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GEOHYDROLOGIC DATA IN THE NAVAJO AND HOPI INDIAN RESERVATIONS, ARIZONA, NEW MEXICO, AND UTAH

PART III

SELECTED LITHOLOGIC LOGS, DRILLERS' LOGS, AND STRATIGRAPHIC SECTIONS

By M. E. Cooley, J. P. Akers, and P. R. Stevens

United States Department of the Interior, Geological Survey

Prepared in cooperation with the Bureau of Indian Affairs

and the Navajo and Hopi Tribes

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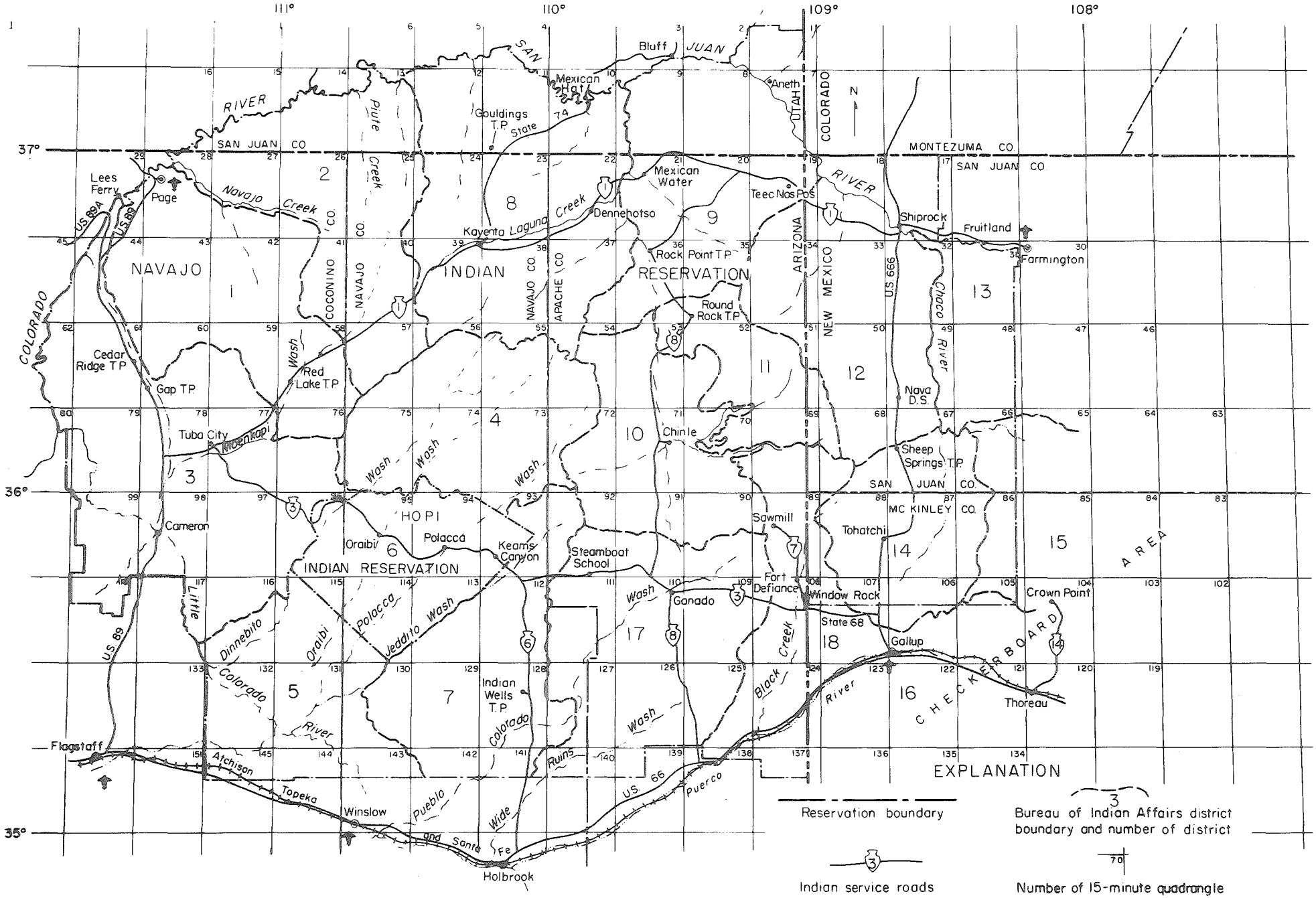

Figure 1.--Map of the Navajo and Hopi Indian Reservations, showing roads, villages, Bureau of Indian Affairs' administrative districts, and 15-minute quadrangles.

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Introduction

The geohydrologic data in this report consist of information about the geology of the Navajo and Hopi Indian Reservations in northeastern Arizona, northwestern New Mexico, and southeastern Utah (fig. 1). This report consists of a compilation of 161 lithologic logs, 168 drillers' logs, and 76 stratigraphic sections, which will supplement the information contained in the forthcoming comprehensive report on the ground-water resources and geology of the reservations. The comprehensive report is to be published as a U.S. Geological Survey Professional Paper.

Purpose, Scope, and Organization of the Report

In 1946 the U.S. Geological Survey was asked by the Bureau of Indian Affairs to make a series of hydrologic investigations to help alleviate the water shortage at several localities. Later, in 1950, the U.S. Geological Survey in cooperation with the Bureau of Indian Affairs began a comprehensive investigation of the geology and ground-water resources of the Navajo and Hopi Indian Reservations, which occupy parts of northeastern Arizona, northwestern New Mexico, and southeastern Utah (fig. 1). The principal objectives of the investigation were as follows: (1) To determine the feasibility of developing ground-water supplies for stock, domestic, institutional, and industrial use in particular areas and at several hundred well sites on the reservations and in adjoining areas owned by the Navajo Tribe; (2) to compile an inventory of the existing ground-water supplies; (3) to make a comprehensive investigation of the geology and determine the factors that control the occurrence and movement of ground water; and (4) to appraise the water potential for future development.

The geohydrologic data of the Navajo and Hopi Indian Reservations are reproduced separately in sections as Parts I, II, III, and IV of Arizona State Land Department Water Resources Report No. 12. Part I (Davis and others, 1963) contains a compilation of the records of drilled wells, dug wells, and springs that were inventoried before 1957. Part II (Kister and Hatchett, 1963) is a compilation of selected chemical analyses from the wells and springs that were sampled. Part III (this report) contains selected lithologic logs, drillers' logs, and stratigraphic sections. Part IV consists of maps of the reservations showing the locations of the wells and springs listed in Parts I, II, and III. Information pertaining to wells drilled after 1957 is available in the open files of the Geological Survey Water Resources Division offices in Tucson and Holbrook, Ariz.

Personnel

The collection, compilation, and analysis of the data contained in this report were under the general supervision of A. N. Sayre and P. E. LaMoreaux, former chiefs, and O. M. Hackett, present chief, of the Ground Water Branch; S. F. Turner, L. C. Halpenny, J. W. Harshbarger, and P. E. Dennis, former district supervisors of the Ground Water Branch in Arizona; and H. M. Babcock, present chief of the Water Resources Division in Arizona. The collection of the data was begun under the direct supervision of Mr. Halpenny and was continued by Mr. Harshbarger.

Substantial contributions——including descriptions of drill cuttings, inventory of water developments, technical assistance in well drilling, and descriptions of the measured sections——were made by other personnel of the Navajo Project. Those deserving special mention are C. A. Repenning, J. H. Irwin, J. T. Callahan, H. G. Page, William Kam, G. E. Davis, W. F. Hardt, R. L. Jackson, and H. A. Whitcomb. The logs and stratigraphic sections were typed by Mrs. Ruth Blubaugh and Mrs. Nancy Smith.

Acknowledgments

The Geological Survey is grateful for the assistance, cooperation, and information given by the late J. J. Schwartz, former head of the Bureau of Indian Affairs' water-development program for the Navajo Indians; by M. H. Miller, Bureau of Indian Affairs engineer; by Buster Kingsley, Bureau of Indian Affairs supervisor of the Hopi Indians; and by other personnel of the Bureau of Indian Affairs and the Navajo and Hopi Tribes connected with the water-development program. The hydrologic information given the Geological Survey by the El Paso Natural Gas Co., various religious missions, and trading posts is greatly appreciated. Acknowledgment is due the many water-well drillers who, since 1948, conscientiously collected drill cuttings of the wells and supplied hydrologic data, with special thanks to the Cowley Bros. Drilling Co., St. Johns, Ariz.; Perry Bros. Drilling Co., Flagstaff, Ariz.; and Myers Drilling Co., Holbrook, Ariz.

Land-Net System and Location of Wells and Sections

The Navajo and Hopi Indian Reservations are in the south-central part of the Colorado Plateaus. The Navajo Indian Reservation occupies parts of Apache, Navajo, and Coconino Counties in northeastern Arizona, San Juan and McKinley Counties in northwestern New Mexico, and San Juan County in southeastern Utah (fig. 1). The Hopi Indian Reservation is within the central part of the Navajo Indian Reservation in Arizona. The reservations comprise an area of about 25,000 square miles, which is about three times the size of the State of New Jersey.

The Navajo Indian Reservation is divided into 17 administrative districts, numbered 1 to 5 and 7 to 18, and the Hopi Indian Reservation comprises district 6 (fig. 1). District 19 is east of the reservation boundary in New Mexico. The reservations and adjoining area were not mapped in detail during this study, but 15-minute planimetric maps of the area were made from aerial photographs. These maps were used for the geologic and hydrologic base maps and are arbitrarily numbered from 1 to 151, starting in the upper-right corner of the area and numbering consecutively in rows from right to left.

The logs and stratigraphic sections are arranged in the numerical order of the 18 administrative districts of the Bureau of Indian Affairs and in accordance with the 15-minute quadrangles within each district. No data

are included in this report from district 19, which is outside the reservation boundary in New Mexico.

Bureau of Indian Affairs Field Number

The ground-water and surface-water developments were inventoried during the 1930's by personnel of the Bureau of Indian Affairs. The water developments, regardless of type, were numbered consecutively in each administrative district. Since this field inventory, new water developments—principally drilled wells—have been assigned a number and added to the inventory.

The wells assigned a Bureau of Indian Affairs field number are identified by a compound number consisting of two main parts. The first part is divided into a numeral that designates the Bureau of Indian Affairs' district and a letter that indicates one of several factors. Since about 1950, it denotes the source of funds used in the drilling of a well; the letter "K" is used for wells drilled under the Bureau's drilling program, and the letter "T" is used for wells drilled under the Navajo Tribal Well-Development Program. However, new wells drilled and all developments inventoried before 1950 may use, instead of "K" or "T," the first letter of the last name of the person who first inventoried the well or spring for the Bureau of Indian Affairs. The second part of the Bureau field number represents the consecutive order in which the drilled wells, dug wells, and springs were inventoried in each district. Some developments contain an additional letter at the end of the field number. These letters are arranged consecutively, beginning with "A." Usually, these field numbers are obtained from the number of a nearby development that was inventoried previously.

Quadrangle Location Number

The quadrangle location number indicates the position of a well or stratigraphic section within a 15-minute quadrangle and consists of three parts. The first part is the number of the quadrangle in which the well or section is located. The second part is the distance in miles west of the northeast corner of the quadrangle, and the third part is the distance in miles south of the northeast corner of the quadrangle (fig. 2). The letter "A" at the end of the quadrangle number means an approximate location.

Stratigraphic Nomenclature

The sedimentary rocks are distinguished largely on the basis of lithologic characteristics and are referred to by their standard formation and member names. Figure 3 lists the stratigraphic names of the rocks used in this report. The water-bearing strata, or aquifers, penetrated by wells are identified as formations and members and are also listed in Part I, Records of Ground-Water Supplies.

Lithologic Logs

The lithologic logs were compiled from laboratory examinations of the drill cuttings. The procedure used in examining the cuttings was summarized by Stevens (1963).

The cuttings were collected by the driller at 10-foot intervals and occasionally at a change in formation. Most of the cuttings were not washed and were put into cloth sample bags at the time of collection, generally when wet. Samples from cable-tool rigs were collected from the material dumped from the bailer or, whenever possible, from the drill bit. In original records, and no attempt was made to revise these terms. Particle size in order of increasing grain size includes clay; silt; very fine grained, fine-grained, medium-grained, coarse-grained, and very coarse grained sand; granule; pebble; cobble; and boulder, according to the Wentworth grade scale. The determination of grain size, roundness, and degree of sorting was made by visual comparison with charts prepared by Payne (1942). The grains are classified as well rounded, rounded, subrounded, subangular, or angular. The sorting is indicated as well sorted, fair sorted, and poorly sorted and, in general, is restricted to sandstone. Material is well sorted if more than 90 percent of the grains is in two adjacent particle-size ranges (Payne, 1942) or fair sorted if more than 90 percent of the grains falls into three or four adjacent ranges; it is poorly sorted if five or more ranges are represented. Quartz grains are the main constituents of the sediments, and they are described as clear, stained, frosted, or amber. Readily identifiable accessory minerals are pyrite, gypsum, calcite, or mica. Where the accessory minerals are not easily identifiable, their color prevalence and other readily distinguished characteristics are described. The clastic rocks are well, firmly, and weakly cemented, and, where recognizable, the composition of the cement is noted. A noncalcareous, weakly cemented sediment is considered to have an "argillaceous" cement.

The correlation of lithologic logs is relatively simple for logs of wells on the reservations, because most stratigraphic units are recognized readily in drill cuttings. Generally, the samples are examined and a continuous log is kept during drilling of new wells. This procedure helps to determine the depth of formational contacts and to predict the additional drilling necessary to reach the desired aquifer.

Drillers' Logs

The terminology used by drillers varies considerably; however, by comparing the driller's log with known thicknesses and descriptions of the rocks on the surface, most of the stratigraphic units can be recognized. Many of the drillers' logs show large stratigraphic intervals as undifferentiated where formational changes are based on minor changes in lithology, unless the formational change is accompanied by changes in the drilling characteristics of the rocks. Most drillers rely more on the drilling characteristics of the rocks than on small variations in composition to identify formational contacts. In some instances, however, because of changes in drilling characteristics, the very weakly consolidated alluvial sediments are represented more accurately in a driller's log than in a lithologic log.

Stratigraphic Sections

One of the main techniques used in the study of sedimentary rocks is the measurement and description of stratigraphic sections; these sections were made at selected points where the rocks are exposed clearly. The thicknesses of most of the sections were measured with a hand level, but a few were measured by the use of a plane table, transit, steel tape, or by a combination of two or more of these methods. Each bed or group of similar beds is described and indicated as a "unit" in the stratigraphic section. Correlation of the stratigraphic units was made in the field.

Color, grain size, rounding, sorting, composition, and cementation of the sedimentary rocks were determined at the time of measurement, and the terminology is the same as that used for the description of the drill cuttings in the lithologic logs. Additional features described include

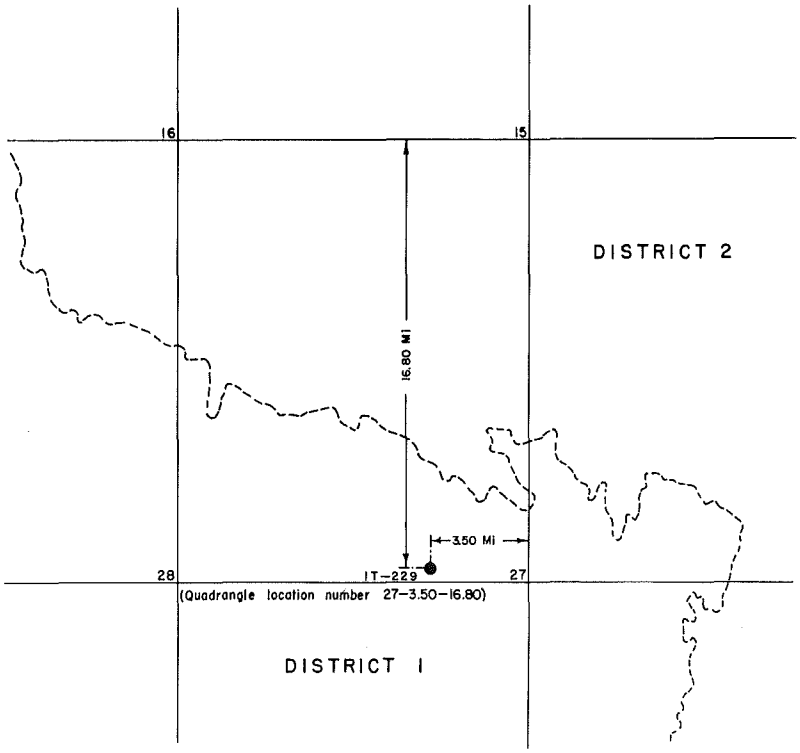

Figure 2.--Sketch showing well-numbering system used in the Navajo and Hopi Indian Reservations.

rotary-drilled wells the samples were taken from the ditch through which the mud circulates to the mud pit. The ditch was cleaned before each sample was collected to reduce contamination; therefore, representative samples from the bit or drilling depth could be obtained. Cuttings were collected periodically by project personnel. Good well logs are contingent on representative samples; thus, a conscientious, cooperative driller who observes proper sampling procedures is essential to the compilation of accurate well records.

The rock type, color, particle size, rounding, sorting, composition, accessory minerals, and cementation are recorded in all lithologic descriptions of the drill cuttings. The color designation was determined from the rock-color chart distributed by the National Research Council (Goddard, 1948), and many of the colors were interpolated using the procedure described in the rock-color chart. Grain size of the detrital rocks is described generally in accordance with the classification presented by Wentworth (1926). In his classification, detrital rocks are listed in order of increasing coarseness as claystone, siltstone, sandstone, granule conglomerate, or pebble conglomerate. These types grade into one another, and modifying terms can be used, such as "sandy siltstone" or "silty sandstone." The term "mudstone" is used to designate a rock containing nearly equal proportions of silt and clay. Many terms, such as silty mudstone or silty claystone, used in the lithologic logs are from the bedding, crossbedding, weathering, topographic expression, description of the lower contact, and the splitting properties.

The general bedding features are described by Harshbarger, Repenning, and Irwin (1957, p. 58).

"The physical features of each sedimentary unit are divided into two general types in the manner devised by Krynine (1948, p. 145-147). He classifies the gross features of the lithologic unit as a whole—its shape and size and the nature of its boundaries—as external. In features classified as internal he includes stratification and other features within the unit. Thus, an individual unit may be tabular in form and be composed of flat-bedded strata. As the tabular form of sedimentary-rock units is by far the most common of external shapes, it has usually not been noted in the descriptions. However, note has been made of external form in the case of lenticular units.

"In the above example of a tabular unit composed of flat-bedded strata, each individual stratum may have internal features of its own, such as crossbedding. If it is desirable, in the description of the unit, to describe this crossbedding within individual strata, considerable confusion may arise, for it seems contradictory to say that a unit is both flat bedded and crossbedded. In order to avoid the burden of describing each different stratum, it seems desirable to describe the sequence as a whole but to include qualifying statements to record variations within the unit. Therefore, to indicate

SYSTEM	SERIES	ENTIRE AREA		
QUATERNARY		Surficial deposits: Alluvium Landslide deposits and talus Windblown sands Terrace deposits Spring deposits Volcanic rocks		
TERTIARY	PLIOCENE	Bidahochi Formation Upper member Volcanic member (tuff) Lower member		
	PLIOCENE(?)	Chuska Sandstone		
	PALEOCENE	Nacimiento Formation		
CRETACEOUS	UPPER	BLACK MESA BASIN	SOUTHERN SAN JUAN BASIN	NORTHERN SAN JUAN BASIN
		Yale Point Sandstone Wepo Formation Toreva Formation Upper sandstone member Middle carbonaceous member Lower sandstone member Mancos Shale	Menefee Formation Point Lookout Sandstone Satan Tongue of Mancos Shale Hosta Tongue of Point Lookout Sandstone Cleary Coal Member of Menefee Formation Crevasse Canyon Formation Gibson Coal Member Dalton Sandstone Member Mulatto Tongue of Mancos Shale Bartlett Barren Member Dilco Coal Member Gallup Sandstone Upper part Tongue of Mancos Shale Lower part Mancos Shale	Ojo Alamo Sandstone Kirtland Shale Upper member Farmington Sandstone Member Lower member Fruitland Formation Pictured Cliffs Sandstone Lewis Shale Cliff House Sandstone Menefee Formation Point Lookout Sandstone Mancos Shale (upper part) Gallup Sandstone Mancos Shale (lower part) Dakota Sandstone
	UPPER AND LOWER	Dakota Sandstone Upper member Middle member Lower member	Dakota Sandstone	
	LOWER			Burro Canyon Formation
JURASSIC	UPPER	ENTIRE AREA		
		Cow Springs Sandstone	Morrison Formation Brushy Basin Member Westwater Canyon Member Recapture Shale Member Salt Wash Sandstone Member Summerville Formation Sandy facies Todilto Limestone Entrada Sandstone Upper sandy member Medial silty member Lower sandy member	Bluff Sandstone
	UPPER AND MIDDLE	Carmel Formation		
JURASSIC AND TRIASSIC(?)		Navajo Sandstone		

TRIASSIC(?)	UPPER	Kayenta Formation Silty facies Sandy facies Moenave Formation Springdale Sandstone Member Dinosaur Canyon Sandstone Member			
TRIASSIC	UPPER	Wingate Sandstone Lukachukai Member Rock Point Member Chinle Formation Church Rock Member Owl Rock Member Petrified Forest Member Upper part Sonsela Sandstone Bed Lower part Monitor Butte Member Lower red member Shinarump Member { Correo(?) Sandstone Member in Zuni Mountains area			
	MIDDLE(?) AND LOWER	SOUTHERN AND SOUTHWESTERN PARTS OF THE RESERVATIONS Moenkopi Formation Holbrook Member Moqui Member Wupatki Member		MONUMENT VALLEY Moenkopi Formation Upper siltstone member Middle sandstone member Lower siltstone member Hoskinnini Member	
TRIASSIC(?)					
PERMIAN		GRAND CANYON Kaibab Limestone Toroweap Formation Coconino Sandstone	DEFIANCE PLATEAU De Chelly Sandstone Upper member Tongue of Supai Formation Lower member	ZUNI MOUNTAINS San Andres Limestone Glorieta Sandstone Yeso Formation Abo Formation	MONUMENT VALLEY Cutler Formation De Chelly Sandstone Member Organ Rock Tongue Cedar Mesa Sandstone Member Halgaito Tongue
CARBONIFEROUS: PERMIAN AND PENNSYLVANIAN		Supai Formation	Supai Formation		Rico Formation
CARBONIFEROUS: PENNSYLVANIAN					Hermosa Formation
CARBONIFEROUS: MISSISSIPPIAN		Redwall Limestone			Stratigraphic units not listed below the Hermosa Formation
CAMBRIAN	MIDDLE	Muav Limestone Bright Angel Shale			
CAMBRIAN	MIDDLE AND LOWER	Tapeats Sandstone			
PRECAMBRIAN		Granite	Quartzite and granite	Granite	

Figure 3. -- Names of the rocks and sediments of the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah.

that variation exists within a unit, the unit is referred to as a coset and the minor units, containing the variations, are referred to as sets. Thus, the hypothetical unit described above would be a flat-bedded coset; an individual tabular crossbedded stratum within it would be considered as a crossbedded set. The definition of a set, as used herein, is a stratum or a group of strata having a uniform lithology, distinguished from other sets by a difference in lithologic character, and included in the description of a larger stratigraphic unit, referred to as a coset. A coset is a sedimentary unit that contains two or more sets and differs recognizably in lithology from adjacent strata or cosets."

The description of the bedding in most sections of this report closely follows the bedding description of McKee and Weir (1953), as modified by Harshbarger and others (1957). In some of the sections thinly laminated and laminated bedding are referred to as very thin bedded. (See tabulation below.)

Bedding	Splitting property	Thickness
Very thick	Massive	More than 120 cm (4 ft)
Thick	Blocky	60-120 cm (2 ft-4 ft)
Thin	Slabby	6-60 cm (2 in-2 ft)
Very thin	Flaggy	1-5 cm (1/2 in-2 in)
Laminated	Shaly (mudstone)	2 mm-1 cm
	Platy (limestone and sandstone)	2 mm-1 cm
Thinly laminated	Fissile	Less than 2 mm (paper thin)

Crossbedding or cross-stratification is divided into three types—simple, planar, and trough—based on the external features of a unit displaying similarly oriented crossbeds, as described by Harshbarger and others (1957, p. 58): "The simple type shows no apparent signs of erosion along the bounding surfaces of the individual group of crossbeds. The planar type is marked by flat surfaces of erosion bounding the group. The trough type is marked by curved surfaces of erosion bounding the group. Festoon crossbedding would be a specialization within the trough type, as its lower boundary is obviously a curved surface of erosion. What has often been referred to as torrential crossbedding ordinarily falls into the planar type. Minor descriptive terms used to modify the three major types are tabular (parallel planar surfaces), wedge (converging planar surfaces), and lenticular (converging curved surfaces)." The crossbeds, as shown below, are classified as to shape, angle of dip, size, and thickness.

Shape	concave or convex (upward)
Angle of dip	
High	more than 20°
Medium	10° to 20°
Low	less than 10°
Size or scale	
Large	more than 20 feet
Medium	1 to 20 feet
Small	less than 1 foot
Thickness	same as classification for bedding

The descriptions of some of the sections include very low angle of dip, which is less than 5° and usually less than 3°, and very large scale crossbeds, which are several tens to more than 100 feet long. Pseudocrossbedding, formed by a progressive advance of ripples upon each other, is common in silty fine-grained sandstone and siltstone beds. Well-formed ripple marks are not common in a pseudocrossbedded unit, although they may occur at the top of the unit.

The other features of the sedimentary rocks relate to weathering and topographic expression, such as slopes, ledges, cliffs, and the size of blocks and particles produced by weathering. For the most part, the terms are self-explanatory. Platy weathering generally is associated with very thin bedded units and flaggy weathering with thin- to thick-bedded sediments, especially those consisting of alternating sandstone and siltstone layers. Hoodoo weathering pertains to rounded, irregular, or pillarlike forms, which often have been described as "rock babies." The basal contact of a unit is described as either sharp or gradational and as either flat or irregular.

The environment in which each unit was deposited was interpreted at the time of field observation from the sedimentary features of the unit. The interpretation of the environment was an aid in determining the existence of local unconformities, intertonguing relations, and gradations between the adjacent units.

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SELECTED LITHOLOGIC LOGS IN THE NAVAJO AND HOPI INDIAN RESERVATIONS,

ARIZONA, NEW MEXICO, AND UTAH

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah

	Thickness (feet)	Depth (feet)
1T-229		
27-3.50-16.80		
QUATERNARY:		
Windblown sands:		
Sand: Grayish-orange (10YR 7/4); fine- to medium-grained; well-sorted; composed of subrounded to subangular, frosted quartz; rare black accessory minerals; calcareous cement.	80	80
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Siltstone: Pale-reddish-brown (10R 5/4); silt and rare to common medium-grained sand; poorly sorted; composed of subrounded to rounded, frosted and amber quartz; calcareous cement.	70	150
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (10R 7/4); very fine to medium-grained; color and sorting vary slightly; composed of subrounded to rounded, frosted quartz; rare black accessory minerals; calcareous cement.	1,098	1,248
1K-223		
28-4.90-12.75		
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandstone: Moderate-reddish-orange (10R 6/6) to moderate-reddish-brown (10R 4/6); very fine to coarse-grained; silty; poorly sorted; composed of rounded to subrounded, stained quartz; rare dark accessory minerals and argillaceous material; weakly cemented; calcareous and ferruginous.	10	10
Arenaceous siltstone: Moderate-reddish-orange (10R 6/6) to moderate-reddish-brown (10R 4/6); silt to medium-grained; rare accessory minerals; weakly cemented, calcareous and ferruginous.	30	40
Sandstone: Moderate-reddish-orange (10R 6/6) to moderate-reddish-brown (10R 4/6); very fine to coarse-grained; silty; poorly sorted; composed of rounded to subangular, stained quartz; rare dark accessory minerals, rare argillaceous material, rare mudstone fragments; weakly cemented, calcareous and ferruginous.	20	60
Siltstone: Moderate-reddish-orange (10R 6/6) to moderate-reddish-brown (10R 4/6); very fine to fine-grained; silty; rare dark accessory minerals; weakly cemented, calcareous and ferruginous.	20	80
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-reddish-orange (10R 6/6) to moderate-reddish-brown (10R 4/6); very fine to medium-grained; silty; fair-sorted; composed of rounded to subangular, stained quartz; rare to moderately common dark accessory minerals, rare argillaceous material, rare mudstone fragments; weakly cemented, calcareous and ferruginous.	50	130
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; fair-sorted; composed of rounded to subangular, stained quartz; rare to moderately common dark accessory minerals, rare argillaceous material, rare mudstone fragments; weakly cemented, calcareous and ferruginous.	1,270	1,400
Sandstone: Grayish-orange-pink (10R 8/2) to moderate-orange-pink (10R 7/4); very fine to fine-grained; silty; fair-sorted; composed of rounded to subangular, stained quartz; rare to moderately common dark accessory minerals, rare argillaceous material, rare mudstone fragments; weakly cemented, calcareous.	17	1,417
1T-227		
41-9.70-4.70		
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained, rare medium-grained; fair- to well-sorted; composed of subangular to subrounded, frosted quartz; common accessory minerals; siliceous cement (0-70 feet); weakly cemented, calcareous (70-300 feet); well-cemented, calcareous (300-350 feet); weakly cemented, calcareous (350-750 feet).	750	750
Sandstone: Moderate-orange-pink (5YR 8/4); fine- to medium-grained; well-sorted; composed of subangular to subrounded, frosted and stained quartz; rare black accessory minerals; very weakly cemented, calcareous.	70	820
Sandstone: Moderate-orange-pink (5YR 8/4) to moderate-pink (5R 7/4); very fine and rare fine-grained; well-sorted; composed of subangular to subrounded, frosted quartz; siliceous cement.	30	850
No samples.	1	851
1K-217		
42-4.05-10.60		
QUATERNARY:		
Alluvium:		
Sand: Pale-reddish-brown (10R 5/4); fine-grained.	10	10
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Siltstone: Moderate-reddish-orange (10R 4/6); clay and silt.	80	90
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-reddish-orange (10R 4/6); fine-grained.	130	220
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained.	120	340
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; claystone fragments.	60	400
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained.	830	1,230
UPPER TRIASSIC(?):		
Kayenta Formation:		
Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; tightly cemented.	10	1,240
1K-220		
42-10.05-9.55		
QUATERNARY:		
Windblown sands:		
Sand: Pale-reddish-brown (10R 5/4); very fine to fine-grained; poorly sorted; composed of quartz; calcareous cement.	10	10
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of quartz.	30	40
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of quartz.	140	180
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	40	220
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	140	360
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	200	560
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	150	710
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	185	895
1K-214		
58-9.90-6.70		
QUATERNARY:		
Alluvium:		
Sand: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; poorly sorted.	60	60
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; silty; fair-sorted.	90	150
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; poorly sorted.	10	160
Clayey siltstone: Light-brown (5YR 6/4 to 5YR 5/6).	10	170
Sandy siltstone: Light-brown (5YR 6/4 to 5YR 5/6).	10	180
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; silty; poorly sorted; claystone fragments.	10	190
Sandy siltstone: Light-brown (5YR 6/4 to 5YR 5/6).	10	200
Clayey siltstone: Light-brown (5YR 6/4 to 5YR 5/6).	10	210
Silty claystone: Light-brown (5YR 6/4 to 5YR 5/6).	10	220
Sandy siltstone: Light-brown (5YR 6/4 to 5YR 5/6).	10	230
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; silty; claystone fragments.	20	250
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; claystone fragments.	80	330
Sandstone: Moderate-pink (5R 7/4); very fine grained; silty; poorly sorted.	26	356

1K-222
59-4, 60-5, 10

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4) to grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; well-sorted; composed of rounded to subrounded, clear and frosted quartz; rare feldspar and dark accessory minerals; calcareous cement.	490	490
UPPER TRIASSIC(?):		
Kayenta Formation:		
Silty facies:		
Arenaceous siltstone: Pale-reddish-brown (10R 5/4); fine-grained; silty; composed of rounded to subrounded, clear, stained, and frosted quartz; rare mica and dark accessory minerals; noncalcareous cement.	9	499

1K-224
59-12, 50-3, 20

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals, rare argillaceous material; weakly cemented, calcareous.	360	360
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	100	460
Sandstone: Moderate-reddish-orange (10R 6/6) very fine to fine-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	30	490
UPPER TRIASSIC(?):		
Kayenta Formation:		
Arenaceous siltstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; silty; poorly sorted; composed of rounded to subangular, clear and stained quartz; rare argillaceous material; weakly cemented, calcareous and argillaceous.	10	500
Arenaceous siltstone and mudstone: Pale-reddish-brown (10R 5/4); clay to medium-grained sand; poorly sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare hematite spherules; weakly cemented, calcareous and argillaceous.	6	506

1K-233
60-13, 10-2, 55

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Very pale orange (10YR 8/2); fine- to medium-grained; well-sorted; composed of subrounded to rounded, clear, stained, and frosted quartz; common dark accessory minerals; minor variations of sorting, size, and color at intervals; siliceous cement.	660	660
Sandstone: Very pale orange (10YR 8/2); silt to medium-grained; poorly sorted; composed of subangular to subrounded, frosted quartz; rare dark accessory minerals; calcareous cement.	30	690
Sandstone: Moderate-orange-pink (5YR 8/4); fine- to medium-grained; fair-sorted; composed of subrounded to rounded, stained and frosted quartz; common dark-gray limestone fragments; siliceous and calcareous cement.	70	760
UPPER TRIASSIC(?):		
Kayenta Formation:		
Siltstone: Grayish-orange-pink (5YR 7/2); silt to fine-grained; sandy; poorly sorted; composed of subangular, stained and frosted quartz; rare black accessory minerals; calcareous cement.	110	870
Tongue of Navajo Sandstone in Kayenta Formation:		
Sandstone: Moderate-orange-pink (10R 7/4); medium-grained; well-sorted; composed of subrounded to rounded, frosted and stained quartz; common black accessory minerals; siliceous cement near top; weakly cemented, calcareous, near bottom; lower 30 feet is chiefly fine grained.	120	990
No samples.	6	996

2K-305
25-4, 05-15, 25

QUATERNARY:		
Alluvium:		
Sand: Light-brown (5YR 6/4); very fine to medium-grained; silty; poorly sorted.	2	2
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of calcareous quartz sand.	238	240
Sandstone: Grayish-orange-pink (10R 8/2) to light-gray (N 7); very fine to fine-grained; well-sorted; composed of calcareous quartz sand with limestone fragments.	20	260
Sandy calcareous siltstone: Grayish-orange-pink (10R 8/2) to light-gray (N 7); limestone fragments.	10	270
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; silty; fair-sorted; composed of calcareous quartz sand.	20	290
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of calcareous quartz sand.	20	310
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of calcareous quartz sand.	10	320
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of calcareous quartz sand.	110	430
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of calcareous quartz sand.	270	700
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; silty; well-sorted; composed of calcareous quartz sand.	45	745
UPPER TRIASSIC(?):		
Kayenta Formation:		
Siltstone and mudstone: Pale-reddish-brown (10R 5/4) and grayish-red (10R 4/2); calcareous cement.	5	750
No samples.	54	804

2T-316
26-1, 05-5, 05

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz with silt; weakly cemented, calcareous.	140	140
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz with silt; weakly cemented, calcareous.	60	200
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz with silt; weakly cemented, calcareous.	100	300
UPPER TRIASSIC(?):		
Kayenta Formation:		
Siltstone and mudstone: Moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4); silt and clay; weakly cemented, calcareous.	50	350
Siltstone: Moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4); silt; reddish-brown mudstone fragments.	20	370
Sandstone: Pale-red (10R 6/2); fine-grained; well-sorted; composed of angular to subangular, clear and stained quartz; rare to common siltstone and mudstone fragments; rare mica; firmly cemented, calcareous and ferruginous.	10	380
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; well-sorted; composed of angular to subangular, clear and stained quartz; rare hematite pellets; rare mudstone fragments; weakly cemented, calcareous.	20	400
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; fair-sorted; composed of angular to subangular, clear and stained quartz; rare mica; weakly cemented, calcareous.	100	500
(Arbitrary contact)		
Moenave Formation:		
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; fair-sorted; composed of angular to subangular, clear and stained quartz; rare mica; weakly cemented, calcareous.	150	650
UPPER TRIASSIC:		
Wingate Sandstone:		
Lukachukai Member:		
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; fair-sorted; composed of angular to subangular, clear and stained quartz; weakly cemented, calcareous.	100	750
Arenaceous siltstone: Pale-red (5R 6/2); fine-grained; silty; composed of quartz sand; rare blue-green siltstone; weakly cemented, calcareous.	20	770
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); very fine grained; well-sorted; composed of angular to subangular, clear and stained quartz; weakly cemented, calcareous.	10	780

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
2T-316—Continued		
26-1.05-5.05		
Rock Point Member:		
No samples.	10	790
Sandstone: Pale-red (5R 6/2) to pale-reddish-brown (10R 5/4); very fine to fine-grained; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common siltstone and mudstone fragments; rare dark accessory minerals; firmly cemented, calcareous.	10	800
Siltstone: Grayish-red (10R 4/2); very fine grained; silty; composed of quartz sand; calcareous and ferruginous cement.	10	810
Chinle Formation:		
Siltstone and mudstone: Pale-red (5R 6/2); silt and clay; rare hematite pellets; calcareous and argillaceous cement.	10	820
No samples.	10	830
Siltstone: Pale-reddish-brown (10R 5/4); fine-grained; silty; composed of blue-green quartz; rare mudstone fragments; rare aggregates; calcareous cement.	20	850
No samples.	8	858
2K-301		
40-4.40-14.85		
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; silty; fair-sorted.	90	90
Sandstone: Moderate-pink (5R 7/4); very fine grained; silty; fair-sorted.	50	140
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; silty; fair-sorted.	30	170
Sandstone: Moderate-pink (5R 7/4); very fine grained; silty; fair-sorted.	330	500
2K-302		
40-6.90-1.10		
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; silty; poorly sorted; light-gray limestone fragments.	10	10
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; fair-sorted; calcareous cement.	20	30
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	20	50
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; limestone fragments.	60	110
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; calcareous cement.	250	360
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; calcareous cement.	10	370
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; calcareous cement.	180	550
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; calcareous cement.	5	555
UPPER TRIASSIC(?):		
Kayenta Formation:		
Silty mudstone: Pale-reddish-brown (10R 5/4); fragments of very fine to medium-grained sand; fair-sorted; calcareous cement.	25	580
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium grained; silty; fair-sorted; calcareous cement.	20	600
Sandy mudstone: Pale-reddish-brown (10R 5/4); fragments of claystone.	10	610
Sandy mudstone: Pale-reddish-brown (10R 5/4); fragments of claystone.	10	620
Clayey mudstone: Pale-reddish-brown (10R 5/4); calcareous cement.	30	650
Moenave Formation:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; well-sorted; calcareous cement.	30	680
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; silty; well-sorted; calcareous cement.	20	700
UPPER TRIASSIC:		
Wingate Sandstone:		
Lukachukai Member:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; well-sorted; calcareous cement.	50	750
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; calcareous cement.	20	770
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; well-sorted; calcareous cement.	10	780
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; calcareous cement.	70	850
No samples.	5	855
2T-304		
40-12.25-16.95		
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	300	300
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	20	320
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	90	410
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	10	420
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; calcareous cement.	10	430
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; calcareous cement.	40	470
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; calcareous cement.	40	510
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	20	530
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	10	540
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	20	560
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	10	570
Sandstone: Pale-red (10R 6/2); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	10	580
Sandstone: Grayish-pink (5R 8/2); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	10	590
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	5	595
UPPER TRIASSIC(?):		
Kayenta Formation:		
Silty mudstone: Grayish-red-purple (5RP 4/2); calcareous cement.	5	600
2K-303		
41-8.25-12.05		
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandstone: Grayish-orange (10YR 7/4); medium-grained; well-sorted; composed of quartz sand; calcareous cement.	20	20
Sandstone: Pale-red (10R 6/2); fine-grained; fair-sorted; composed of quartz sand; clay fragments; calcareous cement.	10	30
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); medium-grained; well-sorted; composed of quartz sand; clay fragments and chert granules; calcareous cement.	20	50
Sandy siltstone: Moderate-brown (5YR 4/4 to 5YR 3/4); pebbles of flint and chert; calcareous cement.	30	80
Sandstone: Grayish-orange-pink (5YR 7/2); fine-grained; well-sorted; composed of quartz sand; calcareous cement.	20	100
calcareous cement.	70	360
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; fair-sorted; composed of quartz sand; claystone fragments; calcareous cement.	70	430
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; silty; fair-sorted; composed of quartz sand; claystone fragments; calcareous cement.	40	470
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; fair-sorted; composed of quartz sand; claystone fragments; calcareous cement.	30	500
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; fair-sorted; composed of quartz sand; calcareous cement.	40	540
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; fair-sorted; composed of quartz sand; calcareous cement.	250	790

Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; composed of quartz sand; claystone, chert, and flint granules; calcareous cement.	20	120
Silty claystone: Light-brown (5YR 6/4 to 5YR 5/6); composed of limestone; calcareous cement.	10	130
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); medium-grained; fair-sorted; composed of quartz sand; claystone fragments; calcareous cement.	40	170
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; fair-sorted; composed of quartz sand; claystone fragments; calcareous cement.	120	290
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; silty; fair-sorted; composed of quartz sand;		
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; fair-sorted; composed of quartz sand; calcareous cement.	60	850
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; silty; fair-sorted; composed of quartz sand; calcareous cement.	60	910
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; silty; fair-sorted; composed of quartz sand; calcareous cement.	40	950
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; silty; fair-sorted; composed of quartz sand;. calcareous cement.	160	1,110
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; fair-sorted; composed of quartz sand; calcareous cement.	10	1,120

3K-313
59-7.45-11.50

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; well-sorted; composed of quartz sand; calcareous cement.	10	10
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	10	20
Sandstone: Moderate-reddish-orange (10R 4/6); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	30	50
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	50	100
Sandstone: Moderate-reddish-orange (10R 4/6); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	60	160
Sandstone: Moderate-reddish-orange (10R 4/6); very fine to medium-grained; well-sorted; composed of quartz sand; calcareous cement.	40	200
Sandstone: Moderate-reddish-orange (10R 4/6); very fine to fine-grained; well-sorted; composed of quartz sand; calcareous cement.	40	240
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz sand; calcareous cement.	20	260
UPPER TRIASSIC(?):		
Kayenta Formation:		
Silty facies:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz sand; fragments of grayish-red mudstone.	20	280
Sandy siltstone: Moderate-reddish-orange (10R 4/6); well-sorted; calcareous cement.	20	300
Sandy siltstone: Pale-reddish-brown (10R 5/4); well-sorted; calcareous cement.	20	320
Mudstone: Moderate-reddish-orange (10R 4/6); well-sorted.	10	330
Siltstone: Moderate-reddish-orange (10R 4/6); well-sorted.	60	390
Sandstone: Moderate-reddish-orange (10R 4/6); very fine grained; well-sorted.	10	400
Sandstone: Moderate-reddish-orange (10R 4/6); very fine to fine-grained; well-sorted; calcareous cement.	20	420
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; fragments of fine white quartz sand and pale-reddish-brown (10R 5/4) sand.	10	430
Sandstone: Pale-reddish-brown (10R 5/4); silty to very fine grained; well-sorted; calcareous cement.	20	450
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; well-sorted; fragments of siltstone.	40	490
Sandstone: Pale-reddish-brown (10R 5/4); silty to very fine grained; well-sorted; calcareous cement.	10	500
Sandy siltstone: Pale-reddish-brown (10R 5/4); well-sorted; calcareous cement.	20	520
Sandstone and silty sandstone: Moderate-reddish-brown (10R 5/4); very fine to fine-grained; silty; well-sorted; calcareous cement.	10	530
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; well-sorted; calcareous cement.	30	560
Sandstone: Pale-reddish-brown (10R 5/4); silty to very fine grained; well-sorted; calcareous cement.	60	620
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; well-sorted; calcareous cement.	10	630
Sandstone: Moderate-reddish-orange (10R 4/6); very fine to medium-grained; silty; well-sorted; calcareous cement.	15	645

3K-316
60-1.50-8.75

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; calcareous cement.	30	30
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; well-sorted; calcareous cement.	60	90
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; calcareous cement.	10	100
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; calcareous cement.	30	130
Sandstone: Moderate-orange-pink (10R 7/4); very fine to medium-grained; well-sorted; calcareous cement.	20	150
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; calcareous cement.	30	180
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; calcareous cement.	30	210
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; well-sorted; calcareous cement.	10	220
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; calcareous cement.	50	270
Silty mudstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	10	280
Sandstone: Moderate-reddish-brown (10R 4/6); very fine to medium-grained; silty; fair-sorted; calcareous cement.	30	310
Sandstone: Moderate-reddish-brown (10R 4/6); very fine to medium-grained; silty; fair-sorted; calcareous cement.	30	340
UPPER TRIASSIC(?):		
Kayenta Formation:		
Silty mudstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	50	390
Silty mudstone: Moderate-reddish-orange (10R 6/6); fragments of very fine white sand, calcareous.	10	400
Siltstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	10	410
Siltstone: Moderate-reddish-orange (10R 6/6); fragments of mudstone; calcareous cement.	10	420
Silty mudstone: Pale-reddish-brown (10R 5/4); fragments of claystone.	10	430
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; well-sorted; calcareous cement.	10	440
Sandy siltstone: Pale-reddish-brown (10R 5/4); well-sorted; calcareous cement.	20	460
No samples.	20	480

3K-317
60-9.55-12.45

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; silty; well-sorted; composed of calcareous quartz sand.	50	50
Sandstone: Moderate-reddish-orange (10R 4/6); very fine to fine-grained; well-sorted; composed of calcareous quartz sand.	100	150
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of calcareous quartz sand.	40	190
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; silty; well-sorted; composed of calcareous quartz sand.	50	240
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of calcareous quartz sand.	40	280
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of calcareous sand.	20	300
Sandstone: Grayish-orange-pink (10R 8/2); very fine to medium-grained; well-sorted; composed of calcareous quartz sand.	167	467

3K-312
77-3.15-16.25

UPPER CRETACEOUS:		
Mancos Shale:		
Sandstone: Pale-brown (5YR 5/2); silty to very fine grained; poorly sorted; calcareous cement.	10	10
Sandy siltstone: Yellowish-gray (5Y 8/1); calcareous cement.	10	20

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

3K-312—Continued
77-3.15-16.25

	Thickness (feet)	Depth (feet)
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Coal: Brownish-black (5YR 2/1).	10	30
Sandy siltstone: Light-olive-gray (5Y 6/1); coal fragments; calcareous cement.	10	40
Coal: Dark-gray (N 3); silty; calcareous cement.	10	50
Sandy siltstone: Medium-dark-gray (N 4); calcareous cement.	10	60
UPPER JURASSIC:		
Cow Springs Sandstone:		
Sandstone: Light-olive-gray (5Y 6/1); silty to very fine grained; poorly sorted; calcareous cement.	80	140
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Sandstone: Moderate-brown (5YR 4/4); silty to very fine grained; poorly sorted; limestone fragments; calcareous cement.	10	150
Sandstone: Yellowish-gray (5Y 8/1); silty to very fine grained; fair-sorted; few fragments of gypsum; calcareous cement.	100	250
Sandstone: Yellowish-gray (5Y 8/1); fine-grained; well-sorted; gypsum; calcareous cement.	10	260
Sandstone: Yellowish-gray (5Y 8/1); silty to fine-grained; fair-sorted; calcareous cement.	40	300
Sandy siltstone: Pale-brown (5YR 5/2); calcareous cement.	20	320
Sandstone: Yellowish-gray (5Y 8/1); silty to fine-grained; fair-sorted; calcareous cement.	70	390
Sandstone: Light-olive-gray (5Y 6/1); silty to fine-grained; fair-sorted; calcareous cement.	60	450
Sandstone: Yellowish-gray (5Y 8/1); silty to medium-grained; poorly sorted; calcareous cement.	10	460
Sandstone: Yellowish-gray (5Y 8/1); silty to fine-grained; fair-sorted; calcareous cement.	80	540
Sandstone: Grayish-orange-pink (5YR 7/2); silty to very fine grained; poorly sorted; calcareous cement.	10	550
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Yellowish-gray (5Y 8/1); fine-grained; fair-sorted; calcareous cement.	290	840
Sandstone: Very light gray (N 8); medium-grained; well-sorted.	17	857

3K-318-2
77-13.95-7.40

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sand: Pale-reddish-brown (10R 5/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	10	10
UPPER TRIASSIC(?):		
Kayenta Formation:		
Tongue of Navajo Sandstone in Kayenta Formation:		
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	20
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	100	120
Sandy siltstone: Pale-reddish-brown (10R 5/4); limestone fragments.	10	130
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	140
Sandstone: Grayish-orange (10YR 7/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	20	160
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	30	190
Silty facies:		
Silty mudstone: Pale-red (5R 6/2); limestone fragments.	10	200
Tongue of Navajo Sandstone in Kayenta Formation:		
Sandstone: Grayish-orange (10YR 7/4); very fine to fine-grained; well-sorted; composed of quartz; fragments of siltstone; calcareous cement.	10	210
Sandstone: Grayish-orange (10YR 7/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	220
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	70	290
Silty facies continued:		
Sandy siltstone: Pale-reddish-brown (10R 5/4); calcareous cement.	10	300

3K-323
77-1.65-3.45

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium and windblown sands:		
Sand: Moderate-orange-pink (5YR 8/4); very fine to coarse-grained; fair-sorted; composed of subrounded to angular, clear and frosted quartz; rare carbonaceous material, rare red siltstone pellets, and rare dark accessory minerals; weakly cemented, calcareous.	10	10
Sand: Moderate-orange-pink (5YR 8/4); very fine to very coarse grained; poorly sorted; composed of subrounded to angular, clear and frosted quartz; chert and quartzite gravel; weakly cemented, calcareous.	10	20
Sand: Light-brown (5YR 6/4); very fine to coarse-grained; silty; fair-sorted; composed of subrounded to angular, clear and frosted quartz; weakly cemented, calcareous.	10	30
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	30	60
Sandstone: Grayish-orange-pink (10R 8/2); very fine to medium-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	50	110
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	20	130
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well- to fair-sorted; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	10	140
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; well- to fair-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	50	190
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	40	230
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well- to fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	100	330
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well- to fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	70	400
UPPER TRIASSIC(?):		
Kayenta Formation:		
Siltstone and mudstone: Pale-red (10R 6/2); silt and clay with some very fine grained sand; calcareous and argillaceous cement.	7	407

Rare Metals Corp. 4
77-7.95-5.70

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Windblown sands:		
Sand: Grayish-orange (10YR 7/4); very fine to coarse-grained; poorly sorted; composed of subangular to rounded, frosted and stained quartz; common black accessory minerals; calcareous cement.	20	20
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well- to fair-sorted; composed of frosted quartz; common black accessory minerals; siliceous cement.	190	210
Sandstone: Very pale orange (10YR 8/2) to moderate-orange-pink (5YR 8/4); silt to medium-grained; fair to poorly sorted; composed of subangular to subrounded, frosted and stained quartz; common black accessory minerals; siliceous cement; calcareous cement in lower 10 feet.	485	695
UPPER TRIASSIC(?):		
Kayenta Formation:		
Sandstone: Moderate-orange-pink (5YR 8/4); silt to fine-grained; poorly sorted; composed of subangular to subrounded, frosted quartz; common black accessory minerals; calcareous cement.	20	715
Sandy siltstone: Pale-red (10R 6/2); very fine to medium-grained; silty; poorly sorted; composed of stained quartz; common mica; calcareous cement.	15	730

3K-320
96-10.65-10.95

QUATERNARY:		
Alluvium:		
Sand: Grayish-yellow (5Y 8/4); very fine to medium-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	50	50
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Arenaceous siltstone: Grayish-red (10R 4/2) and bluish-white (5B 9/1); silt to medium-grained sand; composed of rounded to subrounded, stained and clear quartz; rare dark accessory minerals; common argillaceous material; weakly cemented, calcareous.	10	60
Sandstone: Yellowish-gray (5Y 7/2); very fine to medium-grained; fair-sorted; composed of rounded to subrounded, clear and stained quartz; rare dark accessory minerals; common argillaceous material; weakly cemented, calcareous.	70	130
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Light-greenish-gray (5GY 8/1); very fine to medium-grained; well-sorted; composed of rounded to subrounded, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	220	350
Sandstone: White (N 9); very fine to medium-grained; well-sorted; composed of rounded to subrounded, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	140	490
UPPER TRIASSIC(?):		
Kayenta Formation(?):		
Arenaceous siltstone: Reddish-brown (10R 4/4); silt to medium-grained sand; composed of rounded to subrounded, stained quartz; rare mica and dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	10	500
No samples.	2	502

3K-332
96-9.60-4.35

QUATERNARY:		
Windblown sands:		
Sand: Light-brown (5YR 6/4); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, frosted quartz; common dark accessory minerals; calcareous cement.	10	10
UPPER CRETACEOUS:		
Mancos Shale:		
Arenaceous siltstone: Light-olive-gray (5Y 5/2), yellowish-gray (5Y 7/2), and pale-yellowish-brown (10YR 6/2); silt and fine- to coarse-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; common mica; siltstone is bentonitic; calcareous cement.	70	80
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Arenaceous siltstone: Olive-gray (5Y 4/1); same as siltstone from 10 to 80 feet but contains abundant coal fragments and pyrite.	70	150
UPPER JURASSIC:		
Cow Springs Sandstone:		
Sandstone: Pale-yellowish-brown (10YR 6/2) to light-gray (N 7); fine- to medium-grained; silty; poorly sorted; composed of subrounded to subangular, frosted quartz; rare to abundant mica; rare coal and carbonized plant remains; common red and light-green claystone fragments.	150	300
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Sandstone: Yellowish-gray (5Y 7/2); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, frosted quartz; rare green and common amber and dark accessory minerals; rare biotite and pyrite; weakly cemented, calcareous.	40	340
Sandstone: Yellowish-gray (5Y 7/2) to grayish-orange-pink (5YR 7/2); silt to medium-grained, rare coarse-grained; fair to poorly sorted; composed of frosted quartz; common amber accessory minerals; rare mica and pyrite; calcareous cement.	160	500
Arenaceous siltstone: Light-brown (5YR 6/4); silt and fine- to medium-grained sand; poorly sorted; composed of subrounded to subangular quartz; mica accessory mineral; calcareous cement.	30	530
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Pale-orange-brown (10YR 7/2); fine- to medium-grained; well- to fair-sorted; composed of subrounded to subangular, frosted quartz; rare pyrite; rare micaceous white claystone fragments; siliceous and calcareous cement.	250	780
Sandstone: White (N 9); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, frosted quartz; rare stained quartz; rare dark accessory minerals; calcareous cement.	80	860
No samples.	6	866

3K-326
97-12.00-0.50

QUATERNARY:		
Windblown sands:		
Sand: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, stained and frosted quartz; rare dark accessory minerals; rare altered grains of feldspar; calcareous cement.	50	50
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Very pale orange (10R 8/2); very fine to medium-grained; well- to fair-sorted; composed of rounded to subangular, frosted quartz; rare dark accessory minerals; siliceous cement.	30	80
Sandstone: Yellowish-gray (5Y 8/1); medium-grained; well-sorted; composed of rounded to subrounded, frosted quartz; rare dark and amber accessory minerals; siliceous cement.	10	90
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well- to fair-sorted; composed of subrounded to subangular, frosted quartz; rare dark and amber accessory minerals; siliceous cement.	250	340
Silty sandstone: Grayish-orange-pink (10R 8/2); silt to medium-grained; poorly sorted; composed of frosted quartz; some whitish-green spots; calcareous cement.	8	348

3T-314
118-6.70-2.85

QUATERNARY:		
Alluvium and volcanic rocks:		
Sand: Pale-red (10R 6/2); medium to very coarse grained; poorly sorted; fragments of limestone and siltstone.	10	10
Sand: Pale-red (10R 6/2); medium to very coarse grained; poorly sorted; fragments of limestone, siltstone, basaltic lava, and jasper.	24	34
Sand: Light-gray (N 7); medium to very coarse grained; poorly sorted; fragments of limestone, siltstone, basaltic lava, and jasper.	6	40
Sandy siltstone: Light-brownish-gray (5YR 6/1); poorly sorted; composed of quartz; fragments of limestone and basaltic lava; calcareous cement.	20	60
Sandy siltstone: Light-brownish-gray (5YR 6/1); poorly sorted; calcareous cement.	10	70
Sand: Grayish-orange-pink (10R 8/2); fine- to medium-grained; fair-sorted; fragments of basaltic lava; calcareous cement.	10	80
Sand: Moderate-orange-pink (10R 7/4); fine- to medium-grained; poorly sorted; fragments of basaltic lava.	10	90
Sand: Brownish-gray (5YR 4/1); fine- to medium-grained; poorly sorted; fragments of basaltic lava.	10	100
Volcanic ash: Medium-dark-gray (N 4); poorly sorted; fragments of basaltic lava.	20	120
Volcanic ash: Medium-light-gray (N 6); very fine to fine-grained; fair-sorted.	10	130
Volcanic ash: Medium-light-gray (N 6); very fine to medium-grained; fair-sorted.	10	140
Volcanic ash: Medium-light-gray (N 6); very fine to fine-grained; fair-sorted.	10	150
Volcanic ash: Light-brownish-gray (5YR 6/1); very fine to fine-grained; fair-sorted; fragments of basalt.	20	170
Sandy siltstone: Pale-red (10R 6/2); fair-sorted; fragments of basaltic lava.	10	180
Sandy siltstone: Pale-red (10R 6/2); fair-sorted.	10	190
Sand: Grayish-orange-pink (10R 8/2); fine- to coarse-grained; poorly sorted; fragments of volcanic ash.	20	210
Sand: Moderate-reddish-orange (10R 6/6); fine- to coarse-grained; poorly sorted; fragments of limestone and ash.	10	220
Sand: Light-brown (5YR 6/4); fine- to coarse-grained; poorly sorted; fragments of limestone and ash.	10	230
Sand: Light-brown (5YR 6/4); fine- to coarse-grained; poorly sorted; fragments of limestone, ash, and basaltic lava.	10	240
Sand: Grayish-orange-pink (5YR 7/2); fine to very coarse grained; poorly sorted; fragments of ash and basaltic lava; calcareous cement.	10	250
Sand: Grayish-orange-pink (5YR 7/2); very fine to very coarse grained; poorly sorted; composed of quartz; fragments of ash and basaltic lava; calcareous cement.	20	270
No samples.	30	300

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
4K-382		
55-3.40-10.85		
QUATERNARY:		
Alluvium:		
Silty sand: Light-brown (5YR 6/4); very fine to medium-grained; poorly sorted; composed of quartz; calcareous cement.	20	20
Sand: Pale-yellowish-brown (10YR 6/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	30	50
UPPER CRETACEOUS:		
Wepo Formation:		
Sandstone: Pinkish-gray (5YR 8/1); very fine to coarse-grained; silty; poorly sorted; composed of quartz; fragments of coal; calcareous cement.	30	80
Toreva Formation:		
Sandstone: Medium-light-gray (N 6); very fine to very coarse grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	100
Sandy siltstone: Medium-light-gray (N 6); fragments of coal; calcareous cement.	20	120
Sandstone: Medium-gray (N 5); very fine to very coarse grained; silty; poorly sorted; composed of quartz; biotite; calcareous cement.	20	140
Sandstone: Light-olive-gray (5Y 6/1); very fine to medium-grained; silty; poorly sorted; composed of quartz; fragments of biotite and coal; calcareous cement.	10	150
Sandstone: Medium-light-gray (N 6); very fine to coarse-grained; silty; poorly sorted; composed of quartz; biotite; calcareous cement.	20	170
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	190
No samples.	1	191
4K-380		
56-5.40-9.20		
UPPER CRETACEOUS:		
Wepo Formation:		
Silty mudstone: Yellowish-gray (5Y 8/1); calcareous cement.	20	20
Silty mudstone: Yellowish-gray (5Y 8/1); fragments of claystone; calcareous cement.	20	40
Silty mudstone: Yellowish-gray (5Y 8/1); fragments of claystone and limestone; calcareous cement.	20	60
Siltstone and mudstone: Yellowish-gray (5Y 8/1) to medium-gray (N 5); coal; calcareous cement.	20	80
Sandy siltstone: Yellowish-gray (5Y 8/1); fragments of coal.	30	110
Coal: Black (N 1).	20	130
Sandy siltstone: Medium-dark-gray (N 4); coal; water.	10	140
Siltstone: Very light gray (N 8); calcareous cement.	30	170
Siltstone: Very light gray (N 8); fragments of coal; calcareous cement.	10	180
Silty coal: Dark-gray (N 3).	40	220
Siltstone: Medium-light-gray (N 6); sandy; muddy; coal.	50	270
Sandy siltstone: Medium-gray (N 5); abundant coal; calcareous cement.	70	340
Sandstone: Very light gray (N 8); silt to very fine grained; poorly sorted; calcareous cement.	10	350
Siltstone: Medium-gray (N 5); coal; calcareous cement.	50	400
Sandstone: Very light gray (N 8); silt to very fine grained; poorly sorted; calcareous cement.	50	450
Sandy silty mudstone: Medium-light-gray (N 6); coal; calcareous cement.	60	510
Sandstone: Light-gray (N 7); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement; water.	50	560
Sandstone: Medium-light-gray (N 6); very fine grained; silty; poorly sorted; mudstone fragments; calcareous cement.	10	570
Silty mudstone: Medium-light-gray (N 6); calcareous cement.	20	590
Silty mudstone: Medium-light-gray (N 6); calcareous cement.	30	620
Sandy siltstone: Light-gray (N 7); calcareous cement.	30	650
Toreva Formation:		
Sandstone: Light-gray (N 7); very fine to coarse-grained; silty; poorly sorted; composed of quartz; calcareous cement.	30	680
Sandstone: Medium-light-gray (N 6); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	60	740
Sandstone: Medium-light-gray (N 6); very fine to medium-grained; silty; poorly sorted; composed of quartz; coal; calcareous cement; water.	60	800
Silty coal: Medium-dark-gray (N 8).	40	840
Sandy siltstone: Medium-gray (N 5); calcareous cement; water.	20	860
Sandy siltstone: Medium-gray (N 5); coal; calcareous cement.	60	920
Mudstone: Medium-gray (N 5); fragments of claystone; calcareous cement.	10	930
Silty mudstone: Medium-gray (N 5); fragments of coal and claystone; calcareous cement.	20	950
Mission well		
56-7.35-15.15		
QUATERNARY:		
Alluvium:		
Sand: Pale-yellowish-brown (10YR 6/2); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	30	30
UPPER CRETACEOUS:		
Wepo Formation:		
No samples.	60	90
Sandy siltstone: Light-olive-gray (5Y 6/1); calcareous cement.	10	100
Sandstone: Very light gray (N 8); very fine grained; silty; well-sorted; composed of quartz; calcareous cement.	40	140
Sandy siltstone: Light-gray (N 7); calcareous cement.	20	160
Sandstone: Light-gray (N 7); very fine grained; silty; fair-sorted; composed of quartz; calcareous cement.	50	210
Sandy silty mudstone: Medium-dark-gray (N 4); calcareous cement.	10	220
Sandstone: Very light gray (N 8); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	40	260
Silty mudstone: Medium-dark-gray (N 4); calcareous cement.	20	280
Sandy siltstone: Dark-gray (N 3) to light-gray (N 7); calcareous cement.	70	350
4K-388		
72-10.35-5.35		
QUATERNARY:		
Alluvium:		
Sand: Pale-yellowish-brown (10YR 6/2) to moderate-yellowish-brown (10YR 5/4); very fine to medium-grained; silty; fair to poorly sorted; composed of subrounded to angular, clear quartz; rare carbonaceous material; rare mica and siltstone fragments; weakly cemented, calcareous and argillaceous.	110	110
UPPER JURASSIC:		
Morrison Formation:		
Sandstone: Pale-yellowish-brown (10YR 6/2) to light-brown (5YR 6/4); fine- to coarse-grained; poorly sorted; composed of subrounded to angular, clear and frosted quartz; rare dark accessory minerals; rare argillaceous material; rare mudstone and siltstone fragments; weakly cemented, calcareous and argillaceous.	10	120
Sandstone: Pale-yellowish-brown (10YR 6/2); fine- to coarse-grained; silty; poorly sorted; composed of subrounded to angular, clear and frosted quartz; rare to absent limonite accessory mineral; rare mudstone and siltstone fragments; weakly cemented, calcareous and argillaceous.	30	150
Sandstone: Pale-yellowish-brown (10YR 6/2); fine- to coarse-grained; silty; poorly sorted; composed of subrounded to angular, clear and frosted quartz; com-		
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; rare blue-green and reddish-brown mudstone fragments; weakly cemented; calcareous and argillaceous.	10	200
Sandstone: Light-greenish-gray (5GY 8/1); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; rare reddish-brown mudstone fragments; weakly cemented, calcareous.	10	210
Sandstone: Pale-red (10R 6/2) to grayish-red (10R 4/2); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; rare blue-green and reddish-brown mudstone fragments; weakly cemented, calcareous and argillaceous.	10	220
Sandstone: Very light gray (N 8); very fine to fine-grained; silty; fair to poorly sorted; composed of subrounded to subangular, clear quartz; rare mudstone fragments; weakly cemented, siliceous, calcareous, and argillaceous.	70	290
Cow Springs Sandstone:		
Sandstone: Yellowish-gray (5Y 8/1) and light-greenish-gray (5GY 8/1); very fine to fine-grained; silty; fair to poorly sorted; composed of subrounded to sub-		

mon to absent blue-green and grayish-red-purple (5RP 4/2) siltstone and mudstone fragments; weakly cemented, calcareous and argillaceous.	20	170
Sandstone: Grayish-orange-pink (5YR 7/2) to pale-brown (5YR 5/2); very fine to medium-grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; rare mudstone and siltstone fragments; weakly cemented, calcareous and argillaceous.	20	190
angular, clear quartz; rare mudstone fragments; weakly cemented, calcareous and argillaceous.	120	410
Sandstone: Pinkish-gray (5YR 8/1); very fine to medium-grained; silty; fair to poorly sorted; composed of subrounded to angular, clear and frosted quartz; rare dark accessory minerals; rare argillaceous material; rare mudstone pellets; weakly cemented, calcareous and argillaceous.	40	450
No samples.	8	458

4 T-386
72-7.80-1.70

QUATERNARY:		
Alluvium:		
Silty sand: Pale-yellowish-brown (10YR 6/2); very fine to coarse-grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; rare argillaceous material; weakly cemented, calcareous.	10	10
Silty sand: Pale-yellowish-brown (10YR 6/2); very fine to medium-grained; silty; fair-sorted; composed of subrounded to angular, clear quartz; rare argillaceous material; weakly cemented, calcareous.	40	50
Sand: Moderate-yellowish-brown (10YR 5/4); fine- to coarse-grained; poorly sorted; composed of subrounded to angular, clear, frosted, and amber quartz; rare argillaceous material; rare to common mudstone and siltstone fragments; weakly cemented, calcareous.	20	70
Sand: Moderate-yellowish-brown (10YR 5/4); fine- to coarse-grained; poorly sorted; composed of subrounded to angular, clear, frosted, and amber quartz; rare mica accessory mineral; rare argillaceous material; rare to common mudstone and siltstone fragments; seep zone; weakly cemented, calcareous.	20	90
Silt: Pale-yellowish-brown (10YR 6/2); silt and fine-grained quartz; rare gypsum accessory mineral; rare mudstone fragments; weakly cemented, calcareous and argillaceous.	40	130
UPPER CRETACEOUS:		
Mancos Shale:		
Siltstone and mudstone: Medium-light-gray (N 6); silt and clay; rare mica and limonite accessory minerals; weakly cemented, calcareous and argillaceous.	10	140
Siltstone and mudstone: Medium-light-gray (N 6); silt and clay; rare mica, limonite, and gypsum accessory minerals; weakly cemented, calcareous and argillaceous.	10	150
Mudstone: Medium-light-gray (N 6); clay; rare limonite, rare to absent pyrite, and common to absent gypsum accessory minerals; weakly cemented, calcareous and argillaceous.	20	170
Siltstone and mudstone: Medium-light-gray (N 6); silt and clay; weakly cemented, calcareous and argillaceous.	190	360
Siltstone and mudstone: Medium-light-gray (N 6); silt and clay; fine-grained quartz sand; weakly cemented, calcareous and argillaceous.	10	370
Siltstone and mudstone: Medium-light-gray (N 6); silt and clay; weakly cemented, calcareous and argillaceous.	50	420
Siltstone and mudstone: Medium-light-gray (N 6); silt and clay; rare pyrite and gypsum accessory minerals; weakly cemented, calcareous and argillaceous.	40	460
Mudstone and siltstone: Medium-light-gray (N 6); clay and silt; fine-grained quartz; calcareous and argillaceous cement.	20	480
Arenaceous siltstone: Medium-light-gray (N 6); silt and very fine grained quartz; rare coal fragments; weakly cemented, calcareous.	30	510
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Arenaceous siltstone and mudstone: Medium-light-gray (N 6); silt and clay; very fine to fine-grained quartz; rare coal fragments; weakly cemented, calcareous and argillaceous.	10	520
Coal: Black (N 1); some fine- to medium-grained sand, poorly sorted; composed of subrounded to angular, clear quartz; rare pyrite accessory mineral; rare mudstone fragments; quartz grains are weakly cemented, calcareous; water-bearing.	10	530
Sandstone: Very light gray (N 8); fine- to medium-grained; poorly sorted; composed of subrounded to angular, clear quartz; rare mica accessory mineral; rare coal and mudstone fragments; calcareous cement.	40	570
UPPER JURASSIC:		
Morrison Formation:		
Westwater Canyon Member:		
Silty sandstone: Very light gray (N 8) to light-greenish-gray (5GY 8/1); silt to medium-grained sand; fair- to poor-sorted; composed of subrounded to angular, clear quartz; rare mudstone fragments; weakly cemented, calcareous.	90	660
Silty sandstone: Very light gray (N 8) to light-greenish-gray (5GY 8/1); silt to medium-grained sand; fair- to poor-sorted; composed of subrounded to angular, clear quartz; common reddish-brown and blue-green mudstone fragments; weakly cemented, calcareous.	50	710
Sandstone: Very light gray (N 8) to light-greenish-gray (5GY 8/1); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; rare blue-green mudstone fragments; weakly cemented, calcareous.	20	730
Recapture Shale Member:		
Mudstone: Pale-brown (5YR 5/2); silt and clay; common blue-green mudstone fragments; calcareous cement.	20	750
Mudstone: Pale-brown (5YR 5/2); silt and clay; calcareous cement.	10	760
Arenaceous siltstone: Grayish-orange-pink (5YR 7/2); silt and very fine to medium-grained sand; composed of subrounded to subangular, clear quartz; rare reddish-brown and blue-green mudstone(?) fragments; weakly cemented, calcareous.	10	770
Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; poorly sorted; composed of subrounded to angular, clear and stained quartz; common reddish-brown and blue-green mudstone fragments; calcareous cement.	10	780
Arenaceous siltstone: Grayish-orange-pink (5YR 7/2); silt and very fine to medium-grained sand; composed of subrounded to subangular, clear quartz; rare reddish-brown and blue-green mudstone fragments; weakly cemented, calcareous.	10	790
Cow Springs Sandstone:		
Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; silty; fair to poorly sorted; composed of subrounded to angular, clear quartz; rare mica accessory mineral; common reddish-brown mudstone fragments; weakly cemented, calcareous.	20	810
Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; fair to poorly sorted; composed of subrounded to angular, clear quartz; rare pyrite and mica accessory minerals; common reddish-brown and rare blue-green mudstone fragments; weakly cemented, calcareous.	20	830
Sandstone: Grayish-orange-pink (5YR 7/2); fine-grained; fair to poorly sorted; composed of subrounded to angular, clear quartz; rare pyrite and mica accessory minerals; rare mudstone fragments; weakly cemented, calcareous.	40	870
No samples.	20	890
Sandstone: Yellowish-gray (5Y 7/2); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; common reddish-brown and blue-green mudstone fragments; weakly cemented, calcareous.	10	900
No samples.	2	902

4K-379
73-3.70-6.25

QUATERNARY:		
Alluvium:		
Sand: Moderate-yellowish-brown (10YR 5/4); fine- to medium-grained; fair-sorted.	20	20
Sand: Moderate-yellowish-brown (10YR 5/4); very fine to medium-grained; fair-sorted.	10	30
Sand: Moderate-yellowish-brown (10YR 5/4); very fine to medium-grained; fair-sorted; composed of quartz; basalt fragments; calcareous cement.	10	40
Sand: Moderate-yellowish-brown (10YR 5/4); very fine to very coarse grained; poorly sorted; composed of quartz; basalt fragments; calcareous cement.	50	90
UPPER CRETACEOUS:		
Mancos Shale:		
Sandy mudstone: Yellowish-gray (5Y 7/2); limonite fragments.	20	110
Sandy mudstone: Yellowish-gray (5Y 7/2); quartz and limonite fragments; calcareous cement.	10	120
Sandy mudstone: Medium-gray (N 5); limonite accessory mineral; calcareous cement.	20	140
Sandy mudstone: Medium-gray (N 5); limonite and gypsum accessory minerals; calcareous cement.	20	160
Mudstone: Greenish-gray (5GY 6/1); pyrite, gypsum, limonite, and quartz fragments; calcareous cement.	30	190
Silty mudstone: Light-olive-gray (5Y 6/1); limonite accessory mineral; calcareous cement.	20	210
Silty sandy mudstone: Light-olive-gray (5Y 6/1); calcareous cement.	10	220
Sandy siltstone: Light-olive-gray (5Y 6/1); gypsum accessory mineral; calcareous cement.	10	230
Sandy siltstone: Light-olive-gray (5Y 6/1); calcareous cement.	10	240
Sandy siltstone: Light-olive-gray (5Y 6/1); pyrite accessory mineral; calcareous cement.	10	250

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

4K-379—Continued
73-3.70-6.25

	Thickness (feet)	Depth (feet)
Silty mudstone: Dark-gray (N 3).	10	260
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; fair-sorted; pyrite accessory mineral; calcareous cement.	10	270
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; fair-sorted; pyrite and gypsum accessory minerals; calcareous cement.	30	300
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone: Light-gray (N 7); very fine to coarse-grained; silty; poorly sorted; calcareous cement.	10	310
Sandstone: Light-olive-gray (5Y 6/1); very fine to coarse-grained; silty; poorly sorted; calcareous cement.	10	320
Sandstone: Light-olive-gray (5Y 6/1); very fine to coarse-grained; silty; fair-sorted; gypsum accessory mineral; light-brownish-gray (5YR 6/1) silty sandstone; calcareous cement.	10	330
Silty sandstone and mudstone: Sandstone, light-olive-gray (5Y 6/1), very fine to medium-grained, silty; gypsum accessory mineral; medium-gray (N 5) mudstone; calcareous cement.	20	350
Sandstone: Very light gray (N 8); very fine to medium-grained; silty; fair-sorted; gypsum accessory mineral; medium-gray (N 5) mudstone fragments.	40	390
UPPER JURASSIC:		
Morrison Formation:		
Westwater Canyon Member:		
Silty mudstone: Pale-brown (5YR 4/2); gypsum accessory mineral; claystone fragments; calcareous cement.	40	430
Sandstone: Very light gray (N 8); very fine to fine-grained; well-sorted.	40	470
Silty mudstone: Pale-brown (5YR 4/2); gypsum accessory mineral; claystone fragments; calcareous cement.	50	520
Cow Springs Sandstone:		
Sandstone: Very light gray (N 8); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	30	550
Sandstone: Very light gray (N 8); very fine to fine-grained; composed of quartz; claystone fragments; calcareous cement.	100	650

4K-381
73-6.35-3.25

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Silt: Pale-yellowish-brown (10YR 6/2); calcareous cement.	40	40
Sandy silt: Pale-yellowish-brown (10YR 6/2); coal fragments; calcareous cement.	20	60
Sand: Pale-yellowish-brown (10YR 6/2); very fine to very coarse grained; silty; composed of quartz; fragments of chert and claystone; calcareous cement.	10	70
Sandy silt: Pale-yellowish-brown (10YR 6/2); fragments of chert and claystone; calcareous cement.	20	90
UPPER CRETACEOUS:		
Mancos Shale:		
Silty mudstone: Medium-gray (N 5); claystone fragments; calcareous cement.	110	200
Mudstone and claystone: Medium-dark-gray (N 4); calcareous cement.	70	270
Mudstone and claystone: Medium-gray (N 5); silty; calcareous cement.	20	290
Silty mudstone: Medium-dark-gray (N 4); claystone; calcareous cement.	20	310
Silty mudstone: Medium-gray (N 5); claystone; calcareous cement.	230	540
Silty mudstone: Dark-gray (N 3); claystone; calcareous cement.	60	600
Sandy siltstone and mudstone: Dark-gray (N 3); pyrite; calcareous cement.	30	630
Sandstone: Very light gray (N 8); very fine to coarse-grained; silty; poorly sorted; fragments of silty mudstone.	60	690
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone: Very light gray (N 8); very fine to fine-grained; silty; poorly sorted.	40	730
Sandstone: Very light gray (N 8); very fine to coarse-grained; poorly sorted; fragments of claystone.	10	740
Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; well-sorted.	20	760
Sandy siltstone: Light-brownish-gray (5YR 6/1); biotite flakes; calcareous cement.	3	763

4T-385
73-11.00-15.90

	Thickness (feet)	Depth (feet)
UPPER CRETACEOUS:		
Wepo Formation:		
Silty sandstone: Yellowish-gray (5Y 7/2); silt to coarse-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; rare to absent siltstone fragments; weakly cemented, calcareous.	30	30
Siltstone: Light-olive-gray (5Y 6/1); silt and very fine to coarse-grained quartz; common coal and argillaceous material; weakly cemented, calcareous and argillaceous.	10	40
Silty sandstone: Yellowish-gray (5Y 7/2); silt to fine-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; common mica accessory mineral; rare carbonaceous material and siltstone fragments; weakly cemented, calcareous.	10	50
No samples.	10	60
Silty sandstone: Grayish-orange-pink (5YR 7/2); silt to fine-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; common mica accessory mineral; rare carbonaceous material and siltstone fragments; weakly cemented, calcareous.	30	90
Toreva Formation:		
Silty sandstone: Grayish-orange-pink (5YR 7/2); silt to very coarse grained sand; poorly sorted; composed of subrounded to angular, clear quartz; common mica accessory mineral; rare carbonaceous material and siltstone fragments; weakly cemented, calcareous.	50	140
No samples.	10	150
Arenaceous siltstone: Light-olive-gray (5Y 6/1); silt and very fine to very coarse grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare to absent mica accessory mineral; abundant carbonaceous material; argillaceous cement.	30	180
No samples.	20	200
Arenaceous siltstone: Light-gray (N 7); silt and very fine to very coarse grained sand; poorly sorted; composed of quartz; rare mica accessory mineral; common carbonaceous material; argillaceous cement.	10	210
Silty sandstone: Light-gray (N 7); silt to medium-grained sand; poorly sorted; composed of subangular to angular, clear quartz; common mica accessory mineral; rare to absent carbonaceous material and siltstone and mudstone pellets; weakly cemented, calcareous.	50	260
Arenaceous siltstone: Medium-gray (N 5); silt and fine- to coarse-grained quartz; poorly sorted; abundant coal; weakly cemented, calcareous and argillaceous.	10	270
No samples.	10	280
Silty sandstone: Light-gray (N 7); silt to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; common mica accessory mineral; common carbonaceous material; weakly cemented, calcareous and argillaceous.	20	300
Siltstone: Light-gray (N 7); silt; common carbonaceous material; rare mudstone fragments; weakly cemented, calcareous.	10	310
No samples.	10	320
Siltstone: Light-gray (N 7); silt and very fine grained quartz; rare mica accessory mineral; common mudstone fragments; weakly cemented, calcareous and argillaceous.	10	330
Silty sandstone: Light-gray (N 7); very fine to fine-grained; poorly sorted; composed of subrounded to subangular, clear quartz; common mica accessory mineral; rare to absent carbonaceous material; rare mudstone fragments; weakly cemented, calcareous.	100	430
Mancos Shale:		
No samples.	20	450
Siltstone and mudstone: Medium-light-gray (N 6); silt and clay; firmly cemented, calcareous and argillaceous.	350	800
Siltstone: Medium-light-gray (N 6); silt and very fine grained quartz; rare mudstone fragments; calcareous cement.	130	930
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone: Light-gray (N 7); fine- to medium-grained; well-sorted; composed of subangular to angular, clear quartz; rare to common pyrite and rare mica accessory minerals; rare to common calcite crystals; common siltstone and mudstone fragments; calcareous cement.	20	950
Siltstone and mudstone: Medium-gray (N 5); silt, clay, and very fine to fine-grained quartz; rare to absent pyrite accessory mineral; rare to absent carbonaceous material; calcareous cement.	20	970
Silty sandstone: Light-gray (N 7); silt to medium-grained sand; fair-sorted; composed of subangular to angular, clear quartz; rare to absent pyrite accessory mineral; rare carbonaceous material and siltstone and mudstone fragments; calcareous cement.	30	1,000
No samples.	17	1,017

Pinon 3
73-12.45-10.05

UPPER CRETACEOUS:		
Wepo Formation:		
Sandstone: Yellowish-gray (5Y 8/1); very fine grained; silty; well-sorted.	50	50
Silty claystone: Light-olive-gray (5Y 6/1).	20	70
Toreva Formation:		
Sandstone: Light-olive-gray (5Y 6/1); very fine grained; silty; fair-sorted.	60	130
Clayey siltstone: Light-olive-gray (5Y 6/1).	30	160
Clayey siltstone: Light-olive-gray (5Y 6/1); carbonaceous material.	10	170
Sandstone: Light-olive-gray (5Y 6/1); fine-grained; poorly sorted; siltstone.	50	220
Sandstone: Light-gray (N 7); fine-grained; carbonaceous material.	50	270
Sandstone: Light-olive-gray (5Y 6/1); very coarse grained; poorly sorted; carbonaceous material.	20	290
Silty claystone: Olive-gray (5Y 4/1); carbonaceous material.	140	430
Mancos Shale:		
Claystone: Medium-gray (N 5).	190	620
Silty claystone: Medium-gray (N 5).	60	680
Claystone: Medium-gray (N 5).	220	900
Clayey siltstone: Medium-light-gray (N 6).	10	910
Silty claystone: Medium-gray (N 5).	30	940
Sandy claystone: Medium-gray (N 5).	30	970
Silty claystone: Olive-gray (5Y 4/1).	30	1,000

Pinon 4
73-12.45-10.15

UPPER CRETACEOUS:		
Wepo Formation:		
Sandstone: Grayish-orange (10YR 7/4); very fine to medium-grained; silty; fair-sorted; fragments of basaltic(?) lava.	10	10
Sandstone: Grayish-orange (10YR 7/4); very fine to medium-grained; silty; fair-sorted; fragments of mudstone and basaltic(?) lava; calcareous cement.	30	40
Sandstone: Yellowish-gray (5Y 7/2); very fine to medium-grained; silty; fair-sorted; fragments of mudstone and basaltic(?) lava; calcareous cement.	30	70
Toreva Formation:		
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; fair-sorted.	10	80
Sandstone: Light-gray (N 7); very fine to coarse-grained; silty; fair-sorted; composed of quartz; mica accessory mineral.	30	110
Sandstone: Light-gray (N 7); very fine to very coarse grained; silty; poorly sorted; composed of quartz; mica accessory mineral.	10	120
Sandstone: Light-gray (N 7); very fine to very coarse grained; silty; poorly sorted; fragments of coal.	40	160
Sandstone: Light-gray (N 7); very fine to coarse-grained; silty; poorly sorted.	10	170
Sandstone: Light-gray (N 7); very fine to very coarse grained; silty; poorly sorted; fragments of dark-gray (N 3) mudstone.	30	200
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; fair-sorted; fragments of dark-gray (N 3) mudstone.	20	220
No samples.	110	330

