Ankareh shale

The contact between the Ankareh shale and the Thaynes limestone is somewhat gradational. No known outcrops were found in the mapped area due to the slumping of Tertiary sediments on the Ankareh shale. Good exposures are found, adjacent to the mapped area, south of Diamond Fork. Baker (1947) measured 850 feet of the Ankareh shale in the above locality. The formation consists largely of light reddish-brown sandy shale and shaly sandstone.

Triassic undifferentiated

Peterson (1952) reported that both the Shinarump conglomerate and Chinle formation crop out between Diamond Fork and Thistle. The writer was not able to find these formations in the mapped area, and cannot verify, one way or the other, the findings of Peterson. If the above formations are present, they are concealed beneath the Tertiary rocks.

JURASSIC SYSTEM

Nugget sandstone

An exposure of approximately 200 feet of the Nugget sandstone, in the extreme southeast corner of the thesis area, comprises the only Jurassic in the area mapped. The Nugget sandstone is a massive, medium-grained, buff to yellow brown, cross-bedded sandstone. Peterson (1952) measured nearly 1400 feet of the Nugget sandstone near Thistle. The formation is the equivalent of the Navajo sandstone of the Colorado Plateau.

TERTIARY SYSTEM

North Horn formation

The North Horn formation crops out along the eastern edge of The Pasture and also near the mouth of Snell Canyon. The exposures are very poor and badly eroded, with slope wash obscuring most of the outcrops.

In The Pasture area, the North Horn unconformably overlies the Thaynes limestone, the Ankareh shale, and the Nugget sandstone. It is composed largely of variegated shale and coarse conglomerate. Most fragments in the conglomerate are pebble-to cobble- size, in a fine-grained matrix that has a reddish cement. The pebbles and cobbles are sub-rounded to well-rounded and composed predominantly of dark blue limestone with some quartzite. Usually the variegated shales and siltstones exhibit a pale red color.

The Cretaceous-Tertiary boundary has been placed within the North Horn formation. Spieker (1946) reported Cretaceous and Tertiary fossils from the formation in the Wasatch Plateau. He found dinosaur remains in the lower 500 feet, which was followed by a thickness of 600 feet that was not diagnostic of any particular age. Above this indeterminate zone, Tertiary mammal remains have been found. Schoff (1951) reported that in the Cedar Valley Hills, approximately ten miles south of the mapped area, the North Horn formation attains a thickness of 1500-6700 feet. He considers the major portion of the formation to be of Tertiary age. Peterson (1952) measured 415 feet of Tertiary North Horn formation near Thistle. The writer estimates that 400-500 feet of the North Horn formation crops out in the mapped area. The Flagstaff limestone conformably overlies the North Horn formation in The Pasture area. Because of the thickness of the North Horn formation and its conformable relationship to the Flagstaff limestone, the writer has given the North Horn formation a Tertiary age within The Pasture area. This age determination may not hold true for the small outcrops near the mouth of Snell Canyon.

Flagstaff limestone

The Flagstaff limestone forms a prominent ridge where it dips gently to the west 20-30°. Approximately 1500 feet south of Shurtz Lake there is a good outcrop of the ooidal limestone. The limestone is buff, brown to white, with some light pink streaks. Diameters of the ooids range from 1/4 inch to 7 inches in the only outcrop where they were found. A pebble- to boulder-conglomerate forms a ridge directly to the east of the limestone outcrop. The conglomerate is composed largely of sub-rounded to well-rounded quartzite that ranges from white to purple.

The present writer found no fossils in this formation. Harris (1954) tentatively places the Flagstaff limestone in the Eocene on the basis of gastropods and ostracodes collected in his area.

Volcanic Conglomerate

Volcanic conglomerates crop out on the eastern side of Shurtz Canyon approximately 1/2 mile north and south of Big Springs. The exposures are poor except directly east of Big Springs.

The contact of the Flagstaff limestone and the volcanic conglomerate is not exposed, but it is inferred that the Flagstaff limestone was probably undergoing erosion when the conglomerates were deposited. The volcanic conglomerates in the mapped area consist largely of green tuffaceous sandstone with interbedded conglomerate composed largely of gray quartzite and dark igneous rocks. The boulders and pebbles of the conglomerate have a green coating, probably of ferrous iron. An estimated thickness of 200 feet of the conglomerate is found near Big Springs.

