UTAH GEOLOGICAL AND MINERALOGICAL SURVEY
AFFILIATED WITH
THE COLLEGE OF MINES AND MINERAL INDUSTRIES
UNIVERSITY OF UTAH
SALT LAKE CITY, UTAH

GEOLOGY OF THE SOUTHERN STANSBURY RANGE

TOOELE COUNTY, UTAH

by

John A. Teichert

Bulletin 65 May, 1959

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UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

The Utah Geological and Mineralogical Survey was authorized by act of the Utah State Legislature in 1931; however, no funds were made available for its establishment until 1941 when the State Government was reorganized and the Utah Geological and Mineralogical Survey was placed within the new State Department of Publicity and Industrial Development where the Survey functioned until July 1, 1949. Effective as of that date, the Survey was transferred by law to the College of Mines and Mineral Industries, University of Utah.

The *Utah Code Annotated 1943, Vol. 2, Title 34,* as amended by *chapter 46 Laws of Utah 1949*, provides that the Utah Geological and Mineralogical Survey "shall have for its objects":

1. "The collection and distribution of reliable information regarding the mineral resources of the State.

2. "The survey of the geological formations of the State with special reference to their economic contents, values and uses, such as: the ores of the various metals, coal, oil-shale, hydro-carbons, oil, gas, industrial clays, cement materials, mineral waters and other surface and underground water supplies, mineral fertilizers, asphalt, bitumen, structural materials, road-making materials, their kind and availability; and the promotion of the marketing of the mineral products of the State.

3. "The investigation of the kind, amount, and availability of the various mineral substances contained in State lands, with a view of the most effective and profitable administration of such lands for the State.

4. "The consideration of such other scientific and economic problems as, in the judgment of the Board of Regents, should come within the field of the Survey.

5. "Cooperation with Utah state bureaus dealing with related subjects, with the United States Geological Survey and with the United States Bureau of Mines, in their respective functions including field investigations, and the preparation, publication, and distribution of reports and bulletins embodying the results of the work of the Survey.

6. "The preparation, publication, distribution and sale of maps, reports and bulletins embodying the results of the work of the Survey. The collection and establishment of exhibits of the mineral resources of Utah.

7. "Any income from the sale of maps and reports or from gifts or from other sources for the Survey shall be turned over to the State Treasurer and credited by him to a fund to be known as the Survey Fund to be used under the direction of the Director of the Survey for publication of maps, bulletins or other reports of investigation of the Geological and Mineralogical Survey."

The Utah Geological and Mineralogical Survey has published maps, circulars, and bulletins as well as articles in popular and scientific magazines. For a partial list of these, see the closing pages of this publication. For other information concerning the geological and mineralogical resources of Utah address:

ARTHUR L. CRAWFORD, *Director*

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

College of Mines and Mineral Industries

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Salt Lake City, Utah

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F O R E W O R D

For each bulletin of the Utah Geological and Mineralogical Survey, I have the privilege of introducing the author, the treatise, or the setting. In this case the author and the area combine with history to give the Southern Stansbury Mountains of Utah and this treatise more than geologic significance.

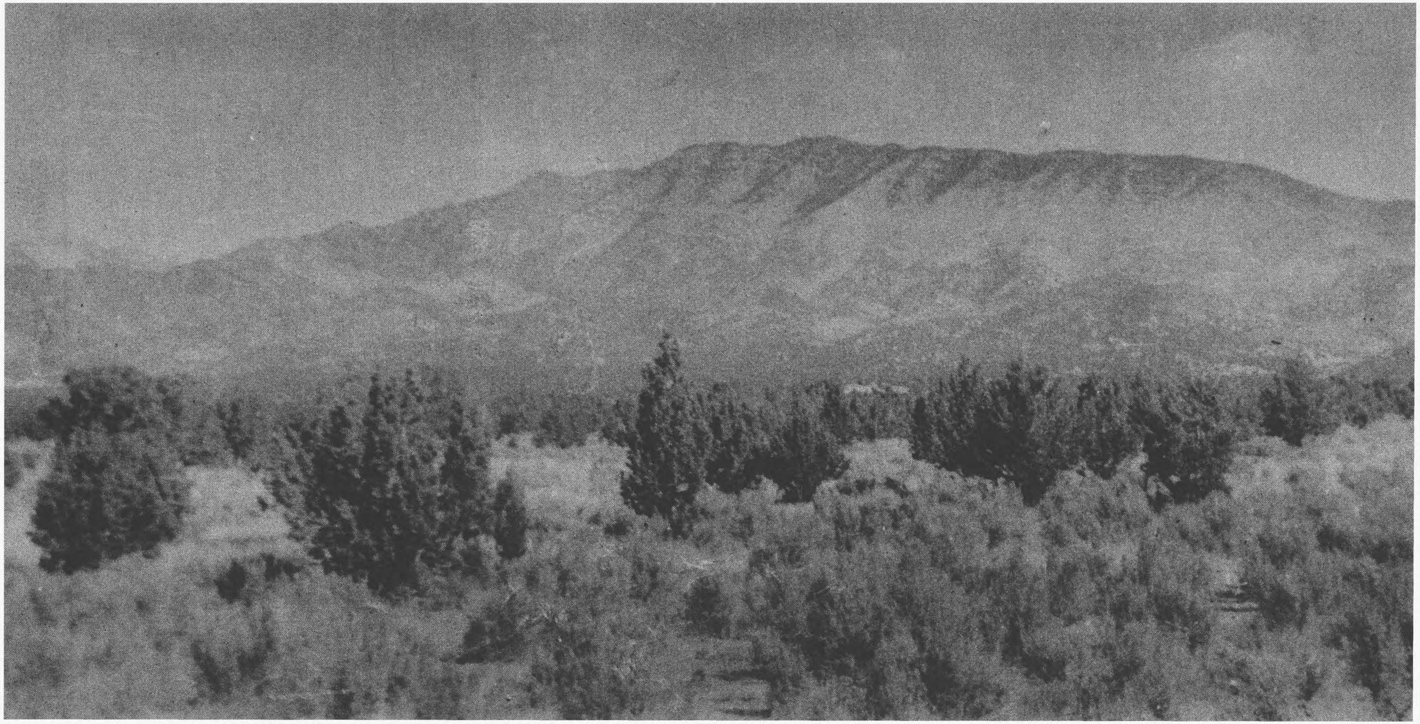
Like "The Virginian" of his native state, the author of this bulletin is a Wyoming cowboy—tall, taciturn, and purposeful. He was drawn to the region of his study by the invisible ties of youthful dreams, the fabric of which was spun from the curiosity to know the haunts of a famous ancestor—Bill Hickman, from whom Hickman Canyon, Indian Hickman, and Hickman Pass derive their names, Like many another bold, courageous, and extremely versatile frontiersman, Bill Hickman ran afoul of the law, but not before he had made many significant contributions to the winning of the West—not the least of which was his part in the establishment of the prototype for all western scenarios, the fabulous, hair-raising pony express for the U.S. mail. In his heyday Hickman was the Kit Carson of the Mormon frontiersmen. Another equally famous character of undaunted nerve was Porter Rockwell, who settled in the same area and became Hickman's neighbor, "just over the mountain" on the line of the pony express.

For cool, daredevil boldness, Hickman had few equals. In Missouri, at the age of thirteen, he knifed a charging wild boar and with the help of his faithful hunting dog subdued and killed him. At the age of fifteen, he stabbed a panther rather than to risk one of his hounds in a melee too thick for shooting. This foolhardy foray narrowly missed costing Hickman his life. The wild slash of the panther's paw ripped off part of his clothing but fortunately missed Hickman's flesh.

As an Indian fighter Hickman rallied the remnants of an ambushed train of emigrants to strike terror into the attacking savages by whom he became known as a great war chief. It was this fearless, indomitable courage, coupled with his intimate knowledge of the endurance of horse and man, of the terrain over which they would have to pass, and of the Indians they would have to outrun or outwit, that gave him the courage during the winter of 1856-57 to join with Hiram Kimball and Porter Rockwell to secure a contract to carry the mail from Independence, Missouri, to Salt Lake City, Utah.

Hickman's record is a tragedy in human psychology—of how a brilliant, versatile, courageous, intensely human and likable character, overstimulated by the misguided zeal of leadership, can progress by insensible stages from strenuous happy living in prosperity to the violent deeds of a desperate man hotly pursued. His surrender to Sam Gilson (another colorful moulder of the West), his sojourn at Fort Douglas, and his eventual death and burial at Lander, Wyoming in August, 1883, are fascinating drama. There is touching human interest—even pathos—in the return of John A. Teichert to the hideout of his ancestor for a challenging study of the rocks and cliffs of this wild domain.

Arthur L. Crawford, Director
UTAH GEOLOGICAL AND MINERALOGICAL SURVEY



Frontispiece. West side of the Stansbury Range, as viewed from Skull Valley.

G E O L O G Y O F T H E S O U T H E R N
S T A N S B U R Y R A N G E
TOOELE COUNTY, UTAH[1]

by

John A. Teichert

A B S T R A C T

The Stansbury Mountains consist of a single north-south trending range located west of Tooele, Utah. Approximately 70 square miles of the Southern Stansbury Mountains were mapped and studied for this report. A section of Paleozoic rocks, in excess of 27,000 feet, is present. This includes 4,800+ feet of Cambrian (not including several thousand feet of unmeasured Tintic quartzite), 1,600+ feet of Ordovician, 600+ feet of Silurian, 600+ feet of Devonian, 3,400+ feet of Mississippian (not including 1,200+ feet of unmeasured Manning Canyon shale), and 14,000+ feet of Pennsylvanian.

Due to a pre-Mississippian uplift, Ordovician, Silurian, and Devonian rocks are absent in the central part of the range. The basal Mississippian rocks rest unconformably on Cambrian beds. Late Devonian beds, where present, are represented by a coarse conglomerate referred to as the Stansbury conglomerate. This formation, which is hundreds of feet thick at the north end of the range, thins to a few tens of feet at the south end.

Precambrian, Mesozoic, and Tertiary rocks are not exposed in the area studied. Quaternary deposits include: pre-Lake Bonneville fan gravels, Lake Bonneville beds, creep and glacial deposits, Recent sand dune deposits and alluvium.

Structurally the range consists of a north-south anticline. At the south end following folding, the west limb was removed by Laramide thrusting. Also during the Laramide period, high angle northwest-southeast normal faulting occurred. Later Basin and Range normal type faults roughly parallel the Laramide faults and fold structures.

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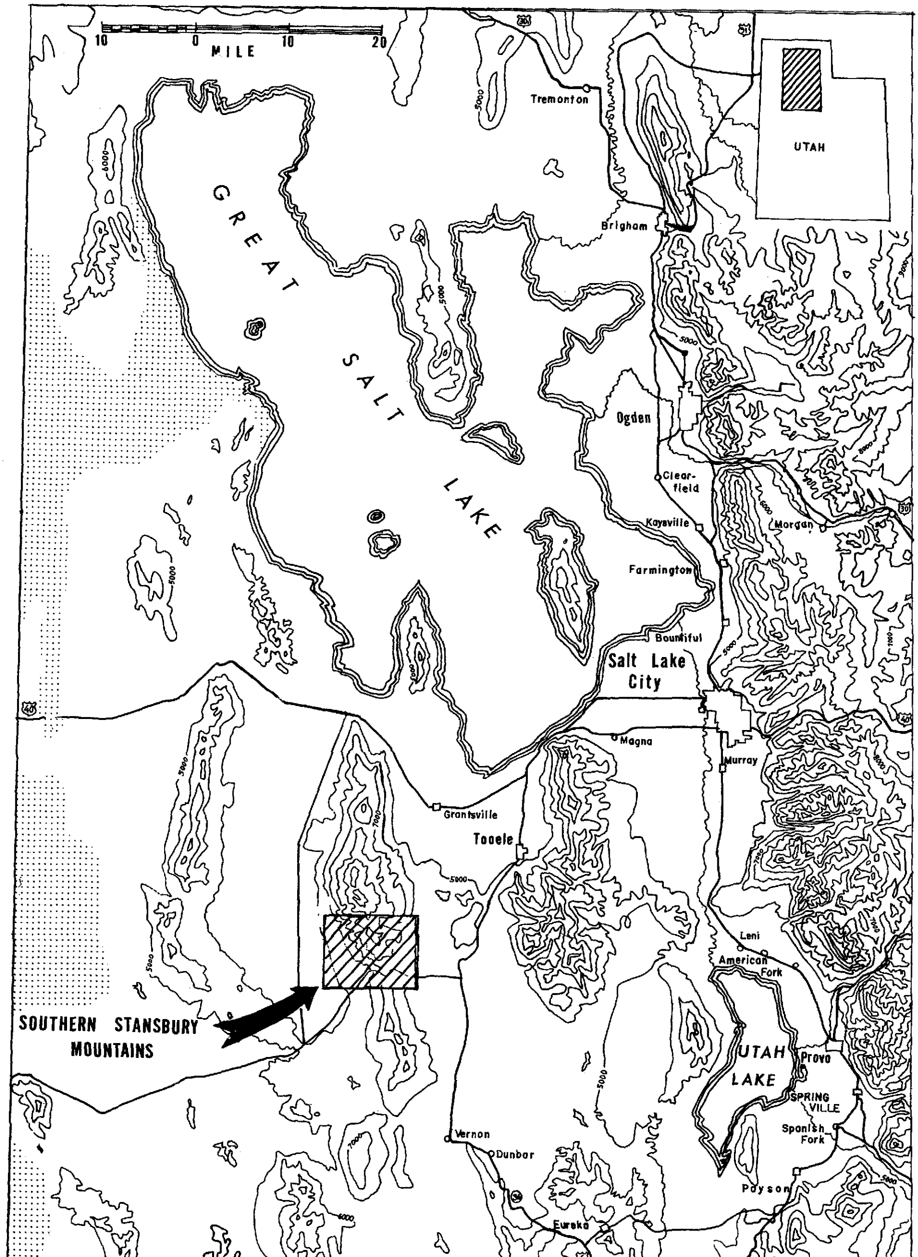
[1]Adapted from a Master's thesis submitted to the Department of Geology, University of Utah, 1958.



Index Map Showing the Location of

SOUTHERN STANSBURY MOUNTAINS

Figure 1.

INTRODUCTION

LOCATION

The area described in this report includes approximately 60 square miles at the southernmost end of the Stansbury Range, and is approximately 10 miles south of Grantsville and 20 miles southwest of Tooele. The Stansbury Range consists of a north-south trending range situated in the eastern part of Tooele County, Utah, in the northeastern part of the Basin and Range province. The range is 25 miles long and in the area considered in this report is approximately 10 miles wide.

The Stansbury Range is separated from the Onaqui Mountains to the south by a low divide known as Johnson Pass. The area is easily accessible from Utah Highway 58 which traverses the southern periphery through Johnson Pass and connects Rush and Skull Valleys. Utah Highway 36 parallels the range on the east side. Graded and primitive roads extend up several of the canyons from both Rush and Skull Valleys.

CLIMATE AND VEGETATION

The Stansbury Range displays great variation of temperature and precipitation. No record of precipitation is present for the area, but the average annual precipitation for nearby Tooele is 16.75 inches. Arid to semi-arid conditions prevail in the valley floor and on the low slopes while precipitation at higher elevation is ample for heavy vegetation. Over 5,000 feet of relief is represented from the valley floor to the highest peaks, and snow remains on the high slopes as late as mid-July.

The vegetation is as varied as the climate. Species of sagebrush (_Artemisia_) are the most prominent plants in the region and are found at all elevations. Various grasses and shrubs intergrowing with the sage are abundant. The Juniper (_Juniperus utahensis_) is the most common tree. Aspen, cottonwood, chokecherry, mahogany, douglas fir, white fir and limber pine, as well as various flowering plants, cacti, and grasses, also occur. Douglas and white fir of sufficient quality and quantity to support a lumbering operation are found in Dry Canyon, on the west side of the range.

The area supports a limited amount of both stock raising and dry farming, and Clover Creek which flows into Rush Valley at the south end of the Stansbury Range furnishes irrigation and culinary water for the communities of Clover and St. John. Several other small streams furnish sufficient water for irrigation of smaller acreage, not to mention the probable great amount that is removed from the area underground

PREVIOUS WORK AND EXPLORATION

The Stansbury Mountains and vicinity were explored briefly by the early pioneer geologists. In reports written before 1900 the Onaqui Range south of Johnson Pass, and the Stansbury Range, which lies north of Johnson Pass, are referred to as the "Onaqui Mountains," and Johnson Pass is called "Reynold's Pass." Brief mention of the range is made by G. K. Gilbert (1890) and by Howell writing in the report of the Wheeler Survey (Wheeler, 1875, pp. 26-27 and 238-239).

King's Fortieth Parallel Report (1877) contains a reconnaissance geologic map (Map 111) of the Stansbury Range, or "Onaqui Mountains." The range is interpreted to be a N-S trending anticline with the abrupt change from east-dipping beds of the Stansbury Mountains to west-dipping in the Onaqui Mountains explained and shown on Plate II by a sudden change of direction in the axis of the anticline.

The rocks in the vicinity of "Reynold's Pass" are described by King as belonging to the Paleozoic "Wasatch Formation." The report also states that "a body of white quartzite not less than 6,000 feet thick is found on Bonneville Peak" (pp. 456-457).

In 1890, G. K. Gilbert's classic monograph was published which describes the Lake Bonneville embankment in Rush and Skull Valleys, and briefly mentions the fault structure on the west side of the range, comparing it with similar displacements in the Oquirrh and Wasatch Ranges.

Gilluly (1932) studied the Oquirrh Range in detail, and much of the stratigraphic terminology that he proposed is used in this report. The work of Nolan (1935) in the Gold Hill and more recently the work of R. Cohenour (1957 unpublished Doctoral thesis) on the Sheeprock Range have greatly assisted the author in recognizing and describing the various formations.

Three Masters' theses have been based on nearby areas: Hubert C. Lambert (University of Utah, 1941) made a study of the structure and stratigraphy of the southern Stansbury Range, in the vicinity of Deseret Peak and Willow Creek; Dwight E. Arnold (University of Utah, 1956) made a study of the geology of the northern Stansbury Range in the vicinity of Flux and Dolomite; and Mack G. Croft (Brigham Young University, 1956) made a study of the geology of the northern Onaqui Mountains, immediately south of Johnson Pass.