4K-383
75-10.10-10.10

UPPER CRETACEOUS:		
Wepo Formation:		
Silty sandstone: Pale-grayish-orange (10YR 8/4); silt to medium-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare to absent gypsum accessory mineral; weakly cemented, calcareous.	20	20
Silty sandstone: Yellowish-gray (5Y 7/2); silt to medium-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare carbonaceous material and mudstone pellets; weakly cemented, calcareous.	10	30
Siltstone: Yellowish-gray (5Y 7/2) and olive-gray (5Y 3/2); silt and fine- to medium-grained sand; composed of quartz; rare carbonaceous and argillaceous material; weakly cemented, argillaceous.	20	50
Siltstone: Light-olive-gray (5Y 6/1); silt and very fine to fine-grained sand; composed of quartz; rare argillaceous material and coal fragments; weakly cemented, argillaceous.	10	60
Silty sandstone: Yellowish-gray (5Y 8/1); silt to medium-grained sand; poorly sorted; composed of subangular, clear quartz; rare carbonaceous material and mudstone fragments; weakly cemented, calcareous and argillaceous.	40	100
Siltstone and mudstone: Medium-light-gray (N 6); silt, clay, and rare fine- to medium-grained quartz; weakly cemented, calcareous and argillaceous.	10	110
Silty sandstone: Very light gray (N 8); silt to fine-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; rare mica accessory mineral; rare carbonaceous material; weakly cemented, argillaceous.	20	130
Siltstone: Very light gray (N 8); silt; rare to absent mudstone pellets; weakly cemented, argillaceous.	30	160
Toreva Formation:		
Silty sandstone: Very light gray (N 8); silt to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare to absent mudstone pellets; argillaceous and siliceous cement.	50	210
Silty sandstone: Very light gray (N 8); silt to medium-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; rare carbonaceous material and mudstone pellets; argillaceous and siliceous cement.	40	250
Silty sandstone: Very light gray (N 8); silt to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; rare carbonaceous material and mudstone pellets; argillaceous and siliceous cement.	80	330
Silty sandstone: Very light gray (N 8); silt to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; rare carbonaceous material; common mudstone fragments; argillaceous and siliceous cement.	20	350
Arenaceous siltstone and mudstone: Light-gray (N 7); clay to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare carbonaceous material; argillaceous cement.	10	360
Sandstone: Light-gray (N 7); very fine to coarse-grained; silty; poorly sorted; composed of subangular to angular, clear quartz; rare mudstone pellets; weakly cemented, siliceous.	10	370
Arenaceous siltstone and mudstone: Light-gray (N 7); clay to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare carbonaceous material; argillaceous, siliceous, and calcareous cement.	10	380
Silty sandstone: Light-gray (N 7); silt to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; common to rare mica accessory mineral; common mudstone pellets; firmly cemented, siliceous.	50	430
Siltstone and mudstone: Light-gray (N 7) to medium-light-gray (N 6); silt, clay, and rare fine- to medium-grained quartz; rare carbonaceous material; weakly cemented, calcareous, argillaceous, and siliceous.	20	450
Silty sandstone: Light-gray (N 7); silt to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare carbonaceous material, mudstone pellets, and coal; weakly cemented, calcareous, argillaceous, and siliceous.	30	480
Carbonaceous mudstone: Light-gray (N 7) to medium-dark-gray (N 4); carbonaceous material and clay; coal and silt; weakly cemented, calcareous.	20	500
Siltstone: Light-gray (N 7); silt and rare very fine-grained quartz; rare to absent mudstone pellets and coal; weakly cemented, calcareous and argillaceous.	30	530
No samples.	10	540

4K-384
75-5.80-5.60

UPPER CRETACEOUS:		
Wepo Formation:		
Arenaceous siltstone: Yellowish-gray (5Y 8/1); silt to fine-grained sand; composed of subangular, clear and stained quartz; rare carbonaceous and argillaceous material; weakly cemented, calcareous and argillaceous.	20	20
Arenaceous siltstone: Yellowish-gray (5Y 8/1); silt to fine-grained sand; composed of subangular, clear and stained quartz; rare carbonaceous material; fragments of light-gray (N 7) mudstone; firmly cemented quartz aggregates; weakly cemented, calcareous and argillaceous.	10	30
Arenaceous siltstone: Yellowish-gray (5Y 7/2); silt to fine-grained sand; common carbonaceous material; weakly cemented, calcareous and argillaceous.	40	70
Siltstone: Yellowish-gray (5Y 7/2) and light-gray (N 7); silt and very fine to fine-grained sand; rare to common carbonaceous material; calcareous and argillaceous cement.	70	140
Silty sandstone: Very light gray (N 8); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; common siltstone fragments; weakly cemented, calcareous.	40	180
Siltstone and mudstone: Light-gray (N 7); silt, clay, and rare very fine to fine-grained quartz; rare to common carbonaceous material; weakly cemented, calcareous and argillaceous.	50	230
Toreva Formation:		
Sandstone: Very light gray (N 8); fine- to coarse-grained; fair-sorted; composed of subangular to angular, clear and frosted quartz; common mica		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

4K-384—Continued
75-5.80-5.60

	Thickness (feet)	Depth (feet)
accessory mineral; rare carbonaceous material; rare mudstone fragments and pellets; siliceous cement.	80	310
Sandstone: Very light gray (N 8); very fine to very coarse grained; silty; poorly sorted; composed of subangular to angular, clear and frosted quartz; rare to common mica and rare to absent pyrite accessory minerals; rare carbonaceous material; rare to common mudstone fragments; siliceous cement.	110	420
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; fair-sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; common mudstone fragments; siliceous cement.	40	460
Sandstone: Medium-gray (N 5); very fine to medium-grained; silty; poorly sorted; composed of subangular to angular, clear quartz; rare to absent pyrite accessory mineral; common to abundant carbonaceous material; abundant mudstone fragments; weakly cemented, calcareous.	40	500
Sandstone: Light-gray (N 7); very fine grained; silty; rare mica accessory mineral; rare carbonaceous material; rare to common mudstone fragments; weakly cemented, calcareous and argillaceous.	10	510
No samples.	5	515

4T-378
75-5.30-12.90

	Thickness (feet)	Depth (feet)
UPPER CRETACEOUS:		
Toreva Formation:		
Sandstone: Moderate-yellowish-brown (10YR 5/4); very fine grained; silty; poorly sorted.	30	30
Silty claystone: Light-olive-gray (5Y 6/1); carbonaceous seams.	10	40
Sandstone: Yellowish-gray (5Y 8/1); fine-grained; poorly sorted; fragments of coal.	10	50
Sandy siltstone: Light-olive-gray (5Y 6/1).	30	80
Sandstone: Medium-light-gray (N 6); fine-grained; poorly sorted; fragments of coal.	20	100
Sandy siltstone: Medium-light-gray (N 6).	10	110
Silty claystone: Medium-light-gray (N 6).	30	140
Sandstone: Medium-light-gray (N 6); fine-grained; poorly sorted; siltstone.	20	160
Mancos Shale:		
Silty mudstone: Medium-gray (N 5); calcareous cement.	20	180
Sandy silty mudstone: Medium-gray (N 5); fragments of limestone.	10	190
Silty mudstone: Medium-gray (N 5); calcareous cement.	20	210
Sandy silty mudstone: Medium-gray (N 5); calcareous cement.	10	220
Silty mudstone: Medium-gray (N 5); calcareous cement.	20	240
Silty mudstone: Medium-gray (N 5); fragments of claystone.	20	260
Silty mudstone: Medium-light-gray (N 6); fragments of claystone; calcareous cement.	10	270
Silty mudstone: Medium-light-gray (N 6); calcareous cement.	10	280
No samples.	4	284

5T-308
130-13.35-16.15

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sand: Grayish-orange-pink (5YR 7/2); medium to very coarse grained; fair-sorted; composed of quartz; fragments of basalt; calcareous cement.	20	20
Sand: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; fair-sorted; composed of quartz; fragments of basalt; calcareous cement.	20	40
Sand: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; composed of quartz; pyrite and mica accessory minerals; calcareous cement.	20	60
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member:		
Sandstone: Light-olive-gray (5Y 6/1); very fine to very coarse grained; silty; poorly sorted; composed of quartz; fragments of limestone; calcareous cement.	30	90
Sandstone: Light-gray (N 7); very fine to coarse-grained; poorly sorted; composed of quartz; fragments of claystone; calcareous cement.	40	130
Sandstone: Light-gray (N 7) to medium-gray (N 5); very fine to medium-grained; composed of quartz; fragments of claystone; calcareous cement.	60	190
Sandy silty mudstone: Grayish-red (5R 4/2).	10	200
Sandstone: Light-gray (N 7) to grayish-red (5R 4/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; fragments of mudstone; calcareous cement.	40	240
Sandstone: Light-brownish-gray (5YR 6/1) to medium-dark-gray (N 4); very fine to medium-grained; silty; poorly sorted; composed of quartz; fragments of mudstone; calcareous cement.	80	320
Silty sandy mudstone: Medium-gray (N 5) to light-brownish-gray (5YR 6/1); calcareous cement.	40	360
Siltstone and mudstone: Grayish-red (5R 4/2) to medium-gray (N 5); calcareous cement.	130	490
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Sandstone: Pale-brown (5YR 5/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; fragments of siltstone; calcareous cement.	40	530
Sandy siltstone: Pale-brown (5YR 5/2); fragments of mudstone.	40	570
Sandy siltstone: Pale-reddish-brown (10R 5/4) to dark-gray (N 3); fragments of gypsum and mudstone.	160	730
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; well-sorted; fragments of siltstone, mudstone, and claystone.	60	790
PERMIAN:		
Kaibab Limestone:		
Silty mudstone: Pale-red (5R 6/2); fragments of limestone.	10	800
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	10	810
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	830
Coconino Sandstone:		
Sandstone: Grayish-orange-pink (10R 8/2); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	70	900
No samples.	5	905

5K-309
132-3.70-16.80

	Thickness (feet)	Depth (feet)
PERMIAN:		
Kaibab Limestone:		
Sandstone: White (N 9); very fine grained; silty; poorly sorted; calcareous cement.	160	160
Coconino Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	160	320
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	312	632

5K-318
132-7.85-8.65

	Thickness (feet)	Depth (feet)
PERMIAN:		
Kaibab Limestone:		
Silty limestone: Very pale orange (10YR 8/2); very fine to fine-grained sand.	120	120
Coconino Sandstone:		
Sandy siltstone: Moderate-orange-pink (5YR 8/4); silt to medium-grained sand; composed of subrounded to subangular, frosted quartz; calcareous cement.	50	170
Silty sandstone: Very pale orange (10YR 8/2); silt to medium-grained sand; fair to poorly sorted from 170 to 300 feet; fair- to well-sorted from 300 to 420 feet; composed of subrounded to subangular, frosted quartz; grains have crystal faces; rare iron oxide stain; weakly cemented, calcareous and siliceous.	252	422

EPNG-L-1
132-5.30-13.40

	Thickness (feet)	Depth (feet)
PERMIAN:		
Kaibab Limestone:		
Sandstone: Very pale orange (10YR 8/2); very fine grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	20
Sandstone: Grayish-yellow (5Y 8/4); very fine grained; silty; poorly sorted; composed of quartz; calcareous cement.	100	120
calcareous cement.	50	290
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	50	340
Sandstone: White (N 9); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	350
Sandstone: Very pale orange (10YR 8/2); very fine to		

Coconino Sandstone:		
Sandstone: Grayish-yellow (5Y 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	30	150
Sandstone: Very pale orange (10YR 8/2); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	70	220
Sandstone: Grayish-yellow (5Y 8/4); very fine to medium-grained; silty; well-sorted; composed of quartz; calcareous cement.	20	240
Sandstone: Very pale orange (10YR 8/2); fine- to medium-grained; well-sorted; composed of quartz; fine-grained; well-sorted; composed of quartz; calcareous cement.	20	370
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	390
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	270	660
Sandstone: Pale-yellowish-orange (10YR 8/6); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	670
No samples.	17	687

5K-313
144-5, 70-1, 25

QUATERNARY:		
Alluvium: Undescribed.	45	45
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Siltstone: Moderate-reddish-orange (10R 6/6); composed of silt; rare mica and dark accessory minerals; weakly cemented, calcareous.	195	240
Siltstone: Pale-reddish-brown (10R 5/4); composed of silt; rare mica and dark accessory minerals; weakly cemented, calcareous.	60	300
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	10	310
PERMIAN:		
Kaibab Limestone:		
Silty sandstone: Grayish-orange (10YR 7/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	20	330
Silty sandstone: Pale-yellowish-orange (10YR 8/6); silt to medium-grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; firmly cemented, calcareous.	50	380
Coconino Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; fair-sorted; composed of well-rounded to subrounded, clear, amber, and frosted quartz; rare dark accessory minerals; weakly to firmly cemented, calcareous and ferruginous.	160	540

6K-320
93-11, 80-9, 35

UPPER CRETACEOUS:		
Wepo Formation:		
Siltstone: Grayish-yellow (5Y 8/4) to yellowish-gray (5Y 7/2); silt; weakly cemented, calcareous.	10	10
Siltstone: Grayish-yellow (5Y 8/4) to yellowish-gray (5Y 7/2); silt and fine-grained quartz sand; weakly cemented, calcareous.	10	20
Siltstone: Pale-yellowish-brown (10YR 6/2); silt; rare coal and mudstone pellets; weakly cemented, argillaceous.	10	30
Arenaceous siltstone: Very pale orange (10YR 8/2); silt and very fine to coarse-grained sand composed of subrounded to angular, clear quartz; rare coal; weakly cemented, argillaceous.	10	40
Toreva Formation:		
Silty sandstone: Yellowish-gray (5Y 7/2); silt to coarse-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; rare coal; weakly cemented, argillaceous.	20	60
Siltstone: Pale-yellowish-brown (10YR 6/2); silt and fine- to coarse-grained quartz sand; rare coal and mudstone pellets; weakly cemented, calcareous.	10	70
Siltstone: Yellowish-gray (5Y 8/1); silt and fine- to coarse-grained quartz sand; rare coal and mudstone pellets; weakly cemented, argillaceous.	40	110
Silty sandstone: Yellowish-gray (5Y 8/1); silt to fine-grained sand; poorly sorted; composed of subangular to angular, clear and stained quartz; rare mica accessory mineral; rare coal and mudstone pellets; weakly cemented, argillaceous.	10	120
Silty sandstone: Yellowish-gray (5Y 8/1); silt to coarse-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; rare coal and carbonaceous material; weakly cemented, argillaceous.	30	150
Siltstone: Yellowish-gray (5Y 8/1); silt and rare coarse-grained quartz sand; rare coal and mudstone pellets; weakly cemented, calcareous.	40	190
Siltstone and mudstone: Medium-light-gray (N 6); silt and clay; common micaceous mudstone fragments; weakly cemented, argillaceous.	10	200
Siltstone and mudstone: Medium-dark-gray (N 4); silt, clay, and fine- to medium-grained quartz sand; common micaceous mudstone fragments; weakly cemented, argillaceous.	10	210
Sandstone: Medium-gray (N 5); fine- to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; rare coal; weakly cemented, calcareous.	10	220
Siltstone: Light-gray (N 7); silt and fine-grained quartz sand; rare mica accessory mineral; rare carbonaceous material and coal; weakly cemented, calcareous and argillaceous.	30	250
Silty sandstone: Light-gray (N 7); silt to medium-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare coal and micaceous mudstone fragments; rare mica flakes (muscovite); weakly cemented, calcareous.	10	260
Siltstone and mudstone: Medium-gray (N 5); silt, clay, and fine- to medium-grained quartz sand; rare coal; weakly cemented, calcareous and argillaceous.	10	270
Silty sandstone: Light-gray (N 7); silt and fine-grained sand; fair-sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; rare coal and mudstone pellets; weakly cemented, calcareous and argillaceous.	20	290
Siltstone and mudstone: Medium-gray (N 5); silt, clay, and fine- to medium-grained quartz sand; rare coal; weakly cemented, calcareous and argillaceous.	10	300
Silty sandstone: Light-gray (N 7); silt to fine-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; rare mica accessory mineral; rare mudstone fragments and carbonaceous material; weakly cemented, calcareous and argillaceous.	50	350
Mancos Shale:		
Siltstone and mudstone: Light-gray (N 7); silt and clay; rare to absent quartz grains; rare to absent carbonaceous material; weakly cemented, calcareous and argillaceous.	110	460
Siltstone and mudstone: Medium-gray (N 5); silt and clay; rare quartz grains; weakly cemented, calcareous and argillaceous.	30	490
No samples.	10	500
Arenaceous silty mudstone: Medium-dark-gray (N 4); clay to fine-grained sand composed of angular, clear quartz; poorly sorted; rare pyrite accessory mineral; common to rare coal; rare claystone fragments; calcareous cement.	60	560
Arenaceous silty mudstone: Medium-dark-gray (N 4); clay, silt, and fine to very coarse grained sand composed of angular clear quartz; poorly sorted; rare pyrite and mica accessory minerals; rare coal and claystone fragments; weakly cemented, calcareous.	180	740
Silty sandstone: Medium-gray (N 5); clay to coarse-grained sand; composed of quartz; weakly cemented, calcareous.	10	750
Arenaceous silty mudstone: Medium-dark-gray (N 4); clay, silt, and fine to very coarse grained sand composed of angular clear quartz; poorly sorted; rare pyrite and mica and rare to absent calcite accessory minerals; rare coal; weakly cemented, calcareous.	160	910
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone: Very light gray (N 8) and medium-dark-gray (N 4); fine- to medium-grained; fair-sorted; composed of subrounded to angular, clear quartz; rare pyrite, mica, and calcite accessory minerals; abundant mudstone fragments; calcareous cement.	20	930
Siltstone and mudstone: Medium-gray (N 5); clay, silt, and coarse to very coarse grained quartz sand; rare pyrite and calcite accessory minerals; carbonaceous material; calcareous cement.	40	970
Sandstone: Very light gray (N 8); fine- to medium-grained; fair- to well-sorted; composed of subrounded, clear quartz; rare pyrite accessory mineral; rare coal; weakly cemented, calcareous.	30	1,000
UPPER JURASSIC:		
Cow Springs Sandstone:		
Silty sandstone: Very light gray (N 8); silt and fine- to medium-grained sand; fair to poorly sorted; composed of subrounded, clear quartz; rare to absent pyrite accessory mineral; weakly cemented, calcareous.	20	1,020
Silty sandstone: Very light gray (N 8); silt to fine-grained sand; fair to poorly sorted; composed of subrounded, clear quartz; weakly cemented, calcareous.	10	1,030
No samples.	2	1,032

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
6K-306		
94-4.65-13.75		
QUATERNARY:		
Alluvium:		
Sand: Moderate-yellowish-brown (10YR 5/4); fine to very coarse grained; poorly sorted; composed of quartz; basalt and limestone fragments; calcareous cement.	40	40
UPPER CRETACEOUS:		
Mancos Shale:		
Sandstone: Yellowish-gray (5Y 7/2); very fine to medium-grained; silty; fair-sorted; limestone fragments; calcareous cement.	20	60
Sandstone: Medium-light-gray (N 6); very fine to medium-grained; silty; fair-sorted; abundant coal fragments; calcareous cement.	20	80
Silty mudstone: Medium-light-gray (N 6); poorly sorted; coal fragments and sand grains; calcareous cement.	20	100
Silty mudstone: Medium-gray (N 5); poorly sorted; coal fragments and sand grains; calcareous cement.	20	120
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone: Medium-light-gray (N 6); very fine grained; silty; fair-sorted; coal fragments; calcareous cement.	20	140
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; silty; fair-sorted; gypsum accessory mineral; calcareous cement.	10	150
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; silty; well-sorted; coal fragments; calcareous cement.	10	160
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; silty; well-sorted; gypsum accessory mineral; calcareous cement.	10	170
Sandstone: Pale-greenish-yellow (10Y 8/2); very fine to fine-grained; silty; well-sorted; calcareous cement.	10	180
UPPER AND MIDDLE JURASSIC:		
Cow Springs Sandstone, Entrada Sandstone, and Carmel Formation undifferentiated:		
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; silty; well-sorted; gypsum accessory mineral; coal; calcareous cement.	20	200
Sandstone: Pale-greenish-yellow (10Y 8/2); very fine to fine-grained; silty; well-sorted; gypsum accessory mineral; calcareous cement.	10	210
Sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained; well-sorted; calcareous cement.	50	260
Sandstone: Yellowish-gray (5Y 8/1); very fine to medium-grained; fair-sorted; limestone fragments; calcareous cement.	10	270
Sandstone: Pale-brown (5YR 5/2); very fine to fine-grained; well-sorted; coal fragments; calcareous cement.	10	280
Sandstone: Pale-brown (5YR 5/2); very fine to fine-grained; limestone fragments; calcareous cement.	30	310
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; well-sorted; gypsum accessory mineral; coal; calcareous cement.	10	320
Sandstone: Pale-brown (5YR 5/2); fine- to medium-grained; silty; well-sorted; coal fragments; calcareous cement.	30	350
Sandstone: Pale-brown (5YR 5/2); very fine to medium-grained; well-sorted; gypsum accessory mineral; coal fragments; calcareous cement.	10	360
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; well-sorted; calcareous cement.	30	390
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; well-sorted; gypsum accessory mineral; coal fragments; calcareous cement.	20	410
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; well-sorted; calcareous cement.	10	420
Sandstone: Very pale orange (10YR 8/2); very fine to coarse-grained; poorly sorted; calcareous cement.	20	440
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; well-sorted; calcareous cement.	10	450
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; well-sorted; calcareous cement.	80	530
Sandstone: Very light gray (N 8); very fine to coarse-grained; fair-sorted; calcareous cement.	10	540
Sandstone: Very light gray (N 8); very fine to medium-grained; fair-sorted; calcareous cement.	10	550
Sandy siltstone: Pale-brown (5YR 5/2); fair-sorted; calcareous cement.	10	560
Sandstone: Very light gray (N 8); very fine to medium-grained; fair-sorted; calcareous cement.	10	570
Sandstone: Very light gray (N 8); fine- to coarse-grained; fair-sorted; calcareous cement.	10	580
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; well-sorted; calcareous cement.	10	590
Silty mudstone: Pale-red (5R 6/2); calcareous cement.	20	610
Sandstone: Pale-red (5R 6/2); very fine to fine-grained; silty; well-sorted; calcareous cement.	20	630
Sandy siltstone: Pale-red (5R 6/2); calcareous cement.	10	640
Sandy siltstone: Pale-reddish-brown (10R 5/4); calcareous cement.	10	650
Silty mudstone: Pale-reddish-brown (10R 5/4); calcareous cement.	10	660
No samples.	50	710
6K-308		
94-12.15-0.35		
UPPER CRETACEOUS:		
Toreva Formation:		
Sandy silty mudstone: Dusky-yellow (5Y 6/4); calcareous cement.	40	40
Silty mudstone: Medium-light-gray (N 6); with claystone; calcareous cement.	20	60
Silty mudstone: Medium-light-gray (N 6); with claystone and coal.	50	110
Sandstone: Light-olive-gray (5Y 6/1); very fine to very coarse grained; fair-sorted; composed of quartz; calcareous cement; seep of water.	10	120
Sandy siltstone: Medium-light-gray (N 6); with claystone and coal.	20	140
Siltstone: Medium-light-gray (N 6); with very coarse grained sand and claystone.	20	160
Silty claystone: Light-olive-gray (5Y 6/1); with coal; calcareous cement.	40	200
Silty claystone: Light-olive-gray (5Y 6/1); calcareous cement.	30	230
Silty mudstone: Medium-light-gray (N 6); with claystone; calcareous cement.	10	240
Sandstone: Medium-light-gray (N 6); fine- to coarse-grained; fair-sorted; composed of quartz; coal and mudstone fragments; calcareous cement.	20	260
Mancos Shale:		
Silty mudstone: Medium-light-gray (N 6); with coal; calcareous cement.	60	320
Siltstone: Medium-light-gray (N 6); coal fragments.	20	340
Silty mudstone: Medium-light-gray (N 6); calcareous cement.	30	370
Silty mudstone: Medium-light-gray (N 6); claystone fragments; calcareous cement.	30	400
Silty mudstone: Medium-light-gray (N 6); fragments of claystone and very fine to fine-grained quartz sand; calcareous cement.	10	410
Silty mudstone: Medium-light-gray (N 6); claystone fragments; calcareous cement.	50	460
Silty mudstone: Medium-gray (N 5); claystone fragments; calcareous cement.	40	500
Sandstone: Light-greenish-gray (5GY 8/1); very fine to fine-grained; well-sorted; composed of quartz; water.	10	510
Silty mudstone: Medium-gray (N 5); claystone fragments; calcareous cement.	20	530
6K-311		
94-0.70-2.70		
UPPER CRETACEOUS:		
Wepo Formation:		
Sandstone: Pale-yellowish-brown (10YR 6/2); very fine to coarse-grained; silty; poorly sorted; composed of clear and stained quartz; weakly cemented, calcareous.	30	30
Sandstone: Very pale orange (10YR 8/2); very fine to coarse-grained; silty; poorly sorted; composed of clear and stained quartz; weakly cemented, calcareous.	20	50
Toreva Formation:		
Sandstone: Very light gray (N 8); very fine to medium-grained; silty; poorly sorted; composed of clear quartz; weakly cemented, calcareous.	30	80
Sandstone: Very light gray (N 8); very fine to coarse-grained; silty; poorly sorted; composed of clear quartz; weakly cemented, calcareous.	20	100
Sandstone: Light-gray (N 7); very fine grained; silty; poorly sorted; composed of clear quartz; weakly cemented, calcareous.	20	120
common coal fragments; weakly cemented, calcareous.	10	160
Sandy siltstone: Very light gray (N 8); silt with quartz grains; common mica accessory mineral; weakly cemented, calcareous.	40	200
Siltstone and mudstone: Medium-gray (N 5); common mica accessory mineral; common coal fragments; weakly cemented, calcareous.	100	300
Sandy siltstone: Medium-light-gray (N 6); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; abundant mica accessory mineral; abundant carbonaceous material; weakly cemented, calcareous.	30	330
Silty sandstone: Light-gray (N 7) to medium-gray (N 5); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; common mica accessory mineral; common carbonaceous material; weakly cemented, calcareous.	20	350

Sandy siltstone: Light-gray (N 7); silt to medium-grained sand; composed of clear quartz; common mica accessory mineral; mudstone fragments; weakly cemented, calcareous.	30	150
Siltstone and mudstone: Medium-light-gray (N 6);		
Mancos Shale:		
Mudstone and claystone: Medium-light-gray (N 6) to medium-gray (N 5); silt and clay; common mica accessory mineral; common carbonaceous material; weakly cemented, calcareous.	63	413

Sunlight Baptist Mission
94-12.80-13.35

UPPER CRETACEOUS:		
Mancos Shale:		
No samples.	100	100
Mudstone: Medium-light-gray (N 6); clay and silt; rare to absent gypsum and rare dark accessory minerals; rare to absent carbonaceous material; weakly to firmly cemented, calcareous and argillaceous.	200	300
Arenaceous mudstone and siltstone: Medium-light-gray (N 6); clay to fine-grained sand; rare to absent gypsum and rare dark accessory minerals; weakly to firmly cemented, calcareous and argillaceous.	30	330
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Arenaceous siltstone: Medium-light-gray (N 6); silt to fine-grained sand; rare mica and dark accessory minerals; rare to common coal fragments; weakly cemented, calcareous.	50	380
Arenaceous siltstone: White (N 9) to very light gray (N 8); silt to fine-grained sand; moderately common coal fragments; weakly cemented, calcareous.	20	400
Arenaceous siltstone: Pale-yellowish-brown (10YR 6/2); silt and very fine to fine-grained sand; rare coal and mudstone fragments; weakly cemented, calcareous.	10	410
Arenaceous siltstone: Light-brown (5YR 6/4); silt to fine-grained sand; rare coal and mudstone fragments; weakly cemented, calcareous.	30	440
UPPER AND MIDDLE JURASSIC:		
Cow Springs Sandstone, Entrada Sandstone, and Carmel Formation undifferentiated:		
Siltstone: Grayish-orange-pink (10R 8/2); silt and very fine to fine-grained sand; rare mudstone fragments; weakly cemented, calcareous.	40	480
Siltstone: Grayish-orange-pink (10R 8/2) to moderate-reddish-orange (10R 6/6); silt and very fine to fine-grained sand; rare mudstone fragments; weakly cemented, calcareous.	80	560
Sandstone: Very light gray (N 8) to pinkish-gray (5YR 8/1); very fine to medium-grained; silty; fair-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare dark accessory minerals; moderately common argillaceous material; weakly cemented, calcareous and argillaceous.	20	580
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; silty; poorly sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	20	600
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare mica and dark accessory minerals; rare mudstone fragments and argillaceous material; weakly cemented, calcareous.	10	610
Sandstone: Grayish-orange-pink (10R 8/2); very fine to coarse-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare mica and dark accessory minerals; rare mudstone fragments and argillaceous material; weakly cemented, calcareous.	10	620
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare mica and dark accessory minerals; rare mudstone fragments and argillaceous material; weakly cemented, calcareous.	10	630
Siltstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; silty; weakly cemented, calcareous.	10	640
Sandstone: Pinkish-gray (5YR 8/1); very fine to medium-grained; silty; fair- to well-sorted; composed of rounded to subangular, clear and stained quartz; rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	10	650
No samples.	10	660
Sandstone: White (N 9); very fine to medium-grained; fair- to well-sorted; composed of rounded to subangular, clear quartz; rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous and argillaceous.	40	700

6K-305-95
95-4.30-16.25

QUATERNARY:		
Alluvium:		
Sand: Grayish-yellow (5Y 8/4); very fine grained; silty; fair-sorted.	20	20
UPPER AND LOWER CRETACEOUS:		
Mancos Shale and Dakota Sandstone:		
Sandy siltstone: Yellowish-gray (5Y 7/2).	40	60
Sandstone: Yellowish-gray (5Y 7/2); very fine grained; silty; fair-sorted.	30	90
UPPER JURASSIC:		
Cow Springs Sandstone:		
Sandstone: White (N 9); very fine grained; silty; fair-sorted; volcanic ash.	10	100
Sandstone: Pale-yellowish-brown (10YR 6/2); very fine grained; fair-sorted; volcanic ash.	10	110
Sandstone: Light-brown (5YR 6/4); very fine grained; silty; fair-sorted.	30	140
Sandstone: Very pale orange (10YR 8/2); very fine grained; silty; fair-sorted; ash(?).	10	150
Sandstone: Yellowish-gray (5Y 7/2); very fine grained; silty; fair-sorted; ash(?).	30	180
Sandstone: Very light gray (N 8); very fine grained; silty; fair-sorted; ash(?).	30	210
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Sandstone: Very light gray (5YR 4/4); very fine grained; silty; fair-sorted.	110	320
Sandy siltstone: Moderate-brown (5YR 4/4).	10	330
Sandstone: Very pale orange (10YR 8/2); very fine grained; silty; fair-sorted.	10	340
Sandy siltstone: Moderate-brown (5YR 4/4).	10	350
Sandstone: Very pale orange (10YR 8/2); fine-grained; fair-sorted.	10	360
Sandstone: Yellowish-gray (5Y 7/2); very fine grained; well-sorted.	10	370
Siltstone: White (N 9).	10	380
Sandstone: Yellowish-gray (5Y 7/2); very fine grained; silty; fair-sorted.	32	412
No samples.	3	415

6K-309A
95-9.45-5.55

UPPER CRETACEOUS:		
Toreva Formation:		
Sandstone: Grayish-yellow (5Y 8/4); very fine to very coarse grained; poorly sorted; composed of quartz; calcareous cement.	9	9
Sandy siltstone: Grayish-yellow (5Y 8/4); biotite accessory mineral; calcareous cement.	41	50
Silty sandstone: Yellowish-gray (5Y 7/2); silt to coarse-grained sand; poorly sorted; composed of quartz; calcareous cement.	10	60
Sandstone: Light-gray (N 7); very fine to fine-grained; silty; fair-sorted; composed of quartz; biotite accessory mineral; calcareous cement.	10	70
Siltstone: Light-gray (N 7); biotite accessory mineral; calcareous cement.	10	80
Sandy siltstone: Yellowish-gray (5Y 7/2); biotite accessory mineral; calcareous cement.	20	100
Silty sandstone: Yellowish-gray (5Y 7/2); silt to medium-grained sand; poorly sorted; composed of quartz; calcareous cement.	20	120
Sandstone: Yellowish-gray (5Y 7/2); very fine to very coarse grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	140
Sandy siltstone: Light-gray (N 7); biotite accessory mineral; calcareous cement.	30	170
Silty mudstone: Medium-light-gray (N 6); claystone fragments; calcareous cement.	2	172

6K-310
95-11.05-12.20

QUATERNARY:		
Alluvium:		
Sand: Pale-yellowish-brown (10YR 6/2); very fine to medium-grained; fair-sorted; composed of quartz; mudstone fragments; calcareous cement.	10	10
Sand: Pale-yellowish-brown (10YR 6/2); very fine to coarse-grained; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	40	50
Sand and gravel: Grayish-orange (10YR 7/4); very fine to very coarse grained sand composed of quartz; silty; poorly sorted; quartz pebbles and mudstone fragments; calcareous cement.	10	60
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; well-sorted; calcareous cement.	20	80
Sandstone: Very light gray (N 8); very fine to fine-grained; well-sorted; calcareous cement.	40	120
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; silty; poorly sorted; calcareous cement.	10	130
Sandstone: Grayish-orange-pink (5YR 7/2); very fine		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
6K-310—Continued 95-11.05-12.20		
to fine-grained; silty; fair-sorted; calcareous cement.	10	140
Sandy siltstone: Pale-reddish-brown (10R 5/4); biotite accessory mineral; calcareous cement.	30	170
Sandstone: Pinkish-gray (5YR 8/1); very fine to fine-grained; well-sorted; calcareous cement.	10	180
Sandstone: Very light gray (N 8); very fine to fine-grained; well-sorted; calcareous cement.	10	190
Sandstone: Yellowish-gray (5Y 8/1); very fine to medium-grained; well-sorted; calcareous cement.	10	200
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well-sorted; calcareous cement.	40	240
Sandstone: Very light gray (N 8); very fine to medium-grained; well-sorted; calcareous cement.	50	290
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	50	340
6M-52A 95-7.55-11.75		
QUATERNARY:		
Alluvium:		
Silty sand: Yellowish-gray (5Y 7/2); fine-grained; poorly sorted.	40	40
Sand: Light-brown (5YR 6/4); medium-grained; poorly sorted.	20	60
Silty sand: Light-brown (5YR 6/4); very fine grained.	20	80
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandy siltstone: Grayish-orange-pink (5YR 7/2).	20	100
Clayey siltstone: Light-brown (5YR 6/4).	10	110
UPPER AND MIDDLE JURASSIC:		
Cow Springs Sandstone, Entrada Sandstone, and Carmel Formation undifferentiated:		
Sandy siltstone: Very pale orange (10YR 8/2); ash(?).	40	150
Sandy siltstone: Light-brown (5YR 6/4).	60	210
Sandstone: Grayish-orange-pink (5YR 7/2); silt to very fine grained sand; poorly sorted.	100	310
Sandstone: Very light gray (N 8); very fine grained; silty; poorly sorted.	40	350
Sandstone: Light-olive-gray (5Y 6/1); very fine grained; silty; poorly sorted.	20	370
Sandstone: Grayish-orange-pink (5YR 7/2); very fine grained; silty; poorly sorted.	20	390
Sandstone: Light-brown (5YR 6/4); very fine grained; silty; poorly sorted.	40	430
Sandstone: Pale-yellowish-brown (10YR 6/2); very fine grained; silty; poorly sorted.	20	450
6K-322 96-1.00-10.50		
UPPER CRETACEOUS:		
Mancos Shale:		
Siltstone and claystone: Dark-gray (N 3) to medium-gray (N 5); fine-grained quartz sand; mica accessory mineral; coal and carbonaceous material; gypsiferous and calcareous cement.	130	130
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone: Light-olive-gray (5Y 6/1); very fine grained; well-sorted; composed of subrounded to subangular, frosted quartz; black and amber accessory minerals; weakly cemented, calcareous.	20	150
UPPER AND MIDDLE JURASSIC:		
Cow Springs Sandstone, Entrada Sandstone, and Carmel Formation undifferentiated:		
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained and rare medium-grained; fair-sorted; composed of rounded to subangular, clear and frosted quartz; black and red and rare mica and pyrite accessory minerals; weakly cemented, calcareous.	20	170
Sandstone: Moderate-orange-pink (10R 7/4); silt to very fine grained sand; fair-sorted; composed of subrounded to subangular, clear, frosted, and stained quartz; rare mica and black accessory minerals; calcareous cement.	10	180
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; well-sorted; composed of subrounded to subangular, frosted quartz; rare mica and black accessory minerals; calcareous cement.	10	190
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, frosted quartz; rare mica and black accessory minerals; weakly cemented, calcareous.	220	410
Arenaceous siltstone: Light-brown (5YR 6/4); silt to very fine grained sand; occasional medium-grained sand; composed of subrounded to subangular, stained and frosted quartz; rare black and mica accessory minerals; few clay pellets; calcareous cement.	70	480
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Pinkish-gray (5YR 8/1); fine-grained; well-sorted; composed of subrounded to subangular, clear and frosted quartz; black, amber, and green accessory minerals; siliceous cement.	50	530
Sandstone: Pinkish-gray (5YR 8/1); fine- to medium-grained; well-sorted; composed of rounded to subrounded quartz; rare pyrite and black accessory minerals.	20	550
No samples.	7	557
6GS-113-1 113-8.70-4.00		
QUATERNARY:		
Alluvium:		
Sand: Pale-yellowish-brown (10YR 6/2); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare to absent hematite pellets and carbonaceous material; weakly cemented, calcareous.	20	20
Sand: Grayish-orange (10YR 7/4) to pale-yellowish-brown (10YR 6/2); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare carbonaceous material; weakly cemented, calcareous.	50	70
Sand: Light-brown (5YR 6/4); very fine to fine-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare to absent dark accessory minerals; weakly cemented, calcareous.	40	110
UPPER AND MIDDLE JURASSIC:		
Cow Springs Sandstone, Entrada Sandstone, and Carmel Formation undifferentiated:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare to absent mica and rare dark accessory minerals; weakly cemented, calcareous.	20	130
Sandstone: Moderate-orange-pink (5YR 8/4) to light-brown (5YR 6/4); very fine to fine-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	61	191
6GS-113-2 113-11.40-5.75		
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine- to medium-grained; silty; fair-sorted; composed of subrounded to angular, clear and stained quartz; rare mica and dark accessory minerals; rare mudstone fragments and carbonaceous material; weakly cemented, calcareous.	10	10
Sandstone: Pale-yellowish-brown (10YR 6/2); fine- to medium-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	10	20
Sandstone: Grayish-yellow (5Y 8/4) to yellowish-gray (5Y 7/2); fine-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	80	100
Sandstone: Grayish-orange-pink (10R 8/2) to pale-red (10R 6/2); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare red mudstone fragments; weakly cemented, calcareous.	10	160
Siltstone: Pale-red (10R 6/2); silt and medium-grained quartz sand; rare mudstone fragments; weakly cemented, calcareous.	10	170
Sandstone: Grayish-orange-pink (10R 8/2) to pale-red (10R 6/2); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	50	220
Siltstone: Pale-red (10R 6/2); silt and medium-grained quartz sand; rare mudstone fragments; weakly cemented, calcareous.	30	250
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Grayish-orange-pink (10R 8/2) to pale-red (10R 6/2); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare dark		

subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	10	110
Sandstone: Pale-red (10R 6/2); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	10	120
Sandstone: Grayish-orange-pink (10R 8/2) to pale-red (10R 6/2); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	10	130
Sandstone: Grayish-orange-pink (10R 8/2) to pale-red (10R 6/2); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; rare to absent blue-green mudstone fragments; weakly cemented, calcareous.	20	150
Silty sandstone: Pale-red (10R 6/2); silt to medium-accessory minerals; weakly cemented, calcareous.	10	260
UPPER TRIASSIC(?):		
Kayenta Formation:		
Arenaceous siltstone: Pale-red (10R 6/2); silt and fine-grained sand; composed of subrounded to subangular, clear quartz; rare mudstone fragments; weakly cemented, calcareous.	50	310
Siltstone: Pale-red (10R 6/2); silt and very fine grained quartz sand; weakly cemented, calcareous.	10	320
Silty sandstone: Pale-red (10R 6/2); silt and fine-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; common reddish-brown and blue-green mudstone fragments; weakly cemented, calcareous.	20	340
Siltstone: Pale-red (10R 6/2); silt and very fine grained quartz sand; weakly cemented, calcareous.	20	360

6K-312
114-8.65-5.05

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Light-orange-brown (5YR 7/4); very fine to medium-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	9	9
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; weakly cemented, calcareous.	25	34
Sandy mudstone: Grayish-red (10R 4/2); composed of silt and clay particles; common very fine to medium-grained clear quartz sand; common mica accessory mineral; rare limestone pellets; weakly cemented, calcareous.	4	38
Sandstone: Pale-orange-pink (10R 7/2); very fine to medium-grained; silty; poorly sorted; composed of rounded to subrounded, clear and stained quartz; weakly cemented, calcareous.	16	54
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; silty; fair-sorted; composed of rounded to subrounded, clear and stained quartz; weakly cemented, calcareous.	20	74
Sandstone: Pale-greenish-yellow (10Y 8/2); very fine to medium-grained; silty; fair-sorted; composed of rounded to subrounded, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	29	103
UPPER TRIASSIC(?):		
Kayenta Formation:		
Sandy siltstone: Pale-reddish-brown (10R 5/4); silt and very fine to medium-grained sand composed of rounded to subrounded, clear and stained quartz; poorly sorted; common mica accessory mineral; weakly cemented, calcareous.	20	123
No samples.	22	145

6K-307
115-0.10-0.30

QUATERNARY:		
Alluvium:		
Silty sand: Yellowish-gray (5Y 7/2); silt to medium-grained sand; poorly sorted; composed of quartz; calcareous cement.	15	15
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Coal: Black (N 1); sand and silt.	10	25
Coal: Black (N 1).	5	30
Silty mudstone: Light-gray (N 7); coal fragments.	10	40
Silt: Light-gray (N 7); coal and gypsum.	10	50
Sandstone: Light-gray (N 7); very fine to fine-grained; silty; well-sorted; calcareous cement.	10	60
UPPER JURASSIC:		
Cow Springs Sandstone:		
Sandstone: Very light gray (N 8); very fine to fine-grained; silty; well-sorted; calcareous cement.	30	90
Sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	40	130
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Sandstone: Very light gray (N 8); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	20	150
Sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	90	240
Sandstone: Light-greenish-gray (5GY 8/1); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	10	250
Sandstone: Light-greenish-gray (5GY 8/1) to very light gray (N 8); fine- to medium-grained; fair-sorted; composed of quartz; pyrite accessory mineral; claystone and siltstone fragments; calcareous cement.	10	260
Sandy siltstone: Light-greenish-gray (5GY 8/1); gypsum.	10	270
Silty mudstone: Pale-red (10R 6/2) to light-greenish-gray (5GY 8/1); coal fragments; calcareous cement.	10	280
Silty mudstone: Pale-reddish-brown (10R 5/4); gypsum.	10	290
Sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	100	390
Sandstone: Very light gray (N 8); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	90	480
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Very light gray (N 8); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement; possible water at 530 to 560 feet.	150	630
UPPER TRIASSIC(?):		
Kayenta Formation:		
Mudstone and claystone: Grayish-red (10R 4/2); calcareous cement.	5	635

6K-310(N)
115-4.10-3.15

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well-sorted; composed of rounded to subrounded, clear and stained quartz; rare dark accessory minerals; weakly to firmly cemented, calcareous.	10	10
Sandstone: Grayish-yellow (5Y 8/4); very fine to medium-grained; well-sorted; composed of rounded to subrounded, clear and stained quartz; rare dark accessory minerals; weakly to firmly cemented, calcareous.	260	270
UPPER TRIASSIC(?):		
Kayenta Formation:		
Mudstone and claystone: Pale-grayish-red (10R 5/2); silt and clay; rare dark accessory minerals; common chert and limestone fragments; weakly cemented, calcareous.	30	300
Arenaceous siltstone: Pale-red (10R 6/2); silt and very fine to medium-grained sand; composed of rounded to subrounded, clear quartz; common chert and limestone fragments; weakly cemented, calcareous.	10	310
Tongue of Navajo Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well-sorted; composed of clear and stained quartz; rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	30	340
Silty sandstone: Grayish-orange-pink (5YR 7/2); silt and very fine to medium-grained sand; poorly sorted; composed of rounded to subrounded, clear quartz; rare dark accessory minerals; common argillaceous material; weakly cemented, calcareous.	20	360
Silty sandstone: Grayish-orange-pink (10R 8/2); silt and very fine to medium-grained sand; fair-sorted; composed of rounded to subrounded, clear quartz; rare argillaceous material; weakly cemented, calcareous.	45	405

7K-361
93-6.35-4.00

QUATERNARY:		
Alluvium and landslide deposits:		
Arenaceous silt: Yellowish-gray (5Y 7/2); silt and very fine to very coarse grained sand; poorly sorted; rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	50	50
Sand: Pale-yellowish-brown (10YR 6/2); very fine to very coarse grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; moderately common black and red accessory minerals; rare		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
7K-361—Continued 93-6.35-4.00		
argillaceous material; weakly cemented, calcareous.	30	80
UPPER CRETACEOUS:		
Mancos Shale:		
Arenaceous siltstone: Pale-yellowish-brown (10YR 6/2); silt and very fine to coarse-grained sand; poorly sorted; rare mudstone fragments; weakly cemented, calcareous.	10	90
Arenaceous siltstone: Light-olive-gray (5Y 6/1); silt and very fine to coarse-grained sand; poorly sorted; rare mudstone fragments; weakly cemented; calcareous.	10	100
Siltstone and mudstone: Medium-gray (N 5); silt, clay, and fine- to coarse-grained sand; poorly sorted; rare to absent petrified(?) wood fragments; calcareous cement.	180	280
Siltstone and mudstone: Medium-gray (N 5); silt, clay, and fine- to coarse-grained sand; poorly sorted; rare pyrite and gypsum accessory minerals; weakly cemented, calcareous.	10	290
Sandstone: Medium-gray (N 5) to light-gray (N 7); fine-grained; silty; well-sorted; composed of subrounded to angular, clear quartz; moderately common dark accessory minerals; common wood and mudstone fragments; rare to absent coal; rare pyrite, mica, and limonite; weakly cemented, calcareous.	20	310
Siltstone: Light-gray (N 7); silt and fine-grained sand; rare pyrite and dark accessory minerals; rare to moderately common coal; rare mudstone fragments; weakly cemented, calcareous.	10	320
Sandstone: Light-gray (N 7); fine- to medium-grained; silty; fair-sorted; composed of subrounded to angular, clear quartz; pyrite accessory mineral; common mudstone fragments and coal; rare wood fragments; weakly cemented, calcareous.	10	330
Siltstone and mudstone: Medium-light-gray (N 6); silt and clay; rare gypsum accessory mineral; moderately common to absent coal fragments; weakly cemented, calcareous.	40	370
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone: Light-gray (N 7); fine- to medium-grained; silty; fair-sorted; composed of subrounded to angular, clear quartz; common pyrite accessory mineral; common mudstone fragments and coal; rare wood fragments; weakly cemented, calcareous.	20	390
Sandstone: Very light gray (N 8); fine-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; rare coal fragments; weakly cemented, calcareous.	70	460
Mudstone and siltstone: Light-gray (N 7); clay, silt, and fine-grained sand; weakly cemented, calcareous and argillaceous.	10	470
Siltstone: Light-gray (N 7); silt; rare coal fragments; weakly cemented, calcareous.	1	471
7K-364 93-4.50-11.50		
TERTIARY:		
Bidahochi Formation:		
Upper member:		
Sandstone: Moderate-orange-brown (5YR 7/4); medium- to coarse-grained sand and rare granule; fair-sorted; composed of subangular to angular, frosted and stained quartz; common black accessory minerals; weakly cemented, calcareous.	50	50
Sandstone: Very pale orange (10YR 8/2); fine to very coarse grained; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; common black accessory minerals; siliceous cement.	30	80
Sandstone: Very pale orange (10YR 8/2); silt to coarse-grained sand; poorly sorted; composed of subrounded to subangular, frosted quartz; micaceous accessory minerals; weakly cemented, calcareous.	20	100
Siltstone: Light-olive-gray (5Y 6/1); clay to silt; common medium- to coarse-grained sand composed of quartz; common mica flakes; siliceous cement.	10	110
UPPER CRETACEOUS:		
Toreva Formation:		
Sandstone: Pinkish-gray (5YR 8/1) to very pale orange (10YR 8/2); medium-grained sand to granule; silty from 170 to 190 feet; fair-sorted; size and sorting vary somewhat from horizon to horizon; composed of angular, frosted quartz; common feldspar grains.	110	220
Siltstone: Light-gray (N 7); silt to clay; few angular quartz grains as large as granule; abundant mica; siliceous cement.	70	290
Sandstone: Same as from 110 to 220 feet; abundant siltstone fragments.	30	320
Siltstone: Medium-dark-gray (N 4); silt to clay; common medium to very coarse grained quartz sand; abundant coal fragments; siliceous cement.	10	330
Silty sandstone: Medium-light-gray (N 6); silt to fine-grained sand, occasional larger grain; fair- to well-sorted; slight variation of size and sorting throughout; composed of subangular to angular, frosted quartz and chert; few siltstone and coal fragments in upper 10 feet; abundant mica and common black accessory minerals; siliceous cement.	80	410
Mancos Shale:		
Siltstone: Medium-light-gray (N 6); silt to clay; sandy; abundant finely divided mica; calcareous cement from 510 to 520 feet and from 560 to 600 feet, siliceous elsewhere.	192	602
7K-355 112-12.80-8.05		
QUATERNARY:		
Alluvium:		
Silty sand: Yellowish-gray (5Y 7/2); silt to medium-grained sand; poorly sorted; composed of quartz; muscovite; calcareous cement.	30	30
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; silty; poorly sorted; composed of quartz; muscovite; calcareous cement.	50	80
UPPER CRETACEOUS:		
Mancos Shale:		
Sandy siltstone: Yellowish-gray (5Y 7/2); calcareous cement.	20	100
Sandy siltstone: Light-gray (N 7); calcareous cement.	20	120
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Coal and carbonaceous siltstone: Medium-dark-gray (N 4) to black (N 1).	10	130
Mudstone: Medium-light-gray (N 4); coal fragments; calcareous cement.	10	140
Siltstone: Medium-light-gray (N 4); coal fragments; calcareous cement.	40	180
Sandstone: Very light gray (N 8); very fine to fine-grained; silty; poorly sorted; composed of quartz.	10	190
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Sandstone: Pale-brown (5YR 5/2); very fine to fine-grained; poorly sorted; composed of quartz; mudstone fragments.	10	200
Sandy siltstone: Pale-brown (5YR 5/2); calcareous cement.	10	210
Sandy siltstone: Moderate-brown (5YR 4/4); mudstone fragments; calcareous cement.	40	250
Sandy siltstone: Very light gray (N 8); calcareous cement.	10	260
Sandy siltstone: Light-brown (5YR 6/4); calcareous cement.	80	340
Sandstone: Pinkish-gray (5YR 8/1); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	360
Sandstone: Very light gray (N 8); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	80	440
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	50	490
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	510
Sandstone: Pinkish-gray (5YR 8/1); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	530
Silty mudstone: Grayish-red (10R 4/2); calcareous cement.	6	536
White Cone T.P. 112-3.50-10.10		
QUATERNARY:		
Alluvium:		
No samples.	50	50
TERTIARY:		
Bidahochi Formation:		
Lower member:		
Siltstone: Light-gray (N 7); silt to fine-grained sand composed of quartz; rare mica accessory mineral; rare argillaceous material; weakly cemented, calcareous.	10	60
stained quartz; weakly cemented, calcareous.	10	280
Sandstone: Yellowish-gray (5Y 8/1) and bluish-white (5B 9/1); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; weakly cemented, calcareous.	10	290
Sandstone: Yellowish-gray (5Y 8/1); fine to very coarse grained; poorly sorted; composed of well-rounded to angular, clear and frosted quartz; rare dark accessory minerals; rare chert and jasper;		

Silty sandstone: Light-gray (N 7); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	10	70
Siltstone: Light-gray (N 7); silt and medium- to coarse-grained sand; composed of rounded to subangular, clear quartz; weakly cemented, calcareous.	30	100
Siltstone: Light-gray (N 7); silt and fine-grained sand composed of quartz; rare mica accessory mineral; rare argillaceous material; weakly cemented, calcareous.	10	110
Sandstone: Yellowish-gray (5Y 8/1); fine to very coarse grained; poorly sorted; composed of well-rounded to angular, clear and frosted quartz; rare feldspar and dark accessory minerals; rare chert and jasper; weakly cemented, calcareous.	20	130
Silty sandstone: Yellowish-gray (5Y 8/1); silt and fine-grained sand; some medium- to coarse-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; rare argillaceous material; weakly cemented, calcareous and argillaceous.	20	150
Silty sandstone: White (N 9) and very light gray (N 8); silt and fine-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; rare argillaceous material; weakly cemented, calcareous and argillaceous.	10	160
Sandstone: Yellowish-gray (5Y 8/1); fine to very coarse grained; poorly sorted; composed of well-rounded to angular, clear and frosted quartz; rare feldspar and dark accessory minerals; rare chert and jasper; weakly cemented, calcareous.	30	190
UPPER JURASSIC:		
Cow Springs Sandstone:		
Sandstone: Pale-red (10R 6/2) to pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; fair to poorly sorted; composed of subrounded to subangular, clear and stained quartz; some well-rounded coarse grains; weakly cemented, calcareous.	20	210
Sandstone: Very light gray (N 8); fine-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; some well-rounded coarse grains; weakly cemented, calcareous.	20	230
UPPER AND MIDDLE JURASSIC:		
Carmel Formation and Entrada Sandstone undifferentiated:		
Sandstone: Pale-red (10R 6/2) and bluish-white (5B 9/1); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; weakly cemented, calcareous.	30	260
Sandstone: Yellowish-gray (5Y 8/1); fine to very coarse grained; silty; poorly sorted; composed of well-rounded to angular, clear and frosted quartz; rare dark accessory minerals; rare chert and jasper; weakly cemented, calcareous.	10	270
Sandstone: Pale-red (10R 6/2) to pale-reddish-brown (10R 5/4); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, clear and weakly cemented, calcareous.	10	300
Sandstone: Very light gray (N 8); fine- to medium-grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; some well-rounded coarse grains; rare dark accessory minerals; rare reddish-brown mudstone pellets; weakly cemented, calcareous.	10	310
Sandstone: Yellowish-gray (5Y 8/1); fine to very coarse grained; poorly sorted; composed of well-rounded to angular, clear and frosted quartz; rare feldspar and dark accessory minerals; rare chert and jasper; weakly cemented, calcareous.	10	320
Sandstone: Yellowish-gray (5Y 8/1), bluish-white (5B 9/1), and pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; fair to poorly sorted; composed of subrounded to subangular, clear and stained quartz; some well-rounded coarse grains; weakly cemented, calcareous.	20	340
Sandstone: Yellowish-gray (5Y 8/1), bluish-white (5B 9/1), and pale-reddish-brown (10R 5/4); fine- to coarse-grained; silty; poorly sorted; composed of well-rounded to angular, clear, stained, and frosted quartz; rare jasper, chert, and blue-green mudstone fragments; weakly cemented, calcareous.	10	350
Sandstone: Yellowish-gray (5Y 8/1); fine to very coarse grained; poorly sorted; composed of well-rounded to angular, clear and frosted quartz; rare feldspar and dark accessory minerals; rare chert and jasper; rare blue-green mudstone fragments; weakly cemented, calcareous.	10	360
Silty sandstone: Yellowish-gray (5Y 8/1), bluish-white (5B 9/1), and pale-reddish-brown (10R 5/4); silt to fine-grained sand; poorly sorted; composed of subrounded to angular, clear and stained quartz; rare blue-green mudstone fragments; weakly cemented, calcareous.	10	370
Sandstone: Pale-yellowish-brown (10YR 6/2); fine-grained; silty; well-sorted; composed of subrounded to angular, clear quartz; rare pyrite mudstone pellets; weakly cemented, calcareous.	10	380
Sandstone: Yellowish-gray (5Y 7/2); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare to absent pyrite accessory mineral; rare blue-green and reddish-brown mudstone fragments; weakly cemented, calcareous.	30	410
Arenaceous siltstone and mudstone: Pale-red (10R 6/2) to pale-reddish-brown (10R 5/4); silt, clay, and fine- to coarse-grained sand composed of quartz; weakly cemented, calcareous.	10	420
Silty sandstone: Light-greenish-gray (5G 8/1); very fine to fine-grained; some well-rounded coarse grains; poorly sorted; composed of clear quartz; common blue-green mudstone fragments; weakly cemented, calcareous.	20	440
No samples.	15	455

7K-367
128-11.30-7.30

(Well drilled in diatreme)		
TERTIARY:		
Bidahochi Formation:		
Volcanic member:		
Silty sandstone: Pinkish-gray (5YR 8/1); silt to coarse-grained sand; poorly sorted; composed of subrounded to subangular, clear and frosted quartz; basalt and augite fragments; calcareous cement.	10	10
Silty sandstone: Pinkish-gray (5YR 8/1); silt to coarse-grained sand; poorly sorted; composed of subrounded to subangular, clear and frosted quartz; calcareous cement.	10	20
Silty sandstone: Pale-yellowish-brown (10YR 6/2); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare mica and altered feldspar accessory minerals; few coarse basalt grains; calcareous cement.	50	70
Tuffaceous sandstone: Pale-yellowish-brown (10YR 6/2); clay to medium-grained sand; poorly sorted; composed of subangular to angular quartz; tuff, cinders, and basalt; common mica accessory mineral; rare olivine grain; few clay pellets; calcareous cement.	50	120
Siltstone: Light-greenish-gray (5GY 8/1); clay to silt and subordinate very fine grained sand; mica and basalt accessory minerals; rare glassy fragments; calcareous cement.	30	150
Tuffaceous siltstone: Very light gray (N 8); rare to common cinders and fine quartz sand; rare mica flakes and red accessory minerals; rare glassy fragments; common selenite crystals in places; rare isolated augite crystals; claystone in places; calcareous cement.	150	300
Tuffaceous siltstone: Very light gray (N 8); same as from 150 to 300 feet but more tuffaceous; common cinders.	20	320
No samples.	202	522

7K-354
129-12.15-2.45

QUATERNARY:		
Alluvium:		
Silty sand: Light-brown (5YR 6/4); silt to medium-grained sand; poorly sorted.	10	10
Sand and gravel: Light-brown (5YR 6/4); silt to medium-grained sand; poorly sorted; basalt fragments.	40	50
UPPER TRIASSIC(?):		
Moenave Formation:		
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	50	100
UPPER TRIASSIC:		
Wingate Sandstone:		
Lukachukai Member:		
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	50	150
Sandstone: Moderate-orange-pink (10R 7/4); very fine grained; silty; fair-sorted; composed of quartz; muscovite.	50	200
Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; silty; fair-sorted; composed of quartz; muscovite.	50	250
Rock Point Member:		
Sandstone: Pale-reddish-brown (10R 5/4) and moderate-orange-pink (10R 7/4); very fine grained; poorly sorted; composed of quartz; muscovite.	20	270
Sandy siltstone: Light-brown (5YR 6/4); muscovite; calcareous cement.	30	300
Sandy siltstone: Moderate-orange-pink (5YR 8/4); muscovite; calcareous cement.	90	390
Sandy siltstone: Moderate-reddish-orange (10R 6/6); muscovite; calcareous cement.	250	640
Sandy siltstone: Moderate-orange-pink (5YR 8/4); muscovite; calcareous cement.	30	670
Sandy siltstone: Moderate-orange-pink (5YR 8/4) and grayish-red (10R 4/2); muscovite and mudstone fragments; calcareous cement.	10	680
Silty mudstone: Moderate-orange-pink (5YR 8/4) and grayish-red (10R 4/2); calcareous cement.	10	690
Silty mudstone: Red (5R 6/2).	10	700

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

7K-356A
129-7.65-17.00

	Thickness (feet)	Depth (feet)
UPPER TRIASSIC:		
Chinle Formation:		
Owl Rock Member:		
Siltstone: Grayish-orange-pink (10R 8/2); mudstone, claystone, and limestone pellets and fragments; calcareous cement.	30	30
Siltstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	40	70
Siltstone: Pale-reddish-brown (10R 5/4); calcareous cement.	20	90
Siltstone: Pale-reddish-brown (10R 5/4); sandy; calcareous cement.	20	110
Siltstone: Pale-red (10R 6/2); sandy; mudstone and limestone fragments; calcareous cement.	70	180
Siltstone: Pale-red (5R 6/2); sandy; mudstone and limestone fragments; calcareous cement.	20	200
Siltstone: Moderate-orange-pink (10R 7/4); calcareous cement.	20	220
Siltstone: Moderate-orange-pink (10R 7/4); limestone fragments; calcareous cement.	60	280
Petrified Forest Member:		
Siltstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	10	290
Siltstone: Pale-reddish-brown (10R 5/4); calcareous cement.	10	300
Siltstone: Grayish-orange-pink (10R 8/2); mudstone fragments; calcareous cement.	10	310
Siltstone: Pale-red (10R 6/2); mudstone fragments; calcareous cement.	80	390
Silty mudstone: Grayish-red (5R 4/2); calcareous cement.	40	430
Silty mudstone: Pale-red (10R 6/2); limestone fragments; calcareous cement.	40	470
Silty mudstone: Pale-red-purple (5RP 6/2); limestone fragments; calcareous cement.	50	520
Silty mudstone and sandy siltstone: Pale-red (10R 6/2); calcareous cement.	30	550
Sandstone: Light-gray (N 7); silt to fine-grained sand; poorly sorted; composed of quartz; biotite accessory mineral; jasper and siltstone fragments; calcareous cement.	30	580
Sandstone: Light-gray (N 7); very fine to medium-grained; fair-sorted; composed of quartz; biotite accessory mineral; jasper fragments; calcareous cement.	20	600
Sandy siltstone: Light-brownish-gray (5Y 8/1) to yellowish-gray (5YR 6/1); mudstone fragments; calcareous cement.	10	610
Sandstone: Light-gray (N 7); very fine to medium-grained; fair-sorted; composed of quartz; biotite accessory mineral; jasper fragments; calcareous cement.	10	620
Sandy silty mudstone: Light-gray (N 7); calcareous cement.	30	650
Sandy silty mudstone: Light-gray (N 7); sandstone fragments.	30	680
Mudstone: Very light gray (N 8); gypsum fragments; calcareous cement.	10	690
Sandy siltstone: Pale-red (10R 6/2); calcareous cement.	20	710
Sandy silty mudstone: Medium-light-gray (N 6); calcareous cement.	10	720
Silty sandstone: Pinkish-gray (5YR 8/1); very fine grained; poorly sorted; biotite accessory mineral; limestone pellets; calcareous cement.	20	740
Mudstone: Grayish-red (5R 4/2); limestone pellets; calcareous cement.	20	760
Sandy silty mudstone: Pale-red (5R 6/2); limestone pellets; calcareous cement.	10	770
Silty sandstone: Pale-red (10R 6/2); silt to fine-grained sand; poorly sorted; composed of quartz; biotite accessory mineral; calcareous cement.	20	790
Sandy siltstone: Grayish-red (5R 4/2); calcareous cement.	10	800
Sandy siltstone and mudstone: Grayish-red (5R 4/2); limestone pellets; calcareous cement.	10	810
Silty sandstone: Grayish-red (5R 4/2); silt to fine-grained sand; poorly sorted; biotite accessory mineral; calcareous cement.	10	820
Sandy siltstone: Grayish-red (5R 4/2); calcareous cement.	10	830
Sandy silty mudstone: Grayish-red (10R 4/2); limestone pellets.	20	850
Silty sandstone: Pale-red (5R 6/2); silt to fine-grained sand; poorly sorted; composed of quartz, partly arkosic; biotite accessory mineral; calcareous cement.	10	860
Silty sandstone: Pale-red (5R 6/2); silt to coarse-grained sand; poorly sorted; composed of quartz, partly arkosic; biotite accessory mineral; chert, jasper, and limestone pellets.	20	880
Sandy silty mudstone: Grayish-red (5R 4/2); calcareous cement.	10	890
Silty sandstone: Grayish-red (5R 4/2) to light-gray (N 7); silt to fine-grained sand; poorly sorted; composed of quartz; biotite accessory mineral; calcareous cement.	10	900
Silty mudstone: Grayish-red (5R 4/2); limestone fragments; calcareous cement.	10	910
Sandy silty mudstone: Grayish-red (5R 4/2) and pale-red (10R 6/2); limestone pellets; calcareous cement.	50	960
Sandy siltstone: Grayish-red (10R 4/2); calcareous cement.	10	970
Sandy siltstone: Grayish-blue (5PB 5/2); calcareous cement.	10	980
Sandy siltstone: Pale-red (10R 6/2); biotite accessory mineral; calcareous cement.	20	1,000
Sandy siltstone: Pale-greenish-yellow (10Y 8/2); biotite and dark accessory minerals; calcareous cement.	20	1,020
Sandy siltstone: Grayish-red-purple (5RP 4/2); biotite accessory mineral; calcareous cement.	40	1,060
Sandy siltstone: Grayish-blue (5PB 5/2); biotite accessory mineral; mudstone pellets; calcareous cement.	10	1,070
Sandy siltstone: Grayish-purple (5P 4/2); biotite accessory mineral; mudstone and limestone pellets; calcareous cement.	20	1,090
Silty mudstone: Medium-gray (N 5) to light-bluish-gray (5B 7/1); calcareous cement.	60	1,150
Sandy siltstone: Brownish-gray (5YR 4/1) and grayish-red-purple (5RP 4/2); biotite accessory mineral; calcareous cement.	30	1,180
Mudstone and sandy siltstone: Medium-bluish-gray (5B 5/1) and medium-gray (N 5); biotite accessory mineral; calcareous cement.	20	1,200
Mudstone: Medium-light-gray (N 6); calcareous cement.	30	1,230
Mudstone: Grayish-red (5R 4/2) and medium-light-gray (N 6); calcareous cement.	30	1,260
Sandy mudstone: Very light gray (N 8) and pale-red (5R 6/2); calcareous cement.	20	1,280
Sandy siltstone: Grayish-orange-pink (5YR 7/2); calcareous cement.	20	1,300
Mudstone: Pale-red-purple (5RP 6/2) and medium-gray (N 5); calcareous cement.	10	1,310
Lower red member:		
Silty sandstone: Medium-gray (N 5); silt to medium-grained sand; poorly sorted; composed of quartz; mudstone pellets and quartz pebbles; calcareous cement.	30	1,340
Sandstone: Light-olive-gray (5Y 6/1); fine- to coarse-grained; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	10	1,350
Silty sandstone: Medium-light-gray (N 6); silt to very coarse grained sand; poorly sorted; composed of quartz; calcareous cement.	10	1,360
Sandy siltstone: Pale-red (10R 6/2); biotite accessory mineral; calcareous cement.	10	1,370
Shinarump Member:		
Silty sandstone: Light-olive-gray (5Y 6/1); silt to very coarse grained sand; poorly sorted; composed of quartz; jasper and siltstone fragments; calcareous cement.	40	1,410
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Sandstone: Very pale orange (10YR 8/2); very fine to coarse-grained; poorly sorted; composed of quartz; mudstone, jasper, and chert fragments; calcareous cement.	50	1,460
Silty sandstone: Pale-brown (5YR 5/2); silt to coarse-grained sand; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	10	1,470
Siltstone: Grayish-red (10R 4/2) and greenish-gray (5GY 6/1); biotite accessory mineral; sandy siltstone fragments; calcareous cement.	40	1,510
Sandy siltstone: Pale-reddish-brown (10R 5/4); calcareous cement.	40	1,550
Sandy siltstone: Moderate-orange-brown (10R 6/4); biotite accessory mineral; calcareous cement.	50	1,600
Silty mudstone: Grayish-red (10R 4/2); calcareous cement.	10	1,610
Sandy siltstone: Moderate-orange-brown (10R 6/4); biotite accessory mineral; calcareous cement.	60	1,670
Silty sandstone: Grayish-orange-pink (5YR 7/2); silt to medium-grained sand; poorly sorted; composed of quartz; biotite accessory mineral; mudstone pellets; calcareous cement.	20	1,690
PERMIAN:		
Coconino Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4) and grayish-red (10R 4/2); very fine to medium-grained; fair-sorted; composed of quartz; mudstone fragments; calcareous cement.	20	1,710
Sandstone: Moderate-yellowish-brown (10YR 5/4); very fine to medium-grained; fair-sorted; composed of quartz; mudstone fragments; calcareous cement.	20	1,730
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; fair-sorted; composed of stained quartz; mudstone fragments; calcareous cement.	114	1,844

8K-422
11-8.70-5.30

PERMIAN:		
Cutler Formation:		
Cedar Mesa Sandstone Member:		
Sandstone: Moderate-orange-brown (5YR 7/4); very fine to fine-grained; well-sorted; composed of rounded to subrounded, stained, amber, and clear quartz; rare dark accessory minerals; rare argillaceous material; firmly cemented, calcareous and ferruginous.	43	43
Sandstone: Pale-orange-brown (10R 6/4) and moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; poorly sorted; composed of rounded to subrounded, stained, amber, and clear quartz; common mica and rare dark accessory minerals; rare argillaceous material; firmly cemented, calcareous and argillaceous.	72	115
Sandstone: Moderate-orange-pink (5YR 8/4); very fine grained; silty; fair to poorly sorted; composed of subrounded to subangular, stained and clear quartz; rare to common mica and rare dark accessory minerals; rare to common hematite concretions; weakly cemented, calcareous.	39	154
Sandstone: Moderate-orange-pink (5YR 8/4), pale-reddish-brown (10R 5/4), and greenish-gray (5GY 6/1); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare mica and dark accessory minerals; common micaceous mudstone pellets; weakly cemented, calcareous.	11	165
Arenaceous siltstone: Moderate-reddish-orange (10R 6/6); silt and very fine to fine-grained sand; composed of subrounded to subangular, stained and clear quartz; rare to common mica and rare dark accessory minerals; weakly cemented, calcareous.	11	176
Sandstone: Moderate-pink-brown (5YR 7/4); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, stained and clear quartz; rare mica and dark accessory minerals; rare hematite concretions; weakly cemented, calcareous.	10	186
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair to poorly sorted; composed of subrounded to subangular, stained and clear quartz; rare mica and dark accessory minerals; rare hematite concretions; weakly cemented, calcareous.	124	310
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; poorly sorted; composed of rounded to subangular, stained and clear quartz; common mica and rare dark accessory minerals; common to absent argillaceous material; weakly cemented, calcareous.	46	356
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of subrounded to subangular, stained and clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	22	378
Sandstone: Reddish-orange-brown (10R 6/4); very fine to fine-grained; silty; fair to poorly sorted; composed of subrounded to subangular, stained and clear quartz; common mica and rare dark accessory minerals; rare argillaceous material; common micaceous mudstone fragments; weakly cemented, calcareous.	32	410
Sandstone: Pale-orange-red (10R 7/2); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, stained and clear quartz; common mica and rare dark accessory minerals; weakly cemented, calcareous.	8	418
Halgaito Tongue:		
Mudstone: Moderate-dusky-red (5R 4/4); silt and clay; abundant mica and common gypsum; weakly cemented, calcareous.	4	422

8A-273A
37-8.20-15.95

QUATERNARY:		
Alluvium:		
Silt and sand: Pale-red (10R 6/2); silt to very fine grained sand; poorly sorted; composed of quartz; calcareous cement.	10	10
Silt and sand: Pale-red (10R 6/2); silt to very fine grained sand; poorly sorted; composed of quartz; calcareous cement.	10	20
Silt and sand: Moderate-orange-pink (10R 7/4); silt to very fine grained sand; poorly sorted; composed of quartz; calcareous cement.	10	30
Silt and sand: Moderate-orange-pink (10R 7/4); silt to very fine grained sand; poorly sorted; composed of quartz; rare light-green (5G 7/4) claystone pellets; calcareous cement.	10	40
Silt and sand: Grayish-orange-pink (5YR 5/2); silt to medium-grained sand; poorly sorted; composed of quartz; few coal fragments; calcareous cement.	10	50
UPPER JURASSIC:		
Entrada Sandstone:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; fair-sorted; composed of rounded to subangular, amber and frosted quartz; rare black accessory minerals; calcareous and ferruginous cement.	10	60
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; fair-sorted; composed of rounded to subangular, amber and frosted quartz; rare black accessory minerals; calcareous and ferruginous cement.	10	70
Siltstone: Moderate-reddish-orange (10R 6/6); composed of subrounded to subangular, clear, stained, and frosted quartz; common black accessory minerals; calcareous cement.	10	80
Siltstone: Moderate-reddish-orange (10R 6/6); composed of subrounded to subangular, clear, stained, and frosted quartz; common black accessory minerals; calcareous cement.	10	90
Arenaceous siltstone: Moderate-reddish-orange (10R 6/6); silt and very fine to fine-grained sand; composed of subrounded to subangular, clear, frosted, and stained quartz; common dark accessory minerals; calcareous cement.	10	100
Sandstone: Moderate-orange-pink (10R 7/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear, frosted, and stained quartz; common black accessory minerals; calcareous cement.	10	110
Sandstone: Moderate-orange-pink (10R 7/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear, frosted, and stained quartz; common black accessory minerals; calcareous cement.	10	120
Sandstone: Moderate-orange-pink (10R 7/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear, frosted, and stained quartz; common black accessory minerals; calcareous cement.	10	130
Arenaceous siltstone: Moderate-reddish-orange (10R 6/6); silt and very fine sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare black and dark-red accessory minerals; calcareous cement.	10	140
Siltstone: Moderate-reddish-orange (10R 6/6); clay, silt, and rare fine-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare black and dark-red accessory minerals; calcareous cement.	10	150
Arenaceous siltstone: Moderate-reddish-orange (10R 6/6); clay, silt, and abundant very fine to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare black accessory minerals; few dark-reddish-brown (10R 3/4) claystone chips; calcareous cement.	10	160
Arenaceous siltstone: Moderate-orange-pink (10R 7/4); clay, silt, and abundant very fine to medium-grained sand; poorly sorted; rare black accessory minerals; common clay chips; rare very fine white (N 9) sandstone gravel; calcareous cement.	10	170
Sandstone: Moderate-orange-pink (10R 7/4); clay, silt, and very fine to medium-grained sand; composed of subrounded to subangular, clear, stained, and frosted quartz; rare dark accessory minerals; common clay chips; rare very fine grained white (N9) sandstone pebbles composed of quartz; calcareous cement.	10	180
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Siltstone: Moderate-orange-pink (10R 7/4); silt and rare fine-grained sand; composed of subrounded to subangular, clear, stained, and frosted quartz; calcareous cement.	10	190
Mudstone: Moderate-orange-pink (10R 7/4); mostly smaller than silt; few very fine sand particles; calcareous cement.	10	200
Mudstone: Moderate-orange-pink (10R 7/4); mostly smaller than silt; few very fine sand particles; calcareous cement.	10	210
Mudstone: Moderate-orange-pink (10R 7/4); mostly smaller than silt; few very fine sand particles; calcareous cement.	10	220
Mudstone: Moderate-orange-pink (10R 7/4); mostly smaller than silt; few very fine sand particles; calcareous cement.	10	230
Siltstone: Moderate-orange-pink (10R 7/4); slightly sandy; clay, silt, and very fine grained sand; poorly sorted; rare black accessory minerals; rare chert pebbles as large as half an inch in diameter; calcareous cement.	10	240
Siltstone: Moderate-orange-pink (10R 7/4); slightly sandy; clay, silt, and very fine grained sand; poorly sorted; rare black accessory minerals; rare chert pebbles as large as half an inch in diameter; calcareous cement.	10	250
Siltstone: Moderate-orange-pink (10R 7/4); clay, silt, and rare very fine grained sand; rare black accessory minerals; calcareous cement.	10	260
Siltstone: Moderate-orange-pink (10R 7/4); clay, silt, and abundant sand; rare black accessory minerals; calcareous cement.	40	300
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-reddish-orange (10R 6/6); silt to fine-grained sand; fair-sorted; composed of		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

8A-273A—Continued
37-8.20-15.95

	Thickness (feet)	Depth (feet)
subrounded to subangular, clear, stained, and frosted quartz; common dark accessory minerals; calcareous cement.	10	310
Sandstone: Moderate-orange-pink (10R 7/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; common dark accessory minerals; calcareous cement.	10	320
No samples.	10	330
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; fair-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; dark-red and black accessory minerals; siliceous cement.	30	360
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; subordinate silt; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; common black and red accessory minerals; weakly cemented, calcareous.	50	410
Sandstone: Same as from 360 to 410 feet, but contains more fine-grained sand.	40	450

8K-431
37-10.65-0.20

	Thickness (feet)	Depth (feet)
UPPER JURASSIC:		
Summerville Formation:		
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, frosted quartz; common white (N 9) clay and dark accessory minerals; calcareous cement.	80	80
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Argillaceous sandstone and arenaceous siltstone: Light-brown (5YR 6/4); silt to very fine grained sand; rare medium grain; rare mica and common finely divided black accessory minerals.	280	360
Siltstone: Moderate-orange-pink (10R 7/4); clay to silt; rare medium grain of angular, clear quartz sand; calcareous cement.	50	410
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (10R 7/4); silt to fine-grained sand; rare medium grain; fair-sorted; composed of subrounded to subangular, frosted quartz; rare dark accessory minerals; rare siltstone fragments; calcareous cement.	40	450
Sandstone: Moderate-orange-pink (5YR 8/4); fine-grained; well-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; common dark accessory minerals; common red siltstone fragments; calcareous cement.	20	470
Sandstone: Moderate-orange-pink (5YR 8/4); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear and frosted quartz; common dark accessory minerals; common red siltstone fragments.	10	480
Sandstone: Same as from 450 to 470 feet, but contains some medium grains and siliceous cement.	40	520
No samples.	8	528

8K-416
38-13.65-1.40

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Silty claystone: Pale-yellowish-brown (10YR 6/2).	10	10
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Light-brown (5YR 6/4); very fine grained; silty; well-sorted.	170	180
Sandstone: Grayish-orange-pink (5YR 7/2); fine-grained; well-sorted; tightly cemented, calcareous.	10	190
Sandstone: Light-brown (5YR 6/4); very fine grained; silty; well-sorted.	150	340
Sandstone: Grayish-orange (10YR 7/4); very fine grained; silty; well-sorted.	10	350
Sandstone: Light-brown (5YR 6/4); fine-grained; poorly sorted; a few medium grains of well-rounded quartz.	40	390
Sandstone: Light-brown (5YR 6/4); very fine grained; well-sorted.	110	500
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; composed of quartz.	170	670
UPPER TRIASSIC(?):		
Kayenta Formation:		
Sandstone: Pale-red (10R 6/2); very fine to fine-grained.	40	710
Sandy siltstone: Grayish-orange-pink (5YR 7/2) to medium-gray (N 5).	10	720
Silty sandstone: Grayish-orange-pink (5YR 7/2).	20	740
No samples.	10	750
Silty sandstone: Grayish-orange-pink (5YR 7/2).	20	770
Silty sandstone: Pale-red (5R 6/2).	10	780
Silty sandstone: Moderate-orange-pink (10R 7/4).	27	807

8K-420
38-0.90-3.35

	Thickness (feet)	Depth (feet)
UPPER JURASSIC:		
Morrison Formation:		
Recapture Shale Member(?):		
Sandstone: Pale-red (10R 6/2); fine- to medium-grained; fair-sorted; composed of quartz; calcareous cement.	30	30
Salt Wash Sandstone Member:		
Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; silty; calcareous cement.	90	120
Sandy siltstone: Grayish-red (10R 4/2); fair-sorted; calcareous cement.	20	140
Sandy siltstone: Light-brownish-gray (5YR 6/1); fine- to coarse-grained sand; fair-sorted; limestone fragments.	20	160
Cow Springs Sandstone:		
Sandstone: Grayish-orange-pink (10R 8/2); fine-grained; well-sorted; composed of quartz; calcareous cement.	30	190
Summerville Formation and Entrada Sandstone undifferentiated:		
Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; well-sorted; composed of quartz; calcareous cement.	30	220
Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; silty; well-sorted; calcareous cement.	40	260
Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; well-sorted; composed of quartz; calcareous cement.	110	370
Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; silty; well-sorted; calcareous cement.	130	500
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandy siltstone: Pale-reddish-brown (10R 5/4); well-sorted; calcareous cement.	30	530
Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; silty; well-sorted; calcareous cement.	70	600
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (10R 7/4); fine-grained; well-sorted; composed of quartz; calcareous cement.	170	770
Sandstone: Moderate-reddish-orange (10R 7/4); very fine grained; composed of quartz; siltstone fragments; calcareous cement; looks like caving.	20	790
Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; composed of quartz; grayish-red (10R 4/2) siltstone fragments; calcareous cement; looks like caving.	30	820
Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; well-sorted; composed of quartz; calcareous cement.	60	880
No samples.	20	900

8K-426
38-4.55-15.20

	Thickness (feet)	Depth (feet)
UPPER JURASSIC:		
Morrison Formation:		
Westwater Canyon Member:		
Sandstone: Yellowish-gray (5Y 7/2) to grayish-yellow (5Y 8/4); fine- to medium-grained; fair-sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; rare to common argillaceous material; weakly cemented, calcareous.	45	45
Sandstone: Yellowish-gray (5Y 7/2); fine- to medium-grained; fair-sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; rare to common argillaceous material; rare blue-green and reddish-brown mudstone fragments; weakly cemented, calcareous.	20	65
weakly cemented, calcareous.	10	335
Sandstone: Light-brownish-gray (5YR 6/1); medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; common mudstone fragments; weakly cemented, calcareous.	30	365
Silty sandstone: Light-brownish-gray (5YR 6/1); silt to medium-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; common blue-green and rare reddish-brown mudstone fragments; weakly cemented, calcareous.	80	445
Sandstone: Pinkish-gray (5YR 8/1); very fine to fine-grained; silty; well-sorted; composed of rounded to subangular, clear quartz; rare mudstone fragments; weakly cemented, calcareous.	40	485

Sandstone: Grayish-orange-pink (10R 8/2) to moderate-orange-pink (10R 7/4); fine- to medium-grained; fair-sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; common argillaceous material; rare mudstone fragments; weakly cemented, calcareous.	10	75
Sandstone: Grayish-orange-pink (10R 8/2) to moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare argillaceous material; mudstone fragments; weakly cemented, siliceous.	10	85
Sandstone: Yellowish-gray (5Y 7/2); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; common argillaceous material; rare siltstone fragments; weakly cemented, siliceous.	40	125
Recapture Shale Member:		
Sandstone: Grayish-red (10R 4/2); very fine to coarse-grained; poorly sorted; composed of subrounded to subangular, clear quartz; abundant siltstone and mudstone fragments; weakly cemented, calcareous.	20	145
Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; silty; fair-sorted; composed of rounded to subangular, clear quartz; common argillaceous material; common blue-green and reddish-brown mudstone fragments; weakly cemented, argillaceous and siliceous.	20	165
Sandstone: Light-greenish-gray (5GY 8/1); fine- to medium-grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; common blue-green and reddish-brown mudstone fragments; weakly cemented, calcareous.	10	175
Sandstone: Grayish-orange-pink (5YR 7/2), pale-reddish-brown (10R 5/4), and pale-blue-green (5BG 7/2); fine- to medium-grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; abundant mudstone fragments; weakly cemented, calcareous.	120	295
Sandstone: Grayish-orange-pink (5YR 7/2), pale-reddish-brown (10R 5/4), and pale-blue-green (5BG 7/2); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; common argillaceous material; abundant mudstone fragments; weakly cemented, calcareous and argillaceous.	30	325
Silty sandstone: Light-brownish-gray (5YR 6/1); silt to medium-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; common reddish-brown and blue-green mudstone fragments;		
Sandstone: Light-brownish-gray (5YR 6/1); very fine to coarse-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare argillaceous material; common mudstone fragments; weakly cemented, calcareous.	30	515
Arenaceous siltstone: Pale-brown (5YR 5/2); silt to coarse-grained sand; composed of clear and pale-green stained quartz; common blue-green and reddish-brown mudstone fragments; weakly cemented, calcareous.	30	545
Sandstone: Pale-brown (5YR 5/2); fine- to coarse-grained; silty; composed of rounded to angular, clear and green stained quartz; rare pyrite accessory mineral; common blue-green and reddish-brown mudstone and siltstone fragments; weakly cemented, calcareous.	50	595
Arenaceous siltstone: Grayish-orange-pink (5YR 7/2); silt to medium-grained sand; composed of quartz; common mudstone fragments; weakly cemented, calcareous.	10	605
Silty sandstone: Grayish-orange-pink (5YR 7/2); silt to fine-grained sand; fair-sorted; composed of quartz; rare argillaceous material; common mudstone fragments; weakly cemented, calcareous.	20	625
Salt Wash Sandstone Member:		
Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; common mudstone fragments; weakly cemented, calcareous.	30	655
Mudstone and siltstone: Pale-brown (5YR 5/2); clay, silt, and some fine-grained sand composed of quartz; fragments of firmly cemented clear quartz aggregates; firmly cemented, calcareous.	10	665
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; fair-sorted; composed of subrounded to angular, clear quartz; common mudstone fragments; firmly cemented, calcareous.	20	685
Silty sandstone: Pinkish-gray (5YR 8/1); silt and fine- to medium-grained sand; fair-sorted; composed of subrounded to angular, clear quartz; common mudstone fragments; weakly cemented, calcareous.	40	725
Silty sandstone: Light-brownish-gray (5YR 6/1); silt and fine- to medium-grained sand; fair-sorted; composed of subrounded to angular, clear quartz; common mudstone fragments; weakly cemented, calcareous.	10	735
Silty sandstone: Moderate-brown (5YR 3/4); silt and fine-grained sand; fair-sorted; composed of subrounded to angular, clear quartz; common reddish-brown mudstone fragments; weakly cemented, calcareous.	34	769

8T-419
38-7.00-9.90

UPPER JURASSIC:		
Morrison Formation:		
Westwater Canyon Member:		
Sandstone: Grayish-yellow (5Y 8/4); fine- to medium-grained; fair-sorted; composed of clear quartz; calcareous cement.	60	60
Recapture Shale Member:		
Sandstone and mudstone: Yellowish-gray (5Y 8/1) sandstone, fine- to medium-grained, well-sorted; grayish-red (5R 4/2) and pale-blue-green (5BG 7/2) mudstone; calcareous cement.	30	90
Sandstone and mudstone: Yellowish-gray (5Y 8/1) sandstone, fine- to medium-grained, well-sorted; grayish-red (5R 4/2) and pale-blue-green (5BG 7/2) mudstone; calcareous cement.	200	290
Silty sandstone and mudstone: Light-greenish-gray (5GY 8/1) silty sandstone, fine- to medium-grained, well-sorted; grayish-red (5R 4/2) and pale-blue-green (5BG 7/2) mudstone; calcareous cement.	230	520
Salt Wash Sandstone Member:		
Siltstone: Bluish-white (5B 9/1); light-greenish-gray (5GY 8/1) silty sandstone, fine- to medium-grained, well-sorted; grayish-red (5R 4/2) and pale-blue-green (5BG 7/2) mudstone; calcareous cement.	100	620
Summerville Formation:		
Silty sandstone: Pale-reddish-brown (10R 5/4); fine-grained; well-sorted; calcareous cement.	70	690
Silty sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; calcareous cement.	40	730
Entrada Sandstone:		
Silty sandstone: Light-brown (5YR 5/6); very fine grained; well-sorted; calcareous cement.	130	860
Silty sandstone: Light-brown (5YR 5/6); very fine grained; well-sorted; calcareous cement.	40	900
Silty sandstone: Light-brown (5YR 5/6); very fine grained; well-sorted; calcareous cement.	50	950
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Silty sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; well-sorted; calcareous cement.	20	970
Silty sandstone: Pale-reddish-brown (10R 5/4); very fine grained; well-sorted; calcareous cement.	110	1,080
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; calcareous cement.	200	1,280