These volcanics appear to be equivalent to unit #1 of Schoff's (1937) Moroni formation. Schoff has since (1951) deleted the term "Moroni formation," and refers to the volcanics as simply "Pyroclastic Rocks."

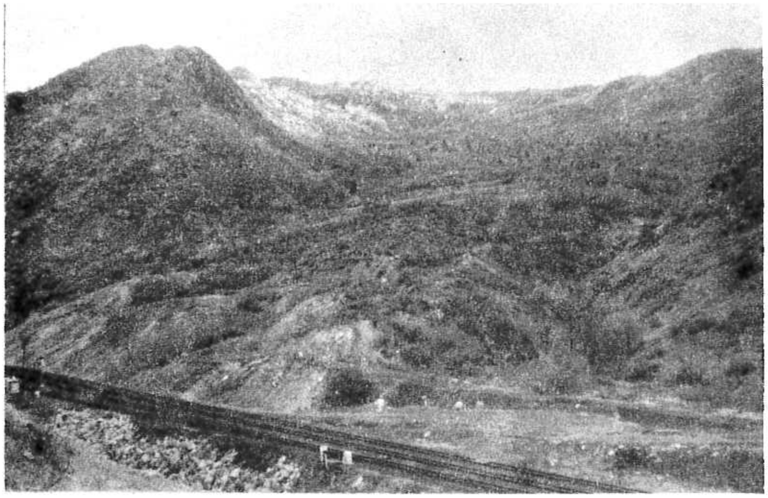
The source of the volcanics is unknown. The sediments are widespread in Thistle Creek Canyon and Diamond Fork. In some outcrops, cross-bedding indicates that the material was deposited by alluvial fans. Although no definite age has been established for these volcanic conglomerates, most writers have placed them in the late Tertiary.

QUATERNARY SYSTEM

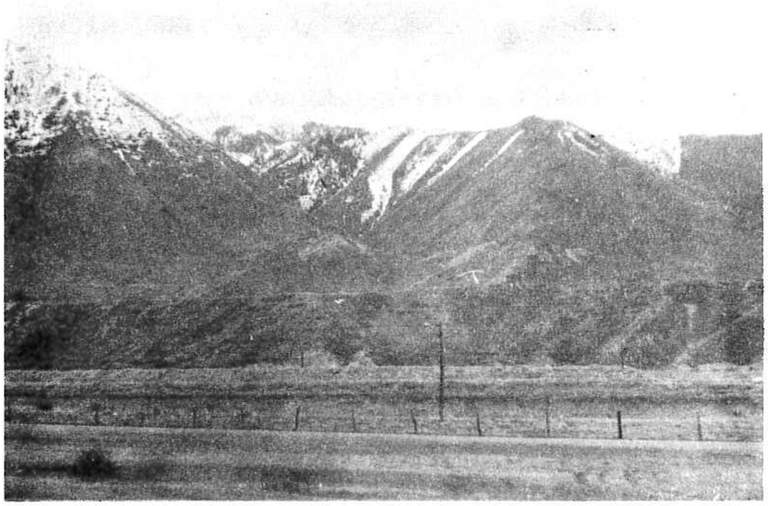
The Quaternary System is represented, in the mapped area, by Lake Bonneville sediments and stream alluvium. Good exposures of Lake Bonneville sediments are found in the mouth of Spanish Fork Canyon and Pole Canyon. No attempt to differentiate the various formations of the Bonneville group was made by the writer, because Dr. H. J. Bissell has mapped these sediments and will soon publish a paper describing his work. Stream alluvium consists of fine sand to coarse cobbles that have been deposited by the intermittent and perennial streams.

Plate II

A. Slumping of Tertiary sediments into railroad cut near Thistle.



B. Near the mouth of Spanish Fork Canyon. Snell Canyon in center with downfaulted blocks of Diamond Creek sandstone near mouth. Prominent Lake Bonneville terrace in foreground.



C. Shurtz Canyon looking south from Spanish Fork Canyon. East dipping Paleozoic beds on right are truncated and covered by Tertiary rocks on left.