PURPOSE

Primary purpose of this investigation was to obtain a detailed and paleontologically dated stratigraphic section of the area, and to establish correlation with neighboring areas, particularly those investigated by students and faculty of Brigham Young University in the Ophir area of the Oquirrh Range. With completion of work in other neighboring regions new areas of correlation were added. The original area was extended to the north in order to include the pre-Mississippian unconformity of the central part of the Stansbury Range and to obtain a more complete Cambrian and Ordovician section.

Secondary purpose of this investigation was to obtain information pertaining to the structure of the Stansbury Range, and its geologic relationship to the Onaqui Range.

FIELD WORK

Field work was carried on intermittently from June, 1955 through November, 1957. Stratigraphic sections were measured by Brunton-tape traverse. Formation contacts, faults and other pertinent information were plotted on aerial photographs taken in 1940 for the U. S. Forest Service (Scale 1:20,000). A blue-line U. S. G. S. topographic map (Scale 1:48,000) was available and upon enlarging (Scale 1:20,000) served as the base map to which information was transferred directly from the photographs.

A C K N O W L E D G E M E N T S

Special appreciation is given to Dr. William Lee Stokes and Dr. Francis W. Christiansen of the University of Utah for their advice and criticism in the field, and in the preparation of the final manuscript.

An expression of gratitude is also due Dr. Armand J. Eardley, Dr. Leonard B. Sand, and Dr. Robert E. Cohenour for helpful suggestions in preparing this report.

The writer wishes to acknowledge the aid of Dr. Keith Rigby and Dr. Harold J. Bissell of the Brigham Young University under whose direction and assistance this project was begun.

Many thanks are due Roy Waite of Shell Oil Company for preparation of thin sections and identification, as well as assistance in the Silurian and Devonian correlation and fossil identiification.

The author is also indebted to Christina Lochman Balk, New Mexico School of Mines; Lehi Hintze, Brigham Young University; and Robert Bright, University of Minnesota for fossil identification.

Grateful recognition is extended the writer's wife, Dorothy, who assisted immeasurably in typing and in the preparation of illustrations.

SEDIMENTARY ROCKS OF THE SOUTHERN STANSBURY MOUNTAINS

System	Series	Formation	Thickness in feet
Quaternary	Recent Pleistocene	alluvium, sand dunes, Lake Bonneville deposits, fan gravels, slump and glacial debris, and landslides. . . .	unmeasured
Pennsylvanian	Virgil to Des Moines	Oquirrh formation	13,971.5+
	Unconformity	Manning Canyon shale.	unmeasured
Mississippian	Chester	Great Blue formation.	1,181.5
	Osage-Kinderhook	Humbug formation.	710.0
		Pine Canyon limestone	709.5
	Meramec	Upper Madison limestone	474.5
		Lower Madison dolomite.	370.0
		Total Madison.	844.5
		Total measured Mississippian . . .	2,601.0
Devonian	Upper	Stansbury-Pinyon Peak formation . . .	276.0
	Middle	Simonson dolomite	229.0
		Sevy dolomite	75.0
		Total Devonian	580.0
Silurian	Niagaran (?)	Laketown dolomite	614.5
		Total Silurian	614.5
Ordovician	Upper	Fish Haven dolomite	248.0
	Middle	Kanosh shale.	162.0
	Lower	Garden City formation	1,201.0
		Total Ordovician	1,611.0
Cambrian	Upper	Upper Cambrian undifferentiated . . .	1,813.4
	Middle	Cole Canyon formation	711.5
		Marjum formation.	298.5
		Wheeler formation	238.0
		Swasey limestone.	144.5
	Lower	Ophir group	647.0
		Tintic quartzite.	unmeasured
		Total measured Cambrian.	4,882.70
		Total Paleozoic not including Manning Canyon shale or Tintic quartzite.	24,075.8+

Figure 2.

S T R A T I G R A P H Y

A thick Paleozoic section is present in the southern Stansbury Mountains which contains rocks ranging in age from Early Cambrian through Pennsylvanian. Mississippian beds lie on the Cambrian at the very north extremity of the mapped area, but in the south, all the Paleozoic systems are represented. An accumulation of sedimentary formations in excess of 28,000 feet, consisting of limestone, quartzite, dolomite, sandstone, and shale, were deposited in a marine environment within the miogeosynclinal belt in this region.

The Paleozoic miogeosyncline was bounded on the west by the Manhattan geanticline of central Nevada and on the east by Kay's "Wasatch line," the hinge line between the negative crustal elements and the stable central interior. This represents a part of the Cordilleran geosyncline which was a long, narrow, sinuous, north-trending seaway extending from Alaska to and through Mexico. This major negative structural element was well developed at the beginning of Cambrian time, and except for minor oscillations, persisted through the middle of the Mesozoic era. Reid (1954) shows a deeper basin within this negative element in the vicinity of the Stansbury Range which he refers to as the "Oquirrh Basin."

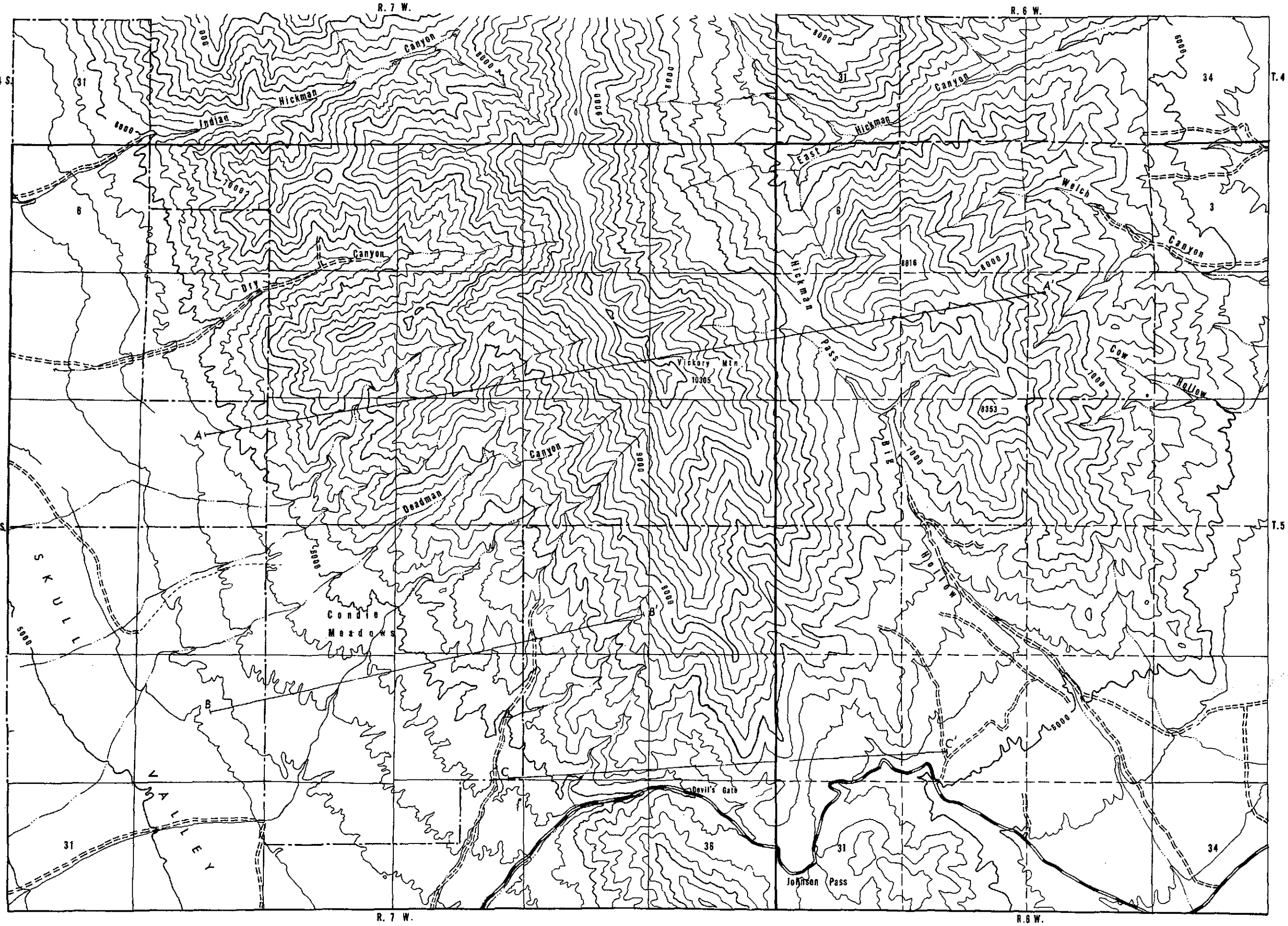
No Mesozoic rocks are present and the Cenozoic is represented only by Quaternary fluvial, lacustrine, aeolian, and morainal deposits.

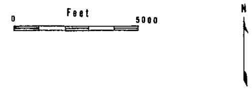
THE CAMBRIAN SYSTEM

A relatively complete Cambrian section is present in the southern Stansbury Mountains. The section begins with a thick section of Tintic, or Prospect Mountain quartzite, the base of which is not exposed. Above the uppermost quartzite ledge-former of the Tintic quartzite the following sequence is present: (1) a shale zone made up chiefly of green fissile shale with interbedded limestone, siltstone, and sandstone; (2) thin-bedded limestones consisting of platy beds one-fourth to two inches in thickness; (3) a zone of dolomite and limestone which varies in thickness from a few inches to several feet.

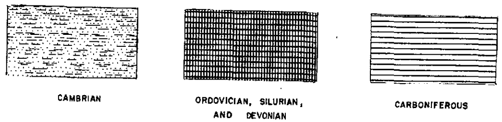
A thick clastic unit of quartzite appears at the base of the Cambrian throughout the Basin and Range province. This unit which is Precambrian in Nevada is of Early Cambrian age in Utah, indicating deposition in a slowly transgressing sea. The shale unit above the quartzite is Early Cambrian in Nevada and Middle Cambrian in Utah, rising in the time scale from west to east, as does the quartzite. The carbonates above the shale zone seem to be restricted to a specific time from Nevada eastward into Utah.

According to Wheeler (1951) the lowermost carbonate unit in the House Range is the Millard limestone. If the limestone formations are restricted by specific time boundaries, then the lowermost limestone in the Stansbury Range will be equivalent to the Millard limestone of the House Range. In the Stansbury Range this limestone


R. 7 W.
R. 6 W.
T. 4 S.
T. 5 S.
Indian Hickman Canyon
East Hickman Canyon
Welch Canyon
Dry Canyon
Hickman Pass
Vickory Mtn.
10305
8816
8353
Cow Hollow
Big Hollow
Deadman Canyon
Condie Meadows
SKULL VALLEY
Devil's Gate
Johnson Pass
A
A'
B
B'
C
C'
31
34
6
3
36
31
34
R. 7 W.
R. 6 W.



LEGEND



TOPOGRAPHIC MAP AND SECTIONS OF SOUTHERN STANSBURY MOUNTAINS TOOELE COUNTY, UTAH

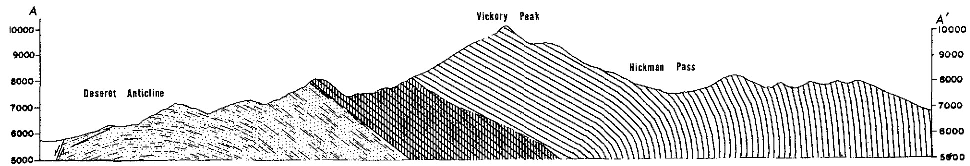
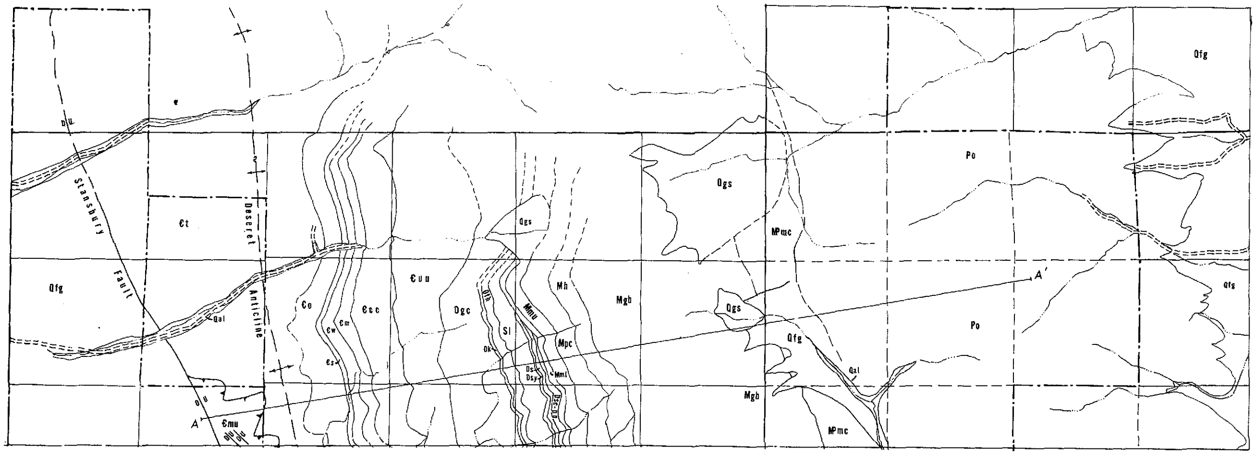
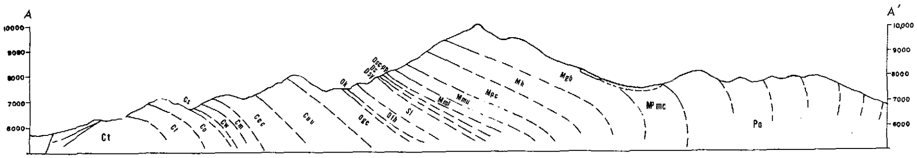


Plate I.





GEOLOGIC MAP AND SECTIONS OF SOUTHERN STANSBURY MOUNTAINS TOOELE COUNTY, UTAH

LEGEND

Quaternary
- Qal — ALLUVIUM
- Qrs — SAND DUNES
- Qgs — SLUMP & GLACIAL DEBRIS
- Qlb — LAKE BEDS
- Qfg — FAN GRAVEL
- Ql — LANDSLIDE DEPOSITS

Penn.
- Po — OQUIRRH FORMATION
- MPmc — MANNING CANYON SHALE

Mississippian
- Mgb — GREAT BLUE FORMATION
- Mh — HUMBUG FORMATION
- Mpc — PINE CANYON LIMESTONE
- Mmu — MADISON LIMESTONE (UPPER)
- Mml — MADISON LIMESTONE (LOWER)

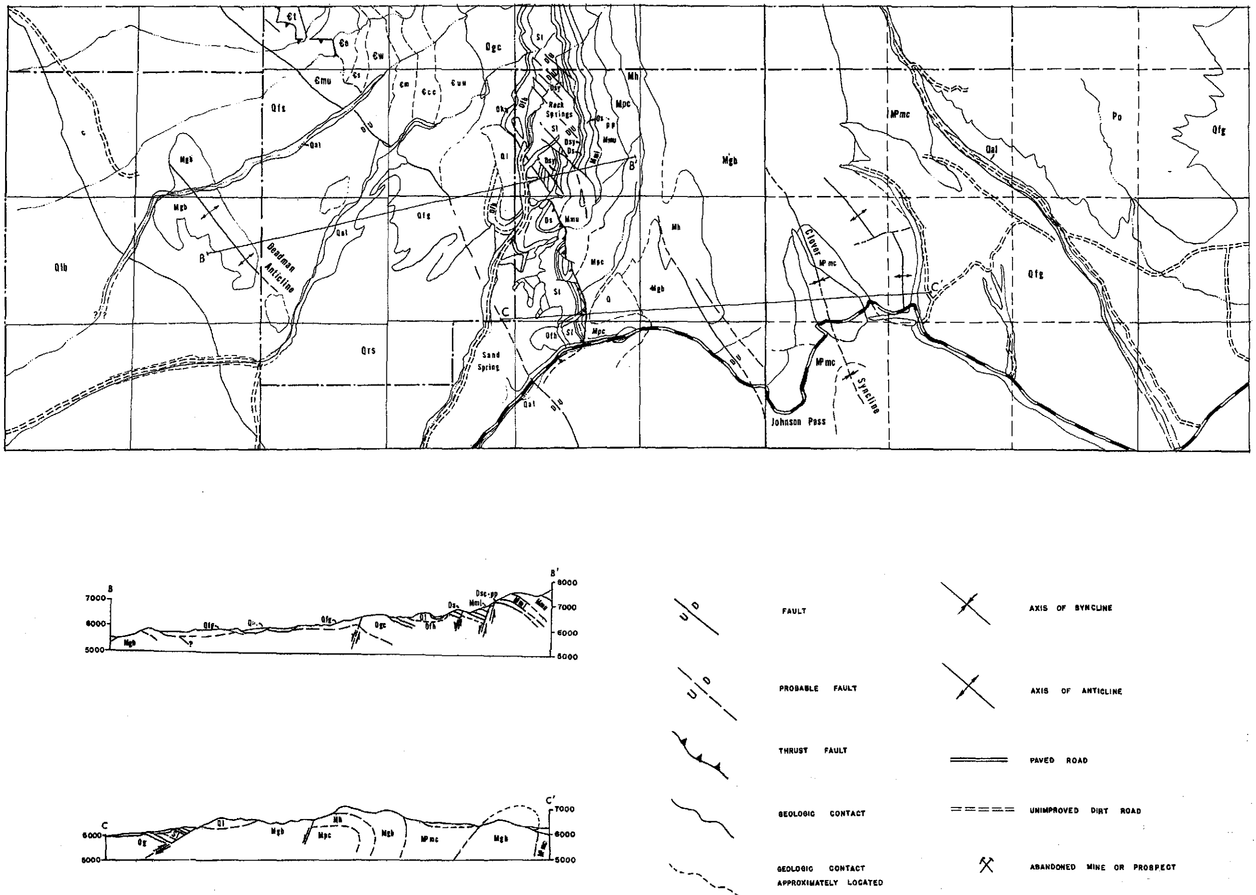
Devonian
- Dsc-pp — STANSBURY-PINYON PEAK FORMATION
- Ds — SIMONSON DOLOMITE
- Dsy — SEVY DOLOMITE

Sil
- Sl — LAKETOWN DOLOMITE

Ordovician
- Ofh — FISH HAVEN DOLOMITE
- Ok — KANOSH SHALE
- Ogc — GARDEN CITY FORMATION

Cambrian
- Cuu — UPPER CAMBRIAN UNDIFFERENTIATED
- Ccc — COLE CANYON FORMATION
- Cm — MARJUM FORMATION
- Cw — WHEELER FORMATION

Cambrian
- Cmu — MIDDLE CAMBRIAN UNDIFFERENTIATED
- Cs — SWASEY LIMESTONE
- Co — OPHIR GROUP
- Ct — TINTIC QUARTZITE



Rock Springs
Deadman Anticline
Clover
Syncline
Sand Spring
Johnson Pass
B
B'
C
C'
FAULT
PROBABLE FAULT
THRUST FAULT
GEOLOGIC CONTACT
GEOLOGIC CONTACT APPROXIMATELY LOCATED
AXIS OF SYNCLINE
AXIS OF ANTICLINE
PAVED ROAD
UNIMPROVED DIRT ROAD
ABANDONED MINE OR PROSPECT

Plate II.

unit precedes the shale unit. The Pioche shale which underlies the Millard in the House Range if present in the Stansbury Range would have to follow the Millard limestone.