8K-435
54-9.90-1.30

UPPER JURASSIC:		
Entrada Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); silt to fine-grained sand; fair-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; common black and rare green accessory minerals; calcareous cement.	30	30
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained, minor silt and rare medium grain; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; calcareous cement.	10	40
Siltstone: Moderate-reddish-orange (10R 6/6); silt to very fine grained sand; fair-sorted; composed of subrounded to subangular, frosted and stained quartz; calcareous cement.	10	50
Sandstone: Moderate-reddish-orange (10R 6/6) and moderate-orange-pink (5YR 8/4); silt to fine-grained sand, rare medium grain; fair-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; dark-red and black accessory minerals; calcareous cement.	50	100
Sandstone: Moderate-orange-brown (5YR 7/4); fine-grained; well-sorted; composed of rounded to subrounded, clear, stained, and frosted quartz; dark-red and black accessory minerals; weakly cemented, calcareous and siliceous.	20	120
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Siltstone: Moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4); rare well-rounded grains of clear quartz; calcareous cement.	10	130
Sandstone: Moderate-orange-pink (10R 7/4); silt to fine-grained sand; fair to poorly sorted; composed of rounded to subangular, clear and frosted quartz; rare black accessory minerals; rare brown siltstone pellets; calcareous cement.	40	170
Sandy siltstone: Moderate-orange-pink (10R 7/4); silt to fine-grained sand; calcareous cement.	20	190
Mudstone: Pale-reddish-brown (10R 5/4); clay to silt; micaceous; calcareous cement.	20	210
Siltstone: Moderate-orange-pink (10R 7/4) to pale-reddish-brown (10R 5/4); mudstone pellets; micaceous.	40	250
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Silty sandstone: Moderate-reddish-orange (10R 6/6);		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

8K-435—Continued
54-9.90-1.30

	Thickness (feet)	Depth (feet)
very fine grained, rare fine or medium grain; fair to poorly sorted; composed of clear and frosted quartz; common dark accessory minerals; weakly cemented, calcareous.	10	260
Sandstone: Moderate-orange-pink (5YR 7/4); very fine to medium-grained; fair- to well-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; common dark accessory minerals; weakly cemented, calcareous.	40	300
Sandstone: Same as from 260 to 300 feet; siliceous cement.	90	390
Sandstone: Same as from 260 to 300 feet.	71	461

9K-219
8-7.70-13.90

	Thickness (feet)	Depth (feet)
QUATERNARY AND UPPER JURASSIC:		
Alluvium and Entrada Sandstone undifferentiated:		
Sand: Brownish-orange-pink (5YR 7/4); very fine to coarse-grained; poorly sorted; composed of well-rounded to subangular, clear, frosted, and stained quartz; rare dark accessory minerals; rare jasper; weakly cemented, calcareous.	80	80
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; poorly sorted; composed of well-rounded to subangular, clear and stained quartz; common to abundant micaceous siltstone fragments; rare dark accessory minerals; weakly cemented, calcareous.	130	210
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; fair-sorted; composed of rounded to subangular, clear and stained quartz; rare dark accessory minerals; common limonite stain; common micaceous siltstone fragments; weakly cemented, calcareous and ferruginous.	60	270
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	160	430
Sandstone: Moderate-orange-pink (5YR 8/4 to 10R 7/4); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	30	460
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	30	490
No samples.	18	508

9T-214
8-12.80-7.35

	Thickness (feet)	Depth (feet)
UPPER JURASSIC:		
Bluff Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	30	30
Sandstone: Grayish-orange-pink (5YR 7/2); very fine grained; well-sorted; composed of quartz; calcareous cement.	10	40
Sandstone: Very pale orange (10YR 8/2); very fine grained; well-sorted; composed of quartz; calcareous cement.	20	60
Sandstone: Grayish-orange-pink (5YR 7/2); very fine grained; well-sorted; composed of quartz; calcareous cement.	20	80
Summerville Formation:		
Sandy siltstone: Pale-brown (5YR 5/2); calcareous cement.	50	130
Sandstone: Very pale orange (10YR 8/2); very fine grained; well-sorted; composed of quartz; calcareous cement.	10	140
Sandy siltstone: Pale-brown (5YR 5/2); calcareous cement.	80	220
Sandy siltstone: Pale-reddish-brown (10R 5/4); calcareous cement.	20	240
Entrada Sandstone:		
Middle member:		
Sandy siltstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	30	270
Silty sandstone: Moderate-reddish-orange (10R 6/6); silt to very fine grained sand; well-sorted; calcareous cement.	60	330
Lower member:		
Sandy siltstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	10	340
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandy siltstone: Pale-reddish-brown (10R 5/4); fragments of very light gray (N 8) very fine grained sandstone; calcareous cement.	100	440
Sandy siltstone: Moderate-reddish-orange (10R 6/6); fragments of very light gray (N 8) very fine grained sandstone; calcareous cement.	20	460
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; small fragments of siltstone; calcareous cement.	30	490
Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; well-sorted; calcareous cement.	10	500
Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; well-sorted; calcareous cement.	20	520
Silty sandstone: Moderate-orange-pink (10R 7/4); silt to very fine grained sand; well-sorted; calcareous cement.	10	530
Silty sandstone: Pale-reddish-brown (10R 5/4); silt to very fine grained sand; well-sorted; calcareous cement.	50	580
No samples.	10	590

9K-221
9-3.60-7.80

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sand: Light-brownish-orange (5YR 7/4); very fine to medium-grained; well-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare dark accessory minerals; weakly cemented, calcareous.	10	10
Sand: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; silty; poorly sorted; composed of rounded to subangular, clear and stained quartz; rare dark accessory minerals; common fragments of micaceous siltstone; weakly cemented, calcareous.	10	20
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandy siltstone and mudstone: Silt, clay, and very fine to medium-grained sand; composed of rounded to subangular, clear and stained quartz; rare mica and dark accessory minerals; weakly cemented, calcareous.	40	60
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Pale-greenish-yellow (10Y 8/2); very fine to fine-grained; poorly sorted; composed of subrounded to subangular, clear and frosted quartz; rare feldspar, mica, and red accessory minerals; weakly cemented, calcareous.	40	100
Sandstone: Very pale orange (10YR 8/2), pale-greenish-yellow (10Y 8/2), and grayish-red (10R 4/2); very fine to medium-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; rare argillaceous material; common mudstone pellets; weakly cemented, calcareous and argillaceous.	30	130
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; some silt; fair-sorted; composed of rounded to subangular, clear and stained quartz; common dark accessory minerals; weakly cemented, calcareous.	70	200
No samples.	9	209

9T-220
9-5.50-3.10

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sand: Light-brown (5YR 6/4); very fine to medium-grained; fair-sorted; composed of well-rounded to subangular, clear, stained, and frosted quartz; common limonite and rare dark accessory minerals; weakly cemented, calcareous and ferruginous.	10	10
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandy siltstone: Pale-reddish-brown (10R 5/4); silt and very fine to medium-grained sand; composed of well-rounded to subrounded, clear and stained quartz; common mica and rare dark accessory minerals; common argillaceous material; weakly cemented, calcareous.	90	130

UPPER JURASSIC:		
Entrada Sandstone:		
Silty sandstone: Pale-reddish-brown (10R 5/4); silt to medium-grained sand; poorly sorted; composed of well-rounded to subrounded, clear and stained quartz; rare mica and dark accessory minerals; common argillaceous material and siltstone fragments; weakly cemented, calcareous.	30	40
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4) to grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of subrounded to subangular, frosted, clear, stained, and pitted quartz; common limonite and rare dark accessory minerals; weakly cemented, calcareous and ferruginous.	275	405

9K-216
20-6.45-11.00

UPPER JURASSIC:		
Morrison Formation:		
Salt Wash Sandstone Member:		
Sandstone: Pale-red (10R 6/2); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	50	50
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	20	70
Sandstone: Grayish-orange-pink (10R 8/2); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	50	120
Sandy siltstone: Grayish-orange-pink (5YR 7/2); calcareous cement.	30	150
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	170
Sandy siltstone: Grayish-orange-pink (5YR 7/2); calcareous cement.	40	210
Bluff Sandstone:		
Sandstone: Pinkish-gray (5YR 8/1); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	230
Summerville Formation:		
Sandy siltstone: Grayish-orange-pink (5YR 7/2); muscovite and biotite accessory minerals; siltstone fragments; calcareous cement.	30	260
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	280
Sandstone: Grayish-orange-pink (10R 8/2); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	300
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	30	330
Entrada Sandstone:		
Sandy siltstone: Moderate-orange-pink (10R 7/4); calcareous cement.	30	360
Sandy siltstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	60	420
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	40	460
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandy siltstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	110	570
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	580
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-reddish-orange (10R 4/6); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	600
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	92	692

9K-217
20-8.10-13.70

QUATERNARY:		
Alluvium:		
Sand: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	10	10
Sand: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	30
Silty sand: Moderate-reddish-orange (10R 6/6); silt and very fine to medium-grained sand; fair-sorted; composed of quartz; calcareous cement.	10	40
Sand: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of quartz; siltstone, mudstone, and limestone fragments; calcareous cement.	11	51

9K-218
21-7.35-9.35

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	150	150
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	40	190
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	20	210
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	230
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	250
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	260
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	280
UPPER TRIASSIC(?):		
Kayenta Formation:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to coarse-grained; poorly sorted; composed of quartz; calcareous cement.	110	390
UPPER TRIASSIC:		
Wingate Sandstone:		
Lukachukai Member:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	110	500
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	16	516

9T-222
35-9.65-1.80

UPPER JURASSIC:		
Morrison Formation:		
Salt Wash Sandstone Member:		
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	40	40
Summerville Formation:		
Sandstone: Moderate-orange-pink (10R 7/4) to pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; rare argillaceous material; rare to moderately common grayish-red mudstone fragments; weakly cemented, calcareous.	60	100
Sandstone: Moderate-orange-pink (10R 7/4) to pale-reddish-brown (10R 5/4); fine- to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and frosted quartz; rare argillaceous material; common grayish-red mudstone fragments; weakly cemented, calcareous.	120	220
Entrada Sandstone:		
Sandstone: Moderate-orange-pink (10R 7/4) to pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear and frosted quartz; rare dark accessory minerals; rare argillaceous material; bottom 20 feet has a higher percentage of silt; weakly cemented, calcareous.	100	320
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear and frosted quartz; rare dark accessory minerals; weakly cemented, calcareous.	40	360
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandstone: Moderate-reddish-brown (10R 4/6); very fine to fine-grained; silt and some medium-grained sand; well-sorted; composed of subrounded to subangular, clear and frosted quartz; rare dark accessory minerals; weakly cemented, calcareous.	40	400
Sandstone: Moderate-orange-pink (10R 7/4) to pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; well-sorted; composed of subrounded to		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

9T-222—Continued
35-9.65-1.80

	Thickness (feet)	Depth (feet)
subangular, clear quartz; rare dark accessory minerals; rare to common mudstone fragments; weakly cemented, calcareous.	50	450
Sandy siltstone and mudstone: Pale-reddish-brown (10R 5/4); clay to medium-grained sand; poorly sorted; weakly cemented, calcareous.	10	460
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; rare dark accessory minerals; weakly cemented, calcareous.	30	490
No samples.	10	500
Sandstone: Moderate-orange-pink (10R 7/4); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; rare to moderately common dark accessory minerals; mudstone fragments; weakly cemented, calcareous.	30	530
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	20	550
UPPER TRIASSIC(?):		
Kayenta Formation:		
Silty sandstone: Moderate-orange-pink (10R 7/4) to pale-red (10R 6/2); silt to fine-grained sand; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	20	570
UPPER TRIASSIC:		
Wingate Sandstone:		
Lukachukai Member:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	80	650
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; rare feldspar and dark accessory minerals; weakly cemented, calcareous.	60	710
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare feldspar and dark accessory minerals; rare to moderately common mudstone fragments; weakly cemented, calcareous.	110	820
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; rare mudstone fragments; weakly cemented, calcareous.	20	840
No samples.	13	853

9K-215
36-10.80-11.50

	Thickness (feet)	Depth (feet)
JURASSIC AND TRIASSIC(?), AND UPPER TRIASSIC(?):		
Navajo Sandstone and Kayenta Formation undifferentiated:		
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	40	40
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	320	360
UPPER TRIASSIC(?) AND UPPER TRIASSIC:		
Kayenta Formation and Wingate Sandstone undifferentiated:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	120	480
Sandy siltstone: Moderate-reddish-orange (10R 6/6); calcareous cement.	161	641

10T-238
53-6.75-5.80

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Silt: Pale-red (10R 6/2); silt and fine- to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare feldspar accessory mineral; rare wood fragments and green micaceous material; weakly cemented, calcareous.	40	40
Sand: Pale-red (10R 6/2); very fine to medium-grained; silty; poorly sorted; composed of subrounded to angular, clear, frosted, and stained quartz; rare mica, feldspar, limonite, and dark accessory minerals; weakly cemented, calcareous.	20	60
Silt: Pale-red (10R 6/2); silt and very fine to medium-grained sand; composed of subrounded to angular, clear, frosted, and stained quartz; rare dark accessory minerals; rare green micaceous material; weakly cemented, calcareous.	20	80
UPPER TRIASSIC:		
Chinle Formation:		
Owl Rock Member:		
No samples.	20	100
Sandstone: Pale-red (10R 6/2); very fine to very coarse grained; silty; poorly sorted; composed of subrounded to subangular, clear, frosted, and amber quartz; rare feldspar, limonite, and dark accessory minerals; rare carbonaceous material; rare green micaceous material and limestone and claystone pellets; weakly cemented, calcareous.	50	150
Siltstone: Grayish-pink (5R 8/2) to light-red (5R 6/6); silt and some sand; rare green micaceous material; rare to common limestone fragments and pellets; weakly cemented, calcareous; bottom 20 feet caved in.	10	160

10T-233
70-7.05-15.30

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sand: Pale-reddish-brown (10R 5/4); very fine to medium-grained; fair-sorted; fragments of light-gray (N 7) siltstone and basaltic lava; calcareous cement.	20	20
UPPER TRIASSIC:		
Chinle Formation:		
Lower red member:		
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; silty; fair-sorted; fragments of light-gray (N 7) siltstone; calcareous cement.	10	30
Sandstone: Light-brownish-gray (5YR 6/1); very fine to medium-grained; silty; fair-sorted; fragments of light-gray (N 7) siltstone; calcareous cement.	10	40
Sandstone: Medium-light-gray (N 6); very fine to medium-grained; silty; fair-sorted; fragments of light-gray (N 7) siltstone; calcareous cement.	20	60
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; fair-sorted; fragments of light-gray (N 7) siltstone; calcareous cement.	10	70
Sandy siltstone: Pale-reddish-brown (10R 5/4); fair-sorted.	20	90
Shinarump Member:		
Sandstone: Grayish-orange-pink (10R 8/2); very fine to medium-grained; fair-sorted; composed of quartz.	20	110
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; silty; fair-sorted; composed of quartz.	30	140
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; fair-sorted; composed of quartz.	240	380
Sandstone: Moderate-orange-pink (10R 7/4); very fine to coarse-grained; poorly sorted; composed of quartz.	20	400
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of quartz.	100	500
Sandy siltstone: Light-brown (5YR 6/4); fair-sorted; calcareous cement.	10	510
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; calcareous cement.	100	610
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; silty; fair-sorted; calcareous cement.	10	620
Sandstone: Moderate-orange-pink (5YR 8/4); fair-sorted; calcareous cement.	10	630
Sandstone: Moderate-reddish-orange (10R 6/6); fair-sorted; calcareous cement.	20	650
Sandstone: Moderate-orange-pink (5YR 8/4); fair-sorted; calcareous cement.	30	680
Sandstone: Moderate-reddish-orange (10R 6/6); fair-sorted; calcareous cement.	50	730

10K-234
71-12.45-14.40

	Thickness (feet)	Depth (feet)
UPPER TRIASSIC:		
Wingate Sandstone:		
Lukachukai Member:		
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous		
No samples; drilling contractors changed at 1,323 feet.	80	1,400
Mudstone: Moderate-red (5R 5/4) and pale-red (5R 6/2); silt and clay; common mica and rare dark accessory minerals; common limestone pellets and		

cement.	10	10
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	10	20
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	50	70
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	30	100
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	40	140
Siltstone: Moderate-orange-pink (5YR 8/4); sandy; calcareous cement.	20	160
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	170
Rock Point Member:		
Siltstone: Moderate-orange-pink (5YR 8/4); sandy; calcareous cement.	60	230
Siltstone: Light-brown (5YR 6/4); sandy; calcareous cement.	420	650
Chinle Formation:		
Owl Rock Member:		
Mudstone and limestone: Pale-red (10R 6/2) and light-gray (N 7); silty; siltstone fragments; calcareous cement.	50	700
Mudstone and limestone: Pale-red (10R 6/2), light-gray (N 7), and grayish-red (10R 4/2); silty; siltstone fragments; calcareous cement.	140	840
Mudstone: Pale-red (10R 6/2) and grayish-red (10R 4/2); silty; siltstone fragments; calcareous cement.	30	870
Mudstone: Pale-red (10R 6/2) and grayish-red (10R 4/2); silty; siltstone and limestone fragments; calcareous cement.	100	970
Mudstone and siltstone: Pale-red (10R 6/2) and grayish-red (10R 4/2); calcareous cement.	30	1,000
Petrified Forest Member, upper part:		
Mudstone and siltstone: Pale-reddish-brown (10R 5/4); calcareous cement.	80	1,080
Mudstone and claystone: Pale-reddish-brown (10R 5/4) and grayish-red (10R 4/2); limestone fragments.	50	1,130
Mudstone and claystone: Pale-reddish-brown (10R 5/4) and grayish-red (10R 4/2); calcareous cement.	20	1,150
Mudstone and claystone: Pale-reddish-brown (10R 5/4) and grayish-red (10R 4/2); limestone fragments; calcareous cement.	170	1,320
fragments; weakly to firmly cemented, calcareous.	100	1,500
Petrified Forest Member, Sonsela Sandstone Bed:		
Sandstone: Very light gray (N 8); very fine to medium-grained; composed of subrounded to subangular, clear quartz; rare chlorite(?) and common mica and feldspar accessory minerals; abundant argillaceous material; weakly to firmly cemented, argillaceous.	20	1,520
Mudstone and claystone: Pale-red (5R 6/2); silt and clay; common mica accessory mineral; weakly cemented, calcareous.	20	1,540
Mudstone: Medium-light-gray (N 6); silt and clay; claystone; weakly cemented, calcareous.	20	1,560
Sandstone: Pale-pink-purple (5RP 7/2); very fine grained; arkosic; composed of subrounded to subangular, clear and stained quartz; common feldspar, mica, chlorite(?), and dark accessory minerals; abundant argillaceous material; weakly cemented, calcareous and argillaceous.	40	1,600
Petrified Forest Member, lower part:		
Mudstone: Medium-red-purple (5RP 5/2) to grayish-red (10R 4/2); silt and clay; common mica and rare dark accessory minerals; common limestone pellets; weakly to firmly cemented, calcareous.	130	1,730
Mudstone: Medium-red-purple (5RP 5/2) and very light gray (N 8); silt and clay; micaceous; abundant dark accessory minerals; bleached stringers; common limestone pellets; weakly cemented.	35	1,765
Lower red member:		
Mudstone: Light-bluish-gray (5B 7/1); limestone calcite fragments; abundant limestone pellet conglomerate.	30	1,795
Mudstone: Very dusky red (10R 2/2) to grayish-red (10R 4/2); clay, silt, and very fine grained sand composed of rounded to subrounded stained quartz; becomes sandiest toward base; common mica and calcite fragments; weakly cemented, calcareous.	35	1,830
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; some silt; composed of well-rounded to angular, clear and stained quartz; some mudstone pellets; weakly cemented, calcareous.	5	1,835
Mudstone and siltstone: Very pale orange (10YR 8/2), dark-reddish-brown (10R 3/4), and moderate-reddish-orange (10R 6/6); some sand; common mica accessory mineral in both units; weakly cemented.	20	1,855
No samples.	7	1,862

10T-242
71-5.10-6.65

QUATERNARY:		
Alluvium:		
Silty sand: Pale-yellowish-brown (10YR 6/2); silt to medium-grained sand; fair- to well-sorted; composed of subrounded to angular, clear quartz; rare limonite and rare to moderately common dark accessory minerals; rare fragments of coal and micaceous mudstone; weakly cemented, calcareous and argillaceous.	20	20
Silt and mud: Pale-yellowish-brown (10YR 6/2); clay, silt, and very fine to coarse-grained sand; poorly sorted; composed of rounded to angular, clear and amber quartz; rare feldspar accessory mineral; weakly cemented, calcareous and argillaceous.	10	30
Silty sand: Pale-yellowish-brown (10YR 6/2) to grayish-orange-pink (5YR 7/2); silt to medium-grained sand; fair- to well-sorted; composed of subrounded to angular, clear quartz; rare limonite, moderately common to absent gypsum, and rare to moderately common dark accessory minerals; rare fragments of coal and micaceous mudstone; weakly cemented, calcareous and argillaceous.	80	110
Sand: Very pale orange (10YR 8/2) to pale-yellowish-brown (10YR 6/2); fine- to coarse-grained; composed of subrounded to angular, clear, frosted, and amber quartz; rare mica, limonite, and gypsum, common feldspar, and moderately common dark accessory minerals; moderately common fragments of mudstone and claystone; weakly cemented, calcareous.	9	119
Silty sand: Pale-yellowish-brown (10YR 6/2); silt to medium-grained sand; fair- to well-sorted; composed of subrounded to angular, clear quartz; rare limonite, rare to absent gypsum, and moderately common dark accessory minerals; rare fragments of coal and micaceous mudstone; weakly cemented, calcareous and argillaceous.	31	150
Sandy mud and silt: Pale-red (10R 6/2); clay, silt, and fine- to coarse-grained sand; poorly sorted; composed of rounded to angular, clear and frosted quartz; rare feldspar accessory mineral; common calcareous material; firmly to weakly cemented, calcareous.	10	160
Silty sand: Pale-yellowish-brown (10YR 6/2); silt and very fine to medium-grained sand; fair- to well-sorted; composed of subrounded to angular, clear quartz; rare to moderately common dark accessory minerals; rare fragments of coal and micaceous mudstone; weakly cemented, calcareous and argillaceous.	10	170
Gravel and sand: Variegated; coarse-grained to granule; well-rounded to angular quartz fragments; moderately common feldspar accessory mineral; quartzite, limestone, mudstone, siltstone, ferruginous, gypsiferous, and calcareous materials.	45	215
Sand: Grayish-pink (5R 8/2) to pale-red (5R 6/2); medium to very coarse grained; poorly sorted; composed of subrounded to angular, clear, frosted, and amber quartz; common fragments of limestone, siltstone, mudstone, jasper, chalcedony, and chert; rare to moderately common feldspar and gypsum and common black and red accessory minerals; weakly cemented, calcareous.	1	216

10K-245
72-0.45-8.90

QUATERNARY:		
Alluvium:		
Sand: Pale-yellowish-brown (10YR 6/2); fine- to medium-grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; weakly cemented, calcareous.	20	20
Silty sand: Light-brown (5YR 6/4) to grayish-orange-pink (5YR 7/2); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	20	40
Silty sand: Light-brown (5YR 6/4) to grayish-orange-pink (5YR 7/2); silt to medium-grained sand; fair to poorly sorted; composed of subrounded to angular, clear quartz; rare to absent mudstone fragments; weakly cemented, calcareous.	20	60
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Siltstone and mudstone: Pale-reddish-brown (10R 5/4) to moderate-reddish-orange (10R 6/6); clay, silt, and medium-grained sand composed of quartz; weakly cemented, calcareous.	10	70
Silty sandstone: Light-brown (5YR 6/4) to grayish-orange-pink (5YR 7/2); silt to medium-grained sand; fair to poorly sorted; composed of subrounded to angular, clear quartz; weakly cemented, calcareous.	60	130
UPPER TRIASSIC:		
Wingate Sandstone:		
Lukachukai Member:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; composed of subrounded		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
10K-245—Continued		
72-0.45-8.90		
to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	210	340
Silty sandstone: Light-brown (5YR 6/4) to moderate-orange-pink (5YR 8/4); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	130	470
Rock Point Member(?):		
No samples.	13	483
Nazlini 2		
90-11.50-7.15		
UPPER TRIASSIC:		
Chinle Formation:		
Lower red member:		
Siltstone: Pale-red (10R 6/2); silt and very fine grained sand composed of quartz; common argillaceous material; rare blue-green micaceous siltstone fragments; firmly cemented, calcareous and argillaceous.	10	10
Siltstone and mudstone: Light-greenish-gray (5GY 8/1); silt and clay; rare gray and reddish-brown mudstone pellets; firmly cemented, calcareous and argillaceous.	20	30
Siltstone and mudstone: Very light gray (N 8); silt and clay; rare calcite crystals; firmly cemented quartz aggregates; rare to absent coal fragments; firmly cemented, calcareous and argillaceous.	30	60
Siltstone and mudstone: Pale-red (10R 6/2) to pale-red-purple (5RP 6/2); silt and clay; common argillaceous material; common grayish-black (N 2) and blue-green mudstone fragments; firmly cemented, calcareous and argillaceous.	10	70
Sandy siltstone: Pinkish-gray (5YR 8/1); silt and very fine to medium-grained sand; poorly sorted; composed of subrounded to angular, clear and stained quartz; common argillaceous material; grayish-black (N 2) and blue-green mudstone pellets; weakly cemented, calcareous and argillaceous.	10	80
Sandy siltstone: Grayish-orange-pink (10R 8/2) to pale-red (10R 6/2); silt and very fine to medium-grained sand; poorly sorted; composed of subrounded to angular, clear and stained quartz; common argillaceous material; grayish-black (N 2) and blue-green mudstone pellets; rare hematite spherules; weakly cemented, calcareous and argillaceous.	20	100
Shinarump Member:		
Silty sandstone: Grayish-orange-pink (10R 8/2) to pale-red (10R 6/2); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; common argillaceous material; dark-gray (N 3) and blue-green mudstone fragments and pellets; weakly cemented, calcareous and argillaceous.	10	110
Silty sandstone: Grayish-orange-pink (10R 8/2); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; dark-gray (N 3) and blue-green mudstone fragments and pellets; weakly cemented, calcareous and argillaceous.	10	120
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare to absent dark accessory minerals; rare mudstone fragments; weakly cemented, calcareous and siliceous.	70	190
Sandstone: Grayish-orange-pink (10R 8/2); very fine to medium-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; common mudstone fragments; weakly cemented, siliceous.	30	220
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare to absent mudstone fragments; weakly cemented, siliceous.	86	306
10T-239		
91-2.45-0.75		
UPPER TRIASSIC:		
Chinle Formation:		
Lower red member:		
Siltstone and mudstone: Pale-red (5R 6/2); silt and clay; moderately common gypsum, rare mica and dark accessory minerals; rare argillaceous material; weakly cemented, calcareous and argillaceous.	5	5
Sandy siltstone: Very light gray (N 8); silt and very fine to medium-grained sand; moderately common gypsum accessory mineral; moderately common argillaceous material; weakly cemented, calcareous and argillaceous.	15	20
Siltstone: Pale-red (5R 6/2); silt; rare gypsum accessory mineral; blue-green and reddish-brown mudstone fragments; weakly cemented, calcareous.	15	35
Siltstone: Pale-reddish-brown (10R 5/4); silt; rare reddish-brown mudstone fragments; weakly cemented, calcareous.	10	45
Siltstone: Pale-reddish-brown (10R 5/4); blue-green and reddish-brown mudstone fragments; weakly cemented, calcareous.	85	130
Siltstone: Pale-red (5R 6/2); silt; blue-green and reddish-brown mudstone fragments; weakly cemented, calcareous.	10	140
Siltstone: Light-brownish-gray (5YR 6/1); silt; rare argillaceous material; greenish-gray mudstone fragments; weakly cemented, calcareous and argillaceous.	5	145
Mudstone and siltstone: Light-bluish-gray (5B 7/1); clay, silt, and fine- to medium-grained sand; limestone and gypsum fragments; weakly cemented, calcareous.	5	150
No samples.	5	155
Siltstone: Very light gray (N 8); silt; rare carbonaceous material; mudstone fragments; weakly cemented, calcareous.	10	165
Mudstone and siltstone: Light-gray (N 7); silt and clay; rare pyrite and dark accessory minerals; subangular fragments of limestone; rare coal; weakly cemented, calcareous.	5	170
Mudstone and siltstone: Grayish-purple (5P 4/2); clay, silt, and fine- to medium-grained sand; rare pyrite accessory mineral; subangular fragments of limestone; weakly cemented, calcareous.	20	190
Shinarump Member:		
Sandstone: Grayish-red-purple (5RP 4/2); fine to coarse-grained; poorly sorted; composed of rounded to angular, clear, stained, frosted, and amber quartz; common mudstone and siltstone fragments; weakly cemented, calcareous.	10	200
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Dark-yellowish-orange (10YR 6/6) to light-brown (5YR 5/6); fine to medium-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; common mudstone fragments; weakly cemented, calcareous.	30	230
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; composed of subrounded to subangular, clear and stained quartz; weakly cemented, calcareous.	5	235
Sandstone: Light-brown (5YR 5/6); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; common mudstone fragments; weakly cemented, calcareous.	25	260
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; silty; composed of subrounded to subangular, clear and stained quartz; common mudstone fragments; weakly cemented, calcareous.	5	265
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; moderately common mudstone fragments; weakly cemented, calcareous.	40	305
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; moderately common mudstone fragments; weakly cemented, calcareous.	15	320
Sandstone: Dark-yellowish-orange (10YR 6/6); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; common mudstone fragments; weakly cemented, calcareous.	10	330
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; common mudstone fragments; weakly cemented, calcareous.	5	335
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; weakly cemented, calcareous.	85	420
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; rare mudstone pellets; weakly cemented, calcareous.	20	440
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair to poorly sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; rare mudstone pellets and argillaceous material, rare to absent carbonaceous material; weakly cemented, calcareous and argillaceous.	308	748

10T-244
91-7.40-1.10

QUATERNARY:		
Alluvium:		
Sandy silt: Moderate-reddish-orange (10R 6/6); silt and very fine to very coarse grained sand; rare to absent gravel; poorly sorted; rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	100	100
Sand and gravel: Moderate-reddish-orange (10R 6/6); very fine to very coarse grained; silty; composed of quartz; moderately common large hematite concretions and common dark accessory minerals; common chalcedony pebbles; calcareous cement.	10	110
UPPER TRIASSIC:		
Chinle Formation:		
Owl Rock Member:		
Siltstone and mudstone: Grayish-red (5R 4/2) to pale-red (5R 6/2); silt and clay; calcareous cement.	1	111

11K-238
35-7.15-10.40

QUATERNARY:		
Alluvium:		
Silty sand: Grayish-orange-pink (10R 8/2) and light-brown (5YR 6/4); silt to coarse-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare dark accessory minerals; rare chert, limestone, and argillaceous material; firmly cemented, calcareous.	20	20
UPPER TRIASSIC:		
Wingate Sandstone:		
Rock Point Member:		
Siltstone: Light-brown (5YR 6/4) and pale-red (10R 6/2); silt and very fine grained quartz sand; rare chert and limestone fragments; firmly cemented, calcareous.	120	140
Chinle Formation:		
Owl Rock Member:		
Siltstone and mudstone: Pale-red (5R 6/2 and 10R 6/2) and light-brown (5YR 6/4); clay and silt; rare to absent calcite crystals; rare to common chert, rare limestone fragments, and some light-blue-green (5BG 6/6) mudstone fragments; firmly cemented, calcareous.	80	220
Silty mudstone: Pale-red (5R 6/2); clay and silt; rare limestone fragments; calcareous cement.	20	240
Silty mudstone: Pale-red (10R 6/2); clay and silt; rare limestone fragments; calcareous cement.	20	260
Silty mudstone: Pale-red (5R 6/2); clay and silt; rare to absent calcite crystals; rare to absent chert and rare limestone fragments; calcareous cement.	20	280
Silty mudstone: Pale-red (10R 6/2); clay and silt; rare chert and limestone fragments; calcareous cement.	30	310
Petrified Forest Member, upper part:		
Silty mudstone: Pale-reddish-brown (10R 5/4) and pale-red (5R 6/2); clay, silt, and rare very fine to fine-grained quartz sand; rare limestone fragments; calcareous cement.	190	500
Silty mudstone: Pale-red (5R 6/2), grayish-red (10R 4/2), and pale-reddish-brown (10R 5/4); clay, silt, and rare very fine to fine-grained quartz sand; calcareous cement.	70	570
Silty mudstone and claystone: Moderate-reddish-brown (10R 4/6); clay and silt; rare limestone fragments; calcareous cement.	20	590
Silty mudstone and claystone: Pale-red (10R 6/2) and pale-reddish-brown (10R 5/4); clay and silt; rare limestone fragments; calcareous cement.	20	610
Silty mudstone: Moderate-reddish-brown (10R 4/6); clay and silt; calcareous cement.	10	620
Silty mudstone and claystone: Pale-red (5R 6/2); clay and silt; calcareous cement.	20	640
Silty mudstone and claystone: Pale-red (5R 6/2) to grayish-red (5R 4/2); clay and silt; limestone pellets and fragments; calcareous cement.	50	690
Silty mudstone and claystone: Grayish-red-purple (5RP 4/2), pale-red (5R 6/2), and grayish-red (5R 4/2); clay and silt; limestone pellets and fragments; calcareous cement.	35	725
Silty mudstone and claystone: Pale-red-purple (5RP 6/2) and grayish-red-purple (5RP 4/2); clay and silt; limestone pellets and fragments; calcareous cement.	50	775
Petrified Forest Member, Sonsela Sandstone Bed:		
Sandstone: Light-brownish-gray (5YR 6/1); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare mica accessory mineral; common claystone fragments; calcareous cement.	5	780
Silty sandstone: Light-brownish-gray (5YR 6/1), pale-reddish-brown (10R 5/4), and pale-red-purple (5RP 6/2); silt to medium-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare to absent pyrite accessory mineral; rare limestone and abundant claystone fragments; calcareous cement.	30	810
Sandy siltstone: Pale-red (5R 6/2); silt to medium-grained sand; poorly sorted; rare limestone; calcareous cement.	5	815
Silty sandstone: Pale-red (5R 6/2) and light-gray (N 7); silt to medium-grained sand; poorly sorted; composed of subrounded to angular, clear and stained quartz; rare mica accessory mineral; calcareous cement.	15	830
Petrified Forest Member, lower part:		
Siltstone and mudstone: Pale-red (5R 6/2); clay, silt, and very fine to medium-grained quartz sand; common limestone fragments; calcareous cement.	70	900
Sandstone: Pale-red (5R 6/1), light-greenish-gray (5G 8/1), and light-brownish-gray (5YR 6/1); fine- to coarse-grained; poorly sorted; composed of subrounded to angular, clear quartz; rare mica accessory mineral; rare limestone fragments and carbonaceous material, common mudstone and siltstone fragments; calcareous cement.	30	930
Sandy siltstone: Pale-red (5R 6/2), light-greenish-gray (5G 8/1), and grayish-red-purple (5RP 4/2); silt to medium-grained quartz sand; rare to absent mica accessory mineral; rare limestone fragments, abundant mudstone fragments, and rare to absent carbonaceous material; calcareous cement.	60	990
Siltstone and mudstone: Light-greenish-gray (5G 8/1) and moderate-reddish-brown (10R 4/6); clay, silt, and fine- to medium-grained quartz sand; rare mica accessory mineral; rare limestone fragments; calcareous cement.	20	1,010
Siltstone: Pale-red (5R 6/2) to grayish-red (5R 4/2); silt; rare limestone and mudstone fragments; calcareous cement.	10	1,020
Sandy siltstone: Pale-red (5R 6/2) to grayish-red (5R 4/2); silt to coarse-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; rare micaceous siltstone; calcareous cement.	10	1,030
Silty sandstone: Pale-red-purple (5RP 6/2) to grayish-red-purple (5RP 4/2); fine- to coarse-grained; poorly sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; rare micaceous siltstone; calcareous cement.	20	1,050
Lower red member:		
Siltstone, mudstone, and claystone: Pale-red (5R 6/2) to grayish-red (5R 4/2); clay, silt, and rare to common fine- to coarse-grained quartz sand; rare limestone and micaceous siltstone fragments; calcareous cement.	50	1,100
Sandy siltstone: Grayish-red (5R 4/2); silt to medium-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; mudstone fragments; calcareous cement.	10	1,110
Siltstone, mudstone, and claystone: Grayish-red (5R 4/2), light-greenish-gray (5G 8/1), and grayish-red-purple (5RP 4/2); clay and silt; rare limestone fragments; calcareous cement.	10	1,120
Sandstone: Pale-red (5R 6/2); very fine to fine-grained; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare mica accessory mineral; rare limestone fragments and common siltstone and mudstone fragments; calcareous cement.	10	1,130
Siltstone and mudstone: Pale-red (5R 6/2), light-greenish-gray (5G 8/1), and pale-reddish-brown (10R 5/4); clay, silt, and rare to common very fine to medium-grained quartz sand; rare mica accessory mineral; rare limestone; calcareous cement.	60	1,190
Shinarump Member:		
Silty sandstone: Pale-red (10R 6/2); very fine to very coarse grained; poorly sorted; composed of subrounded to angular, clear and stained quartz; rare mica and rare to absent pyrite accessory minerals; rare hematite spherules; common siltstone and mudstone fragments; calcareous cement.	20	1,210
Sandstone: Very light gray (N 8); fine- to medium-grained; fair- to well-sorted; composed of subangular to angular, clear quartz; rare pyrite accessory mineral; rare hematite spherules; rare siltstone and mudstone fragments; calcareous cement.	100	1,310
Silty sandstone: Pinkish-gray (5YR 8/1); very fine to medium-grained; fair-sorted; composed of subrounded to angular, clear and frosted quartz; calcareous cement.	10	1,320
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Very pale orange (10YR 8/2); fine- to medium-grained; well-sorted; composed of subrounded to angular, clear quartz; weakly cemented, calcareous.	50	1,370
No samples.	7	1,377

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

11Y-234
51-12.60-6.00

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sand: Grayish-orange-pink (5YR 7/2); fine- to coarse-grained; poorly sorted; limestone fragments; calcareous cement.	10	10
Sand: Pinkish-gray (5YR 3/1) and light-gray (N 7); fine- to coarse-grained; silty; poorly sorted; basalt and claystone fragments; calcareous cement.	10	20
Sand: Grayish-orange-pink (5YR 7/2); fine- to coarse-grained; fair-sorted; basalt fragments; calcareous cement.	10	30
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member, Sonsela Sandstone Bed:		
Sandstone: Very light gray (N 8); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	10	40
Sandstone: Light-gray (N 7); very fine to coarse-grained; silty; poorly sorted; limestone fragments.	10	50
Sandstone: Medium-light-gray (N 6); very fine to coarse-grained; silty; poorly sorted; limestone fragments; calcareous cement.	10	60
Sandstone: Pinkish-gray (5YR 8/1); very fine to coarse-grained; poorly sorted; calcareous cement.	10	70
Petrified Forest Member, lower part:		
Silty mudstone: Pale-red-purple (5RP 6/2); fair-sorted; sand; calcareous cement.	20	90
Silty mudstone: Pale-red-purple (5RP 6/2); claystone fragments; calcareous cement.	50	140
Silty mudstone: Pale-red-purple (5RP 6/2); limestone fragments.	60	200
Silty mudstone: Pale-red-purple (5RP 6/2); limestone fragments.	10	210
Silty mudstone: Grayish-red (5R 4/2); limestone and claystone fragments.	30	240
Silty mudstone: Grayish-red-purple (5RP 4/2); limestone and claystone fragments.	10	250
Silty mudstone: Grayish-red (5R 4/2); limestone and claystone fragments.	10	260
Silty mudstone: Pale-red (5R 6/2); calcareous cement.	40	300
Silty mudstone: Pale-red (5R 6/2); claystone fragments; calcareous cement.	10	310
Silty mudstone: Pale-red-purple (5RP 6/2); claystone fragments; calcareous cement.	20	330
Lower red member:		
Sandstone: Light-brownish-gray (5YR 6/1); very fine to coarse-grained; silty; poorly sorted; mudstone and claystone fragments.	10	340
Sandstone: Pinkish-gray (5YR 8/1); very fine to coarse-grained; silty; poorly sorted; mudstone and claystone fragments.	10	350
Sandstone: Pinkish-gray (5YR 8/1); fine to very coarse grained; silty; poorly sorted; mudstone fragments; calcareous cement.	10	360
Sandstone: Pinkish-gray (5YR 8/1); very fine to fine-grained; well-sorted.	30	390
Sandstone: Pinkish-gray (5YR 8/1); very fine to fine-grained; silty; well-sorted.	10	400
Sandstone: Light-gray (N 7); very fine to fine-grained; silty; well-sorted; calcareous cement.	50	450
Sandstone: Light-brownish-gray (5YR 6/1); fine- to medium-grained; well-sorted; calcareous cement.	30	480
Sandstone: Very light gray (N 8); fine- to medium-grained; well-sorted.	10	490
Shinarump Member:		
Sandstone: Light-gray (N 7); very fine to very coarse grained; poorly sorted; mudstone fragments; calcareous cement.	50	540
Sandstone: Very light gray (N 8); very fine to medium-grained; well-sorted.	10	550
Sandstone: Pinkish-gray (5YR 8/1); fine- to coarse-grained; fair-sorted; mudstone fragments.	80	630
Sandstone: Pinkish-gray (5YR 8/1); fine- to coarse-grained; well-sorted; mudstone fragments.	20	650
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Pinkish-gray (5YR 8/1); very fine to medium-grained; well-sorted; mudstone fragments.	40	690
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; well-sorted; mudstone fragments.	10	700
Sandstone: Very pale orange (10YR 8/2); fine- to medium-grained; well-sorted; composed of quartz; mudstone fragments; calcareous cement.	20	720
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; well-sorted; composed of quartz; mudstone fragments; calcareous cement.	60	780
Sandstone: Very pale orange (10YR 8/2); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	10	790
Sandstone: Grayish-orange-pink (10R 8/2); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	810
Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	830
Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; fair-sorted; composed of quartz; calcareous cement.	40	870
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	880
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	10	890
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	900

11K-237
52-9.15-14.70

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sandy silt: Brownish-orange-pink (5YR 7/4); calcareous cement.	10	10
Sand: Brownish-orange-pink (5YR 7/4); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	20
UPPER TRIASSIC:		
Chinle Formation:		
Shinarump Member:		
Mudstone and claystone: Light-gray (N 7) to medium-gray (N 5).	30	50
Sandy siltstone: Pinkish-gray (5YR 8/1); calcareous cement.	30	80
Sandstone: Pale-orange-brown (10YR 7/2); very fine to coarse-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	100
Sandstone: Yellowish-gray (5Y 8/1); very fine to coarse-grained; silty; poorly sorted; composed of quartz; biotite accessory mineral; calcareous cement.	20	120
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; silty; poorly sorted; composed of quartz; biotite accessory mineral; calcareous cement.	40	160
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	30	190
Sandstone: White (N 9); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	120	310
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	180	490
No samples.	27	517

12T-312
1-7.25-11.30

	Thickness (feet)	Depth (feet)
UPPER CRETACEOUS:		
Dakota Sandstone:		
Sandy silt and mudstone: Yellowish-gray (5Y 8/1) and medium-gray (N 5).	30	30
Sandstone: Yellowish-gray (5Y 8/1) and very pale orange (10YR 8/2); very fine to coarse-grained; silty; poorly sorted; composed of quartz; mudstone fragments.	50	80
LOWER CRETACEOUS:		
Burro Canyon Formation:		
Silty mudstone: Light-greenish-gray (5GY 8/1) and grayish-red (5R 4/2); calcareous cement.	60	140
Sandy siltstone: Yellowish-gray (5Y 8/1) and light-greenish-gray (5GY 8/1); sand and mudstone.	20	160
Mudstone: Light-bluish-gray (5B 7/1) to yellowish-gray (5Y 8/1); sand and silt.	50	210
(5YR 3/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; siltstone fragments; calcareous cement.	20	780
Sandy siltstone: Pale-brown (5YR 5/2) and grayish-brown (5YR 3/2); sandstone and mudstone fragments; calcareous cement.	50	830
Bluff Sandstone:		
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	40	870
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; silty; poorly sorted; composed of quartz; calcareous cement.	90	960
Summerville Formation:		
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; fair to poorly sorted;		

UPPER JURASSIC:		
Morrison Formation:		
Brushy Basin Member:		
Sandy siltstone and mudstone: Light-brownish-gray (5YR 6/1) to light-greenish-gray (5GY 8/1).	30	240
Siltstone and mudstone: Grayish-orange-pink (5YR 7/2) and light-greenish-gray (5GY 8/1).	20	260
Siltstone and mudstone: Light-greenish-gray (5GY 8/1) and grayish-red (5R 4/2); silt to coarse-grained sand fragments; composed of quartz; poorly sorted.	70	330
Sandstone: Yellowish-gray (5Y 8/1), light-greenish-gray (5GY 8/1), and grayish-pink (5R 8/2); very fine to medium-grained; poorly sorted; composed of quartz; siltstone and mudstone; calcareous cement.	20	350
Mudstone and siltstone: Light-bluish-gray (5B 7/1) and very light gray (N 8); sandstone fragments.	20	370
Westwater Canyon Member:		
Sandstone: Very light gray (N 8); very fine to medium-grained; fair-sorted; composed of quartz; siltstone and mudstone fragments; calcareous cement.	130	500
Salt Wash Sandstone Member:		
Sandstone: Light-brownish-gray (5YR 6/1); very fine to medium-grained; silty; poorly sorted; composed of quartz; siltstone fragments; calcareous cement.	60	560
Sandstone: Very pale orange (10YR 8/2) and grayish-red (5R 4/2); very fine to coarse-grained; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	40	600
Sandy siltstone: Pale-brown (5YR 5/2); mudstone fragments; calcareous cement.	10	610
Sandstone: Pale-brown (5YR 5/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	50	660
Sandy siltstone: Pale-brown (5YR 5/2); mudstone fragments; calcareous cement.	70	730
Sandy siltstone: Pale-brown (5YR 5/2) and very pale orange (10YR 8/2); sandstone and mudstone fragments; calcareous cement.	30	760
Sandstone: Pale-brown (5YR 5/2) and grayish-brown composed of quartz; calcareous cement.	140	1,100
Entrada Sandstone:		
Sandstone: Very pale orange (10YR 8/2), grayish-brown (5YR 3/2), and moderate-reddish-orange (10R 6/6); very fine to medium-grained; well-sorted; composed of quartz; mudstone fragments; calcareous cement.	40	1,140
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	60	1,200
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; silty; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	20	1,220
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	15	1,235
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	30	1,265
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	1,285
Sandy siltstone: Grayish-orange-pink (10R 8/2); calcareous cement.	10	1,295
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	20	1,315
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	40	1,355
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	49	1,404

12T-327
1-13.30-11.80

QUATERNARY:		
Alluvium:		
Silty sand: Yellowish-gray (5Y 7/2); very fine to medium-grained; poorly sorted; composed of subrounded to subangular, clear quartz; rare to absent carbonaceous material; weakly cemented, calcareous.	30	30
UPPER JURASSIC:		
Morrison Formation:		
Westwater Canyon Member:		
Silty sandstone: Light-greenish-gray (5GY 8/1); silt to medium-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; rare to absent pyrite accessory mineral; weakly cemented, calcareous.	20	50
Sandy siltstone: Very light gray (N 8); silt and very fine grained quartz sand; weakly cemented, calcareous.	30	80
Silty sandstone: Pinkish-gray (5YR 8/1) and yellowish-gray (5Y 8/1); silt to medium-grained sand; poorly sorted; composed of subrounded to subangular, clear and frosted quartz; rare mudstone fragments; weakly cemented, calcareous.	10	90
Sandstone: Grayish-orange-pink (5YR 7/2), very light gray (N 8), and yellowish-gray (5Y 8/1); very fine to fine-grained; silty; well-sorted; composed of subrounded to angular, clear, stained, and frosted quartz; rare to absent pyrite accessory mineral; rare to absent mudstone fragments; weakly cemented, calcareous; encountered water.	40	130
Salt Wash Sandstone Member:		
Sandstone: Grayish-orange-pink (10R 8/2) to pale-brown (5YR 5/2); very fine to fine-grained; silty; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; common siltstone and mudstone fragments; weakly cemented, calcareous.	10	140
Siltstone: Pinkish-gray (5YR 8/1), light-brownish-gray (5YR 6/1), and pale-red (10R 6/2); silt; common mudstone fragments; weakly cemented, calcareous.	70	210
Sandstone: Pale-red (10R 6/2); very fine to fine-grained; silty; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare siltstone and mudstone fragments; weakly cemented, calcareous.	10	220
Siltstone: Pale-reddish-brown (10R 5/4); silt; common mudstone fragments; weakly cemented, calcareous.	10	230
Sandstone: Grayish-orange-pink (5YR 7/2) and pale-orange (10YR 7/2); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare to common mudstone fragments; weakly cemented, calcareous.	20	250
Siltstone and mudstone: Grayish-red (10R 4/2); clay and silt; weakly cemented, calcareous.	10	260
Siltstone: Moderate-brown (5YR 3/4); silt and rare very fine grained quartz sand; rare mudstone fragments; weakly cemented, calcareous.	10	270
Siltstone and mudstone: Pale-red (10R 6/2) and grayish-pink (5R 8/2); clay and silt; weakly cemented, calcareous.	80	350
Sandstone: Moderate-orange-pink (10R 7/4) to pale-reddish-brown (10R 5/4); very fine grained; silty; well-sorted; composed of subrounded to angular, clear, stained, and frosted quartz; weakly cemented, calcareous.	10	360
Sandy siltstone: Pale-red (10R 6/2); silt and very fine to fine-grained quartz sand; weakly cemented, calcareous.	10	370
Bluff Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; weakly cemented, siliceous.	30	400
No samples.	30	430
Sandstone: Moderate-orange-pink (10R 7/4); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; common to absent siltstone and mudstone fragments; weakly cemented, calcareous.	90	520
Summerville Formation:		
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; well-sorted; composed of rounded to subrounded, clear and stained quartz; rare to absent hematite spherules; firmly cemented, calcareous.	50	570
No samples.	15	585

12T-321
17-6.15-1.20

UPPER CRETACEOUS:		
Point Lookout Sandstone:		
Silty sandstone: Very pale orange (10YR 8/2); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; rare siltstone fragments; weakly cemented, calcareous.	10	10
Silty sandstone: Very pale orange (10YR 8/2) to grayish-orange (10YR 7/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; rare siltstone fragments; weakly cemented, calcareous.	10	20
Silty sandstone: Yellowish-gray (5Y 7/2) to dusky-yellow (5Y 6/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; rare siltstone fragments; weakly cemented, calcareous.	10	30
Silty sandstone: Yellowish-grayish-orange (10YR 7/6); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; rare siltstone fragments; weakly cemented, calcareous.	20	50
Silty sandstone: Yellowish-grayish-orange (10YR 7/6); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; rare mica flakes; rare siltstone fragments; weakly cemented, calcareous.	10	60
Silty sandstone: Yellowish-gray (5Y 7/2); silt to fine-		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

12T-321—Continued
17-6.15-1.20

	Thickness (feet)	Depth (feet)
grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; rare mica flakes; rare siltstone fragments; weakly cemented, calcareous.	10	70
Siltstone: Medium-light-gray (N 6); silt and fine-grained quartz sand; rare mica accessory mineral; weakly cemented, calcareous.	10	80
Silty sandstone: Yellowish-gray (5Y 7/2); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; rare mica accessory mineral; rare siltstone fragments; weakly cemented, calcareous.	10	90
Silty sandstone: Yellowish-gray (5Y 7/2) and grayish-yellow (5Y 8/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear quartz; rare mica accessory mineral; rare siltstone fragments; weakly cemented, calcareous.	30	120
Silty sandstone: Very light gray (N 8); silt to very fine grained sand; fair to poorly sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; weakly cemented, calcareous.	130	250
Silty sandstone: Very light gray (N 8); silt to fine-grained sand; poorly sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; rare to absent mudstone fragments; weakly cemented, calcareous.	40	290
Sandstone: Very light gray (N 8); fine-grained; fair-sorted; composed of subangular to angular, clear quartz; rare pyrite and mica accessory minerals; common mudstone and siltstone fragments; firmly cemented, calcareous.	10	300
Silty sandstone: Very light gray (N 8); very fine grained; poorly sorted; composed of subangular to angular, clear quartz; rare mica accessory mineral; weakly cemented, calcareous.	50	350
Mancos Shale:		
Siltstone and mudstone: Very light gray (N 8); clay, silt, and fine-grained quartz sand; firmly cemented, calcareous.	15	365

12T-322
17-3.65-17.05

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sand: Grayish-yellow (5Y 8/4) to yellowish-gray (5Y 7/2); silt to medium-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; common to absent quartzite gravel; weakly cemented, calcareous.	30	30
Sand: Light-olive-gray (5Y 6/1); silt to coarse-grained sand; poorly sorted; composed of subrounded to angular, clear and frosted quartz; common to absent volcanic fragments; weakly cemented, calcareous.	20	50
UPPER CRETACEOUS:		
Mancos Shale:		
Siltstone and mudstone: Medium-gray (N 5); clay and silt; weakly cemented, calcareous.	44	94

12K-317
18-7.80-3.60

	Thickness (feet)	Depth (feet)
UPPER CRETACEOUS:		
Mancos Shale:		
Mudstone: Yellowish-gray (5Y 7/2); clay and silt; common mica accessory mineral; firmly cemented, calcareous.	20	20
Mudstone and siltstone: Medium-light-gray (N 6) to medium-dark-gray (N 4); clay and silt; common mica accessory mineral; weakly cemented, calcareous.	130	150
Sandstone: Very light gray (N 8); very fine to fine-grained; silty; poorly sorted; composed of rounded to subrounded, clear quartz; abundant mica and common dark accessory minerals; weakly to firmly cemented, argillaceous and calcareous.	30	180
Mudstone: Medium-light-gray (N 6) to medium-dark-gray (N 4); clay and silt; common mica accessory mineral; firmly cemented, calcareous.	50	230
Mudstone: Medium-dark-gray (N 4); clay and silt; common mica and gypsum accessory minerals; firmly cemented, calcareous.	420	650
Mudstone: Very light gray (N 8) to medium-dark-gray (N 4); clay and silt; common mica, bentonitic clay, and gypsum accessory minerals; firmly cemented, calcareous.	10	660
Silty sandstone: Medium-gray (N 5); silt to fine-grained sand; poorly sorted; composed of subrounded, clear quartz; common mica accessory mineral; weakly cemented, calcareous.	10	670
Mudstone: Medium-dark-gray (N 4); clay and silt; common mica and gypsum accessory minerals; firmly cemented, calcareous.	20	690
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; common mica accessory mineral; weakly cemented, calcareous.	10	700
Mudstone: Medium-gray (N 5); clay and silt; common mica accessory mineral; weakly cemented, calcareous.	10	710
Dakota Sandstone:		
Sandy siltstone: Medium-gray (N 5); silt and very fine to medium-grained sand; composed of subrounded to subangular, clear quartz; common mica accessory mineral; weakly cemented, calcareous.	40	750
Sandstone: Very light gray (N 8); very fine to medium-grained; silty; poorly sorted; composed of rounded to subrounded, clear quartz; common mica and rare feldspar and dark accessory minerals; weakly cemented, calcareous.	60	810
Mudstone: Medium-gray (N 5); clay and silt; common mica and gypsum accessory minerals; weakly cemented, calcareous.	20	830
Sandstone: Very light gray (N 8); very fine to medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare feldspar and common pyrite accessory minerals; weakly cemented, calcareous.	30	860
LOWER CRETACEOUS:		
Burro Canyon Formation:		
Sandy siltstone: Light-greenish-gray (5G 8/1); silt to fine-grained sand; composed of subrounded, clear quartz; common mica accessory mineral; common argillaceous material and calcite fragments; weakly cemented, argillaceous and calcareous.	14	874

12K-319
18-1.45-10.40

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Clay: Silty and sandy.	2	2
Sand: Yellowish-gray (5Y 8/1); fine- to coarse-grained; composed of quartz; basalt, jasper, garnet, monzonite, magnetite, and fragments of igneous rocks; calcareous cement.	10	12
Gravel: Fragments of igneous rocks, sandstone, and claystone.	14	26
Sand: Yellowish-gray (5Y 8/1); fine- to coarse-grained; composed of quartz; fragments of igneous rocks, garnet, basalt, magnetite, and jasper.	2	28

12K-320
32-13.20-13.05

	Thickness (feet)	Depth (feet)
UPPER CRETACEOUS:		
Mancos Shale (upper part):		
Sandy siltstone: Yellowish-gray (5Y 7/2); silt to fine-grained sand; composed of subrounded to subangular, clear and stained quartz; common mica and rare gypsum accessory minerals; rare argillaceous material; weakly cemented, calcareous and argillaceous.	20	20
Siltstone: Medium-light-gray (N 6); silt; common mica and rare gypsum and dark accessory minerals; rare to absent carbonaceous material and mudstone and limestone fragments; rare argillaceous material; weakly cemented, calcareous and argillaceous.	440	460
Gallup Sandstone:		
Sandstone: Light-gray (N 7); fine- to coarse-grained; poorly sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	10	470
Sandy siltstone: Light-gray (N 7); silt and very fine to medium-grained sand; composed of rounded to sub-		
UPPER JURASSIC:		
Morrison Formation:		
Brushy Basin Member:		
Sandstone: Light-olive-gray (5Y 6/1); very fine to coarse-grained; silty; poorly sorted; composed of subangular to angular, clear quartz; rare mica, gypsum, pyrite, and limonite, and rare to absent dark accessory minerals; rare limestone fragments and common coal fragments; weakly cemented, calcareous.	10	1,480
Sandstone: Pale-yellowish-brown (10YR 6/2); very fine to medium-grained; poorly sorted; composed of subangular to angular, clear and stained quartz; rare mica, gypsum, pyrite, and dark accessory minerals; common silt and clay fragments and moderately common coal fragments; weakly cemented, calcareous.	10	1,490
Sandstone: Very light gray (N 8) to medium-light-gray (N 6); very fine to medium-grained; silty; poorly sorted; composed of subangular to angular, clear and		

angular, clear quartz; common mica accessory mineral; rare to common argillaceous material; weakly cemented, calcareous and argillaceous.	10	480
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous and argillaceous.	60	540
Mancos Shale (lower part):		
Sandy siltstone: Light-gray (N 7); silt and very fine to fine-grained sand; composed of subrounded to subangular, clear quartz; common mica accessory mineral; weakly cemented, calcareous.	70	610
Siltstone and mudstone: Medium-gray (N 5); clay and silt; common mica and rare to absent pyrite and gypsum accessory minerals; weakly cemented, calcareous.	180	790
No samples.	40	830
Siltstone: Light-gray (N 7) to medium-light-gray (N 6); silt and very fine to fine-grained sand; rare mica and dark accessory minerals; weakly cemented, calcareous.	10	840
Siltstone: White (N 9) to dark-gray (N 3); silt and very fine to fine-grained sand; moderately common to absent gypsum and rare mica and dark accessory minerals; rare firmly cemented quartz aggregates; weakly cemented, calcareous.	110	950
Siltstone: Light-gray (N 7) to dark-gray (N 3); clay and silt; rare dark accessory minerals; weakly cemented, calcareous.	350	1,300
Dakota Sandstone:		
Siltstone: Medium-gray (N 5) to medium-dark-gray (N 4); clay and silt; moderately common gypsum and rare dark accessory minerals; rare pyrite with well-developed crystals; weakly cemented, calcareous.	30	1,330
Silty sandstone: Medium-light-gray (N 6) to medium-gray (N 5); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; moderately common mica and dark accessory minerals; weakly cemented, calcareous.	10	1,340
Sandstone: Yellowish-gray (5Y 7/2); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare mica, feldspar, and pyrite, and moderately common dark accessory minerals; weakly cemented, calcareous and ferruginous.	40	1,380
Sandstone: Yellowish-gray (5Y 7/2) to pale-yellowish-brown (10YR 6/2); fine- to coarse-grained; fair to poorly sorted; composed of subrounded to subangular, clear quartz; rare to common pyrite, and rare mica, limonite, and dark accessory minerals; common claystone and siltstone fragments and rare to absent carbonaceous material; weakly cemented, calcareous and ferruginous.	70	1,450
Clayey siltstone: White (N 9) to grayish-black (N 2); clay, silt, and very fine to medium-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; rare mica and gypsum and rare to absent pyrite accessory minerals; common coal fragments; weakly cemented, calcareous and argillaceous.	20	1,470
stained quartz; rare mica, pyrite, and limonite accessory minerals; moderately common coal fragments; weakly cemented, calcareous.	20	1,510
Sandy siltstone and mudstone: Light-gray (N 7) to medium-light-gray (N 6); clay, silt, and very fine to coarse-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; rare to common gypsum, moderately common pyrite, and rare limonite accessory minerals; common coal fragments; weakly cemented, calcareous and argillaceous.	10	1,520
Westwater Canyon Member and Recapture Shale Member undifferentiated:		
Sandstone: Light-olive-gray (5Y 6/1) to pale-yellowish-brown (10YR 6/2); very fine to medium-grained; poorly sorted; composed of rounded to angular, clear, frosted, and stained quartz; rare gypsum and common mica, pyrite, limonite, and dark accessory minerals; common coal fragments; weakly cemented, calcareous and ferruginous.	30	1,550
Sandstone: Moderate-yellowish-brown (10YR 5/4); very fine to coarse-grained; poorly sorted; composed of rounded to subangular, clear, stained, and amber quartz; common pyrite, limonite, and dark accessory minerals; moderately common siltstone and limestone fragments and carbonaceous material; weakly cemented, calcareous and ferruginous.	10	1,560
Sandstone: Pale-yellowish-brown (10YR 6/2) to yellowish-gray (5Y 7/2); very fine to coarse-grained; fair to poorly sorted; composed of subangular to angular, clear and stained quartz; rare mica, gypsum, pyrite, and dark accessory minerals; common silt and clay fragments and moderately common coal fragments; weakly cemented, calcareous.	70	1,630
Sandstone: Grayish-yellow (5Y 8/4) to yellowish-gray (5Y 7/2); very fine to coarse-grained; poorly sorted; composed of rounded to subangular, clear and frosted quartz; rare feldspar and common pyrite, limonite, and dark accessory minerals; rare chert and common limestone and mudstone fragments; weakly cemented, calcareous.	20	1,650
Sandy siltstone and mudstone: Pinkish-gray (5YR 8/1) to light-greenish-gray (5G 8/1); silt and fine- to coarse-grained sand; poorly sorted; composed of rounded to subangular, clear, stained, and frosted quartz; common pyrite and rare dark accessory minerals; common argillaceous material; firmly cemented, argillaceous and calcareous.	10	1,660
Sandstone: Pale-yellowish-brown (10YR 6/2); very fine to medium-grained; fair- to well-sorted; composed of subrounded to angular, clear and stained quartz; rare feldspar and pyrite, and common limonite and dark accessory minerals; common mudstone fragments; weakly cemented, calcareous.	120	1,780
Cow Springs Sandstone:		
Sandstone: Pale-yellowish-orange (10YR 8/6); fine- to medium-grained; fair-sorted; composed of subrounded to angular, clear and stained quartz; rare feldspar and common dark accessory minerals; common mudstone fragments; weakly cemented, calcareous.	10	1,790
No samples.	10	1,800

12T-324
33-11.15-12.80

UPPER CRETACEOUS:		
Mancos Shale (lower part):		
Siltstone: Light-gray (N 7); sandy; common mica accessory mineral; rare selenite crystals; calcareous cement; common white (N 9) clay fragments from 620 to 670 feet.	670	670
Sandstone: Light-gray (N 7); medium-grained; well-sorted; composed of subangular to angular, clear and frosted quartz; rare pyrite accessory mineral; rare iron stain; rare white (N 9) clay fragments and abundant dark-gray (N 3) siltstone fragments; quartz grains have crystal faces; weakly cemented, calcareous.	10	680
Siltstone: Light-gray (N 7); sandy; common mica accessory mineral; rare selenite crystals; calcareous cement.	10	690
Dakota Sandstone:		
Sandstone: Very light gray (N 8); fine- to medium-grained; well-sorted; composed of subangular to angular, stained and frosted quartz; rare pyrite accessory mineral; rare dark-gray (N 3) siltstone fragments, and abundant white (N 9) clay fragments and iron-cemented aggregates.	10	700
Siltstone: Light-gray (N 7); sandy; common mica accessory mineral; rare selenite crystals; calcareous cement.	21	721

12T-323
34-1.50-10.00

QUATERNARY:		
Alluvium:		
Sand: Moderate-orange-pink (5YR 8/4); silt to granule; poorly sorted; composed of frosted quartz; black accessory minerals; calcareous cement.	30	30
UPPER JURASSIC:		
Morrison Formation:		
Recapture Shale Member:		
Sandstone: Pale-red (10R 6/2); silt to coarse-grained sand; poorly sorted; composed of subrounded to subangular, frosted quartz; abundant black accessory minerals; rare brown mudstone fragments; calcareous cement.	50	80
Sandstone: Pale-red (10R 6/2); fine- to coarse-grained; composed of subangular to angular chert, quartz, jasper, and limestone; common black accessory minerals; common iron-ore pellets; calcareous cement.	40	120
Granule conglomerate: Grayish-red (10R 4/2) and pinkish-gray (5YR 8/1); medium-grained sand to granule; composed of angular chert, quartz, limestone, and sandstone in siltstone matrix; calcareous cement.	80	200
Sandstone: Grayish-red (10R 4/2); fine- to medium-grained; fair-sorted; composed of subangular to angular, frosted quartz; common mica and abundant dark accessory minerals; calcareous cement.	20	220
Salt Wash Sandstone Member:		
Sandstone: Grayish-red (10R 4/2) and white (N 9); fine- to coarse-grained; silty; fair to poorly sorted; composed of subangular to angular quartz; abundant dark-brown siltstone fragments; some horizons mostly dark-brown siltstone; calcareous cement.	70	290
Sandstone: White (N 9); medium-grained; composed of subangular to angular, clear and frosted quartz; common red and amber accessory minerals; abundant dark-brown and greenish-gray siltstone fragments; some recrystallization of quartz—crystal faces apparent on quartz grains.	20	310
Granule conglomerate: Light-gray (N 7); fine-grained sand to granule; poorly sorted; composed of subangular to angular quartz, chert, and limestone; abundant dark-brown and greenish-gray siltstone fragments; rare feldspar crystal; more siltstone fragments near		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

12T-323—Continued
34-1.50-10.00

	Thickness (feet)	Depth (feet)
bottom; calcareous cement.	50	360
Bluff Sandstone:		
Sandstone: Grayish-orange-pink (10R 8/2), moderate-orange-pink (10R 7/4), and grayish-red (10R 4/2); fine-grained, rare coarse grains; fair- to well-sorted; composed of rounded to subangular, clear and frosted quartz; common siltstone fragments.	40	400
Summerville Formation:		
Sandstone: Orange-pink (10R 8/4); medium-grained; well-sorted; composed of subrounded to subangular, stained and frosted quartz; common dark accessory minerals; common brown siltstone fragments; weakly cemented, calcareous.	90	490
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to coarse-grained; fair-sorted; composed of rounded to angular, stained and frosted quartz; common brown siltstone fragments.	59	549
Todilto Limestone:		
Limestone: Medium-light-gray (N 6); dense.	2	551

12K-312
49-11.70-15.20

	Thickness (feet)	Depth (feet)
UPPER CRETACEOUS:		
Menefee Formation:		
Sandstone: Yellowish-gray (5Y 7/2) to grayish-yellow (5Y 8/4); very fine to very coarse grained; silty; poorly sorted; composed of quartz; limonite accessory mineral; calcareous cement.	10	10
Sandstone: Yellowish-gray (5Y 7/2) to grayish-yellow (5Y 8/4); very fine to very coarse grained; silty; poorly sorted; composed of quartz; limonite accessory mineral; siltstone and mudstone; calcareous cement.	10	20
Sandy siltstone: Yellowish-gray (5Y 7/2) to grayish-yellow (5Y 8/4); biotite and limonite accessory minerals; mudstone; calcareous cement.	30	50
Sandstone: Yellowish-gray (5Y 7/2) to grayish-yellow (5Y 8/4); very fine to fine-grained; silty; poorly sorted; composed of quartz; mudstone, siltstone, and coal fragments; calcareous cement.	30	80
Sandy siltstone: Light-gray (N 7) to medium-gray (N 5); mudstone; calcareous cement.	10	90
Sandstone: Very light gray (N 8) to yellowish-gray (5Y 8/1); very fine to fine-grained; silty; fair to poorly sorted; composed of quartz; fragments of carbonaceous material; calcareous cement.	30	120
Siltstone and mudstone: Light-gray (N 7), medium-gray (N 5), and black (N 1); biotite accessory mineral; coal; calcareous cement.	20	140
Siltstone and mudstone: Light-gray (N 7) and medium-gray (N 5); biotite accessory mineral; calcareous cement.	10	150
Siltstone and mudstone: Light-gray (N 7), medium-gray (N 5), and black (N 1); biotite accessory mineral; coal; calcareous cement.	80	230
Sandstone: Light-gray (N 7), medium-gray (N 5), and black (N 1); very fine grained; silty; poorly sorted; composed of quartz; biotite accessory mineral; mudstone and siltstone fragments; calcareous cement.	20	250
Mudstone and siltstone: Medium-gray (N 5) to black (N 1); biotite accessory mineral; coal; calcareous cement.	20	270
Siltstone and mudstone: Medium-gray (N 5) to black (N 1); carbonaceous.	10	280
Siltstone and mudstone: Medium-gray (N 5) to black (N 1); coal; calcareous cement.	10	290
Sandstone: Very light gray (N 8) to medium-gray (N 5); very fine grained; silty; poorly sorted; composed of quartz; siltstone and mudstone fragments; calcareous cement.	10	300
Siltstone and mudstone: Medium-gray (N 5); biotite accessory mineral; coal fragments; calcareous cement.	30	330
Sandstone: Very light gray (N 8) and medium-gray (N 5); very fine grained; silty; poorly sorted; composed of quartz; siltstone and mudstone fragments.	10	340
Siltstone and mudstone: Medium-gray (N 5); biotite accessory mineral; coal fragments; calcareous cement.	20	360
Sandstone: Very light gray (N 8) and medium-gray (N 5); very fine to fine-grained; silty; fair to poorly sorted; composed of quartz; biotite accessory mineral; siltstone and mudstone fragments; calcareous cement.	50	410
Sandstone: Very light gray (N 8) to medium-gray (N 5); very fine to medium-grained; silty; poorly sorted; composed of quartz; siltstone and mudstone; quartz pebbles; calcareous cement.	10	420
Mudstone and siltstone: Medium-gray (N 5); biotite accessory mineral; coal fragments; calcareous cement.	30	450
Sandstone: Light-gray (N 7) to medium-gray (N 5); very fine to fine-grained; silty; poorly sorted; composed of quartz; siltstone and mudstone fragments; calcareous cement.	30	480
Siltstone and mudstone: Light-gray (N 7) to medium-gray (N 5); biotite accessory mineral; sandstone fragments; calcareous cement.	30	510
Siltstone and mudstone: Light-gray (N 7), medium-gray (N 5), and black (N 1); biotite accessory mineral; coal fragments; calcareous cement.	20	530
Siltstone and mudstone: Light-gray (N 7) to black (N 1); biotite accessory mineral; coal fragments; calcareous cement.	50	580
Siltstone and mudstone: Light-gray (N 7) to black (N 1); fragments of quartz sand, very fine to medium-grained, silty, fair-sorted; coal fragments; calcareous cement.	10	590
Mudstone and siltstone: Medium-light-gray (N 6) to medium-gray (N 5); calcareous cement.	10	600
Sandstone: Very light gray (N 8) to medium-gray (N 5); very fine to fine-grained; fair-sorted; composed of quartz; mudstone and siltstone fragments; calcareous cement.	10	610
Mudstone and siltstone: Medium-gray (N 5); biotite accessory mineral; sandstone fragments; calcareous cement.	20	630
Sandstone: Light-gray (N 7) to medium-gray (N 5); very fine to fine-grained; silty; fair to poorly sorted; composed of quartz; mudstone and siltstone fragments.	80	710
Sandy siltstone: Light-gray (N 7) to medium-gray (N 5); biotite accessory mineral; mudstone fragments; calcareous cement.	30	740
Mudstone and siltstone: Medium-gray (N 5).	20	760
Mudstone and siltstone: Medium-light-gray (N 6) to medium-gray (N 5); calcareous cement.	60	820
Mudstone and siltstone: Medium-light-gray (N 6) to medium-gray (N 5); rare fragments of quartz sand, very fine to fine-grained, silty, poorly sorted; calcareous cement.	20	840
Sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained; silty; well-sorted; composed of quartz; biotite accessory mineral; coal fragments; calcareous cement.	7	847
Sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained; silty; well-sorted; composed of quartz; biotite accessory mineral; siltstone, mudstone, and coal fragments; calcareous cement.	3	850
Sandy siltstone: Yellowish-gray (5Y 8/1); mudstone and sandstone fragments; calcareous cement.	20	870
Sandy siltstone: Medium-light-gray (N 6); mudstone fragments; calcareous cement.	20	890
Sandy siltstone: Medium-light-gray (N 6), yellowish-olive-gray (5Y 7/1), and very pale orange (10YR 8/2); fragments of quartz sand, very fine to medium-grained, well-sorted; mudstone fragments; calcareous cement.	10	900
Sandy siltstone and mudstone: Light-gray (N 7); calcareous cement.	20	920
Sandy siltstone and mudstone: Light-gray (N 7) and very light gray (N 8); fragments of quartz sand, very fine to fine-grained, silty, poorly sorted; biotite accessory mineral; calcareous cement.	30	950
Sandy siltstone: Medium-light-gray (N 6); mudstone and sandstone fragments; calcareous cement.	10	960
Sandy siltstone and mudstone: Medium-light-gray (N 6) and medium-gray (N 5); calcareous cement.	30	990
Mudstone: Dark-gray (N 3).	10	1,000

12K-311
50-6.95-5.35

	Thickness (feet)	Depth (feet)
UPPER CRETACEOUS:		
Mancos Shale (lower part):		
Silty claystone: Light-olive-gray (5Y 6/1).	70	70
Clayey siltstone: Greenish-gray (5G 6/1).	20	90
Silty claystone: Dark-greenish-gray (5G 4/1).	120	210
Silty claystone: Greenish-gray (5G 6/1); soapy feel.	80	290
Dakota Sandstone:		
Siltstone: Medium-light-gray (N 6).	30	320
Sandstone: Yellowish-gray (5Y 8/1); fine-grained; well-sorted; siltstone.	10	330
Sandstone: Very light gray (N 8); medium-grained; fair-sorted; siltstone.	40	370
Silty claystone: Medium-gray (N 5).	30	400
Sandstone: Moderate-orange-pink (10R 7/4); medium-grained; fair-sorted; feldspar accessory mineral.	70	630
Clayey siltstone: Grayish-purple (5P 4/2).	10	640
Sandstone: Grayish-pink (5R 8/2); medium-grained; fair-sorted; feldspar accessory mineral.	10	650
Sandstone: Light-brown (5YR 6/4); coarse-grained; poorly sorted; feldspar accessory mineral; claystone.	130	780
Recapture Shale Member:		
Sandstone: Light-brown (5YR 6/4); medium-grained; well-sorted; claystone.	80	860
Sandstone: Light-brown (5YR 6/4); coarse-grained; poorly sorted; feldspar accessory mineral.	70	930

UPPER JURASSIC:		
Morrison Formation:		
Brushy Basin Member:		
Sandstone: Light-olive-gray (5Y 6/1); fine-grained; fair-sorted; siltstone fragments.	10	410
Sandstone: Light-greenish-gray (5G 8/1); coarse-grained; poorly sorted.	30	440
Sandstone: Light-greenish-gray (5G 8/1); medium-grained; fair-sorted.	10	450
Sandstone: Light-greenish-gray (5G 8/1); fine-grained; fair-sorted.	10	460
Sandstone: Light-olive-gray (5Y 6/1); fine-grained; poorly sorted; siltstone.	10	470
Westwater Canyon Member:		
Siltstone: Grayish-pink (5R 8/2); some coarse-grained sand.	10	480
Silty claystone: Grayish-pink (5R 8/2).	40	520
Sandstone: Yellowish-gray (5Y 7/2); medium-grained; claystone.	30	550
Clayey siltstone: Light-greenish-gray (5G 8/1).	10	560
Sandy siltstone: Pale-brown (5YR 5/2); limestone fragments.	60	990
Silty claystone: Grayish-red (10R 4/2); limestone fragments.	30	1,020
Sandstone: Grayish-orange-pink (5YR 7/2); fine-grained; well-sorted; claystone.	20	1,040
Sandstone: Light-brown (5YR 5/2); fine-grained; well-sorted.	60	1,100
Sandstone: Light-brown (5YR 5/2); very fine grained; silty; fair-sorted; carbonaceous material.	30	1,130
Salt Wash Sandstone Member:		
Sandstone: Grayish-orange-pink (10R 8/2); fine-grained; well-sorted.	70	1,200
Summerville Formation:		
Sandstone: Light-brown (5YR 6/4); fine-grained; fair-sorted.	220	1,420
Todilto Limestone(?): Undescribed.	15	1,435
Entrada Sandstone(?):		
Sandstone: Grayish-pink (5R 8/2); medium-grained; poorly sorted; claystone fragments.	40	1,475

12T-325
67-11.70-7.65

QUATERNARY:		
Alluvium:		
Silty sand: Pale-yellowish-brown (10YR 6/2); silt to medium-grained sand; poorly sorted; composed of subangular to angular, frosted quartz; calcareous cement.	40	40
UPPER CRETACEOUS:		
Menefee Formation:		
Sandy siltstone: Light-gray (N 7); silt to fine-grained sand; micaceous; common carbonaceous material; calcareous cement.	20	60
Sandy siltstone: Light-olive-gray (5Y 6/1); very fine to rare coarse-grained sand; well-sorted; composed of subrounded, frosted quartz; common mica flakes; abundant coal; fine-grained sandstone from 60 to 70 feet; weakly cemented, calcareous.	170	230
Sandstone: Light-gray (N 7); fine-grained; well-sorted; composed of angular, clear and frosted quartz; common pyrite and abundant dark accessory minerals; common iron-stained aggregates; weakly cemented, calcareous.	30	260
Sandy siltstone: Light-olive-gray (5Y 6/1); very fine to rare coarse-grained sand; well-sorted; composed of subrounded, frosted quartz; common mica flakes; abundant coal; weakly cemented, calcareous.	14	274

13K-209
31-8.25-9.40

QUATERNARY:		
Alluvium:		
Sand: Light-brown (5YR 6/4); very fine to very coarse grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; limonite nodules and common clay pellets; weakly cemented, calcareous and ferruginous.	30	30
UPPER CRETACEOUS:		
Kirtland Shale:		
Farmington Sandstone Member:		
Sandstone: Yellowish-gray (5Y 7/2) to medium-gray (N 5); very fine to coarse-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common mica and rare feldspar and dark accessory minerals; weakly to firmly cemented, calcareous and ferruginous.	40	70
Sandstone: Yellowish-gray (5Y 7/2) to medium-gray (N 5); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common mica and rare feldspar and dark accessory minerals; weakly to firmly cemented, argillaceous and ferruginous.	30	100
Mudstone and siltstone: Light-gray (N 7) to medium-gray (N 5); common mica accessory mineral; weakly to firmly cemented, calcareous.	30	130
Sandstone: Very light gray (N 8) to medium-gray (N 5); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common mica and rare feldspar and dark accessory minerals; weakly to firmly cemented, calcareous and argillaceous.	10	140
Lower member:		
Mudstone: Light-gray (N 7) to medium-gray (N 5); clay and silt; common mica accessory mineral; weakly to firmly cemented, calcareous.	70	210
Mudstone: Light-gray (N 7) to medium-gray (N 5); clay and silt; common mica accessory mineral; weakly to firmly cemented, calcareous.	10	220
Sandstone: Very light gray (N 8) to medium-gray (N 5); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; common mica and rare feldspar and dark accessory minerals; firmly cemented, calcareous and argillaceous.	30	250
Siltstone and mudstone: Light-gray (N 7) to medium-gray (N 5); clay and silt; common mica accessory mineral; common carbonaceous material; weakly to firmly cemented.	90	340
Sandstone: Very light gray (N 8) to medium-gray (N 5); very fine to fine-grained; silty; composed of subrounded to subangular, clear quartz; common mica and rare feldspar and dark accessory minerals; weakly to firmly cemented, calcareous and argillaceous.	10	350
Sandy siltstone: Light-gray (N 7) to medium-gray (N 5); silt and fine-grained sand; composed of subrounded to subangular, clear quartz; common mica accessory mineral; rare carbonaceous material; weakly cemented, calcareous.	50	400
Sandstone: Very light gray (N 8) to medium-gray (N 5); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; common mica and rare feldspar and dark accessory minerals; weakly to firmly cemented, calcareous and argillaceous.	110	510
Siltstone and mudstone: Light-gray (N 7) to medium-gray (N 5); clay and silt; common mica accessory mineral; common carbonaceous material; weakly to firmly cemented, calcareous.	50	560
Fruitland Formation:		
Siltstone and mudstone: Light-gray (N 7) to medium-gray (N 5); clay and silt; abundant mica accessory mineral; abundant carbonaceous material and coal fragments; weakly to firmly cemented, calcareous.	30	590
Sandstone: Light-gray (N 7) to medium-gray (N 5); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; common mica, rare feldspar, and rare to common gypsum accessory minerals; rare coal fragments; weakly cemented, calcareous and argillaceous.	70	660
Sandstone: Light-gray (N 7) to medium-gray (N 5); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; abundant mica and rare feldspar accessory minerals; rare coal and mudstone and claystone fragments; weakly cemented, calcareous and argillaceous.	90	750
Pictured Cliffs Sandstone:		
Sandstone: Light-gray (N 7) to medium-gray (N 5); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; abundant mica and rare to common feldspar accessory minerals; common mudstone and claystone fragments; firmly cemented, calcareous.	120	870
Silty sandstone: Light-gray (N 7) to medium-gray (N 5); silt to medium-grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; common mica accessory mineral; weakly cemented, calcareous and argillaceous.	115	985
Lewis Shale:		
Sandy siltstone: Light-gray (N 7) to medium-gray (N 5); silt and very fine to medium-grained sand; composed of subrounded to subangular, clear and stained quartz; common mica accessory mineral; weakly cemented, calcareous and argillaceous.	110	1,095
Sandy siltstone: Medium-gray (N 5); silt and very fine to medium-grained sand; composed of rounded to subrounded, clear and stained quartz; common mica accessory mineral; weakly cemented, calcareous and argillaceous.	70	1,165
Siltstone and mudstone: Light-gray (N 7) to medium-light-gray (N 6); rare to absent pyrite and rare dark accessory minerals; rare carbonaceous material; weakly cemented, calcareous.	15	1,180
Sandy siltstone: Medium-light-gray (N 6) to medium-gray (N 5); clay, silt, and very fine to fine-grained sand; poorly sorted; composed of subrounded to angular, clear and stained quartz; rare to absent pyrite and rare mica and dark accessory minerals; rare to absent mudstone and coal fragments; weakly cemented, calcareous.	300	1,480
Cliff House Sandstone:		
Sandstone: Yellowish-gray (5Y 7/2); very fine to medium-grained; silty; fair-sorted; composed of		