STRUCTURE

GENERAL RELATIONS

Most of the area under consideration lies in the southern Wasatch Mountains. East-dipping Paleozoic beds form the Wasatch front, and also form the west flank of a syncline. To the east, younger beds form the core of an anticline. Mesozoic beds dip eastward off the anticline in the eastern part of the mapped area and are considered to have been folded simultaneously with the Paleozoic beds during the Laramide orogeny. Both Paleozoic and Mesozoic rocks are now eroded and partially covered by Tertiary formations in The Pasture area (See Plate II). Basin and Range type faulting along the western part of the mapped area formed the last major tectonic features.

FOLDING

The Paleozoic formations along the Wasatch front dip eastward 25-35^{o} into Pole Canyon. These formations then reverse dip 20-35^{o} to the west to form a syncline, whose axis roughly parallels the right fork of Pole Canyon. The Kirkman limestone and the Diamond Creek sandstone are exposed in the Pole Canyon syncline. The syncline appears to plunge in a northeasterly direction.

The eastern limb of the Pole Canyon syncline is folded over to form a northeastwardly plunging anticline whose axis roughly parallels the ridge west of Shurtz Canyon. The Diamond Creek sandstone and the Park City formation make up the limbs of the Shurtz Canyon ridge anticline. The axis of the anticline closely parallels, and is located approximately one mile east of, the axis of the Pole Canyon syncline. The eastern limb of the anticline dips 30-35^{o} into Shurtz Canyon, where the east-dipping Park City formation and Mesozoic formations have been truncated and covered by Tertiary sediments.

The Paleozoic and Mesozoic formations of the mapped area were folded during the early stages of the Laramide orogeny (Eardley, 1934). The eastern limb of a large anticline, whose axis lay to the west, was later faulted up to form the present Wasatch front.

FAULTING

No evidence of thrust faulting was found in the mapped area. The Wasatch fault line scarp is present near the mouth of Spanish Fork Canyon, where the trend of the fault changes from north-south to almost east-west. The strike of the beds changes direction and roughly parallels the east-west fault line near the mouth of the canyon. Associated with the main Wasatch fault are several smaller faults of the Basin and Range type.

Horses of Diamond Creek sandstone, that are capped by what appears to be North Horn conglomerate, are found in the mouth of Snell Canyon in juxtaposition with the Oquirrh formation. These horses indicate an approximate stratigraphic displacement of 3,000 feet. The area bounded roughly by Snell Canyon and Flat Canyon is made up of two down-drop blocks capped by the Kirkman limestone. Near the mouth of Flat Canyon, the Permian-Oquirrh formation on the north side of the canyon is in juxtaposition with the Pennsylvanian-Oquirrh on the south side of the canyon. The Flat Canyon fault caused a stratigraphic displacement of approximately 2,000 feet, as indicated from fusulinid collections. The Flat Canyon fault apparently occurred prior to the main Wasatch fault, because the Wasatch fault cuts across Flat Canyon with no apparent displacement. South of the Dream Mine is a large down-faulted block of the Oquirrh formation, which probably represents a stratigraphic displacement of several thousand feet.

Undoubtedly several other faults are in the area mapped, but rather than infer faults from sketchy and incomplete indications, the writer has only indicated the ones for which there is clear evidence.

SUMMARY OF GEOLOGIC HISTORY

The geologic history of the mapped and adjacent areas has been well covered in geologic literature. Nolan (1943), Spieker (1946, 1949), Baker, Huddle, and Kenny (1949), Eardley (1951), Bissell (1953), and Hunt (1956) have all written in some detail concerning the geologic events of Central Utah. In this summary the writer will present only the events that are in evidence of having taken place in the area mapped.

Central Utah was the site of a rapidly subsiding basin during early Pennsylvanian time. A tremendous thickness (12,000-26,000 feet) of calcareous and arenaceous sediments was deposited in this subsiding basin. Deposition of the Oquirrh formation continued uninterruptedly into Permian time. The Oquirrh formation is an enigma, not only for its tremendous thickness, but also for the alternating quartzite and limestone beds with only insignificant amounts of shale.

Some time in the Permian, the environment of deposition changed and thinly laminated, limy muds were deposited and were later brecciated due to slumping. This change in lithology is evidenced in the Kirkman limestone. Thick lenses of sand were then deposited (Diamond Creek sandstone) as the littoral zone moved westward. Late in the Permian there was a reinvasion of the sea from the west and the Park City formation was deposited as a limy clastic sediment with abundant silica.