Lithologically the beds above the Millard limestone are much more shaly, silty, and sandy in the Stansbury Range than in the House Range, indicating later inundation and closer position to the source of the sediments.

Tintic quartzite

The Tintic quartzite was named by Smith, Tower, and Emmons (1906, p. 1) for exposures in the Tintic district and it is recognized widely in west central Utah. In the northern part of the area mapped, the upper part of the Tintic is exposed in the core of an anticline which extends along the western edge of the Stansbury Range. The Tintic disappears in the nose of the anticline, which plunges to the south under younger beds of the Ophir group.

Although none of the basal Paleozoic quartzite formations in Utah contain datable fossils, it seems certain that the quartzite in the Stansbury Range is to be correlated with the Tintic quartzite of the Tintic Range and with Prospect Mountain quartzite of the House Range and the Cambrian quartzites of the Wasatch Range. All these quartzites lie conformably beneath the shale sequence which carries fossils of Lower and Middle Cambrian age.

No complete thickness for the Tintic could be obtained in this area, but a thickness of 2,300 to 3,200 feet is found in the Tintic Range (Morris, 1957), 1,375 feet in the House Range, and 2,500 feet in Gold Hill (Nolan, 1935). Robert Cohenour (1957) measured 2,572 feet in the Sheeprock Range whereas 300+ feet is exposed in the Oquirrh Range and 1,500 feet in Cottonwood Canyon of the Wasatch Range. The Tintic quartzite is dominantly a light colored, medium-grained and medium-bedded quartzite with a few beds of micaceous shale in the upper part.

Ophir group

The Ophir formation was elevated to group status by Cohenour (1957) who recognized within it the following formations: Pioche shale, Busby formation, Millard formation, Burnt Canyon formation, Dome limestone, and Condor formation. The author believes that most of these formations can be recognized on the west side of the Stansbury Range in the vicinity of Dry Canyon. A total thickness of 647 feet was measured by the writer in the Stansbury Range.

In both the Tintic Range and the Sheeprock Range shale beds lie conformably on the Tintic quartzite. Cohenour (1957) has correlated these shale beds with the Pioche shale. There are no shale beds immediately above the Tintic quartzite in the Stansbury Range. The writer believes the Pioche shale is missing in the Stansbury Range and that the Busby formation as described by Cohenour(1957, pp. 44-45) conformably overlies the Tintic quartzite. Nolan (1935) considers the Busby quartzite as being the initial deposit of the Middle Cambrian, deposited under shallow water conditions (shown by mud cracks). In the Stansbury Range the basal portion of the Ophir group, 50 to 75 feet thick, is a fairly coarse-grained rock, gray-brown on fresh fracture which weathers to shades of reddish-brown. The rock resembles a graywacke, and shale partings are present. Above the basal coarse-grained quartzite there is little uniformity or continuity in the strata.

The succeeding 296 feet is considered to be equivalent to the Millard formation. It is represented by a basal pisolitic limestone, a middle shale unit, and an upper pisolitic limestone. The following 90.5 feet is a probable Burnt Canyon formation equivalent, whereas the next 27 feet probably represent the Dome limestone and the remaining 155.5 feet the Condor formation equivalent.

On the west side of the Deseret anticline the formations of the Ophir group are missing because of thrusting of younger limestone beds over the shaly beds. Because of the absence of the Pioche shale, the relatively small thicknesses of some of the formations, and the uncertainty due to thrusting and faulting the group has been mapped as one unit.

Fossils from the Ophir group were identified by Christina L. Balk as being from the _Glossopleura_ zone with the following comment: "no Lower Cambrian is present, the two collections, (Ꞓ-1 and Ꞓ-2) representing the _Glossopleura_ zone, would correlate your lithic unit with the Ophir shale if in the south or the Spence shale member in the north." Ꞓ-2, approximately 60 feet higher in section, would be from the Burnt Canyon formation equivalent.

Ꞓ-1 -	_Glossopleura_ cf. _producta_ or bion cf. _Ehmaniella quadrans_ (H. & W.) _Iphidella pannula_ (White)	_Glossopleura_ zone
Ꞓ-2 -	many distorted head of cf. _Ehmaniella quadrans_ (H. & W.) a few tails and 1 free cheek of _Glossopleura_ sp. cf. _Westonia alla_ (H. & W.)	_Glossopleura_ zone

The following section was measured south of Dry Canyon in section 9, T. 5 S., R. 7 W.:

Ophir group	Thickness in feet
1. Shale and siltstone: alternating shale and siltstone. At base is 8 feet of paper-thin light green shale containing slaty cleavage followed by 14 feet of orange-brown, limy siltstone, overlain by approximately 60 feet of light green shale, in turn overlain by limy siltstone, somewhat reddish in color containing fragments of trilobites, and silty bandings along the bedding planes, above is more of the light green shale.	128.5
2. Limestone: gray-black, weathering yellow to buff, dense, very finely crystalline, almost quartzitic, less silty and thinner partings than #1, the top is more silty, brown to light green in color and is a cliff-former.	27

3.	Limestone: black, weathering light gray, dense, finely crystalline, contains numerous silty partings and twiggy bodies.	27
4.	Limestone: blue-black with numerous silty partings, weathers rusty due to the large amount of silt, becoming more silty toward the top with approximately 2 feet of light green micaceous shale.	54
5.	Shale: light green, weathers orange to purple, compact with paper-thin partings, breaks easily, more silty and less micaceous than the shales below, contains slaty cleavage and trilobites (Ꞓ-2).	18.5
6.	Limestone: gray-black on fresh surface, weathering buff to light gray, dense, finely crystalline with silt interspersed in lower part and silty partings above. It contains several beds of light green shale; algal bodies of smaller diameter than in #8 are found at top.	58
7.	Shale and siltstone: lower 30 feet is gray-green irregular platy beds one-fourth to one-half inch thick, silty, micaceous, and sandy becoming more green, silty and less sandy upwards, containing slaty cleavage across bedding planes, weathers red to green, dense, with trilobites (Ꞓ-1) found near the top.	75
8.	Limestone: blue-gray, weathering buff to brown, fine crystalline, containing much silt interspersed, thick- to thin-bedded; in places orange-brown silty bands appear, becoming more silty, manganiferous, and cherty toward the top; the beds contain algal stringers and balls which are larger than in #6; this unit is a slope-former and not well exposed.	181
9.	Sandstone and siltstone: blue-gray, weathering orange-brown; limy and silty quartzitic sandstone, thick-bedded, grading upward into softer, sandier, more limy sandstone that weathers light brown to tan, containing interbedded siltstone.	78
	Total Ophir group	647.0

__Swasey limestone__

The Swasey limestone was named by Walcott (1908) for outcrops on Swasey Peak in the House Range. Wheeler and Steele (1951) report the Swasey as being "dark to medium gray, fine- to medium-grained, thick-bedded argillaceous limestone." The Condor formation is considered by them to be the basal member of the Swasey.

In the Stansbury Range the Swasey limestone lies between the thin-bedded limestone and shale beds of the Condor formation and the flaggy, thin-bedded limestone of the Wheeler formation. The beds, which are thin to thick, generally are not well exposed, but in places they form prominent cliffs.

The following section was measured south of Dry Canyon in section 9, T. 5 S., R. 7 W.; fossils found in the unit are described on page 22.

Swasey limestone	Thickness in feet
1. Limestone: blue-black weathering blue-black with silty partings, where silty partings are exposed it appears tan, partings becoming less prominent upward.	144.5
Total Swasey limestone	144.5

Wheeler formation

The Wheeler formation, named by Walcott (1908) for exposures in the House Range, is 238 feet thick in the Stansbury Range. The formation consists of dark blue-gray, fine-grained, thin-bedded, flaggy limestone characterized by the smoothness and flatness of the bedding plane. Smooth, tan to reddish-tan silty partings furnish breakage planes for the beds. In the House Range the Wheeler formation consists of dull sooty-gray, fine-grained, thin fissile, shaly limestones and calcareous shales. The beds appear thinner bedded and more shaly in the House Range than in the Stansbury Range.

The following section was measured south of Dry Canyon in section 9, T. 5 S., R. 7 W. The formation yielded fossils that are described on page 22.

Wheeler formation	Thickness in feet
1. Limestone: not well exposed, contains a few beds of light gray limestone, mainly black, weathering orange-brown, very finely crystalline laminated to thin flaggy bedding characterized by smoothness and flatness of bedding planes, weathering in slabs and blocks with tan to orange-brown silty partings. Trilobites were found.	179.0
2. Limestone: not well exposed, being a valley-former, appears to be shaly, at top is black limestone, very finely crystalline, thin-bedded to laminated with thin silty laminae, limestone stands in relief.	59.0
Total Wheeler formation	238.0

Marjum formation

The Marjum formation, which is 298.5 feet thick, lies between the Wheeler formation and the Cole Canyon dolomite. The formation is composed of carbonate rocks and shale, being mostly thin-bedded, undulating limestone beds with tan silty partings and laminations.

The Marjum formation was named in the House Range by Walcott (1908), described by Wheeler (1948), and also observed by the writer. It is dark gray, argillaceous, fine-grained, thin-bedded limestone with sooty-gray to almost black, fissile and platy, calcareous irregular bedded shale. Both the Wheeler and Marjum formations appear much the same in the Stansbury and House Range except for the more shaly texture and thinner beds of both formations in the House Range.

Measured south of Dry Canyon in section 9, T. 5 S., R. 7 W.:

Marjum limestone	Thickness in feet
1. Limestone: black, weathering pale blue-gray, dense crypto-crystalline, thin-bedded, found in thin platy beds due to silty partings. Undulating bedding planes give blotched or twiggy appearance, blotches are orange to tan, the lower 70 feet contains trilobites found only on silty partings. The last 20 feet is more pinkish.	298.5
Total Marjum limestone	298.5

Three fossil collections were made from the Swasey, Wheeler, and Marjum formations: Є-3 from the Swasey, Є-4 from the upper part of the Wheeler and Є-5 from the lower part of the Marjum. The following identification and comments were furnished by Christina L. Balk:

Є-3 Ehmaniella cf. waptaensis Rasetti — Bathyuriscus-Elrathina zone
Є-4 Ehmaniella cf. waptaensis Rasetti
Є-5 Ehmaniella cf. waptaensis Rasetti

> This is probably the same species as Deiss's Ehmaniella convexa and the collections of Є-4 and Є-5 represent exactly the same faunule - if they came from different sections, you can be sure that the corresponding beds are exact correlatives - if they came from the same section - you can conclude that the identical faunule extends thru that much of the section - if from the same section I would not expect them to be separated by more than a few tens of feet.
>
> The three collections above would correlate your lithic unit with the Maxfield limestone if in the south, or the Blacksmith dolomite if in the north. This zone covers a wider stratigraphic unit than the preceding one and contains a number of faunules.

Cole Canyon dolomite

The Cole Canyon dolomite, named in the Tintic district for a sequence of alternating light gray and dark blue-gray fine-grained dolomites, is 711.5 feet thick in the Stansbury Range compared to 899 feet measured by Cohenour in the Sheeprock Range. Fossils were not found within the Cole Canyon dolomite; the lower contact is easily distinguished above the thin limestone beds of the Marjum formation. The lower half of the Cole Canyon is predominantly dolomitic, while the upper part contains some limestones. The upper contact is gradational with the clastic limestone and dolomites at the base of the Upper Cambrian.

The following section was measured south of Dry Canyonin section 9, T. 5 S., R. 6 W.:

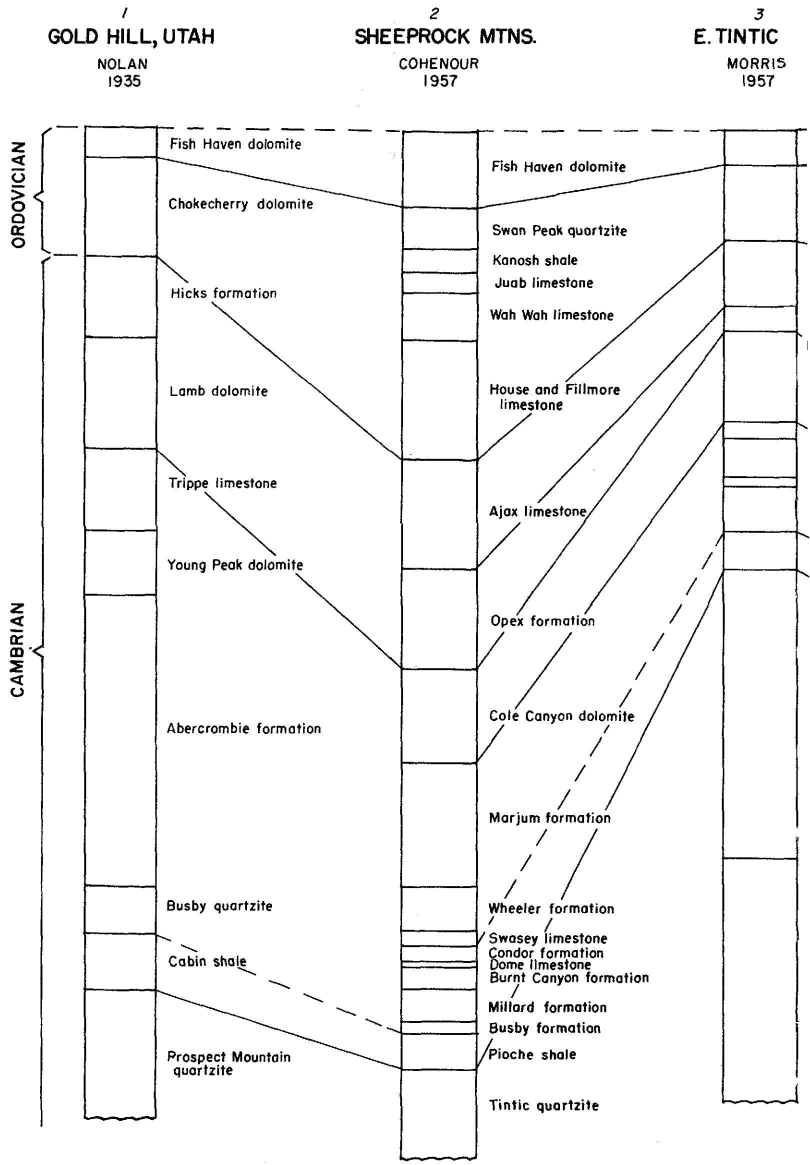
Cole Canyon dolomite

1.	Dolomite: gray-black, weathering orange-brown, medium-to thick-bedded, containing considerable silt, little change except somewhat darker upward in section.	532.5
2.	Dolomite: similar to #1, orange-brown and silty, medium- to thick-bedded ledge-former.	134
3.	Dolomite: gray-black, weathers sandy gray-brown, finely crystalline, thin- to medium-bedded with 2 feet of conglomerate 15 feet from base; top is light gray weathering tan to buff, very dense with thick to massive bedding.	45
	Total Cole Canyon dolomite	711.50

Upper Cambrian undifferentiated

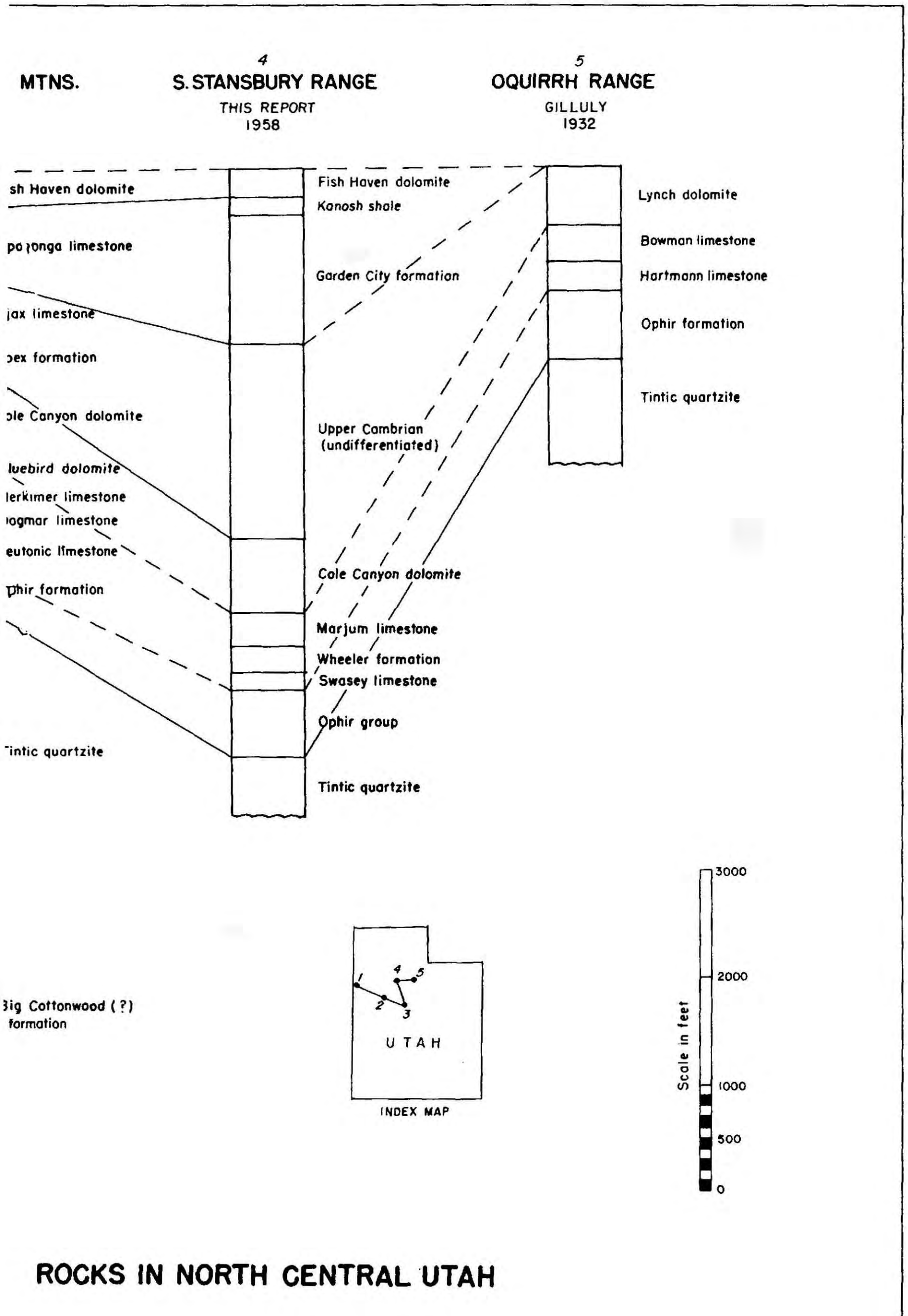
The lower beds of the Upper Cambrian are marked by the abundance of clastic sediments, which seems to indicate a major break in deposition. The lower 774.4 feet, which is probably an Opex formation equivalent, is thin- to thick-bedded. It is represented by alternating beds of shale, oolitic limestone, flat pebble conglomerate, medium- and coarse-grained, brown weathering sandstone, and dusky blue-gray dolomite. The shale beds which are mostly red and green do not appear to continue laterally. Linguloid brachiopods were found near the base but no diagnostic trilobites were discovered.