Table 1. --Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
13K-209—Continued 31-8.25-9.40		
subangular to angular, clear and stained quartz; moderately common pyrite, rare limonite, and dark accessory minerals; moderately common wood fragments		
and common mudstone fragments; weakly cemented, calcareous and argillaceous.	20	1,500
No samples.	5	1,505
13K-210A 31-1.95-16.05		
QUATERNARY:		
Alluvium and windblown sands:		
Sand: Dusky-grayish-yellow (5Y 7/4); very fine to very coarse grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; rare hematite concretions, and common chert and argillaceous material; weakly cemented, calcareous and argillaceous.	60	60
TERTIARY:		
Nacimiento Formation:		
Sandstone: Yellowish-gray (5Y 8/1) to light-gray (N 7); very fine to very coarse grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; common feldspar, and rare to common pyrite and dark accessory minerals; common chert, jasper, and argillaceous material; common mud pellets; weakly cemented, calcareous and argillaceous.	100	160
Sandy siltstone and mudstone: Light-brownish-gray (5YR 6/1) to medium-light-gray (N 6); very fine to medium-grained sand; clay and silt; poorly sorted; composed of subrounded to subangular, clear quartz; abundant to common mica and rare to common dark accessory minerals.	110	270
UPPER CRETACEOUS:		
Ojo Alamo Sandstone:		
Sandstone: Yellowish-gray (5Y 8/1) and light-gray (N 7); very fine to coarse-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; rare feldspar, mica, and dark accessory minerals; common argillaceous material and rare to absent mudstone fragments; common mud pellets; weakly cemented, calcareous and argillaceous.	90	360
Sandstone: Very light gray (N 8); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; common feldspar, pyrite, and mica, and rare epidote and dark accessory minerals; common jasper and rare argillaceous material; weakly to firmly cemented, calcareous, argillaceous, and siliceous.	10	370
Kirtland Shale:		
No samples.	10	380
Siltstone: Pale-green (10G 6/2); silt and very fine to fine-grained sand; well-sorted; rare mica and dark accessory minerals; weakly cemented, calcareous.	10	390
Sandstone: Grayish-green (10GY 5/2); very fine to coarse-grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; rare mica and dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	3	393
13K-208 48-4.25-13.85		
QUATERNARY:		
Alluvium:		
Sand: Yellowish-orange-brown (10YR 6/4); fine- to coarse-grained; fair-sorted; composed of subrounded to subangular, clear quartz; rare feldspar, and red and dark accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	20	20
UPPER CRETACEOUS:		
Kirtland Shale:		
Lower member:		
Sandy mudstone: Yellowish-gray (5Y 7/2); clay, silt, and fine- to medium-grained sand; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	30	50
Sandy siltstone: Yellowish-gray (5Y 7/2) to pale-brown (5YR 5/2); silt and very fine to fine-grained sand; composed of subrounded to subangular, clear quartz; common mica accessory mineral; weakly cemented, calcareous and argillaceous.	10	60
Mudstone: Light-gray (N 7) to medium-gray (N 5); clay and silt; common mica accessory mineral; weakly cemented, calcareous.	10	70
Mudstone: Light-gray (N 7) to medium-gray (N 5); clay and silt; common mica accessory mineral; weakly cemented, calcareous.	20	90
Silty sandstone: Very light gray (N 8); very fine to fine-grained; composed of subrounded, clear quartz; common mica and rare feldspar accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	20	110
Fruitland Formation:		
Mudstone: Light-gray (N 7); clay and silt; rare mica accessory mineral; weakly cemented, calcareous.	10	120
Sandy siltstone: Light-gray (N 7); silt and very fine to fine-grained sand; composed of subrounded, clear quartz; rare mica accessory mineral; abundant argillaceous material; weakly cemented, calcareous and argillaceous.	10	130
Mudstone: Medium-gray (N 5); clay and silt; weakly cemented, calcareous.	20	150
Carbonaceous mudstone: Medium-gray (N 5) to black (N 1); clay and silt; abundant carbonaceous material and coal; weakly cemented, calcareous.	20	170
Sandy siltstone: Silt and very fine to fine-grained sand; composed of subrounded, clear quartz; rare mica accessory mineral; weakly cemented, calcareous and argillaceous.	30	200
Carbonaceous mudstone: Medium-gray (N 5); clay and silt; common carbonaceous material and coal; weakly cemented, calcareous.	20	220
Mudstone: Medium-gray (N 5); clay and silt; weakly cemented, calcareous.	30	250
Carbonaceous siltstone: Black (N 1); silt; abundant carbonaceous material and coal; weakly cemented, calcareous.	20	270
Mudstone and claystone: Medium-gray (N 5); clay and silt; weakly cemented, calcareous.	15	285
Carbonaceous siltstone: Black (N 1); silt; abundant carbonaceous material and common coal; weakly cemented, calcareous.	10	295
calcareous.	10	305
Carbonaceous siltstone: Black (N 1); silt; abundant carbonaceous material and common coal; weakly cemented, calcareous.	5	310
Mudstone: Medium-gray (N 5); clay and silt; common coal; weakly cemented, calcareous.	10	320
Sandy siltstone: Light-gray (N 7); silt and very fine to fine-grained sand; composed of subrounded, clear quartz; rare mica accessory mineral; common argillaceous material; weakly cemented, calcareous.	20	340
Carbonaceous siltstone: Black (N 1); silt; abundant carbonaceous material and common coal; weakly cemented, calcareous.	10	350
Mudstone: Medium-gray (N 5); clay and silt; weakly cemented, calcareous.	30	380
Pictured Cliffs Sandstone:		
Sandstone: Light-gray (N 7); very fine grained; well-sorted; composed of subangular, clear quartz; rare mica and feldspar accessory minerals; argillaceous material; weakly cemented, calcareous and argillaceous.	15	395
Carbonaceous mudstone: Black (N 1); clay and silt; abundant carbonaceous material and common coal; weakly cemented, calcareous and argillaceous.	10	405
Silty sandstone: Very light gray (N 8); silt to fine-grained sand; fair-sorted; composed of subrounded, clear quartz; rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous; water encountered at 425 feet.	55	460
Lewis Shale:		
Silty sandstone: Light-gray (N 7); silt to very fine grained sand; well-sorted; composed of subrounded, clear quartz; common mica and rare dark accessory minerals; common argillaceous material; weakly cemented, calcareous.	10	470
Sandy siltstone: Very light gray (N 8); silt and very fine to fine-grained sand; composed of subrounded, clear quartz; common mica accessory mineral; common argillaceous material; weakly cemented, calcareous.	10	480
Claystone: Medium-gray (N 5); clay; weakly cemented, calcareous.	30	510
Siltstone: Medium-gray (N 5); silt; common mica and dark accessory minerals; weakly cemented, calcareous; Foraminifera Lenticulina(?) present at 650 feet.	140	650
Cliff House Sandstone:		
Sandstone: Light-gray (N 7); very fine to coarse-grained; fair-sorted; composed of subrounded to subangular, clear quartz; abundant pyrite, common limonite, and rare mica and dark accessory minerals; weakly cemented, calcareous and pyritaceous; water-bearing zone.	80	730
Sandy siltstone: Light-gray (N 7); silt and very fine grained sand; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	40	770
Sandy siltstone and mudstone: Light-gray (N 7) to medium-gray (N 5); clay, silt, and very fine grained sand; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	20	790

Mudstone and claystone: Medium-gray (N 5); clay and silt; common coal fragments; weakly cemented,			No samples.	18	808

14K-308
67-10.60-12.80

UPPER CRETACEOUS:			well-sorted; rare siltstone fragments and carbonaceous material.	40	95
Menefee Formation:			Silty claystone: Medium-light-gray (N 6); carbonaceous material.	105	200
Sandstone: Dark-yellowish-brown (10YR 4/2); medium-grained; poorly sorted.	35	35	Silty claystone: Light-olive-gray (5Y 6/1); carbonaceous material.	120	320
Siltstone: Light-olive-gray (5Y 6/1).	10	45	Sandstone: Water.	15	335
Sandstone: Dark-yellowish-brown (10YR 4/2); medium-grained; fair-sorted.	10	55	Mudstone: Undescribed.	45	380
Sandstone: Medium-light-gray (N 6); medium-grained;					

14K-310
67-5.00-8.05

UPPER CRETACEOUS:			Siltstone: Light-gray (N 7) to medium-gray (N 5); biotite and muscovite accessory minerals; rare sand and mudstone fragments; calcareous cement.	50	520
Menefee Formation:			Sandstone: Medium-light-gray (N 6); very fine to medium-grained; fair-sorted; composed of quartz; muscovite accessory mineral; mudstone fragments; calcareous cement.	30	550
No samples.	210	210	Sandy siltstone: Medium-light-gray (N 6) to medium-gray (N 5); mudstone fragments; calcareous cement.	30	580
Sandy siltstone: Light-yellowish-gray (5Y 8/2) to light-gray (N 7); muscovite and limonite accessory minerals; calcareous cement.	10	220	Silty mudstone: Light-gray (N 7); marcasite accessory mineral; claystone fragments.	20	600
Silty mudstone: Medium-light-gray (N 6); muscovite accessory mineral.	40	260	Mudstone: Light-gray (N 7); claystone fragments; calcareous cement.	25	625
Sandy siltstone: Medium-light-gray (N 6); muscovite accessory mineral; calcareous cement.	30	290	Sandstone: Light-gray (N 7); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	15	640
Siltstone: Light-gray (N 7); muscovite accessory mineral; mudstone fragments; calcareous cement.	70	360	Mudstone: Medium-light-gray (N 6); calcareous cement.	2	642
Sandy siltstone: Medium-dark-gray (N 4); muscovite accessory mineral; carbonaceous.	30	390			
Siltstone: Medium-gray (N 5); muscovite accessory mineral; mudstone; calcareous cement.	30	420			
Siltstone: Medium-gray (N 5); muscovite accessory mineral; mudstone; calcareous cement.	50	470			

14T-307
67-3.15-15.80

UPPER CRETACEOUS:			Sandstone: Greenish-gray (5G 6/1); fine-grained; well-sorted; water.	11	380
Menefee Formation:			Clayey siltstone: Greenish-gray (5G 6/1).	20	400
No samples.	155	155	Sandy siltstone: Greenish-gray (5G 6/1).	10	410
Clayey siltstone: Greenish-gray (5G 6/1).	20	175	Sandstone: Light-olive-gray (5Y 6/1); medium-grained; well-sorted; siltstone fragments; increase in water.	5	415
Sandstone: Light-olive-gray (5Y 6/1); medium-grained; fair-sorted.	20	195	Sandstone: Light-olive-gray (5Y 6/1); fine-grained; poorly sorted; siltstone fragments.	8	423
Sandstone: Greenish-gray (5G 6/1); fine-grained; poorly sorted.	40	235	Clayey siltstone: Light-olive-gray (5Y 6/1).	17	440
Clayey siltstone: Greenish-gray (5G 6/1).	85	320	Sandy siltstone: Light-olive-gray (5Y 6/1).	8	448
Silty claystone: Greenish-gray (5G 6/1).	20	340			
Clayey siltstone: Greenish-gray (5G 6/1).	20	360			
Sandy siltstone: Greenish-gray (5G 6/1).	9	369			

14K-305
87-8.45-4.50

UPPER CRETACEOUS:			fair-sorted.	30	185
Menefee Formation:			Sandstone: Light-olive-gray (5Y 6/1); very fine grained; silty; poorly sorted.	10	195
Sandstone: Yellowish-gray (5Y 8/1); very fine grained; silty; poorly sorted.	55	55	Sandstone: Light-olive-gray (5Y 6/1); medium-grained; fair-sorted.	10	205
Sandy siltstone: Yellowish-gray (5Y 8/1).	20	75	Claystone: Light-olive-gray (5Y 6/1); silty.	35	240
Clayey siltstone: Light-olive-gray (5Y 6/1).	30	105	Sandstone: Light-olive-gray (5Y 6/1); very fine grained; silty; poorly sorted; claystone.	10	250
Sandstone: Light-olive-gray (5Y 6/1); very fine grained; silty; poorly sorted; carbonaceous material.	50	155			
Sandstone: Light-olive-gray (5Y 6/1); medium-grained;					

14K-315
88-1.70-12.15

UPPER CRETACEOUS:			subangular, clear quartz; rare mica, and common dark and rare red accessory minerals; common argillaceous material; weakly cemented, calcareous.	80	180
Menefee Formation:			Sandy siltstone and mudstone: Medium-light-gray (N 6); clay, silt, and very fine to fine-grained sand; composed of subrounded to subangular, clear quartz; rare mica, and common dark and rare red accessory minerals; weakly cemented, calcareous.	30	210
Sandstone: Grayish-orange-brown (10YR 6/4); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; rare mica and feldspar, and common dark and rare red accessory minerals; weakly cemented, calcareous.	60	60	Sandy siltstone: Medium-light-gray (N 6); silt and very fine to fine-grained sand; composed of subrounded to subangular, clear quartz; rare mica, and common dark and rare red accessory minerals; common argillaceous material; weakly cemented, calcareous.	40	250
Sandy siltstone: Medium-light-gray (N 6); silt and very fine to medium-grained sand; composed of subrounded to subangular, clear quartz; common mica and dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	20	80	Sandstone: Light-gray (N 7); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common mica, rare feldspar, and common dark and rare red accessory minerals; weakly cemented, calcareous.	55	305
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; rare mica and feldspar, and common dark and red accessory minerals; weakly cemented, calcareous.	20	100			
Sandy siltstone: Medium-light-gray (N 6); silt and very fine to fine-grained sand; composed of subrounded to					

14K-313
106-3.85-5.70

UPPER CRETACEOUS:			composed of quartz; calcareous cement.	30	70
Crevasse Canyon Formation:			Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	90
Gibson Coal Member:			Sandy siltstone: Very light gray (N 8); biotite; calcareous cement.	110	200
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	20	Sandstone: Light-gray (N 7); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	220
Mudstone: Brownish-gray (5YR 4/1) to black (N 1); silty; carbonaceous; coal.	10	30	Sandy siltstone: Very light gray (N 8); calcareous cement.	20	240
Sandy siltstone: Medium-gray (N 5); mica accessory mineral; coal fragments; calcareous cement.	10	40	Sandstone: Light-gray (N 7); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	40	280
Dalton Sandstone Member (possible thin tongue of Mulatto Tongue of Mancos Shale in this interval):					
Sandstone: Yellowish-gray (5Y 8/1) and light-olive-gray (5Y 6/1); fine- to medium-grained; silty; fair-sorted;					

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
14K-313—Continued 106-3.85-5.70		
Dilco Coal Member:		
Mudstone: Medium-gray (N 5); silt and sand; marcasite and muscovite accessory minerals.	80	360
Sandy siltstone: Light-gray (N 7); mudstone fragments; calcareous cement.	40	400
Silty mudstone: Medium-gray (N 5); calcareous cement.	10	410
Siltstone: Medium-light-gray (N 6); calcareous cement.	10	420
Silty mudstone: Medium-gray (N 5); calcareous cement.	50	470
Gallup Sandstone:		
Siltstone: Light-gray (N 7); calcareous cement.	40	510
Mudstone: Light-gray (N 7), medium-gray (N 5), and black (N 1); coal fragments; calcareous cement.	40	550
Sandy siltstone: Light-gray (N 7); muscovite accessory mineral; calcareous cement.	50	600
Silty mudstone: Medium-gray (N 5); biotite accessory mineral; calcareous cement.	22	622
14K-314 107-2.90-2.75		
UPPER CRETACEOUS:		
Menefee Formation:		
Sandstone: Yellowish-gray (5Y 7/2); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare mica, feldspar, and dark and red accessory minerals; weakly cemented, calcareous.	60	60
Sandstone: Light-gray (N 7); very fine to fine-grained; fair-sorted; composed of subrounded to angular, clear and stained quartz; common mica, feldspar, and dark and red accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	30	90
Sandy siltstone: Medium-light-gray (N 6); silt and very fine to fine-grained sand; composed of subrounded to subangular, clear quartz; common mica and dark accessory minerals; common argillaceous and rare carbonaceous material; weakly cemented, calcareous and argillaceous.	80	170
Sandstone: Light-gray (N 7); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; rare feldspar, and common mica and dark accessory minerals; weakly cemented, calcareous.	50	220
Siltstone and mudstone: Medium-light-gray (N 6); clay and silt; common mica accessory mineral; common carbonaceous material; weakly cemented, calcareous.	30	250
No samples.	4	254
15K-337 65-12.30-14.45		
UPPER CRETACEOUS:		
Menefee Formation:		
Siltstone: Dusky-yellow (5Y 6/4); sandy; calcareous cement.	20	20
Siltstone: Yellowish-gray (5Y 7/2); sandy; calcareous cement.	20	40
Mudstone: Medium-light-gray (N 6); silty; calcareous cement.	40	80
Sandstone: Medium-light-gray (N 6); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	90
Siltstone: Medium-light-gray (N 6); calcareous cement.	30	120
Siltstone: Medium-light-gray (N 6); sandy; coal fragments; calcareous cement.	20	140
Siltstone: Medium-light-gray (N 6); calcareous cement.	10	150
Siltstone: Medium-light-gray (N 6); sandy; calcareous cement.	10	160
Sandstone: Medium-light-gray (N 6); very fine to fine-grained; well-sorted; composed of quartz; coal fragments; calcareous cement.	10	170
Siltstone: Light-gray (N 7); sandy; calcareous cement.	30	200
Mudstone: Medium-light-gray (N 6); silty; calcareous cement.	30	230
Siltstone: Light-gray (N 7); sandy; calcareous cement.	30	260
Mudstone: Light-gray (N 7); silty; calcareous cement.	20	280
Sandstone: Light-gray (N 7); very fine to fine-grained; well-sorted; composed of quartz; coal fragments; calcareous cement.	10	290
Mudstone: Medium-light-gray (N 6); silty; claystone fragments.	10	300
Siltstone: Very light gray (N 8); sandy; calcareous cement.	10	310
Mudstone: Light-gray (N 7); silty; calcareous cement.	10	320
No samples.	14	334
15T-339 66-2.70-6.90		
UPPER CRETACEOUS:		
Menefee Formation:		
Silt and coal: Brownish-black (5YR 2/1) to pale-brown (5YR 5/2); rare sand; almost pure coal from 40 to 50 feet; weakly cemented, calcareous.	70	70
Siltstone: Light-gray (N 7); rare coal fragments; sandy from 160 to 170 feet and from 440 to 450 feet; siliceous cement; weakly cemented, calcareous, at some horizons.	290	360
Siltstone: Same as interval from 70 to 360 feet; abundant coal.	40	400
Siltstone: Light-gray (N 7); sandy; rare coal fragments.	40	440
Sandstone: Light-gray (N 7); fine- to medium-grained; silty; fair to poorly sorted; composed of subrounded to subangular quartz; rare pyrite accessory mineral; rare coal; weakly cemented, calcareous and siliceous.	10	450
Siltstone: Same as interval from 400 to 440 feet.	30	480
Sandstone: Same as interval from 440 to 450 feet; common pyrite accessory mineral; silty from 560 to 570 feet.	110	590
Siltstone: Same as interval from 400 to 440 feet; sandy from 620 to 630 feet and from 660 to 670 feet; very calcareous at some horizons; silt-to-sand ratio varies throughout.	370	960
Sandstone: Same as interval from 400 to 440 feet.	27	987
15K-336 85-9.70-9.20		
UPPER CRETACEOUS:		
Menefee Formation:		
No samples.	80	80
Siltstone: Medium-light-gray (N 6); mudstone, claystone, and coal fragments; some calcareous cement.	30	110
Mudstone: Medium-light-gray (N 6); silty; claystone and gypsum; some calcareous cement.	10	120
Mudstone: Medium-light-gray (N 6); silty; claystone, coal, and gypsum; some calcareous cement.	80	200
Mudstone: Medium-light-gray (N 6); silty; claystone; calcareous cement.	60	260
Mudstone: Medium-light-gray (N 6); silty; claystone and coal; calcareous cement.	30	290
No samples.	10	300
Mudstone: Medium-light-gray (N 6); silty; claystone and coal; calcareous cement.	20	320
Mudstone: Medium-light-gray (N 6); silty and sandy; claystone; calcareous cement.	10	330
Mudstone: Medium-light-gray (N 6); silty; claystone; calcareous cement.	40	370
Sandstone: Light-olive-gray (5Y 6/1) to medium-gray (N 5); very fine to fine-grained; silty; mudstone and claystone; calcareous cement.	10	380
Mudstone: Medium-light-gray (N 6); silty; claystone and coal; calcareous cement.	10	390
Sandstone: Light-gray (N 7); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	20	410
Mudstone: Medium-light-gray (N 6); silty; claystone and limestone.	50	460
Mudstone: Medium-light-gray (N 6); silty; claystone, coal, and gypsum; calcareous cement.	20	480
Mudstone: Medium-light-gray (N 6); silty; claystone; calcareous cement.	30	510
Mudstone: Light-gray (N 7); silty; claystone.	40	550
Point Lookout Sandstone:		
Siltstone: Light-gray (N 7); sandy.	50	600
Siltstone: Medium-light-gray (N 6); sandy; mudstone and some coal, limestone, and clay.	67	667
Sandstone: Very light gray (N 8); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	3	670
Sandstone: Very light gray (N 8); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	60	730
Earl Becenti well 85-8.15-17.20		
UPPER CRETACEOUS:		
Point Lookout Sandstone:		
Sandstone: Yellowish-gray (5Y 8/1); very fine grained; silty; poorly sorted.	90	90
Sandstone: Olive-gray (5Y 4/1); fine-grained; silty; poorly sorted.	10	430
Sandstone: Olive-gray (5Y 4/1); very fine grained; silty; poorly sorted; carbonaceous material.	10	440

Satan Tongue of Mancos Shale:		
Siltstone: Light-gray (N 7); sandy.	20	110
Claystone: Light-olive-gray (5Y 6/1); silty.	20	130
Siltstone: Light-olive-gray (5Y 6/1); sandy.	10	140
Siltstone: Light-gray (N 7); clayey.	10	150
Siltstone: Medium-light-gray (N 6); sandy.	90	240
Hosta Tongue of Point Lookout Sandstone:		
Sandstone: Medium-light-gray (N 6); very fine grained; silty.	60	300
Crevasse Canyon Formation:		
Gibson Coal Member:		
Siltstone: Medium-light-gray (N 6); sandy.	50	350
Sandstone: Medium-light-gray (N 6); fine-grained; fair-sorted.	10	360
Sandstone: Medium-light-gray (N 6); very fine grained; silty; poorly sorted.	10	370
Sandstone: Medium-light-gray (N 6); medium-grained; poorly sorted.	10	380
Sandstone: Medium-light-gray (N 6); very fine grained; silty; poorly sorted.	10	390
Siltstone: Medium-dark-gray (N 4); sandy.	30	420
Sandstone: Medium-gray (N 5); fine-grained; silty; poorly sorted.	20	460
Sandstone: Olive-gray (5Y 4/1); fine-grained; silty; poorly sorted; carbonaceous material.	10	470
Dalton Sandstone Member:		
Sandstone: Medium-gray (N 5); very fine grained; silty; poorly sorted.	60	530
Sandstone: Light-gray (N 7); fine-grained; silty; poorly sorted.	60	590
Sandstone: Light-gray (N 7); very fine grained; silty; poorly sorted.	10	600
Sandstone: Light-gray (N 7); medium-grained; fair-sorted.	20	620
Sandstone: Medium-light-gray (N 6); fine-grained; silty; poorly sorted.	10	630
Sandstone: Light-gray (N 7); very fine grained; silty; poorly sorted.	10	640
Sandstone: Light-gray (N 7); very fine grained; well-sorted.	10	650
Siltstone: Very light gray (N 8); sandy.	50	700
No samples.	7	707

Pitt Ranch
85-0.80-14.40

UPPER CRETACEOUS:		
Menefee Formation:		
Mudstone: Pale-yellowish-brown (10YR 6/2) to black (N 1); silty and sandy; coal fragments.	30	30
Siltstone: Pale-yellowish-brown (10YR 6/2); sandy; calcareous cement.	20	50
Mudstone: Medium-gray (N 5) to dark-gray (N 3); silty; coal fragments; calcareous cement.	10	60
Mudstone: Medium-gray (N 5) to dark-gray (N 3); silty; carbonaceous material.	10	70
Mudstone: Medium-gray (N 5) to dark-gray (N 3); silty; coal fragments; calcareous cement.	20	90
Mudstone: Medium-gray (N 5) to dark-gray (N 3); silty; carbonaceous material.	12	102
Mudstone: Medium-light-gray (N 6); silty and sandy; coal fragments.	7	109
Mudstone: Dark-gray (N 3); silty; carbonaceous material.	16	125
Mudstone: Medium-gray (N 5); coal fragments; calcareous cement.	8	133
Siltstone: Very light gray (N 8); sandy; calcareous cement.	42	175
Sandstone: Very light gray (N 8); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	185
Siltstone: Very light gray (N 8); sandy; calcareous cement.	20	205
Mudstone: Medium-gray (N 5); silty; muscovite accessory mineral; coal fragments; calcareous cement.	10	215
Sandstone: Very light gray (N 8); very fine grained; silty; poorly sorted; composed of quartz.	40	255
Mudstone: Light-gray (N 7) to medium-gray (N 5); silty; calcareous cement.	10	265
Sandstone: Very light gray (N 8); very fine grained; silty; poorly sorted; composed of quartz.	15	280
Siltstone and mudstone: Medium-gray (N 5); calcareous cement.	20	300
Sandstone: Medium-light-gray (N 6); very fine grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	310
Siltstone: Medium-gray (N 5); sandy; calcareous cement.	20	330
Siltstone and mudstone: Medium-gray (N 5); sandy; calcareous cement.	30	360
Mudstone: Medium-gray (N 5) to black (N 1); silty; coal fragments; calcareous cement.	20	380
Mudstone: Medium-gray (N 5); silty; calcareous cement.	10	390
Siltstone: Medium-gray (N 5); sandy; calcareous cement.	70	460
Siltstone and mudstone: Medium-gray (N 5); sandy; calcareous cement.	30	490
Point Lookout Sandstone:		
Sandstone: Very light gray (N 8); fine- to medium-grained; well-sorted.	30	520
Sandstone: Light-olive-gray (5Y 6/1); fine- to medium-grained; composed of quartz; coal fragments; calcareous cement.	10	530
Sandstone: Very light gray (N 8); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	50	580
Sandstone: Very light gray (N 8); fine- to medium-grained; well-sorted; composed of quartz; muscovite accessory mineral; calcareous cement.	10	590
Sandstone: Very light gray (N 8); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	610
No samples.	18	628

15K-335
104-8.65-5.20

UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Siltstone: Medium-gray (N 5); carbonaceous material; noncalcareous cement.	80	80
Silty sandstone: Medium-light-gray (N 6); fine-grained; poorly sorted; composed of quartz; carbonaceous material; noncalcareous cement.	60	140
Silty sandstone: Very light gray (N 8); very fine grained; fair-sorted; composed of quartz; noncalcareous cement.	100	240
Sandy siltstone: Medium-light-gray (N 6); noncalcareous cement.	280	520
Gallup Sandstone:		
Upper part:		
Sandstone: Light-gray (N 7); coarse-grained; poorly sorted; composed of quartz; noncalcareous cement.	56	576
Siltstone: Medium-gray (N 5); noncalcareous cement.	24	600
Silty claystone: Light-olive-gray (5Y 6/1); calcareous cement.	20	620
Siltstone: Medium-gray (N 5); calcareous cement.	20	640
Silty sandstone: Light-gray (N 7); very fine grained; fair-sorted; composed of quartz; claystone fragments; noncalcareous cement.	20	660
Sandstone: Light-olive-gray (5Y 6/1); medium-grained; fair-sorted; composed of quartz; coal fragments; noncalcareous cement.	20	680
Tongue of Mancos Shale:		
Siltstone: Medium-light-gray (N 6); clay and silt; noncalcareous cement.	20	700
Silty sandstone: Medium-light-gray (N 6); fine-grained; poorly sorted; composed of quartz; noncalcareous cement.	20	720
Claystone: Dark-gray (N 3); coal fragments; noncalcareous cement.	20	740
Lower part:		
Silty sandstone: Light-gray (N 7); fine-grained; fair-sorted; noncalcareous cement.	40	780
Mancos Shale:		
Siltstone: Medium-light-gray (N 6); calcareous cement.	60	840
Silty claystone: Medium-gray (N 5); calcareous cement.	60	900
Silty claystone: Medium-gray (N 5); calcareous cement.	600	1,500
Sandy siltstone: Medium-light-gray (N 6); calcareous cement.	20	1,520
Sandstone: Medium-light-gray (N 6); fine-grained; well-sorted; composed of quartz; calcareous cement.	20	1,540
Silty claystone: Medium-gray (N 5); calcareous cement.	60	1,600
Claystone: Olive-gray (5Y 4/1); fine-grained quartz sandstone fragments; fair-sorted; calcareous cement.	20	1,620
No samples.	10	1,630

16K-325
104-7.45-14.65

QUATERNARY:		
Alluvium:		
Silty sand: Light-olive-gray (5Y 6/1); very fine to fine-grained; fair-sorted; composed of quartz; calcareous cement.	40	40
Sandy silt: Light-olive-gray (5Y 6/1); jasper fragments; calcareous cement.	10	50
UPPER CRETACEOUS:		
Mancos Shale:		
Mudstone and claystone: Medium-gray (N 5); calcareous cement.	430	480
Mudstone: Light-gray (N 7); gypsum accessory mineral; claystone; calcareous cement.	10	490
Mudstone: Medium-gray (N 5); silty; biotite accessory mineral; calcareous cement.	50	540
Siltstone: Medium-gray (N 5); gypsum accessory mineral; calcareous cement.	10	550
Mudstone: Medium-gray (N 5); silty; gypsum accessory mineral; calcareous cement.	50	600
Siltstone: Medium-light-gray (N 6); calcareous cement.	50	650

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
16K-325—Continued 104-7.45-14.65		
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Siltstone: Medium-light-gray (N 6); sandy; calcareous cement.	10	660
Sandstone: Light-gray (N 7); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	680
Sandstone: Very light gray (N 8); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	15	695
Siltstone: Brownish-gray (5YR 4/1); sandy; calcareous cement.	1	696
16K-332 104-10.60-8.45		
QUATERNARY:		
Alluvium:		
Sandy silt: Light-olive-gray (5Y 6/1); silt and very fine to fine-grained sand; composed of subrounded to subangular, clear quartz; rare mica and dark accessory minerals; rare coal fragments and mudstone fragments; weakly cemented, calcareous and argillaceous.	50	50
Sandy silt: Yellowish-olive-gray (5Y 6/2); silt and very fine grained sand; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	10	60
Sandy silt: Medium-light-gray (N 6); silt and very fine to medium-grained sand; composed of subrounded to subangular, clear and stained quartz; rare mica, limonite, and dark accessory minerals; rare argillaceous material and hematite concretions, and rare to absent carbonaceous material; weakly cemented, calcareous and argillaceous.	80	140
UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Mulatto Tongue of Mancos Shale:		
Siltstone: Light-gray (N 7); silt; rare mica accessory mineral; common argillaceous material; weakly cemented, calcareous.	20	160
Siltstone and mudstone: Medium-light-gray (N 6); clay and silt; rare mica, gypsum, and dark accessory minerals; common calcite fragments; weakly cemented, calcareous.	50	210
Siltstone and mudstone: Light-gray (N 7) and medium-light-gray (N 6); clay and silt; rare mica, gypsum, and dark accessory minerals; common calcite fragments; weakly cemented, calcareous.	10	220
Dilco Coal Member and Gallup Sandstone undifferentiated:		
Siltstone: Olive-gray (5Y 4/1); silt and very fine to fine-grained sand; composed of subangular, clear quartz; rare mica accessory mineral; common argillaceous and carbonaceous material; weakly cemented, calcareous.	40	260
Mudstone: Medium-light-gray (N 6); clay, silt, and chips of fine-grained sand; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	30	290
Sandstone: Medium-light-gray (N 6); fine- to coarse-grained; fair-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; weakly cemented, calcareous.	10	300
Mudstone and siltstone: Medium-light-gray (N 6); clay and silt; rare mica and dark accessory minerals; common coal fragments; weakly cemented, calcareous.	40	340
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; rare mica, feldspar, and dark accessory minerals; weakly cemented, calcareous.	10	350
Mudstone: Medium-gray (N 5) and light-gray (N 7); clay and silt; common mica and rare dark accessory minerals; common to absent coal fragments; weakly cemented, calcareous.	80	430
Sandstone: White (N 9); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare mica, feldspar, and dark accessory minerals; weakly cemented, calcareous.	10	440
Silty sandstone: Very light gray (N 8); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear quartz; common mica and rare dark accessory minerals; rare to common argillaceous material; weakly cemented, calcareous and argillaceous.	10	450
Sandstone: Very light gray (N 8); very fine to medium-grained; fair- to well-sorted; composed of rounded to subangular, clear quartz; common feldspar and rare dark accessory minerals; weakly cemented, calcareous.	40	490
Silty sandstone: Light-gray (N 7); silt and very fine to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; common mica and rare dark accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	10	500
Siltstone and mudstone: Medium-gray (N 5); clay and silt; common mica and dark accessory minerals; rare carbonaceous material; weakly cemented, calcareous.	20	520
No samples.	30	550
Siltstone: Medium-light-gray (N 6) and medium-gray (N 5); silt; rare mica and dark accessory minerals; weakly cemented, calcareous.	13	563
16K-319 105-12.95-7.10		
QUATERNARY:		
Alluvium:		
Fill and adobe.	32	32
UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Dalton Sandstone Member:		
Sandstone: Very pale orange (10YR 8/2).	26	58
Mulatto Tongue of Mancos Shale:		
Shale: Pale-blue (5B 6/2) and bluish-black (5B 2/1).	10	68
Dilco Coal Member:		
Coal and shale: Black (N 1).	2	70
Sandstone: Medium-gray (N 5).	21	91
Shale: Black (N 1).	10	101
Sandstone: Light-gray (N 7).	24	125
Sandstone: Dark-gray (N 3).	11	136
Shale: Bluish-black (5B 2/1).	3	139
Gallup Sandstone:		
Sandstone: Dark-gray (N 3).	29	168
Sandy shale: Undescribed.	2	170
Sandstone: Dark-gray (N 3).	21	191
Sandy shale: Undescribed.	2	193
Sandstone: Light-olive-gray (5Y 6/1); very coarse grained; poorly sorted; composed of quartz; noncalcareous cement.	4	197
Mancos Shale:		
Siltstone: Medium-light-gray (N 6); calcareous cement.	73	270
Siltstone and gypsum: Olive-gray (5Y 3/2); calcareous cement.	5	275
Siltstone: Medium-gray (N 5); calcareous cement.	10	285
Siltstone: Medium-light-gray (N 6); calcareous cement.	5	290
No samples.	5	295
Siltstone: Medium-gray (N 5); calcareous cement.	5	300
Sandy siltstone: Medium-gray (N 5); calcareous cement.	10	310
No samples.	10	320
Siltstone: Medium-gray (N 5).	15	335
No samples.	20	355
Sandstone and siltstone: Medium-light-gray (N 6); very fine grained; calcareous cement.	5	360
No samples.	20	380
Sandstone: Light-olive-gray (5Y 6/1); very fine grained; poorly sorted; composed of quartz; calcareous cement.	5	385
No samples.	10	395
Siltstone: Medium-light-gray (N 6); calcareous cement.	10	405
Siltstone: Medium-light-gray (N 6); calcareous cement.	15	420
Siltstone and sandstone: Medium-light-gray (N 6); silt to very fine grained sand; calcareous cement.	50	470
Claystone: Greenish-gray (5GY 6/1); calcareous cement.	7	477
No samples.	13	490
Siltstone: Medium-gray (N 5); calcareous cement.	10	500
Siltstone: Olive-gray (5Y 4/1); calcareous cement.	10	510
No samples.	10	520
Siltstone and sandy limestone: Medium-light-gray (N 6); calcareous cement.	5	525
Siltstone and sandy limestone: Medium-gray (N 5).	5	530
Shale: Dark-bluish-gray (5B 4/1).	430	960
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Water sand: Very pale orange (10YR 8/2).	3	963
16T-323 105-3.60-8.90		
QUATERNARY:		
Alluvium:		
Sand and silt: Pale-yellowish-brown (10YR 6/2); fine- to medium-grained.	10	10
Sand: Pale-yellowish-brown (10YR 6/2); fine- to coarse-		
Mudstone: Medium-gray (N 5); silty; carbonaceous cement.	10	420
Siltstone: Medium-gray (N 5); sandy.	20	440
Mudstone: Medium-light-gray (N 6); silty; carbonaceous cement.	20	460

grained; poorly sorted; composed of micaceous quartz; basaltic lava fragments.	10	20
Sand: Pale-yellowish-brown (10YR 6/2); fine- to medium-grained; poorly sorted; limestone and basaltic lava fragments.	10	30
Sand: Pale-yellowish-brown (10YR 6/2); fine- to medium-grained; poorly sorted; basaltic lava fragments; limestone and quartz.	20	50
Sand: Pale-yellowish-brown (10YR 6/2); very fine to medium-grained; poorly sorted; limestone fragments; quartz and siltstone.	30	80
UPPER CRETACEOUS:		
Mancos Shale:		
Mudstone: Medium-light-gray (N 6); calcareous cement.	40	120
Limestone: Medium-gray (N 5); clay and silt particles.	10	130
Mudstone: Medium-gray (N 5); sandstone particles.	10	140
Siltstone: Medium-light-gray (N 6); clayey; calcareous cement.	170	310
Mudstone: Medium-light-gray (N 6); sandy; carbonaceous cement.	30	340
Mudstone: Medium-gray (N 5); silty; calcareous cement.	10	350
Mudstone: Medium-gray (N 5); silty; carbonaceous cement.	10	360
Siltstone: Medium-gray (N 5); sandy.	10	370
Siltstone: Pale-yellowish-brown (10YR 6/2); sandy.	10	380
Siltstone: Medium-light-gray (N 6); sandy.	10	390
Mudstone: Medium-light-gray (N 6); silty.	20	410
Siltstone: Pale-yellowish-brown (10YR 6/2); sandy.	40	500
No samples.	150	650
Mudstone: Medium-light-gray (N 6); silty; calcareous cement.	60	710
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Mudstone: Medium-light-gray (N 6); sandy; fragments of very pale orange (10YR 8/2) sandstone, fine- to medium-grained, well-sorted.	10	720
Mudstone: Medium-light-gray (N 6); sandy; calcareous cement.	50	770
Siltstone: Medium-light-gray (N 6); sandy; limestone fragments.	10	780
Mudstone: Medium-light-gray (N 6); silty; calcareous cement.	10	790
Siltstone: Medium-light-gray (N 6); sandy; calcareous cement.	10	800
Mudstone: Medium-light-gray (N 6); silty; calcareous cement.	40	840
Siltstone: Medium-gray (N 5) to dark-gray (N 3).	60	900
UPPER JURASSIC:		
Morrison Formation:		
Brushy Basin Member:		
Sandstone: Very light gray (N 8) to medium-gray (N 5); medium-grained; fragments of medium-light-gray (N 6) and grayish-red (5R 4/2) siltstone.	30	930
No samples.	11	941

Iyanbito Day School 1
105-12.40-15.15

QUATERNARY:		
Windblown sands:		
Sand: Light-brown (5YR 6/4); fine-grained; fair-sorted.	10	10
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member, upper part:		
Claystone: Pale-reddish-brown (10R 5/4); silty.	70	80
Claystone: Pale-reddish-brown (10R 5/4); silty; limestone fragments.	40	120
Claystone: Pale-reddish-brown (10R 5/4); silty.	50	170
Claystone: Pale-reddish-brown (10R 5/4); silty; limestone fragments.	30	200
Claystone: Pale-reddish-brown (10R 5/4); silty.	20	220
Claystone: Pale-red (10R 6/2); silty; limestone fragments.	360	580
Claystone: Grayish-red (10R 4/2); silty; limestone fragments.	40	620
Claystone: Pale-red (10R 6/2); silty; limestone fragments.	50	670
Claystone: Pale-red (10R 6/2).	10	680
Claystone: Pale-red (10R 6/2); silty.	10	690
Claystone: Pale-red (10R 6/2); silty; limestone fragments.	20	710
Claystone: Pale-reddish-brown (10R 5/4); silty; limestone fragments.	50	760
Claystone: Pale-red (10R 6/2); silty; limestone fragments.	70	830
Siltstone: Pale-red (10R 6/2); clayey; limestone fragments.	10	840
Siltstone: Pale-brown (5YR 5/2); sandy.	10	850
Siltstone: Pale-brown (5YR 5/2); clayey; limestone fragments.	20	870
Siltstone: Pale-brown (5YR 5/2); sandy.	20	890
Petrified Forest Member, Sonsela Sandstone Bed:		
Sandstone: Grayish-red (10R 4/2); pebbly; poorly sorted; composed of quartz; siltstone fragments.	10	900
Sandstone: Light-brownish-gray (5YR 6/1); coarse-grained; well-sorted; composed of quartz; siltstone fragments.	10	910
Petrified Forest Member, lower part:		
Siltstone: Brownish-gray (5YR 4/1); sandy; well-sorted.	40	950
Sandstone: Light-brownish-gray (5YR 6/1); silty; well-sorted.	10	960
Siltstone: Light-brownish-gray (5YR 6/1); sandy.	40	1,000
Sandstone: Light-brownish-gray (5YR 6/1); silty; well-sorted.	10	1,010
Siltstone: Light-brownish-gray (5YR 6/1); sandy.	30	1,040
Claystone: Grayish-purple (5P 4/2) and white (N 9); silty; limestone fragments.	10	1,050
Claystone: Pale-red-purple (5RP 6/2); silty; limestone fragments.	10	1,060
Claystone: Grayish-red-purple (5RP 4/2); silty; limestone fragments.	10	1,070
Sandstone: Pinkish-gray (5YR 8/1); fine-grained; calcareous cement.	20	1,090
Claystone: Pale-red (5R 6/2); silty.	30	1,120
Siltstone: Pale-red (5R 6/2); clayey.	40	1,160
No samples.	30	1,190
Mudstone: Grayish-red-purple (5RP 4/2); silty; calcareous cement.	20	1,210
Lower red member:		
Sandstone: Grayish-red-purple (5RP 4/2); medium to very coarse grained; poorly sorted; mudstone fragments; calcareous cement.	10	1,220
Mudstone: Grayish-red-purple (5RP 4/2); silty; limestone and quartz fragments.	30	1,250
Mudstone: Grayish-red-purple (5RP 4/2); silty; calcareous cement.	30	1,280
Mudstone: Grayish-red-purple (5RP 4/2); silty; limestone fragments; calcareous cement.	90	1,370
Mudstone: Grayish-red-purple (5RP 4/2); silty; fine-grained sandstone, quartz, and limestone fragments; calcareous cement.	40	1,410
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Mudstone: Pale-reddish-brown (10R 5/4); silty; calcareous cement.	10	1,420
Mudstone: Grayish-red-purple (5RP 4/2); silty; calcareous cement.	10	1,430
Mudstone: Greenish-gray (5G 6/1) to medium-gray (N 5); silty; calcareous cement.	10	1,440
Mudstone: Grayish-red-purple (5RP 4/2); silty; fine-grained sand; limestone fragments.	20	1,460
Mudstone: Grayish-red-purple (5RP 4/2); silty; limestone fragments; calcareous cement.	50	1,510
PERMIAN:		
Glorieta Sandstone(?):		
No samples.	30	1,540

Mariana Day School
105-3.90-11.60

UPPER CRETACEOUS:		
Mancos Shale:		
Siltstone: Yellowish-gray (5Y 7/2); sandy; gypsum accessory mineral; calcareous cement.	10	10
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; silty; fair-sorted; gypsum accessory mineral.	10	20
Sandstone: Light-gray (N 7); very fine grained; silty; well-sorted; composed of quartz; calcareous cement.	45	65
Mudstone: Medium-gray (N 5); silty; calcareous cement.	65	130
Sandstone: Light-gray (N 7); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	25	155
Siltstone: Medium-gray (N 5); sandy; calcareous cement.	5	160
Sandstone: Light-gray (N 7); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	30	190
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Siltstone: Medium-light-gray (N 6); sandy; coal and mudstone fragments.	20	210
Sandstone: Light-gray (N 7); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	30	240
Mudstone: Dark-gray (N 3); silty; coal.	25	265
UPPER JURASSIC:		
Morrison Formation:		
Brushy Basin Member:		
Claystone: Light-greenish-gray (5GY 8/1); gypsum accessory mineral; coal and limestone fragments.	10	275
Claystone: Light-greenish-gray (5GY 8/1).	50	325
Sandstone: Pinkish-gray (5YR 8/1); very fine to fine-grained; silty; fair-sorted; composed of quartz; claystone fragments; calcareous cement.	40	365
Westwater Canyon Member:		
Sandstone: Very pale orange (10YR 8/2); very fine to very coarse grained; poorly sorted; composed of quartz.	10	375
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; poorly sorted; composed of quartz; calcareous cement.	10	385
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; silty; poorly sorted; composed of quartz; coal and siltstone fragments; calcareous cement.	10	395

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
Mariana Day School—Continued		
105-3.90-11.60		
Sandstone: Light-brown (5YR 6/4); very fine to coarse-grained; poorly sorted; composed of quartz; calcareous cement.	80	475
Sandstone: Light-brown (5YR 6/4); very fine to very coarse grained; poorly sorted; composed of quartz; calcareous cement.	115	590
Recapture Shale Member:		
Sandstone: Yellowish-gray (5Y 7/2) to light-brown (5YR 6/4); fine- to medium-grained; silty; fair-sorted; composed of quartz.	30	620
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	10	630
Mudstone: Pale-red-purple (5RP 6/2); sandy; clay.	2	632
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	43	675
Siltstone: Grayish-orange-pink (5YR 7/2) and light-greenish-gray (5GY 8/1); sandy; calcareous cement.	20	695
Siltstone: Light-greenish-gray (5GY 8/1) and grayish-red (10R 4/2); sandy; calcareous cement.	20	715
Siltstone: Light-greenish-gray (5GY 8/1) and grayish-red (10R 4/2); sandy; calcareous cement.	10	725
Siltstone: Grayish-red (10R 4/2); sand grains; calcareous cement.	70	795
Sandstone: Grayish-orange-pink (5YR 7/2); very fine grained; silty; poorly sorted; composed of quartz; calcareous cement.	65	860
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; well-sorted; composed of quartz; limonite and common magnetite accessory minerals; calcareous cement.	10	870
Silty sandstone: Grayish-orange-pink (5YR 7/2); very fine grained; well-sorted; composed of quartz; calcareous cement.	20	890
Summerville Formation:		
Sandy facies:		
Sandstone: Pale-brown (5YR 5/2); very fine to fine-grained; well-sorted; composed of quartz; magnetite accessory mineral; calcareous cement.	10	900
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	910
Sandstone: Pinkish-gray (5YR 8/1); very fine to fine-grained; well-sorted; composed of quartz; magnetite accessory mineral; calcareous cement.	70	980
Sandstone: Pale-yellowish-brown (10YR 6/2); very fine to fine-grained; well-sorted; composed of quartz; magnetite accessory mineral; calcareous cement.	10	990
Sandstone: Pale-red (10R 6/2) to grayish-red (10R 4/2); very fine to fine-grained; well-sorted; composed of quartz; magnetite accessory mineral; siltstone fragments; calcareous cement.	10	1,000
16K-340		
106-5.45-10.80		
QUATERNARY:		
Alluvium:		
Sandy silt: Pale-yellowish-brown (10YR 6/2); silt and very fine to coarse-grained sand; poorly sorted; rare mica and dark accessory minerals; rare argillaceous material; calcareous cement.	20	20
Sand: Pale-yellowish-brown (10YR 6/2); very fine to coarse-grained; poorly sorted; composed of rounded to subangular, clear and stained quartz; rare to absent limonite and rare dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	20	40
Sandy silt: Pale-yellowish-brown (10YR 6/2); silt and very fine to coarse-grained sand; poorly sorted; rare mica, limonite, and dark accessory minerals; rare to absent silty crystals; calcareous cement.	20	60
Sand: Medium-light-gray (N 6); very fine to medium-grained; silty; composed of subrounded to subangular, clear quartz; abundant siltstone fragments and moderately common argillaceous material; weakly cemented, calcareous and argillaceous.	10	70
Silt and mud: Medium-light-gray (N 6); clay, silt, and fine-grained sand; rare argillaceous material; weakly cemented, calcareous.	10	80
Sand: Light-gray (N 7); fine- to coarse-grained; poorly sorted; composed of rounded to angular, clear, frosted, and amber quartz; rare feldspar and moderately common gypsum accessory minerals; weakly cemented, calcareous.	61	141
16T-335		
106-12.90-10.30		
UPPER CRETACEOUS:		
Menefee Formation and Crevasse Canyon Formation undifferentiated:		
Sandstone: Grayish-orange-brown (10YR 6/4); very fine to medium-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare mica and common dark accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	10	10
Sandy siltstone: Light-yellowish-gray (5Y 8/2) to yellowish-gray (5Y 7/2); silt and very fine to medium-grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common mica and dark accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	30	40
Mudstone and siltstone: Light-gray (N 7) to medium-gray (N 5); clay and silt; common mica accessory mineral; common carbonaceous material; weakly cemented, calcareous.	70	110
Sandy siltstone: Light-gray (N 7) to medium-gray (N 5); silt and very fine to medium-grained sand; composed of subrounded to subangular, clear quartz; common mica, rare feldspar, and rare to common dark accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	70	180
Mudstone and siltstone: Light-olive-gray (5Y 6/1); clay and silt; common mica and rare to common dark accessory minerals; rare carbonaceous material; weakly cemented, calcareous.	20	200
Sandy siltstone: Yellowish-olive-gray (5Y 7/1) to medium-light-gray (N 6); silt and very fine to fine-grained sand; composed of subrounded to subangular, clear quartz; common mica and rare to common dark accessory minerals; common argillaceous material and rare to absent carbonaceous material; weakly cemented, calcareous and argillaceous.	60	260
Mudstone and siltstone: Light-gray (N 7) to medium-gray (N 5); clay and silt; rare to common mica and rare dark accessory minerals; rare to common carbonaceous material; weakly cemented, calcareous.	30	290
Silty sandstone: Light-olive-gray (5Y 6/1); silt and very fine to medium-grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare mica, feldspar, and dark accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	10	300
Sandy siltstone and mudstone: Medium-light-gray (N 6) and some light-brownish-gray (5YR 6/1); clay, silt, and very fine to fine-grained sand; composed of subrounded to subangular, clear and stained quartz; rare to common gypsum, and common mica and dark accessory minerals; rare to common carbonaceous material; weakly cemented, calcareous.	90	390
Silty sandstone: Moderate-reddish-orange (10R 6/6) to pale-grayish-red (10R 5/2); silt and very fine grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common mica, limonite, and dark accessory minerals; common argillaceous material; weakly cemented, calcareous and argillaceous.	30	420
Sandy mudstone: Light-brownish-gray (5YR 6/1) to medium-light-gray (N 6); clay, silt, and very fine to medium-grained sand; composed of subrounded to subangular, clear and stained quartz; common mica and limonite, and rare red and common dark accessory minerals; weakly cemented, calcareous.	20	440
Siltstone: Medium-light-gray (N 6); silt; common mica, and rare red and dark accessory minerals; common carbonaceous material; weakly cemented, calcareous.	40	480
Sandstone: Yellowish-olive-gray (5Y 7/1); very fine to fine-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; rare mica, feldspar, and red and dark accessory minerals; weakly cemented, calcareous.	10	490
Sandy siltstone: Yellowish-olive-gray (5Y 7/1) to medium-light-gray (N 6); silt and very fine to medium-grained sand; composed of subrounded to subangular, clear and stained quartz; rare mica and dark accessory minerals; common argillaceous material; weakly cemented, calcareous.	20	510
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; rare feldspar and common dark accessory minerals; common argillaceous material; weakly cemented, calcareous.	20	530
Mudstone: Medium-light-gray (N 6); clay and silt; common mica and rare dark accessory minerals; common carbonaceous material; weakly cemented, calcareous.	20	550

Rehoboth Mission
106-8.45-15.20

UPPER TRIASSIC:		
Wingate Sandstone:		
Sandstone: Light-gray (N 7) and light-brownish-gray (5YR 6/1); very fine to medium-grained; composed of quartz; mudstone and claystone fragments; calcareous cement.	72	72
Chinle Formation:		
Owl Rock Member:		
Mudstone: Pale-red (10R 6/2); silty.	2	74
Mudstone: Light-greenish-gray (5GY 8/1) and pale-red (10R 6/2); silty; limestone; calcareous cement.	8	82
Siltstone: Pale-red (10R 6/2); calcareous cement.	38	120
Petrified Forest Member, upper part:		
Siltstone: Grayish-red (10R 4/2); calcareous cement.	130	250
Siltstone: Grayish-pink (5R 8/2); silty limestone.	93	343
Siltstone: Moderate-red (5R 5/4); muddy; calcareous cement.	106	449
Mudstone: Moderate-red (5R 5/4); calcareous cement.	129	578
Siltstone: Moderate-red (5R 5/4); muddy; calcareous cement.	68	646
Mudstone: Pale-red (5R 6/2); calcareous cement.	31	677
Sandstone: Light-gray (N 7); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	2	679
Mudstone: Grayish-red (10R 4/2); calcareous cement.	30	709
Siltstone: Pale-red (5R 6/2); muscovite; calcareous cement.	17	726
Siltstone: Pale-red (5R 6/2); sandy; muscovite; calcareous cement.	27	753
Mudstone: Grayish-red (5R 4/2); silty; calcareous cement.	23	776
Mudstone: Pale-red (5R 6/2); silty; calcareous cement.	80	856
Mudstone: Grayish-red (5R 4/2) to medium-gray (N 5); silty; limestone fragments.	17	873
Claystone and mudstone: Pale-red (5R 6/2); calcareous cement.	25	898
Petrified Forest Member, Sonsela Sandstone Bed:		
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	908
Siltstone: Pale-red (5R 6/2); sandstone fragments; calcareous cement.	52	960
Petrified Forest Member, lower part:		
Siltstone and mudstone: Pale-red (5R 6/2); limestone and sandstone; calcareous cement.	126	1,086
Mudstone and sandstone: Light-gray (N 7), pale-red (5R 6/2), and grayish-red (10R 4/2); silt and very fine to medium-grained sand; limestone.	13	1,099
Sandstone: Light-gray (N 7) to yellowish-gray (5Y 7/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	40	1,139
Lower red member and Shinarump Member undifferentiated:		
Mudstone and limestone: White (N 9) to pale-red (5R 6/2); some sandy siltstone.	16	1,155
Sandy siltstone and silty mudstone: Moderate-red (5R 5/4) and grayish-red-purple (5RP 4/2).	15	1,170
Sandstone: Moderate-red (5R 5/4) and grayish-red-purple (5RP 4/2); very fine grained; silty; poorly sorted; some mudstone and limestone.	126	1,296
Claystone: Grayish-red (10R 4/2); calcareous cement.	67	1,363
Claystone: White (N 9), moderate-red (5R 5/4), and grayish-red-purple (5RP 4/2); some siltstone and limestone.	20	1,383
Claystone: Medium-light-gray (N 6); calcareous cement.	15	1,398
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Siltstone, mudstone, claystone, and limestone: Medium-light-gray (N 6), moderate-red (5R 5/4), and grayish-red-purple (5RP 4/2).	20	1,418
Mudstone: Grayish-red-purple (5RP 4/2); silty; calcareous cement.	29	1,447
Siltstone and mudstone: Light-gray (N 7), moderate-red (5R 5/4), and grayish-red-purple (5RP 4/2); limestone fragments.	12	1,459
Siltstone: Medium-light-gray (N 6) and grayish-red-purple (5RP 4/2); silty mudstone; calcareous cement.	8	1,467
Siltstone: Grayish-red (10R 4/2); muscovite; calcareous cement.	8	1,475
Claystone: Medium-light-gray (N 6), moderate-red (5R 5/4), grayish-red (10R 4/2), and grayish-red-purple (5RP 4/2); limestone fragments.	7	1,482
Mudstone: White (N 9) and light-red (5R 6/6); limestone.	8	1,490
MIDDLE(?) AND LOWER TRIASSIC, AND PERMIAN:		
Moenkopi Formation and San Andres Limestone undifferentiated:		
Siltstone: Medium-light-gray (N 6); calcareous cement.	59	1,549
Siltstone: Very light gray (N 8); sandy; calcareous cement.	20	1,569

16K-328
107-4.45-9.80

UPPER CRETACEOUS:		
Menefee Formation:		
No samples.	60	60
Sandstone: Moderate-yellowish-orange-brown (10YR 6/4); very fine to medium-grained; silty; poorly sorted; composed of subangular, clear and stained quartz; common limonite, rare feldspar, and common red and rare dark accessory minerals; rare jasper; weakly cemented, calcareous.	30	90
Sandstone: Light-gray (N 7) and yellowish-gray (5Y 7/2); very fine to medium-grained; silty; fair-sorted; composed of subangular, clear and stained quartz; common limonite, rare feldspar, and common red and rare dark accessory minerals; common siltstone and coal fragments; weakly cemented, calcareous.	70	160
Siltstone: Medium-gray (N 5); clay and silt; common mica accessory mineral; weakly cemented, calcareous.	20	180
Sandstone: Light-gray (N 7); very fine to medium-grained; fair-sorted; composed of subangular, clear quartz; rare feldspar, and common red and rare dark accessory minerals; weakly cemented, calcareous.	30	210
Siltstone: Medium-gray (N 5); common mica accessory mineral; weakly cemented, calcareous.	40	250
Sandstone: Light-gray (N 7); very fine to medium-grained; silty; poorly sorted; composed of subangular, clear quartz; rare feldspar, and common red and rare dark accessory minerals; weakly cemented, calcareous.	60	310
Sandy siltstone: Medium-gray (N 5); silt and very fine to medium-grained sand; composed of subrounded to subangular, clear quartz; common mica accessory mineral; weakly cemented, calcareous.	62	372

16T-339
107-8.55-16.70

QUATERNARY:		
Alluvium:		
Sand: Yellowish-gray (5Y 7/2); very fine to fine-grained; silty; fair-sorted; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	8	8
Silty sand: Brownish-gray (5YR 4/1); silt to fine-grained sand; fair to poorly sorted; composed of subrounded to subangular, clear and stained quartz; common coal fragments; rare argillaceous material; weakly cemented, calcareous.	7	15
Silty sand: Yellowish-gray (5Y 8/1); silt to fine-grained sand; fair to poorly sorted; composed of subrounded to subangular, clear quartz; common coal fragments; rare argillaceous material; weakly cemented, calcareous.	5	20
UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Dilco Coal Member:		
Silty sandstone: Yellowish-gray (5Y 8/1); silt to fine-grained sand; fair to poorly sorted; composed of subrounded to subangular, clear quartz; rare argillaceous material and mudstone fragments; weakly cemented, calcareous.	10	30
Silty sandstone: Light-olive-gray (5Y 6/1); silt to fine-grained sand; fair to poorly sorted; composed of subrounded to subangular, clear quartz; rare argillaceous material and mudstone fragments; weakly cemented, calcareous.	10	40
Silty sandstone: Very light gray (N 8); silt to fine-grained sand; fair to poorly sorted; composed of subrounded to subangular, clear quartz; rare mica accessory mineral; rare to absent carbonaceous material; weakly cemented, calcareous.	60	100
Siltstone and mudstone: Medium-light-gray (N 6); clay, silt, and fine-grained quartz sand; weakly cemented, calcareous.	30	130
Sandstone: Light-olive-gray (5Y 6/1) and black (N 1); fine-grained; well-sorted; composed of subangular to angular, clear quartz; rare pyrite accessory mineral; abundant coal fragments and rare mudstone pellets; weakly cemented, calcareous.	5	135
Coal: Medium-gray (N 5) to grayish-black (N 2); silt and fine-grained quartz sand; rare mudstone fragments; calcareous cement.	5	140
Siltstone: Medium-light-gray (N 6); silt and fine-grained quartz sand; abundant to rare coal fragments; weakly cemented, calcareous.	10	150
Silty sandstone: Light-olive-gray (5Y 6/1); silt to fine-grained sand; poorly sorted; composed of clear and stained quartz; rare pyrite accessory mineral; common coal fragments; weakly cemented, calcareous.	10	160
Siltstone: Medium-light-gray (N 6); silt and fine-grained quartz sand; abundant coal fragments and rare to common mudstone fragments; weakly cemented, calcareous.	30	190
Sandstone: Medium-gray (N 5) to grayish-black (N 2); very fine to fine-grained; well-sorted; composed of subrounded to angular, clear quartz; rare pyrite accessory mineral; abundant coal fragments and common mudstone fragments; calcareous, argillaceous, and siliceous cement.	10	200
Siltstone: Light-olive-gray (5Y 6/1); silt and fine-grained quartz sand; argillaceous and siliceous cement.	20	220

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
16T-339—Continued		
107-8.55-16.70		
Siltstone and mudstone: Medium-light-gray (N 6); clay and silt; rare coal fragments; weakly cemented, calcareous and argillaceous.	20	240
UPPER CRETACEOUS:		
Gallup Sandstone:		
Sandstone: Very light gray (N 8); medium-grained; well-sorted; composed of subangular to angular, clear quartz; rare mudstone fragments; siliceous cement.	20	260
Sandstone: Very light gray (N 8); fine-grained; well-sorted; composed of subangular to angular, clear quartz; siliceous cement.	20	280
Sandstone: Very light gray (N 8); medium-grained; well-sorted; composed of subangular to angular, clear quartz; rare mudstone fragments; siliceous cement.	34	314
16K-302A		
120-12.00-6.45		
QUATERNARY:		
Windblown sands:		
Sand: Light-brown (5YR 6/4); very fine to coarse-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	20
Alluvium:		
Silty sand: Light-brown (5YR 6/4); silt to very coarse grained sand; poorly sorted; composed of quartz; limestone fragments; calcareous cement.	60	80
Silty sand: Grayish-orange-pink (5YR 7/2); silt to very coarse grained sand; poorly sorted; limestone fragments; calcareous cement.	50	130
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member, upper part:		
Siltstone: Pale-red (10R 6/2); sandy; mudstone fragments; calcareous cement.	40	170
Sandstone: Pale-red (5R 6/2); fine- to medium-grained; fair-sorted; composed of quartz; calcareous cement.	10	180
Sandstone: Pale-red (5R 6/2); very fine to coarse-grained; silty; poorly sorted; composed of quartz; limestone fragments; calcareous cement.	20	200
Siltstone: Pale-red (10R 6/2); sandy; limestone fragments; calcareous cement.	10	210
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	230
Siltstone: Pale-red (10R 6/2); sandy; calcareous cement.	30	260
Petrified Forest Member, Sonsela Sandstone Bed:		
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; composed of quartz; limestone fragments; calcareous cement.	20	280
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; poorly sorted; composed of quartz; limestone and siltstone fragments; calcareous cement.	40	320
Mudstone: Pale-red (10R 6/2); silty; calcareous cement.	10	330
Siltstone: Pale-red (10R 6/2); sandy; mudstone fragments.	10	340
Sandstone: Pale-red (10R 6/2); fine- to medium-grained; fair-sorted; composed of quartz; limestone and siltstone fragments; calcareous cement.	20	360
Sandstone: Pale-red (10R 6/2); very fine to coarse-grained; poorly sorted; composed of quartz; limestone fragments; calcareous cement.	10	370
Siltstone: Pale-red (10R 6/2); sandy; limestone and mudstone fragments.	10	380
Sandstone: Pale-red (10R 6/2); very fine to very coarse grained; silty; poorly sorted; composed of quartz; limestone fragments; calcareous cement.	10	390
Sandstone: Pale-red (10R 6/2); very fine to very coarse grained; silty; poorly sorted; composed of quartz; chert fragments; calcareous cement.	30	420
Petrified Forest Member, lower part:		
Claystone: Grayish-red-purple (5RP 4/2); calcareous cement.	10	430
Siltstone: Pale-red (10R 6/2); sandy; limestone fragments; calcareous cement.	20	450
Mudstone: Light-brownish-gray (5YR 6/1); silty; calcareous cement.	40	490
Sandstone: Pale-red (10R 6/2); fine- to medium-grained; fair-sorted; composed of quartz; limestone and chert fragments; calcareous cement.	10	500
Mudstone: Pale-red (10R 6/2); sandy; silty; calcareous cement.	30	530
Siltstone: Grayish-red (10R 4/2); calcareous cement.	10	540
Mudstone: Grayish-red-purple (5RP 4/2); silty; calcareous cement.	30	570
Siltstone: Grayish-red (5R 4/2); calcareous cement.	40	610
UPPER TRIASSIC, AND MIDDLE(?) AND LOWER TRIASSIC:		
Chinle Formation (lower red member) and Moenkopi Formation undifferentiated:		
Mudstone: Pale-red (10R 6/2); silty; calcareous cement.	50	660
Mudstone and claystone: Pale-red (10R 6/2); silty; calcareous cement.	40	700
Siltstone: Pale-red (5R 6/2); sandy; claystone fragments.	20	720
Mudstone and claystone: Pale-red (10R 6/2); sandy.	110	830
Mudstone: Pale-red (5R 6/2); silty; muscovite accessory mineral; limestone fragments; calcareous cement.	50	880
Mudstone: Pale-red (5R 6/2); silty; muscovite accessory mineral; limestone, claystone, sand, and gypsum fragments; calcareous cement.	160	1,040
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	1,050
Mudstone and claystone: Pale-red (5R 6/2); silty; sand grains; calcareous cement.	30	1,080
PERMIAN:		
Glorieta Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	1,100
Sandstone: Very pale orange (10YR 8/2); very fine to coarse-grained; poorly sorted; composed of quartz; calcareous cement.	10	1,110
Sandstone: Very pale orange (10YR 8/2); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	20	1,130
Siltstone: Pale-red (10R 6/2); sandy; biotite accessory mineral; calcareous cement.	10	1,140
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	1,160
Mudstone: Grayish-orange-pink (5YR 7/2); silty; biotite accessory mineral.	10	1,170
Yeso Formation:		
Siltstone: Pale-reddish-brown (10R 5/4); sandy; calcareous cement.	10	1,180
Siltstone: Pale-red (10R 6/2); sandy; gypsum accessory mineral; calcareous cement.	10	1,190
Siltstone: Pale-red (10R 6/2); sandy; calcareous cement.	60	1,250
San Antone Mission		
120-7.35-4.20		
QUATERNARY:		
Alluvium:		
Silty sand: Pale-reddish-brown (10R 5/4); very fine to coarse-grained; poorly sorted; composed of quartz; calcareous cement.	20	20
UPPER TRIASSIC:		
Chinle Formation:		
Owl Rock Member:		
Siltstone: Pale-reddish-brown (10R 5/4); sandy; limestone fragments; calcareous cement.	10	30
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	40
Siltstone: Pale-reddish-brown (10R 5/4); sandy; limestone fragments; calcareous cement.	60	100
Petrified Forest Member, upper part:		
Mudstone: Moderate-red (5R 5/4); silty; limestone fragments; calcareous cement.	70	170
Siltstone: Pale-reddish-brown (10R 5/4); sandy; calcareous cement.	30	200
Siltstone: Pale-red (10R 6/2); sandy; calcareous cement.	50	250
Siltstone: Pale-red (10R 6/2); calcareous cement.	10	260
Siltstone: Moderate-red (5R 5/4); mudstone; calcareous cement.	10	270
Siltstone: Pale-red (10R 6/2); sandy; calcareous cement.	40	310
Siltstone and mudstone: Pale-reddish-brown (10R 5/4); limestone fragments.	10	320
Siltstone and mudstone: Pale-reddish-brown (10R 5/4); calcareous cement.	40	360
Siltstone and mudstone: Pale-reddish-brown (10R 5/4); limestone fragments; calcareous cement.	60	420
Siltstone: Pale-reddish-brown (10R 5/4); calcareous cement.	30	450
Siltstone: Pale-reddish-brown (10R 5/4); mudstone and limestone fragments; calcareous cement.	70	520
Siltstone: Pale-reddish-brown (10R 5/4); calcareous cement.	30	550
Siltstone: Pale-reddish-brown (10R 5/4); mudstone fragments; calcareous cement.	60	610
Mudstone: Pale-red-purple (5RP 6/2); limestone fragments; calcareous cement.	20	630
Siltstone and mudstone: Pale-red (10R 6/2); calcareous cement.	30	660
Siltstone: Pale-red (10R 6/2); calcareous cement.	10	670
Siltstone: Pale-red (5R 6/2); sandy; biotite accessory mineral; calcareous cement.	30	700
No samples.	31	731

16K-341
122-9.40-6.60

UPPER CRETACEOUS:		
Menefee Formation:		
Silty sandstone: Dark-yellowish-brown (10YR 4/2); silt and very fine to medium-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; rare mudstone and coal fragments; weakly cemented, calcareous.	10	10
Siltstone and mudstone: Yellowish-gray (5Y 7/2); clay and silt; weakly cemented, calcareous and argillaceous.	20	30
Siltstone and mudstone: Medium-light-gray (N 6); clay, silt, and some fine-grained quartz sand; rare limonite accessory mineral; weakly cemented, calcareous and argillaceous.	20	50
Sandy siltstone: Medium-light-gray (N 6); silt and fine-grained quartz sand; rare mudstone fragments; weakly cemented, calcareous.	10	60
Silty sandstone: Very light gray (N 8) to light-gray (N 7); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	50	110
Sandstone: Very light gray (N 8) to light-gray (N 7); fine- to medium-grained; silty; poorly sorted; composed of subrounded to angular, clear and stained quartz; rare pyrite accessory mineral; common wood fragments and mudstone pellets; weakly cemented, calcareous.	10	120
Siltstone and mudstone: Light-gray (N 7); clay and silt; weakly cemented, calcareous and argillaceous.	10	130
Menefee Formation and Crevasse Canyon Formation undifferentiated:		
Sandy siltstone: Very light gray (N 8); silt and fine-grained quartz sand; common mudstone fragments and rare carbonaceous material; weakly cemented, calcareous.	30	160
Siltstone: Light-gray (N 7); silt and fine-grained quartz sand; rare to absent mica accessory mineral; rare to common carbonaceous material and rare to absent mudstone fragments; weakly cemented, calcareous.	100	260
Siltstone: Medium-light-gray (N 6); silt; common carbonaceous material and rare mudstone fragments; weakly cemented, calcareous.	10	270
Silty sandstone: Medium-light-gray (N 6); silt to fine-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; common mudstone pellets and rare carbonaceous material; weakly cemented, calcareous.	10	280
Siltstone and mudstone: Light-gray (N 7); clay, silt, and fine-grained quartz sand; rare carbonaceous material; weakly cemented, calcareous and argillaceous.	50	330
Silty sandstone: Very light gray (N 8); silt to fine-grained sand; poorly sorted; composed of subrounded to angular, clear quartz; rare mudstone pellets and carbonaceous material; weakly cemented, calcareous.	20	350
Siltstone: Light-gray (N 7); silt and fine-grained quartz sand; rare mudstone fragments and carbonaceous material; weakly cemented, calcareous.	10	360

Fort Wingate School
122-1.95-2.20

UPPER TRIASSIC:		
Chinle Formation:		
Lower red member:		
Sandstone: Pale-brown (5YR 5/2); very fine to very coarse grained; silty; poorly sorted; composed of quartz; quartz pebbles; siltstone and mudstone fragments; calcareous cement.	20	20
Sandstone: Light-brownish-gray (5YR 6/1); very fine to very coarse grained; silty; poorly sorted; composed of quartz; quartz pebbles; siltstone and mudstone fragments; calcareous cement.	10	30
Siltstone: Pale-red (10R 6/2); sandy; mudstone fragments; calcareous cement.	10	40
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to very coarse grained; silty; poorly sorted; composed of quartz; quartz pebbles; mudstone fragments; calcareous cement.	20	60
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; mudstone pellets; calcareous cement.	10	70
Sandstone: Moderate-orange-pink (5YR 8/4) and pale-red (10R 6/2); very fine to very coarse grained; silty; poorly sorted; composed of quartz; mudstone and siltstone fragments; calcareous cement.	30	100
Siltstone and mudstone: Pale-grayish-red (10R 5/2); sandstone fragments.	10	110
Shinarump Member:		
Calcareous siltstone: Grayish-orange-pink (5YR 7/2); sandstone fragments.	50	160
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Sandstone: Moderate-orange-brown (5YR 7/4); very fine to medium-grained; silty; well-sorted; composed of quartz; calcareous cement.	20	180
Siltstone: Pale-brown (5YR 5/2); sandy; sandstone fragments; calcareous cement.	10	190
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	40	230
Sandstone: Very pale orange (10YR 8/2) to moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; mudstone fragments; calcareous cement.	20	250
Sandstone: Light-orange-brown (5YR 7/4); very fine to very coarse grained; poorly sorted; composed of quartz; calcareous cement.	50	300
PERMIAN:		
Glorieta Sandstone:		
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	30	330
Sandstone: Grayish-orange-red (10R 7/2); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	10	340
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; silty; poorly sorted; composed of quartz; calcareous cement.	7	347
Sandstone: Pale-grayish-red (10R 5/2); very fine to very coarse grained; silty; poorly sorted; composed of quartz; calcareous cement.	1	348

16K-321
123-0.35-3.40

UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Bartlett Barren Member:		
Sandstone: Yellowish-gray (5Y 7/2); medium-grained; poorly sorted; siltstone.	50	50
Siltstone: Light-olive-gray (5Y 5/2); clayey; carbonaceous material and medium-grained sandstone.	50	100
Siltstone: Light-olive-gray (5Y 5/2); clayey.	10	110
Sandstone: Light-olive-gray (5Y 5/2); fine-grained; poorly sorted; siltstone fragments.	20	130
Siltstone: Medium-light-gray (N 6); carbonaceous material.	50	180
Siltstone: Light-gray (N 7); sandy; carbonaceous material.	40	220
Dilco Coal Member:		
Carbonaceous siltstone: Grayish-black (N 2).	20	240
Siltstone: Medium-gray (N 5); sand.	20	260
Siltstone: Medium-gray (N 5); clayey; carbonaceous material.	40	300
Claystone: Medium-light-gray (N 6); silty.	30	330
Claystone: Medium-gray (N 5); silty; carbonaceous material.	200	530
Gallup Sandstone:		
Sandstone: Light-olive-gray (5Y 5/2); medium-grained; fair-sorted; claystone fragments.	10	540
Sandstone: Grayish-pink (5R 8/2); medium-grained; fair-sorted; claystone fragments.	30	570
Sandstone: Very pale orange (10YR 8/2); coarse-grained; poorly sorted; claystone fragments.	30	600
Sandstone: Grayish-pink (5R 8/2); very coarse grained; poorly sorted; claystone fragments.	10	610
No samples.	124	734

16K-337
124-1.80-5.70

QUATERNARY:		
Alluvium:		
Sandy silt: Yellowish-gray (5Y 7/2); silt to fine-grained sand; composed of subrounded to angular, clear quartz; rare mica and feldspar, and moderately common red and black accessory minerals; rare to absent carbonaceous material; weakly cemented, calcareous.	20	20
Sandy silt: Light-olive-gray (5Y 5/2); silt and very fine to medium-grained sand; poorly sorted; rare mica, feldspar, limonite, and dark accessory minerals; moderately common mudstone and claystone fragments, and abundant coal fragments; weakly cemented, calcareous.	10	30
Mud: Light-gray (N 7); clay, silt, and some sand; rare limonite, red, and black accessory minerals; rare to common coal fragments; weakly cemented, calcareous and argillaceous.	20	50
UPPER CRETACEOUS:		
Mancos Shale:		
Sandy siltstone: Light-gray (N 7); silt to fine-grained sand; rare mica, feldspar, and dark accessory minerals; rare to common coal fragments; weakly cemented, calcareous.	40	90
Siltstone: Very light gray (N 8); silt; rare mica, feldspar, and dark accessory minerals; weakly cemented, calcareous.	10	100
Mudstone: Light-gray (N 7); clay, silt, and some sand;		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

16K-337—Continued
124-1.80-5.70

	Thickness (feet)	Depth (feet)
rare limonite and dark accessory minerals; rare coal fragments; weakly cemented, calcareous and argillaceous.	10	110
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; silty; poorly sorted; composed of subangular to angular, clear and stained quartz; moderately common mica, and rare feldspar and dark accessory minerals; rare to absent coal fragments; weakly cemented, noncalcareous.	30	140
Sandstone: Light-brownish-gray (5YR 6/1); very fine to very coarse grained; poorly sorted; composed of subrounded to angular, clear quartz; rare mica, feldspar, and dark accessory minerals; common siltstone, mudstone, and coal fragments; weakly cemented, calcareous.	10	150
Mudstone: Light-gray (N 7); clay, silt, and some sand; rare limonite and dark accessory minerals; rare coal fragments; weakly cemented, calcareous and argillaceous.	10	160
Siltstone: Very light gray (N 8); silt; rare mica, feldspar, and dark accessory minerals; weakly cemented, calcareous.	10	170
Sandstone: Light-gray (N 7); very fine to coarse-grained; silty; poorly sorted; composed of subangular to angular, clear and stained quartz; rare limonite, moderately common feldspar, and common mica and dark accessory minerals; weakly cemented, calcareous.	10	180
Sandy siltstone: White (N 9); silt to fine-grained sand; rare mica, feldspar, and dark accessory minerals; rare coal fragments; weakly cemented, calcareous.	10	190
Sandstone: Very light gray (N 8); very fine to medium-grained; silty; well-sorted; composed of subrounded to subangular, clear and stained quartz; moderately common mica, and rare feldspar and dark accessory minerals; rare to absent coal fragments; weakly cemented, calcareous.	20	210
UPPER JURASSIC:		
Morrison Formation:		
Westwater Canyon Member:		
Siltstone: Greenish-gray (5GY 6/1); silt; rare to absent pyrite, and rare mica and dark accessory minerals; weakly cemented, calcareous.	30	240
Sandstone: Medium-light-gray (N 6); very fine to very coarse grained; silty; poorly sorted; composed of rounded to angular, clear and stained quartz; rare mica and dark accessory minerals; common mudstone and siltstone fragments; weakly cemented, calcareous and argillaceous.	10	250
Sandstone: Yellowish-gray (5Y 7/2); very fine to medium-grained; poorly sorted; composed of subangular to angular, clear and stained quartz; rare mica, feldspar, and limonite, and moderately common dark accessory minerals; weakly cemented, calcareous.	10	260
No samples.	39	299

Cheechilgeetho Day School
136-8.70-0.30

	Thickness (feet)	Depth (feet)
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member, upper part:		
Sandstone: Moderate-brown (5YR 4/4); medium-grained.	40	40
Siltstone: Pale-reddish-brown (10R 5/4); sandy.	40	80
Claystone: Pale-reddish-brown (10R 5/4); silty; limestone fragments.	190	270
Sandstone: Grayish-red (5R 4/2); very coarse grained; composed of limestone fragments.	10	280
Claystone: Grayish-red (5R 4/2); silty; limestone fragments.	280	560
Sandstone: Grayish-red (5R 4/2); very coarse grained; composed of limestone fragments.	20	580
Claystone: Grayish-red (5R 4/2); silty; limestone fragments.	160	740
Petrified Forest Member, Sonsela Sandstone Bed:		
Claystone: Medium-gray (N 5); silty; medium-grained sandstone and limestone fragments; calcareous cement.	60	800
Claystone: Grayish-red (5R 4/2); silty; medium-grained sandstone and limestone fragments.	50	850
Sandstone: Very pale orange (10YR 8/2); fine-grained; calcareous cement.	10	860
Petrified Forest Member, lower part:		
Claystone: Grayish-purple (5P 4/2) and white (N 9); silty.	50	910
Claystone: Grayish-red (5R 4/2); silty.	70	980
Siltstone: Dark-reddish-brown (10R 3/4); clayey.	90	1,070
Lower red member:		
Siltstone: Light-brownish-gray (5YR 6/1); clayey; fine-grained sandstone fragments.	30	1,100
Claystone: Grayish-red (5R 4/2); silty; limestone fragments.	130	1,230
Claystone: Medium-light-gray (N 6); silty.	30	1,260
Siltstone: Grayish-red (5R 4/2); clayey; limestone fragments.	40	1,300
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Siltstone: Light-gray (N 7) to medium-gray (N 5); pebbles(?); limestone fragments.	5	1,305
Pebbly sandstone: Medium-light-gray (N 6); pebbles composed of limestone, siltstone, and fine-grained sandstone.	15	1,320
MIDDLE(?) AND LOWER TRIASSIC, AND PERMIAN:		
Moenkopi Formation and San Andres Limestone undifferentiated:		
Siltstone and sandstone: Pale-brown (5YR 5/2); silt to very fine grained sand; siltstone and limestone fragments.	30	1,350
PERMIAN:		
Glorieta Sandstone:		
Sandstone: Grayish-orange-pink (5YR 7/2); fine-grained; well-sorted; siltstone fragments.	190	1,540
Yeso Formation(?):		
Sandstone: Light-brown (5YR 6/4); fine-grained; composed of quartz; some basalt(?) fragments.	67	1,607

17T-354
91-11.55-11.50

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Silty sand: Light-brown (5YR 6/4); very fine grained; poorly sorted.	60	60
Sand: Light-brown (5YR 6/4); very fine grained; poorly sorted; limestone and quartz fragments.	20	80
Sandy silt: Light-brown (5YR 6/4).	50	130
Sandy silt: Light-brown (5YR 6/4); gray siltstone fragments.	60	190
UPPER TRIASSIC:		
Wingate Sandstone:		
Rock Point Member:		
Siltstone: Moderate-reddish-brown (10R 4/6); silt; very fine grained sandstone fragments.	10	200
Siltstone: Light-brown (5YR 6/4); silt; very fine grained sandstone fragments.	110	310
Sandstone: Moderate-brown (5YR 4/4); very fine grained; silty.	40	350
Chinle Formation:		
Owl Rock Member:		
Sandstone: Moderate-brown (5YR 4/4); very fine grained; silty; limestone fragments.	50	400
Sandstone: Light-brown (5YR 6/4); very fine grained; silty; limestone fragments.	60	460
Siltstone, sandstone, and limestone: Pale-brown (5YR 5/2); very fine grained.	10	470
Limestone and siltstone: Grayish-orange-pink (5YR 7/2).	10	480
Siltstone, limestone, and sandstone: Pale-brown (5YR 5/2); very fine grained.	50	530
Limestone and sandy limestone: Grayish-orange-pink (5YR 7/2); some siltstone fragments.	80	610
Petrified Forest Member:		
Claystone: Pale-brown (5YR 5/2); some limestone fragments.	50	660
Claystone: Pale-brown (5YR 5/2); limestone fragments.	160	820
Claystone: Grayish-red (5R 4/2); limestone fragments.	60	880
Claystone: Pale-red (5R 6/2); limestone fragments.	150	1,030
Claystone: Dark-reddish-brown (10R 3/4); limestone fragments.	20	1,050
Claystone: Grayish-red (5R 4/2); limestone fragments.	210	1,260
Claystone: Grayish-red (5R 4/2); fine-grained sandstone.	40	1,300
Lower red member:		
Siltstone: Grayish-red (5R 4/2); fine-grained sandstone and limestone fragments.	110	1,410
Siltstone, sandstone, and limestone: Pale-brown (5YR 5/2); fine-grained.	30	1,440
Siltstone, sandstone, and limestone: Grayish-purple (5P 4/2) to pale-brown (5YR 5/2); fine-grained.	60	1,500
UPPER TRIASSIC, AND MIDDLE(?) AND LOWER TRIASSIC:		
Chinle Formation and Moenkopi Formation undifferentiated:		
Claystone, siltstone, and limestone: Pale-brown (5YR 5/2).	120	1,620
Claystone, siltstone, sandstone, and limestone: Pale-brown (5YR 5/2) and medium-bluish-gray (5B 5/1); fine-grained.	30	1,650
Claystone, siltstone, and limestone: Pale-brown (5YR 5/2).	40	1,690
Claystone, siltstone, and limestone: Pale-brown (5YR 5/2) and medium-gray (N 5).	97	1,787
Claystone, siltstone, sandstone, and limestone: Pale-brown (5YR 5/2) and medium-gray (N 5); medium-grained.	40	1,827
No samples.	33	1,860

17K-362
109-4.55-11.00

UPPER TRIASSIC:		
Chinle Formation:		
Shinarump Member:		
Sandy siltstone: Moderate-orange-brown (10R 6/4); silt to fine-grained sand; composed of rounded to subangular, clear and frosted quartz; rare limonite and dark accessory minerals; rare argillaceous material; weakly cemented, calcareous and siliceous.	50	50
PERMIAN:		
De Chelly Sandstone:		
Upper member:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; poorly sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare limonite and dark accessory minerals; weakly cemented, calcareous and siliceous.	60	110
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare limonite and dark accessory minerals; weakly cemented, calcareous and siliceous.	50	160
Sandstone: Moderate-orange-brown (10R 6/4); very fine to fine-grained; silty; poorly sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare limonite and dark accessory minerals; weakly cemented, calcareous and siliceous.	20	180
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare limonite and dark accessory minerals; weakly cemented, calcareous and siliceous.	20	200
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; poorly sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare limonite and dark accessory minerals; weakly cemented, calcareous and siliceous.	50	250
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; rare limonite and dark accessory minerals; weakly cemented, calcareous and siliceous.	160	410
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear, stained, frosted, and pitted quartz; rare to common limonite and dark accessory minerals; rare argillaceous material; weakly to firmly cemented, calcareous, siliceous, and ferruginous.	80	490
Lower member:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; fair-sorted; composed of clear, stained, frosted, and pitted quartz; rare to common limonite and dark accessory minerals; weakly to firmly cemented, calcareous, siliceous, and ferruginous.	60	550
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear, stained, frosted, and pitted quartz; rare to common limonite and dark accessory minerals; rare argillaceous material; weakly to firmly cemented, calcareous, siliceous, and ferruginous.	41	591