In early Triassic or late Permian time there was probably a slight local uplift which caused the absence of the upper part of the Park City formation in the area mapped. The Woodside shale was deposited in a shallow shelf environment. The Thaynes limestone was laid down under marine conditions that were followed by an emergent shelf deposition of the Ankareh shale. The Nugget sandstone is an indicator of arid conditions. No rocks of Cretaceous age are found because the area was probably undergoing erosion during this period.

The Wasatch Mountains were folded into an anticlinal structure during the Late Cretaceous. The Paleozoic and Mesozoic east-dipping beds were eroded, and conglomerate (North Horn formation) was deposited in the valley. As flood plains were built up, a fresh water lake was formed in which the Flagstaff limestone was deposited on top of the coarse conglomerates. Volcanics were then deposited, exposed to erosion, and spread as volcanic conglomerate upon the Flagstaff limestone.

During the late Tertiary Basin and Range normal faulting, the Wasatch frontal scarp was formed by the down-faulting of the western limb of the anticlinal fold. Alluvial fans formed along the scarp and were later cut or covered by Lake Bonneville, which left terraces and benches all along the Wasatch front and up Spanish Fork Canyon as far as Thistle.

ECONOMIC GEOLOGY

THE DREAM MINE

A large amount of money and effort have been invested by the Koyle Mining Company, over a period of 60 years, in the Dream Mine, located between Water Canyon and Flat Canyon in the mapped area. A respectable mill has been built, and the property has been improved by roads and new tunneling. Six prospect pits and tunnels are located on the mountain directly east of the Dream Mine. The main Dream Mine tunnel extends in an easterly direction for more than 3,000 feet. It is estimated by the writer, that more than 5,000 feet of tunneling and shafts have been excavated since 1894, when the work first began. Although extensive prospecting has taken place in and around the Dream Mine, no ore has been produced. The geologic environment indicates very little possibility of ore ever being found.

WATER

Springs located in the mouth of Water Canyon, adjacent to the mapped area, supply culinary water to the town of Salem. The Cold Springs located in Spanish Fork Canyon provide the city of Spanish Fork with culinary water. The Castilla Springs, which are hot sulphur water, have been used for many years for medicinal bathing. Numerous springs located in The Pasture area provide a perennial water supply to the cattle grazed there. No springs are found in Pole Canyon, even though it drains a considerable area. The writer believes that the surface water drains off underground through the Kirkman limestone towards the Spanish Fork River. A good water supply could probably be developed in Pole Canyon by drilling a shallow well near the mouth of the canyon.

PETROLEUM POSSIBILITIES

The possibilities of finding oil in the area cannot be ascertained with the present information. A small structure, the Shurtz Canyon ridge anticline, occurs in the area; however the folding is thought to be too tight to provide a good reservoir for oil accumulation. Several samples of the Kirkman limestone and Oquirrh formation, collected along Loafer Ridge, gave off a sweet petroliferous odor when fractured. A fusulinid sample (RR-10) was stained with petroleum and had a pronounced petroliferous odor. If the Wasatch Mountains are truly the east-dipping limb of a large anticlinal fold, the possibility exists that beneath Utah Valley an oil reservoir may be trapped in the Pennsylvanian and Permian formations.

SELECTED REFERENCES

Baker, A. A., and Williams, J. S. (1940) Permian in parts of Rocky Mountain and Colorado Plateau regions: Am. Assoc. Petroleum Geologists Bull., v. 24, p. 617-635

______ and others (1947) Stratigraphy of the Wasatch Mountains in the vicinity of Provo, Utah: U. S. Geol. Survey Oil and Gas Invest. Prelim. Chart #30

______ (1949) Paleozoic geology of north and west sides of Uinta Basin, Utah: Am. Assoc. Petroleum Geologists Bull., v. 33, p. 1161-1197

Bissell, H. J. (1952) Stratigraphy and structure of the northeast Strawberry Quadrangle, Utah: Am. Assoc. Petroleum Geologist Bull., v. 36, p. 575-634

______ (1953) Summary of the structural evolution of Utah Lake Basin, Central Utah: The Compass of Sigma Gamma Epsilon, v. 31, p. 23-33

Boutwell, J. M. (1912) Geology and ore deposits of the Park City district, Utah: U. S. Geol. Survey Prof. Paper 77, 231 p.