The upper part of the Upper Cambrian, an Ajax formation equivalent, is composed entirely of dolomite. Light and dark mottling is common, and pisolite beds were noted in the upper part. The Emerald member, described in the Tintic district, appears to be present in the upper part. The Ajax which was formerly considered as Ordovician has been included in the Upper Cambrian by Morris (1957). In the Stansbury Range the Ajax and Opex could not be mapped separately because the limestone beds have been altered



CORRELATION OF LOWER PALEOZOIC

FIGURE 3



ROCKS IN NORTH CENTRAL UTAH

to dolomite at different horizons throughout the area and no key bed was present. Fossils were poorly preserved but <u>Billingsella</u> spp. was identified.

The following section was measured on ridge south of Dry Canyon in section 10, T. 5 S., R. 7 W.:

Upper Cambrian undifferentiated	Thickness in feet
1. Dolomite: medium gray to blue on fresh surface, buff to brown-gray on weathered surface, dense, coarsely crystalline, upper 10 feet is more limy with oolites, grading from a dolomite into a limestone; at top the beds are somewhat pinkish and more silty.	160
2. Dolomite: white to pinkish-gray, weathers white to tan, sugary texture on weathered surface.	215
3. Dolomite: dense gray to brownish-black on weathered surface, more bluish on fresh surface.	85
4. Dolomite: white to pinkish-gray, weathers white to tan, dense, quartzitic, looks sugary on weathered surface (appears to be a key bed).	62
5. Dolomite: varies light to dark gray, the light is coarse quartzitic, the dark is light on fresh surface and is dense to finely crystalline, contains some silt which gives a sombre-gray color to weathered surface.	229
6. Dolomite: gray to black, tan to buff on weathered surface, sometimes appearing pinkish, dense, finely crystalline in basal 150 feet becoming increasingly lighter in color until it is light gray, weathering tan to white. At 150 feet from base a bed of pebble conglomerates appears; pebbles are angular and matrix is limy, several conglomerates are present but dolomites continue much the same At top there appears an 18-foot orange siltstone and shale bed.	228
7. Limestone: medium to dark gray, weathers white to tan, silty, with silty bands which stand out in relief, is medium-bedded, dense, cryptocrystalline.	27.4
8. Dolomite: salt and pepper gray on fresh surface, weathers charcoal-gray, the top beds contain silty, cherty, and sandy layers alternating with blue-gray dolomite, shows evidence of brecciation probably soon after laying down, basal beds are coarse-grained dolomite and pebble conglomerate.	61

9.	Dolomite: light gray to white, dense, fine to medium crystalline, in places somewhat sugary on weathered surfaces.	298
10.	Dolomite: dense, finely crystalline dolomite, similar to #9.	83
11.	Limestone: black, dense, fine crystalline, thick-bedded with alternating silty partings which are rusty brown in color, tiny scattered algal spots appear throughout.	63
12.	Dolomite: light gray, weathers nearly white, dense and finely crystalline.	64
13.	Limestone: blue-gray to blue-black, silty, thin- to medium-bedded and fine to cryptocrystalline; silt being found in irregular partings, giving tan color.	121
14.	Limestone: blue-black, thin-bedded with many silty partings alternating with light gray, thin-bedded, silty limestone that weathers greenish-gray and contains Linguloid brachiopods. Beds are irregular and seem to be somewhat unconformably on the Cole Canyon dolomite. Four feet of dense buff to brown noncalcareous siltstone that fractures conchoidally appears near the top.	57
	Total Cambrian undifferentiated	1,813.4

THE ORDOVICIAN SYSTEM

Ordovician rocks are exposed along the west flank of the range. A well exposed section was found and measured south of Dry Canyon and north of Rock Springs in sections 14, and 15, T. 5 S., R. 7 W. The Cambrian-Ordovician boundary was established on the basis of lithologic changes which has been the criteria for separation in other regions in Utah (Hintze, 1951). The contact which appears to be conformable places the lowermost limestone beds of the Ordovoican on a dark, massive-bedded dolomite of the Upper Cambrian. In central Utah and several Nevada localities an underlying dolomite is found, while in western Utah a massive unfossiliferous limestone (Notch Peak formation) underlies the House limestone. The House limestone as far as can be determined is equivalent to the Garden City formation.

Three distinct lithologic units are present in the Ordovician of the Stansbury Range. The lower limestone sequence, which is mainly blue-gray, thin- to medium-bedded, silty limestone with intraformational conglomerate correlates with the Garden City formation or lower Pogonip group. A middle unit consists of interbedded siltstone, fissile shale, and limy sandstone corresponds with the Kanosh shale or lower Swan Peak. The upper sequence is a fine to medium crystalline resistant dolomite equivalent to the Fish Haven dolomite.

In the central Stansbury Range, Mississippian beds lie unconformably on the Cambrian. On the north side of Dry Canyon only the Garden City formation is present but the Kanosh shale and the Fish Haven dolomite appear above the Garden City on the south side of the canyon.

Garden City formation

The Garden City formation consists of marine silty limestone, interbedded limy shales, siltstones, and intraformational conglomerates, which appear to conformably overlie Cambrian dolomite.

In the type area, the Garden City formation, according to Richardson (1913), consists of thick- and thin-bedded gray limestone, characterized by abundant conglomerate and breccia.

Much similarity can be recognized between what is here referred to as Garden City and several formations of the Pogonip group. Hintze (1951, p. 20) correlates the lower Ordovician section on the west side and also at the north end of the Stansbury Range with the Garden City formation, and states "that lithologically the lower Garden City formation and the lower Pogonip group are similar; they both contain considerable intraformational conglomerate and scattering of light colored chert stringers. However, the cherty upper part of the Garden City formation differs considerably from the upper Pogonip group."

In section 10, T. 5 S., R. 7 W., over 1,200 feet of Garden City was measured, while approximately 2 miles south less than 1,000 feet was found. The thinness of the southern section may be due to an error in measurement since the exposures of the Garden City formation are poor. Richardson (1913) contends that there is an erosional unconformity at the base of the Garden City formation as well as at the base of the Fish Haven dolomite. He bases this conclusion on the fact that the Garden City formation and Fish Haven dolomite rest on different horizons in different parts of the Randolph quadrangle.

The following section was measured on the ridge south of Dry Canyon in section 10, T. 5 S., R. 7 W.:

Garden City formation	Thickness in feet
1. Limestone: blue-gray, weathers medium gray, thin platy beds with considerable silt, a maroon shale bed is present near the top.	131
2. Limestone: thin-bedded, platy, somewhat shaly, coarsely crystalline.	27.6
3. Limestone: medium blue-gray, weathers gray, fine crystalline, silty; contains thin partings of rust colored silt in subordinate amounts, some chert, and is a ledge-former.	89.9

4.	Limestone: similar to #3, few silty partings and little chert, more dense, medium to thick-bedded.	241.6
5.	Limestone: similar to #6, dense, sublithographic silty partings.	184
6.	Limestone: light gray, weathering rusty in lower part, tan to light gray in upper part, appears quite brecciated consisting of small rounded particles in similar matrix, larger angular particles, possible mud cracks with silty matrix; is ledge-former.	145
7.	Limestone: buff to red, sandy to silty.	79
8.	Limestone: rusty red, silty, fine sand and in places quartzitic; top thirty feet is light to medium gray, sublithographic, weathering pinkish gray.	104
9.	Limestone: light gray to tan on fresh surface, weathers somewhat pinkish to buff, fine to coarse crystalline, friable, silty, interbedded with dense buff siltstone; considerable intraformational conglomerate, beds appear to lens or thin out or grade into other beds in a short distance, gastropods were found.	199
	Total Garden City formation	1,201.1

The following fossils were collected and identified:

Trilobites:		
Symphysurina	lower	Garden City
Sponges:		
Nevadocoelia	middle	Garden City
Bryozoans:		
Dictyonema cf. *flabelliforme*	middle	Garden City
Graptolites:		
Phyllograptus ilicifolius	upper	Garden City
Phyllograptus angustifolius	upper	Garden City

High spiralled gastropods and Orthis type brachiopods.

Kanosh shale

The Kanosh shale, which is equivalent to the lower Swan Peak formation, is found on the west side of the Stansbury Range. Since there is no quartzite such as characterizes the Swan Peak in various other areas, the unit being predominantly a fissile shale will be referred to as the Kanosh shale. Hintze (1951) correlates the Kanosh and lower Swan Peak on paleontological grounds.

The absence of the quartzite in this area, and its presence to the north and south of the Stansbury Range, may indicate an unconformity. Nolan (1935) states that an unconformity exists at the base of Upper Ordovician. He based this conclusion on the variable thickness of the Chokecherry dolomite, under the Fish Haven dolomite, and the absence of the upper quartzite member of the Swan Peak and Eureka quartzite by nondeposition or removal by later erosion.

The Kanosh shale is a very diagnostic unit and contains an abundance of graptolites. The following fossils were found and identified:

Eleutherocentrus petersoni
Didymograptus nitidus
Didymograptus patulus
Didymograptus murchisoni
Lingulid brachiopods

The Garden City-Kanosh boundary is gradational, as a consequence of which two separate measurements differ considerably. Arnold (1956) measured 117 feet at the north end of the Stansbury Range. Bissell, McKinney, and Peterson (Croft, 1956, pp. 7-8) measured 296 feet in section 11, T. 5 S., R. 7 W. at the south end of the Stansbury Range, which agrees favorably with a measurement of 293 feet made by the writer, but is considerably more than a second measurement of 162.3 feet made by the writer. Croft divided the unit into three divisions: (1) a lower interbedded limestone, argillite and orthoquartzite (107 feet); (2) a middle shale and argillaceous limestone (164 feet); (3) and an upper "dolsiltite" and black shale (25 feet). Croft suggests that this last unit may be post-Swan Peak.

The Kanosh-Fish Haven boundary appears to mark a definite break in sedimentation but is usually not exposed. The lower contact with the Garden City formation is gradational. The writer prefers to use the second measurement (see above) of 162.3 feet because there seems to be a more definite break with the basal bed being a black limestone. The formation, a valley- and slope-former, is generally poorly exposed but was a key unit in correlating the lower Paleozoic section.

The following section was measured between Barlow Hollow and Deadman Canyon in section 14, T. 5 S., R. 7 W.:

Kanosh shale	Thickness in feet
1. Shale: black to dark brown, containing lingulid brachiopods and a graptolite fauna.	33.6
2. Siltstone and shale: not well exposed; thin-bedded blue-gray siltstone, and black to dark brown shale, appears orange-brown on weathered surface.	49.0
3. Sandstone: not well exposed; appears somewhat rusty with some silt and quartzite lenses.	32.1

4. Dolomite: black limestone at base, followed by a somewhat limy, dense quartzitic dolomite and quartzite, dirty gray in color, weathering buff to yellow-brown (rusty), and is thin-bedded.	47.6
Total Kanosh shale	162.3

Fish Haven dolomite

The Fish Haven dolomite consists of dense, finely crystalline dolomite. Alternating beds of black and gray mottled dolomite give a distinctly banded pattern to the formation. In outcrop the beds form a resistant hill or slope above the generally less resistant slope-forming Garden City formation and Kanosh shale.

Hintze (1951, p. 23) states that the Upper Ordovician rocks, typically the dark dolomitic facies, are among the most persistent units in the eastern Great Basin. This dolomite has been recognized in northeastern Utah (Richardson, 1919, pp. 409-410) where the name Fish Haven was first used. The name was also applied in the Gold Hill district by Nolan (1935, pp. 16-17) because of similar age and lithology.

At no locality has the Upper Ordovician been reported to lie with angular unconformity upon the underlying quartzite; the lack of quartzite seems rather to indicate an erosional unconformity. Cohenour (1957, fig. 5) has prepared an isopach map showing a salient projecting west from the Oquirrh Range through the south end and middle of the Stansbury Range during Middle Ordovician time for which he has proposed the name "Stansbury Salient."

On the basis of lithology and stratigraphic position, this series of dolomites is correlated with the Fish Haven at the type locality and elsewhere. *Halysites* sp. are fairly plentiful, as well as *Streptelasma* sp. and crinoid stems. Fossils are found mainly in the lower half of the formation.

Measured north of Barlow Hollow in section 14, T. 5 S., R. 7 W.:

Fish Haven dolomite	Thickness in feet
1. Dolomite: dense gray-black, medium crystalline, weathering black with a few interbedded light gray, fine to medium crystalline beds. A few corals were found at the base.	116
2. Dolomite: similar to beds in #1, more fossiliferous, mottled, and massive.	132
Total Fish Haven dolomite	248.0

Laketown dolomite

The Laketown dolomite was named and described by Richardson (1913) for outcrops southeast of Bear Lake in the Randolph quadrangle. He describes it as being a "massive light gray to whitish dolomite, containing lenses of calcareous sandstone having a thickness of approximately 1,000 feet." Fossils are rare.

Nolan (1935) extended the name Laketown to the Gold Hill district to include beds of Silurian age there. The name Laketown is now applied to most of the beds of Silurian age in northern and western Utah and has also been used into eastern Nevada.

In the Tintic district the name Bluebell dolomite is applied to beds of Silurian age. The Bluebell dolomite originally included the Fish Haven dolomite. Morris (1957) has divided the original Bluebell, calling the lower unit Fish Haven and retaining the name Bluebell for the upper unit, which includes the Ordovician, Silurian, and Devonian time boundaries.

In the Stansbury Range the time boundaries cannot be recognized definitely, the contacts being drawn on the basis of lithology. A basal white to light gray, medium-to thin-bedded dolomite is present which is similar to that described by Richardson (1913) and others in various areas. The basal beds are unfossiliferous and a relatively thin unit, overlain by darker dolomite, which contains chert and some pentameroid type brachiopods.

Due to faulting, the dolomite beds in the southern Stansbury Range are extremely shattered and altered. In the vicinity of Rock Springs there is repetition of beds due to normal faulting. To the north the beds are less altered and shattered but are cut out on the south side of Dry Canyon by the pre-Mississippian unconformity.

In the Stansbury Range the Laketown dolomite appears to be similar to the Bluebell of the East Tintic district, being separated into two members by the "curly bed," a bed of crinkley-laminated, medium and light gray dolomite, with laminae less than a millimeter thick. The upper member is principally medium to dark gray, medium- to thick-bedded, medium- to coarse-grained dolomite.

Nolan (1913, p. 17) claims there is little evidence of an unconformity between the Fish Haven dolomite and the overlying Laketown dolomite at Gold Hill, Pioche Nevada, or in the Randolph quadrangle, but contends that the absence of late Upper Ordovician and Early Silurian faunas at these localities implies that there has been a considerable hiatus in sedimentation. Williams (1948, p. 1137) made similar observations in the Logan quadrangle, and came to the same conclusion.

In the upper half of the formation the following forms were found:

Favosites sp.
Halysites sp.
Eridophyllum sp.

The following section was measured north of Barlow Hollow in section 14, T. 5 S., R. 7 W.:

<u>Laketown dolomite</u>	Thickness in feet
1. Dolomite: blue-gray weathering light blue-gray, dense, medium-bedded, with pentameroid brachiopods at base and cherty stringers at the top.	143
2. Dolomite: dark gray to blue, weathering buff to brown, dense, somewhat sandy and silty, with chert appearing at top, somewhat mottled and appears shattered.	65
3. Dolomite: similar to #5 with little chert.	64
4. Dolomite: blue-gray weathering dark blue-gray, dense, finely crystalline, on weathered surface is silty, chert is more in bands and beds are cliff-formers.	58
5. Dolomite: brownish, somber looking, breaks along numerous silty to sandy fractures that give an orange-brown color to weathered surface; these beds contain considerable chert, sand, silt, and in places limonite. Being mottled it gives the appearance of being faulted; this is probably the "leopard skin" bed referred to in the Tintic area which is splattered with chert.	145
6. Dolomite: mainly white to tan on weathered surface, light to medium gray on fresh, dense sublithographic, finely crystalline, thin- to medium-bedded.	139.5
Total Laketown dolomite	614.5

THE DEVONIAN SYSTEM

Devonian rocks are exposed south of Dry Canyon on the west side of the Stansbury Range. No Devonian beds are exposed north of Dry Canyon because of the pre-Mississippian erosional unconformity. The Devonian consists entirely of dolomite and was measured east of Rock Springs in section 23, T. 5 S., R. 7 W. Correlation with other areas was made on lithologic similarity as no diagnostic fossils were found.

Nolan (1935, p. 22) accounts for the origin of the pre-Carboniferous dolomitic formations by the alteration of an original limestone deposit prior to the rock being elevated above sea level, the alteration occurring very shortly after the deposition of the limestone, for the most part in shallow water and probably at times of little or no deposition.

Such features as cross-bedding, oolites, and pisolites, intraformational conglomerates, local unconformities, and lenticular beds occur throughout dolomitic formations. Many of the beds not possessing these features contain mottling due to areas of less complete dolomitization. Near many of these mottled dolomites, beds of relatively pure limestone are found.

