LATE PALEOZOIC AND EARLY MESOZOIC
STRATIGRAPHY OF UINTA MOUNTAINS,
UTAH

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LATE PALEOZOIC AND EARLY MESOZOIC STRATIGRAPHY
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Laramie, Wyoming

ABSTRACT

At the western end of the Uinta Mountains, Triassic rocks rest unconformably on the Permian Park City formation. From the base upward the Triassic rocks are (1) red Woodside shale, (2) marine Thaynes limestone, (3) Anchorah redclays and (4) a conglomerate and overlying sandstones and shales. The Thaynes thin and tongues out eastward, and east of its edge the Woodside and the Anchorah can not be differentiated. The conglomerate, sandstones, and shales were classed as basal Nugget sandstone, Jurassic, by Boutwell (1912), but were excluded from the Nugget (Navajo sandstone) by Heaton (1932), leaving them without a name.

At the eastern end of the mountains, Woodside redclays rest on the Pennsylvania Weber sandstone. The lower part of the Woodside is the time equivalent of the upper Park City (Pocahontas). The Woodside is cut by an unconformity above which lies a conglomerate. The conglomerate was probably a basal member of the Anchorah by Sears (1920). The upper part of the Anchorah (7) of Sears consists of varicolored shales and sandstones and is directly overlain by the massive Navajo sandstone.

The conglomerate and the overlying varicolored beds are readily recognized from one end of the range to the other and constitute an unnamed lithologic unit which lies unconformably above the type Anchorah and below the restricted Nugget at the western end of the mountains, and unconformably above the Woodside and below the Navajo at the eastern end of the range. This unit is here named the Stanaker formation and the basal conglomerate, or grit, is named the Garra grit member of the Stanaker formation. They are probably Upper Triassic in age.

The Jurassic formations of the western Uinta Mountains, from base upward are (1) Nugget sandstone, (2) Twin Creek limestone, (3) Preuss redclays, (4) Stump sandstone, and (5) Morrison formation. Eastward along the mountains (1) the Nugget sandstone persists but is called Navajo on the east, (2) the Twin Creek limestone interfingers with the Carmel redclays, (3) the Preuss redclays grade into the cross-bedded Entrada sandstone, (4) the Stump sandstone grades into Curtis shales and limestones, and (5) the Morrison thins and becomes less conglomeratic. At the eastern end of the Uinta Mountains the Carmel redclays thin out so that the Navajo is directly overlain by the Entrada, forming a single cross-bedded sandstone unit.

INTRODUCTION

Along the Uinta Mountains of northeastern Utah and northwestern Colorado there are striking east-west changes in the stratigraphy of the late Paleozoic and Mesozoic rocks. Because the range trends roughly at right angles to the ancient

3 Manuscript received, March 31, 1946. Read in part before the Association at Denver, April 24, 1944. After the completion of this paper there came to the writers' attention an article entitled "Nomenclature of the Triassic Rocks of Northern Utah," by J. Stuart Williams, which appeared in the American Journal of Science, Vol. 253, No. 9 (September, 1943). The stratigraphic relations described in the three-page article by Williams are in close agreement with those herein described. The writers wish to note that they first described the relations of the Triassic rocks along the Uinta Mountains in a paper read at the twenty-seventh annual meeting of the American Association of Petroleum Geologists, Denver, April, 1947, and that an abstract was published in the program (pp. 35-36). In addition, early in 1947, a report prepared by Krueger for the Union Oil Company of California was placed in the hands of the Indian Commissioner, Fort Duchesne, Utah. This report has been subject to public inspection. Williams refers to the use of the name "Anchorah grit" in unpublished reports. The report by Krueger used that terminology. It is not the writers' intent to discuss the nomenclature proposed by Williams except to express their belief that the units they here name Stanaker formation and Garra grit member are worthy of distinctive local names. The name, Red Wash, given by Williams, may be substituted for Woodside where the writers have used that name in sections in which the Thaynes limestone is not present.

3 Professor of geology, University of Wyoming; State geologist of Wyoming.

4 Chief geologist, Rocky Mountain Division, Union Oil Company of California.
landmasses and shorelines, there are lithologic gradations, interfingerings of facies, and changes in thickness which make long-range correlation difficult or impossible.

Stratigraphic studies have been carried on in the region for more than 70 years, but oddly were largely restricted to the areas at either end of the mountains. Until recently, little was known of the stratigraphy of the intervening region or of the relations of the stratigraphic units which had been described in the strikingly different sections at either end of the range.

In 1918, Schultz4 studied the Permian rocks from one end of the range to the other, and in 1939 J. Stewart Williams5 clarified the east-west relations of these rocks along the mountains. In 1939, Heaton6 gave the first clear picture of the relations of the Jurassic formations at one end of the range to those at the other.

The stratigraphy of the Jurassic Morrison formation of the Uinta Mountains and of contiguous areas has been described by Stokes.7 The Cretaceous stratigraphy of the south flank of the mountains has been treated by Walton.8 A paper by Eardley9 describes the structure and general stratigraphy of the western end of the Uinta Mountains.

During 2 months of the summer of 1939, one writer of this paper, Thomas, had the opportunity to measure or examine all the stratigraphic sections exposed around the Uinta Mountains. This work was under the supervision of Earl B. Noble, manager of exploration of the Union Oil Company of California, and of the co-writer, Krueger. Additional field studies were carried on by Krueger during 1940. Thomas measured stratigraphic sections in the vicinity of the Duchesne River, Lake Fork, Whiterocks Canyon, Vernal, Split Mountain, and Manila. The Vermilion Creek section was studied but not measured. These localities are indicated on the index map (Fig. 1). Krueger measured a section in the Skull Creek area, and the two writers jointly measured a section in the Weber Canyon area. These locality names are used to designate the different sections, even though parts of the sections were measured at a considerable distance from the places named. The exact locations of the sections are given in the headings of the written sections at the end of this paper. All sections were measured with plane table and telescopic alidade. Thicknesses of minor units were measured directly with a tape, a hand level, or a Brunton clinometer set at the angle of dip.

The writers wish to express appreciation to Earl B. Noble, manager of explo-

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"Park City' Beds on Southwest Flank of Uinta Mountains, Utah," ibid., Vol. 33, No. 1 (1939), pp. 82-100.
"Contribution to Jurassic Stratigraphy of Rocky Mountain Region," ibid., pp. 1135-77.
"Geology of the Cretaceous of the Uinta Basin, Utah," ibid., pp. 91-130.
"Geology of the North-Central Wasatch Mountains, Utah," ibid., pp. 819-94.

RATION, and to the Union Oil Company of California for permission to publish this paper. James W. Vernon, a promising student in geology at the University of Wyoming who was killed in a fall from a cliff during the course of geological work later in 1939, served as instrument men for the stratigraphic measurements. Other geologists, all then of the Union Oil Company, who contributed to this work through field observations and by discussions are R. A. Atwill, R. W. Burns, J. C. Hazzard, C. F. Manlove, J. Q. Anderson, and W. C. Rauch. Their assistance is appreciated. In addition, the writers are indebted to J. B. Reeside, Jr., A. A. Baker, and J. D. Love of the United States Geological Survey for reading the manuscript and for offering comments and suggestions.

Over large areas along both flanks of the Uintas, the Paleozoic and Mesozoic rocks are covered by Tertiary beds. Younger glacial or fluviatile deposits constitute a mantle at many places. Well exposed sections, therefore, are found only at intervals along the range. The general regional geology is shown on an older map by Schultz and on more recent maps by Forrester and Walton.

The relations of the Triassic rocks along the mountains are here presented for the first time and this paper, therefore, describes the stratigraphy of the interval between the Permian rocks below, described by Williams, and the Jurassic rocks above, described by Heaton. In addition, new information is given on Permian and Jurassic stratigraphy.

EVOLUTION OF STRATIGRAPHIC NOMENCLATURE
WESTERN UINTA MOUNTAINS

The details of the stratigraphy of the Park City district, at the western end of the Uinta Mountains, were first described by Boutwell in 1907 (Fig. 2). The name, Weber, applied by King in 1876, to a thick sandstone along the Weber River, north of the Park City district, was carried south by Boutwell and applied to the oldest unit exposed in the Park City district. The Weber is classed as Pennsylvanian in age and has been described recently by Williams. To limestones and other beds lying directly above the Weber, Boutwell applied the name, Park City. The Park City is classed as Permian in age and the upper part is correlated with the Phosphoria formation. The name, Woodside, was given
Fig. 2.—Evolution of stratigraphic nomenclature of late Paleozoic and early Mesozoic rocks of Uinta Mountains.
by Boutwell to 700 feet of “fine-grained dark-red shale” overlying the Park City. The next higher formation was named Thaynes limestone by Boutwell. He described the Thaynes as consisting of a lower 445-foot unit made up of fossiliferous limestones, calcareous and other sandstones, and red and gray shale; a middle 115-foot red shale unit; and an upper 630-foot unit lithologically similar to the basal unit. He pointed out that no unconformity was observed below or above the Thaynes. The highest beds exposed in the district were included in the Ankareh formation, named by Boutwell. As described, the Ankareh consisted of more than 1,500 feet of red shales, which in places are sandy, with a number of beds of rather coarse sandstone from 20 to 55 feet thick.

The division between the Thaynes and the Ankareh was based on lithology, the Thaynes being characterized by calcareous beds and the Ankareh by red shales and sandstones. A sandstone lying “at the base of the red shale as a whole and immediately below a thin limestone” was taken arbitrarily as the base of the Ankareh, and typical Thaynes fossils were reported from the basal 200 feet of the Ankareh. Boutwell mentioned a main sandstone member at the top of the Ankareh and the occurrence of petrified wood just below it. The Woodside, Thaynes, and lower Ankareh were classed as Permian; the age of the upper Ankareh was left open to question.

In 1912, Boutwell further described the stratigraphy of the Park City district. Few changes were made other than age assignments. The Woodside, Thaynes, and lower Ankareh were classed as Lower Triassic and the age of the upper Ankareh was again left open to question. The major change made was to bring the name, Nugget, into the region, that name having been applied by Veatch, in 1907, to a sandstone in southwestern Wyoming. The original Nugget of Veatch comprised a lower red beds part, just above the Thaynes, and an upper thick sandstone part. In 1910, the name, Nugget, had been restricted to the sandstone unit, and Boutwell pointed out that at the top of his original Ankareh were white sandstones with some intercalated reddish shales which he thought represented the lower part of the restricted Nugget.