Bushman, J. R. (1950) Unpublished field notes

Campbell, M. R. (1922) Guide book of the Western U. S., part E, the Denver & Rio Grande Western route: U. S. Geol. Survey Bull. 707, p. 185-242

Davis, W. M. (1903) Mountain ranges of the Great Basin: Harvard Coll. Mus. Comp. Zool. Bull. 42, (g. s. 6) p. 129-177

Eardley, A. J. (1932) A limestone chiefly of algal origin in the Wasatch conglomerate, southern Wasatch Mountains, Utah: Michigan Academy of Science Paper, v. 16, p. 399-414

______ (1934) Structure and physiography of the southern Wasatch Mountains, Utah: Michigan Academy of Science Paper, v. 19, p. 377-400

Emmons, S. F. and others (1893) Geological guide book of the Rocky Mountain excursion: 5th International Geol. Congress, p. 381-402

Gilbert, G. K. (1890) Lake Bonneville: U. S. Geol. Survey Monograph 1, 430 p.

Gilluly, J. (1932) Geology and ore deposits of the Stockton and Fairfield Quadrangle, Utah: U. S. Geol. Survey Prof. Paper 173, p. 34-38

Harris, H. D. (1954) Geology of the Birdseye area, Utah: The Compass of Sigma Gamma Epsilon, v. 31, p. 189-208

Hodgson, R. M. (1951) Geology of the Wasatch Mountain front in the vicinity of Spanish Fork Canyon, Utah: The Compass of Sigma Gamma Epsilon, v. 29, p. 47-55

Howell, E. E. (1875) Report on the geology of portions of Utah, Nevada, Arizona, and New Mexico: U. S. Geog. and Geol. Survey West of 100th Meridian (Wheeler) 3, p. 227-301

Hunt, C. B. (1956) Cenozoic geology of the Colorado Plateau: U. S. Geol. Survey Prof. Paper 279, 99 p.

Metter, R. E. (1955) The geology of a part of the Southern Wasatch Mountains: Unpublished Ph. D. Thesis, Ohio State University, 244 p.

Muessig, S. J. (1951) Geology of a part of Long Ridge, Utah: Unpublished Ph. D. Thesis, Ohio State University, 213 p.

Nolan, T. B. (1943) The Basin and Range province in Utah, Nevada, and California: U. S. Geol. Survey Prof. Paper 197-D, p. 141-196

Peterson, P. R. (1952) Geology of the Thistle area, Utah: Unpublished M. A. Thesis, Brigham Young University

Schneider, H. and Perkes, W. E. (1937) Meteorite craters in Spanish Fork Canyon: Utah Academy of Science Proc. 14, p. 61

Schoff, S. L. (1951) Geology of the Cedar Hills, Utah: Geol. Soc. America Bull., v. 62, p. 619-646

Spieker, E. M. (1946) Late Mesozoic and Early Cenozoic history of Central Utah: U. S. Geol. Survey Prof. Paper 205-D, p. 117-161

_____ (1949) Guide book to the geology of Utah: Utah Geological Society, no. 4, 81 p.

Thompson, H. D., Verville, G. J. & Bissell, H. J. (1950) Pennsylvanian fusulinids of the South-Central Wasatch Mountains, Utah: Jour. Paleontology, v. 24, p. 430-465

APPENDIX

The following section in the Oquirrh formation was measured, in the Spring of 1950, by Mr. Jess R. Bushman. He measured over 3,000 feet of the formation from the oldest exposed rocks in the mouth of Water Canyon to where the outcrops disappeared beneath slope wash and vegetation higher up the canyon. Sections were measured alternately from one side of the canyon to the other, depending upon the best outcrop exposure. The fossil identifications are by M. K. Elias, H. J. Bissell, and J. R. Bushman. The description below reads from the highest stratigraphic unit to the lowest.