Nolan has suggested that a prolonged exposure of calcareous mud to current action would also permit selective leaching of calcium carbonate by sea water, a phenomenon which is known to occur at present in nature.

Because of the aphanitic texture of the Sevy dolomite, some have thought that it possibly represents a primary dolomite. Roy Waite (personal communication) reports limestone to be found in small patches within the Sevy dolomite of Nevada, indicating a secondary source for the dolomite, for it is these patches of limestone that contain fossils.

Sevy dolomite

The Sevy dolomite was named by Nolan (1935) from exposures in Sevy Canyon in the Gold Hill area, Utah. Nolan states (p. 18) that "the typical rock is a well-bedded, mouse-gray dolomite in layers 6 to 12 inches thick and weathers to a very light gray." It has an extremely dense texture and fractures conchoidally. In most beds a faint lamination parallel to the bedding is visible. A few beds of darker dolomite occur near the top.

Nolan measured 450 feet of Sevy in the Gold Hill area which is considerably more than is found in the Stansbury Range. The few fossils found in the Gold Hill area are not diagnostic for determination of age. The formation grades upward into overlying Simonson dolomite which contains a Middle Devonian fauna.

The Water Canyon formation which marks the base of Devonian in the Logan quadrangle is reported by Williams to be of Early Devonian age (Williams, 1948). It consists essentially of thin-bedded silty and sandy dolomites that weather smoke-gray to white or buff. This description fits that of the Sevy dolomite of western Utah. It has been supposed by many stratigraphers that Devonian seas did not invade western and northern Utah until late Middle Devonian or Upper Devonian time but Roy Waite (personal communication) reported *Spirifer kobehana* (Lower Devonian age) as being found in the Sevy in eastern Nevada. Because of the lack of fossils no age is set on the Sevy beds of the Stansbury Range.

The range in thickness of the Sevy dolomite in the area would indicate considerable relief on the underlying surface. Williams (1948, p. 1137) reports a hiatus at the base of the Water Canyon dolomite in the Logan quadrangle, though no noticeable unconformity was observed. Nolan (1935, p. 18) observed a truncation of beds at the top of the Laketown dolomite indicating a pronounced unconformity between the Laketown dolomite and the Sevy dolomite.

The following measurement was obtained east of Rock Springs in section 23, T. 5 S., R. 7 W.:

Sevy dolomite

1.	Dolomite: light gray, weathers light gray to white, microcrystalline to finely crystalline slightly sandy in the upper few feet, thin- to medium-bedded, containing good bedding.	75
	Total Sevy dolomite.	75

Simonson dolomite

The Simonson dolomite, named by Nolan (1935) from Simonson Canyon in the Gold Hill area, Utah, consists in the main of dark to medium gray, sucrose, crystallint dolomite, weathering tan to brownish-gray. Both dark and light beds are found. The darker beds are more finely crystalline than the somewhat sandy lighter beds; beds range from thin to massive.

Nolan measured 963 feet at the Gold Hill area (1935 p. 19).

The following section was measured east of Rock Springs in section 23, T. 5 S., R. 7 W.:

Simonson dolomite

1.	Dolomite: light, medium-bedded, sandy on weathered surface, interbedded with medium gray, darker and more dense beds than #2.	37.5
2.	Dolomite: light gray, dense, medium crystalline cliff-former that weathers brownish-gray, becoming lighter and sandier upward in section.	55.5
3.	Dolomite: alternating light and dark beds; the dark is almost lithographic; the light is more sandy, gives a banded appearance.	10
4.	Dolomite: blue-black, finely crystalline, no banding, massive bedded with smattering of calcite, thin laminae present in the lower 9 feet.	29
5.	Dolomite: similar to beds below, being a cliff-former and containing good bedding.	25
6.	Dolomite: medium gray, weathers buff to gray-brown, dense, medium crystalline, medium- to massive-bedded, and sucrose on weathered surface.	72
	Total Simonson dolomite.	229.0

Stansbury-Pinyon Peak formation

The name "Stansbury formation" was proposed by Arnold (1956) for the Devonian outcrops at the north end of the Stansbury Range. He measured 1,741 feet in the Flux area, of which 1,237 feet is reported to be conglomerate.

At the south end of the range the fragments in the conglomerate vary from 1 to 10 centimeters. The fragments are mostly rounded on the edges and most are somewhat elongated and aligned parallel with the bedding planes. The matrix, which is a sandy dolomite, is tan to brown, while the fragments are made up of light and dark dolomite. The light fragments, which are nearly lithographic, appear to be derived from the base of the Laketown dolomite and Sevy dolomite. The dark dolomite fragments show similarity to the Fish Haven dolomite and Laketown dolomite.

Two separate measurements of the Stansbury formation were made at the south end of the Stansbury Range; one showed a thickness of 195.2 feet and the other 276 feet. The thinner section was measured approximately 2 miles north of Rock Springs and may have been affected somewhat by the pre-Mississippian unconformity as only one conglomerate bed is present. The formation varies considerably. On one ridge south of Rock Springs only one conglomerate bed, 60 to 75 feet thick, was observed. This is considerably more than either of the beds mentioned in the detailed description. The character of the limestone and dolomite immediately above, below, and between the two conglomerate beds appears to vary considerably within the range, but the boundary is easily recognized above the sugary dolomites of the Simonson and below the cherty beds at the base of the Madison. The conglomerates are useful key beds in interpreting the fault structure.

The conglomerate, though poorly sorted at the south end of the Stansbury Range, appears to be much better sorted than at the northern end where Arnold (1956, p. 24) reports the fragments to range from 1 millimeter to 30 centimeters, with a maximum size of 74 centimeters. The fragments, ranging in size from 1 to 9 centimeters, account for 64 per cent of the number of rock fragments recorded in Arnold's area. All fragments observed in the conglomerate at the south end of the Stansbury Range would fall into this size range.

Arnold recognized a pre-Mississippian unconformity at the north end of the range. He found on proceeding southward that basal Mississippian beds rest on successively older Paleozoic beds, the conglomerate beds being the first to disappear southward.

As to the origin of the conglomerates, Arnold (1956, p. 26) suggests pre-Mississippian uplift in the central part of the Stansbury Range. He mentions the Timpie area as another possible source, and states that "about 150 feet of Garden City strata overlies the Cambrian rocks conformably, but are in turn overlain by basal Mississippian strata with an angular discordance of about 20 degrees."

The writer cannot definitely pinpoint the source of the conglomerate, but the following observations were made in the area mapped: (1) fragments are much smaller at the south end, (2) conglomerate beds are much thinner to the south, (3) though the central part is missing, the conglomerate appears to be a wedge thinning to the south, (4) the Stansbury formation is the first formation to disappear under the unconformity, (5) nowhere was the formation found on any beds older than Simonson.

On the basis of the above facts it would appear that the conglomerate would have been derived from an area north of the pre-Mississippian unconformity in the central part of the Stansbury Range and that the uplift in the central part of the range occurred following the deposition of at least most of the Stansbury formation. It is entirely possible that the area which is now the central part of the range was the source of the conglomerate, in that a much sharper and greater uplift at the north side of the pre-Mississippian uplift through the central part of the range could possibly have produced the same results as an uplift at the north end of the range.

The upper 70 feet of beds which lie conformably on the conglomerate appear to be equivalent to the Pinyon Peak limestone. The Pinyon Peak limestone was named by Loughlin (1919) for exposures in the Tintic district. As at Tintic, the beds are thin, blue-gray, fine-grained limestone. A tan to buff weathering dolomite is found at the top. A fossil collection was obtained approximately 30 feet below the base of the Madison. This included Bothrophyllum, a coral indicating early Mississippian age. Morris (1957) reports that the Pinyon Peak limestone in the Tintic district overlaps the Devonian-Mississippian time boundary. Because of lithologic similarity and fossils obtained, the writer believes the units described at Tintic and in the Stansbury Range are equivalent.

The following section was measured east of Rock Springs in section 23, T. 5 S., R. 7 W.:

Stansbury-Pinyon Peak formation	Thickness in feet
1. Limestone: basal beds are dark gray to black, finely crystalline, thin-bedded, containing corals; grading into medium gray, tan to buff weathering shaly limestone, containing a variety of fossils of lower Mississippian age. At top is 20 feet of dolomite, which is silty, light gray to tan, weathering tan to buff; is thick-bedded with sugary weathered surface and chert at the top.	67.5
2. Limestone and conglomerate: silty and sandy limestone with silty partings, weathering orange-brown in lower part; overlain by more conglomerate which was not well exposed, but appears to be similar to #3. A limestone which capped the conglomerate was also poorly exposed.	83
3. Conglomerate: made up of fragments of both light and dark dolomite, varying considerably in size, ranging from 1 to 9 centimeters. Fragments are rounded on the edges, most are somewhat elongated and are aligned parallel to the bedding plane. The matrix is dolomitic, tan to brown, and is sandy.	15

4.	Dolomite: dense quartzite grading upwards into limy quartzitic dolomite.	52
5.	Dolomite: orange-brown, weathers orange-brown, limy, silty and sandy; some beds are friable, and silty partings are represented. Though not well exposed, it appears to grade into gray to pink, silty limestone that weathers tan.	58.5
	Total Stansbury-Pinyon Peak formation	276.0

THE MISSISSIPPIAN SYSTEM

Mississippian time in the Rocky Mountain area was marked by much more extensive seaways than most of the previous Paleozoic periods. Following deposition of the Madison limestone, silts and sands became more prominent, indicating rising of adjacent highlands. Following the early carbonate deposition and a subsequent period of clastic deposition came a period of alternating carbonate and clastic deposition.

The Mississippian system is represented in the Stansbury Range by more than 3,000 feet of strata consisting mainly of carbonate sediments. The system has been subdivided into the following units; Lower Madison dolomite, Upper Madison limestone, Pine Canyon limestone, Humbug formation, Great Blue limestone, and part of the Manning Canyon shale.

In various areas in Utah, a pre-Mississippian unconformity is in evidence. That this pre-Mississippian unconformity existed is seen in the central part of the Stansbury Range where Lower Madison dolomite rests on Cambrian beds. In the Uinta Range, Weeks (1907) found Mississippian beds resting on Cambrian, and Nolan, in the Gold Hill quadrangle, found evidence of a pre-Mississippian unconformity. This is in line with the same east-west element that represented the Middle Ordovician.

Gilluly (1932, p. 22) mentions a pre-Mississippian unconformity, which he interpreted to be represented by karst topography between his "Jefferson dolomite" and "Madison limestone." The writer believes, on the basis of lithologic similarity of the Jefferson dolomite, as mapped by Gilluly, and the Lower Madison dolomite as represented in the Stansbury Range, that Gilluly's Jefferson dolomite is of Mississippian age, and that the unconformity he shows between the Jefferson dolomite and the Madison limestone (which does not appear to be represented in the Stansbury Range) is local and of minor significance. If the above conclusion is correct, Mississippian beds in the Oquirrh Range rest on the Lynch dolomite of Cambrian age, corresponding with the unconformity of the Stansbury Range. This correlation seems to be confirmed by Granger and Sharp (1952, p. 9).

Madison limestone

In the Tintic area, Morris (personal communication) has subdivided the Madison limestone into the "Fitchville and Gardison formations," the name Gardner being abandoned because it included part of the Devonian Pinyon Peak.

The writer has subdivided the Madison into two units similar to the subdivision in the Tintic area, but because the names Fitchville and Gardison have not been approved as yet, the units will be referred to informally as "Upper Madison limestone" and "Lower Madison dolomite."

The base of the Madison is not a sharp lithologic contact. The white quartzite referred to in other areas in the underlying Devonian formations does not appear to be present at the south end of the Stansbury Range, so the contact has been arbitrarily taken as the base of the first cherty beds above the Stansbury conglomerate.

The Lower Madison, 370 feet thick, consists of massive- to thin-bedded, light to dark gray dolomite and light gray and buff clastic limestone. The texture shows considerable variety. The middle unit is characterized by oval-shaped, calcite-filled vugs approximately 3 inches in diameter, and is often referred to as the "eye bed." This unit was referred to as Jefferson dolomite by Baker (1949) and also by Gilluly (1932) but fossil evidence indicates Mississippian and not Devonian age (Granger and Sharp, 1952, p. 8).

The Upper Madison limestone, 466.5 feet thick, consists of bluish-gray dense limestone, and is easily distinguished from all the underlying limestones by its freedom from mottling of any sort. Coarse varieties are present, consisting mainly of fossil hash and crinoid stems. The following fossil forms were identified in the field:

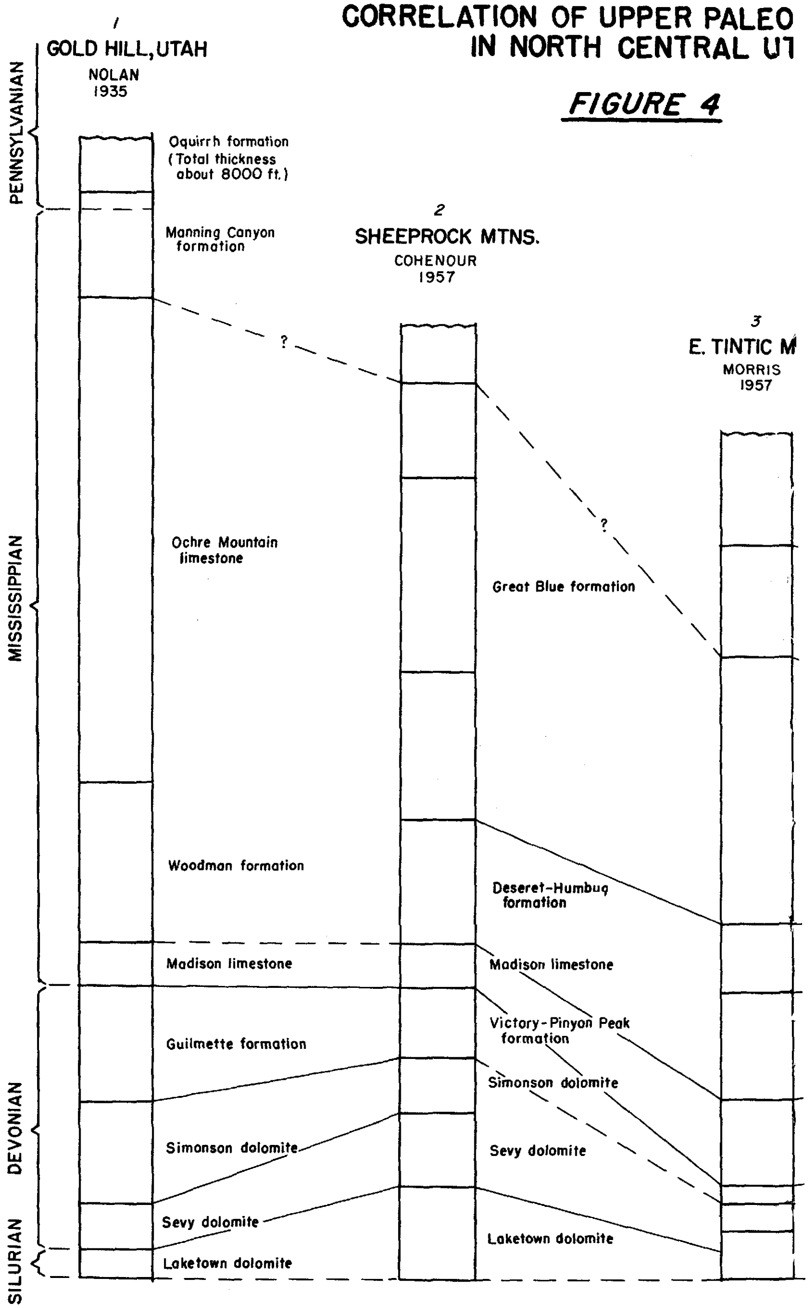
Syringopora sp.
Lithostrotionella sp.
Euomphalus sp.
Caninia sp.