In 1931, Mathews described the Mesozoic rocks of the Wasatch Mountains in the area northwest of the Park City district. The Thaynes was divided into the Pinecrest formation, below, and the Emigration formation, above. The overlying Ankareh, according to Mathews, is unlike the type Ankareh in that instead of being mainly siliceous sandstone, it is an ox-blood red fine-grained shale with

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32 A. C. Veatch, “Geology and Geography of a Portion of Southwestern Wyoming, with Special Reference to Coal and Oil,” U. S. Geol. Survey Prof. Paper 56 (1907).
only thin beds of sandstone. It was implied that the thickness is 450 feet. The Nugget, as differentiated by Mathews, comprised a basal conglomerate, fine- and coarse-grained sandstones, intercalated gypsiferous dark red to pale blue shales and some limestones, and a characteristic creamy white or yellowish white sandstone at the top of the formation. The basal conglomerate, 48 feet thick in one place, rests above an unconformity.

In 1933, Boutwell further described these formations. In the Park City district he recognized Woodside redbeds at the base; Thaynes limestone; Ankareh bright red shale and sandstone and a few thin limestones; and Nugget, described as a "massive coarse-grained grayish-white cross-bedded sandstone carrying no fauna but some petrified wood." He described the Nugget of the Cottonwood district as a "gray sandstone with a basal conglomerate overlying the Ankareh, together with associated red shale members."22

In 1939, Heaton substituted the name Navajo for Nugget and placed the base of the Navajo of the western Uinta Mountains at the base of the massive sandstone unit, excluding the subjacent redbeds and conglomerate. It becomes apparent, therefore, that both Boutwell's and Mathews' concept of the sequence was as follows.

<table>
<thead>
<tr>
<th>Nugget</th>
<th>Thick sandstone unit</th>
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<tr>
<td></td>
<td>Redbeds with petrified wood</td>
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<td></td>
<td>Basal conglomerate</td>
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<tr>
<td>Unconformity</td>
<td></td>
</tr>
<tr>
<td>Ankareh</td>
<td>Redbeds</td>
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<tr>
<td>Thaynes</td>
<td>Limestones et cetera</td>
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<tr>
<td>Woodside</td>
<td>Redbeds</td>
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<tr>
<td>Park City</td>
<td>Limestones et cetera</td>
</tr>
</tbody>
</table>

The important point made here is that both considered the conglomerate and the redbeds with petrified wood to be basal units of the Nugget. As shown later, these two units constitute the so-called Ankareh at the eastern end of the mountains.

**EASTERN UINTA MOUNTAINS**

As early as 1875, Gilbert divided the redbeds of the eastern Uinta Mountains into (1) Lower Trias marls at the base (2) Shinarump conglomerate, and (3) Upper Trias marls above.*

In 1876, Powell described the stratigraphic sequence along the Green River.

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22 Ibid., p. 86.
23 Ross L. Heaton, *op. cit.*
* Stratigraphic names which have been abandoned or have become obsolete are indicated by a dagger preceding the term.
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Red beds with petrified wood
Basal conglomerate
Unconformity
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Red beds
Thaynes
Limestone et cetera
Woodside
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Park City
Limestone et cetera

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* A. R. Schultze, op. cit.

“A Report on the Geology of Portions of Nevada, Utah, California and Arizona,”

names which have been abandoned or have become obsolete are indicated by a

“Geology of the Eastern Portion of the Uinta Mountains,” U. S. Geol. and Geog. (1876).

A thick sandstone, the Weber of current nomenclature, was named the †Yampa
sandstone. The overlying unit of phosphatic shale, limestone and chert, now
recognized as Park City, was called the †Bellerophon limestone. The red beds
next above were called †Shinarump group and divided into †Lower Shinarump,
Shinarump conglomerate, and †Upper Shinarump. Powell said, “The conglomer-
ate which is found in the middle of the group is persistent over a very large
area . . .” (p. 69) and “The variegated beds above . . . the conglomerate are seen
in many places on either flank of the Uinta Mountains . . . ” (p. 54).

Powell differentiated certain beds above the †Shinarump group as the †Ver-
milion Cliff group but it is difficult to determine the boundary in the field to-day.
He gave the name †White Cliff group to the light-colored cross-bedded sandstone
above the †Vermilion Cliff group. This is the Navajo or Nugget sandstone of
current nomenclature.

In 1919, Schultze, studying the phosphate deposits, applied the name, Weber,
to Powell’s †Yampa sandstone and carried the term, Park City formation, into
the eastern Uinta Mountains. In places he included tawny beds in the top of the
Park City, but there are no such beds in the upper part of the type Park City.
The red beds just above were classed as Woodside formation.

Later, in 1920, Schultze, on a chart, classed the main body of red beds above
the Park City as “Woodside and Thaynes (?).” An unconformity was shown
above this unit and the name, Ankareh, was applied to the 300 feet of beds
between the unconformity and the Nugget sandstone.

In 1925, Sears gave a detailed section measured on Vermilion Creek. The
nomenclature of Schultze, 1920, was used except for questioning the name, An-
kareh. The “Ankareh (?)” of Sears comprised a basal conglomerate and over-
lying varicolored beds.

Workers in the eastern Uinta Mountains, therefore, have applied the name,
Ankareh, to a conglomerate and varicolored beds which can be shown to lie above
the type Ankareh and were included in the Nugget sandstone by workers in the
eastern Uinta Mountains. The conglomerate and overlying varicolored beds
constitute important units in the stratigraphy of the Uinta Mountains and have
never been properly named.

PERMIAN STRATIGRAPHY

Park City formation.—The Park City formation of the Uinta Mountains,
originally described by Boutwell, has been discussed recently by A. A. Baker

2 A. R. Schultze, op. cit.

2 A. R. Schultze, “Oil Possibilities in and around Baxter Basin, in the Rock Springs Uplift, Sweet-

2 J. D. Sears, “Geology and Oil and Gas Prospects of Part of Moffat County, Colorado, and

2 J. M. Boutwell, “Stratigraphy and Structure of the Park City Mining District, Utah,” Jour.
and J. Steele Williams,\textsuperscript{38} and by J. Stewart Williams.\textsuperscript{31,32} Baker and Williams discussed the relation of the type Park City to the type Phosphoria of Idaho and showed that the upper cherty limestone unit and the subjacent phosphatic shale unit of the type Park City correspond with the Phosphoria. Even though the phosphatic shale unit of the Park City rests directly on the Weber sandstone in places along the Uinta Range (Fig. 3) and the beds there could conceivably be called Phosphoria formation, the writers have preferred to use the name, Park City, throughout the area since in few places do the beds of Phosphoria lithology have the exact time scope of the type Phosphoria.

J. Stewart Williams\textsuperscript{38} described the interfingering of the Park City with red beds along the south flank of the mountains. The writers remeasured or examined all the sections described by Williams and measured additional ones farther east. The details of the interfingering are given a slightly different interpretation from those illustrated by Williams.

On the Weber River, at the western end of the mountains, in Franson Canyon, the Park City has a typical tripartite division. The upper cherty member is 307 feet thick and overlies the phosphatic shale member, which is 45 feet thick. The

\textsuperscript{38} A. A. Baker and J. Steele Williams, \textit{op. cit.}, pp. 627-29.

\textsuperscript{31} J. Stewart Williams, "Park City' beds on Southwest Flank of Uinta Mountains, Utah," \textit{Bull. Amer. Assoc. Petrol. Geol.}, Vol. 23, No. 1 (1939), pp. 82-100.


\textsuperscript{38} J. Stewart Williams, "'Park City' Beds on Southwest Flank of Uinta Mountains, Utah," \textit{Bull. Amer. Assoc. Petrol. Geol.}, Vol. 23, No. 1 (1939), pp. 82-100.
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![Diagram illustrating relations of Park City and Woodside formations along south flank of Uinta Mountains.](image)

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and J. Steele Williams, op. cit., pp. 627-70.
Williams, "Park City' beds on Southwest Flank of Uinta Mountains, Utah," 
Petrol. Geol., Vol. 23, No. 1 (1939), pp. 82-100.
"boniferous Formations of the Uinta, and Northern Wasatch Mountains, Utah,"
Williams, "Park City' beds on Southwest Flank of Uinta Mountains, Utah," 
Petrol. Geol., Vol. 23, No. 1 (1939), pp. 82-100.

![Figure 4: Thin Park City chert resting on Weber sandstone at Split Mountain.](image)

part of the Park City below the phosphatic shale was not studied in detail, but
lithologically it is similar to parts of the Phosphoria of Idaho and Wyoming, and
the few fossils collected, comprising Schizodus sp., Orbiculoidea utahensis, and
shark denticles like those in the Phosphoria of central Wyoming, suggest a close
relation to the part of the formation above the phosphatic shale.
The phosphatic shale persists as a unit eastward from Franson Canyon along
the south flank of the mountains. In the central part it rests directly on the
Weber sandstone and the lower Park City is missing. Near Vernal, the eastern-
most section in which phosphatic shale was seen, it is 22 feet thick, but at Split
Mountain the member could not be recognized and the basal Park City there
has assumed a cherty nature (Fig. 4).
The upper Park City cherty member, east of Franson Canyon, is penetrated
from the east by tongues of redbeds which are evident in sections along the
Duchesne River, Lake Fork, and at Whiterocks Canyon. The cherty member is
partly replaced by redbeds at Lake Fork, but a cherty limestone tongue extends
eastward and forms the upper unit of the Park City at Lake Fork and at
Whiterocks Canyon. This unit is completely replaced by redbeds between White-
rocks Canyon and the next exposures eastward, near Vernal. A red shale tongue,
named the Mackentire tongue by Williams,44 is recognizable in the Lake Fork
and Whiterocks Canyon sections, but east of the edge of the overlying cherty

39 Ibid., pp. 91-92.
tongue, as near Vernal, can not be separated from the Woodside. The basal part
of the upper Park City cherty member extends eastward as far as Split Mountain,
but at Skull Creek, the easternmost section studied, has been replaced by red or
tawny shale. At Skull Creek, the basal part of the Woodside is the time-equivalent
of the upper Park City cherty member of sections on the west. This interfingering
with and replacement by redbeds is similar to that in Wyoming where the
Phosphoria of sections in central Wyoming is represented in the basal Chugwater
redbeds in southeastern Wyoming.36

TRIASSIC STRATIGRAPHY

GENERAL RELATIONS OF FORMATIONS

In the western part of the Uinta Mountains the older Triassic formations
comprise the Woodside redbeds at the base, the marine Thaynes limestone in the
middle, and the Ankareh redbeds, as restricted by Boutwell (Fig. 5) at the top.
The restricted Ankareh is overlain unconformably by a set of younger Triassic
beds which comprise a conspicuous basal conglomerate, or grit, which Boutwell
considered to be the basal unit of the Nugget sandstone, and an overlying variable
sequence of lavender, red, maroon, ocher and green shales, reddish and tannish
sandstones, silty sandstones, and sandy siltstones, with less common limestones
or calcareous shales. These varicolored beds are overlain by the thick distinctive
Nugget (Navajo) sandstone.