17T-368
109-11.50-16.45

QUATERNARY:		
Alluvium:		
Sand: Grayish-orange-pink (10R 8/2) to pale-brown (5YR 5/2); very fine to medium-grained; silty; poorly sorted; composed of rounded to subangular, clear and frosted quartz; rare dark accessory minerals; rare hematite spherules and argillaceous material; weakly cemented, ferruginous.	20	20
PERMIAN:		
De Chelly Sandstone:		
Upper member:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and frosted quartz; rare dark accessory minerals; rare hematite spherules and argillaceous material; weakly cemented, ferruginous.	40	60
Sandstone: Very pale orange (10YR 8/2) and moderate-orange-pink (5YR 8/4); fine-grained; well-sorted; composed of subangular to angular, clear and frosted quartz; rare dark accessory minerals; rare hematite spherules; weakly cemented, ferruginous.	40	100
Sandstone: Very pale orange (10YR 8/2) and moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of subangular to angular, clear and frosted quartz; rare dark accessory minerals; rare hematite spherules; weakly cemented, ferruginous.	20	120
Sandstone: Moderate-orange-pink (5YR 8/4) to light-brown (5YR 6/4); very fine to fine-grained; silty; well-sorted; composed of subangular to angular, clear and frosted quartz; rare dark accessory minerals; rare hematite spherules; weakly cemented, ferruginous.	10	130
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; fair to poorly sorted; composed of subrounded to angular, clear, stained, and frosted quartz; rare hematite spherules; weakly cemented, ferruginous.	20	150
Sandstone: Moderate-orange-pink (5YR 8/4 and 10R 7/4); very fine to fine-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and frosted quartz; rare dark accessory minerals; weakly cemented, ferruginous.	50	200
Sandstone: Moderate-reddish-orange (10R 6/6) to moderate-orange-pink (10R 7/4); very fine to fine-grained; fair- to well-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare dark accessory minerals; weakly cemented, ferruginous.	60	260
Siltstone: Grayish-orange-pink (10R 8/2); silt and very fine grained quartz sand; poorly sorted; weakly cemented, ferruginous.	10	270
Silty sandstone: Moderate-orange-pink (5YR 8/4) and grayish-orange-pink (5YR 7/2); silt to very fine grained sand; fair-sorted; composed of subrounded to angular, clear and frosted quartz; rare dark accessory minerals; rare argillaceous material; weakly cemented, ferruginous.	20	290
Sandstone: Moderate-orange-pink (5YR 7/4); very fine to fine-grained; silty; fair-sorted; composed of subrounded to subangular, clear and frosted quartz; rare dark accessory minerals; weakly cemented, ferruginous.	20	310
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Silty sandstone: Moderate-orange-pink (10R 7/4) to pale-reddish-brown (10R 5/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear, frosted, and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	80	390
Silty sandstone: Moderate-reddish-orange (10R 6/6) and moderate-orange-pink (10R 7/4); silt to very fine grained sand; fair to poorly sorted; rare dark accessory minerals; weakly cemented, calcareous.	40	430
Silty sandstone: Pale-reddish-brown (10R 5/4) and moderate-orange-pink (10R 7/4); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare dark accessory minerals; weakly cemented, calcareous.	50	480
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to coarse-grained; fair-sorted; composed of rounded to angular, clear, stained, and frosted quartz; rare limonite and common dark accessory minerals; firmly cemented, calcareous and ferruginous; water-bearing.	10	490
Silty sandstone: Moderate-reddish-orange (10R 6/6) and moderate-orange-pink (10R 7/4); silt to very fine grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare dark accessory minerals; weakly cemented, calcareous.	80	570
Silty sandstone: Moderate-reddish-orange (10R 6/6); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; rare dark accessory minerals; rare to absent micaceous material; weakly cemented, calcareous.	35	605

17K-355
110-4.25-16.65

TERTIARY:		
Bidahochi Formation:		
Upper member:		
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	10
Sandstone: Grayish-orange-pink (5YR 7/2); silty; poorly sorted; composed of quartz; basalt fragments; calcareous cement.	130	140
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; poorly sorted; composed of quartz; basalt fragments; calcareous cement.	60	200
Sandstone: Light-brown (5YR 6/4); very fine to coarse-grained; poorly sorted; composed of quartz; jasper and basalt fragments; calcareous cement.	10	210
Sandstone: Grayish-orange (10YR 7/4); very fine to coarse-grained; poorly sorted; composed of quartz; jasper and basalt fragments; calcareous cement.	50	260
Sandstone: Grayish-orange (10R 7/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	10	270
Sandstone: Grayish-orange (10YR 7/4); very fine to coarse-grained; poorly sorted; composed of quartz; calcareous cement.	40	310
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	20	330

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

17K-355—Continued
110-4.25-16.65

	Thickness (feet)	Depth (feet)
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member:		
Sandstone: Pale-red (10R 6/2); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	10	340
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; fair-sorted; composed of quartz; calcareous cement.	20	360
Siltstone: Pale-red (5R 6/2); sandy; calcareous cement.	10	370
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; well-sorted; composed of quartz; calcareous cement.	10	380
Sandstone: Pale-red (5R 6/2); very fine to medium-grained; silty; poorly sorted; composed of quartz; biotite accessory mineral; calcareous cement.	5	385
Mudstone: Pale-red (5R 6/2) and light-greenish-gray (5Y 8/1); silty and sandy; biotite accessory mineral.	5	390
Mudstone: Grayish-red-purple (5RP 4/2); silty and sandy; biotite accessory mineral.	5	395
Mudstone: Grayish-red-purple (5RP 4/2) and pale-red (5R 6/2); silty and sandy; limestone pellets.	10	405
Siltstone: Pale-red (5R 6/2); sandy; calcareous cement.	35	440
Sandstone: Pale-red (10R 6/2); very fine to coarse-grained; silty; poorly sorted; composed of quartz; biotite accessory mineral; calcareous cement.	15	455
Mudstone: Very light gray (N 8); silty; calcareous cement.	10	465
Siltstone: Very light gray (N 8); sandy; calcareous cement.	10	475
Mudstone: Grayish-purple (5P 4/2); silty; calcareous cement.	15	490
Siltstone: Pale-red (10R 6/2); sandy; calcareous cement.	25	515
Siltstone: Pale-red (10R 6/2); sandy; biotite accessory mineral; calcareous cement.	25	540
Mudstone: Grayish-purple (5P 4/2); calcareous cement.	20	560
Siltstone: Pale-red-purple (5RP 6/2); biotite accessory mineral; calcareous cement.	20	580
Siltstone: Pale-red (5R 6/2); sandy; biotite accessory mineral; calcareous cement.	5	585
Siltstone: Grayish-red (5R 4/2); sandy; biotite accessory mineral; calcareous cement.	5	590
Siltstone: Pale-red (10R 6/2); sandy; biotite accessory mineral; calcareous cement.	30	620
Siltstone and mudstone: Pale-red (5R 6/2); calcareous cement.	10	630
Mudstone and siltstone: Pale-grayish-red (5R 5/2); limestone pellets; calcareous cement.	30	660
Siltstone and mudstone: Pale-grayish-red (5R 5/2); calcareous cement.	20	680
Mudstone: Pale-grayish-red (5R 5/2) and medium-light-gray (N 6); calcareous cement.	5	685
Shinarump Member:		
Mudstone: Pale-grayish-red (5R 5/2) and medium-light-gray (N 6); silty and sandy; calcareous cement.	5	690
Mudstone and claystone: Medium-light-gray (N 6); calcareous cement.	30	720
Siltstone and mudstone: Medium-light-gray (N 6); biotite accessory mineral; calcareous cement.	15	735
Sandstone: Medium-light-gray (N 6) and light-brownish-gray (5YR 6/1); fine to very coarse grained; poorly sorted; composed of quartz; siltstone, mudstone, and jasper fragments; calcareous cement.	10	745
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Siltstone: Grayish-red (10R 4/2) to moderate-orange-brown (10R 6/4); sandy; biotite accessory mineral; bleached stringers; calcareous cement.	20	765
Siltstone: Pale-reddish-brown (10R 5/4); sandy; biotite accessory mineral; calcareous cement.	20	785
Siltstone: Pale-reddish-brown (10R 5/4); sandy; biotite accessory mineral; mudstone fragments; calcareous cement.	80	865
Sandstone: Pale-red (10R 6/2); very fine to coarse-grained; silty; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	10	875
Siltstone: Pale-reddish-brown (10R 5/4); mica accessory mineral; mudstone fragments; calcareous cement.	70	945
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	20	965
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	10	975
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	25	1,000
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; well-sorted; composed of quartz; mudstone fragments; calcareous cement.	10	1,010
Sandstone: Grayish-orange (10YR 7/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	5	1,015
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	1,035
Sandstone: Grayish-orange (10YR 7/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	1,055
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	35	1,090
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	1,110
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	30	1,140
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	40	1,180
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	30	1,210
Sandstone: Pale-yellowish-orange (10YR 8/6); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	20	1,230
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	1,240
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	190	1,430
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	160	1,590
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	80	1,670
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	100	1,770
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	40	1,810
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	20	1,830
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; silty; well-sorted; composed of quartz; calcareous cement.	8	1,838

17K-367
110-13.45-10.00

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sand: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; silty; poorly sorted; composed of subrounded to angular, clear and stained quartz; rare feldspar and dark accessory minerals; rare olivine crystals; weakly cemented, calcareous.	20	20
Sandy silt: Pale-red (10R 6/2); silt and very fine to fine-grained sand; well-sorted; rare gypsum and dark accessory minerals; rare argillaceous material; weakly cemented, calcareous and argillaceous.	10	30
Sandstone: Pale-red (10R 6/2); fine- to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; moderately common argillaceous material; weakly cemented, calcareous and argillaceous.	10	40
Sandy siltstone and mudstone: Pale-red (10R 6/2); clay, silt, and fine- to coarse-grained sand; poorly sorted; moderately common argillaceous material; weakly cemented, calcareous and argillaceous.	10	50
Sandstone: Pale-red (10R 6/2); fine- to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; moderately common argillaceous material; weakly cemented, calcareous and argillaceous.	100	150
No samples.	26	176
No samples; base of alluvium at 209 feet (from driller's log).	34	210
UPPER TRIASSIC:		
Wingate Sandstone:		
Rock Point Member:		
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to coarse-grained; poorly sorted; composed of subrounded to angular, clear and frosted quartz; common dark accessory minerals; rare argillaceous material; calcareous cement.	3	213

EPNG N1
110-11.90-13.60

TERTIARY:		
Bidahochi Formation:		
Upper member:		
Sandstone: Light-brown (5YR 6/4); fine-grained; fair-sorted.	260	260
Sandstone: Light-brown (5YR 6/4); medium-grained; poorly sorted; claystone and coarse-grained, well-rounded, frosted quartz.	50	310
Sandstone: Pale-yellowish-brown (10YR 6/2); fine-grained; volcanic ash(?).	70	380
Sandstone: Light-olive-gray (5Y 6/1) and black (N 1); medium-grained; poorly sorted; ash matrix; possible basalt.	30	410
Sandstone: Light-brown (5YR 6/4); coarse-grained; poorly sorted; ash fragments and black (N 1) sand; coarse-grained, well-rounded, frosted quartz.	40	450
UPPER TRIASSIC:		
Wingate Sandstone:		
Rock Point Member:		
Sandstone: Light-brown (5YR 6/4); fine-grained; fair-sorted; siltstone fragments.	200	650
Siltstone: Light-brown (5YR 6/4); clayey.	40	690
Sandstone: Light-brown (5YR 6/4); fine-grained; siltstone.	30	720
Siltstone: Moderate-reddish-orange (10R 6/6); clayey.	40	760
Chinle Formation:		
Owl Rock Member:		
Claystone: Pale-red (10R 6/2); silty; limestone fragments.	190	950
Petrified Forest Member:		
Claystone: Pale-reddish-brown (10R 5/4); silty; limestone fragments.	610	1,560
Sandstone: Light-brownish-gray (5YR 6/1); medium-grained; limestone and claystone fragments.	50	1,610
Siltstone: Light-greenish-gray (5GY 8/1); sandy.	10	1,620
Claystone: Light-brownish-gray (5YR 6/1); silty; limestone fragments.	30	1,650
Claystone and limestone: Grayish-red-purple (5RP 4/2); silty.	30	1,680
Sandstone: Pale-red-purple (5RP 6/2); fine-grained; silty; poorly sorted; limestone fragments.	10	1,690
Sandstone: Pale-red-purple (5RP 6/2); medium-grained; poorly sorted; claystone fragments.	10	1,700
Sandstone: Medium-light-gray (N 6); medium-grained; poorly sorted; claystone fragments.	10	1,710
Sandstone: Light-brownish-gray (5YR 6/1); coarse-grained; poorly sorted; claystone fragments.	10	1,720
UPPER, MIDDLE(?), AND LOWER TRIASSIC:		
Chinle Formation (Petrified Forest Member and lower red member) and Moenkopi Formation undifferentiated:		
Claystone: Very light gray (N 8); silty.	20	1,740
Claystone: Light-brownish-gray (5YR 6/1); silty.	10	1,750
Siltstone: Light-brownish-gray (5YR 6/1); clayey.	10	1,760
Claystone: Grayish-purple (5P 4/2).	20	1,780
Claystone: Grayish-red-purple (5RP 4/2).	30	1,810
Claystone: Grayish-blue (5PB 5/2).	20	1,830
Claystone: Grayish-purple (5P 4/2); silty.	40	1,870
Sandstone: Grayish-purple (5P 4/2); coarse-grained; claystone fragments.	20	1,890
Sandstone: Light-brownish-gray (5YR 6/1); coarse-grained; limestone and claystone fragments.	10	1,900
Claystone: Grayish-purple (5P 4/2); silty; limestone fragments.	50	1,950
Claystone: Grayish-red (5R 4/2); silty; limestone fragments.	10	1,960
Claystone: Medium-gray (N 5); silty; limestone fragments.	10	1,970
Claystone: Grayish-purple (5P 4/2); silty; limestone fragments.	10	1,980
Claystone: Medium-light-gray (N 6); silty; limestone fragments.	10	1,990
Claystone: Greenish-gray (5G 6/1); silty.	30	2,020
Claystone: Variegated light-brownish-gray (5YR 6/1); silty.	45	2,065
Claystone: Variegated brownish-gray (5YR 4/1); silty; limestone fragments.	80	2,145
Claystone: Medium-light-gray (N 6); calcite fragments.	30	2,175
PERMIAN:		
Coconino Sandstone(?):		
Sandstone: Undescribed; water-bearing.	131	2,306

Consolidated Ganado School
110-2.05-2.55

QUATERNARY:		
Alluvium:		
Silty sand: Pale-grayish-red (10R 5/2); very fine to coarse-grained; silty; poorly sorted; composed of quartz; calcareous cement.	20	20
UPPER TRIASSIC:		
Chinle Formation:		
Lower red member:		
Siltstone: Pale-red (10R 6/2); sandy; mudstone fragments; calcareous cement.	40	60
PERMIAN:		
Coconino Sandstone:		
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	70
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	70	140
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	150
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	160
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	170	330
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	60	390
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	40	430
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	172	602

17K-356
125-8.85-13.00

TERTIARY:		
Bidahochi Formation:		
Upper member:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to medium-grained; silty; poorly sorted; composed of quartz; calcareous cement.	110	110
Sandstone: Grayish-orange (10YR 7/4); fine- to coarse-grained; poorly sorted; composed of quartz; jasper and basalt fragments; calcareous cement.	10	120
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to coarse-grained; poorly sorted; composed of quartz; jasper and basalt fragments; calcareous cement.	10	130
Sandstone: Grayish-orange (10YR 7/4); fine- to coarse-grained; poorly sorted; composed of quartz; jasper and basalt fragments; calcareous cement.	30	160
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to coarse-grained; poorly sorted; composed of quartz; jasper and basalt fragments; calcareous cement.	50	210
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to coarse-grained; silty; poorly sorted; composed of quartz; jasper and basalt fragments; calcareous cement.	20	230
Sandstone: Grayish-orange (10YR 7/4); very fine to coarse-grained; silty; poorly sorted; composed of quartz; jasper and basalt fragments; calcareous cement.	20	250
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	20	270
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to coarse-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	280
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to coarse-grained; silty; poorly sorted; composed of quartz; calcareous cement.	10	290
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member, upper part:		
Mudstone: Pale-red (10R 6/2); silty; calcareous cement.	10	300
Siltstone and mudstone: Pale-reddish-brown (10R 5/4); calcareous cement.	23	323

17M-145A
125-1.85-6.55

PERMIAN:		
De Chelly Sandstone:		
Sandstone: Pale-yellowish-orange (10YR 8/6); fine-grained; well-sorted; composed of quartz.	20	20
Sandstone: Grayish-orange (10YR 7/4); fine-grained; well-sorted; composed of quartz.	20	40
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	150	190
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	20	210
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	50	260
Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; calcareous cement.	60	320
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; calcareous cement.	10	330
Silty sandstone: Pale-reddish-brown (10R 5/4); silt to		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

17M-145A—Continued
125-1.85-6.55

	Thickness (feet)	Depth (feet)
fine-grained sand; fair-sorted.	20	350
No samples.	10	360
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted.	10	370
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; fair-sorted; grayish-red (10R 4/2) siltstone fragments.	10	380
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted.	40	420
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; siltstone fragments.	30	450
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; fair-sorted; pale-reddish-brown (10R 5/4) siltstone fragments.	10	460
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; fair-sorted; grayish-red (10R 4/2) siltstone fragments.	10	470
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; fair-sorted; grayish-red (10R 4/2) siltstone and medium-light-gray (N 6) mudstone fragments.	20	490
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; fair-sorted.	10	500
Sandstone: Light-brownish-gray (5YR 6/1); very fine to coarse-grained; silty; fair-sorted.	10	510
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; medium-light-gray (N 6) mudstone and pale-reddish-brown (10R 5/4) siltstone fragments.	20	530
Siltstone: Pale-reddish-brown (10R 5/4); sandy; well-sorted.	10	540
Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; well-sorted; siltstone fragments.	10	550
Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; well-sorted; siltstone fragments.	20	570
Siltstone: Light-brown (5YR 6/4); sandy; well-sorted; calcareous cement.	10	580
Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; well-sorted; siltstone fragments.	10	590
Siltstone: Pale-reddish-brown (10R 5/4); sandy; medium-light-gray (N 6) mudstone fragments.	10	600
Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; silty; siltstone fragments.	20	620
Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; silty; siltstone fragments.	50	670
Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; silty; siltstone fragments.	20	690
No samples.	70	760

18K-330
69-9.70-16.55

	Thickness (feet)	Depth (feet)
UPPER TRIASSIC:		
Chinle Formation:		
Shinarump Member:		
Sandstone: Pale-red (10R 6/2); very fine grained; silty; poorly sorted; composed of quartz; biotite accessory mineral; calcareous cement.	10	10
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; silty; poorly sorted; composed of quartz; muscovite accessory mineral; calcareous cement.	20	30
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; silty; fair-sorted; composed of quartz; muscovite accessory mineral; calcareous cement.	20	50
Mudstone: Light-gray (N 7) to medium-dark-gray (N 4); silty and sandy; calcareous cement.	10	60
Sandstone: Pinkish-gray (5YR 8/1); very fine to medium-grained; silty; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	40	100
Sandstone: Pale-reddish-brown (10R 5/4); fine- to coarse-grained; silty; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	10	110
Sandstone: Pale-red (10R 6/2); fine- to coarse-grained; silty; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	20	130
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	50	180
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	230	410
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	150	560
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of quartz; calcareous cement.	120	680
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	90	770
No samples.	5	775

18T-337
89-2.90-0.60

	Thickness (feet)	Depth (feet)
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member, upper part:		
Siltstone: Pale-red (10R 6/2), moderate-orange-pink (10R 7/4), and rare spots of white (N 9); clay to silt; rare very fine to medium-grained quartz; calcareous cement.	90	90
Siltstone: Medium-gray (N 5); rare medium-grained quartz; calcareous cement.	40	130
Sandy siltstone: Pale-red (5R 6/2); micaceous; calcareous cement.	10	140
Sandstone: Grayish-red-purple (5RP 4/2); medium-grained; fair-sorted; composed of subangular to angular, clear, stained, and frosted quartz; common feldspar, rare mica, and abundant black accessory minerals; common limestone.	10	150
Siltstone and silty limestone: Very light gray (N 8) and pale-red-purple (5RP 6/2); calcareous cement.	10	160
Sandy siltstone: Light-brownish-gray (5YR 6/1); rare biotite accessory mineral; common quartz; calcareous cement.	10	170
Petrified Forest Member, Sonsela Sandstone Bed:		
Sandstone: Pinkish-gray (5YR 8/1) and very light gray (N 8); fine- to coarse-grained; fair to poorly sorted; composed of subrounded to subangular, frosted quartz; biotite accessory mineral; common siltstone fragments; calcareous cement.	50	220
Siltstone: Grayish-red (5R 4/2); rare angular chert and fine- to medium-grained jasper; abundant limestone fragments; calcareous cement.	10	230
Sandy siltstone: Light-brownish-gray (5YR 6/1); silt to coarse-grained sand composed of angular chert and quartz; calcareous cement.	10	240
Sandstone: Light-brownish-gray (5YR 6/1); medium to very coarse grained; poorly sorted; composed of subangular to angular, clear, stained, and frosted quartz; rare pyrite accessory mineral; jasper, chert, and siltstone fragments; weakly cemented, calcareous.	70	310
Petrified Forest Member, lower part:		
Siltstone: Light-gray (N 7); mica and angular chert accessory minerals; firmly cemented, calcareous.	10	320
Sandy siltstone: Light-gray (N 7); silt and medium- to coarse-grained sand composed of angular, frosted quartz and jasper; mica accessory mineral; calcareous cement.	10	330
Sandstone: Light-gray (N 7); medium to very coarse grained; poorly sorted; composed of subangular to angular, clear, stained, and frosted quartz; mica and dark accessory minerals; rare limestone and siltstone fragments; calcareous cement.	40	370
Silty sandstone: Light-gray (N 7) to greenish-gray (5GY 6/1); fine-grained; fair- to well-sorted; composed of subangular to angular quartz; mica and black accessory minerals; rare siltstone and limestone fragments; firmly cemented, calcareous.	50	420
Siltstone: Greenish-gray (5GY 6/1); sandy in places; common pyrite at some horizons; common grayish-red-purple (5RP 4/2) siltstone fragments at some horizons; firmly cemented, calcareous.	60	480
Silty sandstone: Greenish-gray (5GY 6/1); very fine to fine-grained; fair-sorted; composed of subangular quartz; abundant mica accessory mineral; rare very dark red (5R 2/6) siltstone fragments and very pale orange (10YR 8/2) limestone fragments; firmly cemented, calcareous.	9	489

18K-329
107-12.75-3.95

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Silty sand: Yellowish-gray (5Y 7/2) and black (N 1); coal.	10	10
Sandy silt: Yellowish-gray (5Y 7/2) and black (N 1); muscovite accessory mineral; coal.	20	30
Gallup Sandstone:		
Sandstone: Medium-gray (N 5); very fine to fine-grained; silty; poorly sorted; composed of quartz; muscovite accessory mineral; carbonaceous mudstone fragments.	30	515
Sandstone: Light-brown (5YR 6/4) and medium-gray		

Silt and mud: Yellowish-gray (5Y 7/2); sandy.	10	40
UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Dilco Coal Member:		
Siltstone and mudstone: Medium-light-gray (N 6); coal.	195	235
Siltstone: Light-gray (N 7); sandy; calcareous cement.	30	265
Siltstone and mudstone: Medium-gray (N 5); sandy; biotite accessory mineral; coal.	40	305
Carbonaceous mudstone: Medium-gray (N 5) to black (N 1); silty; sand.	180	485
(N 5); very fine to fine-grained; fair-sorted; composed of quartz; sandy siltstone and mudstone fragments.	10	525
Sandstone: Yellowish-gray (5Y 7/2) to medium-gray (N 5); fine- to coarse-grained; poorly sorted; composed of quartz; pyrite accessory mineral; siltstone and mudstone fragments.	30	555
Mudstone: Medium-light-gray (N 6); silty; muscovite accessory mineral.	10	565
No samples.	2	567

18T-328
108-5, 10-16, 70

UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Dilco Coal Member:		
Siltstone: Pale-yellowish-brown (10YR 6/2); sandy.	30	30
Siltstone: Medium-light-gray (N 6); sandy.	50	80
Sandstone: Pale-red (10R 6/2); very fine to fine-grained; silty; well-sorted.	10	90
Siltstone: Medium-gray (N 5); sandy.	10	100
Sandstone: Light-brownish-gray (5YR 6/1); very fine to medium-grained; silty; fair-sorted.	20	120
Sandstone: Light-brownish-gray (5YR 6/1); very fine to very coarse grained; poorly sorted.	20	140
Siltstone: Medium-light-gray (N 6); sandy.	20	160
Gallup Sandstone:		
Sandstone: Light-gray (N 7); very fine to fine-grained; silty; well-sorted; composed of quartz; calcareous cement.	50	210
Siltstone: Light-gray (N 7); sandy; calcareous cement.	10	220
Siltstone and coal: Grayish-black (N 2); sandy.	40	260
Siltstone: Medium-light-gray (N 6); sandy.	60	320
Sandstone: Medium-light-gray (N 6); very fine to fine-grained; silty; well-sorted.	70	390
Siltstone: Medium-light-gray (N 6); sandy; gypsum accessory mineral.	30	420
Siltstone: Medium-gray (N 5); sandy; gypsum accessory mineral; coal.	30	450
Siltstone: Medium-light-gray (N 6); sandy; calcareous cement.	130	580
Mancos Shale:		
Mudstone: Medium-light-gray (N 6); silty and sandy; calcareous cement.	80	660
Mudstone: Medium-dark-gray (N 4); silty; claystone and sandstone fragments; calcareous cement.	60	720
Mudstone: Medium-gray (N 5); silty; clay; calcareous cement.	240	960
Mudstone: Medium-gray (N 5); silty and sandy; gypsum accessory mineral; claystone; calcareous cement.	90	1,050
Mudstone: Medium-gray (N 5); sandy; coal fragments and very fine to fine-grained sand.	20	1,070
Siltstone: Medium-light-gray (N 6); sandy; gypsum accessory mineral; mudstone and claystone.	20	1,090
Mudstone and claystone: Medium-gray (N 5); calcareous cement.	30	1,120
Mudstone: Medium-gray (N 5); silty and sandy; claystone; calcareous cement.	30	1,150
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Mudstone: Medium-gray (N 5); silty; clay; fine-grained sandstone fragments; calcareous cement.	40	1,190
Sandstone: Light-gray (N 7); silty; poorly sorted; gypsum accessory mineral; claystone fragments; calcareous cement.	40	1,230
Siltstone: Medium-light-gray (N 6); sandy; gypsum accessory mineral; mudstone fragments; calcareous cement.	40	1,270
UPPER JURASSIC:		
Morrison Formation:		
Westwater Canyon Member:		
Sandstone: Medium-light-gray (N 6); very fine to fine-grained; silty; fair-sorted; gypsum accessory mineral; mudstone fragments; calcareous cement.	40	1,310
Sandstone: Medium-light-gray (N 6); very fine to medium-grained; silty; fair-sorted; mudstone fragments; calcareous cement.	30	1,340
Siltstone: Medium-light-gray (N 6); sandy; mudstone.	10	1,350
Sandstone: Yellowish-gray (5Y 8/1); very fine to medium-grained; well-sorted; composed of quartz; mudstone fragments; calcareous cement.	8	1,358

Fort Defiance Consolidated School
108-3, 65-0, 85

QUATERNARY:		
Alluvium:		
Sandy silt: Moderate-brown (5YR 4/4); calcareous cement.	5	5
Sandy silt: Light-brown (5YR 6/4); calcareous cement.	10	15
Sandy silt: Grayish-red-brown (10R 3/2); calcareous cement.	55	70
Gravelly sand and sandy silt: Pale-red (10R 6/2); light-gray (N 7) and dark-gray (N 3) quartz pebbles less than 1 inch in diameter.	5	75
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member, upper part:		
Mudstone and claystone: Pale-red (10R 6/2); limestone fragments; calcareous cement.	10	85
Siltstone and mudstone: Light-gray (N 7) and pale-red (5R 6/2); calcareous cement.	20	105
Mudstone: Pale-red (5R 6/2) and medium-gray (N 5); limestone fragments; calcareous cement.	10	115
Mudstone: Grayish-red (10R 4/2); limestone fragments; calcareous cement.	20	135
Petrified Forest Member, Sonsela Sandstone Bed:		
Mudstone and claystone: Medium-gray (N 5); calcareous cement.	20	155
Sandstone: Grayish-pink (5R 8/2); very fine to medium-grained; fair-sorted; composed of quartz; mudstone and claystone fragments; calcareous cement.	40	195
Petrified Forest Member, lower part:		
Mudstone and claystone: Pale-red (5R 6/2); calcareous cement.	30	225
No samples; burned in fire at rig.	315	540
Mudstone and claystone: Medium-gray (N 5) to grayish-red-purple (5RP 4/2); sandy; calcareous cement.	10	550
Mudstone and claystone: Pale-red (10R 6/2) to medium-gray (N 5); sandy; calcareous cement.	10	560
Mudstone and claystone: Medium-gray (N 5) to grayish-red-purple (5RP 4/2); calcareous cement.	10	570
Lower red member:		
Siltstone: Pale-red (10R 6/2); sandy; biotite accessory mineral; calcareous cement.	40	610
Sandstone: Pale-red (10R 6/2); medium to very coarse grained; fair-sorted; composed of quartz; calcareous cement.	10	620
Mudstone and claystone: Grayish-red (5R 4/2); sandy; calcareous cement.	20	640
Siltstone: Pale-red (10R 6/2); sandy; calcareous cement.	20	660
Siltstone and mudstone: Light-gray (N 7) to medium-gray (N 5); calcareous cement.	10	670
Shinarump Member:		
Sandstone: Very pale orange (10YR 8/2); very fine to very coarse grained; poorly sorted; composed of quartz; mudstone fragments; calcareous cement.	30	700
Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	20	720
Sandstone: Yellowish-gray (5Y 8/2); very fine to fine-grained; silty; fair-sorted; composed of quartz; calcareous cement.	10	730
Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; fair-sorted; composed of quartz; mudstone pellets; calcareous cement.	10	740
Sandstone: Light-brown (5YR 6/4); very fine to coarse-grained; poorly sorted; composed of quartz; mudstone pellets; calcareous cement.	10	750
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	15	765
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	45	810
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	40	850
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of quartz; calcareous cement.	10	860
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of quartz; calcareous cement.	41	901

St. Michaels School
108-5, 50-7, 30

UPPER TRIASSIC:		
Chinle Formation:		
Lower red member:		
Sandstone: Grayish-purple (5P 4/2); medium-grained; pebbly; poorly sorted; composed of quartz; claystone fragments and chert; noncalcareous cement.	8	8
Sandstone: Yellowish-gray (5Y 7/1); fine-grained; silty; poorly sorted; composed of quartz; noncalcareous cement.	22	30
Siltstone: Pale-red (5R 6/2); noncalcareous cement.	13	43

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
St. Michaels School—Continued 108-5.50-7.30		
Shinarump Member:		
Sandstone: Light-brown (5YR 6/4); medium to very coarse grained; pebbly; poorly sorted; composed of quartz; calcite accessory mineral; claystone; calcareous cement.	65	108
PERMIAN:		
San Andres Limestone:		
Limestone: Moderate-yellowish-brown (10YR 5/4); argillaceous cement.	4	112
Limestone: Light-olive-gray (5Y 6/1).	18	130
De Chelly Sandstone:		
Upper member:		
Sandstone: Light-brown (5YR 6/4); fine-grained; well-sorted; composed of quartz; calcareous cement.	230	360
Tongue of Supai Formation(?):		
Sandstone: Light-brown (5YR 6/4); fine-grained; fair-sorted; composed of quartz; calcareous cement.	15	375
Window Rock Old Well 6 108-4.35-6.20		
QUATERNARY:		
Alluvium:		
Silt: Grayish-orange-pink (5YR 7/2) to light-brown (5YR 6/4); silt and fine-grained sand; composed of subrounded to subangular, clear quartz; weakly cemented, calcareous.	10	10
Silty sand: Grayish-orange-pink (5YR 7/2) to light-brown (5YR 6/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; weakly cemented, calcareous.	10	20
Silt and mud: Pale-yellowish-brown (10YR 6/2); clay and silt; rare carbonaceous material and shell fragments; weakly cemented, calcareous.	10	30
Sand: Grayish-orange-pink (5YR 7/2) to light-brown (5YR 6/4); very fine to fine-grained; silty; well-sorted; composed of subrounded to subangular, clear quartz; rare carbonaceous material; weakly cemented, calcareous.	10	40
Sand: Grayish-orange-pink (5YR 7/2) to light-brown (5YR 6/4); fine- to coarse-grained; silty; poorly sorted; composed of subrounded to angular, clear quartz; rare mica and dark accessory minerals; rare mudstone pellets; weakly cemented, calcareous.	10	50
Sand: Pale-yellowish-brown (10YR 6/2); fine- to coarse-grained; poorly sorted; composed of subrounded to angular, clear and stained quartz; rare dark accessory minerals; rare siltstone and mudstone fragments; weakly cemented, calcareous.	10	60
Sand and gravel: Pale-red (10R 6/2); fine- to coarse-grained; angular gravel, 2/10-3/10 inch in diameter; poorly sorted; composed of siliceous limestone and subrounded to angular, clear, stained, and frosted quartz; rare dark accessory minerals; rare mudstone, siltstone, and wood fragments; weakly cemented, calcareous.	10	70
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member:		
Siltstone: Very light gray (N 8); silt and rare medium-grained quartz sand; rare mudstone pellets and coal fragments; weakly cemented, calcareous.	20	90
Calcareous mudstone and siltstone: Light-greenish-gray (5G 8/1) and light-brownish-gray (5YR 6/1); clay and silt; rare pyrite accessory mineral; rare carbonaceous material; calcareous cement.	20	110
Calcareous mudstone and siltstone: Light-bluish-gray (5B 7/1); clay and silt; rare pyrite accessory mineral; rare limestone and coal fragments; rare micaceous mudstone pellets; calcareous cement.	10	120
Siltstone and mudstone: Pale-red-purple (5RP 6/2); clay and silt; weakly cemented, calcareous.	20	140
Siltstone: Light-gray (N 7); silt; common blue-green and reddish-brown mudstone fragments; calcareous cement.	10	150
Siltstone and mudstone: Pale-red (5R 6/2); clay and silt; weakly cemented, calcareous.	20	170
Lower red member:		
Sandstone: Pinkish-gray (5YR 8/1); fine-grained; well-sorted; composed of subangular to angular, clear quartz; rare micaceous mudstone pellets; firmly cemented, calcareous and siliceous.	10	180
Sandstone: Bluish-white (5B 9/1) to light-bluish-gray (5B 7/1); fine-grained; well-sorted; composed of subangular to angular, clear quartz; rare to absent mica flakes, and rare pyrite and dark accessory minerals; rare micaceous mudstone pellets; firmly cemented, calcareous and siliceous.	50	230
Sandstone: Pale-purple (5P 6/2) and light-gray (N 7); fine- to coarse-grained; poorly sorted; composed of subangular to angular, clear quartz; common pyrite, and red and black accessory minerals; common mudstone and limestone fragments; rare to common chert and jasper; calcareous and ferruginous cement.	30	260
Sandstone: Grayish-red-purple (5RP 4/2); fine- to coarse-grained; silty; poorly sorted; composed of subangular to angular, clear quartz; rare to absent mica and common dark accessory minerals; common mudstone fragments; calcareous and ferruginous cement.	40	300
Sandstone: Pinkish-gray (5YR 8/1); fine- to coarse-grained; silty; poorly sorted; composed of subangular to angular, clear quartz; rare pyrite accessory angular, clear quartz; rare mudstone pellets and chert; weakly cemented, calcareous.	10	350
Sandstone: Very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6); fine- to medium-grained; well-sorted; composed of subangular to angular, clear quartz; rare dark accessory minerals; rare red mudstone pellets; siliceous cement.	20	370
Sandstone: Moderate-orange-pink (5YR 8/4), grayish-orange-pink (5YR 7/2), and pale-red (10R 6/2); fine- to coarse-grained; silty; poorly sorted; composed of subrounded to angular, clear and stained quartz; rare pyrite and mica accessory minerals; common mudstone fragments and rare chert; firmly cemented quartz aggregates; weakly cemented, calcareous and ferruginous.	20	390
Sandstone: Moderate-orange-pink (5YR 8/4), grayish-orange-pink (5YR 7/2), and grayish-red (10R 4/2); fine- to coarse-grained; silty; poorly sorted; composed of subrounded to angular, clear and stained quartz; rare mudstone fragments and chert; siliceous cement.	40	430
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Very pale orange (10YR 8/2) to moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare jasper; firmly cemented, siliceous and ferruginous.	20	450
Sandstone: Very pale orange (10YR 8/2), moderate-orange-pink (5YR 8/4), and light-brown (5YR 6/4); very fine to medium-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare to absent jasper; firmly cemented, siliceous and ferruginous.	110	560
Silty sandstone: Light-brown (5YR 6/4) and grayish-red (10R 4/2); very fine to fine-grained; silty; fair to poorly sorted; composed of subrounded to subangular, clear and stained quartz; firmly cemented, siliceous and ferruginous.	10	570
Sandstone: Very pale orange (10YR 8/2) to moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; firmly cemented, siliceous and ferruginous.	40	610
Sandstone: Very pale orange (10YR 8/2), moderate-orange-pink (5YR 8/4), and grayish-red (10R 4/2); very fine to medium-grained; well to poorly sorted; composed of subrounded to subangular, clear and stained quartz; some sandy siltstone; firmly cemented, siliceous and ferruginous.	30	640
Sandstone: Very pale orange (10YR 8/2) to moderate-orange-pink (5YR 8/4); very fine to medium-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare to absent hematite accessory mineral; firmly cemented, siliceous and ferruginous.	70	710
Sandstone: Moderate-orange-pink (5YR 8/4) and moderate-reddish-orange (10R 6/6); very fine to medium-grained; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; firmly cemented, siliceous and ferruginous.	40	750
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to medium-grained; silty; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare hematite pellets; weakly cemented, calcareous.	30	780
Sandstone: Grayish-orange (10YR 7/4) to dark-yellowish-orange (10YR 6/6); fine- to medium-grained; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare to common hematite pellets; calcareous, siliceous, and ferruginous cement.	50	830
Sandstone: Grayish-orange (10YR 7/4) to dark-yellowish-orange (10YR 6/6); fine- to medium-grained; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; common hematite pellets; rare mudstone and siltstone fragments; calcareous, siliceous, and ferruginous cement.	10	840
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; rare to common dark		

mineral; rare mudstone pellets and chert; weakly cemented, calcareous.	10	310
Shinarump Member:		
Sandstone: Very light gray (N 8); fine- to coarse-grained; poorly sorted; composed of subangular to angular, clear quartz; rare mudstone pellets and chert; weakly cemented, calcareous.	20	330
Sandstone: Pinkish-gray (5YR 8/1); fine- to coarse-grained; silty; poorly sorted; composed of subangular to angular, clear quartz; rare mudstone pellets and chert; weakly cemented, calcareous.	10	340
Sandstone: Pinkish-gray (5YR 8/1); fine- to medium-grained; fair-sorted; composed of subangular to accessory minerals; rare hematite pellets; rare siltstone fragments and rare to absent chert; weakly cemented, calcareous.	30	870
Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare dark accessory minerals; rare siltstone fragments and chert; weakly cemented, calcareous.	20	890
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Siltstone: Grayish-red (10R 4/2); silt and some fine- to medium-grained quartz sand; weakly cemented, calcareous.	5	895

18K-332
109-0.25-15.60

PERMIAN:		
De Chelly Sandstone:		
Sandstone: Grayish-orange (10YR 7/4); very fine to medium-grained; fair-sorted; composed of rounded to subangular, clear and stained quartz; rare dark accessory minerals; rare hematite concretions; firmly cemented, siliceous and calcareous.	40	40
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; well-sorted; composed of rounded to subangular, clear and stained quartz; rare limonite and dark accessory minerals; rare hematite concretions; firmly cemented, siliceous and calcareous.	40	80
Sandstone: Moderate-orange-pink (5YR 8/4); very fine to fine-grained; silty; fair to poorly sorted; composed of rounded to subangular, clear and stained quartz; rare limonite and dark accessory minerals; rare hematite concretions; firmly cemented, siliceous and calcareous.	130	210
Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; rare to common hematite concretions; firmly cemented, siliceous and ferruginous.	30	240
Sandstone: Moderate-orange-pink (5YR 8/4) to moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; rare to common hematite concretions; firmly cemented, siliceous and ferruginous.	120	360
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Sandstone and mudstone: Moderate-orange-pink (5YR 8/4) and dusky-red (5R 3/4); clay, silt, and very fine to fine-grained sand; well-sorted; composed of subrounded to subangular, clear and stained quartz; common limonite accessory mineral; common hematite concretions; common mica in mudstone fragments; weakly to firmly cemented, siliceous and ferruginous; mudstone fragments weakly cemented, calcareous.	45	405

18T-339
124-6.30-12.25

UPPER TRIASSIC:		
Chinle Formation:		
Lower red member and Shinarump Member undifferentiated:		
Siltstone: Light-brownish-gray (5YR 6/1); silt and rare quartz pebbles as much as 4 mm in diameter; common mica accessory mineral; rare selenite crystals; calcareous cement.	10	10
Sandy siltstone: Light-bluish-gray (5B 7/1); silt and abundant coarse-grained quartz sand; rare biotite accessory mineral; common angular chert and jasper pebbles; rare coal fragments and abundant bentonitic clay fragments; calcareous cement.	70	80
Sandy siltstone: Light-brownish-gray (5YR 6/1); silt and abundant coarse-grained quartz sand; rare biotite accessory mineral; common angular chert and jasper pebbles; rare coal fragments and abundant bentonitic clay fragments; calcareous cement.	20	100
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Siltstone: Moderate-brown (5YR 4/4); clay and silt; fair-sorted; rare mica and quartz accessory minerals; common white (N 9) bentonitic clay pellets; weakly cemented, siliceous and calcareous at base.	60	160
Sandy siltstone: Pale-brown (5YR 5/2); silt to very fine grained sand; fair-sorted; rare mica and very coarse grained quartz accessory minerals; tightly cemented, calcareous.	30	190
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Grayish-orange (10YR 7/4); fine- to medium-grained; well-sorted; composed of subangular to angular, clear and frosted quartz; secondary quartz; abundant iron oxide spherules; rare siltstone fragments near top; slight color changes at intervals due to iron oxide; sugary in appearance at intervals; tightly cemented, siliceous and calcareous.	110	300
Siltstone and limestone: Siltstone—pale-brown (5YR 5/2), limestone—very pale orange (10YR 8/2); calcareous cement.	10	310
Sandstone: Moderate-orange-pink (5YR 8/4); fine-grained; well-sorted; composed of subangular quartz; common chocolate-brown spherules; tightly cemented, siliceous and calcareous.	80	390
Sandstone: Very pale orange (10YR 8/2); fine-grained; well-sorted; composed of subangular quartz; abundant chocolate-brown spherules; rare chocolate-brown clay fragments; very tightly cemented, siliceous.	10	400
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Silty sandstone: Light-brown (5YR 6/4); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, stained and frosted quartz; rare claystone fragments; firmly cemented, siliceous.	10	410
Sandy siltstone: Pale-brown (5YR 5/2); silt to very fine grained sand; fair to poorly sorted; mica accessory mineral; weakly cemented, calcareous.	40	450
Gypsum: White (N 9); crystalline and amorphous.	10	460
Siltstone: Pale-brown (5YR 5/2); white (N 9) gypsum.	30	490
Siltstone: Pale-brown (5YR 5/2); minor gypsum.	60	550
Siltstone: Medium-light-gray (N 6) to dark-gray (N 3); rare quartz and jasper grains; common white (N 9) amorphous gypsum; petroliferous odor when treated with dilute hydrochloric acid; calcareous cement in lower 10 feet.	20	570
Sandy siltstone: Pale-brown (5YR 5/2); abundant gypsum at 620 and 670 feet.	430	1,000

18K-335
125-6.45-16.15

TERTIARY:		
Bidahochi Formation:		
Upper member:		
Sandstone: Pale-red (10R 6/2) to moderate-reddish-orange (10R 6/6); very fine to coarse-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; quartzite, and rare to common jasper, chert, and basalt fragments; rare argillaceous material and rare to absent wood fragments; weakly cemented, calcareous.	70	70
Sandstone: Pale-red (10R 6/2) to moderate-reddish-orange (10R 6/6); very fine to medium-grained; silty; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; rare quartzite, jasper, chert, and basalt; weakly cemented, calcareous.	30	100
Conglomerate: Grayish-orange (10YR 7/4); fine-grained sand to granule; poorly sorted; composed of rounded to angular, clear and stained quartz and limestone; purple quartzite, biotite granite, basalt, red chert, and clean fine-grained sandstone granules; common dark accessory minerals; rare argillaceous material; weakly cemented, calcareous.	90	190
Sandstone: Moderate-yellowish-brown (10YR 5/4); fine- to medium-grained; rare coarse grains; silty; well-sorted; composed of rounded to subangular, clear and stained quartz; rare mica and common dark accessory minerals; rare argillaceous material and common red chert; weakly cemented, calcareous.	10	200
Conglomerate: Grayish-orange (10YR 7/4); fine-grained sand to granule; poorly sorted; composed of rounded to angular, clear and stained quartz and limestone; quartzite, biotite granite, clean very fine to fine-grained sandstone, and red chert granules; common dark accessory minerals; rare silt and argillaceous material; weakly cemented, calcareous.	10	210
Sandstone: Moderate-yellowish-brown (10YR 5/4); fine- to medium-grained; silty; fair to poorly sorted; composed of rounded to subangular, clear and stained quartz; rare mica and common dark accessory min-		

Table 1.--Selected lithologic logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
18K-335—Continued		
125-6.45-16.15		
erals; rare argillaceous material and common red chert; weakly cemented, calcareous.	50	260
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; silty; fair to poorly sorted; composed of rounded to subangular, clear and stained quartz; rare mica and common dark accessory minerals; rare to common argillaceous material; weakly cemented, calcareous.	20	280
Mudstone: Pale-red (5R 6/2) to pale-reddish-brown (10R 5/4); silt and very fine to coarse-grained sand; poorly sorted; composed of rounded to subangular, clear and stained quartz; rare to common mica and common dark accessory minerals; abundant argillaceous material; weakly cemented, calcareous and argillaceous. Contains fragments of very light gray (N 8) sandstone composed of fine- to coarse-grained, subrounded to angular, clear quartz; common mica and rare to common dark accessory minerals; firmly cemented, calcareous.	10	290
Sandy siltstone and mudstone: Moderate-reddish-orange (10R 6/6) and pale-reddish-brown (10R 5/4); clay, silt, and fine- to coarse-grained sand; poorly sorted; composed of rounded to angular, clear quartz; contains micaceous mudstone; weakly cemented, calcareous.	20	310
Sandy siltstone: Pale-reddish-brown (10R 5/4); silt and fine- to medium-grained sand; rare micaceous mudstone fragments; weakly cemented, calcareous.	90	400
PERMIAN:		
De Chelly Sandstone:		
Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; fair-sorted; composed of subrounded to angular, clear and frosted quartz; rare dark accessory minerals; common reddish-brown micaceous mudstone and rare blue-green mudstone; rare to common siltstone fragments; weakly cemented, calcareous.	5	405
Sandstone: Grayish-orange-pink (5YR 7/2) to grayish-red (10R 4/2); fine- to medium-grained; poorly sorted; composed of subrounded to angular, clear and frosted quartz; rare blue-green mudstone fragments and chert; common reddish-brown micaceous mudstone; calcareous and siliceous cement.	2	407
Sandstone: Grayish-orange-pink (10R 8/2); fine- to medium-grained; silty; fair-sorted; composed of rounded to angular, clear and frosted quartz; rare dark accessory minerals; rare argillaceous material; rare hematite pellets; common to absent chert; siliceous cement.	33	440
Sandstone: Pale-red (5R 6/2), moderate-reddish-orange (10R 6/6), and pale-reddish-brown (10R 5/4); very fine to fine-grained; well-sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; rare small reddish-brown mudstone fragments; weakly cemented, calcareous.	110	550
Sandstone: Moderate-orange-pink (5YR 8/4), grayish-orange-pink (5YR 7/2), and light-brown (5YR 6/4); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear and frosted quartz; rare dark accessory minerals; rare hematite pellets; weakly cemented, calcareous.	10	560
Sandstone: Grayish-orange-pink (5YR 7/2) to light-brown (5YR 6/4); very fine to fine-grained; silty; fair-sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; rare pale-red mudstone fragments; weakly cemented, calcareous.	30	590
Sandstone: Moderate-orange-pink (5YR 8/4) to grayish-orange-pink (5YR 7/2); very fine to fine-grained; silty; fair-sorted; composed of subrounded to angular, clear quartz; rare dark accessory minerals; rare to absent pale-red mudstone and chert fragments; weakly cemented, calcareous.	120	710
Sandstone: Pale-red (10R 6/2) to pale-reddish-brown (10R 5/4); very fine to fine-grained; silty; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; weakly cemented, calcareous.	20	730
Sandstone: Pale-red (10R 6/2) to pale-reddish-brown (10R 5/4); very fine to medium-grained; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; rare dark accessory minerals; rare hematite and chert; weakly cemented, calcareous.	15	745
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Shale: Pale-reddish-brown (10R 5/4).	3	748
18K-331		
137-6.80-4.40		
TERTIARY:		
Bidahochi Formation:		
Upper member:		
Sandstone: Light-orange-brown (5YR 7/4); very fine to coarse-grained; poorly sorted; composed of rounded to subangular, clear and stained quartz; rare feldspar, limonite, and dark accessory minerals; common jasper and rare to common mud pellets; weakly cemented, calcareous.	440	440
Sandstone: Light-orange-brown (5YR 7/4) and pale-brown (5YR 5/2); very fine to coarse-grained; poorly sorted; composed of rounded to subangular, clear and stained quartz; rare mica, feldspar, limonite, and dark accessory minerals; common jasper, rare to common mud pellets, and common to abundant argillaceous material; weakly cemented, calcareous and argillaceous.	20	460
Sandstone: Very pale orange (10YR 8/2) to grayish-orange-pink (5YR 7/2); fine- to coarse-grained; fair to poorly sorted; composed of rounded to subangular, clear and stained quartz; rare mica, olivine, basalt, and hematite, and rare to common dark accessory minerals; common mud pellets and jasper; weakly cemented, calcareous.	30	490
Lower member:		
Sandstone: Pale-orange-brown (10YR 7/2); very fine to medium-grained; silty; poorly sorted; composed of rounded to subangular, clear and stained quartz; rare olivine, basalt, and hematite, and rare to common dark accessory minerals; common jasper and mud pellets, and rare bentonite; weakly cemented, calcareous.	100	590
No samples.	10	600
18T-341		
138-4.10-0.65		
TERTIARY:		
Bidahochi Formation:		
Upper member:		
Sandstone: Light-brown (5YR 6/4); medium- to coarse-grained; rare very coarse grains; fair-sorted; composed of subrounded to subangular, frosted quartz; calcareous cement.	40	40
Silty sandstone: Pale-red (10R 6/2); silt to rare granule; composed of rounded to angular, frosted quartz; rare black accessory minerals; rare red siltstone fragments; calcareous cement.	10	50
UPPER TRIASSIC:		
Chinle Formation:		
Lower red member:		
Siltstone: Pale-reddish-brown (10R 5/4); clay, silt, and rare medium-grained sand; common mica accessory mineral; calcareous cement.	20	70
Siltstone: Pale-red (10R 6/2); silt and very fine grained sand; abundant mica accessory mineral; calcareous cement.	60	130
Shinarump Member:		
Sandstone: Grayish-orange-pink (10R 8/2); fine- to medium-grained; well-sorted; composed of subrounded to subangular, stained and frosted quartz; secondary quartz, crystal growth; silty and calcareous from 250 to 260 feet; siliceous and ferruginous cement.	150	280
Sandstone: Orange-brown (5YR 7/4); fine-grained; well-sorted; composed of subangular to angular, stained quartz; common black accessory minerals; secondary quartz, crystal faces; sorting and color vary, some horizons mostly very fine to fine-grained sand; calcareous and ferruginous cement.	90	370
Sandstone: Grayish-orange-pink (10R 8/2); fine- to medium-grained; well-sorted; composed of subrounded to subangular, stained and frosted quartz; secondary quartz, crystal growth; siliceous and ferruginous cement.	10	380
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Sandstone: Moderate-reddish-orange (10R 6/6); medium-grained; well-sorted; composed of rounded to subangular, stained quartz; rare selenite crystals; rare brown siltstone fragments; weakly cemented, calcareous.	10	390
Sandstone: Grayish-orange-pink (10R 8/2); fine- to medium-grained; well-sorted; composed of subrounded to subangular, stained and frosted quartz; secondary quartz, crystal growth; abundant siltstone fragments; lower 10 feet contains white sandstone fragments; siliceous and ferruginous cement.	39	429

SELECTED AND MODIFIED DRILLERS' LOGS OF WELLS

IN THE NAVAJO AND HOPI INDIAN RESERVATIONS, ARIZONA, NEW MEXICO, AND UTAH

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah

1A-23
42-13.65-16.85

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Surficial deposits:		
Soil	5	5
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone, red	210	215
Shale, red	4	219
Sandstone, red	84	303
Sandstone, light-colored	35	338
Sandstone, red	125	463
Sandstone, light-colored	91	554
Sandstone, red, seep of water, bottom strata	31	585
UPPER TRIASSIC(?):		
Kayenta Formation:		
Shale, red	17	602
Sandstone, red	43	645
Shale, red	33	678
Tongue of Navajo Sandstone in Kayenta Formation:		
Sandstone, red, water 1/2 gpm	34	712
Shale, red	6	718
Sandstone, hard	30	748
Water sand, light-colored, soft, more than 5 gpm by bailer	12	760
Rock, hard, batters drilling bit	10	770

1A-125
43-8.90-6.60

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Surface sand	4	4
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone, buff, hard shell 83 to 86 feet	166	170
Sandstone, pink	115	285
Sandstone, dark-pink	102	387
Sandstone, buff	15	402
Sandstone, red, very soft	45	447
Sandstone, red, hard and sharp	28	475
Sandstone, red, soft	40	515
Sandy shale, red	12	527
Sandstone, pink	7	534
Sandstone, red, soft, coarse, water	49	583
Shale, red	6	589
Sandstone, pink, sharp	10	599
Sandy shale, red	21	620
Sandstone, red	16	636
Sandstone, buff	4	640
Sandstone, pink	29	669
Sandy lime, pink	2	671
Sandy shale, light-red	13	684
Hard shell	1	685
Sandy shale, red	57	742
Sandstone, red	26	768
Sandstone, buff, fine and sharp	14	782
Sandstone, brown, coarse	4	786
Sand, pink	31	817
Sandstone, red	19	836
Sandstone, buff	18	854
Sandstone, pink	6	860
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone and Kayenta Formation undifferentiated:		
Sandy shale, red	80	940
Sandy shale, pink	35	975
Sandstone, buff	18	993
Sandy shale, red	17	1,010
Sandstone, red, coarse	55	1,065
Sandstone, light-red, soft	18	1,083
Sandy shale, red, streaks soft and sharp	7	1,090
Sandstone, pink, very fine, sharp and hard	28	1,118
Sandy lime, red, very hard	17	1,135
Sandstone, pink, soft streak	12	1,147
Shale, red, very hard streak	21	1,168
Sandstone, white, very hard, will not mix	9	1,177
UPPER TRIASSIC(?):		
Kayenta Formation:		
Shale, red, soft mud rings on bit	4	1,181
Sandstone, red	4	1,185
Sandy shale, red, fine, medium soft	34	1,219
Sandstone, red, sharp, hard	21	1,240
Shale, red	7	1,247
Sandstone, red	21	1,268

1K-213
43-8.30-14.00

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Surficial deposits:		
Soil	2	2
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone, dark-yellow	43	45
Sandstone, light-yellow	50	95
Sandstone, white	14	109
Sandstone, light-yellow	26	135
Sandstone, yellow, hard	12	147
Sand, yellow	70	217
Sand, white	33	250
Sand, yellow	15	265
Sand, brown	58	323
Sand, white	45	368
Sand, brown	7	375
Sand, yellow	10	385
Sand, white	38	423
Sand, yellow	4	427
Sand, white	16	443
Sand, brown	77	520
Sand, white	80	600
Sand, brown	30	630
Sand, white	13	643
UPPER TRIASSIC(?):		
Kayenta Formation:		
Sandy shale, brown	7	650
Sandy shale, red	13	663
Lime, brown	3	666
Sand and gravel, coarse	9	675
Sandstone, brown	120	795
Shale, red	7	802
Water sand, water	18	820
Sandstone, white	10	830
Shale, red	5	835
Sandstone, red	35	870

1K-231
44-0.30-10.80

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Surficial deposits:		
Soil	3	3
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone, pink	17	20
Sandstone, white, caving	3	23
Sandstone, pink	33	56
Sand, white, caving	6	62
Sandstone, pink	90	152
Sandstone, cream	148	300
Sandstone, pink, some hard	168	468
Sandstone, yellow	186	654
Sandstone, brown-red	66	720
Sandstone, pink	120	840
Sandstone, red, hole blows air from 1,000-foot level	348	1,188
UPPER TRIASSIC(?):		
Kayenta Formation:		
Shale, red	12	1,200

1K-228
58-10.55-12.25

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Surficial deposits:		
Alluvium	10	10
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Sandstone, gray	10	20
Sandstone, red	10	30
Sandstone, yellow	10	40
Sandstone, pink	10	50
Sandstone, gray, small amount of water at 80 feet	40	90
Sandstone, red, large amount of water at 140 feet, raised to 60 feet	60	150
Sandstone, gray	70	220
Shale, red	10	230
Sandstone, gray	5	235
Shale, red	65	300
Sandstone, gray	40	340
Shale, red	30	370
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone, yellow	130	500
No information	4	504

1A-25
60-3.75-3.70

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sand, red	230	230
Sand, red	35	265
UPPER TRIASSIC(?):		
Kayenta Formation:		
Sandy shale, red	35	300
Sand, red	60	360
Shale, red	26	386
Sand, red	42	428
Shale, red	17	445
Water sand, making 150 gph	5	450
Sand, red	80	530
Sandy shale, red	80	610
Water sand, white, with increased water flow	15	625
Water sand, white	15	640
Moenave Formation:		
Sandstone, red, hard	35	675
Sandstone, red, soft	45	720
Sandstone, red, hard	20	740

2K-306
14-2.45-16.10

QUATERNARY:		
Alluvium:		
Fill	4	4
Sand and boulders	32	36
UPPER TRIASSIC(?):		
Kayenta Formation and Moenave Formation undifferentiated:		
Sandstone, red, hard	45	81
Shale, red	12	93
Sandstone, red	97	190
Sandstone and shale, very dark-red, layers	94	284
UPPER TRIASSIC:		
Wingate Sandstone:		
Sandstone, light-red	221	505
Sandstone, red, water	15	520
Sandstone, light-red	20	540
Chinle Formation:		
Shale, purple, red, gray	30	570
Sandstone, red, flaky, soapstone(?)	120	690
Sandstone, light-colored, hard	18	708
Sandstone, red, hard	2	710
Sandstone, red	7	717
Sandstone, gray	3	720
Sandstone, red	80	800
Shale, red, sticky	23	823

2K-321
40-8.50-5.75

QUATERNARY:		
Surficial deposits:		
Top soil, 5 feet to 30 feet, buff sandstone	30	30
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone, buff	60	90
Sandstone, buff	65	155
Sandstone, buff	27	182
Sandstone, buff	27	209
Sandstone, buff, seep at 265 feet	93	302
Sandstone, buff, more water at 370 feet	81	383
Sandstone, buff, more water at 460 to 470 feet	95	478
No information	55	533

2T-317
41-2.80-11.00

QUATERNARY:		
Surficial deposits:		
Top soil	80	80
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone	870	950

3M-156
76-6.75-9.40

QUATERNARY:		
Surficial deposits:		
Soil	2	2
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Sandstone, hard	23	25
Quick sand	70	95
Sand, hard	5	100
Sandy shale	255	355
Sand, some water	20	375
Shale, red	5	380
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Water sand, 30 gpm on 1 hour test	149	529

3K-311
96-5.20-1.00

QUATERNARY:		
Alluvium:		
Alluvial fill	6	6
Clay, yellow	11	17
UPPER CRETACEOUS:		
Mancos Shale:		
Shale, brown	26	43
UPPER AND LOWER CRETACEOUS, AND UPPER JURASSIC:		
Dakota Sandstone and Cow Springs Sandstone undifferentiated:		
Sandstone, dark-gray	34	77
Sandstone, light-gray	28	105
Shale, light-gray	10	115
Shale, light-brown	10	125
Sandstone, light-gray	130	255
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Shale, dark-red	45	300
Sandstone, light-gray	10	310
Shale, red	5	315
Sandstone, light-gray, seep of water near bottom of strata	68	383
Shale, red	17	400
Sandstone, light-gray	20	420
Shale, red	15	435
Sandstone, light-gray	30	465
Shale, red	20	485
Sandstone, seep of water at 500 feet	48	533
Shale, red	13	546
Sandstone, light-gray	18	564
Shale, red and gray	51	615
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone, light-gray, water	130	745

3A-151
97-5.30-10.00

QUATERNARY:		
Surficial deposits:		
Surface sand and soil	26	26
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone, buff, soft	24	50
Sandstone, gray, hard and sharp	3	53
Sandstone, pale-green, hard	18	71
Sandstone, white, soft	19	90
Limestone, white, crystallized, extra hard and sharp	11	101
Shale lenses, sandstone, lime, gypsum, shells, white, buff, blue, gray, extra soft	69	170
Limestone, white, hard and sharp	20	190
Limestone, white, crystallized, extra hard and sharp	5	195
Sandstone, white, soft	25	220
Shale, brownish-purple, soft	17	237
Limestone, hard	7	244
Sandstone, white, soft, 2 gpm	6	250
Sandstone, white, fine, tight, 6 gpm	12	262

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
3A-151—Continued 97-5.30-10.00					
Sandstone, white, water sand, water raised to 218 feet	5	267	Sandy shale, white, soft	69	336
3K-331 98-8.70-15.90					
UPPER TRIASSIC:			Sandy shale	15	435
Chinle Formation:			Shale, red	65	500
Shinarump Member:			Sandy shale, red	20	520
Shale, red	40	40	PERMIAN:		
Sandstone	15	55	Kaibab Limestone:		
Shale, red	15	70	Lime rock	220	740
Sandstone, seep of water, not enough for drilling	12	82	Crevasse	5	745
MIDDLE(?) AND LOWER TRIASSIC:			Lime and sandstone	40	785
Moenkopi Formation:			Sandstone, poorly cemented and some runs	43	828
Shale, red	338	420			
3A-154 115-13.0-1.0 A					
JURASSIC AND TRIASSIC(?):			UPPER TRIASSIC(?):		
Navajo Sandstone:			Kayenta Formation and Moenave Formation undifferentiated:		
Sand, gray	136	136	Shale, chocolate-colored	98	260
Sandstone, gray, porous	26	162	Shale, red	750	1,010
3K-310 117-2.85-10.80					
QUATERNARY:			Sandy shale, brown	15	30
Surficial deposits:			Red beds	133	163
Soil, sandy	5	5	Sand, gravelly, coarse, water	7	170
MIDDLE(?) AND LOWER TRIASSIC:			Sand, hard	23	193
Moenkopi Formation:					
Clay, red	10	15			
4K-389 55-10.75-2.50					
QUATERNARY:			Shale, black	10	100
Alluvium:			Shale and coal, layers, gray	50	150
Fill, 2 gpm, bad water	20	20	Coal	15	165
UPPER CRETACEOUS:			Shale, blue	25	190
Wepo Formation:			Sandstone, gray	10	200
Shale and coal	10	30	Sandstone, layers, gray, blue shale	50	250
Sandstone, gray	20	50	Sandstone, gray	155	405
Shale, blue	20	70	Shale, black	12	417
Sandstone, gray	20	90			
4K-387 57-3.70-14.15					
UPPER CRETACEOUS:			Shale and coal	10	210
Toreva Formation:			Shale and sandstone lenses, blue	40	250
Shale, blue	20	20	Sandstone, gray	20	270
Sandstone, yellow	10	30	Shale, blue	310	580
Shale, blue	10	40	Sandstone, blue	20	600
Sandstone, yellow	20	60	Shale, blue	260	860
Sandstone, gray	90	150	UPPER AND LOWER CRETACEOUS:		
Mancos Shale:			Dakota Sandstone:		
Shale, blue	20	170	Coal, water	10	870
Shale and sand, blue, seep of water at 180 feet	10	180	Sandstone, gray	40	910
Shale, blue	20	200	Sandstone, gray or white	35	945
4M-4 73-13.15-2.30					
QUATERNARY:			UPPER AND LOWER CRETACEOUS:		
Surficial deposits:			Dakota Sandstone:		
Surface soil	35	35	Sandstone, water	51	598
Broken sand	30	65	Sand and shale	7	605
UPPER CRETACEOUS:			Sand, hard, tight	30	635
Mancos Shale:			UPPER JURASSIC:		
Shale, dark-blue	482	547	Cow Springs Sandstone:		
			Sandy shale, white	52	687
			Shale, red, bottom of hole	3	690
4R-26 73-1.90-13.70					
QUATERNARY:			Sandstone	115	220
Alluvium:			UPPER AND MIDDLE JURASSIC:		
Adobe	40	40	Morrison Formation, Entrada Sandstone, and Carmel Formation undifferentiated:		
Blow sand	42	82	Sandy shale, light	95	315
UPPER CRETACEOUS:			Shale, red	35	350
Mancos Shale:			Sandy shale, light	35	385
Shale	16	98	Shale, red	7	392
UPPER JURASSIC:			Sandy shale, light	40	432
Morrison Formation and Cow Springs Sandstone undifferentiated:			Shale, red	5	437
Sandstone	1	99	Very sandy shale, nearly white	258	695
Sandy shale	6	105			
4R-27 73-7.15-12.65					
QUATERNARY:			UPPER AND LOWER CRETACEOUS:		
Alluvium:			Dakota Sandstone:		
Adobe	25	25	Very sandy shale, seep of water	8	586

Blow sand	37	62	Coal and slate	18	604
Sand and mud, water	10	72	Sandy shale	22	626
Sand and gravel, bad water, shut off	3	75	Water sand, Dakota(?)	18	644
UPPER CRETACEOUS:			Sandy shale	31	675
Mancos Shale:			Sandstone, caving bad at 675 feet	13	688
Shale	503	578			

4M-87
74-7.70-16.75

QUATERNARY:			Toreva Formation:		
Surficial deposits:			Coarse sand, water	2	163
Sand and soil	42	42	Shale, gray	6	169
Gravel	10	52	Shale, black	20	189
UPPER CRETACEOUS:			Shale, gray	5	194
Wepo Formation:			Sandy shale, gray	3	197
Sandy clay, yellow	48	100	Shale, gray	30	227
Clay, gray	2	102	Shale, brown, coal streaks	3	230
Sandy clay, yellow	25	127	Shale, brown	19	249
Shale, gray	8	135	No information	1	250
Sandy shale, brown	26	161			

4M-89
74-10.70-11.85

QUATERNARY:			Sandy shale, light	40	115
Alluvium:			Sandstone, water sand	29	144
Adobe	35	35	Shale, gray	1	145
UPPER CRETACEOUS:					
Wepo Formation:					
Clay, yellow	40	75			

4K-377
75-2.00-6.90

QUATERNARY:			Sandstone, yellow	12	92
Surficial deposits:			Shale, gray	54	146
Soil	4	4	Sandstone, gray	8	154
UPPER CRETACEOUS:			Shale, gray	31	185
Wepo Formation:			Sandstone, gray	11	196
Shale, light-colored	10	14	Shale, gray	42	238
Sandstone, light-gray	7	21	Sandstone, gray	9	247
Clay, yellow	11	32	Shale, gray	13	260
Shale, dark-brown	3	35	Sandstone, gray, water	18	278
Shale, yellow	15	50	Shale, gray	22	300
Sandstone, light-gray	30	80	Sandstone, very light gray	15	315

5K-307
115-3.25-12.80

QUATERNARY:			UPPER TRIASSIC:		
Alluvium:			Wingate Sandstone:		
Valley fill	105	105	Sandstone, red, soft	33	148
Sand with gravel at 115 feet, water	10	115	Shale, red	3	151

5K-304
131-9.0-13.0 A

QUATERNARY:			UPPER TRIASSIC:		
Surficial deposits:			Chinle Formation:		
Soil	12	12	Shale, dark-blue	5	95
Silt and sand, water at 15 feet of top	38	50	Shale, yellow, soft	60	155
Sand, dry	10	60	Shale, red, soft	20	175
Sand, dark, water 15 feet of top	30	90	3 gpm permanent	5	180
			Shale, red and yellow	25	205

5K-305
131-4.10-12.60

QUATERNARY:			Sand, gray	6	608
Alluvium:			Shale, dark-red to red	54	662
Alluvial fill	38	38	PERMIAN:		
Sand and gravel, salt water, 30 gpm	41	79	Kaibab(?) Limestone:		
UPPER TRIASSIC:			Shale, gray	12	674
Chinle Formation:			Coconino Sandstone:		
Shale, blue and purple	176	255	Sand, red	6	680
Shale, red and green	106	361	Sand, red	10	690
Shale, gray	14	375	Sand, gray to red, very hard	25	715
Shinarump Member:			Sand, yellow, very hard	20	735
Sand, yellow	5	380	Sand, red, water 2 gpm, salty	5	740
Shale, red	5	385	Sand, white, water at 740 to 785 feet	45	785
Sand, yellow	15	400			
MIDDLE(?) AND LOWER TRIASSIC:					
Moenkopi Formation:					
Shale, red	202	602			

5M-103
132-11.35-16.95

QUATERNARY:			Sandstone, white	100	400
Volcanic rocks:			Sandstone, white, cutting good, wearing cable	100	500
Malpais boulders, black	24	24	Sandstone, white	200	700
Boulders, red, a form of malpais	6	30	Sandstone, white, water	33	733
PERMIAN:			Sandstone, water-bearing, 610 feet water sand	107	840
Kaibab Limestone:			Sandstone, yellow, bearing water, tested 10 gpm	10	850
Lime, white	70	100	Sandstone, yellow, no water	155	1,005
Lime, white, no cracks	100	200	No information	156	1,161
Lime, yellow, base of Kaibab 240 feet	40	240			
Coconino Sandstone:					
Sandstone	60	300			

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
5M-104 132-12.30-9.70					
QUATERNARY:			Lime, red	82	350
Volcanic rocks:			Coconino Sandstone:		
Cinders	58	58	Sand rock	295	645
Lava	47	105	Water sand, water	20	665
PERMIAN:			Sand, pink	92	757
Kaibab Limestone:					
Lime, gray	163	268			
5M-86 144-10.75-3.90					
MIDDLE(?) AND LOWER TRIASSIC:			Sandstone, yellow	45	80
Moenkopi Formation:			Limestone, buff	120	200
Surface soil and red shale	12	12	Coconino Sandstone:		
Limestone, red	8	20	Sandstone, buff	10	210
Shale, red	10	30	Sandstone, gray	10	220
PERMIAN:			Sandy shale, yellow	3	223
Kaibab Limestone:			Sandstone, white, water-bearing	6	229
Shale, yellow	5	35	Sandstone, yellow	24	253
5M-122 145-9.70-4.10					
PERMIAN:			Underground cave opening	8	477
Kaibab Limestone:			Sand pocket, sand running in	13	490
Lime, white, very broken cracks and crevasse	100	100	Yellow, white streaks	10	500
Lime, white, very broken cracks, hard to keep hole straight	100	200	Sandstone, white	25	525
Lime, white to grayish, hard	55	255	Sandstone, yellow, soft	75	600
Coconino Sandstone:			Sandstone, yellow, soft, with sand pocket	27	627
Sandstone, medium-hard	45	300	Sandstone, soft, with sand pocket at 643 feet	48	675
Sandstone, yellow, soft	100	400	Sandstone, yellow, bearing water	63	738
Sandstone, yellow, soft	69	469			
5T-320 145-1.40-6.00					
PERMIAN:			Coconino Sandstone:		
Kaibab Limestone:			Sandstone, yellow	25	240
Limestone boulders	4	4	Sandstone, white	110	350
Limestone	16	20	Sandstone, yellow	130	480
Limestone	195	215	Sandstone, white	73	553
6K-85 93-10.70-12.80					
QUATERNARY:			Shale	22	1,044
Alluvium:			Shale, brown	23	1,067
Sand, fine, water	72	72	Sandstone, brown, water rose to 200 feet below surface	33	1,100
UPPER CRETACEOUS:			Sandstone, light-gray	22	1,122
Toreva Formation and Mancos Shale undifferentiated:			Sandstone, light-red, and green to white shale	123	1,245
Shale	517	589	Sandstone, light-red	10	1,255
Shale with fossils	22	611	Sandstone, pale	33	1,288
Shale	72	683			
Shale, black	6	689			
Shale	311	1,000			
UPPER AND LOWER CRETACEOUS, AND UPPER AND MIDDLE JURASSIC:					
Dakota Sandstone, Cow Springs Sandstone, Entrada Sandstone, and Carmel Formation undifferentiated:					
Shale, black and red	22	1,022			
6M-80 93-13.65-5.90					
QUATERNARY:			Shale, black	169	385
Surficial deposits:			UPPER AND LOWER CRETACEOUS:		
Soil	40	40	Dakota Sandstone:		
Sand	18	58	Sandstone, little water	37	422
Sand and gravel, water	26	84	Shale, black	20	442
UPPER CRETACEOUS:			Sandstone, flowing water	26	468
Mancos Shale:			Coal	3	471
Shale, black	128	212	Clay, gray	2	473
Shale, gray	4	216			
6M-3 94-0.70-11.50					
QUATERNARY:			Sand and gravel, water	5	65
Surficial deposits:			UPPER CRETACEOUS:		
Soil	30	30	Mancos Shale:		
Sand, water	30	60	Shale, black	31	96
6M-10A 94-6.75-11.30					
QUATERNARY:			Sandstone, artesian water	7	241
Alluvium:			Shale, black, coal	24	265
Drift sand	3	3	Sandstone, artesian water	42	307
Clay, gray	26	29	Shale, gray	8	315
Sand, water	7	36	Coal	4	319
Adobe	15	51	Clay, gray	15	334
Mud, water	4	55	UPPER JURASSIC:		
Adobe	21	76	Cow Springs Sandstone:		
Sandstone and gravel	16	92	Chalk	80	414

UPPER CRETACEOUS:		
Mancos Shale:		
Shale, black	141	233
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Coal	1	234
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Shale, red	14	428

6M-19
94-11.05-17.05

QUATERNARY:		
Alluvium:		
Blow dust	3	3
Sand	7	10
Clay	40	50
Broken rock	10	60
Sand, fine, water	27	87
Sandstone and gravel, water	3	90
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Shale, red	20	110
Sandstone	35	145

6M-40
94-12.60-6.50

QUATERNARY:		
Surficial deposits:		
Sandy soil	10	10
UPPER CRETACEOUS:		
Toreva Formation:		
Sandstone, yellow	35	45
Sandstone, gray	15	60
Shale, gray	10	70
Sandstone	31	101
Mancos Shale:		
Shale, blue, water level 550 feet	739	840
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Shale, black, some coal	58	898
Sand, gray	22	920
Shale, blue	85	1,005
UPPER JURASSIC:		
Cow Springs Sandstone:		
Shale, red clay	155	1,160
Sandstone, red	80	1,240
Water sand, white, loose	10	1,250

6K-302
95-5.65-8.50

QUATERNARY:		
Alluvium:		
Bottom of caisson, sand, water	80	80
Clay, yellow	5	85
Sand and gravel, water	12	97
UPPER CRETACEOUS:		
Mancos Shale:		
Shale, above water shut off with 10-foot casing	183	280
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Coal, water	14	294
Sandstone, water 4 gpm	6	300
Shale, gray	10	310
Slate, dark	5	315
UPPER AND MIDDLE JURASSIC:		
Cow Springs Sandstone, Entrada Sandstone, and Carmel Formation undifferentiated:		
Sandy shale, white, 15 gpm at 350 feet	45	360
Shale, red with streaks of white	15	375
Sandy shale, white	10	385
Shale, red	2	387
Sandy shale, white	11	398
Shale, red, 12 gpm at 400 feet	65	463
Sandy shale, white	27	490
Shale, red	34	524
Sandy shale, white	5	529
Shale, very dark red	19	548
Sandy shale, white	5	553
Sandy shale, white, water	17	570
Shale, red	5	575
Sandstone, gray, dry	13	588
Sandy shale, white	18	606
Shale, red	6	612
Sandy shale, white	96	708
Shale, red	7	715

6M-35
95-8.50-15.20

QUATERNARY(?):		
Alluvium(?):		
Old well, no log	65	65
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Shale, red	13	78
Shale, gray	16	94
Sandstone, water	4	98
Shale, gray	9	107
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sandstone, gray	23	130
Sandstone, red	3	133

6M-61
95-2.90-3.90

QUATERNARY:		
Alluvium:		
Sand	4	4
Clay	34	38
Blow sand	45	83
Sand and mud, fine, water	47	130
Sand, some gravel, water	7	137
UPPER CRETACEOUS:		
Mancos Shale:		
Shale	27	164

6M-64
95-4.45-1.25

QUATERNARY:		
Surficial deposits:		
Soil	2	2
UPPER CRETACEOUS:		
Toreva Formation:		
Sand rock	53	55
Shale, light	20	75
Sand	33	108
Shale, light	12	120
Sand	25	145
Shale, dark	20	165
Sandy shale, dark	55	220
Sand	15	235
Mancos Shale:		
Shale, dark	600	835
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Water sand	25	860

6H-12
113-3.15-4.55

QUATERNARY:		
Surficial deposits:		
Surface soil	6	6
Sand	72	78
Fine sand, water	7	85
Gravel and sand, water cemented out	20	105
UPPER CRETACEOUS:		
Mancos Shale:		
Shale, black	31	136
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Coal	2	138
Shale, black	2	140
Sandstone, water	32	172
Coal	3	175
Shale, black	19	194

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
6H-13					
113-5.25-5.75					
QUATERNARY:			UPPER AND MIDDLE JURASSIC:		
Surficial deposits:			Entrada Sandstone and Carmel Formation undifferentiated:		
Surface soil	15	15	Shale, red	28	148
Sand	56	71	Sandstone, gray	90	238
UPPER JURASSIC:			Shale, red	35	273
Cow Springs Sandstone:			Sandstone, gray, water	28	301
Sandstone, red	13	84	Shale, red	29	330
Sandstone, gray, water at 102 feet	36	120	No information	20	350
6M-25					
114-5.55-9.00					
QUATERNARY:			UPPER TRIASSIC(?):		
Alluvium:			Moenave Formation:		
Clay	45	45	Sand, fine	25	97
Sand, fine, water	10	55			
Sand and gravel, water	17	72			
6M-29					
114-1.40-1.80					
QUATERNARY:			Sand and clay, very fine	38	158
Surficial deposits:			Sand and gravel	2	160
Soil	80	80	UPPER AND MIDDLE JURASSIC:		
Sand	18	98	Entrada Sandstone and Carmel Formation undifferentiated:		
Sand, water	17	115	Shale, red and gray	40	200
Sand and gravel	5	120			
7H-1					
92-10.55-16.25					
TERTIARY:			Shale, gray	30	575
Bidahochi Formation:			UPPER AND LOWER CRETACEOUS:		
Sand, light-brown	125	125	Dakota Sandstone:		
Sand, brown, shale streaks	10	135	Sand, gray, water 2-1/2 gpm, Mesaverde	15	590
UPPER CRETACEOUS:			Shale, black	9	599
Mancos Shale:			Sandy shale, gray	2	601
Shale, blue	125	260	Sand, gray, water, Mesaverde	46	647
Hard lime shell	4	264	Shale, green	4	651
Shale, blue	271	535	Sand, gray, shale streaks	14	665
Shale, black	10	545			
7K-365					
111-12.25-1.90					
QUATERNARY:			Sand	106	206
Surficial deposits:			Shale, gray	184	390
Top soil	5	5	UPPER AND LOWER CRETACEOUS:		
Sand, loose	83	88	Dakota Sandstone:		
TERTIARY:			Coal and shale	10	400
Bidahochi Formation:			Sandstone, gray, 2 gpm at 425 feet, increase at 460 and 475 feet	94	494
Sandstone	12	100			
7H-15					
112-7.00-3.25					
QUATERNARY:			Sand, gray, no water	25	850
Surficial deposits:			Shale, dark	35	885
Surface soil	4	4	UPPER AND LOWER CRETACEOUS:		
TERTIARY:			Dakota Sandstone:		
Bidahochi Formation:			Water sand, Mesaverde	20	905
Blow sand and quicksand	341	345	Shale, black	88	993
Bentonite	45	390			
UPPER CRETACEOUS:					
Mancos Shale:					
Shale, gray	435	825			
7H-45					
112-10.40-13.30					
QUATERNARY:			UPPER AND LOWER CRETACEOUS		
Alluvium:			Dakota Sandstone:		
Sand, red, soft	48	48	Coal	5	160
Conglomerate and gravel	2	50	Shale, blue	50	210
UPPER CRETACEOUS:			Water sand, Mesaverde	22	232
Mancos Shale:			Shale, blue	28	260
Shale, blue	105	155	Water sand	4	264
7K-369					
113-0.75-12.50					
QUATERNARY:			Sand and shale, 1 gpm at 100 feet	10	105
Alluvium:			Sand and red shale	15	120
Sandy clay	4	4	Sandstone, white, 8 gpm at 270 to 297 feet	177	297
Cinders and clay	76	80	Shale, red	3	300
UPPER AND MIDDLE JURASSIC:			Shale, red and blue	110	410
Cow Springs Sandstone, Entrada Sandstone, and Carmel Formation undifferentiated:			Sandy shale, buff	30	440
Shale, red	15	95	Sandy shale, red	57	497

7H-121A
127-10.8-12.6 A

QUATERNARY:		
Alluvium:		
Clay, red, reworked	37	37
Clay, red, heavy, reworked	43	80
Sandy clay, red, sand particles and small lime pebbles	10	90
Sand and fine gravel, medium to coarse, 1-1/2 gpm	8	98
Silty clay, dark-reddish-brown	17	115
No information	20	135
Sand and some gravel, very fine, poorly cemented	15	150
Sand, fine, lime pebbles and fragments of anhydrite, water	7	157
Sand, medium, water	4	161
Sand, coarse, fine gravel, water	6	167
UPPER TRIASSIC:		
Chinle Formation:		
Shale, red, very soft, caves	23	190

7H-246
128-13.4-8.8 A

QUATERNARY:		
Surficial deposits:		
Surface soil	35	35
TERTIARY:		
Bidahochi Formation:		
Sand, white	20	55
Sand or sandy shale, red	21	76
Sandy shale, red	24	100
Sandstone, red	620	720
UPPER TRIASSIC:		
Chinle Formation:		
Sandy shale, white, soft, small seep, bad water	15	735
Sandy shale or sandstone, red	175	910
Sandy shale, lighter color, gray or pink turning to red	102	1,012

7K-352
129-6.30-3.35

QUATERNARY:		
Alluvium:		
Malpais	20	20
TERTIARY:		
Bidahochi Formation:		
Shale, light-colored	120	140
Shale, green	20	160
Shale, red	20	180
Conglomerate, very hard	18	198
UPPER TRIASSIC(?):		
Moenave Formation:		
Sandstone, red	62	260
Shale, red	32	292
Shale, gray and red	24	316
Shale, red	32	348
UPPER TRIASSIC:		
Wingate Sandstone:		
Sandstone, red, water 1 gpm	6	354
Shale, dark-red, soft	56	410
Sandstone, light-red, water 1 gpm	30	440
Shale, red, soft	15	455
Sandstone, red	8	463
Shale, light-red	37	500
Sandstone, light-red, very dirty	45	545
Shale, light-red	35	580
Sandstone, red	15	595
Sandstone, very light red	20	615
Sandy shale, light-red	80	695
Sandstone, red, water increased slightly	3	698
Sandy shale, red	7	705
Sandstone, red, water increased slightly, Navajo(?)	5	710
Sandy shale, red	8	718
Sandstone, red, water increased to 7 gpm, Navajo(?)	17	735
Shale, red	40	775

7K-366
129-5.95-1.20

QUATERNARY:		
Alluvium:		
Sand	12	12
Malpais gravel	8	20
Gravel and sand	11	31
Malpais gravel	14	45
Sandy shale	10	55
Malpais gravel and sand	27	82
TERTIARY:		
Bidahochi Formation:		
Sandstone, tan	40	122

7H-247
141-4.0-4.0 A

QUATERNARY:		
Alluvium:		
Clay, red	24	24
Clay, red	5	29
UPPER TRIASSIC:		
Chinle Formation:		
Shale, blue	30	59
Painted Desert badlands, red	60	119
Shale, blue, sticky	148	267
Clay, red, hard	15	282
Shale, red, hard	2	284
Shale, red	54	338
Shale, gray	20	358
Shale, gray	18	376
Shale, red, fine	21	397
Shale, white	18	415
Shale, red	23	438
Shale, white	22	460
Shale, red	20	480
Shale, red	10	490
Shale, gray	25	515
Shale, gray	30	545
Shale, red	36	581
Shale, gray	87	668
Shale, red	16	684
Shale, gray	15	699
Shale, gray	20	719
Shale, red	23	742
Shale, gray, Chinle 986 feet	12	754
Shale, red	68	822
Shale, gray	53	875
Shale, red	140	1,015

8K-424
11-7.25-9.05

QUATERNARY:		
Surficial deposits:		
Top soil	2	2
Gravel and red clay	26	28
PERMIAN:		
Cutler Formation:		
Sandstone, buff, hard	14	42
Sandstone, light-red, soft	28	70
Sandstone, buff, hard	33	103
Sandstone, red, soft	11	114
Sandstone, buff, very hard	21	135
Sandstone, light-red, medium-hard	59	194
Sandstone, buff, very hard	14	208
Sandstone, white, medium-hard, seep at 218 feet	20	228
Sandstone, gray, very hard	8	236
Sandstone, light-tan, medium-hard	26	262
Shale, red, medium-hard	26	288
Sandstone, dark-red, medium-hard	11	299
Sandstone, light-red, very hard	13	312
Shale, red	6	318
Sandstone, light-red, very hard	5	323
Sandstone, buff, very hard	8	331
Sandstone, light-red, medium-hard	49	380
Shale, red, very soft and gummy	9	389
Sandy shale, red	31	420
Sandstone, red, medium-hard	68	488
Shale, gumbo, red	11	499
Sandstone, red, soft	52	551
Sandstone, light-red, medium-hard	39	590
Sandstone, buff, very hard	10	600