The following section was measured east of Rock Springs in section 23, T. 5 S., R. 7 W.:

Lower Madison dolomite	Thickness in feet
1. Limestone: light gray, weathering buff to gray-brown; top 8 feet is medium blue-gray, weathering gray-black with a sandy appearance forming contact with upper Madison.	41
2. Limestone: coarse, dolomitic, gray-black weathering, without chert bands, white calcite blobs present, and is a cliff-former.	195
3. Dolomite: brownish-gray, dense, very fine-grained, thin-bedded, limy, weathers buff, medium crystalline, sandy in the basal 57 feet. A little shale is found above this but	134

CORRELATION OF UPPER PALEO
IN NORTH CENTRAL U

FIGURE 4



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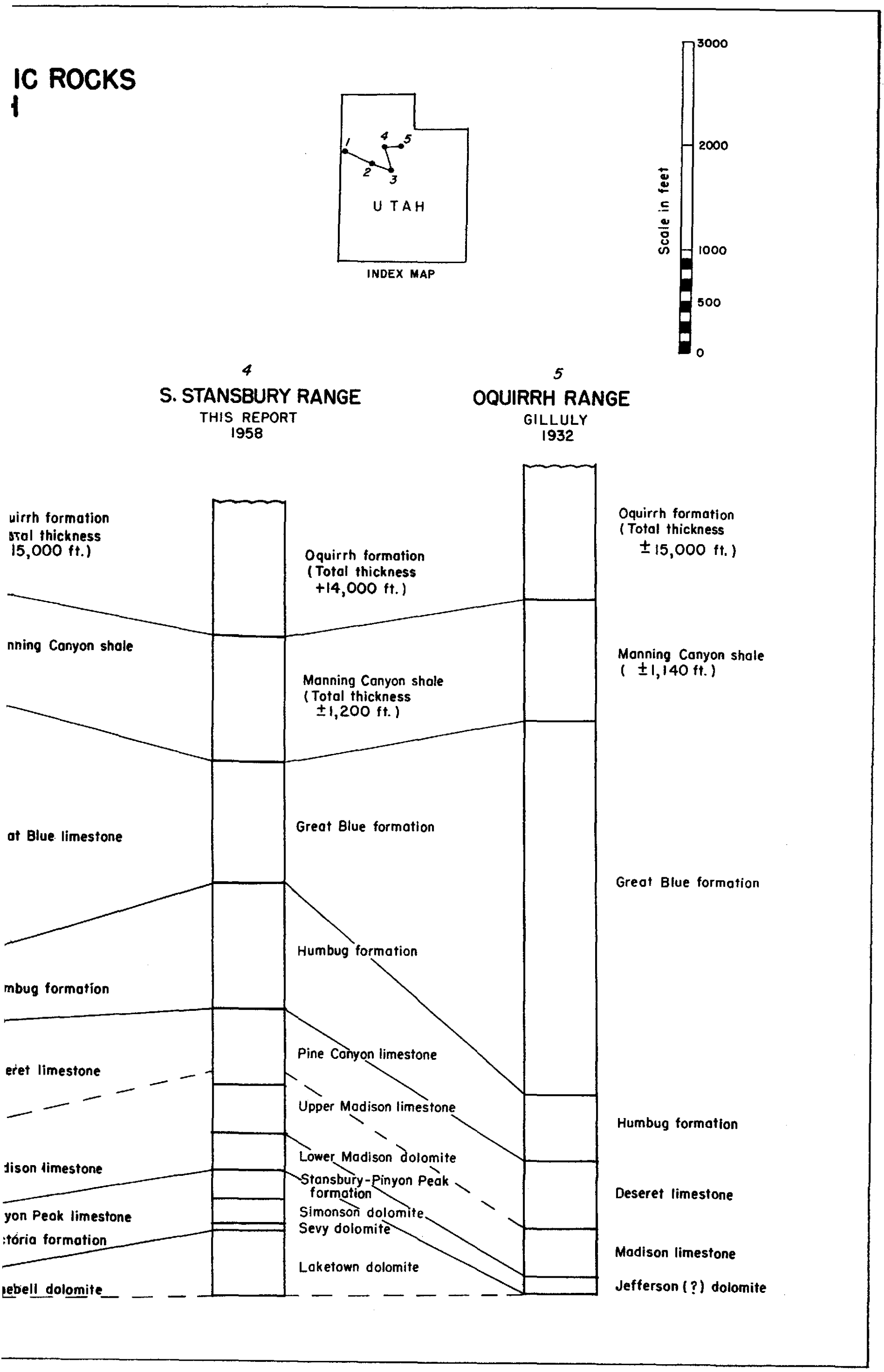

1
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U T A H
INDEX MAP
3000
2000
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4
S. STANSBURY RANGE
THIS REPORT
1958
5
OQUIRRH RANGE
GILLULY
1932
uirrh formation
otal thickness
15,000 ft.)
nning Canyon shale
at Blue limestone
mbug formation
eret limestone
dison limestone
yon Peak limestone
tória formation
ebell dolomite
Oquirrh formation
(Total thickness
+14,000 ft.)
Manning Canyon shale
(Total thickness
±1,200 ft.)
Great Blue formation
Humbug formation
Pine Canyon limestone
Upper Madison limestone
Lower Madison dolomite
Stansbury-Pinyon Peak formation
Simonson dolomite
Sevy dolomite
Laketown dolomite
Oquirrh formation
(Total thickness
± 15,000 ft.)
Manning Canyon shale
(±1,140 ft.)
Great Blue formation
Humbug formation
Deseret limestone
Madison limestone
Jefferson (?) dolomite

for the most part it is a dense blue, dolomitic limestone with alternating chert bands and a few calcite blobs. It is a slope-former, rather massive with few good bedding planes.

Total Lower Madison limestone	370.0

The following section was measured east of Rock Springs in section 23, T. 5 S., R. 7 W.:

Upper Madison limestone	Thickness in feet
1. Limestone: dark blue-black weathering dark blue-gray, thicker bedded than #2 and #3, slope-forming, probable contact with Mississippian Pine Canyon: Eumpholids are abundant.	12
2. Limestone: dark gray to gray-black, weathering the same with considerable pinkish beds finely crystalline, beds 6 inches to 1.5 feet thick.	232
3. Limestone: dark blue-black, weathers red to dark gray, thin, fossiliferous beds, finely crystalline, characterized by step-like beds; fossils stand out in relief, contains calcite stringers and in places small vugs filled with calcite; beds are 1/2 inch to 6 inches; occasional red, pinkish silty beds or partings; considerable calcite at top.	230.5
Total Upper Madison limestone	474.5
Total Madison limestone	844.5

Pine Canyon limestone (?)

The Pine Canyon limestone, named by Loughlin (1919, pp. 40-41) for exposures in the Tintic district, is exposed along the west face of the Stansbury Range. At present it appears that the name Pine Canyon limestone will probably be abandoned. In the Tintic area the Upper Madison has been redefined to include the chert beds of the lower Mississippian Pine Canyon and renaming the upper beds of the Pine Canyon, calling them Deseret. In the Stansbury Range the units appear to be similar, but an unconformity with as much as 25° angular discordance was noted by the writer, below the massive chert beds. Below the chert beds the Madison consists of smooth, flaggy limestone beds. Above the unconformity, breccia was found in several places followed by the massive cherty limestones. Because of the unconformity and dissimilarity of the units the writer believes the logical break in the Stansbury Range is below the cherty limestone, and the name Pine Canyon is therefore used.

Reid (1954, p. 16) reports that the Madison formation of the Wasatch Plateau area is of Kinderhookian and Osagian age, with no angular discordance known at the base, but reports an erosional unconformity (disconformity) above, stating "a post-Osagian erosional interval profoundly influenced the upper portion of the Madison formation." Lindgren and Loughlin (1919, p. 41) state that the lower part of the Pine Canyon is Madison age and that the upper coarse-grained limestones are of late Mississippian age.

Fossils found included fenestellid bryozoans, crinoid columnals, productid brachiopods, and Lithostrotionella sp.

The following section was measured east of Rock Springs in section 23, T. 5 S., R. 7 W.:

Pine Canyon limestone	Thickness in feet
1. Limestone: gray-black, finely crystalline, weathering almost black, becoming increasingly more clastic toward top; top bed contains thick cherty bands and is dense, dark blue limestone; at the base a few fossils were found, mainly corals, calcitic and not well preserved; none in middle but a few at top.	202
2. Limestone: the lower 33 feet is blue limestone, above that the beds are very sandy alternating with dense limestone for 72 feet; above, the beds are shaly, more silty, thin platy, light gray-brown in color; the beds become increasingly more limy until no clastics are visible at the top.	208
3. Covered interval: the beds are not exposed, being a slope- and valley-former; pieces of chert and shale are abundant.	116
4. Limestone: dark gray, similar to bed below with cherty banding; and some brecciation found at top.	141.5
5. Limestone: dark gray, weathers buff to dark gray-brown, contains fossils, with no chert bandings but with few blobs, could possibly still be upper Mississippian Madison formation. The basal beds were found to be somewhat conglomeratic and in places rest unconformably on the Mississippian Madison limestone.	42
Total Pine Canyon limestone	709.5

Humbug formation

The Humbug formation conformably overlies the Pine Canyon (?) limestone, but a definite break is present between the clastic beds of the Humbug formation and the underlying beds of the Pine Canyon. In the area measured, the Humbug formation is a slope-former, covered mainly by float from the clastic beds, which largely masks the really considerable limestone portion of the formation. The sandstones and quartzites alternate with limestone in the formation, and according to Gilluly (1932) these clastic sediments make up only 30 per cent of the section.

The general absence of fine clastic material is striking, considering the numerous alternations of limestone and coarser clastic rocks. Gilluly (1932) attributes the presence of such clastic rocks as the quartzite of the Humbug formation to powerful current action, yet the limestone may indicate an area free from currents. Gilluly suggests that there may have been an alternation of active currents and calm, or that the contributing terrane consisted dominantly of quartzose and limy sediments.

Tower and Smith (1897, p. 625) named the formation from outcrops in the vicinity of the Humbug mine in the Tintic district. In northern and central Utah the Humbug has been recognized at many localities. On the basis of similar lithology and stratigraphic position, the Humbug in the Stansbury Range is correlated with the Humbug formation described by Gilluly (1932, p. 28) in the Oquirrh Range. He found that the sandstones are lenticular and lens out, and that the formation could possibly differ considerably in thickness within a few feet.

Fossils collected include poorly preserved brachiopods and corals. The following were collected in the Onaqui Range to the south by Croft (1956, p. 21):

Ekvasophyllum sp.
Lithstrotion Whitneyi (Meek)
Diphyphyllum (?) sp.

The following section was measured east of Rock Springs in section 23 and 24, T. 5 S., R. 7 W.:

Humbug formation	Thickness in feet
1. Limestone: similar to the beds below, grading upward into a better limestone, contact seems to be gradational with denser quartzitic limestone.	315
2. Limestone: the beds are coarse, granite-gray to white with coarse sandy banding; some pinkish beds appear; thicker beds have spalled appearance on weathered surface; thin beds are pink to gray-brown, weathering orange-brown to pink, silty to sandy, friable and porous, limestone having been removed on weathered surface	164
3. Limestone: light blue-gray to gray-brown (salt and pepper), weathering gray-brown; dense, medium crystalline, very sandy, somewhat quartzitic, it has conchoidal fracture; medium-to massive-bedded, often no fossils.	231
Total Humbug formation	710.0

Great Blue limestone

The name "Great Blue," before being adopted by Spurr (1895, p. 375) for exposures in the Mercur mining district, was originally a miner's term. The Great Blue limestone consists of a lower and an upper limestone, separated by shaly beds, which were named the "Long Trail shale member" by Gilluly (1932, p. 29). Gilluly found the Long Trail shale to be about 85 feet thick, which is considerably more than in the Stansbury Range, where it is poorly exposed. In the Stansbury Range the Long Trail shale could not be followed with certainty and therefore was not mapped as a separate unit.

The upper and lower boundaries of the Great Blue are conformable and gradational with the Humbug formation and Manning Canyon shale. The lower boundary was arbitrarily placed at the top of the highest group of sandstones, although considerable sandstone occurs higher in the section; also the first good limestone is present at the base.

Bryozoans are present throughout the section and corals occur profusely in the lower portion.

The following species were collected:

Faberophyllum sp.
Ekvasophyllum sp.

The writer correlates the Great Blue limestone of the Stansbury Range with the Great Blue of the type area in the Oquirrh Range (Gilluly, 1932, p. 30) on the basis of similar fauna, lithology, and stratigraphic position.

The lower part of the following section was measured east of Rock Springs in section 24, T. 5 S., R. 7 W.: The upper part of the section above unit #9 was offset to the south and measured south of Vickory Canyon in section 25, T. 5 S., R. 7 W., and section 30, T. 5 S., R. 6 W.:

Great Blue formation	Thickness in feet
1. Limestone: lower 8 feet is brown, medium crystalline, very silty, weathers orange-brown; followed by 12 feet of dark blue limestone that is medium-bedded, medium crystalline, somewhat silty; weathers gray to pink and grades into quartzite of Manning Canyon.	20
2. Limestone: medium blue-gray, weathers gray to tan, medium-bedded with much silt in irregular stringers and contains a little chert.	8
3. Shale: very compact gray-green shale, which has a pink and orange hue on weathered surface, weathers in approximately 1/8-inch beds.	27
4. Limestone: gray to brown, weathering gray-tan to orange-brown, coarsely crystalline, silty, medium-bedded, containing a little chert and some indistinct fossils, base is a denser gray weathering limestone the two being gradational.	25

5.	Limestone: contains four feet of cherty limestone at the base, overlain by 30 feet of gray-green very silty limestone that weathers tan to orange, not well exposed, this in turn is capped by 5 feet of dense, finely crystalline, gray limestone that weathers orange-brown.	39
6.	Limestone: medium to dark gray, weathers medium gray, somewhat silty, medium-bedded; contains a few chert nodules; calcite stringers are abundant.	31
7.	Limestone: not well exposed, appears to be silty, weathering tan to orange-brown.	10
8.	Limestone: blue-gray, weathers gray, medium- to thick-bedded, medium crystalline, occasional chert nodules and a few calcite stringers.	15
9.	Limestone: blue-gray, weathers dark gray, fine crystalline, silty, contains some chert nodules and numerous calcite stringers.	58
10.	Limestone: the basal 10 feet is maroon, thin-bedded, silty; above is a dark gray, dense, finely crystalline, medium-bedded limestone, capped by a dark gray, dense, finely crystalline limestone with thin silty interbeds.	73
11.	Limestone: dark blue-gray, dense, finely crystalline in thin to thick beds; contains approximately 5 feet of tan to orange-brown, thin-bedded, silty limestone about 30 feet from the top.	148
12.	Limestone: similar to #11, medium crystalline, dense with a few platy beds.	191
13.	Limestone: dark gray-blue; dense, finely crystalline to crypto-crystalline, somewhat silty and platy, top bed is very fossiliferous.	83
14.	Limestone: basal beds are brown, dense, silty limestone overlain by 26 feet of medium blue crystalline limestone; upper beds are not well exposed but appear to be alternating dense blue, and tan to light brown beds of silty to quartzitic limestone.	157
15.	Limestone: massive tan to gray, silty limestone weathering blue-gray; has a meringue or mottled appearance on weathered surface; it grades upward to a dense blue limestone in the upper six feet.	23

16. Limestone: medium to dark gray, fine to medium crystalline, dense, crinoidal limestone at the base, followed by 19 feet of coarsely crystalline crinoidal limestone of medium blue-gray color, weathering light blue-gray, overlain by brown to gray quartzitic limestone which weathers sandy brown. 305

17. Limestone: light gray, weathering brown, dense, fine-grained, somewhat sandy and silty, beds contain no banding and are not well exposed. 162

18. Limestone: lower thirty-eight feet is medium gray, weathers medium to dark gray, coarsely crystalline limestone, containing corals and crinoid stems; little sand or silt present. Above, the beds contain sandy bands and are coarsely crystalline, blue-gray to light brown weathering light brown and are medium- to thick-bedded, containing fragments of fossils. 81

Total Great Blue formation 1,181.5

Manning Canyon shale

The Manning Canyon shale, named by Gilluly, (1932, p. 31-34) for Manning Canyon in the Oquirrh Mountains of central Utah, is predominantly black shale. Other clastic sediments, including quartzite, quartzose sandstone, siltstone, calcilutite, mudstone, argillaceous and blue-gray clastic limestone are present. Chert and ellipsoidal concretionary claystone nodules, lined with pyrite and limonite replacements, are present in the shales.

Several attempts to measure the Manning Canyon shale at the south end of the Stansbury Mountains met with failure. A thick, poorly exposed section is represented on the east side of Johnson Pass, where, beginning at Vickory Canyon to the north, the formation is a valley-former in a south-plunging syncline. In Big Hollow, a partially exposed section is found; but it is, in the main, covered by valley fill.

Sadlick (1955) measured over 1,300 feet of Manning Canyon in Soldiers Canyon in the Oquirrh Mountains. This measurement agrees fairly well with the measured distance berween the Great Blue limestone and the Oquirrh formation in Big Hollow. Because of extensive folding, the ease with which shales may thicken and thin under stress, the lack of exposed beds, and the great amount of valley fill which could cover faults, no thickness could be obtained for this formation.

The Manning Canyon-Great Blue contact has been arbitrarily placed at the base of a dense, somewhat limonitic quartzite. Although the bed is not everywhere exposed, the presence of quartzite and the appearance of red and brown colored material with shale in the float of covered sections, indicates the presence of Manning Canyon shale.

The Manning Canyon-Oquirrh contact is not exposed, although north of this area, in East Hickman Canyon, 140 feet of black fissile shale is present at the top of the Manning Canyon shale, underlying the gray silty limestone of the Oquirrh formation. The contact can be fairly well followed in covered areas by noting the presence or lack of black shale in the float.

In the Gold Hill district (Nolan, 1935, pp. 31-33), in the Oquirrh Range (Gilluly, 1932, pp. 32-33) (Sadlick, 1955), and elsewhere, the Manning Canyon shale lies across the Mississippian-Pennsylvanian time boundary.

The following fossils were collected:

<u>Dictyoclostus</u> sp.
<u>Spirifer occidentalis</u> (?)
<u>Diaphragmus</u> sp.
<u>Myalina</u> sp.
<u>Derbya</u> (?)
<u>Cleiothyradina</u>
<u>Composita subtilita</u> (?)

THE PENNSYLVANIAN SYSTEM

Marine conditions prevailed in the area for most of Pennsylvanian time. During gradual subsidence thousands of feet of sediments were deposited. This accumulation represents by far the thickest stratigraphic unit in the Stansbury Range.

The Oquirrh formation which is in excess of 14,000 feet thick makes up all the Pennsylvanian system except for a little of the Manning Canyon shale which is lower Pennsylvanian. Because of the cyclic nature and lensing of beds within the formation, no attempt was made to subdivide it into thinner units. Croft (1956, p. 24) subdivided the formation in the Onaqui Range into three lithologic units as follows: (1) a lower black limestone unit, (2) a middle sandy limestone unit, and (3) an upper predominantly siliceous limestone and orthoquartzite unit, corresponding to the Morrow, Atokan and Des Moines series respectively.

Apparently an unconformity exists between Johnson Pass, where Croft described the Oquirrh sequence, and the divide between East Hickman Canyon and Big Hollow, because the black limestone found at the base of the Oquirrh formation east of Johnson Pass is absent in Big Hollow. The first fusulinids found, 196 feet above the Manning Canyon, indicated lower Des Moines in age so both the Morrow and Atokan are probably absent.

On the basis of fusulinids the Oquirrh as measured in sections 7, 8, 9, 10, T. 5 S., R. 6 W. contains approximately 3,500 feet of Des Moines age rocks, 6,500 feet of Missouri age rocks, and 4,000 feet of Virgil age rocks.

<u>Oquirrh formation</u>

The Oquirrh formation which is exposed on the east side of the Stansbury Range was named by Gilluly (1932, pp. 34-35) for a thick sequence of alternating limestones and sandstones in the Oquirrh Range. Gilluly found a total thickness in excess of 14,000 feet.

This formation is reported to be 26,000 feet thick in central Utah (Thompson, Verville, and Bissell, 1950, p. 430) of which 16,200 feet is referred to the Pennsylvanian and 9,280 feet to the Permian. Only beds of Pennsylvanian age were exposed in the Stansbury Range of which nearly 14,000 feet were measured. These figures indicate a thickness of the Pennsylvanian exceeding any other locality in the entire Rocky Mountain province.

The beds of the Oquirrh formation occur in cyclic fashion. The repetition of similar beds is not due to duplication of strata by faulting or over-thrusting but is a result of the cyclic nature of the formation. Individual beds are generally lenticular. Due to the cover and repetition of similar beds, it was impossible to subdivide the formation.

At the south end of the Stansbury Range, the Manning Canyon-Oquirrh contact is not exposed but it appears to be gradational. Where limestone becomes greatly predominant over shale the beds are assigned to the Oquirrh formation. North of the area in East Hickman Canyon over 140 feet of black fissile shale is exposed at the top of the Manning Canyon shale.