To the eastward, the major changes in the older Triassic formations are (1) a
general thinning, and (2) the wedging-out of the Thaynes limestone. The wedging-
out of the Thaynes brings the lower redbeds (Woodside) into contact with the
upper redbeds (Ankareh) and there is no apparent demarcation between rocks
representing the two units.

The grit and overlying varicolored beds which unconformably overlie the
type Ankareh along the western part of the mountains persist eastward with but
little change and are conspicuous at the eastern end of the range, where they
have been called Ankareh (?) formation. These beds are here given the name
Stanker formation, and the basal conglomerate designated as the Gartra grit
member. Their stratigraphic details are discussed fully later in this paper.

EARLIER TRIASSIC STRATIGRAPHY

Nomenclatural problems.—It is unfortunate, perhaps, that Boutwell divided
the older Triassic rocks into three formations, since away from the type locality
the lower redbeds (Woodside) can be separated from the upper redbeds (Ankareh)
only where the Thaynes limestone is present. East of the wedge-edge of the
Thaynes, the single redbeds unit might be referred to as “Woodside-Ankareh,”
but the use of such hyphenated names is not in accord with the best principles of

36 Horace D. Thomas, “Phosphoria and Dinwoodie Tongues in lower Chugwater of Central and
stratigraphic nomenclature. It would be best to apply a group name to include Woodside, Thaynes, and Ankareh which could be used as a formation name where the Thaynes limestone is absent. This would involve the application of a new name which would have to be substituted for the name, Woodside, as it is now used in many places. Such a revision made now might not be entirely workable later. For instance, the Woodside thins strikingly between Vernal and Skull Creek (Fig. 5) and this thinning is known to continue southward and southeastward. In the thin sections the Woodside is probably equivalent only to type Woodside, with no Ankareh equivalent present. The writers prefer to postpone any revision of the nomenclature until the time when additional detailed information is available on the stratigraphy of the older Triassic rocks over a greater area than that considered in this paper and until regional relationships are better understood. Until that time it seems best in the Uinta Mountains region to use the names, Woodside, Thaynes, and Ankareh, in a formal sense over the area where all three are present, and to use the name, Woodside, as has been done, over the area in which the Thaynes is lacking, taking recognition of the fact that in some places beds as young as Ankareh may be included in the upper part of the Woodside.

Woodside shale.—Along the western part of the Uinta Mountains, the Woodside consists of 500 to 800 feet of red to maroon shales, siltstones, and very fine-grained sandstones, the monotonous color being broken rarely by thin gray or greenish siltstones or sandstones. Along the eastern part of the mountains, however, the red color of the formation gives way to considerable thicknesses of tawny, tan, or olive-drab beds. No traces of fossils were found in any part of the Woodside on the south flank of the Mountains.

In western Wyoming the Phosphoria is overlain disconformably by the Dinwoody formation, which has been dated by Newell and Kummel as early Lower Triassic in age. The type Woodside rests directly above the Phosphoria equivalent of the Park City, and it is likely that the lower Woodside is a red beds facies of the same age as the Dinwoody. Eastward, along the Uinta Mountains, however, it is impossible to separate red beds of Park City age from true Woodside, and the base of the Woodside descends in the section until at Skull Creek the entire upper Park City is represented by the basal Woodside. The red Chugwater and Spearfish shales of eastern Wyoming are similarly made up of Permian and Triassic parts which can not be separated at the present time.

Near Vernal the lower part of the Woodside is characterized by tawny beds which rest on the thin basal chert of the Park City and are 350 feet thick. They were classed as the upper part of the Park City by Schultz, although he pointed out their similarity to the Dinwoody formation of Wyoming. The tawny beds


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Newell and Bernhard Kummel, "Lower Eo-Triassic Stratigraphy of Western

2 Z. A. Geological Reconnaissance of the Uinta Mountains, Northern Utah, with

Although tawny beds are conspicuous in the eastern part of the Uinta Mountains
they do not constitute a definite unit. They are partly Park City in age and
partly Woodside in age and should be included with the Woodside rather than
as a distinct stratigraphic unit.

The eastward thinning of the Woodside in the area where it is overlain by
Thaynes limestone is probably attributable to more rapid sedimentation on the
west than on the east during the same span of geologic time. The thinning of the
Woodside and Ankarah, where the two units are not separated by Thaynes lime-
stone, as in the area between Vernal and Skull Creek, is apparently related to
the unconformity at the base of the Gartrite grit. It is suggested that the Woodside
at Skull Creek probably represents rocks nearly equivalent to the type Woodside,

J. D. Sears, op. cit., p. 281.

and that beds of post-Woodside age were largely removed by erosion prior to the deposition of the Carra grit (Fig. 6).

_Thaynes limestone._—The Thaynes limestone at the western end of the mountains is made up of gray to brown thick-bedded to thin-bedded limestones, sandy limestones, and calcareous sandstones. Certain parts are very fossiliferous, but no attempt was made by the writers to obtain complete faunal collections for study. The Thaynes is, however, obviously a normal marine deposit. As the Thaynes thins eastward it becomes a white very fine-grained sandy limestone in beds ranging from one to two feet in thickness. In the vicinity of Deep Creek, between Whiterocks Canyon and Vernal, the Thaynes has thinned to less than 2 feet, but still contains a few fossils. East of Deep Creek it is not identifiable, although some thin calcareous laminae persist for a short distance.

_Ankareh formation._—The Ankareh, like the Woodside, is made up predominantly of red to maroon shales, siltstones and very fine-grained sandstones. There may be intercalated beds of coarser sandstone, either gray or red in color, but these do not form an appreciable part of any section. A thin bed of gypsum was noted in the Ankareh along Lake Fork, but no gypsum was seen elsewhere.

There is some indication that there is a gradation between the Thaynes limestone and the Ankareh, with limestone replaced by red beds eastward (Fig. 6). It is suggested that the red beds thicken eastward between Weber River and Duchesne River at the expense of the Thaynes, which thins. The fact that Boutwell reported marine fossils in calcareous beds in the lower part of the sequence he classed as Ankareh, and that the dividing line between Thaynes and Woodside was arbitrarily placed at the point of major lithologic change, lends support to this concept. The eastward thinning of the Ankareh between Duchesne River and Whiterocks Canyon is attributable to erosion and beveling of the Ankareh prior to the deposition of the Carra grit.

**Later Triassic Stratigraphy**

_**General considerations.**_—It has been pointed out that the conglomerate and varicolored beds which at the west end of the Uinta Mountains were included by Boutwell in the base of the Nugget and which at the east end of the mountains were called Ankareh (?) by Schultz, constitute important stratigraphic units which are without names. It is the object here to apply new names and to describe the regional stratigraphy of the units.

It would be possible to bring in formation names from elsewhere and apply them to the rocks in question, but if new names are given there is no chance for an error in correlation and, in addition, the names will be distinctive of the Uinta Mountain region.

As frequently happens in selecting names for stratigraphic units in the West, the writers were hard-pressed to find suitable geographic names near best ex-

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Canyon is attributable to erosion and beveling of the Ankareh

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**Later Triassic Stratigraphic Considerations.** —It has been pointed out that the conglomerate and

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well, “Geology and Ore Deposits of the Park City District, Utah,” U.S. Geol.

r. 1913, 39 and P1. 5.
The upper contact of the grit is sharp and the bed is in most places directly overlain by shale. In places, as in the type section, there are thin grit beds lithologically like the main grit body, but not as coarse-grained, interbedded in the shales just above the Gartra. Whether or not there are thin grit beds above the Gartra grit member in other sections can not be determined because of poor exposures.

Variations in thickness of the Gartra grit are as follows: Weber River, 33 feet; Duchesne River, 26 feet; Lake Fork, 67 feet, Whiterocks Canyon, 43 feet; Split Mountain, 93 feet; Skull Creek, 66 feet; and Vermilion Creek, according to Sears, 88 feet.43

In one section, directly along the Duchesne River near Hanna, the grit could not be found. It is present on Farm Creek, several miles east of Hanna, and also at the west in the Park City district, on the Weber River, and, according to Mathews,44 at many places in the Wasatch Mountains. Since the bed presents all the characters of a fluvial deposit, it would not be unexpected for it to thin out in places; however, it may be covered or faulted out along the Duchesne River.

At Manila, on the north flank of the mountains, the Gartra differs strikingly in lithologic character from the occurrences on the south flank of the mountains.

43 J. D. Sears, op. cit., p. 286.
44 A. A. L. Mathews, op. cit., pp. 41-42.
There it consists of lenses of purplish red limestone pebble conglomerate set in a matrix of purplish red cross-bedded coarse-grained sandstone. The bed has a sharp contact with the subjacent Woodside and lithologically is strikingly dissimilar to the underlying red siltstones. The thickness is 18 feet. Higher in the section, however, and separated from the limestone pebble conglomerate by 120 feet of shales, is a 3-foot bed of very coarse-grained quartz granule grit which is lithologically like the grit on the south flank of the mountains.

The part of the Stanaker formation lying above the Gartra grit member is made up of varicolored shales and sandstones which are sharply overlain by the massive Nugget or Navajo sandstone. Lying between two resistant units, these softer beds are generally not well exposed. The main body of the Stanaker formation comprises an alternation of shales which vary in color from maroon to red, pink, lavender, ocher, and green, and of sandstones which are gray, red, purple, or yellow in color. The different colors in any one section seem fairly well confined to certain beds. Limestones are not conspicuous, but in the Weber River section there is a pink and gray platy thin-bedded ribbon limestone near the top of the formation, and some sandstones in other sections are calcareous.

The only fossils found in the formation were fragments of silicified wood. Boutwell mentioned the occurrence of petrified wood in beds he classed with the Nugget sandstone, but which probably represent the Stanaker formation.

The thickness of the upper part of the Stanaker, exclusive of the Gartra grit, is as follows: Weber River, 394 feet; Duchesne River, 255 feet; Lake Fork, 370 feet; Whiterocks Canyon, 259 feet; Brush Creek (type section) 240 feet; Split Mountain, 287 feet; Skull Creek, 227 feet; Manila, 284 feet; and Vermilion Creek, 120 feet, according to Sears.

The feldspathic nature of the Gartra grit implies that it was derived from a granitic terrane. It is quite possible that the source of the grit was the granite of the Uinta Mountains, about 125 miles southeast of the eastern end of the Uinta Mountains. This uplift was a positive area well into Jurassic time. The limestone pebble conglomerate of the Manila area appeared to have a different source, although later some grit was carried that far northward. This limestone pebble conglomerate is lithologically like the Jelm conglomerate which occurs along the Sierra Madre and Medicine Bow Mountains of southeastern Wyoming, east of the Uinta Mountains.