Bed	Description	Thickness (feet)	Cumulative Thickness
58	Limestone, olive gray weathering to pale yellowish brown, thin bedded with platy partings, brachiopods and worm trails?	339	3005
57	Limestone, medium gray weathering to light gray, silty, massive, brachiopods, corals, *Triticites springvillensis*	35	2666
56	Quartzite, pale yellowish brown weathering to same color, calcareous cement	82	2631
55	Quartzite and sandstone, yellowish gray, weathers to same color, limy near top, slope former	92	2549
54	Limestone, brownish gray weathering to pale brown, silty, thin to massive bedded, seamed with calcite veinlets, cliff former, brachiopods, bryozoans, corals	81	2457
53	Limestone, medium light gray weathering to medium dark gray, massive, calcite veinlets, prominent outcrop	6	2376

Bed	Description	Thickness (feet)	Cumulative Thickness
52	Limestone, medium light gray weathering to light olive gray, sandy, massive, slope former	110	2370
51	Quartzite, yellowish gray weathering to same color, cross-bedded, vertically jointed, cliff former	38	2260
50	Limestone, medium gray weathering to olive gray, sandy, massive, cliff former	40	2222
49	Quartzite, light olive gray weathering to same color, calcareous cement, slope former	34	2182
48	Sandstone, light olive gray weathering to pale yellowish brown, limy, thin-bedded, partial cliff former	23	2148
47	Quartzite, olive gray weathering to yellowish gray, sandy on weathered surfaces, calcareous cement, cliff former	193	2125
46	Limestone, dark greenish gray weathering to light olive gray, silty, massive, chert nodules, brachiopods and bryozoans	4	1932
45	Quartzite, light yellow gray weathering to same color, cross-bedded, vertically jointed, partial cliff former	120	1928
44	Covered	129	1808
43	Sandstone, light olive gray weathering to olive gray, brachiopods and crinoids	109	1679

Bed	Description	Thickness (feet)	Cumulative Thickness
42	Limestone, olive gray weathering to pale yellowish brown, sandy, sand stringers and nodules, brachiopods, corals, crinoids	37	1570
41	Quartzite, light gray weathering to light olive gray, calcareous, massive	19	1533
40	Sandstone, yellowish gray weathering to same color, limy, white pisolitic forms near top	14	1514
39	Quartzite, yellowish gray weathering to same color, calcareous cement, cliff former	35	1500
38	Covered	36	1465
37	Quartzite, light olive gray weathering to olive gray, calcareous	11	1429
36	Limestone, medium gray weathering to brownish gray, sandy and silty, white calcite veins, nodular and lenticular chert, bryozoans, corals, crinoids, <u>Fusulina</u> <u>sp</u>.	74	1418
35	Sandstone, medium gray weathering to medium light gray, silty, limy, nodular and lenticular chert, slope former, crinoids	18	1344
34	Limestone, medium gray weathering to light gray, silty and sandy, massive, good horizon marker, extends from Flat Canyon south to Maple Canyon, underlain by thin bed of silty shale making it stand out as an abrupt cliff, <u>Triticites</u>	12	1326
33	Quartzite, yellowish gray weathers to same color, cross-bedded, vertically jointed	104	1314

Bed	Description	Thickness (feet)	Cumulative Thickness
32	Limestone, medium dark gray weathering to light olive gray, silty, Fusulina	19	1210
31	Limestone and chert, medium dark gray weathering to medium light gray, chert in beds 1/2 inch to 2 inches thick, sandy, brachiopods, bryozoans, crinoids	81	1191
30	Quartzite, yellowish gray weathering to same color, cross-bedded	41	1110
29	Limestone, medium gray weathering to medium light gray, sandy, corals, and crinoids	24	1069
28	Quartzite, yellowish gray weathering to same color, cross-bedded	84	1045
27	Limestone, grayish black weathering to dark gray, few large chert nodules	6	961
26	Dolomite, medium dark gray weathering to medium light gray, banded, white crystalline dolomite bands	9	955
25	Quartzite, pale yellowish brown weathering to yellowish gray, vertically jointed	35	946
24	Limestone, olive gray weathering to pale yellowish brown, silty, some chert, slope former	76	911
23	Limestone, dark gray weathering to pale yellowish brown, inter-bedded shaly sand with some chert, abundant bryozoans: Pinneretepora trilineata, Fenestella stabilis, Fenestella elongata, Rhombotrypella nikiforovae, crinoids, sponges	51	835