The fusuline genera mentioned in the section were kindly identified by Roy Waite, Shell Oil Company.

Fusulina cf. F. rockymontana	L. Des Moines
Fusulina	Des Moines
Fusulinella cf. F. alta, Millerella	Des Moines
Oketaella	Des Moines (?)
Triticites	Missouri
Waeringella	L. Virgil

Also collected were: Juresania sp., Syringapora sp., Composita subtilita (?), Linoproductus sp.

The following section was measured from Hickman Pass to Cow Canyon in sections 7, 8, 9, and 10, T. 5 S., R. 6 W.:

Oquirrh formation	Thickness in feet
1. Limestone and siltstone: gradational between a dense blue to brown silty limestone and calcareous siltstone, in places is quartzitic; beyond this point the beds are covered by valley fans and alluvium.	139
2. Limestone and sandstone: medium crystalline, dense light gray-brown, very sandy limestone, alternating with a calcareous silty sandstone which is gradational with the limestone; the two show little difference.	463
3. Sandstone: basal bed is a dense, finely crystalline, brownish-black, cherty limestone; followed by 120 feet which are not exposed, overlain by 120 feet of dense pink, silty sandstone.	249

4.	Covered interval: float appears to be the same as #3.	930
5.	Sandstone: basal 42 feet is alternating limestone and quartzite followed by 167 feet of calcareous pink to orange-brown silty sandstone; upper 91 feet is not exposed but appear to be similar to the beds below.	300
6.	Quartzite: medium to orange-brown calcareous, dense, sandy quartzite with a few limestones; the basal bed contains fusulinids(*Waeringella*).	124
7.	Conglomerate: 39 feet of conglomerate with a coarse calcareous sandy matrix, followed by 19 feet of brown calcareous, dense, fine-grained sandstone, capped by 4.5 feet of somewhat sandy limestone pebble conglomerate.	62.5
8.	Siltstone and limestone: alternating medium gray, sandy limestone and thin-bedded, calcareous, gray-brown siltstone with undulating bedding planes; weathers tan.	314
9.	Limestone and sandstone: medium gray, silty limestone, alternating with medium gray to brown sandstone that weathers brown.	87
10.	Siltstone: platy, calcareous, tan siltstone with a few purple siltstones and medium gray silty limestones. There is a basal fusulinid bed (*Waeringella*).	131
11.	Quartzite: light brown, dense, sandy quartzite, weathering pink to orange-brown, little change except for an occasional limestone bed.	406
12.	Limestone and siltstone: basal beds are medium gray, coarsely crystalline and somewhat fossiliferous limestone overlain by alternating platy maroon and tan siltstone, and gray-brown, silty and platy limestone with a few medium-bedded limestones similar to the basal beds. The top 70 feet is chiefly thin platy, maroon siltstone.	250
13.	Quartzite: noncalcareous, dense, orange-brown, sandy quartzite with fusulinid bed (*Waeringella*) indicating lower Virgilian age.	110.5
14.	Siltstone and limestone: a maroon plated limestone at the base with a medium gray silty limestone alternating with an orange-brown calcareous sandy siltstone grading into a sandstone near the top.	114

15.	Siltstone and limestone: alternating calcareous sandy siltstone, and silty limestone; a medium- to thick-bedded cherty limestone at the top.	109
16.	Sandstone: calcareous, white to gray, tan weathering limestone, it appears pitted due to weathering-out of fusulinids.	83.5
17.	Limestone and quartzite: very light gray, silty limestone at the base grading into a light gray-brown calcareous quartzite, with a light gray medium crystalline limestone at the top.	63
18.	Limestone: silty, light to medium gray limestone with a few beds of tan and maroon limy siltstone; beds are not well exposed.	131
19.	Siltstone and limestone: beds were not well exposed but appear to be mottled, silty limestone, and limy siltstone, yellow to brown on weathered surface.	146
20.	Siltstone and limestone: alternating tan to orange, limy siltstone and light gray, silty, limestone with a few calcareous sandstones at the base and fusulinid bed (*Triticites*) at the top.	108
21.	Limestone: silty gray limestone with a few alternating bands of siltstone and 2 feet of dark blue fossiliferous limestone in the middle.	35.7
22.	Sandstone: calcareous, red to orange-brown, fine-grained sandstone with a few alternating silty limestones.	62
23.	Limestone: light gray, medium- to thick-bedded, fine to coarsely crystalline, silty to sandy limestone with fossils in basal bed.	38.5
24.	Limestone: silty, tan to gray, medium-bedded limestone.	26.5
25.	Quartzite and limestone: tan to pink, dense, quartzite with very sandy and cherty limestone and conglomerate at base, at the top is a light gray, sandy to silty fossiliferous limestone approximately 6 feet thick.	41.5
26.	Limestone: at base is a light gray, sandy limestone with a 4 to 5 foot cherty bed; upward in section is an alternating maroon and tan to brown silty limestone with a few interbedded cherty limestones.	127
27.	Quartzite: sandy, calcareous, tan quartzite that weathers tan to brown and grades into a sandy limestone.	78

28.	Limestone: silty, medium-bedded, orange-brown limestone, grading into sandy quartzite above.	79.5
29.	Limestone and quartzite: alternating blue-black, dense finely crystalline limestone that weathers medium gray; and clacareous, sandy gray-brown quartzite which weathers orange-brown; the upper half of this section is thin-bedded silty limestone with undulating silty parting and weathering purple to brown, with fusulinid (*Triticites*), coral and crinoid bed at the top.	268
30.	Limestone and quartzite: alternating sandy limestone and calcareous white to tan quartzite; the limestone is more prominent below and the quartzite above.	176
31.	Limestone: light blue-gray, dense, fine to crypto-crystalline, silty limestone, alternating with silty to sandy, tan to gray, cherty limestone beds which are gray-brown on the fresh surface.	244
32.	Quartzite and limestone: alternating quartzite and silty to sandy, orange-brown weathering limestone which is a ledge-former; the top is capped by a limestone conglomerate.	450
33.	Quartzite and limestone: similar alternating, calcareous quartzite and silty limestone, with a fusulinid bed (*Triticites*) indicating Missourian in age.	453
34.	Quartzite and limestone: alternating calcareous sandy quartzite and silty orange-brown limestone with a bed of large fusulinids (*Triticites*) at the top.	336
35.	Siltstone and limestone: calcareous sandy, siltstone and pinkish silty limestones lower in the section, with quartzite near the top.	360
36.	Limestone and siltstone: maroon to tannish brown, platy limestone to siltstone. The change of the attitude of the beds may represent a slight unconformity.	89
37.	Limestone and sandstone: a light to medium gray, silty limestone alternating with calcareous buff, fine-grained, friable sandstone.	75.5
38.	Quartzite: similar to the two lower beds, more calcareous and red in color, becoming denser and redder in sections.	548

39.	Quartzite: tan to orange-brown, dense, medium crystalline quartzite with a few limestones in the lower part.	163
40.	Limestone: medium gray, dense, silty limestone that weathers gray to maroon, with alternating sandstone and brown weathering quartzite toward the top.	280
41.	Siltstone and limestone: alternating buff to brown siltstone and gray to maroon, silty limestone beds containing some fossils.	140
42.	Quartzite: tan to orange-brown, dense quartzite with a few alternating beds of silty limestone and conglomerate.	250
43.	Conglomerate: quartzite cobbles of fist size with a limy matrix.	8
44.	Limestone: brown to gray, in places somewhat pinkish, weathering tan to gray-buff, silty to sandy, very fossiliferous, medium crystalline.	74.5
45.	Quartzite: buff to tan, finely crystalline, limy, quartzite with a few alternating limestones.	250
46.	Siltstone and limestone: alternating buff to brown thin-bedded siltstones and limestones, little limestone is found in the upper 150 feet; the beds grading into sandy quartzite.	300
47.	Quartzite and siltstone: basal 21 feet is buff to light gray-brown quartzite followed by 74 feet of maroon platy siltstone overlain by quartzite with interbedded conglomerate.	174
48.	Quartzite: orange-brown to reddish-brown, sandy quartzite capped by 5 feet of dense sublithographic blue-black limestone (numerous prospect holes found along this bed).	128
49.	Siltstone and limestone: maroon siltstones and silty limestones which were platy and fossiliferous, a gray-brown limestone was found at the base.	71
50.	Siltstone and limestone: beds were not well exposed but appear to be shaly siltstones and silty limestones, maroon to gray in color.	240
51.	Quartzite: orange-brown to dark brown quartzite in the lower half; the top being a valley-former was covered with a mantle and was not exposed.	108

52.	Quartzite: grading into silty and sandy limestone.	100.5
53.	Limestone and siltstone: at the base is a medium gray, dense, finely crystalline silty limestone with beds 3 to 4 feet thick. The middle unit is a valley-former and was not exposed, the top 50 feet is a shaly maroon thin-bedded siltstone.	112
54.	Quartzite: orange-brown, silty, and finely crystalline limy quartzite.	94
55.	Limestone and sandstone: approximately 20 feet of medium gray, silty dense, finely crystalline limestone with interbedded buff to brown sandstone.	20
56.	Sandstone: orange-brown, soft, friable sandstone with two interbedded sandy limestones of medium gray color becoming more quartzitic toward top.	72
57.	Siltstone and limestone: at base is buff to brown sandy quartzite followed by sandy siltstone, and silty limestone containing corals, crinoids and bryozoans.	79
58.	Siltstone and sandstone: maroon, limy siltstone, grading into alternating sandy siltstone and sandy quartzite.	78.8
59.	Limestone: at base is 6 feet of blue-gray, dense cherty limestone containing large fusulinids (Oketaella), overlain by dense, brown, limy quartzite.	92.5
60.	Limestone and siltstone: platy, maroon, silty limestone and siltstone, containing fossils, not well preserved.	117.5
61.	Quartzite: silty, platy, maroon-gray limestone weathering buff to brown, containing many bryozoans and crinoid stems, grading upward into a sandstone which again grades into a quartzite.	219
62.	Limestone: blue-gray, dense, finely crystalline limestone, containing a few fusulinids alternating with chert and sandstone beds.	63.0
63.	Quartzite: grading from a limy siltstone at base into a dense gray-brown quartzite that weathers orange-brown becoming sandy and friable toward the top.	131.5
64.	Limestone: pinkish platy and silty limestone which is a valley-former and not well exposed.	95.5

65.	Sandstone and quartzite: similar to #66 being sandy quartzite and sandstone, reddish-brown in color with a few interbedded conglomerates.	264
66.	Quartzite and sandstone: limy and siltyquartzite grading into a silty limestone. The blue-black dense lithographic limestone is 5 to 6 feet thick.	244
67.	Limestone: medium gray, dense, massive beds containing numerous crinoid stems (encrinoidal).	35
68.	Siltstone and sandstone: the lower 200 feet is quite silty while the next 600 feet is composed of sandstones and quartzites. The lower part of this is reddish-brown sandstone while the top is a buff-limy quartzite containing _Fusulina_.	800
69.	Limestone: cherty and sandy limestone, some quartzite but more lime with terrace at top.	200
70.	Siltstone, limestone and sandstone: slope-former, not well exposed.	200
71.	Siltstone and sandstone: alternating siltstones and sandstones with occasional sandy limestone; the beds are not well exposed; at the top is a limestone bed which forms a terrace around the hillside.	197
72.	Limestone: 64 feet of pinkish platy, silty, limestone, overlain by 10 feet of tan to buff limestone, followed by a similar sandy to silty, pinkish limestone. Samples were taken at 136 feet; above, the beds are more sandy, overlain by 7 feet of blue-black, cherty limestone, medium to coarse crystalline.	172
73.	Limestone: purple-gray platy and silty limestone, weathers light pinkish gray in lower 43 feet; contains brachiopod fragments and fusulinids (_Fusulinella_ cf. _F. alta_, _Millerella_); next 28 feet is similar with thicker beds, better exposed, containing a few chert blobs. Above, the beds are siltier and more cherty, weathered tan to brown, medium gray on fresh surface. At 84 feet from base is a very dense, light gray and finely crystalline fossiliferous limestone 4 to 5 feet in thickness in which a trilobite was found, Above, the beds become increasingly sandier, the upper 18 feet is a dark cherty limestone with considerable brachiopods and bryozoans at the top.	146

74.	Limestone: lower half is silty, blue-gray in color; thin-bedded alternating with bands of sand or chert in the upper portion, the lower 2 1/2 feet is a coarse-grained coquina limestone. At top the beds are more massive ledge-formers.	81
75.	Limestone: base is a fusulinid bed (*Fusulina*) overlain with 20 feet of gray-black limestone. Beds are 2 to 3 feet thick with occasional chert stringers. Above this, the beds are not well exposed but the float indicates it is much sandier and siltier.	85.5
76.	Limestone: 2 1/2 feet of white to tan, dense, finely crystalline limestone that is light brownish-gray on fresh surface, bed does not seem to carry out to the south; above the tan bed is 3 1/2 feet of blue-black finely crystalline, dense limestone that weathers blue-gray; this in turn is overlain by a light gray-brown, sandy limestone, with sandy and cherty stringers standing in relief on weathered surface, giving a banding appearance. The fossils indicated Des Moines age.	18
77.	Limestone: dark blue-gray, at base is almost all fusulinids (*Fusulina* cf. *F. rockymontana*) that indicate Des Moines in age; dense and finely crystalline with a fetid odor. There are many corals found in the lower 25 feet; it is good limestone with a few cherty stringers at the top.	62.5
78.	Limestone: light to medium gray, silty to sandy, weathers tan to brown; part of the surface is covered with a brown chert; the beds becoming more dense, then cherty toward the top; the main fossils seem to be crinoid stems and bryozoans.	15
79.	Covered interval: samples of sandy limestone containing corals were noted in the float, but no outcrops were present in the lower 180 feet.	181
	Total Oquirrh formation	13,971.5
	Total Paleozoic, not including Manning Canyon shale or Tintic quartzite	24,075.8

Quaternary deposits consist of landslides, fan gravels, Lake Bonneville sediments, glacial and creep deposits, alluvium and sand dunes all unconformably overlying the older, uplifted Paleozoic sequence. Igneous rocks are absent, although pyroclastics appear a few miles to the north and south of the area.

Landslide deposits

Landslide deposits are in evidence on the west side of the Stansbury Range. West and south of Rock Springs beds of the Mississippian Pine Canyon limestone and the Madison limestone lie unconformably on beds of Silurian and Ordovician age. In the vicinity of Devil's Gate, west of Johnson Pass, beds of the Mississippian Great Blue formation are found on the Pine Canyon limestone, with occasionally a little of the Humbug formation showing. This sudden disappearance of the Humbug formation is attributed to landsliding. In both of the above indicated deposits the beds have remained mostly intact, sliding forward over older beds. The source of the landslide blocks appears to be the steep western escarpment of the Stansbury Range. The writer believes the landslide blocks are collapse structures which were the result of erosion and undercutting following the removal of the west limb of the anticline by thrusting.

Pre-Lake Bonneville fan gravels

Pleistocene fans extend apron-like from the base of the western escarpment and in the piedmont on the east side of the range. The fans are unconformably overlain by lacustrine sediments and are indented by wave-cut terraces, and are thus of pre-Lake Bonneville age. The fan gravel is composed of poorly sorted debris, and appears to be derived mainly from the uplifted Paleozoic sequence in the adjoining mountains. The material appears to be mainly unconsolidated, but in deeper canyons which bisect the fans, the material is seen to be weakly cemented in places.

Lake Bonneville beds

Lake Bonneville touched only the southwest corner of the area mapped. For the most part the flooding by the lake waters resulted in the reworking of gravels previously deposited in the interconnecting fans extending out from the canyons on the west side of the range. Of particular interest are the numerous terraces which can be noted west of the area mapped, as one approaches Dry Canyon by way of the Indian Reservation. Six well-defined terraces can be seen to the north and eight to the south.

Creep and glacial debris

Glaciation has affected several canyons within the Stansbury Range (Lambert, 1941). In Dry Canyon and East Hickman Canyon creep or mud flows have erased much of the evidence of glaciation. The only cirque in the area is seen east of Vickory Peak, on the divide between Big Hollow and East Hickman Canyon. The glacial debris which is made up of limestone boulders from the Great Blue formation, extends only a short distance beyond the cirque, covering the Manning Canyon shale which forms the divide between Big Hollow and East Hickman Canyon. The absence of cirques which are abundant in the canyons to the north is probably due to lower resistance of the limestone beds which form the ridge crest in the area mapped while the Tintic quartzite is the ridge-former to the north.

The creep deposits very much resemble glacial deposits, the topography being very hummocky and marked by pot holes. The absence of cirques and the presence of large scars on the hillside above the material in the creep seem to prove the manner of origin.

RECENT

Sand dunes

Sand dunes cover most of the southwest corner of the area, unconformably overlying the Lake Bonneville sediments. They are obviously post-Lake Bonneville or Recent. The dunes are restricted to the vicinity of Johnson Pass, not being found north of Deadman Canyon. The material in the dunes consists of fine quartz sand blown in from the desert to the west.

Alluvium

Numerous alluvial fans are present within the various canyons throughout the area indicating Recent origin. Stream beds are veneered with recent gravel, sand, silt, and clay.

S T R U C T U R E

GENERAL SETTING

The origin of the Basin and Range type of structure of Utah and Nevada has been discussed in a large number of reports. Gilbert (1874) regarded the ranges as faulted monoclines in which the strata on one side of the faults have been lifted. Anticlines being rare except as local subsidiary features, King (1878) modified this view in which he emphasizes that compression first took place forming a region of anticlines and synclines and that vertical faulting was superimposed on early anticlinal folds.

Dutton (1880), while not denying the theory of flexing and later faulting, was not convinced that the present relief of the ranges is in any way associated with the folding. He states that the present mountains are uplifted fault blocks of a previously developed featureless platform, and that the present relief has been carved by erosion.

Up to this point each new theory was harmonious, in that each new idea was an amplification of the preceding, but with Spurr (1901) harmony was ended and has not been restored. He advanced the challenging idea that the Basin Ranges are primarily the result of erosion, that faulting was only local, and that the effect of faulting was of short duration. Davis (1903-1905) presented a concept of erosion and described the physiographic features present in the Basin Ranges. Keys (1908) advanced the theory of desert leveling, stating that Basin and Range are largely remnantal, their prominence resulting from differential degradation, with the wind as the chief erosive agent. The ranges exist because their rocks are harder than those of the valleys between. He claims the steep fronts are not necessarily the result of faulting, but could have resulted from wind action.