Age and correlation.—The writers have no paleontologic evidence which might determine the age of the Stanaker formation, but on the basis of regional rela-

41 J. D. Sears, op. cit., p. 280.
42 A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., "Correlation of the Jurassic Formations of Parts of Utah, Arizona, New Mexico and Colorado," U. S. Geol. Survey Prof. Paper 183 (1930), p. 44, Fig. 15.
tionships it is probably Upper Triassic in age. The Thaynes has generally been
classed as Lower Triassic in age. The marine faunas in the lower part of the
type Ankareh have not been studied, but Boutwell pointed out that they show
general agreement with the Thaynes fauna. The Ankareh, therefore, is probably
Lower Triassic in age.

In southern Utah and Arizona and in central and southeastern Wyoming are
beds whose age has not been determined to the satisfaction of all, but which are
generally classed as Upper Triassic. They are characterized in part by coarse
clastic sediments and in places rest unconformably on the older Triassic rocks.
These are such units as the Shinarump ané Chinde of the Colorado Plateaus, the
Jelm of southeastern Wyoming, and the Popo Agie of central Wyoming. The
writers believe that the Stanaker is correlative with these formations, and like
them should be assigned to the Upper Triassic.

It is of interest to note that early workers, in 1875 and 1876, correlated the con-
glomerate, here called the Gartra grit, with the Shinarump conglomerate of
southern Utah and Arizona. Baker, Dane, and Reeside were the last writers to
consider at any length the later Triassic rocks of the Uinta Mountains,49 and
the Stanaker formation, which they calleé Ankareh (?) at Vermilion Creek, at
Dinosaur Quarry (Split Mountain), and at other localities in northwestern Colo-
rado and northeastern Utah, was classed as Upper Triassic and correlated with
the Chinle formation.

On the other hand, some geologists have suggested that the beds now called
Stanaker may be Jurassic in age, and such a consideration can not be lightly dis-
missed. Because the writers correlate the Stanaker with the Shinarump and the
Chinle, and because the Chinle has yielded vertebrates considered to be Triassic
types, a Triassic age is favored for the Stanaker. If, however, the paleontologic
evidence furnished by the Chinle be overlooked, the physical relations of the
Stanaker would favor its being considered es the introductory Jurassic unit. Both
Boutwell and Mathews drew the Triassic-Jurassic boundary at the base of the
Gartra grit on the basis of physical evidence. Reeside states, in respect to the
Stanaker, that "The Ankareh (?) formation of the eastern Uintas . . . is most
logically viewed as introductory to the Nugget."50 In addition, Mathews51 has
reported a single Trigonias from the Nugget, and this has been cited by later writ-
ers in discussing the Jurassic age of the Navajo or Nugget. It must be recalled
that Mathews included the Stanaker as the basal unit of his Nugget, and it is
likely that the fossil came from the Stanaker formation, for he says the specimen

40 A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., op. cit.
41 J. B. Reeside, Jr., "Triassic-Jurassic Red Beds of the Rocky Mountain Region: A Discussion,"
42 A. A. L. Mathews, op. cit., p. 42.
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In central and southeastern Wyoming and in central and southeastern Wyoming areas have not been determined to the satisfaction of all, but which are classed as Upper Triassic. They are characterized in part by coarse grains and in places rest unconformably on the older Triassic rocks. Such units as the Shinarump and Chinele of the Colorado Plateaus, the eastern Wyoming, and the Popo Agie of central Wyoming. The evidence that the Stanaker is correlative with these formations, and like the other Triassic.

There is no hard evidence that early workers, in 1875 and 1876, correlated the concretions called the Carra Grit, with the Shinarump conglomerate of Utah and Arizona. Baker, Dane, and Reeside were the last writers to evaluate the last Triassic rocks of the Uinta Mountains, and the formation, which they called Ankareh (?) at Vermilion Creek, at Carra (Split Mountain), and at other localities in northeastern Colorado, was classed as Upper Triassic and correlated with these formations.

On the other hand, some geologists have suggested that the beds now called the Ankerthia and the Shinarump are Lower Jurassic in age, and a consideration can not be lightly dismissed the writers correlate the Stanaker with the Shinarump and the Chinele. Thus the Chinele has yielded vertebrates considered to be Triassic in age is favored for the Stanaker. If, however, the paleontologic evidence is overlooked, the physical relations of the older rocks favor its being considered as the introductory Jurassic unit. Both Mathews and Wilmarth drew the Triassic-Jurassic boundary at the base of the unit as the basis of physical evidence. Reeside states, in respect to the Ankerthia formation of the eastern Uintas . . . is most likely as introductory to the Nugget. In addition, Mathews has a single Trigonia from the Nugget, and this has been cited by later writers to the Jurassic age of the Navajo or Nugget. It must be recalled that included the Stanaker as the basal unit of his Nugget, and it is fossil from the Stanaker formation, for he says the specimen was found in "... the sandstones near the base above the conglomerate." The value of a single fossil, about which nothing is known other than the original report, is surely subject to question, however.

In summary it may be said that lithology and stratigraphic position favor a correlation of the Stanaker with the Shinarump and Chinele, whose Upper Triassic age seems well established. Other evidence suggests a possible Jurassic age.

**Jurassic Stratigraphy**

Heaton was the first to correlate the Jurassic rocks between southeastern Idaho, the south flank of the Uinta Mountains, and northwestern Colorado. This work filled in the stratigraphy of an area not included by Baker, Dane, and Reeside in their treatise on the Jurassic formations of Utah, Arizona, New Mexico, and Colorado.

The writers had independently reached the same conclusions as Heaton prior to the publication of his work, and are in complete accord with his correlations. Since Heaton gave no lithologic details of the various formations, other than by depicting them on a correlation chart and discussing them in general terms, the writers believe it worthwhile to make available the stratigraphic details. In addition, localities not discussed by Heaton are considered.

**Nugget or Navajo sandstone.**—As shown on the correlation chart (Fig. 8) and the diagram showing stratigraphic relations (Fig. 6), the Navajo or Nugget sandstone, everywhere along the Uinta Mountains, rests on the Stanaker formation. The contact of the massive cross-bedded Navajo with the older varicolored beds is not commonly exposed. Where visible it is sharp, but there is little physical evidence of an unconformity at that stratigraphic level. The lithology of the Navajo is uniform along the mountains, as given in the measured sections, but the color changes from salmon-pink along the western end of the range to white along the eastern part. On Rock Creek, about 1.5 miles east of the Duchesne River, the upper part of the Navajo is white and the lower part is salmon pink. The color change cuts obliquely across the sandstone without regard to bedding. There is a general thinning from west to east, the thickness of the formation ranging from 1,293 feet at Weber River to 780 feet at Split Mountain. The thickness near Ma- nila, on the north flank of the Mountains, is 838 feet.

**Twin Creek limestone and Coral reef rocks.**—In the western part of the Uinta Range the thick marine Twin Creek limestone overlies the Nugget. Along the Weber River the Twin Creek consists of 1,351 feet of light gray limestone, shaly limestone, and calcareous shale; certain beds containing abundant columnals of Pentacrinus and specimens of Trigonia, Comptonettis, and other invertebrate fossils. Eastward the Twin Creek thins in a short distance, the major thinning taking place.
Fig. 8.—Correlation of formations along south flank of Uinta Mountains.
place between the Duchesne River (771 feet) and Lake Fork (257 feet). Between Lake Fork and Whiterocks Canyon, the Twin Creek is replaced by the Carmel redbed, but thin tongues of marine limestone extend eastward as far as Deep Creek, where *Trigonias* was found in a 10-foot limestone separated from the Navajo sandstone by 30 feet of red shale. This bed was traced eastward as far as Stanaker Draw, north of Vernal, by R. W. Burns, who reports that it is fossiliferous throughout that area. In the Vernal area the Carmel is mainly redbeds, with gypsum or lighter-colored beds in places. The Carmel thins eastward from White- 

rocks Canyon and is absent in the section on Skull Creek, although Heaton found it present but very thin in that area, probably at a point west of the place where the writers measured their section. At Vermilion Creek, the Carmel consists of 20 feet of red shale which was included by Sears in the Nugget sandstone. East of the wedge-edge of the Carmel, the cross-bedded Entrada sandstone, which overlies the Carmel in the eastern part of the Uinta Mountains, rests directly on the Navajo sandstone and, because of lithologic similarity, there is no apparent demarcation between the two sandstones.

On the north flank of the mountains, near Manila, the Carmel comprises 324 feet of redbeds and gypsum, with fossiliferous beds near the base containing *Camptosaurus* and *Trigonias*.

*Preuss redbeds and Entrada sandstone.*—Along the Weber River, at the western end of the Uintas, the Twin Creek is overlain by about 1,200 feet of redbeds which are not well exposed and which represent the Preuss formation of southeastern Idaho. These beds apparently comprise unit No. 7 of Stanton's section published in 1893. The Preuss thins eastward and on Farm Creek, near the Duchesne River, is well exposed and comprises 660 feet of pink-red shales, siltstones, and very fine-grained sandstones. The Preuss thickens to 858 feet at Lake Fork. The writers believe that there the lower part represents the upper Twin Creek of sections on the west and is, therefore, related to the Carmel, but because of poor exposures at Lake Fork there is difficulty in separating the Preuss redbeds from Carmel redbeds (Fig. 6). East of Lake Fork the Preuss is replaced by a facies of decidedly different lithologic character—the cross-bedded Entrada sandstone. The main difference between the two is that the Preuss consists of silty plane-bedded redbeds and the Entrada is a cross-bedded clean quartz sandstone which is pink or white in color. Baker, Dane and Reeside have shown that the Entrada of southern Utah comprises two facies—a red earthy sandstone facies on the west which grades into a cross-bedded sandstone facies on the east. This gradation is probably comparable with that between the Preuss and the Entrada along the Uintas. The Entrada persists eastward with but little change until it merges with

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44 R. W. Burns, personal communication (1941).
45 J. B. Sears, *op. cit.*, p. 268.
47 A. A. Baker, C. H. Dane, and J. B. Reeside, *op. cit.*, Fig. 12, p. 49.
the Navajo because of the thinning-out of the intervening Carmel. In the Vermilion Creek section the Entrada was included in the Nugget by Sears.68

At Manila, on the north flank of the mountains, the Entrada shows a composite of the two lithologic types; a lower unit made up mainly of typical cross-bedded Entrada sandstone and an upper unit made up mainly of pink-red siltstone representing the Preuss lithology (Fig. 9).