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
8K-432 12-6.45-14.65					
QUATERNARY:			Sandstone, red	43	105
Surficial deposits:			Sandstone, red, hard, seep of water	125	230
Soil	8	8	Sandstone, red, hard	215	445
PERMIAN:			Sandstone, white, very hard	6	451
Cutler Formation:					
Cedar Mesa Sandstone Member:					
Lime, red	54	62			
8K-403 22-5.35-10.70					
QUATERNARY:			Shale, red, sticky	13	276
Alluvium:			Sand, red, hard	17	293
Surface sand	2	2	Sand, red, coarse, water 47 gpm	82	375
JURASSIC AND TRIASSIC(?):			UPPER TRIASSIC:		
Navajo Sandstone:			Wingate Sandstone:		
Sand, pink, hard	31	33	Sand, red	125	500
Sand, brown	27	60	Sandy shale, red	15	515
Sand, red, hard	22	82	Sand, red, coarse, water	63	578
Sand, brown	66	148	Sandy shale, red	66	644
Sand, red, hard	2	150	Sand, red, hard	10	654
Sand, light-red	20	170	Shale, red	2	656
Sand, gray, water	5	175	Sand, red	5	661
Sand, light-red	17	192	Shale, red	7	668
Sand, brown	61	253	Sandy shale, red	14	682
UPPER TRIASSIC(?):			Shale, red	25	707
Kayenta Formation:					
Sandy shale, red, fine	10	263			
8K-402 23-11.65-3.15					
QUATERNARY:			red shale	15	70
Alluvium:			Gravel, coarse, carrying water	5	75
Blow sand, red, very cavey	20	20	PERMIAN:		
Shale, red	5	25	Cutler Formation:		
Sand, red, soft	25	50	Sandy shale, red	10	85
Gravel, dry	5	55	Sand rock, red, hard	30	115
Sand, red, soft, Navajo, with streaks of			Shale, red, tough	8	123
8K-436 23-1.40-13.10					
QUATERNARY:			Shale, red	2	130
Surficial deposits:			Sandstone, light-brown, 3 gpm	16	146
Top soil	1	1	Shale, red	4	150
Shale and gravel, red	89	90	JURASSIC AND TRIASSIC(?):		
UPPER AND MIDDLE JURASSIC:			Navajo Sandstone:		
Carmel Formation:			Sandstone, light-red, 6 to 8 gpm at 172 feet	156	306
Shale, red	26	116			
Sandstone, red	12	128			
8A-299 24-4.80-13.50					
JURASSIC AND TRIASSIC(?):			Sandstone, red, hard, water at 190 to 500 feet	310	500
Navajo Sandstone:					
Sand, red, Navajo	190	190			
8K-566 24-2.7-1.7(A)					
UPPER TRIASSIC:			MIDDLE(?) AND LOWER TRIASSIC:		
Chinle Formation:			Moenkopi Formation:		
Shinarump Member:			Shale, red	17	112
Sandstone	95	95			
8A-277 37-11.45-10.75					
UPPER JURASSIC:			Sandy shale, gray	45	120
Morrison Formation:			Sandy shale, gray	25	145
Sandy shale, gray	20	20	Sand, gray, soft	30	175
Sandy shale, gray	25	45	Sand, gray, hard	30	205
Sandy shale, gray	30	75	Sand, red, coarse	7	212
8K-401 39-7.20-1.50					
JURASSIC AND TRIASSIC(?):			Sandstone, red	40	195
Navajo Sandstone:			Sandstone, red, water, Navajo(?)	5	200
Sandstone, red	148	148	Sandstone, red	20	220
Sandstone, red, water, Navajo(?)	7	155	Sandstone, red	30	250
9K-211 7-10.20-13.50					
QUATERNARY:			Shale, red	5	218
Alluvium:			Sandstone, red, Navajo(?)	22	240
Alluvial fill	70	70	Sandy shale, light	30	270
UPPER JURASSIC:			Sandstone, red	240	510
Morrison Formation, Bluff Sandstone, Summerville Formation, and Entrada Sandstone undifferentiated:			Sandstone, light-red, salt water	23	533
			UPPER AND MIDDLE JURASSIC:		
			Carmel Formation:		
Shale, red and brown	138	208	Sandstone, dark-red	17	550
Sand, white, seep of water, Morrison(?)	5	213			

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19-5.90-6.85

UPPER JURASSIC:		
Morrison Formation and Bluff Sandstone undifferentiated:		
Sandstone, gray, 1 gpm at 20 feet	30	30
Sandstone, gray, layers of red shale	20	50
Sandstone, gray	20	70
Sandstone, red or pink, aquifer about 400 feet	30	100
Sandstone, pink	10	110
Shale, red, perforations recommended 360 to 550 feet	10	120
Sandstone and shale layers	30	150
Sandstone, red	60	210
Shale, red, production probably 20 to 30 gpm at unknown depth	10	220
Sandstone, red	30	250
Sandstone, gray	110	360
Shale, blue, bail test at 370 feet, no increase	10	370
Sandstone, gray	50	420
Summerville Formation:		
Shale, red	10	430
Sandstone, yellow	20	450
Shale, red	10	460
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sandstone, light-red	60	520
Sandstone, red, bailed to 250 feet at 32 gpm	23	543

9B-17
20-4.00-3.65

UPPER JURASSIC:		
Entrada Sandstone:		
Sandstone, upper third of Navajo Sandstone	35	35
Sandstone	35	70
Sandstone	35	105
Sandstone, red, Navajo	45	150
Sand, red	20	170
Sandstone, red	70	240
Sand, red	35	275
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Sand and shale streaked, red	25	300
Sandstone, red	25	325
Sand, red, show of water, 1-1/2 bailer	5	330
Sandstone, red	25	355
Sand and shale, red	35	390
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Water sand, red	135	525
No information	3	528

9Y-12
21-1.75-1.40

QUATERNARY:		
Alluvium:		
Surface sand, Navajo Sandstone	10	10
UPPER JURASSIC:		
Morrison Formation:		
Sandstone	12	22
Boulders	15	37
Shell and shale	8	45
Gumbo	15	60
Sandy shale	25	85
Sandy lime, hardy	10	95
Gumbo	5	100
Lime, gray, hard	10	110
Sandstone, brown, hard	15	125
Lime, gray	5	130
Sandstone, brown	5	135
Sand, small amount of water	5	140
Summerville Formation and Entrada Sandstone undifferentiated:		
Shale and shell	35	175
Lime	7	182
Sandy shale	8	190
Shale and shells	40	230
Gumbo	30	260
Clay, red	45	305
Shale, red	50	355
Sand, water, 7 bailers per hour	12	367
Shale, red, water, 8 bailers per hour	31	398
Sand	12	410
UPPER AND MIDDLE JURASSIC:		
Carmel Formation:		
Shale, red	88	498
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Water sand	12	510
Shale, gray	28	538
Water sand	42	580
Water sand, streaks of shale	12	592

9Y-81
21-2.30-16.30

JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Sand, red, approximate top of Navajo Sandstone	75	75
Sand, red	105	180
Water sand	7	187
Sand, light	48	235
Water sand	8	243
Sandstone	30	273
Water sand	7	280
Sand	60	340
UPPER TRIASSIC(?):		
Kayenta Formation:		
Sandstone	100	440
UPPER TRIASSIC:		
Wingate Sandstone:		
Sandy shale, red	65	505
Sand and shale	15	520
Sandstone	30	550
Sandy shale, red	45	595
Sand and shale, red	50	645
Shale, red	75	720
Sand, water	66	786
Sand and shale	50	836

9Y-97
36-4.30-7.85

QUATERNARY:		
Surficial deposits:		
Soil	60	60
Mud sand and water	78	138
Sand and gravel, very fine, water	14	152
UPPER TRIASSIC:		
Wingate Sandstone:		
Sandstone, red	13	165

9Y-98B
36-6.95-2.60

QUATERNARY:		
Alluvium:		
Alluvial fill	40	40
Alluvial fill, clay and sand, water	90	130
Alluvial fill, clay, very dirty	40	170
Sand and gravel	8	178
Clay	2	180
Sand	26	206
Gravel, coarse, water	4	210
UPPER TRIASSIC:		
Wingate Sandstone:		
Sandstone, red	23	233

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
9Y-92		
37-1.85-14.25		
QUATERNARY:		
Alluvium:		
Silty sand, very fine, dark-pink, Navajo	50	50
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Siltstone, dark-pink	130	180
10K-7		
53-6.45-10.00		
QUATERNARY:		
Alluvium:		
Adobe and silt, water at 41 feet, bail 25 gpm	68	68
Sand and silt	122	190
Bone gravel at 190 feet	13	203
UPPER TRIASSIC:		
Chinle Formation:		
Shale, red	32	235
Shale, red	15	250
Shale, gray	9	259
Shale, light-gray	6	265
Water sand, 5 gpm	17	282
Shale, red	18	300
Shale, red	76	376
Shale, gray	4	380
Shale, red	42	422
Shale, gray	13	435
Shale, red	120	555
Shale, gray	40	595
Shale, red	76	671
Shale, gray	11	682
Sand, gray, hard	5	687
Shale, gray	8	695
Shale, red	10	705
Sandy shale, dark	10	715
Sandy shale	25	740
Shinarump Member:		
Water sand	49	789
10K-213		
53-0.30-11.05		
UPPER TRIASSIC:		
Chinle Formation:		
Sand, brown	26	26
Sand, gray	94	120
Shale, blue	11	131
Shinarump Member:		
Sand, gray, showing of water	87	218
10R-166		
53-5.45-16.15		
QUATERNARY:		
Surficial deposits:		
Surface soil	14	14
Sand and water	16	30
Clay and mud	16	46
Sand and mud	15	61
Clay	11	72
10R-174		
53-11.45-1.90		
QUATERNARY:		
Alluvium:		
Blow sand	44	44
UPPER TRIASSIC(?) AND UPPER TRIASSIC:		
Kayenta Formation and Wingate Sandstone undifferentiated:		
Sandstone, red	68	112
UPPER TRIASSIC:		
Wingate Sandstone:		
Water sand, gray, 2 gpm	13	125
10K-221		
54-6.90-6.25		
UPPER JURASSIC:		
Morrison Formation:		
Sandstone, gray	62	62
Sandy shale, brown	11	73
Sandy shale, gray	19	92
Sandstone, red	6	98
Sandstone, gray, water	16	114
Shale, gray	16	130
Sandstone, gray	42	172
Shale, red and brown	15	187
Sandstone, gray, seep of water at 220 feet	33	220
Shale, red	37	257
Sandstone, gray	38	295
Shale, red	77	372
Sandstone, gray	9	381
Shale, red	9	390
Sandstone, gray, seep of water	16	406
Shale, red	27	433
Sandstone, gray, seep of water	22	455
Shale, brown	5	460
Sand, very fine, light-red	40	220
Sand, light-red, very fine, friable	55	275
Sand, light-red, fine, clean	15	290
Sand, light-pink, very fine, water at 220 to 300 feet	10	300
10K-7		
53-6.45-10.00		
Sand, brown	25	814
Sand, light, water	8	822
Shale, gray	8	830
PERMIAN:		
De Chelly Sandstone:		
Sand, light, water flow 4-1/2 gpm	80	910
Sand, brown	61	971
Sand, soft	39	1,010
Sand, hard	10	1,020
Sand, brown, hard and soft	20	1,040
Sand, hard	10	1,050
Water sand, soft, flow increased 1 gpm	4	1,054
Sand, hard	11	1,065
Sand, iron shells	38	1,103
Sand, hard	37	1,140
Broken sand, lime shells	60	1,200
Sand, hard	40	1,240
Sand, soft, water increased to 15 gpm	6	1,246
Sand, broken, lost to 9 gpm	80	1,326
Sand, soft, small water gain	6	1,332
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Broken lime shells	26	1,408
Sand, very hard	48	1,456
Sandy shale	49	1,505
Sand	4	1,509
10K-213		
53-0.30-11.05		
PERMIAN:		
De Chelly Sandstone:		
Sand, light-gray, water	107	325
Sand, buff, dry	19	344
10R-166		
53-5.45-16.15		
Sand and gravel	12	84
Clay	36	120
Gravel	2	122
Sand, gravel, clay	41	163
UPPER TRIASSIC:		
Chinle Formation:		
Shale, red	27	190
10R-174		
53-11.45-1.90		
Sandy shale, red	42	167
Water sand, gray, 1 gpm	8	175
Sandy shale, red	176	351
Shale, red	250	601
10K-221		
54-6.90-6.25		
Shale, red	43	510
Sandstone, gray, seep of water	18	528
Sandy shale, light	18	546
Shale, red	17	563
Sandy shale, light	102	665
Shale, red	13	678
Sandy shale, light, bottom of Morrison	54	732
UPPER AND MIDDLE JURASSIC:		
Summerville Formation, Entrada Sandstone, and Carmel Formation undifferentiated:		
Shale, red, Carmel	274	1,006
Gravel, salt water, raised to 480 feet of top	2	1,008
Shale, red	90	1,098
Very hard formation	3	1,101
Shale, red, soft	6	1,107
Sandstone, shale	31	1,138
JURASSIC AND TRIASSIC(?):		
Navajo Sandstone:		
Water sand, Navajo	77	1,215

Sandstone, gray, seep of water	7	467			

10R-111
54-1.15-9.15

QUATERNARY:			Shale, red	20	80
Alluvium:			Shale, red	60	140
Sand	35	35	Shale, red	10	150
UPPER JURASSIC, AND JURASSIC AND TRIASSIC(?):			Sandy shale, red	60	210
Summerville Formation, Entrada Sandstone, and Navajo Sandstone undifferentiated:			Sand, red, Navajo	57	267
Sandy shale, red	25	60	Sand, red, water	28	295
			Sand, red, water	65	360

10R-119
54-1.45-1.90

QUATERNARY:			Shale, red, soft, water lost at 145 feet	105	215
Alluvium:			Shale, red, clay and sandstone, soft	3	218
Sand, red, soft	16	16	Shale and sandstone, red, soft	17	235
UPPER AND MIDDLE JURASSIC:			Sand, yellow, red shale, hard	15	250
Summerville Formation, Entrada Sandstone, and Carmel Formation undifferentiated:			Same as above, enough water to drill with	60	310
Clay, red, soft	56	72	JURASSIC AND TRIASSIC(?):		
Sandstone, gray, red, soft	8	80	Navajo Sandstone:		
Clay, red, soft	25	105	Sand, yellow, water, soft	50	360
Sandstone, gray, about 1 gpm	5	110			

10K-236
70-12.90-3.80

QUATERNARY:			PERMIAN:		
Surficial deposits:			De Chelly Sandstone:		
Soil	2	2	Sandstone, buff	20	185
UPPER TRIASSIC:			Sandstone, yellow	55	240
Chinle Formation:			Sandstone, medium-red, seep of water at 405 feet	170	410
Shale, blue	118	120	Sandstone, light-red	116	526
Sandstone, gray	22	142			
Shale, red	3	145			
Shinarump Member:					
Sandstone, gray	20	165			

10T-243
70-12.65-12.00

QUATERNARY:			Sandy shale, red	8	18
Surficial deposits:			Conglomerate, gray	22	40
Top soil	3	3	PERMIAN:		
UPPER TRIASSIC:			De Chelly Sandstone:		
Chinle Formation:			Sandstone, red, seep at 505 feet	589	629
Shinarump Member:					
Sandy shale, gray	7	10			

10K-200
71-3.50-1.85

QUATERNARY:			Sand, gray, sharp	36	130
Surficial deposits:			Shale, purplish-brown	14	144
Soil	24	24	Shale, dark-red	41	185
UPPER TRIASSIC:			Clay and shale, light-gray	37	222
Chinle Formation:			Mudstone and shale, dark-gray	9	231
Clay and shale, dark-red	16	40	Mudstone, grayish-black, specks of aragonite	9	240
Sand and silt, red, pebbles	14	54	Clay and shale, dark-gray	27	267
Sand and conglomerate, coarse	8	62			
Clay and shale, gray	32	94			

10K-232
71-2.30-6.85

QUATERNARY:			Clay and broken rock	35	155
Surficial deposits:			Sand, water	35	190
Soil	4	4	Sand and gravel, coarse, water	17	207
Sand and mud, water	12	16	Conglomerate	16	223
Broken rock and clay	19	35	PERMIAN:		
Sand, fine-grained, water	20	55	De Chelly Sandstone:		
Clay, soft	65	120	Sandstone	57	280

10R-3
71-2.90-17.05

QUATERNARY:			Sand and gravel, water	8	38
Surficial deposits:			UPPER TRIASSIC:		
Surface soil	18	18	Chinle Formation:		
Sand	8	26	Shale, red	20	58
Clay	4	30			

10R-58
71-7.50-15.10

QUATERNARY:			UPPER TRIASSIC:		
Alluvium:			Chinle Formation:		
Shale, brown	15	15	Shale, brown	15	100
Shale, brown	65	80	Shale, red	10	110
Rock, red, water at 80 feet	5	85	Shale, green, gray, and brown	7	117

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
10R-135					
71-13.65-10.65					
QUATERNARY:			Sand and gravel, water	2	82
Alluvium:			UPPER TRIASSIC:		
Adobe	20	20	Wingate Sandstone:		
Blow dust	35	55	Sandstone, red	45	127
Sand, water	25	80			
10R-170					
71-4.15-3.65					
QUATERNARY:			Sand, very fine	28	114
Surficial deposits:			Sand, coarse, some gravel, water	4	118
Soil	8	8	UPPER TRIASSIC:		
Sand, mud, and water	47	55	Chinle Formation:		
Clay	31	86	Shale, light	44	162
10R-49					
72-7.50-8.75					
QUATERNARY:			Sand, water	12	106
Alluvium:			UPPER JURASSIC:		
Adobe	50	50	Cow Springs Sandstone:		
Blow dust	35	85	Chalk, white, Morrison(?)	91	197
Clay, dark	9	94			
10R-51					
72-7.45-12.15					
QUATERNARY:			UPPER JURASSIC:		
Surficial deposits:			Cow Springs Sandstone:		
Surface soil	22	22	Sandy shale, white	10	90
Blow dust	50	72	Shale, red	35	125
Sand and gravel, water	8	80			
Amerada 1					
72-5.85-8.55					
QUATERNARY:			Shale, red with green flecks	30	250
Alluvium:			UPPER TRIASSIC:		
Alluvial fill	40	40	Wingate Sandstone:		
UPPER AND MIDDLE JURASSIC:			Shale, orange	50	300
Entrada Sandstone and Carmel Formation undifferentiated:			Shale, dark-red	30	330
			Sandstone, hard shell	5	335
Shale, red, sticky, with green streaks	160	200	Shale, orange	125	460
Shale, red-gray	20	220			
10R-24					
90-11.50-0.70					
UPPER TRIASSIC:			Sandstone, red	70	675
Chinle Formation:			Sand, red	40	715
Shinarump Member:			PERMIAN AND PENNSYLVANIAN:		
Clay, red	10	10	Supai Formation:		
Sand rock	50	60	Sand and shale, red	20	735
Sand, soft	45	105	Sandy shale	13	748
Sand, red, Navajo(?)	40	145	Shale	9	757
Sand, white	10	155			
PERMIAN:					
De Chelly Sandstone:					
Sand, red, water at 500 feet, 1/2 gpm	450	605			
10GS-90-1					
90-10.0-7.0 A					
PERMIAN:			Sandy shale, red	35	440
De Chelly Sandstone:			Sandy shale, brown-red, thin gray layers	185	625
Sandstone, crossbedded	210	210	Shale, red, soft	40	665
PERMIAN AND PENNSYLVANIAN:			Sandy shale, alternating red and gray	55	720
Supai Formation:			Shale, brown, red, and gray	30	750
Shale, red	20	230	Shale, red, soft	10	760
Sandstone, coarse, brown, crossbedded	35	265	Sandy shale, mottled red and gray	45	805
Sandy shale, brown-red, few gray layers	120	385	PRECAMBRIAN(?):		
Sandstone, red-brown, coarse, crossbedded	20	405	Granite, red	21	826
10R-21					
91-13.50-0.75					
QUATERNARY:			UPPER TRIASSIC:		
Surficial deposits:			Wingate Sandstone:		
Surface soil	90	90	Shale, red	47	173
Sand, mud, and water	33	123			
Sand and gravel, water	3	126			
10R-61					
91-8.35-6.90					
QUATERNARY:			Water sand	1	63
Alluvium:			UPPER TRIASSIC:		
Blow dust	12	12	Chinle Formation:		
Broken rock	2	14	Shale, red	29	92
Shale, red	48	62			

10R-16
92-4.30-0.55

QUATERNARY:		
Alluvium:		
Adobe	2	2
Blow dust	88	90
Clay, blue	25	115
Sand, mud, and water	19	134
UPPER JURASSIC:		
Cow Springs Sandstone and Entrada Sandstone undifferentiated:		
Sand, fine	2	136
Shale, red	4	140
Sandstone, red, Navajo(?)	20	160
Shale, red	53	213

11Y-54
35-12.50-16.65

QUATERNARY:		
Alluvium:		
Broken rock	8	8
UPPER TRIASSIC:		
Chinle Formation:		
Shale, light	6	14
Shale, yellow	6	20
Shale, light	18	38
Shale, red	9	47
Shale, light	12	59
Sandstone, water, 6 gpm bailer	9	68
Shale, light	22	90
Hard rock	27	117
Shale, white	31	148
Shale, red	17	165
Shale, gray	13	178
Shale, red	77	255
Sandstone, gray	40	295
Shale, gray	11	306
Sandstone, gray	19	325
Shale, red	90	415
Shale, gray	10	425
Shale, red	7	432
Sandstone, red, seep of water at 460 feet	28	460
Sandstone, red	38	498
UPPER TRIASSIC AND PERMIAN:		
Chinle Formation (Shinarump Member) and De Chelly Sandstone undifferentiated:		
Sandstone, gray, water flow, 4 gpm, no increase below 608 feet	252	750

11K-243
52-1.80-1.50

QUATERNARY:		
Alluvium:		
Blow sand	25	25
UPPER TRIASSIC:		
Chinle Formation:		
Shale	225	250
Sandstone, gray, picked up water at 265 feet	130	380
Sandstone, reddish-gray	40	420
Sandstone, gray	10	430

11K-249
52-6.00-4.20

QUATERNARY:		
Alluvium:		
Blow sand	5	5
UPPER TRIASSIC:		
Chinle Formation:		
Shinarump Member:		
Sandstone, light-gray	60	65
Shale, light-red	5	70
Shale, light-blue	45	115
Sandstone, gray	65	180
PERMIAN:		
De Chelly Sandstone:		
Sandstone, light-gray, water at 350 feet	315	495
Sandstone, light-brown, water level at 265 feet	84	579

11Y-58
52-11.55-2.35

QUATERNARY:		
Surficial deposits:		
Soil	3	3
Broken rock	5	8
Rock	12	20
UPPER TRIASSIC:		
Chinle Formation:		
Shale, brown	21	41
Shale, gray	19	60
Shale, brown	19	79
Shale, gray	21	100
Shinarump Member:		
Sandstone, gray, flow, very weak	28	128
Shale, gray	6	134
Sandstone, white	32	166
Sandstone, gray, flow, 7 gpm	36	202

12T-332
1-11.90-8.85

UPPER JURASSIC:		
Morrison Formation:		
Shale, gray	12	12
Lime, hard, green	2	14
Shale, gray	10	24
Sandstone, mixed	7	31
Shale, white and red	14	45
Sandstone, gray, seep at 54 feet	33	78
Shale, blue	12	90
Sandy shale, gray	10	100
Sandstone, gray, 10 gpm	7	107
Sandstone, gray, coarse, water level 34 feet	28	135
Sandstone, gray, fine	21	156
Sandstone, gray, coarse, water increased	69	225
Shale, brown	30	255
Sandstone, white, water level 35 feet	22	277
Sandy shale, brown	35	312
Sandstone, gray, hard	23	335
Sandstone, gray	10	345
Shale, lense, brown and gray	5	350
Sandstone, red and gray	25	375
Shale, red, hard	21	396
Sandstone, gray, hard	7	403
Sandstone, very hard	21	424
Sandstone, hard, gray	10	434
Sandstone, gray	6	440
Shale, red	2	442
Sandstone, red and gray	18	460
Sandstone, gray, very hard, 5 feet in 14 hours	5	465
Shale, red	40	505
Bluff Sandstone:		
Sandstone, light-brown	2	507
Sandstone, light-brown, flow started at 590 feet	178	685
Summerville Formation:		
Shale, red	5	690

12K-308
7-10.25-2.55

QUATERNARY:		
Alluvium:		
River boulders	17	17
UPPER JURASSIC:		
Morrison Formation:		
Shale, red	3	20
Shale, red	4	24
No information	26	50
Sandy shale, red	50	100
Morrison Formation and Bluff Sandstone undifferentiated:		
Sandy shale, light-brown	137	237
Water sand, red, flow 1 gpm	20	257
UPPER AND MIDDLE JURASSIC:		
Entrada Sandstone and Carmel Formation undifferentiated:		
Shale, red	23	280

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
12K-308—Continued 7-10.25-2.55		
Water sand, red, flow 2-1/2 gpm	35	315
Shale, red	24	339
Sandstone, red, salt water, flow 1/2 gpm	2	341
Shale, red	26	367
Sandstone, red, salt water, flow 5 gpm	11	378
Shale, red	7	385
Sandstone, red	6	391
Shale, red	64	455
Sandstone, red, salt water 1-1/2 gpm	21	476
Shale, red	33	509
JURASSIC AND TRIASSIC(?), UPPER TRIASSIC(?), AND UPPER TRIASSIC:		
Navajo Sandstone, Kayenta Formation, and Wingate Sandstone undifferentiated:		
Sandstone, light-red, salt-water flow	639	1,148
UPPER TRIASSIC:		
Wingate Sandstone:		
Shale, red	6	1,154
Sandstone, red, dry	9	1,163
12K-300 17-10.65-14.85		
QUATERNARY:		
Alluvium:		
Sand gravel	40	40
UPPER CRETACEOUS:		
Mancos Shale:		
Shale, dark	235	275
Sand, fine, salt water	12	287
Sandstone, hard, gray	8	295
Shale, dark	30	325
Sandstone, light-gray, fine, brittle	7	332
Shale, dark	648	980
Sandstone, gray, dense, flour-grained	15	995
Shale, hard, black	15	1,010
Dakota Sandstone:		
Sandy shale, fine, brown	20	1,030
Sandstone, gray, flour-grained, sulphur water 8 feet	8	1,038
Shale, dark-gray	64	1,102
Sandstone, water flows, 10 gpm	20	1,122
Shale and coal	38	1,160
Sandstone, white, water flows 10 gpm	8	1,168
UPPER JURASSIC:		
Morrison Formation:		
Talc and shale	32	1,200
12R-148 18-8.25-15.90		
QUATERNARY:		
Alluvium:		
Sand, gray, Mancos Shale above Tocito	15	15
Sandy shale	15	30
UPPER CRETACEOUS:		
Mancos Shale (upper part):		
Broken lime shells	15	45
Shale, blue	385	430
Shale, gray	40	470
Lime shells	25	495
Shale, gray	40	535
Gallup Sandstone:		
Sandstone, hard, top of Tocito	5	540
Lime shells	15	555
Shells and shale	15	570
Water sand, 35 feet	35	605
Shale, gray	15	620
Shale, gray	30	650
Shale, gray, sandy	12	662
Water sand, light, 31 feet	31	693
Mancos Shale (lower part):		
Shale, blue	2	695
12K-309 32-11.25-5.00		
QUATERNARY:		
Alluvium:		
Surface shale	18	18
UPPER CRETACEOUS:		
Mancos Shale (upper part):		
Rock, blue	8	26
Sand, gray	4	30
Shale, sandy	10	40
Shale, dark	20	60
Shale, dark	65	125
Lime, blue	6	131
Shale, dark	531	662
Sand	4	666
Gallup Sandstone:		
Sand, artesian water, Tocito	32	698
Mancos Shale (lower part):		
Shale, gray to dark, with few streaks of sand and sandy shale	804	1,502
Dakota Sandstone:		
Sand	8	1,510
Sand, artesian water, first Dakota	50	1,560
Shale, dark	20	1,580
Sand, small amount of water	10	1,590
Shale, dark	20	1,610
Shale, very hard	10	1,620
Sand	12	1,632
Sand, artesian water, second Dakota(?)	8	1,640
12R-91 32-7.10-15.45		
QUATERNARY:		
Alluvium:		
Clay, yellow, Lewis Shale	12	12
UPPER CRETACEOUS:		
Lewis Shale:		
Shale	10	22
Shale, brown	103	125
Sandy shale, brown	60	185
Shale, brown	315	500
Cliff House Sandstone:		
Sandy shale, brown	55	555
Sand, hard, gray, fresh water, top of Cliff House, Mesaverde	5	560
Water sand	110	670
Menefee Formation:		
Shale, blue	5	675
12K-310 33-3.30-5.85		
UPPER CRETACEOUS:		
Mancos Shale (upper part):		
Shale, brown	8	8
Shale, yellow	22	30
Shale, blue	425	455
Gallup Sandstone:		
Tocito, water sand	5	460
Sand, hard	40	500
Sand and shale	15	515
Shale, blue	4	519
Water sand	11	530
Sand	15	545
Mancos Shale (lower part):		
Shale, blue	55	600
Shale, brown	25	625
Shale, blue	234	859
Shale, hard	5	864
Shale, blue	373	1,237
Shale, hard	18	1,255
Lime	10	1,265
Shale, blue	65	1,330
Dakota Sandstone:		
Sand	5	1,335
Sand and shale	15	1,350
Sand	20	1,370
Sandy shale	25	1,395
Sand, water	25	1,420
Sand	34	1,454
UPPER JURASSIC:		
Morrison Formation:		
Shale, green	28	1,482
12M-49 49-6.75-15.55		
UPPER CRETACEOUS:		
Pictured Cliffs Sandstone:		
Sandstone, approximate top of Cliff House Sandstone, Mesaverde	20	20
Shale, gray	15	170
Gumbo	20	190
Shale, brown	50	240
Lime	5	245

Shale, black	15	35
Shale, black	8	43
Water sand, gray, filled hole 3 feet per hour	2	45
Lewis Shale:		
Shale, gray	25	70
Shale, gray	30	100
Shale, gray	40	140
Gumbo	15	155
Shale	15	260
Cliff House Sandstone:		
Water sand, coarse, gray	5	265
Coal	5	270
Gumbo	15	285
Sandy shale, gray	5	290
Menefee Formation:		
Gumbo	20	310

12R-242
49-7.75-5.80

UPPER CRETACEOUS:		
Pictured Cliffs Sandstone:		
Sand, white, top of Cliff House	40	40
Sand, brown	15	55
Sand	55	110
Sandy shale	5	115
Sand and shale	45	160
Sandy shale, brown	45	205
Water sand, gray	30	235
Lewis Shale:		
Coal	3	238
Shale	12	250
Sandy shale	20	270
Cliff House Sandstone:		
Sand, gray, water	40	310
Sand, gray, water	50	360
Menefee Formation:		
Shale, blue	2	362

12R-125
67-11.55-4.50

QUATERNARY:		
Surficial deposits:		
Soil	3	3
UPPER CRETACEOUS:		
Menefee Formation:		
Shale, gray	12	15
Sand	5	20
Shale, brown	10	30
Shale, gray	2	32
Sand, water, rose to 20 feet	8	40
Shale	8	48
Sand	4	52
Shale	15	67
Sand, water, rose to 35 feet	13	80
Shale	65	145
Sand, water, rose to 30 feet	35	180
Shale	10	190
Sand	5	195
Shale, gray	35	230
Shale, brown	5	235
Shale	105	340
Sand	10	350
Shale	10	360
Sand	12	372
Shale	4	376
Sand	14	390
Sand, coarse	2	392
Shale	108	500
Sand	10	510
Shale, brown	15	525
Sand	2	527
Shale, brown	16	543
Shale, gray	3	546
Shale, brown	6	552
Sand	32	584
Shale, brown	18	602
Sand, Tocito sand, good water, flow 1-1/2 gpm	22	624
Shale, gray	36	660

13R-109
31-2.55-9.35

QUATERNARY:		
Surficial deposits:		
Sandy soil	70	70
UPPER CRETACEOUS:		
Kirtland Shale:		
Sandy shale, blue	80	150
Sand, gray, seep of water, stands at 130 feet from top	2	152
Shale, blue	13	165
Water sand	21	186
Shale, blue	71	257
Sandstone, gas	18	275
Sandstone, seep, water salty	9	284
Shale, blue	56	340
Sandstone, water salty	28	368
Shale, blue	22	390
Sandstone, water very salty	12	402
Shale	38	440

13T-211
31-5.20-1.85

QUATERNARY:		
Surficial deposits:		
Alluvium	15	15
Sand and gravel	10	25
Sand, soft	10	35
UPPER CRETACEOUS:		
Kirtland Shale:		
Sand, hard	10	45
Sandy shale, gray	20	65

13R-59
66-13.70-2.65

UPPER CRETACEOUS:		
Cliff House Sandstone:		
Sandstone, approximate top of Cliff House, Mesaverde Group	20	20
Shale	10	30
Lime	5	35
Sand rock	15	50
Menefee Formation:		
Shale	40	90
Lime	4	94
Gumbo	31	125
Sandy shale	20	145
Gumbo	25	170
Lime	5	175
Sand, gray, tight, 1 bailer per hour	12	187
Sandy shale	13	200
Gumbo	10	210
Shale, brown	26	236
Lime	4	240
Lime	1	241
Water sand, gray, coarse, water rose 75 feet in 15 minutes	16	257
Shale, brown	8	265
Gumbo	7	272
Gumbo	8	280
Shale, brown	10	290
Gumbo	14	304

14N-85
67-8.00-10.25

UPPER CRETACEOUS:		
Menefee Formation:		
Shale, light-gray	12	12
Shale, dark-gray	113	125
Shale, light-gray	75	200
Shale, dark-gray	25	225
Shale, light-gray	55	280
Shale, black, carbonaceous	20	300
Shale, light-gray	40	340
Shale, dark-gray	96	436
Sand, light-gray, water 2-1/2 gpm	9	445
Shale, gray	88	533
Sand, dark-gray, fine, water flows 15 gpm	37	570
Shale, gray	54	624
Sand, light-gray, fine, water, no increase	51	675
Shale, gray and streaks of sand	115	790

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
14N-85—Continued 67-8.00-10.25		
Sand, light-gray	95	885
Sand, dark-gray, fine, small increase in water	15	900
Shale, gray	100	1,000
Point Lookout Sandstone(?):		
Sandstone(?), increase to 30 gpm(?)	30	1,030
14A-81 86-12.95-15.30		
QUATERNARY:		
Surficial deposits:		
Surface soil	4	4
UPPER CRETACEOUS:		
Point Lookout Sandstone:		
Sand, brown, soft	86	90
Sand, gray	40	130
Sand, light-gray, water 1 gpm	5	135
Shale, blue	40	175
Shale, hard	1	176
Sandy shale, gray	69	245
Sand, water increased to 5 gpm	20	265
Sandy shale, gray	110	375
Mancos Shale:		
Shale, black	9	384
Shale, gray	11	395
14K-302 87-6.50-15.40		
QUATERNARY:		
Alluvium:		
Surface	45	45
UPPER CRETACEOUS:		
Menefee Formation:		
Shale, gray	2	47
Sand, brown	23	70
Sandy shale	4	74
Water sand	5	79
Sandy shale	13	92
Shale, sticky	12	104
Water sand, bailer test 140 gpm	8	112
Coal with shell	2	114
Water sand	18	132
Shell	6	138
Sand shell	10	148
Sand	7	155
Shale, dark	13	168
Shell, gray	6	174
Hard shell	4	178
Sandy shale	37	215
Point Lookout Sandstone:		
Shale, gray	3	218
Sand	5	223
Coal	2	225
Shale, brown	10	235
Shale, gray	15	250
Sand, coarse, hard	13	263
Sand	4	267
Shale, gray	11	278
Coal	1	279
Sand, hard, water raised	2	281
Crevasse Canyon Formation:		
Shale, gray	7	288
Coal and gravel, water flowing 1-1/2 gpm	2	290
Shale, gray	3	293
Hard shell	3	296
Shale, black	5	301
Shale, gray	17	318
Coal	5	323
Shale, brown	7	330
Shale, black	20	350
Water sand	6	356
Coal	7	363
Sand, hard, water	7	370
Shale, brown	4	374
14M-1 87-10.75-15.55		
QUATERNARY(?):		
Alluvium:		
Sand and clay	80	80
UPPER CRETACEOUS:		
Menefee Formation:		
Sand, fine	22	102
Shale	2	104
Clay, blue, tough	8	112
Shale, shallow rock layers	62	174
Sandstone, light-gray, hard	12	186
Shale and slate	6	192
Sandstone, light-gray, hard	33	225
Shale	9	234
Sandstone	2	236
Shale	6	242
Slate, hard	8	250
Sandstone	12	262
Shale	23	285
Point Lookout Sandstone(?):		
Sandstone, extra hard	3	288
Sand rock, loose	10	298
Coal, water raised to 28 feet from surface	1	299
Crevasse Canyon Formation:		
Shale, tough and sticky	33	332
Shale	8	340
Sandstone	2	342
Slate, very hard	14	356
Sandstone	1	357
Shale	41	398
Sandstone, water raised to 20 feet from surface	4	402
Shale	20	422
Shale, sandstone, and coal	4	426
Gallup fire clay	20	446
Rock, dirt, very hard, carrying mineral	8	454
Sandstone, light-gray	166	620
Fire clay	2	622
Sandstone, light-gray	62	684
Sandstone, dark-brown	18	702
Fire clay	20	722
Sandstone, light-gray	20	742
Fire clay	11	753
Sandstone, light-gray	21	774
Fire clay	26	800
Sandstone, thin coal layer	16	816
Fire clay	90	906
Sandstone, light-gray, water over casing 90 gph	37	943
Coal	3	946
Sandstone, light-gray	3	949
Fire clay	6	955
Rock, dark, close-grained, hard	9	964
Fire clay	24	988
Shale	13	1,001
Gallup Sandstone(?):		
Sand rock, close-grained, hard	17	1,018
Fire clay, very tough and sticky	17	1,035
Sand rock, close-grained, very hard	15	1,050
Sand rock, light-yellow, water flows 300 gph	8	1,058
Sand rock, light-gray	24	1,082
Sand rock, light-yellow, water flows 2,500 gph	12	1,094
Sand rock, light-gray, well flows 6,000 gph	14	1,108
Mancos Shale:		
Shale	42	1,150
14M-26 87-0.65-7.95		
QUATERNARY:		
Alluvium:		
Clay	10	10
Sand rock	2	12
Clay	2	14
Rock	2	16
UPPER CRETACEOUS:		
Menefee Formation:		
Fire clay	2	18
Rock, hard, dark	4	22
Fire clay	6	28
Sand rock, water	4	140
Fire clay	12	152
Sand rock, close-grained	30	182
Fire clay	233	415
Sand rock, more flow	2	417
Fire clay	80	497
Shale	2	499
Rock, dark	3	502
Shale	3	505
Sand rock, water	2	507
Fire clay	18	525

Sand rock	2	30
Coal	2	32
Sand rock	2	34
Fire clay	102	136
Sand rock, more flow	14	539
Fire clay	4	543
Shale	12	555

14N-95
87-8.05-3.15

QUATERNARY:		
Alluvium:		
Top shale	10	10
Sand, cavey	60	70
UPPER CRETACEOUS:		
Menefee Formation:		
Shale	130	200
Water sand, water raised to 100 feet of top, test 30 minutes 96 gallons	20	220
Shale	100	320
Water sand, water raised to 75 feet of top	20	340
Shale	45	385
Water sand, water raised to 60 feet of top	20	405
Shale	65	470
Sandy shale, brown	185	655
Water sand, water raised to 80 feet of top	35	690
Shale	50	740
Shale, blue	70	810
Shale, gray	45	855
Coal	10	865
Shale	138	1,003
Coal	12	1,015
Water sand, water flows 2 gpm	30	1,045
Sand	37	1,082
Shale	103	1,185

14K-301
88-0.90-9.90

QUATERNARY:		
Alluvium:		
Sand and gravel	34	34
UPPER CRETACEOUS:		
Menefee Formation:		
Shale, blue	76	110
Shale, gray	15	125
Shale, brown	109	234
Sandy shale, brown	81	315
Sand, water	4	319
Shale, brown	26	345
Sandy shale, brown	50	395
Sand, water, 5 bailers per hour	5	400
Shale, blue	138	538
Sand, water	12	550
Shale, blue	20	570
Sand, water, raises within 300 feet of surface	25	595
Sandy shale, hard	5	600
Shale, brown	25	625
Sandy shale, hard	5	630
Sand, water	30	660
Sand, white	25	685
Sandy shale, gray	10	695
Shale, brown	25	720
Sandy shale, gray	10	730
Sand, water	25	755
Shale, brown	3	758
Sandy shale, hard	7	765
Sandy shale, gray	44	809
Sand, water	12	821
Shale, blue	3	824
Shale, brown	13	837
Shale, gray	7	844
Shale, brown, hard	4	848
Sand, hard	6	854
Sand, water	16	870
Shale, brown	10	880
Shale, gray	20	900
Sandy shale, gray	12	912
Shale, brown	18	930
Shale, gray	40	970
Shale, hard	1	971
Shale, gray	69	1,040
Shale, gray, soft	15	1,055
Sandy shale, gray	9	1,064
Shale, blue	6	1,070
Shale, hard	2	1,072
Shale, blue	13	1,085
Shale, brown	35	1,120
Shale, gray	5	1,125
Shale, blue	10	1,135
Shale, brown	5	1,140
Shale, light-gray	15	1,155
Shale, gray	35	1,190
Sand, water	6	1,196
Sandy shale, gray	44	1,240
Shale, brown	23	1,263
Sand, water	1	1,264
Coal	6	1,270
Shale, brown	5	1,275
Point Lookout Sandstone:		
Sand, water, raised within 240 feet of surface, tested 63 gpm	79	1,354
Sandy shale, gray	62	1,416
Sand, water	39	1,455
Crevasse Canyon Formation:		
Shale, brown	11	1,466
Sand, water	6	1,472
Sandy shale, gray	20	1,492
Sand, water	38	1,530
Shale, hard	4	1,534
Sand, water	6	1,540
Shale, hard	2	1,542
Sandy shale, gray	8	1,550
Sand	6	1,556
Sandy shale, gray	54	1,610
Sand, water	14	1,624
Shale, gray	41	1,665
Sand, water	20	1,685
Shale, brown	10	1,695
Coal	5	1,700
Sand, water	8	1,708
Shale, gray	7	1,715
Coal	3	1,718
Shale, brown	72	1,790

14K-303
88-4.40-14.55

QUATERNARY:		
Alluvium:		
Alluvial fill	48	48
UPPER CRETACEOUS:		
Menefee Formation:		
Sandstone, hard in upper part, water at 54 feet	9	57
Clay	7	64

14K-300
107-1.45-2.90

UPPER CRETACEOUS:		
Menefee Formation and Crevasse Canyon Formation undifferentiated:		
Shale, yellow	6	6
Sand, yellow	6	12
Shale, yellow	34	46
Sandy shale, gray	35	81
Shale, gray	9	90
Sandy shale, gray	10	100
Sand, gray	34	134
Shale, gray	8	142
Sand, gray	5	147
Shale, brown	4	151
Sand, gray, water 1/2 gpm	5	156
Shale, blue	19	175
Shale, gray	46	221
Sand, gray, water 18 gpm	23	244
Shale, brown	28	272
Shale, gray, a little sandy	4	276
Shale, gray	12	288
Sand, gray, water	4	292
Shale, gray	6	298
Shale, brown	20	318
Sandy shale, light-gray	41	359
Sand, gray, water	9	368
Shale, gray	30	398
Sand, gray	2	400
Shale, brown	8	408
Shale, gray	53	461
Hard shell	1	462
Sandy shale, gray	13	475
Coal	3	478
Shale, gray	45	523
Sand, gray	2	525

Table 2. --Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
14K-300—Continued 107-1.45-2.90					
Shale, gray	31	556	Shale, brown	15	1,000
Hard shell	1	557	Shale, gray	16	1,016
Shale, brown	2	559	Shale, brown	22	1,038
Hard shell, gray	5	564	Shale, gray	16	1,054
Shale, gray	33	597	Shell	4	1,058
Shell	3	600	Shale, gray	23	1,081
Shale, gray	25	625	Sandy shale, light-gray	7	1,088
Shale, brown	4	629	Sand, gray, hard	2	1,090
Shale, gray	33	662	Shale, dark-gray with streaks of coal	34	1,124
Sand, gray, water, 3 bailers per hour	9	671	Shale, gray	26	1,150
Shale, gray	32	703	Shale, brown	26	1,176
Sand, gray	6	709	Sand, hard	3	1,179
Hard shell	2	711	Shale, brown	53	1,232
Sand, gray, hard	19	730	Shale, gray	25	1,257
Shale, dark-brown	7	737	Sand, hard	3	1,260
Shale, gray	59	796	Sandy shale, gray	26	1,286
Hard shell	1	797	Sandy shale, brown	27	1,313
Shale, brown	4	801	Shale, light-gray, lime(?)	11	1,324
Shale, gray	25	826	Sandy shale, gray	26	1,350
Shale, brown	1	827	Gallup Sandstone:		
Shale, gray	75	902	Sand, gray, water	33	1,383
Sandy shale, gray	20	922	Shale, gray	44	1,427
Sand, gray, water 18 gpm	8	930	Sand, water 14 gpm	21	1,448
Sandy shale, gray	12	942	Shale, gray	49	1,497
Shale, gray	22	964	No information	53	1,550
Sand	3	967			
Shale, gray	18	985			
15B-24 65-8.35-4.70					
UPPER CRETACEOUS:			Shale, blue	30	240
Pictured Cliffs Sandstone:			Cliff House Sandstone:		
Sand, yellow	15	15	Sand, gray	20	260
Sand, yellow	5	20	Sandy shale, gray	65	325
Lewis Shale:			Sandy shale, gray	25	350
Shale, brown	10	30	Sand, 2 bailers per hour	25	375
Shale, brown	30	60	Shale, blue	10	385
Shale, blue	40	100	Sand, water, more water at 390 feet	65	450
Shale, blue	40	140	Sand, water, more water	20	470
Shale, blue	50	190	Menefee Formation:		
Shale, blue	20	210	Shale, blue, hard	30	500
15K-302 65-8.70-11.10					
QUATERNARY:			Water sand	8	533
Surficial deposits:			Shale, light	14	547
Surface soil	14	14	Water sand	13	560
UPPER CRETACEOUS:			Shale, gray	8	568
Menefee Formation:			Sand	22	590
Shale, brown	41	55	Shale, brown	4	594
Shale, blue	5	60	Sand	11	605
Shale, brown	2	62	Shale, gray	35	640
Shale, gray, muddy	58	120	Shale, dark	5	645
Sandy shale, gray	14	134	Sand	12	657
Dry sand	3	137	Water sand	5	662
Shale, gray	28	165	Shale, gray	19	681
Shale, light	9	174	Hard shell	3	684
Sandy shell	2	176	Shale, gray	13	697
Shale, gray	24	200	Shale, brown	3	700
Sandy shale, showing of water	8	208	Shale, gray	27	727
Shale, gray	56	264	Sandy shell, hard	2	729
Water sand, white	6	270	Sand, hard	4	733
Shale, dark	70	340	Shale, gray	27	760
Shale, brown	10	350	Shale, gray, sticky	5	765
Shale, gray	12	362	Shale, gray	42	807
Hard shell	3	365	Water sand	23	830
Shale, brown	5	370	Shale, gray	3	833
Shale, gray	65	435	Shale, light	3	836
Shale, brown, with shell	15	450	Shale, gray	2	838
Shale, brown	8	458	Water sand, dark-gray	17	855
Sand, hard, bailer test showing 40 gpm	8	466	Sand, hard, brown	5	860
Shale, gray	19	485	Shale, gray	67	927
Hard shell	2	487	Sand	3	930
Shale, gray	18	505	Sand shell, hard	1	931
Shale, brown	20	525	Shale, gray	31	962
15A-18 66-6.35-12.20					
QUATERNARY:			Hard rock	3	225
Alluvium:			Shale, black	85	310
Clay and rock	10	10	Sandstone, gray	5	315
UPPER CRETACEOUS:			Shale, blue	35	350
Menefee Formation:			Sandstone, gray, water, flow	20	370
Shale, black	76	86	Shale, blue	28	398
Hard rock	4	90	Sandstone, gray, water, flow	8	406
Sandstone, soft, water	4	94	Shale, brown	29	435
Shale, brown	50	144	Sandstone, gray, water, flow	59	494
Sandstone, gray, water raised to 56 feet	31	175	Shale, brown	23	517
Shale, brown	5	180	Sandstone, gray, water, flow	8	525
Hard rock	2	182	Shale, blue	25	550
Shale, black	40	222			

15B-10
86-0.60-14.35

QUATERNARY:		
Alluvium:		
Alluvial earth	80	80
UPPER CRETACEOUS:		
Menefee Formation:		
Sandstone, white, pumping water	160	240
Hard shell	5	245
Shale, clay	230	475
Point Lookout Sandstone:		
Sandstone, gray, water flows	50	525
Hard shell	10	535
Sandstone, hard, gray	49	584
Shale	50	634
Sandstone, white, water	18	652
Blackjack and coal	11	663
Sandstone, white	37	700
Fire clay, blue	23	723
Sandstone, white, water flowed more	61	784
Hard shell	21	805
Sandstone, white, water	40	845
Crevasse Canyon Formation:		
Shale, dark	60	905
Shale, blue	65	970
Shale	30	1,000
Sandstone, gray	30	1,030
Shale, sandy	20	1,050
Sandstone, gray	42	1,092
Shale	28	1,120
Sandstone, white, water increased, best flow	80	1,200
Hard shell	10	1,210
Sandstone, hard, gray	110	1,320
Sandstone, white, water increases	80	1,400
Shale, brown, hard	120	1,520
Shale and clay, small show of oil and gas	15	1,535
No information	5	1,540

15B-26
86-6.65-2.50

UPPER CRETACEOUS:		
Menefee Formation:		
Sandstone	20	20
Shale, blue	103	123
Sandstone, seep of water	10	133
Shale, blue	67	200
Water sand, 80 gph	10	210
Shale.	25	235
Water sand, 50 gpm	17	252
Shale	38	290
Sandy shale	15	305
Shale	70	375
Sandy shale	65	440
Shale	58	498
Sandy shale	14	512
Shale, set casing 8-5/8 wide at 543 feet 10 inches	31	543
Slate and shale	62	605
Water sand	5	610
Slate	8	618
Sand, water raised to 35 feet from top	17	635
Shale	60	695
Water sand, water raised to 15 feet of top	20	715
Shale	45	760
Sandstone	10	770
Shale	25	795
Sand	15	810
Hard shell	2	812
Sand, water raised to 10 feet from top	8	820
Shale	20	840
Coal	2	842
Shale, 848 feet of 6-5/8-inch casing	8	850
Sand, water, 1 quart per minute	40	890
Shale	60	950
Lime shell, hard	5	955
Shale, cavey	17	972

15B-6B
104-11.70-2.60

UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Clay	6	6
Coal	3	9
Shale, black	41	50
Sandstone, gray, water raised to 45 feet	32	82
Sandstone, hard	2	84
Sandstone, gray, water, no raise above 45 feet	34	118
Shale, black	12	130
Sandstone, gray, water, no raise above 45 feet	106	236
Shale, blue	324	560
Sandstone, gray, water, raised to 2 feet	45	605
Shale, brown	82	687
Sandstone and shale, gray, water, flow	53	740
Shale, brown	5	745
Sandstone, dirty	20	765
Shale and sandstone	11	776
Sandstone, gray	59	835
Mancos Shale:		
Shale, blue	205	1,040
Sandstone, gray	2	1,042
Shale, blue	58	1,100
Layers of sandstone and shale	96	1,196

15B-35
104-1.5-6.4 A

QUATERNARY:		
Surficial deposits:		
Surface soil	10	10
UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Sandy shale, yellow	60	70
Shale, blue	64	134
Sand, gray	10	144
Shale, gray	271	415
Crevasse Canyon Formation and Gallup Sandstone undifferentiated:		
Sand, gray, water at 418 feet at 16 gpm	14	429
Shale, gray	2	431
Sand, gray, more water at 436 feet	5	436
Shale, gray	3	439
Shale, gray, more water at 442 feet	3	442
Shale, gray	13	455
Shale, brown	9	464
Shale, gray	24	488
Sand, gray	10	498
Shale, black	5	503
Sand, gray	2	505
Shale, black	28	533
Sand, gray	4	537
Shale, black	6	543
Sand, gray	5	548
Shale, brown	5	553
Sand, gray, more water 555 feet, raised to 50 feet from top	2	555
Shale, black	9	564
Shale, gray	11	575
Sand, white	51	626
Shale, black	7	633
Sand, gray	5	638
Shale, blue	24	662
Sand, gray	13	675
Shale, blue	40	715

Santa Fe 1
107-0.30-15.30

QUATERNARY:		
Alluvium:		
Sandy	75	75
Clay, blue	43	118
Sandy mud, yellow	22	140
Gravel	10	150
UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Clay, blue	2	152
Sandstone, soft	8	160
Fire clay	10	170
Coal	2	172
Fire clay	43	215
Sandstone, gray	10	225
Fire clay	50	275
Sandstone, white	25	300
Fire clay	75	375
Sandstone, white	20	395
Fire clay	85	480
Sandstone, white	35	515
Fire clay	45	560
Sandstone, white	25	585
Fire clay	120	705
Sandstone, white	20	725
Fire clay	80	805
Diamond coal vein	7	812

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

Santa Fe 1—Continued
107-0.30-15.30

	Thickness (feet)	Depth (feet)
Fire clay	13	825
Sandstone, white	15	840
Fire clay	125	965
Sandstone, white	35	1,000
Gallup Sandstone:		
Silty sandstone	60	1,060
Fire clay	35	1,095
Shale, black	5	1,100
Fire clay	2	1,102
Sandstone, Mesaverde	98	1,200
Sandstone, white, fine-grained	65	1,265
Boulders, hard	5	1,270
Sandstone, white, carrying water	80	1,350
Mancos Shale:		
Shale	90	1,440
Sandstone	10	1,450
Shale	415	1,865
Shell bed	10	1,875
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone	53	1,928
Dry hole, Mancos Shale	47	1,975
Sandstone	75	2,050
UPPER JURASSIC:		
Morrison Formation and Cow Springs Sandstone undifferentiated:		
Sandstone, white	255	2,305
Sandstone, pink	5	2,310
Clay, red	5	2,315

Baca Day School
120

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Surface sand	6	6
UPPER TRIASSIC:		
Chinle Formation:		
Sand, hard	2	8
Shale, purple	7	15
Sand, dark-gray	6	21
Shale, dark-blue	7	28
Shale, gray	11	39
Shale, red	3	42
Shale, purple	10	52
Lime, gray	36	88
Shale, purple	22	110
Lime, gray	2	112
Shale, green	2	114
Water sand, gray	10	124
Sandy shale, gray	23	147
Sand, gray, no water	27	174
Sandy shale, gray	14	188
Sand, gray	25	213
Shale, gray	17	230
Shale, red	14	244
Shale, gray	26	270
Shale, purple	30	300
Shale, red	17	317
Shale, brown	8	325
Shale, gray	27	352
Lime shell	3	355
Shale, red, conglomerate of hard substance	26	381
Sandy lime	15	396
Sand, gray	7	403
Water sand, very little water	4	407
Shale, red	33	440
Shale, red, lime shells	32	472
Shale, gray	40	512
Sand, gray, hard	15	527
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Lime shell, gray	21	548
Lime, gray	22	570
Water sand	5	575
Sandy shale, brown	5	580
Shale, red	28	608
Sand, gray	11	619
PERMIAN:		
San Andres Limestone:		
Lime, gray	48	667
Glorieta Sandstone:		
Sand, white, water, 1 bailer per hour	7	674
Sand, white, hard	4	678
Sand, hard, gray	7	685
Sand, white	112	797
Shale, gray	3	800
Sand, white	52	852
Yeso and Abo Formations undifferentiated:		
Shale, gray	3	855
Sand, red	14	869
Sand, red streaks of shale	16	885
Sandy shale, red	17	902
Sand, red	13	915
Shale, red	14	929
Sand, red, water	5	934
Shale, red	6	940
Clay, red, sticky	8	948
Shale, red	17	965
Sandy shale, red	50	1,015
Lime shell	1	1,016
Sand, gray	8	1,024
Lime, gray	13	1,037
Shale, blue	1	1,038
Sandy, gray	4	1,042
Sandy shale, gray	11	1,053
Sand, gray	3	1,056
Sandy shale, red	4	1,060
Sandstone, red	14	1,074
Lime, dark-gray	2	1,076
Lime, black, hard	4	1,080
Sandy lime, gray	5	1,085
Sandy shale, red	38	1,123
Lime, dark-gray	4	1,127
Sandy shale, red	65	1,192
Shale, red	8	1,200
Sandy shale, red, 19 feet of this water	256	1,456
Sand, red, water	68	1,524
Sandy shale, red	24	1,548
Shale, red	22	1,570
Sandy shale, red	70	1,640
Sandstone, red	39	1,679
Sandy shale, red	12	1,691
Shale, red	19	1,710
Sandy shale, red	9	1,719
Sand, hard, iron pyrite	5	1,724
Sandy shale, red	13	1,737
Hard shell	4	1,741
Shale, red	86	1,827
Hard shell	3	1,830
Shale, red	89	1,919
Sand, red	16	1,935
Shale, red	7	1,942
Sandy shale, red	7	1,949
Sand, red	7	1,956
Shale, red	31	1,987

ATSF Guam
121-6.5-1.8 A

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Alluvium:		
Sand	10	10
Clay	35	45
Sand and gravel	10	55
Sandy clay	20	75
Gravel with petrified wood	1	76
UPPER TRIASSIC:		
Chinle Formation:		
Shale, blue, hard	16	92
Sandstone, white, soft	11	103
Shale, red	5	108
Sandstone, red, hard	27	135
Shale, red	10	145
Sandstone, artesian water, flow 12 gpm	10	155
Sandstone, gray, water flowing	55	210
Shale, blue, hard	200	410
Shale, soft	130	540
Sandstone, red, hard	20	560
Shale, red, hard	40	600

16K-338
123-8.75-3.50

	Thickness (feet)	Depth (feet)
QUATERNARY:		
Surficial deposits:		
Soil, clay	3	3
UPPER CRETACEOUS:		
Crevasse Canyon Formation:		
Sandstone, limy	6	9
Shale, gray	60	69
Sand, dark-gray	5	141
Sandy shale, gray	15	156
Sandstone, gray, water	5	161
Shale, gray	8	169
Sandstone, gray, water	43	212
Shale, brown	7	219
Shale, gray	26	245

Shale, brown	3	72
Shale, gray, hard, streaks of 8 inches to 3 feet, possibly limy	42	114
Gallup Sandstone:		
Sand rock, red	22	136
Sandstone, gray, dry	8	253
Sandstone, gray, probably dry	8	261
No information	8	269

Dean Kirk Trading Post
123-12.4-3.4 A

QUATERNARY:		
Alluvium:		
Adobe, water, alkali 150 feet	150	150
UPPER CRETACEOUS:		
Mancos Shale:		
Shale, blue, clay, water, salty 225 feet	110	260
Sandstone	52	312
Shale, blue, clay	20	332
Sandstone lens	7	339
Shale, gray	14	353
Shale, black	5	358
Coal	1	359
UPPER AND LOWER CRETACEOUS:		
Dakota Sandstone:		
Sandstone, white, water good	7	366
Shale, brown and black, porous	6	372
Sandstone, artesian flow	78	450

17K-344
90-13.05-14.50

QUATERNARY:		
Surficial deposits:		
Soil	15	15
Blow sand	19	34
Sand and gravel	13	47
UPPER TRIASSIC:		
Chinle Formation:		
Shale, gray	65	112
Sandstone, gray	13	125
Shale, gray	20	145
Shale, pink	35	180
Shale, gray	5	185
Shale, red	235	420
Shale, gray	60	480
UPPER TRIASSIC AND PERMIAN:		
Chinle Formation (Shinarump Member) and De Chelly Sandstone undifferentiated:		
Water sand	37	517
Sandstone, yellow	8	525

17M-44
90-13.85-17.00

QUATERNARY:		
Alluvium:		
Adobe, clay, and mud	74	74
Sand and gravel, water	4	78
PERMIAN:		
De Chelly Sandstone:		
Sandstone, red	27	105

17M-66
91-6.60-12.50

QUATERNARY:		
Alluvium:		
Blow dust	62	62
Sandstone, red	38	100
Shale, blue	8	108
Sandstone, water 6 gpm	2	110
Shale, red	16	126
Sandstone, water	2	128
UPPER TRIASSIC:		
Chinle Formation:		
Rock, very hard	2	130

Steamboat Day School
92-5.50-17.10

QUATERNARY:		
Surficial deposits:		
Soil	40	40
UPPER JURASSIC:		
Morrison Formation and Cow Springs Sandstone undifferentiated:		
Sand, does not cave	20	60
Sandstone	105	165
Shale, sandy, gray	93	258
Water sand, raised to 120 feet of top	7	265
Sandstone, white, chalky	178	443
Shale, red	29	472
Shale, gray	9	481
Shale, red	72	553
Water sand, raised to 365 feet of top	39	592
Sand, white, chalky	33	625
Entrada Sandstone:		
Shale, red, caving	39	664

17K-374
109-5.30-2.85

QUATERNARY:		
Surficial deposits:		
Top soil	8	8
UPPER TRIASSIC:		
Chinle Formation:		
Shinarump Member:		
Sand, red, dirty	64	72
PERMIAN:		
De Chelly Sandstone:		
Sandstone, pale-red	78	150
Sandstone, light-pink, approximately 2 gpm 220 to 240 feet	195	345

17K-349
110-1.45-16.95

QUATERNARY:		
Alluvium:		
Sand, fine, dry	96	96
Sandstone, soft	6	102
Conglomerate	13	115
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Shale, red	17	132

17K-373
110-13.00-5.70

QUATERNARY:		
Surficial deposits:		
Top soil	8	8
TERTIARY:		
Bidahochi Formation:		
Sand, tan	127	135
Sandy shale, gray	27	162
Sandy shale, brown	18	180
Sandy shale, red	40	220
Sandy shale, gray	20	240
Sandy shale, brown	40	280
Sandy shale, red	20	300
Sandy shale, white	15	315
UPPER JURASSIC:		
Cow Springs Sandstone:		
Sandy shale, red, seep at 355 feet	135	450
Sand, red, fine, seep at 378 feet	50	500

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
17M-44A 110-0.55-1.40					
QUATERNARY:			Shale, brown	10	50
Alluvium:			PERMIAN:		
Broken rock	16	16	De Chelly Sandstone:		
UPPER TRIASSIC:			Sandstone, red, water	73	123
Chinle Formation:			No information	2	125
Shale, blue	24	40			
17M-91 110-10.20-6.85					
QUATERNARY:			Sandy clay, red	5	80
Alluvium:			Sand, fine, some gravel, water	8	88
Sand, red, fine, some clay	31	31	UPPER TRIASSIC:		
Sand, clean, medium-grained, water	24	55	Wingate Sandstone:		
Sand and silt, red, very fine	14	69	Clay, dark-red	24	112
Sand, fine, clean, water	6	75			
17T-369 110-2.50-12.40					
QUATERNARY:			Shale, red	60	130
Alluvium:			Shale, light-red	130	260
Fill	10	10	Shale, pale-red	25	285
TERTIARY:			MIDDLE(?) AND LOWER TRIASSIC:		
Bidahochi Formation:			Moenkopi Formation:		
Sandy shale, light	30	40	Shale, purple	15	300
Shale, red, quite hard	30	70	Shale, red	15	315
17M-203 111-9.95-13.45					
QUATERNARY:			Sand, fine	8	78
Alluvium:			Clay, gray, red, sand	7	85
Sand, brown, some clay	30	30	Sand, coarse, water	10	95
Sand and silt, fine	15	45	TERTIARY:		
Sand, fine	15	60	Bidahochi Formation:		
Clay	10	70	Sandstone, light-brown	37	132
17M-207 111-7.80-5.05					
QUATERNARY:			Sand, gray, medium-grained, Dakota, water	9	113
Alluvium:			Sandy silt, gray, Dakota	11	124
Sandy silt	24	24	Sand, light-gray, fine-grained, water, Morrison	5	129
Clay	15	39	Sand, light-gray, fine-grained, water, Morrison	3	132
Clay, gray	39	78	Sand, gray, fine-grained, water, Morrison	7	139
Sand, brown, poorly sorted, Dakota, water	8	86	Sandstone, light-gray, poorly sorted, Morrison	46	185
UPPER JURASSIC:					
Cow Springs Sandstone:					
Shale, gray, Dakota	18	104			
17K-307 125-13.85-5.65					
TERTIARY:			Shale, red, sticky	19	382
Bidahochi Formation:			PERMIAN AND PENNSYLVANIAN:		
Sand	6	6	De Chelly Sandstone and Supai Formation undifferentiated:		
Shale, red	12	18	Water sand	33	415
Sand, red	2	20	Sand, red, hard	55	470
Shale, red	10	30	Sand, red, coarse	20	490
Sand and shale, gray	10	40	Sand, red, soft	41	531
Shale, red and gray	9	49	Sandy shale, red	15	546
Shale, gray	47	96	Sand, red	45	591
Shale, red	9	105	Sand, gray, hard	16	607
Shale, gray	5	110	Sand, blue	2	609
UPPER TRIASSIC:			Sand, gray	11	620
Chinle Formation:			Sand, brown	4	624
Shale, red	13	123	Sand, red	3	627
Sandstone, red, hard	5	128	Sand, gray, hard	6	633
Shale, red	12	140	Sand, red	4	637
Water sand, gray	14	154	Sand, brown, hard	33	670
Shale, blue	1	155	Sand, red	4	674
Shinarump Member:			Sand, brown, soft, water	20	694
Sand, gray	16	171	Sand, red, soft	30	724
Sand, gray and white	66	237	Sand, brown, hard	9	733
MIDDLE(?) AND LOWER TRIASSIC:			Sand, brown, soft, water	3	736
Moenkopi Formation:			Sand, brown, hard	14	750
Shale, red, hole plugged at 610 feet	6	243	Sand, brown, soft, water	8	758
Sand, white	27	270	Sand, brown, water, 5-1/2-hour bailer test	13	771
Shale, red	5	275	Sand, brown	19	790
Sand, white	15	290	Water sand, soft, water	15	805
Shale, red	10	300	Sand, light-brown	20	825
Sand, gray	25	325	Sand, brown	45	870
Shale, red, sticky	15	340			
Sandy shale, red	23	363			
17M-133 125-5.90-11.70					
QUATERNARY:			Sand, hard	5	225
Surficial deposits:			Sand, brown, soft	15	240
Soil			Sand, red	135	375
PERMIAN:			PERMIAN AND PENNSYLVANIAN:		
De Chelly Sandstone:			Supai Formation:		
Coconino sand			Bentonite	25	400
Sand, red			Sand, red, hard	45	445
Sandstone			Sand, red	40	485

Sand, red	37	95	Sand, gray, top of water sand	10	495
Rock, red	9	104	Sand, red, water	40	535
Sand, red, water 35 gpm	37	141	Rock, red, water	25	560
Rock, red	44	185	Sandstone, red, water	3	563
Sand, red	35	220	Sandy shale, red	4	567

17M-263
125-12.0-16.0 A

TERTIARY:			Shale, red, soft	40	630
Bidahochi Formation:			Shale, blue, soft	5	635
Sand, red, soft	145	145	Water sand, soft, 1 quart per minute	5	640
Clay, sand, and gravel, soft	55	200	MIDDLE(?) AND LOWER TRIASSIC:		
Clay, red, soft	20	220	Moenkopi Formation:		
Clay, light-red, soft	30	250	Sand, red, soft	15	655
Sandstone, gray, 1/2 gpm	20	270	Sandy shale, red, soft	45	700
UPPER TRIASSIC:			Shale, red, 7 feet of broken formation at 760 feet	75	775
Chinle Formation:			PERMIAN:		
Shale, blue, soft	25	295	De Chelly Sandstone:		
Sandstone, red, soft	15	310	Sand, red, very sharp	5	780
Shale, light-gray	75	385	Sand, red, soft but very sharp	5	785
Shale, pink, soft	60	445	Sand, pink, soft and very sharp	35	820
Shale, blue, soft	40	485	Sand, red, soft and very sharp	20	840
Shale, blue, soft	65	550	Sand, red, soft and very sharp	160	1,000
Sand and shale, soft	10	560			
Shale, red, soft	30	590			

17K-347
126-0.30-5.80

QUATERNARY:			Sand, brown, water	15	85
Alluvium:			Shale, red	20	105
Sandy shale, red	42	42			
Quicksand	13	55			
UPPER TRIASSIC:					
Chinle Formation:					
Shale, red	15	70			

17M-117
126-5.90-8.80

QUATERNARY:			Sand, fine, water	8	106
Alluvium:			Shale, light-gray	20	126
Sandy clay	17	17	UPPER TRIASSIC:		
Sandy loam	38	55	Chinle Formation:		
TERTIARY:			Shale, red	17	143
Bidahochi Formation:					
Sandy and silt	43	98			

17M-187
126-13.90-2.50

TERTIARY:			Sandy shale	30	270
Bidahochi Formation:			Shale, red	60	330
Sand, 1/2 gpm at 184 feet	184	184	Shale, brown	20	350
Shale, brown	46	230	Water sand, 30 gpm	61	411
Clay, white, bentonite	10	240			

17M-262
126-1.75-8.90

QUATERNARY:			Sand, silt	17	110
Alluvium:			Gravel, water	3	113
Sand, soft, run	28	28	Sand, fine	13	126
Adobe, sand	45	73	UPPER TRIASSIC:		
Sand	15	88	Chinle Formation:		
Sand, fine	3	91	Shale, dark	5	131
Water sand, light	2	93			

17K-340
127-6.65-0.50

QUATERNARY:			Sand, water	28	116
Surficial deposits:			UPPER TRIASSIC:		
Soil	40	40	Wingate Sandstone:		
Sand, water	9	49	Shale, red	70	186
Clay	39	88			

17K-350
127-1.30-17.10

QUATERNARY:			UPPER TRIASSIC:		
Alluvium:			Chinle Formation:		
Valley fill	60	60	Shale, red	29	115
Mud and gravel, water	26	86			

17K-352
140-7.45-1.65

QUATERNARY:			Sand and gravel, salt water	19	70
Alluvium:			UPPER TRIASSIC:		
Valley fill	6	6	Chinle Formation:		
Sand, gravel, and mud	45	51	Shale, red	8	78

Table 2.--Selected and modified drillers' logs of wells in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Thickness (feet)	Depth (feet)
18K-306		
89-8.10-8.10		
QUATERNARY:		
Alluvium:		
Alluvial fill, water, 30 gpm	15	15
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Sandstone, light-red	7	22
Sandy shale, light-red	17	39
Sandstone, light-red	4	43
Shale, red	19	62
Sandstone, reddish-brown, very hard	628	690
Sandstone, reddish-brown	74	764
Sandstone, light-gray	5	769
PRECAMBRIAN:		
Quartzite:		
Sandstone, reddish-brown, quartz	15	784
Sandstone, gray, very hard	2	786
Sandstone, gray, very hard lenses and soft ones	12	798
Fine quartz	47	845
18K-327		
89-5.50-16.75		
QUATERNARY:		
Alluvium:		
Sand and gravel	8	8
Quicksand, some gravel	8	16
Sand and gravel	10	26
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Sandstone, water at 26 feet	4	30
18T-344		
89-8.20-9.40		
QUATERNARY:		
Surficial deposits:		
Alluvium	25	25
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Sand rock, red	78	103
Lime, gray, water	32	135
Sand, red, coarse, more water	21	156
Lime, layers of red and gray	31	187
Sand rock, coarse, hard	19	206
Sand, red, veryfine, hard	5	211
Sand, red, coarse, raised to 45 feet when drilling	13	224
Quartz, red	1	225
Fort Defiance 3		
89-5.50-16.85		
QUATERNARY:		
Alluvium:		
Sand and gravel, center of creek	15	15
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Sandstone, 350 gpm	3	18
18A-152		
108-6.00-11.10		
QUATERNARY:		
Alluvium:		
Surface	12	12
UPPER TRIASSIC:		
Chinle Formation:		
Sandstone, red	18	30
Sandy shale, red, hard	20	50
Hard shell	3	53
Shale, gray	17	70
Sand, white, coarse	13	83
Shale, gray	5	88
Sand, hard, sharp	15	103
Water sand, gray, hard	11	114
Water sand, brown, coarse	14	128
Sand, hard, tight	11	139
PERMIAN:		
De Chelly Sandstone:		
Upper member:		
Sand, hard	14	153
Sand, hard, sharp	114	267
Sandy shale, red	33	300
Sand, hard	8	308
Sandy shale, gray	22	330
Sandy shale, red	8	338
Tongue of Supai Formation:		
Shale, red	23	361
Hard shell	22	383
Sand, hard, fine	3	386
Hard shell	5	391
Sand, hard	13	404
Sand, hard, sharp	7	411
Sand, hard	13	424
Shale, red	2	426
Shale, red	41	467
Sandy shale	2	469
Lower member:		
Sand, hard	3	472
Water sand, flow 3 gpm	8	480
Hard shell	3	483
Sand, hard	20	503
Water sand, tight	10	513
Sand, red	5	518
Water sand	14	532
Sand, hard	12	544
Sand, gray, hard	6	550
Sand, red, hard	31	581
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Shale, light-gray	21	602
Sand, hard	18	620
Sandy shale, red, hard	141	761
Hard shell	10	771
Sandy shale, hard	26	797
Hard shell	3	800
Sandy shale, red	42	842
18K-324		
124-12.50-14.95		
UPPER TRIASSIC:		
Chinle Formation:		
Subsoil, red clay and shale	32	32
Sandstone	3	35
Conglomerate	2	37
Sandstone, red	3	40
Clay, red, hard to mix, 2 feet to run	36	76
Sandstone, hard, blue	5	81
Shale, brown	3	84
Sandstone, brown on top changed to whitish blue at 96 feet	12	96
Water sand, hole full of water	6	102
Sandy shale, blue	4	106
Sandstone	4	110
Sandy shale, brown	25	135
Sandy shale, blue	11	146
Sandstone, blue, hard, reduced hole at 148 to 8-1/4 inches	2	148
Sandstone, blue	7	155
Shale, blue	15	170
Clay, brown and red	30	200
Sandstone, hard	10	210
Sandy clay, red	10	220
Sandstone, red and white alternation, hard and soft spots, drills close and hard on bits, reduced hole to 6-1/2 inches at 280 feet	62	282
Sandstone, top of water sand at 350, sand coarse grained at 360, specks of white, main body of sand nearly white, brownish cast, brown flecks at 360	78	360
Shinarump Member:		
Sandstone	20	380
18T-336		
124-12.70-13.75		
QUATERNARY:		
Alluvium:		
Silt and clay	15	15
Silt and sand	25	40
Gravel and clay	35	75
Silt and fine sand	27	102
Gravel	2	104
PERMIAN:		
De Chelly Sandstone:		
Sandstone	16	120

ATSF Houck B
124-12.70-15.40

QUATERNARY:		
Alluvium:		
Old well (caisson)	28	28
Sand and clay filled in old well	7	35
Clay and gravel	13	48
Clay	7	55
Sand	8	63
Clay	3	66
Sand	10	76
Clay	4	80
Quicksand	25	105
Gravel and clay	3	108
UPPER TRIASSIC:		
Chinle Formation:		
Clay, red, hard	7	115

18A-210
125-1.00-12.95

TERTIARY:		
Bidahochi Formation:		
Sandy soil	24	24
Sand, white	16	40
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Shale, red	30	70
Shale, red	30	100
Sand, water, 160 gpm	5	105
Shale, red	10	115
PERMIAN:		
De Chelly Sandstone:		
Sandstone	35	150
Sandstone	40	190
Sand	5	195
Sand	45	240
Sand	20	260
Sand	45	305
Sandstone	35	340
PERMIAN AND PENNSYLVANIAN:		
Supai Formation:		
Sandy shale	45	385
Sand and shale, brown	30	415
Sandy shale	50	465
Sandy shale	50	515
Sandy shale	5	520
Sandy shale	4	524
Sand	11	535
Sandy shale	51	586
Sandy shale	4	590
Sand	20	610
Lime, white	8	618
Lime, black	8	626
Lime, white	3	629
Sandy shale, brown	36	665
Sandy shale	30	695
Sandy shale, brown	30	725
Sand, white	5	730
Sand, white	5	735
Sandy shale, brown	15	750
Sandy shale	30	780
Sandy shale	25	805
Sandy shale, brown	30	835
Sandy shale	40	875
Sandy shale	25	900
Sandy shale	30	930
Sandy shale	25	955
Shale, brown	25	980
Sandy shale, brown	40	1,020
Sandy shale	15	1,035
Sandy shale	25	1,060
Sandy shale, brown	4	1,064
Sandy shale, brown	36	1,100

18A-112
137-9.90-0.20

TERTIARY:		
Bidahochi Formation:		
Sand	118	118
Water sand, about 1/2 gpm	12	130
Sandstone	20	150
Shale	20	170
Sandy shale	30	200
Shale, gray	30	230
Bentonite	40	270
Sandy shale	10	280
Water sand, 250 gph	10	290
Sandstone	24	314

18A-315
138-0.5-1.5 A

TERTIARY:		
Bidahochi Formation:		
Sand and clay	23	23
Bentonite	17	40
Sand, gray	85	125
Sand, loose	80	205
Sand, wet from 220 feet, water from 258 to 263 feet	25	230
Muddy sand, soft	53	283
Shale, gray	22	305
Shale, red	10	315
Shale, brown	120	435
Shale, gray	20	455
Shale, blue	50	505
Shale, gray	5	510
Shale, light-brown	10	520
Shale, blue	13	533
Shale, blue	2	535
Shale, brown	30	565
Sand, red	25	590
Sand, gray	5	595
MIDDLE(?) AND LOWER TRIASSIC:		
Moenkopi Formation:		
Shale, gray	60	655
Sandy shale, red	25	680
Shale, brown	28	708
PERMIAN:		
De Chelly Sandstone:		
Sand, gray, hard	123	831
Sand, pink, hard	19	850
Sand, red	15	865
Sand, pink	45	910
Sand, red, 1 quart per minute at 940	70	980
Sandy shale	71	1,051

ATSF Chambers 1
138-10.60-4.30

QUATERNARY:		
Alluvium:		
Sandy clay, struck water at 50 feet	90	90
UPPER TRIASSIC:		
Chinle Formation:		
Clay, blue	15	105
Sandstone, red	30	135
Water sand	25	160
Clay, blue	20	180
Water sand	30	210
Sandy clay	110	320
Sandstone, water shut off at 495 feet	195	515
Shinarump Member:		
Sandstone, white	90	605

Lee Well
138-11.00-2.70

QUATERNARY:		
Alluvium:		
Sand and streaks of clay	80	80
UPPER TRIASSIC:		
Chinle Formation:		
Shale	218	298
Sandstone	20	318
Shale	84	402

SELECTED STRATIGRAPHIC SECTIONS IN THE NAVAJO AND HOPI INDIAN RESERVATIONS,

ARIZONA, NEW MEXICO, AND UTAH

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah

DISTRICT 1

1.—Cow Springs

North side of Black Mesa, 4 miles east of Cow Springs Trading Post
58-3.2-6.5

[Measured by J. W. Harshbarger]

	Feet
UPPER AND LOWER CRETACEOUS:	
Dakota(?) Sandstone:	
9. Sandstone: Yellowish-orange (10YR 7/6); fine-grained; calcareous and ferruginous cement; thin-bedded, beds ½ to 5 inches thick; crossbedded; forms a rough cliff; contains abundant limonite streaks.	15
UNCONFORMITY: Erosional relief, 4 inches to 1.5 feet; contains coarse-grained sandstone and granule conglomerate; sharp contact due to color change.	
UPPER JURASSIC:	
Cow Springs Sandstone:	
8. Sandstone: Light-gray (N 7); fine-grained; firmly cemented, calcareous and ferruginous; flat, thin-bedded, beds 1 to 4 inches thick; partially crossbedded; forms a rough, pitted, rounded cliff; contains near bottom lenticular manganese beds, 2 to 12 inches thick and 50 to 100 feet long; commonly contains iron manganese concretions, 6 inches to 3 feet in diameter.	104
7. Sandstone: Dusky-yellow (5Y 6/4); fine-grained; weakly cemented; massive; flat-bedded; forms a smooth, rounded cliff; contains manganese stringer near top and abundant black iron specks.	28
6. Sandstone: Same as unit 4; contains abundant limonite nodules, ½ to ¾ inch in diameter.	51
5. Siltstone: Greenish-gray (5GY 6/1); weakly cemented, calcareous; flat, thin-bedded, beds 1/8 to ½ inch thick; forms a recess in main rounded cliff.	2
4. Sandstone: Greenish-gray (5GY 6/1); very fine grained; firmly cemented, calcareous; thin-bedded, beds 1/16 to 4 inches thick; crossbedded, large-scale crossbeds; forms a smooth, rounded, slick cliff; contains hard, calcareous green pods (1 x 6 inches).	94
3. Sandstone: Pinkish-gray (5YR 8/1); very fine grained; firmly cemented; thick-bedded, beds 6 to 14 inches thick; crossbedded, large-scale crossbeds; forms a smooth, rounded, slick cliff; contains several weakly cemented silty green stringers, 1 to 2 inches thick.	40
Slope: Concealed by talus and vegetation; appears to consist of weakly cemented beds of sandstone and red shale; boundary between Cow Springs Sandstone and Entrada Sandstone is in this unit.	36
Total Cow Springs Sandstone	355
Entrada Sandstone:	
2. Sandstone: Light-brown (5YR 6/4); fine-grained; very weakly cemented, calcareous; thin-bedded, beds ⅛ to ¾ inch thick; crossbedded; alternates with light-gray (N 7) sandstone beds; forms a poorly exposed, smooth, banded slope; contains several reddish-brown shale partings, ¼ to 1 inch thick.	54
1. Sandstone: Light-brown (5YR 6/4); very fine grained; firmly cemented, calcareous; thin-bedded; crossbedded, large-scale crossbeds; forms a smooth, rounded, slick, steep slope; contains numerous crisscross light-gray (N 7) streaks or bands.	134
Total incomplete Entrada Sandstone	188
Valley: Covered by alluvium and vegetation.	

2.—Blue Canyon

In Blue Canyon along western side of Black Mesa,
19½ miles east of Tuba City
76-8.1-5.5

[Measured by J. W. Harshbarger]

UPPER AND LOWER CRETACEOUS:	
Dakota(?) Sandstone:	
28. Sandstone: Yellowish-orange (10YR 7/6); fine-grained; firmly cemented, calcareous and ferruginous; thin-bedded; crossbedded; forms a resistant cap rock for main cliff.	3
UNCONFORMITY: Erosional surface; 1-foot relief filled with coarse-grained sandstone; bluish-gray shale partings.	
UPPER JURASSIC:	
Cow Springs Sandstone:	
27. Sandstone: Yellowish-gray (5Y 8/1); same as unit 25.	63
26. Sandstone: Light-greenish-gray (5GY 8/1); very fine grained; weakly cemented, calcareous; thin-bedded, beds ½ to 3 inches thick; crossbedded, large-scale crossbeds; forms a smooth, rounded cliff; contains abundant kaolin specks.	42
25. Sandstone: Yellowish-gray (5Y 8/1); very fine grained; weakly cemented; flat, thin-bedded; partially crossbedded; forms a smooth, rounded cliff.	74
24. Shale: Light-gray (N 7); sandy; weakly cemented; flat-bedded; forms a recess in cliff.	1
23. Sandstone: Light-greenish-gray (5GY 8/1); very fine grained; firmly cemented; thin-bedded, beds ¼ to 3 inches thick; crossbedded, large-scale crossbeds; forms a smooth, rounded cliff; contains green silty stringers and pods and abundant limonite concretions.	79
Total Cow Springs Sandstone	259
TRIASSIC(?)—Continued	Feet
Moenkopi Formation—Continued	
Hoskinnini Member—Continued	
37. Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained matrix containing many coarse grains of subrounded quartz; firmly cemented with calcium carbonate and chloride; even, thin-bedded; weathers into a regular slope.	1.5
36. Sandstone: Yellowish-gray (5Y 7/2); very fine grained matrix containing abundant coarse grains of subrounded quartz; firmly cemented with calcium carbonate and chloride; even-bedded.	.8
35. Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained matrix containing coarse grains of subrounded quartz; firmly cemented with calcium carbonate and chloride; even, thin-bedded.	2.0
34. Sandstone: Yellowish-gray (5Y 7/2); very fine grained matrix containing many coarse grains of subrounded quartz; cemented with calcium carbonate; even, thin-bedded; weathers into an irregular slope.	.5
33. Sandstone, alternating with thick intervals of siltstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; firmly cemented with calcium carbonate and chloride; even, thin- to medium-bedded, nonrhythmic sequence of bedding; weathers into a rounded cliff; commonly contains light-gray (N 7) spots and streaks.	44
32. Sandstone: Moderate-orange-pink (10R 7/4); very fine grained matrix containing many coarse grains of subrounded quartz; well cemented with calcium carbonate; even to crinkly bedding; weathers into a rounded cliff; base of sandstone is sharp and irregular; base of Hoskinnini Member.	4.0
Total Hoskinnini Member	53.1
UNCONFORMITY.	
PERMIAN:	
Cutler Formation:	
De Chelly Sandstone Member:	
31. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; well cemented with calcium carbonate; thick-bedded; large-scale crossbeds; weathers into a rounded cliff.	68
De Chelly Sandstone Member and Organ Rock Tongue transitional zone:	
30. Siltstone and sandstone, interbedded: Moderate-reddish-brown (10R 4/6); very fine grained; abundant arenaceous material; firmly cemented with calcium carbonate and iron oxide; even-bedded, beds from 1 to 2 feet thick; weathers into an irregular cliff; contains rare streaks and mud lumps.	36
Organ Rock Tongue:	
29. Siltstone and sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; poorly sorted; abundant arenaceous material in matrix; weakly cemented with calcium carbonate and iron oxide; even, thin-bedded; weathers into an irregular slope; contains float of calcareous shale-pellet conglomerate in thin interval in upper part; three 1- to 2-foot-thick light-gray (N 7) sandstone units are evenly spaced 60 to 120 feet below top and at bottom.	172
28. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; well cemented with calcium carbonate and iron oxide; thin-bedded; crossbedding; weathers into a vertical ledge.	5.0
27. Siltstone: Pale-reddish-brown (10R 5/4); very fine grained; fair-sorted; weakly cemented with calcium carbonate and iron oxide; thin-bedded; crossbedding in short inclined banks; weathers into a regular slope.	3.0
26. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; firmly cemented with calcium carbonate and iron oxide; thick-bedded; crossbedding in short inclined banks; weathers into a rounded knob; commonly contains leached spots and streaks.	2.0
25. Siltstone: Pale-reddish-brown (10R 5/4); very fine grained; well-sorted; well cemented with calcium carbonate and iron oxide; medium- to thick-bedded; crossbedded units intercalated with parallel-bedded units; weathers into an irregular cliff; contains rare leached spots; siltstone is intercalated with thin mudstone beds.	20
24. Siltstone and mudstone, interbedded: Pale-reddish-brown (10R 5/4); weakly cemented with calcium carbonate and iron oxide; even, thin-bedded; weathers into an irregular slope.	45
23. Mudstone: Moderate-reddish-brown (10R 4/6); cemented with calcium carbonate and iron oxide; even, thick-bedded; weathers into a regular slope; contains rare bands; rare thin siltstone beds intercalated with mudstone.	55
22. Siltstone and mudstone, interbedded: Moderate-reddish-brown (10R 4/6); very fine grained; well cemented with calcium carbonate and iron oxide; even, medium- to thick-bedded; weathers into an irregular slope; commonly contains leached spots and streaks.	67
21. Mudstone and siltstone, interbedded: Moderate-reddish-brown (10R 4/6); very fine grained; well cemented with calcium carbonate and iron oxide; even, thick-bedded; weathers into an irregular slope; siltstone layers in unit are approximately 2 feet thick.	20
20. Siltstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; cemented with calcium carbonate and iron oxide; thin- to medium-bedded; crossbedding; weathers into a vertical ledge.	4.0
19. Mudstone: Pale-reddish-brown (10R 5/4); even, thin-bedded; forms a slope; weathers into soil unit and is poorly exposed.	35
Total Organ Rock Tongue	426

Arbitrary contact, based on changes in lithology and bedding structures.