Baker (1913) suggests that the Basin Ranges are really mountains of tangential compression with considerable overthrusting and reverse faulting. In addition, he reports warping into anticlines and synclines, faulting forming grabens, and, in still more numerous cases, tilted blocks bounded on one side by fault scarps.

Ferguson (1924-1926) recognized at least four stages of faulting in west central Nevada. This was the first statement that the blocks were not all essentially contemporaneous. Since 1928 there has been considerable work done in various parts of the Great Basin which has contributed to understanding the different features of block faulting. Eardley (1951, p. 477) uses four types of evidence to show that individual ranges in the Great Basin are bordered by block faulting: "physiographic evidence, stratigraphic evidence, exposures of fault plane, and presence of recent fault scarps along the range fronts." Eardley (p. 481) refers to five periods of Basin-Range faulting and considers the part of folding and thrusting in the regional structure.

STANSBURY RANGE

It is impossible to explain the structure of the Stansbury Range by any of the early theories alone. It is evident that intensive folding followed by both thrust and normal faulting, together with erosion have all played a part in bringing about the present appearance of the range.

FOLDS

Deseret anticline

The major structure within the Stansbury Range is the Deseret anticline, which was described by Arnold (1956, p. 49) from evidence in the Timpie area and found by the writer to continue throughout the length of the range. At the south end of the range the axis of the anticline strikes N. 12° W. and the nose plunges 20 degrees to the south. The limbs, where both are present, are nearly symmetrical, but the west limb has been removed by faulting south of Spring Creek leaving only the gentle east-dipping strata of the east limb. In the vicinity of Dry Canyon, the limbs of the anticline appear to be dipping at approximately 50 degrees, while to the south the beds on the flanks of the fold rarely exceed 35 degrees.

The Deseret anticline, as well as being unusually long, was undoubtedly at one time a very broad structure. In the vicinity of Dry Canyon, where the core of the anticline is exposed in the resistant beds of the Tintic quartzite, it is 8 miles from the axis of the anticline on the west to the point where the east limb disappears beneath the valley alluvium. This represents also an exposure of over 25,000 feet of strata.

Beyond the nose of the Deseret anticline, where the resistant beds of the Tintic quartzite plunge under the younger Cambrian beds, minor folding is much more in evidence. Several minor subparallel folds extend southward toward Johnson Pass. Croft (1956, p. 28) refers to the folding south of Johnson Pass as the "Onaqui Fold System." Folds of this system have the same general trend as the anticline and are south-plunging, being flextures of the beds on the limb of the anticline. Two flextures are worthy of mention, and discussion of these will follow.

Clover syncline

The Clover syncline described by Croft (1956) is the dominant structural feature of the southeastern part of the area, extending from Vickory Canyon south of Johnson Pass where it plunges and disappears beneath the alluvium. This fold is asymmetrical, the strata on the west flank between Johnson Pass and Vickory Canyon being sharply overturned. In Johnson Pass the axis is displaced by a series of steeply dipping parallel faults which trend northeast. The Great Blue limestone is exposed on the limbs of the syncline, with Manning Canyon shale exposed in the trough north of Johnson Pass and the Oquirrh formation south.

Deadman anticline

The name Deadman anticline is proposed by the writer for the structure cut by the drainage from Deadman Canyon. This structure, which is an outlyer west of Condie Meadows, is separated by over a mile of fan gravels from the nearest exposure east of the Stansbury fault. This structure, expressed on the surface in strata of the Great Blue formation, is asymmetrical, the east limb dipping somewhat steeper. The anticline strikes N. 37° W., and at the south the nose is found to plunge at 18 degrees to the south. The structure, a little over 1 mile in length, is cut off on the north by Spring Creek and the alluvial fans which extend out from the west side of the range.

The relationship of this structure to the Deseret anticline could not be determined. The lithology varies somewhat from that of the Great Blue limestone in the Stansbury Range, and it appears impossible to project the strata to coincide with that of the Stansbury Range. This writer believes that this structure has been thrust in from the west by the same action that removed the west limb of the Deseret anticline, (see Orogenic History) thus accounting for the change in lithology and the steepness of the east limb.

UNCONFORMITIES

Various minor breaks and disconformities mentioned in descriptions of neighboring areas appear to be present in the stratigraphic sequence of the Stansbury Range. Brief mention will be made of these regional disconformities, but primary attention is given to the important local unconformities found in the Stansbury Range.

Pre-Upper Ordovician unconformity

The lowermost important disconformity is at the base of the Fish Haven dolomite. The Fish Haven appears to conformably overlie the Kanosh shale, which is equivalent to the lower Swan Peak formation. Although no angular disordance was noted, the absence of Middle Ordovician beds within the Stansbury Range is in accord with written descriptions by Hintze (1951), Nolan (1935), and others in which the absence of Eureka quartzite and Swan Peak quartzite at Tintic, Gold Hill, Lakeside, and in the Stansbury Range seem to indicate a hiatus in sedimentation or an erosional unconformity. Cohenour (1957, fig. 5) has prepared an isopach map showing a salient projecting west from the Oquirrh Range through the south and central parts of the Stansbury Range during Middle Ordovician time, for which he has proposed the name "Stansbury Salient." Nondeposition or erosion in this area would account for the absence of the quartzite beds of the upper Swan Peak formation and Eureka quartzite which are found to the south (Cohenour, 1957) and to the northwest (Paddock, 1956) of the Stansbury Range.

Pre-Mississippian unconformity

Late Devonian was marked by local uplift which resulted in the deposition of a great thickness of conglomerate, especially in the northern part of the Stansbury Range. In the central part of the range, Mississippian beds rest unconformably on Cambrian indicating considerable erosion. On the north side of Dry Canyon, Mississippian beds rest on the Garden City formation, whereas on the south side of Dry Canyon the Kanosh shale and Fish Haven dolomite are present. Proceeding to the south, between Dry Canyon and Deadman Canyon, beds of the Laketown dolomite, Sevy dolomite, Simonson dolomite, and Stansbury conglomerate make their appearance beneath the unconformity. Arnold (1956) reports a similar discordance at the northern end of the range with successively older beds disappearing to the south. This unconformity appears to be the result of uplift along an east-west element extending to the west from the Uinta Mountains, previously referred to as the Stansbury Salient.

Post-Madison unconformity

A distinct angular unconformity occurs locally between the Madison limestone and the Pine Canyon limestone in the Stansbury Range. A maximum discordance of 25° was measured east of Rock Springs. The unconformity does not appear to be everywhere present; the beds above and below the contact follow nearly the same trend and, except near the contact, appear parallel. The lowermost beds of the Pine Canyon are hashy with breccia found several places above the basal beds. The discordance may be the result of folding and bedding plane slipping or thrusting, affecting only the upper beds of the thin-bedded Madison limestone. This disturbance resulted possibly from a shift of the zone of subsidence from the Madison Basin, east of the Stansbury Range, to the Brazer Basin to the west. Reid (1954) reports the Madison formation of the Wasatch Plateau to be Kinderhookian and Osagian age with no angular discordance known at the base, but reports an erosional unconformity (disconformity) above, stating "a post-Osagian erosional interval influenced the upper portion of the Madison formation."

The lower cherty beds of the Pine Canyon are considered as Madison by Gilluly (1932) and Morris (1957), but because of the discordance mentioned and the change in lithology this writer feels justified in separating the units as described.

Pre-Des Moines unconformity

In the Stansbury Range an unconformity is present in the lower Pennsylvanian beds. The Manning Canyon-Oquirrh contact is not exposed, but beds of Morrow and Atokan age which are present in exposures of the Clover Syncline on the east side of Johnson Pass, are absent four miles to the north at Hickman Pass. Here beds of Des Moines age overlie the Manning Canyon shale which is considered to be Chester and Springer in age. Croft (1956) reports 85 to 120 feet of Morrowan rocks in the Clover syncline. This unit is typically a dark gray to black, fine crystalline limestone. Croft also measured 1,596 feet of Atokan rocks in the vicinity. At Hickman Pass this author found *Fusulina* cf. *F. rockymontana* 196 feet above the

Manning Canyon shale, indicating a considerable hiatus to the north. The dip of the beds of the Manning Canyon and Oquirrh formations appear to be nearly the same, but the strike of the beds of the Oquirrh makes an angle with the Manning Canyon shale of approximately 30 degrees. This unconformity indicates uplift within the central part of the Stansbury Range, again in line with the east-west element extending from the ancient Uinta Mountains.

In the Gold Hill district (Nolan, 1935, pp. 33-36) the genus _Fusulina_ occurs immediately above the Manning Canyon shale. The genus _Fusulina_ according to Thomas, Verville, and Bissell (1950) occurs in rocks of Des Moines age, thus indicating a similar unconformity between the basal beds of the Oquirrh and the Manning Canyon in the Gold Hill area.

Paddock (1956) reports several irregular contacts occuring within the Simonson and Laketown dolomites of the Newfoundland Mountains. In the Stansbury Range the dolomite formation of Upper Ordovician, Silurian and Devonian have been extremely shattered, altered, and repeated by faulting. Several disturbances probably affected these formations in the Stansbury Range, but these could not be identified with certainty.

OROGENIC HISTORY

It is impossible to correlate the various phases of the Laramide and Cedar Hills orogenies as described or reviewed in adjacent areas with specific structures or events in the Stansbury Range. The deep erosion and absence of Cretaceous and Tertiary conglomerates would indicate that this area was relatively high in Late Cretaceous and early Tertiary and consequently was part of the source area of the conglomerates of the Indianola, Price River, and North Horn formations of central Utah.

Laramide orogeny

No structures in the mapped area could be correlated with the Cedar Hills orogeny, but the area was probably involved in the Cottonwood uplift which, according to Eardley (1951, p. 328), was an E-W compressional movement during the first stage of the Laramide orogeny (probable early Montana time). During the second stage, middle and late Montana time, the Price River conglomerate was deposited in central Utah. The second stage was an interval of strong folding and thrusting. This stage probably gave rise to the Sheeprock overthrust which this writer believes carried north through the Onaqui Range into the Southern Stansbury Range. Due to east-west compressional stresses the beds were folded and the west limb of the Deseret anticline was thrust over the younger less resistant beds of the Manning Canyon shale in the vicinity of Johnson Pass, where these shale beds formed the nose of the anticline. The attitude of the faults and the direction of movement of the thrust indicates that the compressional forces were directed from west and northwest.

Thrusting occurred mainly south of the point where resistant beds of the Tintic quartzite outcrop in the nose of the Deseret anticline. On the west side of the anticline the beds of the Ophir group are missing, indicating a reverse movement in which the younger Cambrian limestone beds have moved up onto the Tintic quartzite cutting out the shale beds of the Ophir group.

Following the thrusting, the compressive force being released, normal faults were formed. These faults show a northwest trend, strike N. 35° to 40° W., and dip approximately 70° to the west and in places show as much as 1,000 to 2,000 feet of displacement. A long period of erosion is thought to have ensued, during which period the anticline was deeply eroded. Landsliding undoubtedly occurred in which the more competent beds on the east limb of the fold slid westward over the eroded surface. The beds of the landslide, which remained intact, are Mississippian age and rest unconformably on older beds.

A number of east-west transverse faults cut the range. Along these faults, numerous gossans and calcite mineralization appears, but as a whole show very little displacement.

Basin Range orogeny

The last tectonic stage recognized in the area is the development of the Stansbury fault which is a recent normal fault extending along the west side of the Onaqui and Stansbury Range for approximately 30 miles. The displacement is probably of considerable magnitude though nowhere measurable. The range rises abruptly from the waste-filled valleys and gravel fans which extend to the west from the escarpment.

E C O N O M I C   P R O D U C T S

MINE PROSPECTS

Numerous prospect pits are found at the south end of the Stansbury Range. They are generally located along faults or folds where the bedrock is brecciated or slightly mineralized. The Ahlstorm mine drift, west of Devil's Gate in section 26, T. 5 S., R. 7 W., extends for several hundred feet in a N-NE direction along what appears to be the brecciated zone in the Laketown dolomite. To the knowledge of the author, no ore has been shipped from the district, though according to reports of residents in the area, assays of samples would indicate economic value, if ore were obtainable in large enough quantities.

Quarrying operations of economic importance, in the Great Blue formation and Fish Haven dolomite, are carried on at Flux and Dolomite at the north end of the range. The distance to the railroad would probably make mining of these beds unprofitable at the south end.

SAND AND GRAVEL

Sand and gravel, obtained from alluvial fans, have been used for the paving of the various highways in the area though the material appears to be of inferior quality.

TIMBER

Trees of sufficient quality and quantity to supply a lumbering operation are obtained from Dry Canyon on the west side of the range. A distance of 60 miles to the mill in Tooele hardly makes this a profitable enterprise.

WATERSHED

The Stansbury Mountains comprise an important watershed which drains into Skull and Rush Valleys. Many springs rise from the alluvial fans which skirt the range and several perennial streams supply water for agricultural industries. At the southern end of the Stansbury Range these streams include Indian Hickman and Condie Creeks which drain into Skull Valley on the west side of the range, and East Hickman and Clover Creeks which drain into Rush Valley on the east side of the range.

Clover Creek, the most prominent stream in the area, issues along the Great Blue-Manning Canyon contact. According to Carpenter (1913) the creek discharges 14 second-feet in the spring and 3 1/2 second-feet in the fall of the year. The water is used at Clover and St. John to irrigate approximately 600 acres.

The water from Condie Creek has been diverted by the proprietors of the Hatch Ranch and is piped several miles to the south to supplement irrigation as well as to add considerable acreage to the Hatch Ranch which lies immediately to the south of Utah Highway 58 in Skull Valley.

A number of springs have been developed for livestock watering, the location of most of these springs appears to be controlled either by the Stansbury fault or beds of the Manning Canyon shale. On the west side of the range the springs rise from the shallow fans below the western escarpment of the Stansbury fault. On the east side of the range various springs rise from the Manning Canyon shale in Big Hollow and in East Hickman Canyon, several having been piped into troughs for stock watering.

The Stansbury Range, being over 10,000 feet in elevation, receives considerable snowfall which persists into July. Considerable moisture is lost in the valley alluvium, in places reappearing as springs along the western escarpment. The spring water is soon lost in the gravel that comprises the fans which extend out from the range.

A few small wells have been drilled in Skull Valley which recover some of the escaping water. This writer believes that a large underground reservoir exists and that considerably more acreage could be brought into production by tapping this underground source.

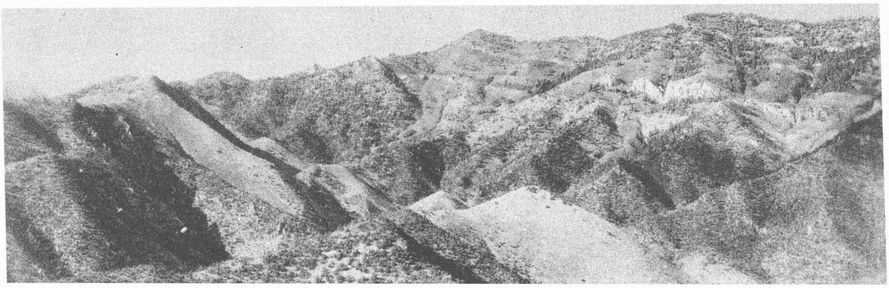

Fig. 5. Western face of the Stansbury Range in the vicinity of Vickory Peak. Cambrian beds are seen at left with Garden City formation forming treeless slope and Great Blue formation exposed on the ridge crest.

Fig. 6. East slope of the Stansbury Range (just north of the area covered by this bulletin) showing the location of the silica (S) quarry of the Murray Refractories Company. At "V," above the silica deposit, is the location of one of Utah's three variscite (Utah's gem mineral) localities. Deseret Peak is on the left center skyline. The view is from the air above South Mountain west of Stockton, Utah.

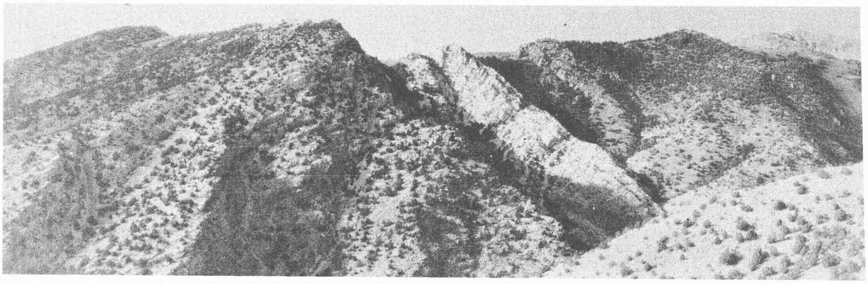

Fig. 7. Deseret anticline in the vicinity of Indian Hickman Canyon. Tintic quartzite is exposed along the axis.

Fig. 8. East slope of the Stansbury Range looking west, with East Hickman Canyon in the foreground and Deseret Peak (highest in the range) at the upper right.

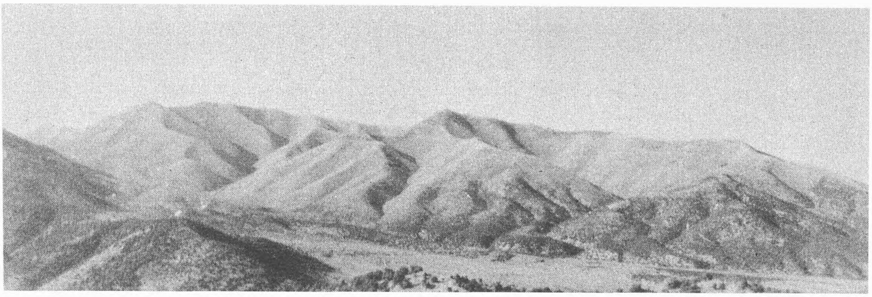

Fig. 9. An aerial view looking northeast near the mouth of Big Hollow from over Johnson Pass. Manning Canyon shale forms the valley with the Oquirrh formation forming the slope and hills in the background.

Fig. 10. View northwest toward the head of Big Hollow with Deseret Peak on the skyline. The two vegetated areas within Big Hollow are the upper and lower shales of the Manning Canyon formation. Great Blue limestone forms Vickory Peak, upper left, and the Oquirrh formation forms the hills to the right.

Fig. 11. Chert banding found in the beds of the lower Pine Canyon formation.

Fig. 12. Stansbury conglomerate as observed at the south end of the Stansbury Range. Many pebbles are aligned parallel to the bedding.

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RS-28. Plate VII — Geologic Index Map of Utah (showing U.S. Geological Survey Publications in Utah)

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