Fig. 9.—Jurassic formations exposed along Manila-Vernal road about 5 miles south of Manila, Utah.

Stump sandstone and Curtis formation.—Along the Weber River the Preuss is overlain by 223 feet of sandstones and shales which were classed as Stump by Heaton,69 and as Curtis (?) by Eardley.60 Although Stanton64 reported Trigonia from this unit nearly 50 years ago, no later paleontologic evidence has been given to confirm the Stump, or Curtis, age of the beds. After much searching the writers were able to find three specimens of Belemnites densus,62 and this fossil is abundant in a widespread zone over parts of Utah, Idaho, Colorado, Wyoming, and Montana. Belemnites densus has been reported from the type Stump of Idaho and was

68 J. D. Sears, op. cit., p. 280.
69 Ross L. Heaton, op. cit., Fig. 10.
64 T. W. Stanton, op. cit., p. 44.

62 Belemnites densus has recently been referred by various authors to the genus Pachyteuthis, but for the time being the writers prefer to retain the more familiar name for this well known index fossil.
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found by the writers in the Stump or in the Curtis of every section studied around 
the Uinta Mountains. The name, Stump, is used by the writers in the Weber 
River, the Duchesne River, and Lake Fork areas so that the southeastern 
Idaho Jurassic terminology is uniformly used in all the western sections. East of 
Lake Fork, however, the name, Curtis, is used and along the eastern part of the moun-
tains the lithologic character is somewhat different from that on the west. In 
general the Curtis is made up of a basal medium-grained to coarse-grained 
bedded sandstone which rests with sharp contact on the subjacent beds. The 
middle part of the formation is greenish gray shale with intercalated fossiliferous 
sandstones, limestones, and coquinal limestones. The Curtis at Whiterocks Can-
yon and near Vernal and Manila has a conspicuous limestone member at the top 
which is characterized by abundant specimens of the brachio pod genus Kallirhyn-
chia. Glaucite is one of the characteristic features of the Curtis and occurs as 
small nodules or grains in sandstones, shales, or limestones. The Twin Creek of 
Sears' Vermilion Creek section 65 is the Curtis; Kallirhynchia occurs at the top and 
Belemnites is abundant farther down.

There is a suggestion of an unconformity at the base of the Stump or Curtis.
In the SW. 1/4 of Sec. 30, T. 1 N., R. 6 W., between Lake Fork and the Duchesne 
River, the basal Stump rests on an irregular surface below which about 2 feet of 
upper Preuss is truncated in a horizontal distance of about 50 feet. J. C. Hazzard 64 
has reported that there is a similar relation near the W. 1/4 corner of Sec. 10, T. 
1 S., R. 9 W., where at least 50 feet of upper Preuss is cut out below the basal 
contact of the Stump over a distance of about 1 mile.

Morrison formation.—The stratigraphy of the Morrison formation along the 
Uinta Mountains and in contiguous areas has been described recently by Stokes. 65

Correlation with Wyoming Jurassic rocks.—Since the Jurassic units in the 
Manila section, on the north flank of the Uintas, can be confidently correlated 
with those on the south flank, that section serves as a key in correlating the 
Jurassic formations of central Utah, described by Baker, Dane, and Reeside, 66 
with those in Wyoming to the north of the Uintas.

Thomas examined cores from the Jurassic section in the Selegna Petroleum 
Corporation's Hardy well No. 1 in Sec. 11, T. 20 N., R. 104 W., in the North 
Baxter Basin gas field in Wyoming, about 60 miles north of the Manila section. 
Although coring was not continuous, the following units were differentiated.

Morrison: Variegated shale
Curtis: About 120 feet thick; glauconitic limestones, shales and sandstones; Kallirhynchia not far 
below top
Entrada: About 95 feet thick; gray sandstone

60 J. D. Sears, op. cit., p. 280.
61 J. C. Hazzard, personal communication (1941).
62 W. L. Stokes, “Morrison and Related Deposits in and adjacent to the Colorado Plateau,” 
63 A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., op. cit.
Fig. 10.—Correlation of Jurassic formations between Uinta Mountains and Baxter Basin gas field, Wyoming.
TWIN CREEK OR CARMEL: At top; about 100 feet of dark limestones and calcareous shales with fragments of marine fossils; lower part, 75 feet of red and green shales with a 5-foot bed of anhydrite. A 60-foot gap intervened between these cores and those representing the subjacent formation NUGGET OR NAVAJO: 200 feet plus; gray sandstone.

In March, 1941, a group of geologists met to study cores from the Red Desert Oil Company's Edith Aspden well No. 1 in Sec. 34, T. 18 N., R. 103 W., in the South Baxter Basin field. The following lithologic descriptions were prepared by W. T. Nightingale for the units differentiated (Fig. 10).

CURTIS: 152 feet: glauconitic greensands and sandy limestones with some oolitic limestone layers; greenish green sandy shale at base; Bedmites densus present.

ENTRADA: 92 feet; gray to white medium fine-grained sandstone.

TWIN CREEK: 140 feet; upper part microcrystalline limestone with argillaceous limestone and shale partings; middle part greenish gray silty calcareous shale; lower part brown microcrystalline limestone with green shale partings.

NUGGET: 573 feet; light-colored massive medium-grained sandstone.

JKLM (Stanaker equivalent): 380 feet; upper 170 feet, green dolomitic shales and brown silty dolomite; middle 150 feet, maroon silty shale; basal 60 feet, white fine- to medium-grained sandstone containing pink feldspar grains in lower part.

It is evident, therefore, that both Twin Creek and Carmel lithologic types are present in the Baxter Basin area; the Twin Creek type represented by dark fossiliferous limestones and the Carmel type by red and green shales and anhydrite.

Recently Love et al. and Imlay have discussed the Jurassic formations of the Wind River Basin in central Wyoming, north of the Baxter Basin field, recognizing Nugget sandstone at the base overlain by Gypsum Spring, lower Sundance, upper Sundance, and Morrison. It is suggested on the basis of stratigraphic sequence and lithologic similarity that the Navajo, Carmel, Entrada, and Curtis of the Manila area are to be correlated with the Nugget, Gypsum Spring, lower Sundance, and upper Sundance of the Wind River Basin. There can be little question of the correlation of Navajo with Nugget and of Curtis with Upper Sundance. There is some question, however, on the correlation of the Carmel with the Gypsum Spring and the Entrada with the lower Sundance. Because the Carmel and the Gypsum Spring are both gysiferous redbed sequences resting directly on the Navajo or Nugget sandstone, the writers would correlate these units. Imlay, however, on a paleontologic basis, correlates the Carmel of central Utah with the lower Sundance of the Wind River Basin, rather than with the Gypsum Spring.


70 Ralph W. Imlay, op. cit., Table 1.
STRATIGRAPHIC SECTIONS

Weber River Section

Stratigraphic section measured on east side of Weber River, just north of Peoa, T. 1 S., R. 5 E., Summit County, Utah, by Horace D. Thomas and Max L. Krueger.

THICKNESS

in Feet

LOWER PART OF MORRISON

Red, lavender, and mauve clay shales with purple, tan, or white sandstones which vary in texture from fine-grained to conglomeratic. Limestone nodules common in clay shales at certain horizons and polished pebbles ( gastrolithes ) in middle of interval. ............................................. 432

Light gray dense crinkly algal (? ) limestone .......................................................... 2

Red shale ........................................................................................................ 2

Gray siliceous algal (?) limestone with questionable fossil fragments .................. 1

Pink shale ...................................................................................................... 3

STUMP

Greenish gray to tan hard fine-grained quartztitic sandstone; upper 4 feet calcareous, with obscure fragments of fossil shells; Balamutia densa rare ........................................... 40

Gray to tan flaky shales, sandy shales, and thin sandstones .............................. 142

Flesh-colored soft platy cross-bedded medium-grained sandstone .............. 41

Thickness of Stump .................................................................................... 223

PREUSS

Poorly exposed pink-red siltstones and very fine-grained sandstones ............. 1,196

Thickness of Preuss .................................................................................. 1,196

TWIN CREEK

Drab-gray very calcareous shale with interbedded thin flesh-colored limestones and thin fine-grained sandy limestones ........................................ 211

Drab-gray calcareous shale, weathering splintery, with a few thin limestones ..... 420

Platy thin-bedded to shaly limestone and sandy limestone weathering tan and gray .. 36

Light gray soft massive claystone .................................................................. 6

Medium dark gray calcareous shale, weathering splintery ................................. 45

Tan thin-bedded very fine-grained sandstone ................................................ 40

Gray calcareous shale with two thin beds of red shale ................................... 72

Gray to blue thin-bedded to shaly limestone and calcareous shale with layers of coquinal limestone made up of small gastropods and Pentacraites columnelli; thin bedded parts dense and brittle ............................................................. 521

Thickness of Twin Creek ........................................................................ 1,351

NUGGET

Salmon-pink quartztitic sandstone, incompletely exposed

Stratigraphic section measured from Mahogany Hills, north of the Weber River, to the mouth of Franson Canyon, south of the Weber River, T. 1 S., R. 6 E., Summit County, Utah, by Horace D. Thomas and Max L. Krueger.

THICKNESS

in Feet

TWIN CREEK

Basal part gray to blue thin-bedded limestone and calcareous shale

NUGGET

Salmon-pink massive cross-bedded friable medium-grained sandstone ........... 1,203

Thickness of Nugget .................................................................................. 1,203

STANAKER

Mainly covered; pink and gray platy thin-bedded ribbon limestone at top just below Nugget; lower part shows isolated exposures of bright red platy sandstones, gray and red pottled massive sandstones, red siltstones, and bright red shales .............................................. 394
STRATIGRAPHY OF UINTA MOUNTAINS, UTAH

MORRISON

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
</tr>
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</table>
| 1
| 2
| 3

an hard fine-grained quartzitic sandstone; upper 4 feet calcareous, with:

- 40
- 142
- 41

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
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</table>
| 1,106
| 1,106

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<tr>
<th>Thickness in Feet</th>
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</table>
| 25
| 25

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<tr>
<th>Thickness in Feet</th>
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</table>
| 2
| 432

<table>
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<tr>
<th>Thickness in Feet</th>
</tr>
</thead>
</table>
| 1
| 409

pineous shale, weathering splintery, with a few thin limestones: 211

calcareous shale, weathering splintery 420

calcareous shale, weathering splintery 45

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
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</table>
| 521

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
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</table>
| 10
| 10

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<tr>
<th>Thickness in Feet</th>
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</table>
| 5
| 20

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<th>Thickness in Feet</th>
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</table>
| 307

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<tr>
<th>Thickness in Feet</th>
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| 3
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<tr>
<th>Thickness in Feet</th>
</tr>
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</table>
| 1
| 1

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<tr>
<th>Thickness in Feet</th>
</tr>
</thead>
</table>
| 41

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
</tr>
</thead>
</table>
| 2
| 2

DUCHESSINE RIVER SECTION

Stratigraphic section measured along Farm Creek in southern part of T. 1 N., R. 7 W., and northern part of T. 1 S., R. 7 W., several miles west of Hanna, Duchesne County, Utah, by Horace D. Thomas.