Entrada Sandstone:

22. Sandstone: Pale-red (5R 6/2); very fine grained; firmly cemented, calcareous; flat, thin-bedded, beds $\frac{1}{4}$ to 1 inch thick; crossbedded, large-scale crossbeds; forms a knobby, nodular (stone babies), rounded cliff; contains abundant crisscross light-gray (N 7) streaks or bands. 109
21. Sandstone: Light-gray (N 7) and light-brown (5YR 6/4); very fine grained; very weakly cemented; interbedded; thin-bedded, beds a quarter of an inch thick; crossbedded; forms a streaked and mottled, steep slope. 29
20. Shale: Pale-red (5R 6/2) and light-gray (N 7); very fine grained; silty; friable; interbedded; thin-bedded, beds $\frac{1}{4}$ to $\frac{1}{2}$ inch thick; crossbedded; forms a mottled slope. 48
19. Sandstone: Reddish-brown; very fine grained; firmly cemented; thin-bedded, beds $\frac{1}{8}$ to 2 inches thick; forms a knobby, rounded, steep slope; alternates with light-gray (N 7) silty sandstone; contains rare manganese streaks, 2 to 5 inches long. 35
18. Sandstone: Very light gray (N 8); fine-grained; weakly cemented, calcareous; thin-bedded; crossbedded, large-scale crossbeds; forms a mottled, steep slope; contains several weakly cemented shale partings, thin-bedded, 2 to 6 inches thick. 73

Total Entrada Sandstone 294

Arbitrary contact, based on changes in lithology and bedding structures.

UPPER AND MIDDLE JURASSIC:

Carmel Formation:

17. Shale: Pale-red (5R 6/2); clayey texture; thin-bedded, $\frac{1}{4}$ to $\frac{3}{4}$ inch thick; forms a slope; several beds of light-gray (N 7) sandstone. 4
16. Sandstone: Same as unit 14. 25
15. Shale: Pale-red (5R 6/2); clayey texture; weakly cemented, calcareous; thin-bedded, paper-thin; forms a recess. 1
14. Sandstone: Light-gray (N 7); fine-grained; weakly cemented; flat, thin-bedded, $\frac{1}{2}$ to 2 inches thick; forms a rough, pitted cliff; contains several pale-red (5R 6/2) shale partings, 1 to 3 inches thick. 29
13. Shale: Reddish-brown; clayey texture; thin-bedded; forms a smooth slope; several light-gray (N 7) sandstone beds. 11
12. Sandstone: Same as unit 14; forms a slope; contains gypsiferous shale at top. 19
11. Shale and sandstone, interbedded: Reddish-brown and light-gray (N 7); very fine grained; weakly cemented; thin-bedded; forms a banded and mottled slope. 13
10. Sandstone: Same as unit 8. 11
9. Shale and sandstone: Same as unit 11. 14
8. Sandstone: Pinkish-gray (5YR 8/1); very fine grained; flat, thin-bedded, beds $\frac{1}{8}$ to 3 inches thick; forms a smooth, rounded cliff; contains several pale-red (5R 6/2) shale partings, 1 to 5 inches thick. 43
7. Shale: Same as unit 4. 29
6. Sandstone: Light-gray (N 7); fine-grained; firmly cemented; flat, thin-bedded; forms a ledge. 1

Slope: Concealed by talus; appears to be same as unit 4. 11

5. Sandstone: Pinkish-gray (5YR 8/1); fine-grained; firmly cemented; flat, thin-bedded; forms a resistant ledge; contains manganese streaks. 4
4. Shale: Pale-reddish-brown (10R 5/4); clayey texture; weakly cemented; thin-bedded, beds $\frac{1}{8}$ to $\frac{1}{2}$ inch thick; forms a banded slope; alternates with thin light-gray (N 7) sandstone beds. 16
3. Sandstone: Very light gray (N 8); fine-grained; weakly cemented, calcareous; flat, thin-bedded; forms a smooth, steep slope; contains several pale-red (5R 6/2) shale partings; beds exhibit crinkling. 13
2. Shale: Pale-reddish-brown (10R 5/4); clayey texture; weakly cemented; thin-bedded, beds $\frac{1}{4}$ to $\frac{1}{2}$ inch thick; forms a steep slope; contains flat-bedded light-gray (N 7) sandstone stringers. 5

Total Carmel Formation 249

UNCONFORMITY: Erosional surface; in places, 1-foot relief is filled with reworked Navajo Sandstone; in other places, flat-bedded reddish-brown shale truncates large-scale crossbedded sandstone.

JURASSIC AND TRIASSIC(?):

Navajo Sandstone:

1. Sandstone: Pale-yellowish-orange (10YR 8/6); fine-grained; weakly cemented, calcareous; thin-bedded; crossbedded, large-scale crossbeds; forms a rough, pitted, steep slope; unmeasured.

DISTRICT 2

3.—Mouth of Nokai Creek

South side of San Juan River, north side of Piute Mesa, 15 miles northeast of Navajo Mountain Day School
13-4.0-3.5 (A)

[Measured by C. B. Read]

MIDDLE(?) AND LOWER TRIASSIC:

Moenkopi Formation: Undescribed.

UNCONFORMITY(?).

TRIASSIC(?):

Moenkopi Formation:

Hoskinnini Member:

38. Sandstone: Yellowish-gray (5Y 7/2); very fine grained matrix containing coarse grains of well-rounded quartz; cemented with calcium carbonate and arenaceous material; fissile bedding; bed contains abundant quartz encrustation. 0.3

Organ Rock Tongue and Cedar Mesa Sandstone Member transitional zone:

18. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; well cemented with calcium carbonate; even, medium-bedded; weathers into a rounded ledge; unit is well jointed. 2.0
17. Siltstone: Moderate-reddish-brown (10R 4/6); very fine grained; cemented with calcium carbonate and argillaceous material; even, thin-bedded; weathers into a regular slope. 2.5
16. Sandstone: Yellowish-gray (5Y 7/2); fine-grained; well-sorted; firmly cemented with calcium carbonate; even, thin-bedded; weathers into a rounded ledge. 1.0
15. Siltstone: Moderate-reddish-brown (10R 4/6); very fine grained; firmly cemented with calcium carbonate and argillaceous material; even, thin-bedded; weathers into a slope. 4.0
14. Sandstone: Yellowish-gray (5Y 7/2); fine-grained; well-sorted; firmly cemented with calcium carbonate; even, medium-bedded; weathers into a rounded ledge. 2.5
13. Siltstone: Moderate-reddish-brown (10R 4/6); very fine grained; firmly cemented with calcium carbonate and argillaceous material; even, thin-bedded; weathers into a regular slope. 4.5
12. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; well-sorted; firmly cemented with calcium carbonate; even, thin-bedded; weathers into a rounded ledge. 1.2
11. Siltstone: Moderate-reddish-brown (10R 4/6); very fine grained; well-sorted; cemented with calcium carbonate and argillaceous material; even, thin-bedded; weathers into a regular slope. 2.0
10. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; cemented with calcium carbonate and argillaceous material; even, medium-bedded; weathers into a rounded ledge; sandstone contains rare crystalline limestone nodules. 2.5
9. Siltstone: Moderate-reddish-orange (10R 6/6); very fine grained; cemented with calcium carbonate; even, thin-bedded; weathers into a slope. .3
8. Sandstone: Grayish-orange-pink (10R 8/2); fine-grained; well-sorted; well cemented with calcium carbonate; crinkly, thick-bedded; weathers into a rounded cliff; sandstone contains abundant tubes and nodules of medium-gray (N 5) crystalline limestone. 5.0
7. Siltstone: Moderate-reddish-orange (10R 6/6); very fine grained; cemented with calcium carbonate and argillaceous material; even, thin-bedded; weathers into a regular slope. 1.5
6. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; well cemented with calcium carbonate; even, thin-bedded; weathers into a rounded ledge; excellent jointing; sandstone contains nodules, plates, and tubes of dark-gray (N 3) crystalline limestone. 1.0
5. Siltstone: Moderate-reddish-brown (10R 4/6); very fine grained; cemented with calcium carbonate and argillaceous material; even, thin-bedded; weathers into a regular slope. .5
4. Sandstone: Grayish-orange-pink (10R 8/2) to pale-reddish-brown (10R 5/4); fine-grained; well cemented with calcium carbonate; even, thin- to medium-bedded; usually weathers into an irregular ledge; sandstone contains very thin partings of moderate-reddish-brown (10R 4/6) siltstone; strata contain abundant nodules of medium-gray (N 5) crystalline limestone. 5.0
3. Siltstone: Moderate-reddish-brown (10R 4/6), very fine grained; well cemented with calcium carbonate; even, thin-bedded; weathers into an irregular slope. 7.0
2. Sandstone and siltstone, interbedded: Grayish-orange-pink (10R 8/2) sandstone, fine-grained, well cemented with calcium carbonate; moderate-reddish-brown (10R 4/6) siltstone, thin-bedded; unit weathers into an irregular cliff. 24
1. Sandstone: Grayish-orange-pink (10R 8/2); fine-grained; well cemented with calcium carbonate; medium- to thick-bedded; crossbedding; weathers into a rounded cliff. 36

Total Organ Rock Tongue and Cedar Mesa Sandstone Member transitional zone 102.5

Total incomplete Cutler Formation 634.5

4.—Navajo Point

Southeastern tip of Kaiparowits Plateau, 15 miles northwest of Navajo Mountain Trading Post
15-11.0-5.0

[Measured by T. E. Mullens, G. W. Weir, and V. L. Freeman]

UPPER AND LOWER CRETACEOUS:

Dakota Sandstone:

Top of measured section, not top of exposure; underlying units form prominent bench.

51. Sandstone and shale: Brown sandstone and medium-gray (N 5) to black (N 1) shale, weathering brown; contains some low-grade coal and plant fragments; contains fossils of pelecypods. 12
50. Sandstone and conglomerate: Unit contains horizontal laminations and crossbeds; rough lenticular beds, 5 to 32 feet thick, are mostly crossbedded; forms a steep cliff.
    Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering pale yellowish orange (10YR 8/6) and dark yellowish orange (10YR 6/6); fine- to medium-grained; poorly sorted; composed of well-rounded, clear quartz; common white, orange, and gray accessory minerals; firmly cemented.
    Conglomerate: Composed of pebbles having a maximum diameter of 3 inches and an average diameter of $\frac{3}{8}$ inch; abundant gray, black, and white siliceous chert

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah--Continued

	Feet
UPPER AND LOWER CRETACEOUS--Continued	
Dakota Sandstone--Continued	
pebbles; rare red and orange siliceous pebbles.	72
Total incomplete Dakota Sandstone	84
UPPER JURASSIC:	
Morrison Formation:	
Salt Wash Sandstone Member:	
49. Sandstone and claystone: Unit is very poorly exposed. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2); fine-grained; well-sorted; composed of subangular, clear quartz; rare accessory minerals; very weakly cemented. Claystone: Very dusky red purple (5RP 2/2); contains fine-grained sand; bedding and lamination are obscured; forms a covered slope.	27
48. Conglomeratic sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering white (N 9); medium-grained; fair-sorted; composed of subrounded quartz; rare white accessory minerals; white, tan, and rare gray chert pebbles, maximum diameter 2 inches, average diameter ½ inch; firmly cemented, calcareous; lenticular beds average 5 feet in thickness; medium-scale crossbeds; forms a rough cliff.	17
47. Claystone: Dark-reddish-brown (10R 3/4), and very sandy pinkish-gray (5YR 8/1) to light-greenish-gray (5GY 8/1); some fine-grained sand; forms a steep, rubbly slope; very poorly exposed.	11.5
46. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); medium-grained; poorly sorted; composed of well-rounded, clear quartz; rare white accessory minerals; slightly friable; lenticular beds are 5 to 15 feet thick; medium-scale crossbeds; forms a steep, ledgy slope; contains pebbles as much as 1½ inches in diameter that are composed of white and tan chert, milky quartz, and dark-gray (N 3) silicified limestone; channeling.	58
45. Covered interval: Probably composed of sandstone and claystone similar to the underlying units.	108
44. Sandstone: White (N 9), weathering white (N 9) speckled with light brown (5YR 6/4 to 5YR 5/6); fine-grained; well-sorted; composed of subangular, clear quartz; common white and rare black and green accessory minerals; firmly cemented; lenticularly bedded; small- to medium-scale crossbeds; forms a vertical cliff and ledge; locally contains crystalline concretions the size of walnuts.	20.9
43. Covered interval: Probably interbedded sandstone and claystone.	30
42. Conglomeratic sandstone: White (N 9), weathering brown; fine- to medium-grained; fair to poorly sorted; composed of well-rounded, clear and frosted quartz; common red accessory minerals; pebbles as much as 1½ inches in diameter are composed of white, tan, dark-red, and brown chert; firmly cemented; crossbedded with small, choppy units of fluvial type; forms a cliff and ledge.	20.2
41. Covered interval: Probably shale; units 37 through 41 are lenticular; forms a nearly vertical cliff.	2.5
40. Sandstone: Yellowish-gray (5Y 8/1) to pinkish-gray (5YR 8/1), weathering light brown (5YR 6/4 to 5YR 5/6); fine- to coarse-grained; fair-sorted; composed of subrounded, clear quartz; common white and rare black and orange accessory minerals; firmly cemented; beds are about 1 foot thick; medium-scale crossbeds; forms a cliff; channeling.	33.7
39. Claystone: Grayish-red (5R 4/2 to 10R 4/2) and light-greenish-gray (5GY 8/1); clay and silt; bedding is obscured; forms a rubble-covered slope.	9.0
38. Sandstone: Same as unit 38 except that pebbles are slightly smaller.	17.5
37. Claystone and sandstone: Unit weathers into a rubble-covered slope; very poorly exposed. Claystone: Dark-reddish-gray and greenish-gray (5G 6/1); clay and silt. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2) speckled with brown; very fine to fine-grained; fair-sorted; composed of subangular, clear quartz; common black and red accessory minerals; firmly cemented; beds are 1 to 4 feet thick; structureless.	30.2
36. Conglomeratic sandstone: Yellowish-gray (5Y 8/1), weathering light brown (5YR 6/4 to 5YR 5/6); fine- to coarse-grained; poorly sorted; composed of well-rounded, clear quartz; common white and rare black, red, and orange accessory minerals; pebbles, 2 to 2½ inches in diameter, are composed of white, tan, and some black and light-green chert and are scattered or concentrated in stringers; firmly cemented, calcareous; irregular, lenticularly bedded; small-scale crossbeds; forms a blocky cliff.	12
35. Claystone: Dark-reddish-brown (10R 3/4), weathering dark reddish brown (10R 3/4); contains some fine-grained sand; forms a slope; unit is poorly exposed.	6.6
34. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2) speckled with brown, weathering light brown (5YR 6/4 to 5YR 5/6); fine-grained; well-sorted; composed of subangular quartz; common white and rare black accessory minerals; firmly cemented; consists of a single massive bed; forms a small ledge.	4.4
33. Silty sandstone: Greenish-gray (5G 6/1) and grayish-red (5R 4/2 to 10R 4/2); fine-grained; fair-sorted; weakly cemented; partly covered.	2.6
32. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2) speckled with brown, weathering light brown (5YR 6/4 to 5YR 5/6); fine- to medium-grained; fair-sorted; composed of subrounded, clear quartz; common white accessory minerals; firmly cemented; lenticular beds are 4 to 16 feet thick; cross-	
UPPER JURASSIC--Continued	Feet
Bluff Sandstone--Continued	
crossbedding, sweeping small- to medium-scale crossbeds; forms a rounded cliff.	100.8
19. Sandstone: White (N 9), weathering white (N 9); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; common white and rare orange and red accessory minerals; weakly cemented, calcareous; sweeping large-scale crossbeds; forms a rounded, irregular slope.	7.5
18. Sandstone: Moderate-reddish-brown (10R 4/6) to white (N 9), weathering pale reddish brown (10R 5/4); fine-grained; well-sorted; composed of subangular, amber-stained quartz; common black and white accessory minerals; firmly cemented; abundant clay along some cross-bedded partings; upper 83 feet of unit contains wedge crossbedding of medium- to large-scale crossbeds; lower 20 feet of unit is pale red (5R 6/2 to 10R 6/2) and moderate reddish brown, containing short, choppy, and long, sweeping crossbeds; forms a vertical or rounded cliff.	103
Total Bluff Sandstone	226.6
Summerville Formation:	
Sandy facies:	
17. Sandstone: Moderate-reddish-orange (10R 6/6), weathering moderate reddish brown (10R 4/6); silt to fine-grained sand; fair to poorly sorted; composed of well-rounded, fine- to medium-grained quartz; firmly cemented; parallel beds are 1 inch thick; forms a bare, rounded slope; some lighter colored sandstone lenses and streaks.	35
16. Sandstone: Moderate-reddish-orange (10R 6/6), weathering moderate reddish orange (10R 6/6); very fine to fine-grained; composed of subrounded to angular quartz; rare black accessory minerals; abundant very fine grained white chert; weakly to firmly cemented; trough cross-bedding, thin laminae one-sixteenth of an inch to the thickness of a sand grain; forms a rounded ledge; contains concentrations of well-rounded quartz and chert grains, some of which are frosted; several irregularly spaced lenses of silty sandstone, moderate-reddish-brown (10R 4/6) and parallel-bedded; entire unit may be a lens within the parallel-bedded sandstone; generally poorly exposed.	71.4
15. Sandstone: Moderate-reddish-brown (10R 4/6), weathering moderate reddish brown (10R 4/6); silt to very fine grained sand; composed of quartz; well-cemented; regular parallel beds are 1 to 2 inches thick; forms a rubbly slope.	15
14. Sandstone: Grayish-orange (10YR 7/4) to white (N 9) in top part, weathering moderate reddish orange (10R 6/6); very fine to fine-grained; composed of rounded to angular quartz; common black accessory minerals; common white chert; weakly cemented; parallel-bedded in upper part; low-angle crossbedding in lower part; forms rounded ledges in gullies.	33
13. Sandstone: Moderate-reddish-orange (10R 6/6), weathering moderate reddish brown (10R 4/6) irregularly banded with dark red; very fine to fine-grained; composed of clear quartz; some silt and rare well-rounded, fine- to medium-grained quartz; firmly cemented; parallel beds are 1 inch thick; forms a bare, rounded slope in gully; contains some lighter colored sandstone lenses; some parts split fissile.	60
Total Summerville Formation	214.4
Entrada Sandstone:	
12. Sandstone: White (N 9), weathering white (N 9); fine- to medium-grained; composed of well-rounded to subangular quartz; common black accessory minerals; abundant white and common colored chert; weakly cemented, friable; low-angle crossbeds, alternating with some thinly laminated parallel beds; forms a rounded ledge.	2.2
11. Sandstone: Pale-reddish-orange, weathering moderate reddish brown (10R 4/6); very fine to fine-grained; composed of rounded to angular quartz; rare black accessory minerals; firmly cemented; structureless; generally forms a smooth, rounded slope; forms a ledge in gully; differs from unit below mainly in color and weathering.	16
10. Sandstone: White (N 9), grayish-orange (10YR 7/4), and moderate-reddish-brown (10R 4/6); weathering moderate reddish orange (10R 6/6) to pale reddish brown (10R 5/4); very fine to medium-grained; composed of rounded to subrounded quartz; rare to common black, red, and orange accessory minerals; weakly cemented; trough crossbedding; long, sweeping crossbeds are a quarter of an inch to several inches in thickness; forms a round, smooth unscalable cliff set slightly back along parallel parting planes; scattered pits, as much as 1 foot in diameter, in face of cliff; medium grains of frosted quartz are concentrated along the crossbedded surfaces; white (N 9) to grayish-orange (10YR 7/4) veinlets of firmly cemented limy sandstone; rare grayish-red (5R 4/2 to 10R 4/2) sandy shale partings, about ½ to 1 inch in thickness, are very fissile and horizontal; some of sandstone is lenticular and contorted; unit is described mostly from basal 100 feet.	375
Total Entrada Sandstone	393.2
Top of contact is very irregular; Entrada Sandstone lies on red claystone of Carmel Formation with at least 12 feet of relief, probably due to rolling and contorted bedding; no clear evidence of channeling.	
UPPER AND MIDDLE JURASSIC:	
Carmel Formation:	
9. Claystone, mudstone, and sandstone: Units are of variable	

beds; forms a cliff and ledge; channeling; contains pebbles composed of white, tan, and rare black and red chert; a 2-foot parting of sandy claystone and clayey sandstone is 29.8 feet above base of unit. 48

31. Claystone and sandstone: Contains 3 beds totaling about 7 feet of sandstone same as unit 32; unit forms a rubble-covered slope.
    Claystone: Moderate-reddish-brown (10R 4/6); free of sand grains.
    Sandstone: White (N 9), weathering white (N 9); very fine to fine-grained; fair-sorted; composed of subangular, clear quartz; rare orange and black accessory minerals; weakly cemented; no sedimentary structures observed. 22

30. Sandstone: Grayish-orange (10YR 7/4) speckled with brown, weathering pale yellowish brown (10YR 6/2); very fine to fine-grained; composed of subrounded to subangular, clear quartz; common black and white accessory minerals; firmly cemented; no sedimentary structures displayed; forms a single massive ledge; abundant limonite specks. 3.8

29. Covered interval. 4.8

28. Conglomeratic sandstone: White (N 9) spotted with brown; fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; abundant white accessory minerals; common lenses of granules and pebbles composed of white and rare gray chert; pebbles average three-eighths of an inch in diameter; firmly cemented; very lenticularly bedded; medium-scale crossbeds; forms a vertical cliff; channeling. 29.5

27. Sandstone and sandy claystone, interbedded: Unit is lenticular.
    Sandstone: White (N 9) speckled with light brown (5YR 6/4 to 5YR 5/6), weathering brown; fine- to medium-grained; fair-sorted; composed of subangular, clear quartz; common white accessory minerals; firmly cemented; beds range in thickness from 8 inches to 5 feet; medium-scale crossbeds.
    Sandy claystone: Grayish-red-purple (5RP 4/2), weathering grayish red purple (5RP 4/2); clay and fine-grained sand. 21

26. Claystone and sandstone, interbedded: Unit forms a steep, rubbly slope.
    Claystone: Pale-yellowish-green (10GY 7/2), grayish-green (10GY 5/2), and dark-yellowish-orange (10YR 6/6); clay, silt, and fine-grained sand; claystone beds range in thickness from 2 to 5 feet.
    Sandstone: White (N 9) speckled with brown; fine-grained; well-sorted; composed of subangular, clear quartz; rare black accessory minerals; firmly cemented; medium-scale crossbeds. 13.9

25. Sandstone: White (N 9) speckled with light brown (5YR 6/4 to 5YR 5/6), weathering moderate reddish brown (10R 4/6); fine- to medium-grained; fair-sorted; composed of subrounded, clear quartz; common white and rare black and orange accessory minerals; firmly cemented; trough crossbedding; forms a rounded and vertical-faced ledge. 3.0

24. Sandstone: White (N 9) to light-greenish-gray (5G 8/1), weathering white (N 9) to light greenish gray (5GY 8/1); very fine to medium-grained; poorly sorted; composed of subrounded, clear quartz; common orange and rare white and black accessory minerals; weakly to firmly cemented; bedding and lamination are not displayed; forms a partly covered slope; common interstitial clay; poorly exposed. 5.4

23. Conglomeratic sandstone: White (N 9) speckled with brown, weathering grayish orange (10YR 7/4); fine- to medium-grained; poorly sorted; composed of subangular, clear quartz; common white and black and rare orange and red accessory minerals; lenses contain granules and pebbles composed mostly of white and gray chert; weakly cemented; parallel beds, 1 to 15 feet thick, are separated usually by thin clay partings; forms a rough, nearly vertical cliff; near bottom is a 2-foot unit composed of claystone and sandstone, which is same as unit 28 except that it is mostly green. 49.5

22. Sandstone and claystone, interbedded: Unit forms a steep slope or, where capped by resistant units, a vertical cliff.
    Sandstone: Light-greenish-gray (5GY 8/1), weathering light greenish gray (5GY 8/1) except where coated by pink wash from above; very fine to fine-grained; fair-sorted; composed of subangular, clear quartz; common black and orange accessory minerals; firmly cemented, calcareous; lenticular and slightly wavy beds range in thickness from less than 1 inch to 3 inches.
    Claystone: Dark-reddish-brown (10R 3/4) and pale-green (10G 6/2); varies from pure to silty and sandy claystone. 4.0

Total Salt Wash Sandstone Member 616

Bluff Sandstone:

21. Sandstone: White (N 9), weathering white (N 9) except where covered by pink wash from above; fine-grained; well-sorted; composed of subrounded, clear quartz; common black and orange and rare white accessory minerals; weakly cemented, friable; horizontally bedded; some crossbeds; contains rare medium to coarse grains of well-rounded, frosted quartz. 15.3

20. Sandstone: White (N 9) to pinkish-gray (5YR 8/1), mottled with light brown (5YR 5/6); weathering white (N 9) to pinkish gray (5YR 8/1), mottled with light brown (5YR 5/6), but paler than unweathered colors; fine-grained; well-sorted; composed of subangular, clear quartz; common black, white, and orange accessory minerals; firmly cemented; 2- to 10-foot-thick beds, alternating parallel (25 percent) and crossbedded (75 percent); trough thickness and are transitional along strike; contorted bedding in entire unit; forms a steep slope covered with talus at the base of the Entrada Sandstone; very poorly exposed.
    Claystone: Dark-reddish-brown (10R 3/4); clay and fine-grained sand; composed of quartz; splits fissile; parallel-bedded, laminae average an eighth of an inch in thickness.
    Mudstone: Moderate-reddish-brown (10R 4/6), weathering moderate reddish brown (10R 4/6); abundant very fine to fine-grained quartz in a clay and silt matrix; splits slightly fissile.
    Sandstone: Pale-reddish-brown (10R 5/4), weathering pale reddish brown (10R 5/4) discolored with pale green (5G 7/2) in irregular blotches; silt to very fine grained sand; composed of quartz; rare accessory minerals; bedding is obscured. 85

8. Sandstone: White (N 9), weathering grayish orange pink (10R 8/2 to 5YR 7/2); very fine grained; composed of quartz; common black accessory minerals; rare red and orange chert; well-cemented; bedding is obscured; nodular concretionary weathering; forms an indistinct ledge. 3.2

7. Claystone: Dark-reddish-brown (10R 3/4), discolored with spots as much as a quarter of an inch in diameter and thin seams of pale green (5G 7/2); sand grains disseminated throughout; well-indurated; splits slightly fissile and shaly; forms a poorly exposed slope. 36

6. Covered interval: Probably reddish-brown mudstone; forms a bench. 16.4

5. Mudstone: Moderate-reddish-brown (10R 4/6), weathering moderate reddish brown (10R 4/6); abundant very fine to fine-grained quartz in clay and silt matrix. Unit is capped by a 3-inch bed of sandstone, described as follows: moderate-orange-pink (10R 7/4); very fine to fine-grained; composed of quartz; common black accessory minerals; firmly cemented; bedding is obscured. Unit forms a covered bench; poorly exposed. 11

4. Sandstone: Pale-yellowish-orange (10YR 8/6), weathering grayish orange pink (10R 8/2 to 5YR 7/2); fine-grained; composed of rounded to subrounded quartz; common black accessory minerals; common white and rare red and orange chert; friable to firmly cemented; crossbedding in medium-size irregular units, fluvial appearing; weathers blocky; forms a ledge; pink spots, probably due to iron staining; limonite nodules give sandstone a pisolitic texture; unit is variable in thickness. 5.2

3. Claystone: Dark-reddish-brown (10R 3/4), weathering moderate reddish brown (10R 4/6); well-indurated; splits slightly fissile; weathers hackly; contains thin, irregular, green clay seams; forms a very poorly exposed, gentle, concave slope. 16.5

2. Sandstone: Pale-red (10R 6/2 to 5R 6/2), weathering pale reddish brown (10R 5/4); fine- to medium-grained; composed of rounded, frosted quartz; common black accessory minerals; rare red chert; firmly cemented; very low angle crossbeds, laminae $\frac{1}{8}$ to $\frac{1}{4}$ inch in thickness; weathers slabby; forms a bench on top of the Navajo Sandstone; variable but persistent in thickness. 2.0

Total Carmel Formation 175.3

JURASSIC AND TRIASSIC(?):
Navajo Sandstone (incomplete):
Top of contact is uneven, truncates Navajo Sandstone crossbeds.

1. Sandstone: White (N 9) to pale-red (10R 6/2 to 5R 6/2); large, long, sweeping crossbeds.

5.—Piute Canyon

East side of Piute Canyon, 7 miles east-northeast of Navajo Mountain Trading Post
25-10.4-10.8

[Measured by C. A. Repenning and J. H. Irwin]

JURASSIC AND TRIASSIC(?):
Navajo Sandstone:

11. Sandstone: Undescribed.

UPPER TRIASSIC(?):
Kayenta Formation:

10. Sandstone: Same as unit 9; forms series of ledges and cliffs. 207

Moenave Formation:
Springdale Sandstone Member:

9. Sandstone: Pale-red-purple (5RP 6/2); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear and white quartz; common mica accessory mineral; argillaceous material; firmly cemented; lenticular, thick to very thick bedded; unit is a coset; wedge planar and lenticular trough crossbedding, concave low-angle and small- to medium-scale crossbeds; weathers rounded; forms a rounded and vertical cliff; commonly contains mud galls; fluviatile environment; base is sharp and irregular. 50

8. Sandstone: Grayish-orange-pink (10R 8/2 to 5YR 7/2); fine- to medium-grained; fair to poorly sorted; composed of subrounded to subangular, clear quartz; common argillaceous material; well-cemented; lenticular, thin- to thick-bedded; unit is a coset; weathers pitted; forms a ledge; forms spring horizon with extensive arenaceous travertine deposits; contains sandstone and siltstone pebbles; base is sharp and irregular. 4

Total Springdale Sandstone Member 54

Dinosaur Canyon Sandstone Member:

7. Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; well-sorted; composed of subrounded

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah--Continued

UPPER TRIASSIC(?)--Continued — Feet

Moenave Formation--Continued

Dinosaur Canyon Sandstone Member--Continued

to subangular, clear, stained, amber, and white quartz; firmly cemented; flat, lenticular, thin- to thick-bedded; weathers rounded; forms a rounded cliff; fluviatile environment; base is sharp and irregular with 3 feet of relief. 28

Total Moenave Formation 82

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member:

6. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; composed of subrounded to subangular, stained quartz; firmly cemented; massive; unit is a coset; lenticular and tabular planar crossbedding, concave high-angle and large-scale crossbeds; weathers rounded; forms a rounded cliff; includes abundant white chert grains, especially along bedding planes; eolian environment; base is sharp and flat. 127

Rock Point Member:

5. Sandstone: Pale-red (5R 6/2 to 10R 6/2); medium-grained; well-sorted; composed of subrounded to subangular, clear and amber quartz; muscovite accessory mineral forms about 10 percent and is concentrated mainly along bedding planes; firmly cemented, crystalline calcite; lenticular, flat-bedded; plunging and symmetrical trough crossbedding, concave low-angle and medium-scale crossbeds; weathers flaggy; forms an irregular slope; contains abundant conglomerate beds as much as 4 feet thick; pebbles range from 1 to 5 inches in size and are composed of subrounded to subangular limestone and sandstone fragments of very poor sphericity, long dimension invariably horizontal; thickness of this unit was observed to be as much as 30 feet; it is absent in the line of section and channels out unit 4; unit has no effect on the base of the Lukachukai Member; contains abundant plant remains, apparently reed or grass; base is a sharp and irregular channel surface that in places has vertical or overhanging walls. ---

4. Sandstone: Moderate-reddish-brown (10R 4/6); very fine grained; well-sorted; composed of subrounded to subangular, stained and amber quartz; firmly cemented; massive, flat, thin- to thick-bedded; unit is a set; weathers blocky and knobby; forms an irregular cliff; deltaic or possibly fluviatile; base is gradational. 35

3. Siltstone: Moderate-reddish-brown (10R 4/6); well-sorted; composed of stained and amber quartz; firmly cemented; flat, thin- to thick-bedded; unit is a set; weathers blocky and and hackly; forms an irregular slope; contains ripple marks and worm trails; fluviatile and deltaic environment; base is sharp and flat. 81

Total Rock Point Member 116+

Total Wingate Sandstone 243+

Chinle Formation:

Owl Rock Member:

2. Siltstone: Banded with pale blue green (5BG 7/2), grayish red purple (5RP 4/2), and grayish red (5R 4/2 to 10R 4/2); well-sorted; unit is a set; weathers hackly; forms a covered slope; base is gradational and irregular. 7

1. Limestone: Pale-red-purple (5RP 6/2); amorphous; thin- to thick-bedded, beds as much as 2 feet thick; weathers blocky; forms a series of ledges; contains abundant chert stringers and balls; base is concealed; base of section, not base of exposure. 10

Total incomplete Owl Rock Member 17

6.--Navajo Canyon

In Navajo Canyon at the end of the Navajo Canyon Truck Trail, 20 miles northeast of Kaibito
26-2.3-15.4

[Measured by C. A. Repenning, J. H. Irwin, P. R. Stevens, and M. E. Cooley]

JURASSIC AND TRIASSIC(?):

Navajo Sandstone:

14. Sandstone: Undescribed.

UPPER TRIASSIC(?):

Kayenta Formation:

13. Siltstone: Undescribed; lenticular. 22
12. Sandstone: Undescribed; forms a ledge. 82
11. Siltstone and claystone: Undescribed. 49
10. Sandstone: Undescribed; forms a ledge. 127

Total Kayenta Formation 280

Unconformity: 15 to 20 feet of relief.

Moenave Formation:

Dinosaur Canyon Sandstone Member:

9. Sandstone: Moderate-reddish-orange (10R 6/6); medium-grained; composed of subrounded to subangular, clear and amber quartz; well-cemented; lenticularly bedded; asymmetrical trough crossbedding; weathers blocky; forms a ledge; contains very coarse grains of white chert and amber quartz; base is concealed. 11.2

8. Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; composed of subrounded to subangular, stained quartz; well-cemented; flat, thin- to thick-bedded; unit is a coset; tabular planar crossbedding, low- to high-angle and small-scale crossbeds; weathers blocky; forms a ledge; fluviatile environment; base is sharp and irregular with 3 feet of relief. 11.2

UPPER JURASSIC--Continued — Feet

Morrison Formation--Continued

Salt Wash Sandstone Member--Continued

32. Sandstone, mudstone, and conglomerate, interbedded: About 30 percent of unit is flat bedded, 40 percent is structureless, and 30 percent is crossbedded.
   - Sandstone (70 percent of unit): Yellowish-gray (5Y 7/2) to grayish-orange-pink (5YR 7/2), weathering light brown (5YR 6/4) to pale brown (5YR 5/2); very fine to fine-grained; fair-sorted; composed of subrounded, clear quartz; feldspar, mica, and black accessory minerals; abundant brown limonite specks; lenticular sets of flat, laminated to very thin bedding; planar and trough crossbedding, very low angle and small-scale crossbeds; forms an irregular, blocky, vertical ledge.
   - Mudstone (10 percent of unit): Similar to unit 28.
   - Conglomerate (20 percent of unit): Grayish-orange-pink (5YR 7/2), weathering pale brown (5YR 5/2); very fine grained sand to $\frac{3}{8}$-inch pebbles; composed of subangular, clear and stained quartz and quartzite; feldspar and black and red accessory minerals; some green mudstone pellets; lenticular; structureless; low to very low angle and small-scale symmetrical trough sets; forms irregular, hackly, vertical faces; some quartz grains show quartz overgrowths. 28

31. Sandstone, mudstone, and conglomerate, interbedded: About 30 percent of unit is flat bedded, 30 percent is structureless, and 40 percent is crossbedded; forms a flat, crumbly slope on top of unit 30 and is capped by a friable, rounded ledge.
   - Sandstone (70 percent of unit): Very pale orange (10YR 8/2) to yellowish-gray (5Y 7/2), weathering olive gray (5Y 3/2) to pale brown (5YR 5/2); very fine to fine-grained; poorly sorted; composed of subangular, clear quartz; rare mica and black and green accessory minerals; uniformly distributed brown limonite specks; sets of planar and symmetrical trough crossbedding, low to very low angle and small- to medium-scale crossbeds; forms an irregular, blocky, hackly ledge.
   - Mudstone (25 percent of unit): Similar to unit 28.
   - Conglomerate (5 percent of unit): Grayish-orange-pink (5YR 7/2), weathering pale yellowish brown (10YR 6/2); very fine grained sand to $\frac{1}{2}$-inch pebbles; poorly sorted; composed of subrounded to subangular, clear quartz; feldspar, mica, and black, red, and white accessory minerals; abundant brown limonite specks; structureless bedding; planar crossbedding, low to very low angle and small-scale crossbeds; forms an irregular and vertical cliff. 67

30. Mudstone, predominantly: Undescribed; forms a covered slope. 6.5

29. Sandstone, mudstone, and conglomerate, interbedded: Unit consists of approximately 22 beds and grades upward from predominantly mudstone and ripple-marked and crossbedded sandstone at the bottom to mudstone, structureless sandstone, and conglomerate at the top.
   - Sandstone (83 percent of unit): Yellowish-gray (5Y 8/1) and grayish-orange-pink (5YR 7/2), weathering light brownish gray (5YR 6/1) and light brown (5YR 6/4) respectively; very fine to coarse-grained; poorly sorted; composed of subangular, clear and stained quartz; feldspar and black and red accessory minerals; lenticular, laminated, and ripple-marked sets; symmetrical trough and planar crossbedding, low- to medium-angle and small- to medium-scale crossbeds; forms an irregular, blocky, and hackly ledge.
   - Mudstone (15 percent of unit): Similar to unit 28.
   - Conglomerate (2 percent of unit): Grayish-orange-pink (5YR 7/2), weathering pale yellowish brown (10YR 6/2); fine-grained sand to $\frac{1}{2}$-inch pebbles; pebbles are composed of subrounded, frosted quartz and quartzite; biotite, feldspar, and red accessory minerals; contains green mudstone pellets as much as half an inch in diameter and some interstitial mudstone; lenticular sets of structureless or laminated to very thin beds are enclosed by sandstone; forms a knobby, etched, vertical cliff. 82

28. Mudstone: Mottled and banded pale-olive (10Y 6/2) and dark-reddish-brown (10R 3/4), weathering yellowish gray (5Y 7/2) and grayish red (10R 4/2) respectively; clay to very fine grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; black and white accessory minerals; lenticular laminated and structureless beds; weathers to a smooth, crumbly, puffy, and covered slope. 1.0

Total incomplete Salt Wash Sandstone Member 302.5

Cow Springs Sandstone:

27. Sandstone: White (N 9) to pale-red (10R 6/2), weathering pale red (10R 6/2) to pale reddish brown (10R 5/4); very fine to fine-grained; composed of subrounded, clear, frosted, and amber-stained quartz; minor black and red accessory minerals; some interstitial mudstone; unit consists of flat, laminated, slightly crinkled beds; forms a massive, vertical cliff; concentration of gypsum in upper 1 foot of unit; lower contact appears to be an erosion surface. 46

26. Sandstone: White (N 9), weathering pale red (10R 6/2) and pale reddish brown (10R 5/4); very fine grained; fair- to well-sorted; composed of rounded, clear and frosted quartz; black and orange accessory minerals; rare mudstone seams; wedge simple crossbedding, medium-angle

7. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; composed of subrounded to subangular, clear and amber quartz; white chert accessory mineral; well-cemented; flat-bedded; unit is a coset; weathers blocky; forms an irregular slope; contains ripple marks and worm trails; fluviatile environment. 30

6. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; composed of subrounded to subangular, clear, amber, and stained quartz; well-cemented; unit is a coset; wedge planar crossbedding, low- to high-angle and small-scale crossbeds; weathers rounded; forms a rounded cliff; contains coarse-grained chert; eolian and fluviatile environment; base is sharp and flat. 23

5. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; composed of subrounded to subangular, clear, amber, and stained quartz; white chert accessory mineral; well-cemented; flat-bedded; unit is a coset; asymmetrical trough crossbedding, concave low-angle and small-scale crossbeds; weathers rounded and blocky; forms a rounded slope; fluviatile environment; base is sharp and flat. 35

Total Dinosaur Canyon Sandstone Member 110.4

UPPER TRIASSIC:
Wingate Sandstone:
Lukachukai Member:

4. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; composed of subrounded to subangular, clear, amber, and stained quartz; white and amber quartz accessory minerals; well-cemented; unit is a coset; wedge planar crossbedding, concave low-angle and medium- to large-scale crossbeds; weathers rounded; forms a rounded cliff; coarse grains of chert and amber quartz occur along laminae; base is sharp and flat. 17

Rock Point Member:

3. Conglomerate: Moderate-reddish-orange (10R 6/6); flat, lenticularly bedded; weathers rounded; forms a ledge; fluviatile environment; base is sharp and irregular with 4 feet of relief.
   Matrix: Medium-grained; poorly sorted; composed of subrounded to subangular, amber quartz; well-cemented.
   Pebbles: As much as 1 inch in diameter; composed of amber quartz, gray sandstone, calcite, and black and white quartz. 4.0

2. Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; well-sorted; composed of subrounded to subangular, amber quartz; weakly cemented; lenticular, laminated to thin-bedded; weathers knobby; forms a ledgy slope; fluviatile environment; base is sharp and flat. 60

Total Rock Point Member 64

Total Wingate Sandstone 81

Chinle Formation:
Owl Rock Member:

1. Limestone: Pale-red-purple (5RP 6/2), weathering pale pink (5RP 8/2). 2.0

7.—Cummings Mesa

East side of Cummings Mesa, 25 miles north of Kaibito
27-1.0-3.5

[Measured by J. D. Lowell]

UPPER JURASSIC:
Morrison Formation:
Salt Wash Sandstone Member:

34. Sandstone, mudstone, and conglomerate, interbedded: bedding is mostly flat.
   Sandstone (50 percent of unit): Yellowish-gray (5Y 8/1) to grayish-orange-pink (5YR 7/2), weathering grayish orange pink (5YR 7/2) to light brown (5YR 6/4); fine-grained; fair to poorly sorted; composed of subrounded, clear and frosted quartz; feldspar and black and green accessory minerals; abundant limonite specks; flat, laminated to very thin beds in lenticular sets; forms a flat, crumbly slope above unit 33 that is capped by a friable, rounded ledge.
   Mudstone (30 percent of unit): Mostly red; similar to unit 28.
   Conglomerate (20 percent of unit): Very pale orange (10YR 8/2), weathering grayish orange pink (5YR 7/2); fine-grained sand to 2-inch pebbles; composed of subrounded, clear and frosted quartz; feldspar, mica, diorite, and black and white accessory minerals; abundant brown limonite specks; very thin beds in irregular lenticular sets. 31

33. Sandstone, mudstone, and conglomerate, interbedded: Entire unit is capped by a less resistant unit and its upper surface forms the principal topographic break in the Salt Wash Sandstone Member exposure, which in other places is a continuous vertical cliff below this horizon.
   Sandstone (63 percent of unit): Very pale orange (10YR 8/2), weathering grayish orange pink (5YR 7/2); very fine to fine-grained; fair-sorted; composed of subrounded, clear quartz; feldspar and black and green accessory minerals; abundant limonite specks; contains sets of lenticular trough crossbedding, low to very low angle and small-scale crossbeds; partly structureless; forms a friable, blocky ledge.
   Mudstone (35 percent of unit): Predominantly red; similar to unit 28.
   Conglomerate (2 percent of unit): Similar to conglomerate in unit 32. 87

and medium-scale crossbeds; forms a massive, smooth cliff; eolian environment. 58

25. Sandstone: Pale-red (10R 6/2), weathering pale reddish brown (10R 5/4); very fine to fine-grained; fair-sorted; composed of subrounded, amber-stained quartz; rare black accessory minerals; some interstitial mudstone; laminated to very thin bedded; lenticular sets of trough and simple crossbedding, high-angle and medium-scale crossbeds; crossbedding resembles that in the upper part of the Navajo Sandstone; forms a rounded, vertical cliff. 37

Total Cow Springs Sandstone 141

Summerville Formation:

24. Sandstone: Grayish-light-red (10R 4/2) to moderate-reddish-brown (10R 4/6); very fine to fine-grained; fair-sorted; composed of subrounded, frosted and amber-stained quartz; rare black and white accessory minerals; interstitial mudstone; some pseudocrossbedding; lenticular sets of symmetrical trough crossbedding, low-angle and small-scale crossbeds; forms a smooth, vertical cliff. 45

23. Covered interval: Probably weakly cemented sandstone. 20

22. Sandstone: White (N 9) to pale-reddish-brown (10R 5/4); very fine to medium-grained; poorly sorted; composed of subrounded, clear and amber-stained quartz; rare red, green, and black accessory minerals; interstitial mudstone; half of unit contains pale-reddish-brown (10R 5/4) bands composed of horizontal and pseudocrossbedded layers, and other half contains white (N 9) bands composed of pseudocrossbedded and crossbedded layers; lenticular sets of symmetrical trough crossbedding, low-angle and small-scale crossbeds; forms a smooth, rounded, vertical cliff. 61.5

21. Sandstone: Pale-reddish-brown (10R 5/4); fine- to medium-grained; fair to poorly sorted; composed of subrounded amber-stained quartz; minor black and white accessory minerals; flat, laminated to very thin bedding in lower part grading upward to lenticular crossbedding at the top; low to very low angle and small- to medium-scale crossbeds; unit forms a smooth, vertical cliff; lower contact is a possible erosion surface and is marked by a large slump of unit 21 into unit 20 and by several small faults. 37

20. Sandstone: White (N 9), weathering light gray (N 7); fine- to medium-grained; fair-sorted; composed of rounded, clear, frosted, and amber-stained quartz; black, red, and yellow accessory minerals; weakly cemented, calcareous and ferruginous; wedge simple crossbedding, medium-angle and large-scale crossbeds; forms a smooth, rounded, vertical cliff; eolian environment; base is gradational. 39

19. Sandstone: Light-brown (5YR 6/4), weathering very light brown; silt to medium-grained sand; poorly sorted; composed of subrounded, amber-stained quartz; some interstitial mudstone near the bottom, grading upward to a clean crossbedded sandstone at the top; forms a rounded cliff; fluviatile environment. 22

Total Summerville Formation 224.5

Entrada Sandstone:

18. Sandstone: Light-brown (5YR 6/4), weathering very light brown; very fine to fine-grained; fair-sorted; composed of subrounded, amber-stained quartz; rare black and white accessory minerals; slightly friable; simple crossbedding, medium-angle and medium- to large-scale crossbeds; forms a smooth, rounded cliff; base is gradational. 57

17. Sandstone: Moderate-reddish-brown (10R 4/6); silt to fine-grained sand; poorly sorted; composed of subangular, amber-stained quartz; minor black accessory minerals; slightly friable; cemented with calcite and interstitial mudstone; lenticular sets of planar crossbedding, very low angle and medium-scale crossbeds; forms a rounded cliff; base is gradational. 28

16. Sandstone: Light-brown (5YR 6/4), weathering very light brown; very fine grained; fair-sorted; composed of subrounded, amber-stained quartz; rare black and white accessory minerals; calcareous and ferruginous cement; sets of planar crossbedding, medium- to high-angle and medium-scale crossbeds; weathers to a smooth, rounded cliff; white (N 9) bed at top, 1 foot thick. 3.0

15. Sandstone: Light-brown (5YR 6/4), weathering very light brown; very fine to fine-grained; poorly sorted; composed of subrounded, amber-stained and clear quartz; rare feldspar and black accessory minerals; lenticular sets of planar crossbedding, low-angle and small-scale crossbeds; forms a hackly, vertical cliff. .5

14. Sandstone: Light-brown (5YR 6/4), weathering very light brown; fine-grained; fair-sorted; composed of subrounded to subangular, amber-stained quartz; rare black and white accessory minerals; weakly cemented, calcareous and ferruginous; structureless and lenticular crossbedded sets, interbedded; wedge planar crossbedding, low-angle and small- to medium-scale crossbeds; forms a massive, rounded, vertical cliff; base is gradational. 199.5

13. Sandstone: Composed of two white (N 9) beds and one pink bed; very fine to fine-grained; fair-sorted; composed of rounded, clear quartz; rare black, red, and green accessory minerals; very thick, flat-bedded, partly structureless; forms a massive, smooth, rounded cliff. 35

12. Sandstone: Light-brown (5YR 6/4), weathering very light brown with some thin white (N 9) banding; very fine grained; fair-sorted; composed of subrounded, amber-stained quartz; rare black and white accessory minerals; weakly cemented, calcareous and ferruginous; structureless; forms a partly covered, crumbly slope; base is concealed. 61.5

Total Entrada Sandstone 384.5

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER AND MIDDLE JURASSIC:
Carmel Formation:

		Feet
11.	Mudstone: Same as unit 9 except that it contains some interbedded mottled brown and gray beds and very fine grained sandstone.	47
10.	Sandstone: Light-olive-gray (5Y 6/1), weathering white (N 9); very fine grained; fair-sorted; composed of subangular, clear quartz; rare black accessory minerals; firmly cemented; thick-bedded; structureless; forms a massive, smooth cliff.	2.0
9.	Mudstone: Moderate-reddish-brown (10R 4/6) to light-brown (5YR 5/6), weathering pale reddish brown (10R 5/4); mostly silt; weakly cemented; flat, laminated beds; forms a partly covered, smooth, crumbly slope.	29.5
8.	Sandstone: White (N 9), weathering light olive gray (5Y 6/1); fine-grained; fair-sorted; composed of subangular, frosted quartz; rare mica and black accessory minerals; planar crossbedding, low-angle crossbeds; weathers hackly, flaggy, and etched; forms a ledge.	3.0
7.	Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very friable; forms a crumbly slope; similar to unit 2.	10
6.	Sandstone: Moderate-reddish-brown (10R 4/6), weathering moderate reddish orange (10R 6/6); fine-grained; well-sorted; composed of rounded, amber-stained quartz; rare mica and black accessory minerals; flat-bedded; weathers flaggy and hackly; forms a slope that grades upward into a ledge.	17
5.	Sandstone: Similar to unit 3.	1.5
4.	Sandstone: Similar to unit 2.	8.0
3.	Sandstone: Light-brown (5YR 6/4), weathering pale yellowish brown (10YR 6/2); medium-grained; fair-sorted; composed of subangular, clear and amber-stained quartz; rare white accessory minerals; well-cemented; laminated; medium- to high-angle crossbeds; forms a rounded ledge.	4.0
2.	Sandstone: Moderate-reddish-brown (10R 4/6) to light-brown (5YR 5/6); very fine grained; fair-sorted; composed of rounded, amber-stained quartz; structureless; forms a crumbly slope.	17
	Total Carmel Formation	139

JURASSIC AND TRIASSIC(?):
Navajo Sandstone (incomplete):

1. Sandstone: Light-brown (5YR 5/6), weathering light brown (5YR 6/4); fine- to medium-grained; poorly sorted; composed of rounded, frosted and amber-stained quartz; rare feldspar and black accessory minerals; wedge crossbedding, high-angle and large-scale crossbeds; forms a rounded cliff.

8.—Keethla Valley

North side of Black Mesa, 5½ miles east of Cow Springs Trading Post
37-13.7-6.0

[Measured by G. A. Williams]

UPPER CRETACEOUS:
Toreva Formation:

		Feet
40.	Sandstone: Grayish-yellow (5Y 8/4), weathering grayish yellow (5Y 8/4); very fine grained; calcareous cement; thick-bedded; simple crossbedding, medium-scale crossbeds; splits slabby; forms a smooth ledge; commonly contains yellowish-brown iron nuggets of various shapes; plant fragments and pelecypods.	85
39.	Siltstone: Light-olive-gray (5Y 6/1), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds.	26
38.	Lignite and coal: Contains very thin bone.	10
37.	Concealed interval.	42
36.	Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); fine-grained; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds.	7
35.	Concealed interval.	23
34.	Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); very fine grained; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds.	14
33.	Coal.	10
32.	Siltstone: Light-olive-gray (5Y 6/1), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds.	12
31.	Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); very fine grained; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; some thin layers of shale; plant fragments and molds.	65
30.	Mudstone: Light-olive-gray (5Y 6/1); clay and silt; calcareous cement; contains some coal; lignite.	14
29.	Coal: Weathered.	4
28.	Siltstone: Light-greenish-gray (5GY 8/1), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds.	29
27.	Sandstone: Pale-greenish-yellow (10Y 8/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); very fine grained; thinly laminated, flat-bedded; splits fissile; weathers smooth; forms a slope; plant fragments and imprints.	3
3.	Sandstone: Grayish-yellow (5Y 8/4), weathering yellowish gray (5Y 8/1 to 5Y 7/2); fine-grained; thin-bedded; indicates much reworking with sand-filled channels; splits slabby; weathers smooth; forms a ledge; concretions; commonly contains ovoid yellowish-red iron concretions in upper part of unit; plant fragments, molds, and imprints.	23
2.	Carbonaceous siltstone: Light-brownish-gray (5YR 6/1), weathering dark gray (N 3); flat, thinly laminated; splits fissile; weathers smooth; forms a slope; plant fragments and imprints.	23
1.	Sandstone: White (N 9) to orange-pink, weathering yellowish white; medium- to coarse-grained; calcareous cement; thick-bedded; simple crossbedding, medium-scale crossbeds; splits massive; weathers smooth; forms a cliff; iron zone at 60 feet; commonly contains ovoid yellowish-red iron concretions; plant fragments and molds.	92
	Total Toreva Formation	874

DISTRICT 3

9.—Lees Ferry

A.—Echo Cliffs, north side of Colorado River, half a mile north of Lees Ferry
29-4.5-8.5

[Measured by J. T. Callahan]

JURASSIC AND TRIASSIC(?):
Navajo Sandstone:

18.	Sandstone: Grayish-orange (10YR 7/4), weathering yellowish gray (5Y 8/1 to 5Y 7/2); very fine to fine-grained; splits friable; thin-bedded; large-scale crossbeds; weathers smooth; forms a cliff; contains sandstone concretions ½ to 6 inches in diameter.	750+
17.	Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; thin-bedded; medium-scale crossbeds; weathers smooth; forms an irregular ledge.	15
16.	Sandstone: Dark-reddish-brown (10R 3/4); very fine grained; weakly cemented; flat, very thin bedded; weathers smooth and rounded; forms a slope.	1.0
15.	Sandstone: Very pale orange (10YR 8/2), weathering light gray (N 7); fine-grained; splits friable; flat, thin-bedded; weathers smooth; forms a ledge.	5.0
14.	Sandstone: Moderate-red (5R 5/4), weathering dusky brown (5YR 2/2) to black (N 1); fine-grained; weakly cemented, calcareous; splits friable; very thin bedded; large-scale crossbeds; forms a cliff; contains sandstone concretions half an inch in diameter.	53
	Total Navajo Sandstone	824+

UPPER TRIASSIC(?):
Kayenta Formation:

13.	Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; highly calcareous cement; flat, very thin bedded; weathers rough and irregular; forms a ledge; top 1 foot contains sandstone concretions.	3.0
12.	Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; calcareous cement; flat, very thin to thin-bedded; small-scale crossbeds; weathers smooth, rounded, and blocky; forms a ledge.	23
11.	Limestone: Grayish-orange-pink (10R 8/2); finely crystalline; flat, very thin bedded; weathers rough and blocky; forms a ledge.	.5
10.	Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; highly calcareous cement; flat, thin-bedded; weathers smooth and blocky; forms a cliff; upper 2 feet of unit is gray sandstone.	33.5
9.	Sandstone: Moderate-reddish-brown (10R 4/6); very fine grained; massive; weathers smooth and rounded; forms a slope.	5.0
	Total Kayenta Formation	65

Moenave Formation:
Springdale Sandstone Member:

8.	Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; firmly cemented; large-scale crossbeds; weathers smooth and blocky; forms a cliff; bottom 9 feet contains lenses of mudstone-pellet conglomerate.	36
7.	Sandstone: Moderate-reddish-brown (10R 4/6); very fine grained; weakly cemented; small-scale crossbeds; weathers rough and irregular; forms a slope; top 3 inches of unit is mudstone; contains thin wedges of sandstone.	18
	Total Springdale Sandstone Member	54

Dinosaur Canyon Sandstone Member:

6.	Sandstone: Pale-reddish-brown (10R 5/4), weathering dark reddish brown (10R 3/4) to black (N 1); fine-grained; firmly cemented; very thin bedded; medium- and large-scale crossbeds; weathers smooth and blocky; forms a cliff; bottom 10 feet of unit contains mud-pellet conglomerate interbedded with fine-grained sandstone.	105
5.	Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; very thin bedded; simple and trough crossbedding, medium-scale crossbeds; weathers smooth and blocky; forms a cliff; top of unit contains bleached streaks.	62
4.	Sandstone: Pale-reddish-brown (10R 5/4), weathering pale reddish brown; very fine grained; flat, very thin bedded; medium-scale crossbeds; weathers smooth and	

calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 27

26. Siltstone: Light-olive-gray (5Y 6/1), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; coal in upper 3 feet of unit; plant fragments and molds. 23

25. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); very fine grained; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; plant fragments and molds. 34

24. Claystone: Light-olive-gray (5Y 6/1), weathering yellowish gray (5Y 8/1 to 5Y 7/2); thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 6

23. Lignite: Grayish-brown (5YR 3/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; contains coal; plant fragments and molds. 12

22. Siltstone: Light-gray (N 7), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; much of unit is concealed; plant fragments and molds. 48

21. Coal. 4

20. Siltstone: Dusky-yellow (5Y 6/4), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 30

19. Sandstone: Grayish-yellow (5Y 8/4), weathering yellowish gray (5Y 8/1 to 5Y 7/2); fine-grained; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 4

18. Siltstone: Grayish-yellow (5Y 8/4), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; concretions; plant fragments and molds. 24

17. Coal. 4

16. Siltstone: Yellowish-gray (5Y 8/1 to 5Y 7/2) to moderate-yellowish-brown (10YR 5/4), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 12

15. Coal. 3

14. Siltstone: Light-gray (N 7), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 55

13. Sandstone: Moderate-yellowish-brown (10YR 5/4), weathering yellowish gray (5Y 8/1 to 5Y 7/2); fine-grained; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; sandstone is capped by an iron layer; plant fragments and molds. 5

12. Siltstone: Dark-yellowish-brown (10YR 4/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 35

11. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); very fine grained; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; plant fragments and molds. 4

10. Siltstone: Olive-gray (5Y 4/1), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 41

9. Siltstone(?): Grayish-yellow (5Y 8/4), weathering yellowish gray (5Y 8/1 to 5Y 7/2); fine-grained; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 3

8. Siltstone: Light-olive-gray (5Y 6/1), weathering yellowish brown; silt; thinly laminated, flat-bedded; splits fissile; weathers smooth; forms a slope; plant fragments and imprints. 5

7. Sandstone: Dark-yellowish-brown (10YR 4/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); very fine grained; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 1

6. Siltstone: Medium-dark-gray (N 4), weathering yellowish brown; silt; thinly laminated, flat-bedded; splits fissile; weathers smooth; forms a slope; plant fragments and imprints. 11

5. Sandstone: Grayish-yellow (5Y 8/4), weathering yellowish gray (5Y 8/1 to 5Y 7/2); medium-grained; calcareous cement; thin-bedded; simple and trough crossbedding, medium-scale crossbeds; splits slabby; weathers smooth; forms a ledge; channeled; plant fragments and molds. 1

4. Siltstone: Light-olive-gray (5Y 6/1) and pale-yellowish-orange (10YR 8/6), weathering yellowish brown; silt; rounded; forms an irregular cliff; contains zones of ripple-marked and mud-cracked surfaces. 98

3. Sandstone: Moderate-reddish-brown (10R 4/6), weathering dark reddish brown (10R 3/4); very fine grained; firmly cemented; thin-bedded; large-scale crossbeds; weathers smooth and blocky; forms a cliff. 47

2. Conglomerate: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering light brown (5YR 6/4) to light gray (N 7); thin-bedded; weathers smooth; forms a ledge.
   Matrix: Composed of medium-grained silty sandstone; firmly cemented, calcareous.
   Gravel: Red chert pebbles, subrounded to angular, 7 to 50 mm in diameter; limestone pebbles, subrounded, less than 25 mm in diameter; colorless quartz granules, well-rounded. 2.0

Total Dinosaur Canyon Sandstone Member 314

Total Moenave Formation 368

UNCONFORMITY: Forms an erosion surface, contact sharp and undulating; depressions 1 foot deep on top surface of Chinle Formation.

UPPER TRIASSIC:
Chinle Formation:
Owl Rock Member:

1. Siltstone: Moderate-reddish-brown (10R 4/6); silt; calcareous cement; massive; weathers irregular and rough; forms a slope; contains abundant green spots; top of unit is bleached light grayish green. 3.0

B.—Echo Cliffs, south of Colorado River, 1½ miles southwest of Lees Ferry
29-5.5-10.2

[Measured by J. P. Akers and M. E. Cooley]

UPPER TRIASSIC(?):
Moenave Formation:
Dinosaur Canyon Sandstone Member:

22. Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; well-sorted; composed of subrounded to subangular, stained quartz; firmly cemented, calcareous; flat-bedded; forms an irregular ledge; contains abundant subrounded to subangular pebbles less than half an inch in diameter at base of unit; base is gradational. 10+

UPPER TRIASSIC:
Chinle Formation:
Owl Rock Member:

21. Siltstone: Pale-red (10R 6/2); weakly cemented, calcareous; flat, very thin bedded; forms a regular slope; base is gradational. 11

20. Limestone: Moderate-yellowish-brown (10YR 5/4) to pale-red (10R 6/2) and pale-red-purple (5RP 6/2); contains chert pockets and concretionary limestone; unit is mostly covered. 22

19. Limestone and limy siltstone: Composed chiefly of limestone nodules as much as 3 inches in diameter cemented in a limy siltstone matrix; unit is mostly covered; base is covered. 57

Total Owl Rock Member 90

Petrified Forest Member:

18. Siltstone: Pale-red (10R 6/2); silt; weakly to firmly cemented, calcareous; very thick bedded; forms a rolling slope; base is gradational. 32

17. Sandstone: Light-brown (5YR 6/4) to gray; medium- to coarse-grained; fair-sorted; composed of rounded to subrounded, clear, stained, and frosted quartz; black accessory minerals; weakly to firmly cemented, calcareous; irregular, thick to very thick bedded; unit is a coset; wedge simple crossbedding, low- to high-angle and small- to medium-scale crossbeds; weathers rounded; forms an irregular ledge; base is gradational. 9

16. Siltstone: Same as unit 10. 67

15. Sandstone: Same as unit 11. 5

14. Siltstone: Same as unit 10 except somewhat sandier. 22

13. Sandstone: Same as unit 11; conglomerate stringers near base same as conglomerate of unit 12. 11

12. Siltstone: Same as unit 10; contains 1 lenticular bed of gray conglomerate 2 feet thick; conglomerate is composed of angular quartz, angular limestone, and sandstone pebbles less than 3 inches in diameter; matrix is sandstone. 49

11. Sandstone: Grayish-purple (5P 4/2); medium- to coarse-grained; fair-sorted; composed of rounded to subrounded, clear, stained, and frosted quartz; mica and black accessory minerals; weakly to firmly cemented, calcareous; irregular, lenticular, thin to very thick bedded; unit is a coset; wedge simple, planar, and trough crossbedding, low- to high-angle and small- to medium-scale crossbeds; weathers rounded; forms an irregular ledge; base is gradational. 24

10. Sandy siltstone: Grayish-purple (5P 4/2); silt to fine-grained sand; poorly sorted; composed of rounded to subrounded, clear, stained, and frosted quartz; mica and black and red accessory minerals; firmly cemented, calcareous; irregularly bedded; unit is a coset; wedge simple and planar crossbedding, low-angle and medium- to large-scale crossbeds; weathers fluffy; forms a rolling slope; contains several thin sandy lenses same as unit 9; abundant limestone nodules near top; unit becomes sandier toward the top; abundant Unio(?) fossils at one horizon in middle of unit; base is gradational. 61

9. Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; poorly sorted; composed of rounded to subrounded, clear, stained, and frosted quartz; mica and black, red, and rare green accessory minerals; weakly to firmly cemented, calcareous; irregular, lenticular,

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER TRIASSIC—Continued — Feet

Chinle Formation—Continued

Petrified Forest Member—Continued

thick to very thick bedded; unit is a coset; wedge trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers blocky; forms an irregular ledge. 3

8. Mudstone: Light-brown (5YR 6/4) and grayish-purple (5P 4/2) streaks; poorly cemented, calcareous; lenticular, very thick bedded; weathers fluffy; forms a rolling slope. 190

7. Siltstone: Grayish-purple (5P 4/2); some clay; weakly cemented, calcareous; very thick bedded; weathers fluffy; forms a regular slope; contains several resistant lenses of sandstone same as unit 6; base is gradational. 32

6. Sandstone: Light-brownish-gray (5YR 6/1); fine- to medium-grained; fair-sorted; composed of clear, stained, and frosted quartz; green accessory minerals; firmly cemented, calcareous; irregular, lenticular, very thin to thin-bedded; unit is a coset; pseudocrossbedding; weathers blocky; forms an irregular slope; base is gradational. 11

5. Sandstone and siltstone: Pale-red (10R 6/2) to yellowish-gray (5Y 8/1); silt and fine to very coarse grained sand; poorly sorted; composed of rounded to subrounded, clear, stained, and frosted quartz; green accessory minerals; weakly to firmly cemented, calcareous; irregular, lenticular, thick to very thick bedded; wedge trough crossbedding, medium- to large-scale crossbeds; weathers rounded, blocky, and pitted; forms an irregular ledge; north of section unit is split into two parts by a wedge of siltstone; south of section unit is very irregular and consists of alternations of sandstone and siltstone; some horizons of sandstone contain stippled cream-colored conglomerate; base is gradational. 48

4. Mudstone: Grayish-orange-pink (10R 8/2) to light-bluish-gray (5B 7/1) and moderate-orange-pink (5YR 8/4); firmly cemented, calcareous; very thick bedded; weathers fluffy; contains resistant sandstone lenses at 35 and 70 feet above the bottom, and numerous small sandstone lenses about 4 inches thick and 10 feet long throughout unit; some sandstone lenses join together at low angles; contains some conglomerate; base is gradational. 104

3. Conglomerate: Pale-blue (5PB 7/2); very thick bedded; weathers smooth, rounded, and fluffy; grades upward into silty sandstone; base is gradational.

Matrix: Medium- to coarse-grained; poorly sorted; composed of rounded, clear, stained, and frosted quartz.

Gravel: Composed of subrounded chert and jasper pebbles less than $1\frac{1}{2}$ inches in diameter. 40

Total Petrified Forest Member 708

Shinarump Member:

2. Conglomeratic sandstone: Yellowish-gray (5Y 8/1); unit is a coset; wedge and tabular simple and trough crossbedding, concave low- to high-angle and small- to large-scale crossbeds; weathers blocky; common honeycomb weathering; forms a vertical cliff; unit becomes platy and silty near top; contains petrified logs, one of which is 3 feet in diameter and 50 feet in length; base is sharp and irregular.

Matrix: Fine to very coarse grained; poorly sorted; composed of rounded to subrounded, clear, stained, and frosted quartz; mica accessory mineral.

Gravel: Composed of well-rounded quartz and quartzite pebbles, and angular limestone and mudstone fragments as much as 6 inches in diameter; gravel is alined in stringers and thick lenses. 30+

Total Chinle Formation 828+

UNCONFORMITY: Erosional relief from channeling, 50 feet.

MIDDLE(?) AND LOWER TRIASSIC:

Moenkopi Formation:

1. Siltstone and sandy siltstone: Pale-reddish-brown (10R 5/4); silt to fine-grained sand; poorly sorted; weakly to firmly cemented, calcareous. 10+

C.—Base of Paria Plateau, north of Colorado River $1\frac{1}{2}$ miles west-southwest of Lees Ferry
29-6.5-9.5

[Measured by J. P. Akers and M. E. Cooley]

UPPER TRIASSIC:

Chinle Formation:

Shinarump Member:

7. Conglomerate: Weathers yellowish gray (5Y 8/1 to 5Y 7/2); weakly to firmly cemented, siliceous; irregular, thick to very thick bedded; trough crossbedding, medium-scale crossbeds; weathers blocky; forms an irregular ledge; contains numerous shaly lenses in lower half of unit; fluviatile environment; base is sharp and irregular.

Matrix: Composed of medium- to coarse-grained sand, poorly sorted.

Gravel: Composed of rounded to subrounded pebbles and cobbles as much as 6 inches in diameter, chiefly 1 to 2 inches in diameter. 93

UNCONFORMITY: 20 feet of relief; some channels are 300 feet wide and 20 feet deep, and are filled with medium- to coarse-grained conglomeratic sandstone; channels contain abundant subrounded to angular, yellowish-green mudstone fragments as much as 2 feet in diameter that form pits in the matrix as a result of weathering; trough crossbedding, medium- to large-scale crossbeds; top of Moenkopi Formation is marked by a 1-foot greenish-gray (5GY 6/1) bleached zone.

UPPER TRIASSIC(?)—Continued — Feet

Moenave Formation—Continued

Dinosaur Canyon Sandstone Member—Continued

21. Sandstone: Light-brownish-gray (5YR 6/1); fine-grained; occasional stringer of coarser material; rare mud pellets near bottom of unit; forms a cliff; joints and cracks are bleached white and lined with calcite crystals. 18

Total Moenave Formation 130

Contact: Appears erosional, small channels as much as 3 feet deep and 20 feet wide carved into the Chinle Formation; a few angular chert fragments are in the lower sandstone unit of the Moenave Formation.

UPPER TRIASSIC:

Chinle Formation:

Owl Rock Member:

20. Conglomerate: Grayish-orange-pink (10R 8/2); forms a slope; highly fractured and brittle.

Matrix: Very fine grained; composed of sandstone or siltstone.

Pebbles: Light-gray (N 7); composed of concretionary limestone and mudstone averaging half an inch in diameter. 3

19. Limestone: Pale-red (10R 6/2) to grayish-orange-pink (10YR 8/2), mottled; conglomeratic in local areas, with occasional angular sandy fragments ranging from $\frac{1}{2}$ to 2 inches in diameter; forms a ledge; contains much chert and jasper in irregular, discontinuous bands and in pockets; bands are parallel to bedding. 2

18. Conglomerate: Same as unit 20. 16

17. Limestone or limy siltstone: Pale-red (10R 6/2) and light-olive-gray (5Y 6/1); contains small, angular, red siltstone fragments and occasional concretionary limestone pebbles as much as 3 inches in diameter; forms a slope. 16

Total Owl Rock Member 37

Petrified Forest Member:

16. Siltstone: Pale-red (5R 6/2); contains many rounded, green, bleached spots; forms a slope. 80

15. Conglomerate: Light-brownish-gray (5YR 6/1); intricate high-angle crossbeds in sandier areas; forms a steep slope.

Matrix: Grayish-red-purple (5RP 5/2); fine-grained sandstone.

Pebbles: Rounded mud pellets averaging a quarter of an inch in diameter and concretionary limestone pebbles as much as three-eighths of an inch. 29

14. Sandstone: Pale-red (5R 6/2), with horizontal white streaks a quarter of an inch thick; fine- to medium-grained; simple crossbedding, high-angle crossbeds; forms a slope; contains several conglomerate lenses same as unit 15. 103

13. Sandstone: Pale-red (5R 6/2) to pinkish-gray (5YR 8/1); medium-grained; very friable; splits in paper-thin flakes; lenses of chocolate-colored mudstone $2\frac{1}{2}$ feet thick and resistant lenses of pink sandstone 6 inches thick; platy trough crossbedding in a $2\frac{1}{2}$-foot gray-green sandstone lens near top; toward bottom, unit becomes increasingly argillaceous and contains concretionary limestone pebbles and cobbles as much as 4 inches in diameter; forms a steep slope; contains much micaceous material. 165

12. Mudstone: Grayish-blue (5PB 5/2); occasional blue sandstone lenses 6 inches thick; some highly calcareous sandy pockets 2 inches in diameter; forms a slope. 110

Total Petrified Forest Member 437

Mesa Redondo Member of Cooley (1958):

11. Sandstone: Grayish-red (5YR 4/2), with white horizontal stripes and speckles; medium-grained; conglomeratic in local areas, with sandstone fragments as much as 2 inches in diameter; mudstone lenses less than 1 foot thick and mud pockets less than 1 foot in diameter; stringers of coarser material; simple crossbedding, low-angle and medium-scale crossbeds; forms a cliff. 13

10. Mudstone: Medium-gray (N 5), mottled; very sandy in places, with an occasional sandstone lens 1 foot thick and 30 feet long. 11

9. Sandstone: White (N 9) and a few pale-red (5R 6/2) bands; medium-grained; composed of quartz; calcite cement; friable; trough crossbedding, small-scale crossbeds; contains occasional quartz pebbles as much as a quarter of an inch in diameter. 11

8. Sandstone: Grayish-red-purple (5RP 5/2); very fine grained; numerous lenses of coarser sandstone, highly crossbedded with fissile parting; forms a cliff; contains much argillaceous material; ripple marks on foliation surfaces. 49

7. Sandstone: Pale-red-purple (5RP 6/2); shaly; friable; simple crossbedding, low-angle crossbeds. 17

6. Sandstone: Gray (N 8); medium- to coarse-grained; composed of quartz; intricate trough crossbedding, high-angle and medium- to large-scale crossbeds; forms a cliff that breaks off into large blocks; contains an occasional stringer of coarser material. 17

5. Sandstone: Pale-red (5R 6/2); very fine grained; formed of concretionary balls from $\frac{1}{2}$ to 3 inches in diameter; forms a cliff. 15

4. Sandstone: Light-gray (N 8); coarse-grained; poorly sorted; streaked with long, thin lenses of coarser material containing isolated well-rounded pebbles as much as $3\frac{1}{4}$ inches in diameter, 2 to 5 pebbles per square foot; splits scaly and friable on exposed surfaces; very low-angle crossbeds; forms a cliff. 33

3. Sandstone: Light-gray (N 8); fine-grained; friable; occasional horizontal streak of muddy material and occasional lens of hard, resistant sandstone; platy parting; forms

MIDDLE(?) AND LOWER TRIASSIC:
Moenkopi Formation:

6. Sandy siltstone: Grayish-red (10R 4/2); silt to very fine grained sand; fair-sorted; mica accessory mineral; weakly to firmly cemented, calcareous; flat, gnarly, very thin to thick-bedded; weathers blocky; forms an irregular ledge; beds appear massive on cliff face but are platy on weathered surface; beds are lenticular and grade laterally into weakly cemented siltstone that forms recesses; base is gradational. 43

5. Siltstone and mudstone, alternating: Grayish-red (10R 4/2); contains nontapered shrinkage cracks $\frac{1}{4}$ inch wide and $\frac{1}{2}$ inch deep, forming polygonal blocks as much as 3 inches on a side; polygonal blocks lie flat or are slightly inclined; siltstone beds are less than 5 feet thick and alternate with mudstone beds less than 2 feet thick; beds are lenticular and grade into each other in short distances; ripple marks are common at various intervals; abundant gypsum veinlets; some crystalline gypsum; sandier in upper third of unit; base is gradational.
   Siltstone: Silt and some very fine grained sand; fair-sorted; weakly to firmly cemented, calcareous; weathers blocky and smooth; forms an irregular ledge and rolling slope.
   Mudstone: Clay, silt, and very fine grained sand; poorly sorted; mica accessory mineral; weakly to firmly cemented; flat, gnarly, very thin bedded; weathers blocky and smooth; forms an irregular slope and ledge. 215

4B. Siltstone, sandy siltstone, and silty sandstone: Moderate-brown (5YR 3/4); abundant gypsum veinlets in upper 5 feet of unit; base is gradational.
   Siltstone: Silt and very fine grained sand; fair-sorted; mica accessory mineral; weakly to firmly cemented, calcareous; flat, very thin bedded; weathers smooth; forms a rolling slope and ledge.
   Sandy siltstone: Same as unit 4A.
   Silty sandstone: Same as unit 4A.

4A. Silty sandstone and sandy siltstone: Moderate-brown (5YR 3/4); silt and fine-grained sand; fair-sorted; forms an irregular slope; base is gradational.
   Silty sandstone: Mica accessory mineral; firmly cemented, calcareous; flat, very thin to thin-bedded; trough crossbedding; weathers blocky; contains ripple marks, some of which are one-eighth of an inch from crest to crest.
   Sandy siltstone: Poorly cemented, calcareous; flat, very thin to thin-bedded. 90

3. Siltstone and sandstone, alternating: Grayish-olive-green (5GY 3/2), weathering light brown (5YR 5/4); weathers blocky; forms an irregular ledge; lower half of unit contains thin beds of conglomerate same as unit 2A; some bleaching along vertical joints; abundant calcite geodes with crystals; weathering reveals platy nature of unit; base is gradational.
   Siltstone: Poorly cemented, calcareous; flat, very thin to thick-bedded.
   Sandstone: Silt and fine-grained sand; mica accessory mineral; firmly cemented, calcareous; flat, very thin to thick-bedded; asymmetrical trough crossbedding; contains ripple marks. 27

2B. Conglomerate and siltstone, alternating: Yellowish-gray (5Y 8/1 to 5Y 7/2); forms a transitional zone between units 2A and 3; base is gradational.
   Siltstone: Same as unit 3.
   Conglomerate: Same as unit 2A; irregular, very thin to thick-bedded; weathers blocky; forms an irregular ledge. 6

2A. Conglomerate: Yellowish-gray (5Y 8/1 to 5Y 7/2); irregular, very thick bedded; crossbedded; weathers pitted and knobby with solution holes; forms an irregular ledge.
   Matrix: Composed of clay to very coarse grained sand; poorly sorted; weakly to firmly cemented, calcareous.
   Gravel: Composed of chert, limestone, mudstone, and sandstone fragments as much as 3 feet in diameter. 29

Total Moenkopi Formation 410

UNCONFORMITY: Erosional, as much as 15 feet of relief caused by channeling; channels are filled with angular chert pebbles and cobbles $\frac{1}{4}$ to 8 inches in diameter, reworked from the Kaibab Formation, and subrounded sandstone boulders as much as 3 feet in diameter.

PERMIAN:
Kaibab Limestone:

1. Sandy and silty limestone: Grayish-olive-green (5GY 3/2), weathering yellowish gray (5Y 8/1 to 5Y 7/2); silt and fine-grained sand; well-cemented, calcareous; flat, gnarly, thin- to thick-bedded; weathers pitted and knobby; forms an irregular ledge and recesses in silty horizons; contains abundant chert. 10

10.—Lowery Spring

3 miles west of Navajo Bridge
29-11.0-12.0

[Measured by J. P. Akers]

UPPER TRIASSIC(?):
Moenave Formation:
Dinosaur Canyon Sandstone Member:

22. Sandstone: Moderate-reddish-orange (10R 8/6); fine-grained; massive, very thin bedded; exposed surfaces show characteristic rounded weathering and platy nature of apparently massive beds; forms a steplike slope; contains many mudstone lenses; mud cracks and ripple marks are common. 112

a cliff. 9

2. Sandstone: Light-olive-gray (5Y 6/1); fine-grained; fissile to platy parting; some structureless beds less than 1 foot thick; minutely crossbedded; forms a slope; contains much micaceous material; ripple marks on all foliation surfaces; contains ironstone surrounded by concentric stained rings as much as 8 inches in diameter. 31

Total Mesa Redondo Member 206

Shinarump Member:

1. Conglomeratic sandstone: Yellowish-gray (5Y 8/1); medium- to coarse-grained; well to poorly sorted; composed of rounded to subrounded quartz; minor black accessory minerals; trough crossbedding, low- to medium-angle and small- to large-scale crossbeds; contains petrified logs; pebbles in conglomeratic part are as much as 3 inches in diameter and alined in stringers; pebbles are composed of chert, quartzite, and petrified-wood chips. 50

Total Chinle Formation 780

UNCONFORMITY: Erosional relief of 15 feet.