Bed	Description	Thickness (feet)	Cumulative Thickness
22	Quartzite, light olive gray weathering to pale yellowish brown, alternating cliff former and slope former	115	784
21	Dolomite, light gray weathering to yellowish gray, sandy	3	669
20	Quartzite, yellowish gray weathering to same color, limy, thin-bedded with some cross-bedding, vertically jointed	100	666
19	Limestone, medium gray weathering to light olive gray, silty, chert nodules, brachiopods, corals, crinoid stems, <u>Syringopora</u> abundant	10	566
18	Quartzite, light olive gray weathering to same color, cliff former, vertically jointed, cross-bedded	51	556
17	Limestone, medium dark gray weathering to light gray, fine-grained, massive, few chert nodules, distinctive marker bed	5	505
16	Limestone, medium dark gray weathering to medium light gray, sandy, cliff former, crinoid stems and brachiopods	61	500
15	Dolomite, medium light gray weathering to yellowish gray, sandy, cross-bedded in part, cliff former and prominent marker	67	439
14	Chert, dark gray weathering to light brown, interbedded with thin sandy limestone, cliff former	34	372
13	Limestone, medium dark gray weathering to yellowish gray, sand stringers, crinoids, some nodular and lenticular chert	16	338

Bed	Description	Thickness (feet)	Cumulative Thickness
12	Limestone, medium dark gray weathering to medium light gray, silty, thin-bedded, cherty, slope former	21	322
11	Limestone, medium dark gray weathering to light gray, silty, cherty, Spirifer rockymontanus, Linoproductus sp., Rhombopora, Spiriferina Kentuckyensis, Fistulipora, Spiriferina sp.	4	301
10	Limestone, medium gray weathering to light gray, sandy, nodular and lenticular chert, Fenestrellina sp., Linoproductus	23	297
9	Limestone, medium gray weathering to light gray, fetid odor, Rhombopora, Fistulipora rockymontanus, Carbonaria, Fusulinella	27	274
8	Limestone, medium dark gray weathering to dark gray, shaly, thin-bedded, cherty, crinoids	24	247
7	Dolomite, medium gray weathering to pale yellowish brown, silty, chert nodules, Neospirifer, Spirifer rockymontanus, crinoid stems	15	223
6	Quartzite, yellowish gray weathering to same color, cross-bedded, vertically jointed	67	208
5	Dolomite, medium light gray weathering to yellowish gray, sandy, corals	10	141
4	Limestone, medium dark gray weathering to yellowish gray, cherty, silty, Productids, Marginifera? crinoid stems	52	131

Bed	Description	Thickness (feet)	Cumulative Thickness
3	Chert and limestone, dark gray weathering to medium dark gray, silty, chert dominates over limestone, cliff former	40	79
2	Limestone, medium dark gray weathering to medium light gray, sandy, massive, inter-bedded with nodular and lenticular black chert, crinoid stems	28	39
1	Dolomite, medium light gray weathering to same color, sandy, massive, coarsely crystalline texture, some calcite stringers	11	11
	Total measured section	3005	