LOWER PART OF MORRISON

Red shale with several beds of white medium-grained sandstone 533

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
</tr>
</thead>
</table>
| 5
| 22

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
</tr>
</thead>
</table>
| 111
| 72

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
</tr>
</thead>
</table>
| 210
<table>
<thead>
<tr>
<th></th>
<th>Thickness in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREUSS</strong></td>
<td></td>
</tr>
<tr>
<td>Pink-red very fine-grained sandstone with intercalated beds of thin-bedded siltstone and of red shale.</td>
<td>285</td>
</tr>
<tr>
<td>White massive fine-grained sandstone.</td>
<td>4</td>
</tr>
<tr>
<td>Pink-red massive to thin-bedded fine- to medium fine-grained sandstone with interbedded siltstones at top; downward becomes less sandy and lower part is pink-red soft blocky siltstone with some shaly beds.</td>
<td>380</td>
</tr>
<tr>
<td><strong>TWIN CREEK</strong></td>
<td></td>
</tr>
<tr>
<td>Gray and greenish gray platy finely laminated calcareous shale.</td>
<td>68</td>
</tr>
<tr>
<td>Gray shale with thin layers of brown finely laminated siltstone.</td>
<td>8</td>
</tr>
<tr>
<td>White massive fine-grained calcareous sandstone.</td>
<td>8</td>
</tr>
<tr>
<td>Greenish gray and red shales with thin beds of brown platy limestone.</td>
<td>114</td>
</tr>
<tr>
<td>Greenish gray thin-bedded to thinly laminated sandy siltstones, calcareous siltstones, and sandy shales.</td>
<td>100</td>
</tr>
<tr>
<td>Light gray, greenish gray and grayish green thin-bedded to finely laminated sandy siltstones, calcareous shales and calcareous siltstones with several thin red shale layers; some beds ripple-marked.</td>
<td>204</td>
</tr>
<tr>
<td>Light gray thin-bedded dense porcellaneous limestone.</td>
<td>105</td>
</tr>
<tr>
<td>Red shale.</td>
<td>12</td>
</tr>
<tr>
<td>Dark gray fossiliferous thin-bedded oolitic limestone, finely crystalline limestone, and shaly limestone, all weathering light gray; upper 20 feet platy and forms a ledge; <em>Pentacrinus</em> and other Twin Creek fossils common.</td>
<td>149</td>
</tr>
<tr>
<td><strong>NUGGET</strong></td>
<td></td>
</tr>
<tr>
<td>Sandstone, uppermost part lavender, hard and cross-bedded; 15 feet near top bright red and plane-bedded; major part salmon-pink massive cross-bedded sandstone.</td>
<td>1,183</td>
</tr>
<tr>
<td><strong>STANAKER</strong></td>
<td></td>
</tr>
<tr>
<td>Red flaky shale.</td>
<td>2</td>
</tr>
<tr>
<td>Greenish gray thin-bedded fine-grained sandstone; grades down into subjacent bed.</td>
<td>1</td>
</tr>
<tr>
<td>Salmon-pink thin-bedded fine-grained sandstone; resistant and caps a hogback.</td>
<td>5</td>
</tr>
<tr>
<td>Apple-green flaky shale.</td>
<td>9</td>
</tr>
<tr>
<td>Green, brown, and red mottled thin-bedded very fine-grained calcareous sandstone.</td>
<td>4</td>
</tr>
<tr>
<td>Pink massive clayey siltstone.</td>
<td>11</td>
</tr>
<tr>
<td>Red beds, covered, petrified wood in float near base; ½ mile to west other beds lie in part of this interval.</td>
<td>223</td>
</tr>
<tr>
<td><em>Gastrea</em> grit member: Mottled gray and pink cross-bedded quartz grit with scattered quartz pebbles ranging up to ½ inch in diameter; hard and firmly cemented; forms a hogback.</td>
<td>26</td>
</tr>
<tr>
<td><strong>ANKAREH</strong></td>
<td></td>
</tr>
<tr>
<td>Red beds; not measured, W. C. Rauch measured an interval of 1,680 feet between base of Nugget and top of Thaynes several miles west of Farm Creek.</td>
<td></td>
</tr>
<tr>
<td>Stratigraphic section measured along the Duchesne River, north of Hana, in T. 11 N., R. 8 W., Duchesne County, Utah, by W. C. Rauch and checked in the field by Horace D. Thomas and Max L. Krueger.</td>
<td></td>
</tr>
<tr>
<td><strong>ANKAREH</strong></td>
<td></td>
</tr>
<tr>
<td>Brick-red shale, sandy shale, and very fine-grained red sandstone with several thin white sandstones. Exact thickness not determined, but interval from base of Nugget to top of</td>
<td></td>
</tr>
<tr>
<td>Thickness in Feet</td>
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<td></td>
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<tr>
<td>285</td>
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<td>380</td>
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<td>669</td>
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<td>149</td>
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<td>771</td>
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<tr>
<td>1,183</td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{Braynes measured 1,680 feet. If thickness of Stanaker on Farm Creek (281 feet) be subtracted, approximate thickness of Ankareh is 1,400 feet.} \]

**Thickness of Ankareh**

- **Thaynes**
  - Tan to gray thin-beded to thick-beded sandy limestone with thin layers of calcareous sandstone; abundant fossils
  - Thickness of Thaynes

- **Woodside**
  - Red sandy shales and thin-bedded sandstones, some ripple-marked, with several thin lighter-colored sandstone beds
  - Thickness of Woodside

- **Park City**
  - Gray to creamy limestone, cherty limestone and geoidal shaly limestone with a red-bed unit about 10 feet thick near middle; thickness estimated
  - Black phosphatic shale with beds of black limestone and nodular phosphate rock; thickness estimated

- **Approximate thickness of Park City**

- **Weber**
  - Sandstone, not measured

**Lake Fork Section**

Stratigraphic section measured along Lake Fork in Ts. 1 and 2 N., R. 5 W., Duchesne County, Utah, by Horace D. Thomas. Lower Morrison and Curtis measured on west side of Lake Fork in Sec. 2, T. 1 N., R. 5 W. Section from Curtis through Park City measured from NW. 1/4 of Sec. 1, T. 1 N., R. 5 W., northward to Mackenzie Draw in Sec. 26, T. 1 N., R. 5 W.

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
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</thead>
<tbody>
<tr>
<td>49</td>
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<tr>
<td>3</td>
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<tr>
<td>10</td>
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<tr>
<td>79</td>
</tr>
<tr>
<td>32</td>
</tr>
<tr>
<td>130</td>
</tr>
</tbody>
</table>

**Preuss**

- Redbeds, poorly exposed; isolated exposures show pink-red fine-grained shaly sandy siltstone and some light gray and greenish gray very fine-grained shaly sandstones and sandy shales
  - Thickness of Preuss

**Twin Creek**

- Light gray heavy bedded sandy limestone with coquinal layers made up almost entirely of *Trigonites*; large *Camptonites* and frilled *Owenia* also occur in this bed.
  - Poorly exposed pink very fine-grained siltstone, red shale, and gray shale
  - Thickness of Twin Creek
<table>
<thead>
<tr>
<th>Thickness in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray, tan and pink dense limestone.</td>
</tr>
<tr>
<td>Light gray porcellaneous limestone with interbedded shaly limestone and gray calcareous shale; carries <em>Pectenculus, Campanulina, Ostrea</em>, and minute gastropods</td>
</tr>
<tr>
<td>Light gray dense porcellaneous limestone at top grading down into heavier-bedded limestone which becomes thin-bedded and very sandy in lower 8 feet</td>
</tr>
</tbody>
</table>

**Thickness of Twin Creek** | 257 |

**NUGGET**

Gray to white massive cross-bedded medium-grained sandstone weathering creamy colored to tan; generally resistant but with softer parts | 1,192 |

**Thickness of Nugget** | 1,192 |

**STAMAKER**

Greenish gray sandy shale or shaly sandstone becoming red toward base; not well exposed | 43 |
| Pink-red thin-bedded fine-grained sandstone; forms ledges | 41 |
| Light gray dense heavy-bedded fine-grained sandstone | 16 |
| Red beds, poorly exposed, mainly talus covered | 269 |

**Gauta grif member**: Gray medium- to coarse-grained sandstone which downward becomes light gray to tan coarse-grained quartz grit and conglomeratic grit; basal part most conglomeratic, with quartz pebbles as large as 1 inch in diameter | 67 |

**Thickness of Stamaker** | 437 |

**ANKAREH**

Olive-gray siltstone, grades downward into subjacent bed | 10 |
| Red siltstone and very fine-grained sandstone | 114 |
| Gray massive cross-laminated medium-grained sandstone with small calcite pisolithic concretions | 7 |
| Red shale | 7 |
| Light gray medium-grained sandstone with small calcite pisolithic concretions | 11 |
| Red flaky shales, finely laminated siltstones, and thin-bedded very fine-grained ripple-marked sandstones | 415 |
| White gypsum | 4 |
| Red siltstones and very fine-grained sandstones | 285 |

**Thickness of Ankareh** | 862 |

**THAYNES**

White to light gray thin-bedded very fine-grained very calcareous sandstone and sandy limestone; forms ridge with subjacent bed | 26 |
| Light gray to tan thin- to heavy-bedded limestone and sandy limestone, resistant and forms a ridge; no fossils noted | 56 |

**Thickness of Thaynes** | 82 |

**WOODSIDE**

Red thin-bedded siltstones and very fine-grained sandstones | 316 |
| White to light gray thin-bedded very fine-grained sandstone | 15 |
| Red flaky shales and siltstones | 14 |
| Greenish gray very fine-grained ripple-marked micaceous sandstone; hard and resistant | 3 |
| Red to maroon shales, siltstones and very fine-grained sandstones | 357 |
| Tawny to drab siltstone | 5 |

**Thickness of Woodside** | 710 |

**PAK CITY**

Light gray dense limestone 5 feet thick at top; 70 feet cherty limestone and creamy chert next below; 10 feet lavender cherty limestone at base | 85
HORACE D. THOMAS AND MAX L. KRUEGER

Thickness
in Feet

30
53
70
537
1,192
43
45
16
269
10
114
16
11
415
4
385
862
95
56
82
316
15
14
3
357
5
710
30
56
269
900

Mackenzie red beds tongue of Woodside: Bright red shales, siltstones and very fine-grained sandstones. 30
Yellowish cherty limestone and chert. 56
Black shale with layers of phosphate rock and with beds of dense black limestone 1 to 5 feet thick in middle. 67
Thickness of Park City. 62

WEBER

Buff hard dense cross-beded medium-grained sandstone; not measured

WHITEROCKS CANYON SECTION

Stratigraphic section measured on west side of Whiterocks River in SW 1/4 of Sec. 18 and NW 1/4 of Sec. 19, T. 2 N., R. 1 E., Uintah County, Utah, by Horace D. Thomas. Section of Jurassic rocks was also measured on east side of river in SE 1/4 of Sec. 18, T. 2 N., R. 1 E.

TERTIARY COVER

Curtis

Gray thin-beded cross-beded oolitic fossiliferous limestone, parts sandy, Kallirrhynchos sp. abundant. 50
Gray shale with thin fossiliferous limestone beds ranging from a few inches to several feet in thickness. Fornesites denudis. 91
Gray thin-beded cross-beded medium- to coarse-grained sandstone; on the east side of the canyon this bed has a 1-foot chert pebble conglomerate at top. 38

Thickness of Curtis. 170

Entrada

Soft pink-red very fine-grained silty sandstone and white very fine-grained sandstone; interval not well exposed but pink-red and white beds seem interbedded in about equal thicknesses. 260

Thickness of Entrada. 269

CARMEL (Measured on east side of river)

Red shale and gray shale, very poorly exposed; this interval contains beds of gypsum on west side of river. 181
White massive gypsum. 5
Red shale. 25
White massive gypsum. 15
Red, gray and olive-green shales and sandy shales. Limestone; upper 10 feet light gray thin-beded dense porcellaneous limestone; middle 3 feet gray calcareous shale; basal 4 feet very fossiliferous oolitic limestone in 6-inch beds; abundant Trigonopsis sp. 21
Gray, red and olive-green shales. Tan coquina limestone with abundant Cymatoceras sp. 40
Dark gray flaky shale becoming lighter in color and clayey near base. 1

Thickness of Carmel. 320

NAVADO

Dark, massive cross-beded medium fine-grained tar-saturated sandstone; saturation is essentially complete and only where there are small calcite concretions, small quartzitic patches, or tightly cemented 1-inch laminae, is rock unsaturated. 992

Thickness of Navajo. 992
STANAKER
Covered interval; suggestion of red, lavender, and ochre beds

_Calca grit member:_ Tan heavy-bedded cross-laminated coarse-grained quartz grit with sporadic quartz pebbles and here and there gray chert pebbles up to 1-inch in diameter

_Thickness of Stanaker_ 302

ANKAREH
Red beds, very poorly exposed

_Thickness of Ankareh_ 533

THAYNES
White thin-bedded very fine-grained sandy limestone in beds from 1 to 2 feet thick, with interbedded red siltstones; two-thirds of interval is limestone; poorly preserved high-spired gastropods in basal limestone

_Thickness of Thaynes_ 12

WOODSIDE
Red shales and siltstones; lower part covered

_Thickness of Woodside_ 535

PARK CITY
Gray cherty limestone and bedded chert; forms ridge

_Upper part; tan limestone, sandy limestone and sandstone; all cherty and with bedded chert at top; contains Plagioglyptis; lower part greenish gray shales and siltstones, silicified oolites, and black phosphate rock, lithologic details not discernible._

_Thickness of Park City_ 215

WEBER
Gray hard medium-grained sandstone cut by secondary quartz veins; some parts of upper 100 feet quartzitic; not measured

TERNAL SECTION

Stratigraphic section measured north of Vernal, Uintah County, Utah, from Sec. 1, T. 5 S., R. 22 E., northward to a gorge tributary to gorge of Brush Creek near NW. cor. of Sec. 35, T. 2 S., R. 22 E., and west of the Vernal-Manila highway, by Horace D. Thomas.

LOWER MORRISON
Variegated mauve, lavender, and maroon clay shales with thin brown lenticular sandstones and thin beds of chert pebble conglomerate

CURTIS
Gray thin bedded cross-laminated oolitic sandy limestone

Gray shales interbedded with thin gray sandy limestones

Dark gray flaky shale and sandy shale with thin layers of gray sandstone and coquina limestone in upper half; lower half much darker flaky shale; Belonmites present throughout

Gray soft coarse-grained glauconitic sandstone; thin beds of gray sandy shale in upper part

_Thickness of Curtis_ 190

ENTRADA
Pink, red or tan very soft, very fine-grained sandstone; not well exposed

White to tan very soft, almost unconsolidated, fine-grained sandstone

_Thickness of Entrada_ 268
FACE D. THOMAS AND MAX L. KRUEGER

Stratigraphy of Uinta Mountains, Utah

CARMEL
Red and greenish shales alternating in about equal parts; red at top, then gray, then red, gray at base.

White soft mudstone fine-grained sandstone.

Red shale.

Gray shale.

Bright red shale and siltstone.

Thickness of Carmel

NAVAJO
Gray to cream to buff massive cross-bedded medium fine-grained sandstone weathering into knobs and turrets.

Thickness of Navajo

STANAKER (Type section)
Lavender clay shale.

Tan thin-bedded medium-grained sandstone.

Lavender clay shale.

Red to tan heavy bedded to thin-bedded medium fine-grained sandstone; some parts silty and weather more readily; forms hogback.

Red siltstone.

Red thin-bedded fine-grained sandstone.

Lavender and other clay shale with two 3-foot beds of massive medium-grained red sandstone.

Yellow to ochre soft massive very calcareous sandstone and sandy limestone.

Lavender red and purple clay shale with thin red massive very fine-grained sandstones.

Gray coarse-grained feldspathic quartz grit; locally quartzitic.

Lavender clay shale.

Gray coarse-grained feldspathic quartz grit.

Lavender clay shale.

Garza grit member: Gray massive cross-bedded feldspathic quartz grit with sporadic quartz pebbles up to one inch in diameter; resistant and forms a hogback; rests on irregular surface truncating subjacent red Woodside shales; locally varies from 40 to 80 feet in thickness.

Thickness of Stanaker

WOODSIDE
Dark red shales, siltstones and very fine-grained sandstones

Tan, gray and red thin-bedded to finely laminated ripple-marked very fine-grained calcareous sandstone grading down into olive-gray shale.

Tan thin-bedded to finely laminated very fine-grained calcareous sandstone.

Gray to tan flaky shale.

Red shale.

Gray to tan flaky shale.

Red flaky shale; within 300 feet along strike becomes gray.

Olive-gray to tan flaky shale with thin slabby sandy beds.

Brown thin-bedded ripple-marked very fine-grained calcareous sandstone; forms a ledge.

Olive-gray and tan flaky shale with several thin brown platy very fine-grained sandstones.

Thickness of Woodside

PARK CITY
Gray heavy bedded dense limestone with much gray chert.

Greenish gray flaky shale.

Gray dense cherty limestone.

Olive-gray shale at top grading downward into red shale below; about 10 feet thin-bedded yellow ochre siltstone at base.

Gray thick-bedded limestone and sandy limestone with chert nodules and bedded chert; calcite goethite throughout; upper 5 feet with abundant Plagioglyptis and Euphonytis.

Thickness of Woodside

1289
Dark greenish gray and black phosphatic shale and thin beds of oolitic phosphate rock; upper part somewhat sandy and cherty, with quartz geodes .................................................. 22

Thickness of Park City .................................................. 91

WEBER
Creamy to tan massive cross-bedded medium-grained quartz sandstone; not measured

SPLIT MOUNTAIN SECTION
Stratigraphic section measured near mouth of gorge of Green River at Split Mountain, several miles east of Dinosaur National Monument, approximately along line between T. 5 S., R. 23 E., and T. 5 S., R. 24 E., Uintah County, Utah, by Horace D. Thomas.

LOWER MORRISON
Variegated lavender, mauve, gray and green clay shale

CURTIS
Gray ripple-marked fine-grained sandstones with interbedded gray sandy shales ........... 78
Dark gray fissile shale containing Bolomities denius and other typical Curtis invertebrates. 36
Gray heavy-bedded to thin-bedded medium- to coarse-grained sandstone ..................... 60
Sandstone similar to above but thin layers of gray fissile shale ................................. 10
Gray heavy bedded to thin-bedded coarse-grained sandstone with impressions of pelecypods; contact with subjacent bed sharp .................................................. 10

Thickness of Curtis .................................................. 104

ENTRADA
White to red sandstone, mottled on a large scale, which is soft, massive, cross-laminated and fine-grained; weather into rounded domes, not along bedding planes ............................. 142

Thickness of Entrada .................................................. 142

CARMEL
Bright red shales, siltstones and very fine-grained sandstones with two 10- to 15- foot beds of gray shale .................................................. 104

Thickness of Carmel .................................................. 104

NAVAJO
Tan soft massive cross-bedded fine- to medium-grained sandstone which weathers into smooth knobs and domes; basal contact sharp .................................................. 780

Thickness of Navajo .................................................. 780

STANAKER
Lavender-red fine-grained sandstones and shales about 70 feet thick at top; red soft fine-grained sandstones aggregating about 70 feet in thickness in middle; lower part consists of lavender, red, and other shales .................................................. 287
Gargo gris member: Gray cross-bedded coarse-grained quartz grit and conglomerate; parts are well sorted fine- to medium-grained sandstone, others are granule grits with angular to poorly rounded sporadic quartz pebbles up to 1 inch in diameter; resistant and forms hogback; rests with sharp irregular contact on subjacent bed .................................................. 93

Thickness of Stanaker .................................................. 380

WOODBINE
Brick-red to bright red shales and siltstones, with several thin harder very fine-grained sandstones .................................................. 502
Brownish red massive medium- to fine-grained sandstone; forms a ledge ..................... 10
Brownish red thin-bedded to finely laminated siltstone and very fine-grained sandstone with about a dozen 1- to 4-inch gray, olive-green or tan layers .................................................. 51
Horace D. Thomas and Max L. Krueger

Dark greenish gray and black phosphate shale and thin beds of dolomite phosphate rock; upper part somewhat sandy and cherty, with quartz gravel.

Thickness of Park City

Webber

Creamy to tan massive cross-beded medium-grained quartz sandstone; not measured

Split Mountain Section

Stratigraphic section measured near mouth of gorge of Green River at Split Mountain, several miles east of Dinosaur National Monument, approximately along line between T. 6 S., R. 25 E., and T. 5 S., R. 24 E., Uintah County, Utah, by Horace D. Thomas.