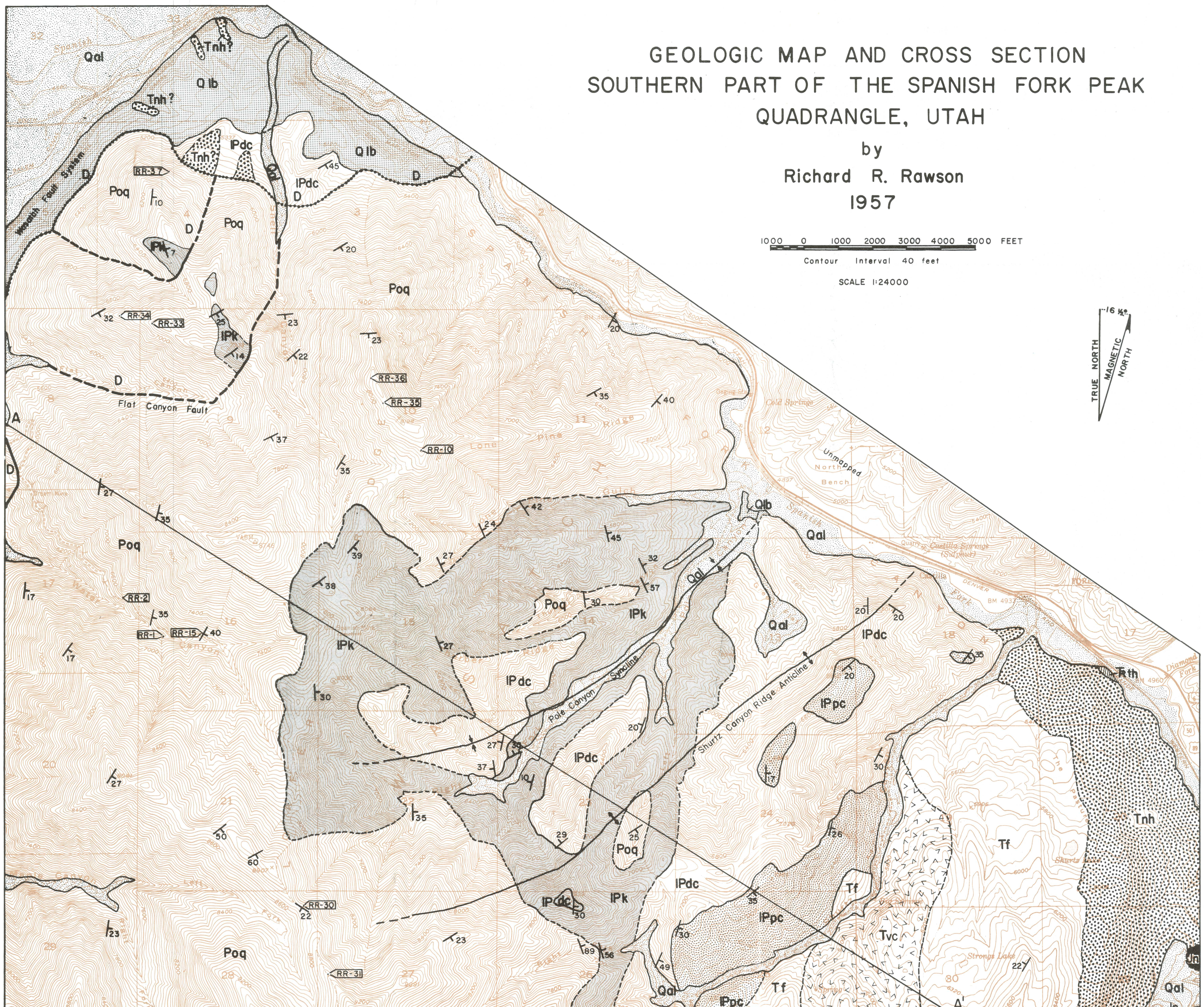
GEOLOGIC MAP AND CROSS SECTION SOUTHERN PART OF THE SPANISH FORK PEAK QUADRANGLE, UTAH

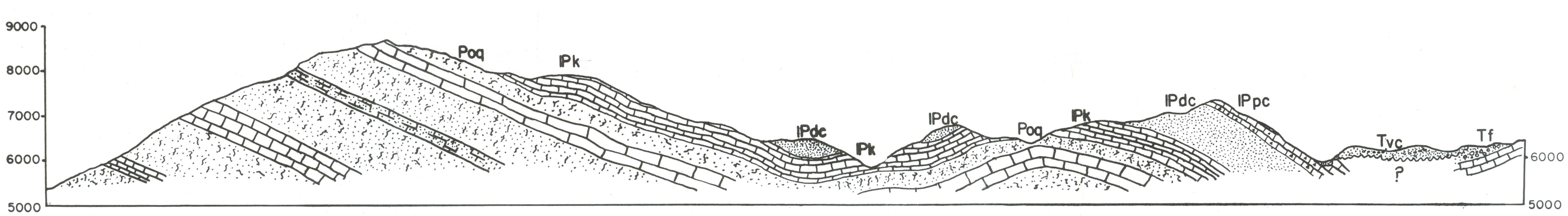
by

Richard R. Rawson

1957

PLATE III





Section along A—A'

EXPLANATION

SEDIMENTARY ROCKS

QUATERNARY

- Qal — Alluvium
- Qlb — Lake Bonneville group

TERTIARY

- Tvc — Volcanic Conglomerate
- Tf — Flagstaff limestone
- Tnh — North Horn formation

JURASSIC

- Jn — Nugget sandstone

TRIASSIC

- Ꞅth — Thaynes limestone

PERMIAN

- IPpc — Park City formation
- IPdc — Diamond Creek sandstone
- IPk — Kirkman limestone

PENN.

- Poq — Oquirrh formation

SYMBOLS

- Dip and strike (10)
- Adit
- Fault: dots = covered, dashes = approx. location, D = downthrown side
- Fossil locality (RR-10)
- Spring