Lower Morrison

Variegated lavender, mauve, gray and green clay shale

Curtis

Gray rippled medium-fine-grained sandstones with interbedded gray sandy shales.

Gray heavy bedded to thin-beded medium- to coarse-grained sandstone.

Sandstone similar to above but thin layers of gray shale.

Gray heavy bedded to thin-beded coarse-grained sandstone with impressions of pelecypods; contact with subjacent bed sharp.

Thickness of Curtis

Entrada

White to red sandstone, mottled on a large scale, which is soft, massive, cross-laminated and fine-grained; weathers into rounded domes, not along bedding planes.

Thickness of Entrada

Carnel

Bright red shales, siltsstones and very fine-grained sandstones with two 10- to 15-foot beds of gray shale.

Thickness of Carnel

Navajo

Tan soft massive cross-beded fine- to medium-grained sandstone which weathers into smooth knobs and domes; based contact sharp.

Thickness of Navajo

Stanacker

Lavender and red fine-grained sandstones and shales about 70 feet thick at top; red soft fine-grained sandstones with interbedded red shales aggregating about 70 feet in thickness in middle; lower part consists of lavender, red, and other shales.

Granite gravel member. Gray cross-beded coarse-grained quartz grit and conglomerate; parts are well sorted fine- to medium-grained sandstone, others are granule grits with angular to poorly rounded specific quartz pebbles up to 1 inch in diameter; resistant and forms hogback; rests with sharp irregular contact on subjacent bed.

Thickness of Stanacker

Woodside

Brick-red to bright red shales and siltsstones, with several thin harder very fine-grained sandstones.

Brownish red medium- to fine-grained sandstone forms a ledge.

Brownish red thin-beded to finely laminated siltsstone and very fine-grained sandstone with about a dozen 1- to 4-inch gray, olive-green or tan layers.

Stratigraphy of Uinta Mountains, Utah

Gray, tan, and ochre firm platy claystone and siltstone with some red layers and red motting.

Red shale with several thin gray, yellow, or ochre sandy shales, calcareous shales and very fine-grained sandstones.

Yellowish-brown calcareous siliciclastic siltstone.

Red shale with thin very fine-grained sandstone layers.

Yellow shaly mudstone.

Yellowish gray massive very fine-grained sandstone with thin shale layers.

Thickness of Woodside

Park City

Gray massive sandy limestone.

Gray clay to tan platy dense limestone with gray chert layers and nodules; lower part shaly.

Gray thin-beded to heavy bouldered very sandy limestones, limy sandstones and dense gray limestones with large brown chert nodules and layers; contains Platyphylax and Euphasia miles in upper half.

Thickness of Park City

Webber

Gray massive cross-beded sandstone with numerous small linny concretions which impart a pseudo-limestone appearance to uppermost part; not measured

Skull Creek Section

Stratigraphic section measured on south flank of Skull Creek anticline in T. 4 N., R. 101 W., Moffit County, Colorado, by Max L. Krueger.

Lower Morrison

Variegated clay shales

Curtis

Gray shale.

Brown soft shales with thin gray sandstones and fossiliferous limestone; Dolomites denus and other Curtis intervals present.

Thickness of Curtis

Entrada and Navajo

White tobuff cross-beded fine- to medium-grained sandstone with 25 feet of harder ledgeforming sandstone at top.

White dense limestone.

White to buff cross-beded fine- to medium-grained sandstone.

Thickness of Entrada and Navajo

Stanacker

Upper part brick-red massive silty sandstone; lower part dark purplish, light red and brick-red shales.

Mottled purple hard sandy shale.

Granite gravel member. Grayish white massive cross-beded feldspathic grit and pebble conglomerate; 3 feet red shale near middle.

Thickness of Stanacker

Woodside

Red shales, siltsstones and very fine-grained sandstones; some greenish gray shales.

Red thin-beded platy fine-grained sandstone.
Buff to gray gypsiferous clay shale with a few thin sandstones at top; lower part orange-yellow shale with interbedded thin tan siltstones; basal contact sharp

Thickness of Woodside

288

WEVER
White to buff massive cross-beded sandstone; not measured

MANILA SECTION
Stratigraphic section measured on north flank of Uinta Mountains, south of Manila, Daggett County, Utah, by Horace D. Thomas. Specific localities as follows: Section from Morrison to Navajo measured adjacent to Manila-Vernal Highway in Sec. 6, T. 2 N., R. 20 E.; section of Navajo and Garria measured in Sec. 3, T. 2 N., R. 19 E.; section of upper Woodside measured about 1 mile south of Horseshoe Canyon west of Green River in Sec. 3, T. 2 N., R. 20 E.; and section of lower Woodside and Park City measured along Hide Out Canyon road in Sec. 3, T. 2 N., R. 20 E.

LOWER PART OF MORRISON
Variegated clay shale; not measured

CURTIS
Gray heavy to thin-beded hard dense crystalline limestone with abundant specimens of Kallithyrisia myrma in upper part; forms dip-slope of hogback

68

Dark gray shale with thin interbedded limestones; abundant specimens of Belemnitella densus

110

Thickness of Curtis

178

ENTRADA
Pinkish red siltstones and very fine-grained sandstones

84

Yellow massive cross-beded fine- to medium-grained sandstone; resistant and forms a cliff

72

Pinkish red soft massive very fine-grained sandstone

25

White- and pink-mottled massive fine-grained sandstone

20

Thickness of Entrada

201

CARMEL
Red and gray flaky shale and siltstone

101

Light gray gypsum

3

Very light gray shale with thin beds of gypsum and gypsum veins

47

Light gray heavy-beded gypsum

9

Brick-red and light gray shale, interbedded

31

Light gray massive gypsum

5

Brick-red flaky shale with several interbedded greenish-gray flaky shale beds and two 6-inch beds of light gray fine-grained very calcareous sandstone

86

Dark gray heavy bedded coquinal and oolitic limestone split by several dark shale layers

22

Gray shale with thin layers of coquinal limestone

16

Brown slubby fossiliferous shale limestone with Cymatocellies, Trigonia and Ostrea

3

Dark gray flaky shale

7

Thickness of Carmel

324

NAVAJO
Light gray to tan massive cross-beded well sorted fine-grained sandstone; forms cliff throughout area

838

Thickness of Navajo

838

STANAKER
Tan sandy shale sharply overlain by Navajo sandstone

10

Apple-green flaky shale

2
### MANILA SECTION

Assured on north flank of Uinta Mountains, south of Manila, Daggett County, Utah. Specific localities as follows: Section from Mormon to Navajo on U.S. Highway 6 in Sec. 6, T. 3 N., R. 20 E.; section of Navajo and T. 2 N., R. 20 E.; section of upper Woodside measured about 1 mile west of Green River in Sec. 3, T. 2 N., R. 20 E.; and section of lower Woodside measured about 1 mile west of Red Creek on U.S. Highway 6 in Sec. 3, T. 2 N., R. 20 E.

#### Thickness

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>288</td>
<td>shale with a few thin sandstones at top; lower part orange- and tan siltstones; basal contact sharp</td>
</tr>
<tr>
<td>568</td>
<td>interbedded sandstone; not measured</td>
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#### Stratigraphy

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>24</td>
<td>Greenish gray thin-beded shaly siltstone and very fine-grained shaly sandstone</td>
</tr>
<tr>
<td>10</td>
<td>Purplish red shale</td>
</tr>
<tr>
<td>64</td>
<td>Purplish red irregularly bedded medium-grained sandstone interbedded with red shale</td>
</tr>
<tr>
<td>5</td>
<td>Purplish red limestone pebble and clay pebble conglomerate</td>
</tr>
<tr>
<td>40</td>
<td>Purplish red flaky shale</td>
</tr>
<tr>
<td>3</td>
<td>Gray sandy very coarse-grained quartz sandstone and quartz granule grit; poorly sorted</td>
</tr>
<tr>
<td>15</td>
<td>Purplish red shale</td>
</tr>
<tr>
<td>10</td>
<td>Lavender, mottled yellowish, hard cherty sandstone</td>
</tr>
<tr>
<td>95</td>
<td>Lavender to red flaky shale</td>
</tr>
<tr>
<td>18</td>
<td>Luttrell conglomerate member: Purplish red limestone pebble conglomerate in lenses set in red sandstone, cross-beded coarse-grained sandstone with sharp internal contact on subjacent beds</td>
</tr>
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#### Thickness of Staraker

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
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</tr>
</thead>
<tbody>
<tr>
<td>392</td>
<td>Woodside</td>
</tr>
</tbody>
</table>

#### Woodside

- Red siltstone and very fine-grained sandstone with some red shale; weathers into a vertical scarp in places and is relatively resistant
- Massive soft gypsum with thin breaks of bright-red shale
- Tawny to greenish gray very fine-grained ripple-marked sandstones, limy sandstones, siltstones, and calcareous shales, with thin beds of gypsum
- Tan and gray fine-grained thin-beded sandstones, sandy shales and siltstones; some beds calcareous; ripple-marks conspicuous; obscure molds of Peloclypylida in talus
- Brown platy medium-grained sandstone
- Tan to gray thin-beded very fine-grained sandstones and sandy shales; basal contact sharp

#### Thickness of Woodside

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1,456</td>
<td>Park City</td>
</tr>
</tbody>
</table>

#### Park City

- Light gray dense siliceous limestone and coquinal limestone; upper part thin-beded, lower part heavy-beded; carries abundant bryozoa and Euph limosus subfusus
- Light gray dense heavy-beded limestone with calcite geodes, nodular gray chert, and layers of white to gray chert
- Interbedded gray flaky shale and light gray dense argillaceous limestone with calcite geodes and nodular gray chert
- Other yellow soft massive siltstone
- Red and gray sandy shale
- Gray gypsum or anhydrite, lenticular
- Tan and coarse-beded medium- to coarse-grained quartzitic sandstone
- Interbedded gray dense heavy-beded very clayey limestone and fine-grained sandstones; some thin tan shale breaks; sandy parts contain calcite geodes; Flagiolitya in talus
- Black to very dark gray shale and calcareous sandstone; details obscure, forms slope

(Note: Following beds probably equilvalent to lower part of Park City of western Uintas)

#### Cliffs-forming massive sandstone unit consisting mainly of massive to irregularly bedded buff to yellow very fine- to fine-grained sandstone with calcite geodes in lower part. Vertical variation is such that parts are calcareous and others shaly with gradations between; some beds siliceous or quartzitic; irregular patches of brown chert in upper part

#### Thickness of Park City

<table>
<thead>
<tr>
<th>Thickness in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>390</td>
<td>Weber</td>
</tr>
</tbody>
</table>

#### Weber

- Tan cross-beded sandstone