11.—Cedar Ridge

A.—Along Echo Cliffs, half a mile east of Cedar Ridge Trading Post
61-0.4-7.8

[Measured by J. T. Callahan]

JURASSIC AND TRIASSIC(?):
Navajo Sandstone:

27. Sandstone: Pinkish-gray (5YR 8/1) to yellowish-gray (5Y 7/2) with dark-reddish-brown (10R 3/4) zones, weathering light gray (N 7) to brown; fine-grained; weakly cemented, calcareous; very thick bedded; large-scale crossbeds; forms a vertical cliff. 290

UPPER TRIASSIC(?):
Kayenta Formation:

26. Siltstone: Moderate-reddish-brown (10R 4/6), weathering moderate reddish brown (10R 4/6); silt; argillaceous cement; flat, very thin bedded; forms a ledge. 33.5

25. Sandstone: Moderate-reddish-orange (10R 6/6), weathering medium gray (N 5); fine-grained; calcareous cement; flat, thin-bedded; friable; forms a ledge; contains many ripple-marked surfaces. 6.0

24. Siltstone: Moderate-reddish-brown (10R 4/6), weathering dark reddish brown (10R 3/4); silt; argillaceous cement; flat, very thin bedded; weathers rough; forms a slope; unit contains two 1-foot beds of sandstone; top 3 inches is leached greenish gray (5GY 6/1); commonly contains greenish-gray (5GY 6/1) leached spots. 45.5

23. Sandstone: Pinkish-gray (5YR 8/1), weathering dark gray (N 3) to brown; fine-grained; thin-bedded; medium-scale crossbeds; weathers rough; forms a cliff. 28

22. Siltstone: Pale-reddish-brown (10R 5/4), weathering moderate reddish brown (10R 4/6); silt; flat, thin-bedded; forms a slope; part of unit is covered; contains leached streaks. 56.5

21. Sandstone: Pinkish-gray (5YR 8/1), weathering light gray (N 7); fine-grained; calcareous cement; splits friable; thin-bedded; small- to medium-scale crossbeds; forms a ledge; contains small lenses of green mudstone fragments. 2.0

20. Mudstone: Pale-red (10R 6/2), weathering moderate reddish brown (10R 4/6); flat, very thin bedded; forms a slope; unit is mostly covered. 13

19. Sandstone: Pale-reddish-brown (10R 5/4), weathering reddish brown; fine-grained; weakly cemented; very thin bedded; pseudocrossbedding; small-scale crossbeds; forms a ledge; contains abundant ripple marks. 5.0

18. Siltstone: Pale-reddish-brown (10R 5/4), weathering moderate reddish brown (10R 4/6); silt; weakly cemented; massive, very thin bedded; forms a slope; middle of unit contains a very fine grained, grayish-red (5R 4/2) sandstone bed 1 foot thick; contains abundant leached streaks. 32

17. Sandstone: White (N 9), weathering light gray (N 7); fine-grained; calcareous cement; splits friable; thin-bedded; medium-scale crossbeds; forms a ledge; contains mudstone fragments in lenses. 2.5

16. Siltstone: Pale-reddish-brown (10R 5/4), weathering moderate reddish brown (10R 4/6); silt; very thin bedded; forms a slope; 70 percent of unit is covered; contains abundant leached spots. 28

15. Sandstone: Pale-reddish-brown (10R 5/4) to moderate-reddish-brown (10R 4/6), weathering moderate reddish brown (10R 4/6); fine-grained; calcareous cement; flat, thin-bedded; forms a cliff; contains $\frac{1}{4}$-inch leached spots; contains conglomerate that lenses out within 20 feet horizontally. 18

14. Covered interval: Some pale-reddish-brown (10R 5/4) mudstone, splits fissile, laminated; forms a slope; contains leached streaks. 15.5

Total Kayenta Formation 285.5

Moenave Formation:
Springdale Sandstone Member:

13. Sandstone: Very light gray (N 8) to light-brown (5YR 6/4) locally, weathering medium gray (N 5); fine-grained; splits friable; thin-bedded; medium-scale crossbeds; forms a ledge. 6.0

12. Sandstone: Pale-reddish-brown (10R 5/4), weathering moderate reddish brown (10R 4/6); very fine grained; calcareous cement; massive; forms a slope; contains abundant leached spots; top few inches is a fissile-splitting mudstone. 13

100

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER TRIASSIC(?)—Continued — Feet
Moenave Formation—Continued
Springdale Sandstone Member—Continued
11. Sandstone: Pale-reddish-brown (10R 5/4), weathering light brown (5YR 5/6); fine-grained; calcareous cement; massive, very thick bedded; forms a cliff; contains an 8-inch bed of medium-grained sandstone 10 feet from top; contains lenticular pale-yellowish-brown (10YR 6/2) bands, 1 inch to 8 feet thick. 38.5
10. Conglomerate: Dark-reddish-brown (10R 3/4), weathering dark reddish brown (10R 3/4); thin-bedded; medium-scale crossbeds; forms a slope.
Matrix: Pale-reddish-brown (10R 5/4) sandstone, fine-grained.
Gravel: Flat mudstone pellets, 10 to 20 mm in diameter. 3.0
Total Springdale Sandstone Member 60.5

Dinosaur Canyon Sandstone Member:
9. Sandstone: Pale-red (10R 6/2), weathering moderate reddish brown (10R 4/6); fine-grained; calcareous cement; splits friable; thick-bedded; medium-scale crossbeds; forms a ledge. 5.0
8. Siltstone and sandstone: Pale-reddish-brown (10R 5/4), weathering moderate reddish brown (10R 4/6); silt to fine-grained sand; flat, thin to very thin bedded; forms a slope; thin sandstone beds, 1 to 2 feet thick, alternate with siltstone beds 5 to 8 feet thick. 40
7. Sandstone: Pale-reddish-brown (10R 5/4), weathering dark reddish brown (10R 3/4); fine-grained; calcareous cement; flat, very thin to thin-bedded; weathers smooth; forms a cliff; contains abundant ripple marks in upper 2 feet of unit; a 2-foot bed of grayish-red (10R 4/2) mudstone is 18 feet from bottom. 24.2
6. Siltstone: Moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4), weathering pale reddish brown (10R 5/4); silt; flat, very thin to thin bedded; small- to medium-scale crossbeds; forms a slope; contains abundant leached spots and streaks; contains interbedded fine-grained sandstone layers as much as 2 feet thick. 75
5. Sandstone: Light-brown (5YR 5/6), weathering moderate brown (5YR 3/4); fine-grained; weakly cemented; thin-bedded; small-scale crossbeds; forms a ledge; contains stringers of medium-grained white (N 9) sand. 14
4. Siltstone: Moderate-reddish-brown (10R 4/6), weathering light brown (5YR 5/6); silt; argillaceous cement; very thin bedded; small-scale crossbeds; forms a slope; contains small leached spots; upper 1 foot of unit is grayish-red (10R 4/2) mudstone; upper 1 inch is leached light greenish gray (5GY 8/1); top of unit is undulating. 15.5
3. Sandstone: Light-brown (5YR 5/6), weathering moderate brown (5YR 3/4); fine-grained; calcareous cement; flat, very thin bedded; forms a ledge; contains rare leached spots; upper 2 feet contains abundant ripple marks. 4.0
2. Conglomerate: Pale-reddish-brown (10R 5/4), weathering moderate reddish brown (10R 4/6); very thin bedded; forms a ledge; contains lenses.
Matrix: Very light gray (N 8) to pale-red (10R 6/2) sandstone, medium- to coarse-grained, calcareous cement.
Gravel: Composed of subrounded to angular, red chert, rare clear and gray quartz, and gray limestone; 4 to 15 mm in diameter. 2.0
Total Dinosaur Canyon Sandstone Member 179.7
Total Moenave Formation 240.2

UNCONFORMITY: Erosional surface; contact sharp, undulating, with channel 2 feet wide and 1 foot deep filled with conglomerate of overlying unit.
UPPER TRIASSIC:
Chinle Formation:
Owl Rock Member:
1. Siltstone: Moderate-reddish-brown (10R 4/6), weathering light brown (5YR 5/6); argillaceous cement; very thin bedded; forms a slope. 2.0

B.—Along U.S. Highway 89, 9 miles north-northwest of Cedar Ridge Trading Post
44-5.0-16.8

[Measured by J. P. Akers and M. E. Cooley]

UPPER TRIASSIC:
Chinle Formation:
Shinarump Member:
18. Conglomeratic sandstone: Very pale orange (10YR 8/2); medium to very coarse grained; poorly sorted; well to firmly cemented, siliceous; thick to very thick bedded; trough crossbedding; weathers blocky; forms an irregular ledge and slope; lower 10 feet is partly covered; base is concealed. 22
UNCONFORMITY: Erosional, channels as much as 10 feet deep.
MIDDLE(?) AND LOWER TRIASSIC:
Moenkopi Formation:
17. Sandstone: Same as unit 15. 12
16. Siltstone and mudstone: Same as unit 14. 2
15. Sandstone: Moderate-brown (5YR 4/4); very fine to fine-grained; fair-sorted; weakly to firmly cemented, calcareous; flat, very thick bedded; trough crossbedding; weathers rounded; forms a ledge; base is sharp. 8
14. Sandy siltstone and mudstone: Moderate-brown (5YR 4/4); clay to fine-grained sand; poorly sorted; weakly to firm-

12.—Coal Canyon

Head of Coal Canyon, 13½ miles southeast of Tuba City
77-2.0-15.4

[Measured by J. W. Harshbarger]

UPPER AND LOWER CRETACEOUS:
Dakota(?) Sandstone: — Feet
12. Sandstone: Medium-gray (N 5); very fine grained; firmly cemented, calcareous; thin-bedded; crossbedded; forms top of main cliff; contains abundant carbonaceous remains. 4.0
UNCONFORMITY: Erosional surface; relief, 0 to 4 feet; channeled into Cow Springs Sandstone.
UPPER JURASSIC:
Cow Springs Sandstone:
11. Sandstone: Very light gray (N 8); fine-grained; very weakly cemented, calcareous; thin-bedded, beds ⅛ to 1 inch thick; large-scale crossbeds; forms a smooth cliff; contains limonite streaks. 25
10. Sandstone: Yellowish-gray (5Y 7/2); fine-grained; very weakly cemented; thin-bedded; crossbedded; forms a pitted cliff. 49
9. Sandstone: Light-gray (N 7); very fine grained; weakly cemented; thin-bedded; crossbedded; forms a banded, smooth cliff; alternates with thin beds of pale-red (5R 6/2) sandstone. 31
8. Sandstone: Reddish-brown; very fine grained; flat, thin-bedded, beds ¼ to 2 inches thick; forms a smooth cliff; contains two maroon shale partings, 1 to 2 inches thick. 8.0
Total Cow Springs Sandstone 113

Entrada Sandstone:
7. Shale: Pale-red (5R 6/2) and grayish-red (5R 4/2); clayey texture; very weakly cemented; flat, thin-bedded; forms a smooth slope. 4.0
6. Sandstone: Very light gray (N 8); fine-grained; weakly cemented; thin-bedded; large-scale crossbeds; forms a pitted cliff. 64
Total Entrada Sandstone 68

UPPER AND MIDDLE JURASSIC:
Carmel Formation:
5. Sandstone: Pale-yellowish-orange (10YR 8/6); very fine grained; weakly cemented; flat, thin-bedded, beds ⅛ to ½ inch thick; forms a steep, smooth slope; commonly contains limonite streaks. 35
4. Sandstone: Yellowish-gray (5Y 7/2); fine-grained; flat-bedded; forms a ledge; contains abundant calcareous nodules and concretions. 1.5
3. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2); fine-grained; very weakly cemented; thin-bedded, beds ⅛ to 1 inch thick; crossbedded; forms a smooth slope; several pale-red (5R 6/2) shale stringers, 1 to 2 inches long. 53
2. Shale: Grayish-red (5R 4/2); clayey texture; weakly cemented; flat-bedded, paper-thin; forms a smooth slope. 9.0
1. Sandstone: Pinkish-gray (5YR 8/1); fine-grained; very weakly cemented; flat, thin-bedded; forms a long, smooth slope; contains abundant limonite streaks. 81
Total incomplete Carmel Formation 179.5

Valley: Covered by alluvium and vegetation.

13.—Willow Springs

Along Echo Cliffs, 8 miles west of Tuba City
78-7.55-5.25

[Measured by J. T. Callahan]

JURASSIC AND TRIASSIC(?):
Navajo Sandstone (incomplete):
26. Sandstone: Moderate-reddish-orange (10R 6/6), very fine grained; trough crossbedding, high-angle and large-scale crossbeds; weathers blocky and pitted; forms a cliff; base is sharp and flat. 105
UPPER TRIASSIC(?):
Kayenta Formation:
Silty facies:
25. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; gnarly, flat-bedded; weathers massive; forms a ledge. 2
24. Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; unit is a thin-bedded coset; crossbedded sets contain trough crossbedding, small- to medium-scale crossbeds; weathers massive to blocky; forms a ledge. 11
23. Siltstone: Pale-reddish-brown (10R 5/4); flat, thin-bedded; weathers massive; forms a slope; contains abundant gray spots. 5
22. Limestone: Light-gray (N 7); finely crystalline; flat, thin-bedded; weathers pitted; forms a ledge. 1
21. Sandstone: Light-brown (5YR 5/6); very fine grained; structureless; weathers massive; forms a ledge; commonly contains leached streaks and spots. 11
20. Sandstone and siltstone, interbedded: Sandstone is 1 to 10 feet thick; siltstone is 1 to 20 feet thick; unit is a flat-bedded coset; crossbedded sets contain trough crossbedding, medium-scale crossbeds; forms a partly covered slope. 156
19. Covered interval: Forms a slope. 84
18. Sandstone: White (N 9); very fine grained; trough cross-

ly cemented; flat, very thin to thick-bedded; weathers rounded; forms an irregular slope and ledge; commonly contains ripple marks; upper half of unit is composed of alternating beds of siltstone and mudstone; mudstone contains nontapered shrinkage cracks that outline small polygonal blocks; lower half of unit is covered; base is concealed. 33

13. Limy sandstone: Light-brownish-gray (5YR 6/1), weathering brownish gray (5YR 4/1); very fine grained sand; fair-sorted; well to firmly cemented; thick-bedded; trough crossbedding; weathers blocky; forms an irregular ledge; weathering reveals that entire unit is platy and ripple laminated; vertical joints common; open joints are lined with calcite crystals; base is gradational. 6

12. Limy sandstone: Brownish-gray (5YR 4/1), weathering light brownish gray (5YR 6/1); very fine to fine-grained; fair-sorted; well-cemented, calcareous; irregular, very thin to thin-bedded; weathers hackly; forms an irregular ledge; commonly contains ripple marks and calcite veinlets; base is sharp. 19

11. Sandstone: Brownish-gray (5YR 4/1), weathering yellowish gray (5Y 7/2); very fine to fine-grained; fair-sorted; firmly cemented, calcareous; flat, thick-bedded; trough crossbedding; weathers pitted with development of holes; forms a ledge; base is sharp and flat. 4

10. Silty sandstone: Moderate-brown (5YR 3/4); silt to fine-grained sand; fair to poorly sorted; weakly to firmly cemented, calcareous; flat, irregular, very thin to thin-bedded; trough crossbedding; weathers hackly; forms a recess; base is gradational. 8

(Section continued a quarter of a mile northwest of units 10 to 18.)

9. Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; fair-sorted; composed of quartz; firmly cemented, calcareous; flat, thin- to thick-bedded; trough crossbedding; weathers pitted, knobby, and etched; forms an irregular ledge; contains limonite streaks about $\frac{1}{6}$ x 5 inches; weathered surfaces appear sugary and glittery in the sunlight; commonly contains black iron concretions, $\frac{1}{4}$ to $\frac{1}{2}$ inch; recess occurs 3 feet from bottom, beds of which appear to be finer grained; vertical joints common; base is sharp and gradational. 34

8. Silty sandstone: Yellowish-gray (5Y 7/2); silt to very fine grained sand; weakly to firmly cemented, calcareous; irregular, very thin to thin-bedded; weathers pitted and etched; contains rare gypsum veins less than half an inch thick; base is gradational. 8

7. Mudstone: Yellowish-gray (5Y 7/2); clay, silt, and very fine to fine-grained sand; weakly cemented, calcareous; very thin bedded; weathers rounded and hackly; forms a rolling slope; units 7 and 8 appear to be bleached from ground water moving through unit 9; base is sharp. 4

6. Mudstone: Moderate-brown (5YR 3/4); clay and silt; fine-grained mica accessory mineral; weakly cemented, calcareous; very thin bedded; weathers hackly; forms an irregular slope; a 2-foot bed of more resistant thin-bedded silty mudstone occurs at 8 feet; base is gradational. 16

5. Siltstone and silty limestone: Moderate-brown (5YR 3/4); mica accessory mineral; weakly to firmly cemented, calcareous; irregular, very thin to thin-bedded; weathers blocky; forms an irregular slope; commonly contains ripple marks; unit consists of an alternation of siltstone forming recesses and crinkled-bedded ledges of limestone covered with a coating of muddy gypsum; maximum thickness of siltstone beds is 10 feet and limestone beds is 1 foot; base is gradational. 76

4. Siltstone: Moderate-brown (5YR 3/4); mica accessory mineral; weakly to firmly cemented, calcareous; flat, very thin bedded; weathers smooth; forms a rolling slope; commonly contains ripple marks and shrinkage cracks; unit has several sandy and limy horizons at widely spaced intervals; contains some 6-inch-thick sandstone ledges that are bleached; upper 48 feet of unit is covered; base is sharp. 138

3B. Silty sandstone: Yellowish-gray (5Y 7/2); silt to very fine grained sand; poorly sorted; firmly cemented, calcareous; flat, thin- to thick-bedded; forms an irregular ledge; commonly contains ripple marks; lithology is same as unit 3A except that sandstone ledges are more prominent; base is gradational. 6

3A. Sandstone and sandy siltstone: Light-gray (N 7) to very pale orange (10YR 8/2), weathering greenish gray (5G 6/1); silt to fine-grained sand; poorly sorted; weakly to firmly cemented, calcareous; flat, very thin to thin-bedded; weathers blocky; forms an irregular ledge; commonly contains ripple marks; base is sharp. 7

2. Conglomerate: Light-gray (N 7) to yellowish-gray (5Y 7/2); irregular, thick to very thick bedded; weathers blocky and etched; forms an irregular ledge; contains some mudstone beds; base is sharp and irregular.
   Matrix: Clay to coarse-grained sand; poorly sorted; firmly cemented, calcareous.
   Gravel: Pebbles and cobbles, as much as 6 inches in diameter at base of unit and progressively smaller towards top; composed of angular chert. 10

Total Moenkopi Formation 391

UNCONFORMITY: Erosional, channels 4 feet deep; contact above unconformity is bleached.

PERMIAN:
Kaibab Limestone:

1. Sandy limestone: Yellowish-gray (5Y 8/1); very fine to fine-grained sand; fair to poorly sorted; firmly cemented, calcareous; flat, thick to very thick bedded; weathers pitted and knobby; forms a ledge; contains solution pits and abundant calcite geodes. 10+

bedding, medium-scale crossbeds; weathers massive to blocky; forms a ledge. 4

17. Sandstone: Pale-red (10R 6/2); fine-grained; gnarly, flat, thin-bedded; forms a slope; contains abundant light-green (5G 7/4) streaks. 3

16. Sandstone: Pale-red (10R 6/2); fine-grained; gnarly, flat, thin-bedded; weathers massive to blocky; forms a ledge; contains abundant leached streaks. 6

15. Covered interval: Forms a slope. 33

14. Sandstone: Pale-red (10R 6/2); very fine grained; very thick bedded; weathers massive to blocky; forms a ledge. 4

13. Covered interval: Forms a slope. 21

12. Sandstone: Pale-red (10R 6/2); very fine grained; flat, thin-bedded; weathers massive to blocky; forms a ledge; contains abundant leached spots; base is sharp and irregular. 30

11. Sandstone: Pale-red (10R 6/2); very fine grained; planar crossbedding, medium-scale crossbeds; forms an irregular cliff; contains mud-cracked surfaces. 12

10. Mudstone: Grayish-red (5R 4/2); flat, laminated bedding; weathers massive; forms a ledge; contains green leached spots. 2

9. Covered interval: Forms a bench and slope. 110

Total Kayenta Formation 495

Moenave Formation:
Springdale Sandstone Member:

8. Sandstone: Light-brown (5YR 6/4); fine-grained; trough crossbedding, low-angle and medium-scale crossbeds; weathers massive; forms a cliff; contains mud lenses at bottom; unit is lenticular. 40

7. Sandstone: Pale-red (10R 6/2); very fine grained; trough crossbedding, low-angle and medium-scale crossbeds; weathers massive to blocky; forms a cliff; contains interbedded lenses of sandstone and mud-pellet conglomerate; unit is lenticular. 37

Total Springdale Sandstone Member 77

Dinosaur Canyon Sandstone Member:

6. Sandstone and siltstone, interbedded: Unit is a flat, lenticularly bedded coset; crossbedded sets contain trough crossbedding, small- to medium-scale crossbeds; forms a slope; contains a few thin mudstone beds. 89

5. Covered interval: Forms a slope. 182

4. Sandstone: Very light gray (N 8); very fine to medium-grained; trough crossbedding, medium-scale crossbeds; weathers massive to rounded; forms a cliff; contains stringers of coarse sand and ripple-marked surfaces. 34

3. Siltstone: Moderate-brown (5YR 4/4); flat, laminated bedding; weathers shaly; forms a slope; top of unit is leached gray. 2

2. Conglomerate: Pale-reddish-brown (10R 5/4); trough crossbedding, small-scale crossbeds; weathers massive and pitted; forms a ledge.
   Matrix: Medium-grained sandstone.
   Gravel: Siltstone pebbles, 20 to 37 mm in diameter; mudstone pellets, 7 to 13 mm in diameter; subrounded red chert pebbles, 10 mm in diameter; colorless quartz granules. 1

Total Dinosaur Canyon Sandstone Member 308

Total Moenave Formation 385

UNCONFORMITY: 1 to 2 feet of relief.

UPPER TRIASSIC:
Chinle Formation (incomplete):

1. Siltstone: Light-brown (5YR 6/4); flat, thin-bedded; weathers knobby; forms a slope; commonly contains leached spots. 5

14.—Marble Platform

East side of Marble Platform, 20 miles southwest of Gap Trading Post
79-7.0-12.3

[Measured by J. P. Akers and M. E. Cooley]

UPPER TRIASSIC:
Chinle Formation:
Shinarump Member:

13. Conglomeratic sandstone: Pale-yellowish-orange (10YR 8/6); irregular, very thick bedded; unit is a coset; asymmetrical and wedge trough crossbedding, medium-scale crossbeds; forms a rounded cliff; rare angular limestone fragments; contains petrified logs, one of which is 3 feet in diameter; base is sharp.
   Matrix: Fine to very coarse grained; poorly sorted; composed of rounded to subrounded, clear, stained, and frosted quartz; firmly cemented, siliceous.
   Pebbles: As much as 1 inch in diameter. 17

MIDDLE(?) AND LOWER TRIASSIC:
Moenkopi Formation:

12. Siltstone: Same as unit 10. 27

11. Sandstone: Same as unit 9. 2

10. Sandy siltstone: Moderate-brown (5YR 4/4); fair-sorted; composed of clear, stained, and frosted quartz; weakly cemented, calcareous; flat-bedded; pseudocrossbedding; forms an irregular slope; base is gradational. 6

9. Sandstone: Moderate-brown (4YR 4/4); silt and very fine grained sand; poorly sorted; composed of subrounded to subangular quartz; firmly cemented, calcareous; flat-bedded; forms a vertical cliff; base is gradational. 11

8. Siltstone and sandstone, interbedded: Siltstone beds are as much as $1\frac{1}{2}$ feet thick and sandstone beds are as much as 2 feet thick; shrinkage cracks and current marks occur

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

MIDDLE(?) AND LOWER TRIASSIC—Continued — Feet

Moenkopi Formation—Continued

near top of unit; top sandstone of unit is lenticular; base is sharp.

Siltstone: Moderate-yellowish-brown (10YR 5/4); mica accessory mineral; weakly cemented, calcareous; irregular, very thin bedded; pseudocrossbedding; forms recesses.

Sandstone: Moderate-brown (5YR 4/4), weathering moderate yellowish brown (10YR 5/4); very fine grained; fair-sorted; composed of subrounded to subangular, clear and frosted quartz; firmly cemented, calcareous; flat, irregularly bedded; unit is a coset; pseudocrossbedding; forms an irregular slope. 71

7. Limy sandstone: Grayish-yellow (5Y 8/4), weathering light brown (5YR 6/4); very fine grained; fair-sorted; composed of subrounded to subangular, clear and frosted quartz; mica and rare black accessory minerals; firmly cemented, calcareous; very thick bedded; unit is a coset; asymmetrical and wedge trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers pitted; forms a vertical cliff; base is sharp. 36

6B. Sandy siltstone: Moderate-yellowish-brown (10YR 5/4); same as unit 5; contains seams of gypsum and appears to contain less sandstone; gypsum seams are horizontal and as much as 1 inch thick; unit has several resistant limestone ledges as much as 4 inches thick; near top of unit is a vertical cliff that has subdued hoodoo weathering; units 5, 6A, and 6B are very similar and could be shown as one unit; base is gradational. 104

6A. Silty sandstone: Moderate-yellowish-brown (10YR 5/4); very fine grained; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; mica accessory mineral; firmly cemented, calcareous; irregular, very thin to thin-bedded; pseudocrossbedding; weathers hackly; forms an irregular ledge; contains some very thin beds of grayish-orange (10YR 7/4) limestone; base is gradational. 3

5. Sandy siltstone: Moderate-yellowish-brown (10YR 5/4); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; mica and some red accessory minerals; weakly cemented, calcareous; flat, very thin bedded; weathers hackly; forms an irregular slope; commonly contains ripple marks; base is gradational. 76

4. Limy siltstone: Moderate-yellow (5Y 7/6); silt and medium- to coarse-grained sand; poorly sorted; composed of subangular to angular, clear and frosted quartz; firmly cemented, calcareous; flat, irregular, thin- to thick-bedded; weathers blocky and pitted; forms a ledge; unit contains abundant chert granules; base is sharp. 2

3. Limy conglomerate: Grayish-yellow (5Y 8/4), weathering moderate yellow (5Y 7/6); firmly cemented, calcareous; flat, irregular, thin- to thick-bedded; base is concealed.

Matrix: Very fine to fine-grained sand.

Pebbles: Angular chert and limestone fragments as much as half an inch in diameter. 1

2. Limy conglomerate: Grayish-yellow (5Y 8/4); firmly cemented, calcareous; flat, irregularly bedded; weathers pitted and knobby; base is sharp.

Matrix: Very fine to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear and frosted quartz.

Pebbles: Angular chert and limestone fragments $\frac{1}{16}$ to 3 inches in diameter. 2

Total Moenkopi Formation 341

UNCONFORMITY: Erosional, 5 feet of relief.

PERMIAN:

Kaibab Limestone:

1. Sandy limestone: Grayish-yellow (5Y 8/4); very fine grained; composed of subrounded to subangular, clear, stained, and frosted quartz; flat, gnarly, thick to very thick bedded; weathers pitted, knobby, and etched; forms an irregular ledge; abundant calcite geodes. 15+

15.—Dinosaur Canyon

Ward Terrace, 3 miles south of Dinosaur Canyon and 20 miles south of Tuba City
97-12.5-10.5

[Measured by J. T. Callahan and R. L. Jackson]

JURASSIC AND TRIASSIC(?):

Navajo Sandstone (incomplete):

6. Sandstone: Light-gray (N 7); fine- to medium-grained; fair-sorted; composed of rounded to subrounded, clear quartz; rare black accessory minerals; firmly cemented; trough crossbedding, high-angle and large-scale crossbeds; weathers massive and blocky; forms a vertical cliff; contains four thin beds of aphanitic light-gray (N 7) limestone and one 3-foot bed of dark-reddish-brown (10R 3/4) mudstone that wedges out along exposure; base is sharp and flat. 314

UPPER TRIASSIC(?):

Kayenta Formation:

Silty facies:

5. Sandstone, mudstone, and some limestone: Banded with brown, gray, and some reddish brown; flat, lenticularly bedded; weathers rounded, blocky, and knobby; forms an irregular slope; channeling common; sandstone predominates near bottom; limestone contains abundant bedded chert. 89

MIDDLE(?) AND LOWER TRIASSIC—Continued — Feet

Moenkopi Formation—Continued

careous; flat, thick-bedded; unit is a set; pseudocrossbedding; weathers hackly; forms an irregular ledge; base is gradational. 8

7. Siltstone and mudstone: Pale-reddish-brown (10R 5/4); clay, silt, and very fine to fine-grained sand; mica accessory mineral; weakly cemented, calcareous; flat, irregular, very thin to thin-bedded; pseudocrossbedding; weathers hackly; forms a regular slope; base is gradational. 15

6. Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; red accessory minerals; weakly to firmly cemented, calcareous; irregular, lenticular, thin to very thick bedded; unit is a coset; lenticular, wedge, and tabular trough crossbedding; concave low- to high-angle and small- to large-scale crossbeds; some pseudocrossbedding; weathers blocky; forms a vertical and irregular cliff; bedding is very lenticular, some lenses thicken from 0 to 6 feet in a lateral distance of 40 feet; mud fragments weather out, leaving pits; mudstone lenses are as much as 2 feet thick; base is sharp. 26

5. Siltstone and sandstone: Same as unit 4 except that siltstone forms rounded cliff faces; sandstone ledges occur at 16 feet and at the bottom; base is gradational. 31

4. Siltstone and silty sandstone: Pale-reddish-brown (10R 5/4); commonly contains shrinkage cracks as large as 8 inches across and $\frac{1}{2}$ inch wide; a few beds contain raindrop impressions; base is gradational.

Siltstone: Silt and fine-grained sand; fair to poorly sorted; feldspar accessory mineral; weakly cemented, calcareous; flat, irregular, very thin bedded; pseudocrossbedding; forms an irregular slope.

Silty sandstone: Silt to fine-grained sand; fair-sorted; composed of subrounded to subangular quartz; firmly cemented, calcareous; flat, thin- to thick-bedded; pseudocrossbedding; weathers hackly. 7

3. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; fair-sorted; composed of subrounded to subangular, clear and frosted quartz; rare red accessory minerals; firmly cemented, calcareous; very thick bedded; tabular trough and simple crossbedding, concave medium-scale crossbeds; weathers blocky; forms a vertical cliff; some layers are flat bedded; base is sharp. 47

2. Siltstone and silty sandstone, alternating: Pale-reddish-brown (10R 5/4); siltstone beds are less than 1 foot thick and sandstone beds are as much as 2 feet thick; sandstone beds are very lenticular near top of unit; gypsum incrustations are as much as half an inch thick along joints; base is sharp.

Siltstone: Silt and very fine to fine-grained sand; fair to poorly sorted; composed of clear, stained, and frosted quartz; mica and red accessory minerals; weakly cemented, calcareous; flat, irregular, very thin to thin-bedded; pseudocrossbedding; forms an irregular slope.

Silty sandstone: Silt to fine-grained sand; fair to poorly sorted; composed of clear, stained, and frosted quartz; red accessory minerals; weakly to firmly cemented, calcareous; flat, very thin to thin-bedded; trough crossbedding, small- to medium-scale crossbeds; pseudocrossbedding; forms an irregular ledge and slope. 87

Total Moenkopi Formation 366

PERMIAN:

Kaibab Limestone:

1. Sandy limestone: Very fine grained; composed of subrounded to subangular, clear, stained, and frosted quartz; well-cemented, calcareous; flat, irregular, thick to very thick bedded; weathers pitted and etched; forms a vertical cliff; contains chert and common calcite geodes. 50+

17.—Black Point

A.—Northeast of Black Point, northeast of Little Colorado River, and 14 miles southeast of Cameron
116-12.0-1.0

[Measured by J. H. Stewart, H. F. Albee, O. B. Raup, and F. G. Poole]

Top of section, not top of exposure.

UPPER TRIASSIC(?):

Moenave Formation:

Dinosaur Canyon Sandstone Member (incomplete):

14. Sandstone: Light-brown (5YR 5/6), weathering light brown (5YR 5/6); mostly very fine to fine-grained, about 15 percent is medium to very coarse grained; fair-sorted; composed of subrounded, clear quartz; medium to very coarse grains are rounded and composed of milky quartz and rare orange and gray grains; weakly cemented, calcareous; composed of horizontal beds and thin trough and planar sets of small- to medium-scale crossbeds; splits massive; forms bare, rounded knolls; basal 1.5 feet is light greenish gray (5GY 8/1); basal contact is sharp and horizontal; only basal 15 feet examined.

UPPER TRIASSIC:

Chinle Formation:

Owl Rock Member:

Tongue of Navajo Sandstone:

4. Sandstone: Light-brown (5YR 6/4); very fine grained; well-sorted; composed of subrounded to subangular clear and stained quartz; rare black accessory minerals; poorly cemented; trough crossbedding, low-angle and small-scale crossbeds; weathers massive; forms a vertical cliff; contains rare chert fragments 1 inch in diameter; base is sharp. 26

Silty facies continued:

3. Siltstone, mudstone, and some limestone: Banded with brown, gray, and reddish brown; flat, lenticularly bedded; weathers rounded, blocky, and knobby; forms an irregular slope; channeling common; limestone contains abundant flat-bedded chert; base is sharp and flat. 563

Total Kayenta Formation (including tongue of Navajo Sandstone) 678

Moenave Formation:

Dinosaur Canyon Sandstone Member:

2. Sandstone, siltstone, and cherty limestone: Moderate-reddish-brown (10R 4/6) to gray (N 6).
   - Limestone: Moderate-gray (N 7); aphanitic; flat, thin-bedded; weathers knobby and pitted; contains jasper and chert; caps unit.
   - Sandstone: Very fine grained; trough crossbedding, low-angle and small- to medium-scale crossbeds.
   - Siltstone: Very thick bedded; weathers irregular; forms irregular rolling slope; base is sharp and irregular. 202

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member:

1. Sandstone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; poorly sorted; composed of subrounded to subangular, stained and frosted quartz; rare black accessory minerals; firmly cemented, calcareous; flat, lenticular, very thick bedded; unit is a coset; trough crossbedding, low- to high-angle and small- to large-scale crossbeds; weathers massive and blocky; forms a rounded cliff. Bottom of unit contains a 2- to 6-inch bed of flat mud pellets, as much as 1 inch in diameter, and rare chert pebbles (5 mm) in a matrix of coarse-grained clear quartz and red chert sand. This bed overlies the unconformity. This unit is not representative of the Lukachukai Member of the Wingate Sandstone, as it is at its marginal limits and is not present a short distance to the northwest. Base is sharp and irregular. 74

Unconformity: Slight relief.

Chinle Formation: Undescribed.

16.—Moenkopi Wash

North side of Little Colorado River, 1 mile downstream from mouth of Moenkopi Wash and 3 miles northwest of Cameron
98-12.1-6.3

[Measured by J. P. Akers and M. E. Cooley]

UPPER TRIASSIC:

Chinle Formation:

Shinarump Member:

25. Conglomerate: Pale-greenish-yellow (10Y 8/2); firmly cemented, siliceous; flat, irregularly bedded; simple and trough crossbedding, concave low-angle and medium- to large-scale crossbeds; forms a vertical cliff; contains a petrified log 2 feet in diameter and 20 feet long; base is sharp.
   - Matrix: Fine- to coarse-grained sand; composed of rounded to subrounded, clear, stained, and frosted quartz; mica accessory mineral.
   - Pebbles: As much as 4 inches in diameter; composed of well-rounded quartz. 53

24. Sandstone: Pale-purple (5P 6/2), weathering pale purple (5P 6/2); medium-grained; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; mica accessory mineral; firmly to weakly cemented, siliceous; flat-bedded; unit is a coset; wedge and tabular simple and planar crossbedding, small- to medium-scale crossbeds; forms a vertical and rounded cliff; base is gradational. 25

23. Siltstone: Pale-blue-green (5BG 7/2); weakly cemented, calcareous; flat, very thick bedded; forms an irregular slope; base is sharp. 11

Total Chinle Formation 89

UNCONFORMITY: Erosional, 20-foot relief.

MIDDLE(?) AND LOWER TRIASSIC:

Moenkopi Formation:

22. Sandstone: Same as unit 8. 10
21. Siltstone and mudstone: Same as unit 7. 13
20. Limestone conglomerate: Moderate-yellowish-brown (10YR 5/4); well-cemented, calcareous; weathers pitted; forms a ledge; may be fossiliferous. 2
19. Siltstone and mudstone: Same as unit 7. 7
18. Sandstone: Same as unit 8. 7
17. Siltstone and mudstone: Same as unit 7. 24
16. Sandstone: Same as unit 8. 1
15. Siltstone and mudstone: Same as unit 7. 13
14. Sandstone: Same as unit 8. 15
13. Siltstone and mudstone: Same as unit 7. 17
12. Sandstone: Same as unit 8. 1
11. Siltstone and mudstone: Same as unit 7. 17
10. Sandstone: Same as unit 8. 5
9. Siltstone and mudstone: Same as unit 7. 13
8. Sandstone: Pale-reddish-brown (10R 5/4); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; mica and black and red accessory minerals; firmly cemented, calcareous; structureless; rare horizontal stratification planes; fractures into angular fragments; forms a ½-mile-wide flat; parts of unit are poorly exposed; thick interval contains abundant limestone nodules at 118.8 feet. 148.8
11. Siltstone and limestone: Unit forms a bench and badlands topography, with minor ledges and conspicuous benches on the top limestone bed; unit is spread over about three-quarters of a mile along line of section.
   - Siltstone: Light-brown (5YR 6/4), pale-reddish-brown (10R 5/4), and rare grayish-red (5R 4/2), weathering light brown (5YR 6/4); nonbentonitic; firmly cemented, noncalcareous; structureless; fractures into small angular fragments.
   - Limestone: Pale-red (5R 6/2 and 10R 6/2) and light-greenish-gray (5GY 8/1); dense, aphanitic; common seams and granule-size masses of coarsely crystalline calcite; well-cemented; flat, very thin to thick-bedded; six thin to thick beds of limestone are interstratified with the siltstone; limestone nodules are common in thick to very thick intervals; the limestone beds comprise about 6 feet of the unit. 142.8
10. Limestone: Pale-red (10R 6/2) and light-greenish-gray (5GY 8/1); dense, aphanitic; well-cemented; flat, thin-bedded; forms a vertical cliff and underlies an extensive bench that extends for several miles; unit 10 and top part of unit 9 form most conspicuous cliff in Chinle Formation, which caps cuesta; about 25 percent of unit contains thin-bedded pale-reddish-brown (10R 5/4) siltstone interstratified with the limestone; unit contains rare stringers of orange and white chert; the limestone beds in this unit appear to be more continuous than the limestone in the top part of unit 9. 5.6

Total Owl Rock Member 328.2

Petrified Forest Member:

9. Claystone, siltstone, and silty limestone. Claystone and siltstone: Pale-red (5R 6/2), commonly mottled with greenish gray (5GY 6/1); bentonitic; firmly cemented, calcareous in parts; structureless. Silty limestone: Pale-red (10R 6/2), commonly mottled with greenish gray (5GY 6/1); aphanitic; well-cemented. Limestone nodules are generally about 1 inch in diameter; a few irregular lenses of limestone are in top 15 feet; limestone nodules in basal 17 feet form about 70 percent of unit and in part form an interconnecting network; limestone nodules constitute about 30 percent of unit from 17 to 45.2 feet above base, about 5 percent of unit from 45.2 to 86.4 feet, and about 50 percent of unit from 86.4 feet to top of unit. To north of line of section, the unit from 45.2 to 86.4 feet appears to contain sandstone similar to that of unit 8; entire unit is tabular; forms a steep slope and ledge in the basal 17 feet and a vertical cliff, continuous with that of unit 10, from 86.4 to 108.5 feet. 108.5
8. Claystone and sandstone. Claystone: Grayish-red-purple (5RP 4/2) and rare pale-reddish-brown (10R 5/4), weathering pale red (5R 6/2); bentonitic; firmly cemented; structureless. Sandstone: Light-greenish-gray (5GY 8/1) and yellowish-gray (5Y 8/1), commonly mottled with grayish red (10R 4/2), weathering yellowish gray (5Y 8/1); very fine to coarse-grained; poorly sorted; composed of subangular, clear and milky quartz; some coarse-grained dark-green mica and common orange accessory minerals; firmly cemented, noncalcareous; composed of thin trough sets of low-angle and small-scale crossbeds. Entire unit forms a steep slope and badlands topography; along line of section sandstone forms middle third of unit, but away from line of section the sandstone channels into and in places entirely cuts out the underlying claystone unit; thin resistant bed of sandstone from 36.1 to 36.9 feet forms a small ledge. 96
7. Silty claystone and silty limestone: Unit is tabular; forms most prominent ledge in the Chinle Formation below the ledge capping the cuesta.
   - Silty claystone: Grayish-red-purple (5RP 4/2), weathering pale red purple (5RP 6/2); bentonitic; firmly cemented, noncalcareous; structureless.
   - Silty limestone: Light-greenish-gray (5GY 8/1) and pale-red (5R 6/2); aphanitic; well-cemented; contains rare rounded granule-size masses of limestone; irregular nodules of silty limestone are as much as 9 inches in diameter; thin lenses of silty limestone extend for at least 50 feet along the outcrop; silty limestone constitutes about 50 percent of the unit. 14.5
6. Clayey sandstone, siltstone, and claystone. Clayey sandstone: Light-greenish-gray (5GY 8/1) and light-brownish-gray (5YR 6/1) with minor pale-reddish-brown (10R 5/4) mottling, weathering pale red (10R 6/2) and light greenish gray (5GY 8/1); same type of clayey sandstone as in unit 4; clayey sandstone has some horizontally laminated sets and some thin trough sets of low-angle and small-scale crossbeds. Siltstone and claystone: Pale-reddish-brown (10R 5/4), pale-red (10R 6/2), and pale-red-purple (5RP 6/2), weathering pale reddish brown (10R 5/4); bentonitic; firmly cemented; structureless.
13. Siltstone and limy siltstone: Unit forms a steep slope containing conspicuous light-colored bands developed on the limy siltstone; thick interval contains common limestone nodules 4 feet below the top; about 1.5 feet of unit is limy siltstone.
   - Siltstone: Same as siltstone in unit 11.
   - Limy siltstone: Light-greenish-gray (5GY 8/1) and pale-red (10R 6/2); firmly cemented; flat, very thin to thin-bedded; limy siltstone lenses are interstratified with the siltstone. 31

UPPER TRIASSIC--Continued — Feet

Chinle Formation--Continued

Petrified Forest Member--Continued

Entire unit forms steep badland slopes; unit differentiated from units below by presence of conspicuous pale-reddish-brown (10R 5/4) bands; commonly contains limestone nodules; forms a continuous ledge along line of section from 111.7 to 122.8 feet, which ledge contains abundant pale-olive (10Y 6/2) claystone beds; abundant large limestone nodules are in a claystone bed about 3 feet thick at bottom of this ledge; about 60 feet of unit is claystone; base of unit is near or at base of cliffs and is placed arbitrarily below lowest pale-reddish-brown (10R 5/4) band. 183.1

5. Clayey sandstone, siltstone, and claystone: Same as unit 4 except that unit is about 50 percent red with rare purple and 50 percent gray; in addition, the unit has many thin to very thick intervals containing common to abundant limestone nodules; these nodules are light greenish gray (5GY 8/1) and pale red (10R 6/2) and average from ½ to 1 inch in diameter; about 100 feet of unit is claystone and siltstone; units 4 and 5 are exposed completely but form a broad flat about 3½ miles wide; the thickness of units 4 and 5 was calculated with the help of a plane-table traverse. 116

4. Clayey sandstone, siltstone, and claystone: Light-greenish-gray (5GY 8/1), light-gray (N 7), medium-light-gray (N 6), greenish-gray (5GY 6/1), common grayish-red (5R 4/2 and 10R 4/2), and rare pale-red (5R 6/2) and grayish-red-purple (5RP 4/2), weathering yellowish gray (5Y 8/1), light greenish gray (5GY 8/1), and rare purple and red, colors banded. Clayey sandstone: Very fine to medium-grained; poorly sorted; composed principally of subangular milky quartz, about 10 percent orange and green grains, and about 5 percent medium- to coarse-grained dark-green mica; weakly cemented, argillaceous; stratification appears to be expressed as color bands; color bands are horizontal with breaks a few inches to as much as 20 feet apart; probably 10 to 20 percent of the clayey sandstone has color bands that indicate it is composed of trough sets of low-angle and large-scale crossbeds, which are generally 5 to 10 feet thick. Siltstone and claystone: All gradations from claystone to sandy siltstone; firmly cemented; structureless or in horizontal bed from 5 to 20 feet thick. Clay in unit is bentonitic; entire unit forms badland topography; unit forms lighter colored badlands near bottom of Chinle Formation; many silicified tree logs in zone from 92 to 102 feet below top of unit; logs are as large as 4.2 feet in diameter and 85 feet long; about 70 feet of unit is claystone and siltstone; the clayey sandstone commonly contains clay galls. 400

3. Sandstone: Yellowish-gray (5Y 8/1) and grayish-red (10R 4/2), streaked and mottled; fine-grained, rare medium to coarse grains; fair-sorted; composed of subangular, milky quartz; medium-grained dark mica and orange and gray accessory minerals; abundant interstitial white material; firmly cemented, slightly calcareous; composed of thin planar sets of small- to medium-scale crossbeds; forms a ledge and underlies bench; top 5 to 10 feet of unit is well cemented with calcareous cement and appears to form an irregular contact with unit 4; lateral relations of unit are complex and poorly exposed, in places a 10-foot bed of siltstone separates the unit, to the south the sandstone overlying the siltstone probably pinches out in a few hundred feet, to the north the siltstone pinches out and the unit is entirely a massive sandstone; also, to the north the unit appears to fill a broad channel that cuts out unit 2. 40.6

Total Petrified Forest Member 958.7

Shinarump Member:

2. Conglomerate and pebbly sandstone, sandstone, and siltstone: Entire unit is lenticular; forms a ledge and underlies a prominent bench.

Conglomerate and pebbly sandstone (80 percent of unit): Very pale orange (10YR 8/2), pale-yellowish-orange (10YR 8/6), pale-red (10R 6/2), and grayish-red (5R 4/2), weathering very pale orange (10YR 8/2) and pale yellowish orange (10YR 8/6).

Matrix: Fine to very coarse grained; poorly sorted; composed of subangular, clear quartz.

Gravel: Granules to pebbles composed of rounded quartz, quartzite, and rare chert; average diameter ½ to 1 inch, maximum diameter 2 inches; weakly cemented, noncalcareous; composed of thin to thick, trough sets of medium-scale crossbeds; most sets are poorly defined; partly structureless.

Sandstone (10 percent of unit): Same as conglomerate and pebbly sandstone, except that some parts are fair sorted and fine grained.

Siltstone (10 percent of unit): Light-gray (N 7) and pale-red (5R 6/2), weathering light gray (N 7) and pale red (5R 6/2); well-cemented, noncalcareous; forms irregular lenses, some of which appear to be boulders. 30.3

Total Chinle Formation 1,317.2

UNCONFORMITY: Contact of Shinarump Member and Moenkopi Formation is sharp and has minor irregularities as much as 1 foot in depth; to the north of the section the contact appears to form a channel cutting at least 3 feet into the Moenkopi Formation.

MIDDLE(?) AND LOWER TRIASSIC:

Moenkopi Formation (incomplete):

1. Siltstone: Pale-reddish-brown (10R 5/4) and grayish-red (10R 4/2), weathering pale reddish brown (10R 5/4)

MIDDLE(?) AND LOWER TRIASSIC--Continued — Feet

Moenkopi Formation--Continued

3. Siltstone and silty sandstone, alternating:

Siltstone: Pale-reddish-brown (10R 5/4); silt to very fine grained sand; weakly cemented, calcareous; flat, irregular, lenticular, very thin to thin-bedded; sandstone ledges occur 5 and 45 feet from base; mudstone and mud cracks are near top of unit; forms a regular slope.

Silty sandstone: Pale-reddish-brown (10R 5/4); silt to coarse-grained sand; poorly sorted; composed of subangular, clear quartz; weakly cemented, calcareous; flat, lenticular, very thin to thin-bedded; pseudocrossbedding; weathers blocky and hackly; forms an irregular ledge; common calcite geodes; some coarse-grained sand stringers and siltstone fragments; mud cracks; base is gradational. 72

2. Conglomeratic and limy sandstone: Moderate-orange-pink (10R 7/4); very fine grained; fair-sorted; composed of subangular grains; weakly to firmly cemented, calcareous; flat, irregular, thin- to thick-bedded; weathers blocky; forms an irregular ledge; contains angular chert fragments as much as 2 inches in diameter; base is sharp. 1

Total Moenkopi Formation 307

PERMIAN:

Kaibab Limestone:

1. Sandy limestone: Grayish-orange (10YR 7/4); fine- to medium-grained sand; irregular, flat-bedded; weathers blocky and pitted; forms an irregular ledge. 10

DISTRICT 4

18.--North Low Mountain

Low Mountain, 8 miles east-southeast of Pinon
73-5.6-13.6

[Measured by J. P. Akers and H. G. Page]

UPPER CRETACEOUS:

Toreva Formation:

6. Conglomeratic sandstone: Light-yellowish-gray (5Y 8/2), weathering very pale orange (10YR 8/2); fine to very coarse grained; poorly sorted; contains subrounded to subangular pebbles as much as half an inch in diameter; pebbles are coarser and more prevalent in upper part of unit; firmly cemented; flat, thin to very thick bedded; unit is a coset; wedge, asymmetrical, and plunging trough crossbedding, concave high-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; contains brown to black siltstone lenses as much as 10 feet thick; base is gradational and irregular. 76

5. Siltstone: Dusky-brown (5YR 2/2) to black (N 1); clay to very fine grained sand; poorly sorted; weakly cemented; flat, thin to very thin bedded; weathers hackly to smooth; forms an irregular slope; base is gradational and irregular. 40

4. Sandstone: Light-yellowish-gray (5Y 8/2); fine- to medium-grained; fair-sorted; mica and iron-rich accessory minerals; firmly cemented; flat, thick to very thick bedded; unit is a coset; wedge planar crossbedding, concave low-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; a dark-brown titaniferous sandstone bed, 1 to 6 inches thick, caps unit; base is gradational and irregular. 13

3. Siltstone and sandstone: Weathers hackly; forms an irregular slope; base is gradational and irregular.

Siltstone: Dusky-brown (5YR 2/2) to black (N 1), weathering brown to black; clay and silt.

Sandstone: Light-yellowish-gray (5Y 8/2); fine- to medium-grained; poorly sorted; mica and iron-rich accessory minerals; weakly to firmly cemented; flat, very thin to thick-bedded; tabular and asymmetrical trough crossbedding, concave high-angle and small-scale crossbeds. 38

2. Sandstone: Light-yellowish-gray (5Y 8/2), weathering very pale orange (10YR 8/2); silt to very coarse grained sand; poorly sorted; mica, selenite, and iron-rich accessory minerals; weakly to firmly cemented; flat, very thin to very thick bedded; unit is a coset; tabular, asymmetrical, and plunging trough crossbedding; concave high-angle and medium-scale crossbeds; tabular planar crossbedding and low-angle crossbeds in basal 11 feet of sandstone; weathers blocky; forms a vertical cliff; contains carbonaceous siltstone layers as much as 6 inches thick and brown siltstone; base is gradational and irregular. 25

Total Toreva Formation 192

Mancos Shale (incomplete):

1. Siltstone and sandstone: Gray and dusky-brown (5YR 2/2); clay to fine-grained sand; poorly sorted; selenite crystals accessory mineral; weakly to firmly cemented; flat, very thin to thin-bedded; weathers hackly; forms an irregular slope; contains Collignoniceras [Prionotropis woollgari Mantell(?)] zone at base, fragmental specimens found in float below, none found in place; unit is bleached; base is gradational and concealed. 15

19.--Wepo Wash

West side of Wepo Wash, 6½ miles northeast of Pinon
73-8.9-4.8

[Measured by J. P. Akers and H. G. Page]

and grayish red (10R 4/2); common very fine grained white mica accessory mineral; well-cemented, noncalcareous; flat, very thin to thick-bedded; minor ripple bedding; forms a steep rubble-covered slope; about 30 feet of unit is exposed; contains some gray and purple bands; top 5 feet is massive.

Base of section, base of exposure.

B. —South of Black Point, west of Little Colorado River, and 17 miles south-southeast of Cameron
117-4.5-4.0

[Measured by M. E. Cooley, J. P. Akers, and P. R. Stevens]

UPPER TRIASSIC:
Chinle Formation:
Shinarump Member:

11. Conglomeratic sandstone: Olive-gray (5Y 4/1).
    Matrix: Very fine to very coarse grained; composed of subrounded to subangular, clear and stained quartz; black and red accessory minerals; well-cemented, siliceous.
    Pebbles: Well-rounded; composed of quartz, quartzite, jasper, and some dark volcanic material as much as 1 inch in diameter; alined in stringers and concentrated in lenses. Wedge simple and trough crossbedding, low- to high-angle and medium- to large-scale crossbeds; weathers blocky; forms a vertical ledge; base is gradational. 22
10. Conglomerate: Yellowish-gray (5Y 8/1).
    Matrix: Very coarse grained; poorly sorted; composed of angular quartz sand; black and red accessory minerals; well-cemented, siliceous.
    Pebbles: Same as pebbles in unit 11 but more evenly disseminated throughout unit. High-angle and small- to medium-scale crossbeds; weathers blocky; forms a vertical ledge; base is sharp. 5

Total Chinle Formation 27

UNCONFORMITY: Erosional; 1-foot bleached zone in top of Moenkopi Formation; relatively flat.

MIDDLE(?) AND LOWER TRIASSIC:
Moenkopi Formation:

9. Sandy siltstone: Pale-reddish-brown (10R 5/4); silt to medium-grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; mica accessory mineral; firmly cemented, calcareous; lenticular, thin-bedded; forms an irregular rolling slope; contains several sandstone lenses as much as 2 inches thick; near top unit becomes muddy and color changes to a variegated and mottled blue gray, yellow, orange, and brown; base is gradational. 36
8. Sandstone: Pale-reddish-brown (10R 5/4); silt to medium-grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; black accessory minerals; weakly to firmly cemented, calcareous; lenticular, thin- to thick-bedded; lenticular and wedge crossbedding, small-scale crossbeds; weathers blocky; forms an irregular ledge; numerous bone fragments in conglomeratic lenses; unit contains several siltstone beds similar to unit 7A; swash(?) and rill marks on some foliation surfaces; base is gradational and irregular. 20

7E. Siltstone: Same as unit 7A. 27
7D. Siltstone and sandstone, alternating: Sandstone is same as unit 7B, with ripple marks. 6
7C. Siltstone: Same as unit 7A. 22
7B. Sandstone: Pale-yellowish-brown (10YR 6/2); very fine to fine-grained; fair sorted; composed of subrounded, clear and stained quartz; biotite accessory mineral; weakly cemented, calcareous; lenticular, flat-bedded; pseudocrossbedding; weathers blocky; forms a ledge; base is sharp. 6
7A. Sandy siltstone: Dark-reddish-brown (10R 3/4); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular quartz; mica accessory mineral; weakly cemented, calcareous; flat, irregular, lenticular, very thin to thin-bedded; weathers hackly; forms an irregular slope; contains a few very fine grained sandstone beds; common bleached zones and gypsum stringers; base is gradational. 40

6. Sandy siltstone and sandstone, alternating.
    Sandy siltstone: Grayish-red (5R 4/2); silt to very fine grained sand; poorly sorted; composed of subrounded clear quartz; weakly cemented, calcareous; flat, irregular, lenticular, very thin to thin-bedded; weathers blocky and hackly; base is gradational.
    Sandstone: Pale-reddish-brown (10R 5/4); silt to medium-grained sand; poorly sorted; composed of rounded to subrounded, clear and stained quartz; weakly cemented, calcareous; flat, irregular, lenticular, very thin to thin-bedded; pseudocrossbedding; weathers blocky and hackly; forms an irregular ledge; base is gradational. 34
5. Limy sandstone: Pinkish-gray (5YR 8/1); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; black accessory minerals; firmly cemented, calcareous; lenticularly bedded; lenticular simple and trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers blocky and pitted; forms a vertical cliff; base is flat and sharp. 40
4. Sandy siltstone: Light-olive-gray (5Y 5/2) and light-red (5R 6/6); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular grains; argillaceous material; weakly to firmly cemented, calcareous; flat, lenticular, very thin to thin-bedded; weathers blocky and rounded; forms an irregular ledge; base is gradational. 3

UPPER CRETACEOUS:
Yale Point Sandstone:

12. Sandstone: Yellowish-gray (5Y 8/1); very fine to medium-grained; fair to poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; feldspar and mica accessory minerals; weakly to firmly cemented; tabular planar and asymmetrical trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers blocky; forms an irregular cliff; commonly contains encrustations of iron oxide and iron-stained petrified wood; base is irregular and gradational. 50

Wepo Formation:

11. Siltstone and sandstone: Base is gradational.
    Siltstone: Light-gray (N 7) to dark-gray (N 3) and brown; weakly cemented; flat, very thin to thin-bedded; weathers smooth; forms an irregular to regular slope; contains carboniferous material.
    Sandstone: Yellowish-gray (5Y 8/1); very fine to medium-grained; high-angle crossbeds; forms a ledge. 314
10. Sandstone: Yellowish-gray (5Y 8/1); silt to very coarse grained sand; fair to poorly sorted; composed of subrounded to subangular, clear, stained, amber, and frosted quartz; feldspar accessory mineral; firmly cemented; irregular, lenticular, thick to very thick bedded; wedge, tabular, and asymmetrical trough crossbedding; low-angle and medium-scale crossbeds; weathers rounded, pitted, and knobby; forms an irregular cliff; vertical jointing; base is sharp. 28
9. Siltstone or mudstone: Olive-gray (5Y 3/2) to black (N 1); weakly cemented; flat, laminated to thin-bedded; weathers smooth; forms a regular slope; lenticular sandstone beds occur throughout unit; base is gradational. 73
8. Sandstone: Yellowish-gray (5Y 8/1); very fine to coarse grained; fair to poorly sorted; composed of subrounded to subangular, clear and frosted quartz; feldspar and mica accessory minerals; weakly to firmly cemented; irregular, lenticular, thin to very thick bedded; asymmetrical trough crossbedding, medium-scale crossbeds; weathers rounded and blocky; forms an irregular ledge and slope; commonly contains iron concretions as much as 3 inches in diameter and flattened mud pellets; carbonized plant fragments common along bedding planes; base is sharp. 23
7. Silty sandstone: Yellowish-gray (5Y 8/1); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular quartz; mica accessory mineral; weakly cemented; irregular, very thin to thin-bedded; forms an irregular ledge and slope; unit becomes progressively silty toward top until it becomes a siltstone; contains an iron-cemented ledge of medium-grained dusky-yellow (5Y 6/4) sandstone having trough crossbedding and containing iron concretions as much as 2 inches in diameter; a 5-foot-thick bed of lignite occurs near top of unit; base is gradational. 84
6. Sandstone: Same as unit 4; crossbedding is better developed than in unit 4; iron stains along crossbeds; commonly contains iron-stained concretions as much as 8 inches in diameter near the top; two bluish-gray mudstone lenses $3\frac{1}{2}$ feet thick occur in unit; unit is conglomeratic toward top. 67
5. Mudstone and sandstone: Sandstone beds occur about 20 and 45 feet above base of unit; base is concealed.
    Mudstone: Olive-green; mica accessory mineral; weakly to firmly cemented; forms a regular slope.
    Sandstone: Yellowish-gray (5Y 8/1); very fine to medium-grained; fair-sorted; composed of clear, stained, and frosted quartz; mica accessory mineral; weakly to firmly cemented; irregular, lenticular, thick to very thick bedded; asymmetrical trough crossbedding, small-scale crossbeds; weathers pitted and knobby; forms a ledge and slope. 67

Total Wepo Formation 656

Toreva Formation:

4. Conglomeratic sandstone: Yellowish-gray (5Y 8/1); fine to very coarse grained; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; feldspar and mica accessory minerals; firmly cemented; irregular, lenticular, gnarled, thin to very thick bedded; tabular simple and trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers rounded, pitted, and knobby; forms an irregular cliff; commonly contains mudstone lenses and fragments; contains numerous resistant iron-stained zones; base is irregular and sharp. 50
3. Siltstone: Pale-yellowish-brown (10YR 6/2); clay, silt, and medium-grained sand; composed of quartz; mica accessory mineral; weakly cemented; flat, irregular, very thin to thin-bedded; unit is carboniferous and contains several sandstone lenses; alternating sandstone and mudstone beds near top of unit; base is gradational. 47
2. Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; fair to poorly sorted; composed of clear, stained, frosted, and amber quartz; weakly to firmly cemented, calcareous; irregular, lenticular, very thick bedded; wedge trough crossbedding, low-angle and medium-scale crossbeds; weathers rounded, pitted, and knobby; forms an irregular cliff; contains rare limy lenses and is gnarly near bottom; contains a few beds of brown carbonaceous siltstone; shark's teeth in lower limy ledge; base is gradational. 45

Total Toreva Formation 142

Mancos Shale:

1. Siltstone: Dark-gray (N 3) to black (N 1) and brown; weakly cemented; very thin to thin-bedded; forms an

Table 3. - Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER CRETACEOUS—Continued — Feet

Mancos Shale—Continued

irregular slope; lignite at various horizons near top; contains pelecypods near base; base is concealed. 13

DISTRICT 6

20.—Toreva

Second Mesa, 2 miles north-northwest of Toreva and 7 miles southeast of Oraibi
95-0.6-12.2

[Measured by H. G. Page and J. M. Evensen]

UPPER CRETACEOUS:

Toreva Formation:

8. Sandstone: Yellowish-gray (5Y 8/1) to very pale orange (10YR 8/2); very fine to very coarse grained; poorly sorted; subrounded to subangular grains; weakly to firmly cemented; flat, thin to very thick bedded; lenticular and plunging planar crossbedding, high-angle and medium-scale crossbeds; weathers massive and blocky; forms a vertical cliff; contains argillaceous material and flattened clay galls as much as 2 inches in diameter; iron-rich concretions less than 5 inches in diameter are common near top; fluviatile environment; base is sharp. 61

7. Sandstone: Yellowish-gray (5Y 8/1); medium-grained; high-angle crossbeds. 18

6. Sandstone and siltstone, interbedded: Yellowish-gray (5Y 8/1) to green; clay to medium-grained sand; poorly sorted; weakly to firmly cemented; flat, very thin to thick-bedded; weathers smooth to blocky; forms irregular slopes and ledges; base is gradational and irregular.

Unit consists, in descending order, of:

d.	Siltstone: Green.	5.5
c.	Claystone: Brownish-green.	12.5
b.	Siltstone: Buff.	.5
a.	Mudstone: Light-brownish-green.	3.5

22

5. Sandstone: Yellowish-gray (5Y 8/1); fine- to coarse-grained; poorly sorted; flat, thin to very thick bedded; unit is a coset; lenticular and plunging trough crossbedding, high-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; contains argillaceous inclusions; a 3-foot-thick zone composed of alternating sandstone and siltstone occurs 7 feet above bottom of unit; iron-rich cap as much as 6 inches thick; fluviatile environment; base is sharp. 40.5

4. Claystone, coal, mudstone, and siltstone, alternating: Light-gray (N 7) to black (N 1); clay to fine-grained sand; poorly sorted; weakly to firmly cemented; flat, irregular, very thin to thick-bedded; weathers smooth to blocky; forms an irregular slope; base is gradational and irregular.

Unit consists, in descending order, of:

n.	Siltstone: Buff.	7.75
m.	Siltstone: Green.	.50
l.	Siltstone: Brownish-green.	3.00
k.	Claystone: Purple.	5.25
j.	Mudstone: Brown.	3.50
i.	Sandstone: Yellowish-gray (5Y 8/1).	4.00
h.	Mudstone: Dusky-brown (5YR 2/2).	3.00
g.	Lignite: Black (N 1).	4.50
f.	Claystone: Light-gray (N 7); baked.	.25
e.	Lignite: Black (N 1).	2.50
d.	Claystone: Light-gray (N 7); baked.	.25
c.	Mudstone: Dusky-brown (5YR 2/2).	3.50
b.	Coal: Black (N 1); subbituminous.	5.00
a.	Mudstone: Black (N 1); carbonaceous.	1.00

44

3. Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; fair-sorted; weakly to firmly cemented; flat, irregular, thin to very thick bedded; unit is a coset; lenticular trough crossbedding, concave high-angle and medium-scale crossbeds; weathers blocky and massive; forms a vertical cliff; fluviatile environment; base is sharp.

Unit consists, in descending order, of:

e.	Sandstone: Yellowish-gray (5Y 8/1).	14.5
d.	Surface of erosion(?).	
c.	Sandstone: Yellowish-gray (5Y 8/1); lenticular.	2.0
b.	Sandstone: Light-buff.	24
a.	Sandstone: Light-gray (N 7).	8.5

49

2. Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); fine-grained; well-sorted; weakly to firmly cemented; flat, thick to very thick bedded; unit is a coset; tabular and plunging planar crossbedding, concave low-angle (lower 20 feet) to high-angle (upper 58 feet) and medium- to large-scale crossbeds; weathers massive and blocky; forms a vertical cliff; argillaceous parting planes; base is gradational and irregular.

UPPER CRETACEOUS—Continued — Feet

Mancos Shale—Continued

1. Limy siltstone and sandstone: Yellowish-gray (5Y 8/1) to dusky-brown (5YR 2/2); silt to fine-grained sand; slightly crystalline; fair-sorted; mica and red accessory minerals; firmly cemented; flat, gnarly, thin-bedded; unit is a coset; concave medium-angle and small-scale crossbeds; weathers blocky; forms an irregular ledge; fucoids are present; also present are Collignoniceras (Prionotropis) woollgari, abundant plant fragments, Inoceramus(?), and fish vertebrae; base is sharp and irregular. 0.5

Total incomplete Mancos Shale 19.5

22.—Tovar Mesa

26 miles northeast of Leupp
114-7.5-14.0

[Measured by R. L. Jackson and J. T. Callahan]

UPPER TRIASSIC(?):

Kayenta Formation:

12. Cherty limy sandstone and sandy limestone: Light-gray (N 7), moderate-reddish-orange (10R 6/6), and moderate-reddish-brown (10R 4/6), mottled; fine- to medium-grained; poorly sorted; composed of subangular, frosted quartz; common red accessory minerals; well-cemented, highly calcareous; irregularly and gnarly bedded; weathers rough and knobby; forms an irregular ledge and caps mesas in the area; abundant chert and jasper inclusions; base is sharp and irregular. 5.0

Unconformity: Erosional, 5 to 10 feet of relief.

Moenave Formation:

Dinosaur Canyon Sandstone Member:

11. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2); very fine to coarse-grained; poorly sorted; composed of rounded to subangular, clear and frosted quartz; common red and rare black accessory minerals; argillaceous material; weakly cemented; trough crossbedding, high-angle crossbeds; weathers rough; forms an irregular cliff; contains rare secondary chert inclusions that are concentrated along bedding planes; base is sharp and irregular. 15

10. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2) and moderate-reddish-brown (10R 4/6); medium-grained; poorly sorted; composed of subangular, clear and stained quartz; rare red and black accessory minerals; weakly cemented, calcareous; massive, flat-bedded; contains some trough crossbedding, high-angle and medium-scale crossbeds; weathers smooth and rounded; forms a recess; contains mudstone partings and rare petrified wood; base is sharp and irregular. 7.8

9. Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; common black accessory minerals; well-cemented; simple and trough crossbedding, low- to high-angle and medium- to large-scale crossbeds; weathers smooth and rounded; forms a rounded cliff; unit contains lenses of mudstone and siltstone that thin visibly along the strike; base is sharp. 61.3

8. Mudstone: Dark-reddish-brown (10R 3/4); firmly cemented; gnarly and irregularly bedded; weathers hackly; forms a recess; unit is lenticular and thins visibly along strike; base is sharp. 5.0

7. Siltstone: Moderate-reddish-brown (10R 4/6); abundant black accessory minerals; firmly cemented; flat-bedded; trough crossbedding, low-angle crossbeds; weathers rough; forms an irregular slope; flat-bedded units grade upward into crossbedded units, which average 4 feet in thickness; base is sharp and flat. 33.8

6. Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); very fine grained; fair-sorted; composed of subangular, clear and stained quartz; common black accessory minerals; firmly cemented; simple and trough crossbedding, low- to high-angle and large-scale crossbeds; weathers smooth and rounded; forms a rounded cliff; base is sharp and flat. 46.7

5. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2), weathering dark gray (N 3); very fine to fine-grained; poorly sorted; composed of subrounded to subangular, clear and frosted quartz; rare black and amber accessory minerals; well-cemented, calcareous and siliceous; irregular, thin-bedded; weathers flaggy; forms a ledge; contains common calcite geodes one-sixteenth of an inch in diameter; contains dinosaur tracks on the upper surface; base is flat. 1.0

4. Sandstone: Pale-reddish-brown (10R 5/4), weathering moderate brown (5YR 4/4 to 5YR 3/4); silt to very fine grained sand; poorly sorted; composed of subrounded to subangular, stained quartz; abundant black and common red accessory minerals; well-cemented; simple and trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers knobby; forms a rounded cliff; contains poorly preserved dinosaur tracks; thin lenses of dusky-red (5R 3/4) mudstone; base is concealed. 62.2

3. Covered interval: Forms irregular and rolling flats. 49.7

2. Limestone: Light-brownish-gray (5YR 6/1), weathering medium brownish gray (5YR 5/1); coarsely crystalline; gnarly, very thin bedded; weathers pitted; forms an irregular ledge; contains poorly preserved plant remains; base is sharp and flat. 1.5

1. Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; poorly sorted; composed of rounded, clear and stained quartz; rare black accessory minerals; very thin bedded; simple and trough crossbedding, low-angle and medium-

Unit consists, in descending order, of:

g. Sandstone.	20.5	
f. Mudstone lens.	1.0	
e. Sandstone.	12	
d. Mudstone.	2.0	
c. Sandstone.	15	
b. Mudstone.	3.0	
a. Sandstone.	25	78.5

Total Toreva Formation 313

Mancos Shale (incomplete):

1. Mudstone: Grayish-buff; clay to silt; fair-sorted; weakly cemented; selenite accessory mineral; flat, laminated to very thin bedded; weathers smooth; forms a rolling slope; silt content increases toward top; concretions common; base is concealed. 137.5

21. —Awatobi

East side of Jeddito Wash, 10 miles southwest of Keams Canyon
113-4.3-2.0

[Measured by H. G. Page, C. A. Repenning, and J. P. Akers]

UPPER CRETACEOUS:
Toreva Formation:

8. Sandstone: Yellowish-gray (5Y 8/1), weathering very pale orange (10YR 8/2) to grayish orange pink (10R 8/2); fine to very coarse grained; poorly sorted; feldspar and mica accessory minerals, some red zones; firmly cemented; flat, thin to very thick bedded; unit is a coset; wedge, asymmetrical, and plunging trough crossbedding, concave low- to medium-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; unconsolidated rock deformation is present in form of slumping and folding of strata; commonly contains mud pellets, flattened lenses as much as 6 inches in diameter, and sand concretions as much as 3 inches in diameter; conglomeratic toward top, pebbles as much as half an inch in diameter; claystone lens 3 feet thick near top; base is gradational and irregular. 110
7. Siltstone and sandstone: Yellowish-gray (5Y 8/1); clay to medium-grained sand; poorly sorted; mica and black [manganese(?)] accessory minerals; weakly to firmly cemented; flat, very thin to thin-bedded; sandstone unit is a coset; wedge trough crossbedding, low- to medium-angle and medium-scale crossbeds; weathers smooth to blocky; forms an irregular slope with sandstone ledges; commonly contains sand concretions as much as 1½ inches in diameter; sandstone lens in middle of unit has low-angle and medium-scale crossbedding, with unconsolidated rock deformation present; carbonized wood float found in middle of unit; crumbly brownish-green claystone 97 feet above bottom of unit; interbedded siltstone and sandstone in upper 7 feet; base is gradational and irregular. 110
6. Sandstone: Yellowish-gray (5Y 8/1); fine-grained; well-sorted; mica and black and red accessory minerals; firmly cemented; flat, thin- to thick-bedded; unit is a coset; tabular trough crossbedding, concave low-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; vertical jointing, trending northeast and northwest sets; commonly contains sand concretions as much as 1 inch in diameter; fossil fucoids are present; middle of unit is carbonaceous and contains common plant fragments; lower 5 feet weathers to a slope; base is gradational and irregular. 87
5. Sandstone: Yellowish-gray (5Y 8/1) to very pale orange (10YR 8/2); fine- to medium-grained; fair-sorted; mica accessory mineral; firmly cemented; flat, thick-bedded; unit is a coset; wedge, asymmetrical, and plunging trough crossbedding, concave low-angle and medium-scale crossbeds; weathers blocky and massive; forms a vertical cliff; vertical jointing; commonly contains sand concretions as much as 3 inches in diameter; lower 16 feet is very pale orange (10YR 8/2) and has very low angle crossbeds; upper 11 feet is yellowish gray (5Y 8/1) and has medium-angle crossbeds; thin siltstone lenses are present; iron-rich dusky-brown (5YR 2/2) cap a few inches thick is at top of unit; fluviatile environment; base is gradational and irregular. 27
4. Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; fair-sorted; mica and black accessory minerals; firmly cemented; flat, thin-bedded; unit is a coset; wedge trough crossbedding, concave low-angle and medium-scale crossbeds; weathers blocky to hackly; forms an irregular slope; commonly contains sand concretions as much as 1 inch in diameter and thin lenses of brown siltstone; fish and sharks' teeth, fish scales, and reptile bone found; base is gradational and irregular. 24
3. Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; fair-sorted; mica accessory mineral; well-cemented; flat, thin- to thick-bedded; unit is a coset; wedge and tabular trough crossbedding, concave low-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; commonly contains siltstone lenses as much as 1½ feet thick; unconsolidated rock deformation present; sharks' teeth found 10 feet above bottom and in iron-rich brown lens, 5 inches thick, on top of unit; base is sharp and irregular. 31

Total Toreva Formation 389

Mancos Shale:

2. Siltstone: Grayish-brown (5YR 3/2); clay to very fine grained sand; poorly sorted; black and red accessory minerals; weakly cemented; flat, laminated to very thin bedded; weathers hackly; forms an irregular slope; clam shells found in silty sandstone 15 feet above bottom of unit; base is sharp and irregular. 19

scale crossbeds; weathers smooth and rounded; forms a rounded and vertical cliff; base is concealed. 35.8

Total incomplete Moenave Formation 319.8

23. —Blue Point

15 miles southwest of Oraibi
115-4.10-0.75

[Measured by C. A. Repenning and William Kam]

UPPER CRETACEOUS:
Toreva Formation:
Lower sandstone member:

10. Undescribed. 40

Tongue of Mancos Shale:

9. Undescribed. 25

Lower sandstone member continued:

8. Undescribed. 25

Total incomplete Toreva Formation (including tongue of Mancos Shale) 90

Mancos Shale:

7. Upper slope unit: Undescribed. 47
6. Ledge-forming unit containing ammonite fossils: Undescribed. 57
5. Lower slope unit: Undescribed; cone-in-cone structure 238 feet above bottom; lowest Inoceramus labiatus zone occurs 53 feet above base and contains abundant I. labiatus, abundant Neocardioceras sp., and common fragments and rare recognizable specimens of Ostrea sp.; highest Gryphaea newberryi zone occurs 26 feet above bottom and contains abundant G. newberryi, common Exogyra columbella, common coral similar to Haimesiastraea conferta Vaughan, and G. wratheri(?). 320

Total Mancos Shale 424

UPPER AND LOWER CRETACEOUS:
Dakota Sandstone:

4. Claystone, carbonaceous siltstone, and coal: Dark-gray (N 3); flat, laminated to very thin bedded; forms a regular slope; upper 10 feet is coal; contains abundant gypsum crystals; upper contact with Mancos Shale is sharp and irregular; contains common Gryphaea newberryi; lower contact is gradational. 20
3. Sandstone: Grayish-yellow (5Y 8/4); medium-grained; well-sorted; composed of subrounded to subangular, clear and frosted quartz; common mica accessory mineral; forms a ledge; base is gradational. 2
2. Clayey sandstone and carbonaceous shale: Medium-bluish-gray (5B 5/1); clay to fine-grained sand; fair-sorted; composed of subrounded to subangular quartz; flat, very thin bedded; splits shaly; weathers smooth; forms a regular slope; coal beds in top of unit range from 1 to 3 feet in thickness. 19
1. Sandstone: Grayish-yellow (5Y 8/4); medium- to coarse-grained; composed of subrounded to subangular, clear and frosted quartz; common mica accessory mineral; well-cemented, calcareous; irregular, lenticular, thin to very thick bedded; unit is a coset; tabular planar crossbedding, low-angle and small-scale crossbeds dip to the northeast; some crossbeds are convex; contains some trough crossbedding, medium-angle and medium-scale crossbeds; weathers pitted and knobby; forms a vertical cliff; contains abundant clay pebbles, very coarse grained sand, and quartz pebbles; upper part of unit is medium grained, with iron-rich concretions and coal chips concentrated along crossbedding planes; base is sharp and irregular, with 30 feet of relief in a distance of 300 feet and 4 to 5 feet of relief in a distance of 20 feet. 16

Total Dakota Sandstone 57

UNCONFORMITY.
JURASSIC: Undescribed.

DISTRICT 7

24. —White Cone

2 miles south-southeast of White Cone Trading Post,
19 miles south-southeast of Keams Canyon
112-2.3-12.0

[Measured by C. A. Repenning and J. H. Irwin]

TERTIARY:
Bidahochi Formation:
Upper member:

14. Sandstone: Yellowish-gray (5Y 8/1); fine- to coarse-grained; poorly sorted; composed of subrounded to subangular, clear and colored quartz; black accessory minerals; argillaceous material; firmly cemented, calcareous; flat, thin-bedded; trough crossbedding, low-angle and small-scale crossbeds; weathers flaggy; forms an irregular slope; contains mud galls, pebbles, ripple marks and tracks; section begins at top of White Cone; fluviatile environment; base is sharp and flat. 33.6
13. Silty sandstone: Light-greenish-gray (5G 8/1); clay, silt, and fine- to medium-grained sand; poorly sorted; composed of subangular, white quartz; weakly cemented, calcareous; flat, laminated to very thin bedded; weathers rounded; forms an irregular slope; contains snails; lacustrine environment; base is sharp and flat. 3.0
12. Sandstone: Yellowish-gray (5Y 8/1); fine- to coarse-grained; poorly sorted; composed of subrounded to subangular, clear and colored quartz; black accessory minerals; argillaceous material; firmly cemented, calcareous; flat, thin-bedded; wedge trough crossbedding, low-angle

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

TERTIARY—Continued — Feet

Bidahochi Formation—Continued

Upper member—Continued

and small-scale crossbeds; weathers rounded and flaggy, etching on crossbedding planes; forms a regular slope; contains mud galls and pebbles; fluviatile environment; base is sharp and flat. 23.4

11. Silty sandstone: Light-greenish-gray (5GY 8/1); clay, silt, and fine- to medium-grained sand; poorly sorted; composed of subangular, white quartz; argillaceous material; weakly cemented, calcareous; flat, laminated to very thin bedded; weathers rounded; forms an irregular slope; contains snails; lacustrine environment; base is sharp and flat. 7.6

10. Sandstone: Light-greenish-gray (5GY 8/1); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; firmly cemented, calcareous; flat, thin-bedded; weathers blocky; forms a ledge; contains argillaceous zones; shell fragments; lacustrine environment; base is sharp and flat. 2.7

9. Silty sandstone: Light-greenish-gray (5GY 8/1); clay, silt, and fine- to medium-grained sand; poorly sorted; composed of subangular, white quartz; weakly cemented, calcareous; flat, laminated to very thin bedded; weathers rounded; forms a ledge or irregular slope; contains mudstone beds; contains Sphaerium cf. S. dentatum Haldeman, Lymnaea cf. L. emarginata Say, and Helisoma cf. H. trivolvis Say, all identified by T. C. Yen, and unidentified fish bones; lacustrine environment; base is sharp and flat. 42.2

8. Claystone: Banded with light olive gray (5Y 6/1), yellowish gray (5Y 7/2), and pale red (5R 6/2); weakly cemented, calcareous and argillaceous; laminated, flat-bedded; weathers smooth; forms a regular slope; contains abundant sandstone lenses; lacustrine environment; base is sharp and irregular. 47.4

7. Sandstone: Yellowish-gray (5Y 8/1); very fine grained; well-sorted; composed of subangular, clear quartz; common red and black accessory minerals; weakly cemented, calcareous; flat, thin-bedded; weathers smooth; forms a regular slope; commonly contains yellow spots; lacustrine environment; base is sharp and flat. 4.0

6. Claystone: Same as unit 8; lacustrine environment; base is sharp and flat. 13.2

5. Volcanic conglomerate: Moderate-olive-brown (5Y 4/4); poorly sorted; abundant black accessory minerals; firmly cemented, calcareous; flat, thin-bedded; weathers blocky; forms a ledge; lacustrine environment; base is sharp and irregular.
   Matrix: Composed of subangular, clear quartz.
   Gravel: Composed of subangular to angular basalt and agglomerate pebbles, 3 to 10 mm in diameter, and subhedral augite crystals. .5

4. Claystone: Same as unit 8. 13.7

3. Volcanic conglomerate: Same as unit 5. 8.6

Total incomplete upper member 199.9

Unconformity: Erosional, slight relief, less than 3 inches.

Lower member:

2. Claystone: Same as unit 8. 49.9

1. Sandstone: Same as unit 7. 5.6

Total incomplete lower member 55.5

Total incomplete Bidahochi Formation 255.4

25.—Barrel Butte

4 miles north of Teastoh Trading Post, 23 miles southwest of Keams Canyon
113-9.5-14.0

[Measured by C. A. Repenning]

UPPER AND LOWER CRETACEOUS:

Dakota Sandstone (incomplete):

10. Sandstone and shale: Undescribed.

UPPER JURASSIC:

Cow Springs Sandstone:

9. Sandstone: Grayish-orange (10YR 7/4), grayish-orange-pink (10R 8/2) in upper 5 feet; medium- to coarse-grained, some fine and very coarse grained sand; poorly sorted; composed of subrounded, clear quartz; feldspar accessory mineral; well-cemented, ferruginous and siliceous; flat, thick-bedded; wedge and some asymmetrical trough crossbedding, low-angle and medium-scale crossbeds; weathers rounded, blocky, and pitted; etched on some crossbedding planes; forms a rounded cliff; contains abundant granule stringers; fluviatile environment; base is gradational. 60.6

8. Sandstone: Grayish-yellow (5Y 8/4) to moderate-yellow-green (5GY 7/4), some zones of moderate red (5R 5/4); fine-grained; fair-sorted; composed of rounded quartz; weakly cemented, calcareous; flat, thin-bedded; simple and trough crossbedding, low-angle and small-scale crossbeds; weathers rounded; forms a rolling slope; fluviatile environment; base is sharp and erosional(?). 107.4

7. Sandstone: Grayish-yellow (5Y 8/4); medium-grained; fair-sorted; composed of subangular, clear quartz; amber quartz accessory mineral; weakly cemented, calcareous; flat, thin-bedded; simple and trough crossbedding, high-angle and medium-scale crossbeds; weathers blocky, etched along crossbedding planes; forms a ledge; fluviatile environment; base is sharp and irregular, forms an erosion surface. 8.0

Total Cow Springs Sandstone 176

UPPER TRIASSIC—Continued — Feet

Wingate Sandstone—Continued

Rock Point Member—Continued

(Section continued 5 miles south of Indian Wells Trading Post, 128-2.5-10.5.)

12. Sandstone: Dark-grayish-orange (10R 6/4); fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; common black accessory minerals; firmly cemented, calcareous; massive; wedge trough crossbedding, low-angle and medium-scale crossbeds; weathers rounded; forms a rounded cliff; fluviatile environment; base is sharp and irregular. 14.2

11. Sandstone: Light-brown (5YR 5/4); very fine grained; well-sorted; composed of subrounded to subangular, clear, frosted, and amber quartz; common black accessory minerals; firmly cemented, calcareous; flat, laminated; simple and trough crossbedding, low-angle and small-scale crossbeds; weathers knobby and flaggy; forms a rolling slope; channeled surface with 8 feet of relief occurs 147 feet above bottom; fluviatile environment; base is sharp and irregular, containing channels 4 feet deep. 220.4

10. Siltstone: Light-brown (5YR 5/4); clay to very fine grained sand; fair-sorted; composed of quartz; firmly cemented, calcareous; flat, laminated to thick-bedded; weathers smooth to knobby; forms a regular slope; contains abundant stringers of gypsum and lime pellets; lacustrine environment; base is flat and gradational. 145.6

Total Rock Point Member 514.6

Total Wingate Sandstone 568

Chinle Formation:

Owl Rock Member:

9. Mudstone: Grayish-orange-pink (5YR 7/2); weakly cemented, calcareous and argillaceous; massive; weathers smooth; forms a regular slope; common lime pellets; quiet-water environment; base is sharp and irregular. 19.8

8. Conglomerate: Light-greenish-gray (5G 8/1); massive; weathers blocky; forms a ledge; unit can be considered a sandy limestone; quiet-water environment; base is sharp and irregular with 5 inches of relief.
   Matrix: Finely crystalline.
   Gravel: Composed of subrounded to subangular limestone and siltstone pebbles, 0.5 to 10 mm in diameter. 1.0

7. Mudstone: Same as unit 9. 11.2

6. Conglomerate: Same as unit 8. .5

5. Mudstone: Same as unit 9. 5.6

4. Conglomerate: Same as unit 8. 3.0

3. Mudstone: Same as unit 9. 8.1

2. Sandy and clayey limestone: Mottled with pale green (5G 7/2) and grayish orange pink (5YR 7/2); gnarly; forms a ledge; contains abundant clay galls and chert granules; quiet-water environment; base is irregular and gradational. 3.5

1. Mudstone: Same as unit 9. 14.2

Total incomplete Chinle Formation 66.9

27.—Castle Butte

$1\frac{1}{2}$ miles south-southwest of Castle Butte Trading Post, 18 miles west-southwest of Indian Wells Trading Post
129-5.9-15.0

[Measured by R. L. Jackson and D. B. Brodie]

TERTIARY:

Bidahochi Formation:

Volcanic member:

20. Monchiquite: Dark-gray (N 3); aphanitic; weathers blocky; forms an irregular cliff and caps mesas in the area; base is irregular. 100+

Lower member:

19. Siltstone: Same as unit 17; forms a steep, regular slope. 109

18. Volcanic ash: White (N 9), weathering light gray (N 7); clay and silt; well-sorted; angular grains; weakly cemented; massive; weathers blocky; forms a prominent, irregular ledge; base is gradational. 2.3

17. Siltstone: Moderate-brown (5YR 4/4 to 5YR 3/4); poorly sorted; composed of subangular, clear and stained quartz; firmly cemented; flat, laminated to very thin bedded; weathers hackly; forms a steep, rolling slope; commonly contains quartz granule inclusions; base is gradational. 38

16. Conglomerate: Moderate-brown (5YR 4/4 to 5YR 3/4), weathering dusky brown (5YR 2/2); massive; weathers hackly; forms a rolling slope; base is sharp.
   Matrix: Silt to very coarse grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common black accessory minerals; weakly cemented.
   Gravel: Composed of subrounded to subangular quartz, jasper, and chert pebbles, 1/16 to 1 inch in diameter; gravel is relatively sparse. 2.5

Total lower member 151.8

Total Bidahochi Formation 251.8+

UNCONFORMITY: Erosional, very low relief, approaching a disconformity.

UPPER TRIASSIC:

Wingate Sandstone:

Rock Point Member:

UPPER AND MIDDLE JURASSIC:
Carmel Formation:

6. Siltstone and some sandstone: Moderate-reddish-brown (10R 4/6); silt to very fine grained sand; poorly sorted; composed of subangular quartz; amber quartz and black accessory minerals; firmly cemented, calcareous; gnarly, laminated; wedge trough crossbedding, low-angle and small-scale crossbeds; weathers knobby; forms a regular slope; fluviatile environment; base is sharp and irregular, forms an erosion surface. 19

5. Sandstone: Grayish-yellow (5Y 8/4), weathering grayish orange (10YR 7/4); fine- to medium-grained; fair-sorted; composed of subangular, clear quartz; brown and white quartz accessory minerals; weakly cemented, calcareous; massive; simple crossbedding, low-angle and medium-scale crossbeds; weathers knobby; forms an irregular slope; fluviatile environment; base is flat and gradational. 16.8

4. Siltstone and sandstone: Weathers rounded; forms a regular slope; cherty limestone lens, 0.1 foot thick and 20 feet long, about 15 feet above bottom; fluviatile environment; base is sharp and flat with minor channeling.
   Siltstone: Moderate-reddish-brown (10R 4/6); flat, laminated; common limestone pellets.
   Sandstone: Yellowish-gray (5Y 8/1); very fine grained; fair-sorted; composed of subangular, stained quartz; weakly cemented, calcareous; flat, thin-bedded. 44.8

Total Carmel Formation 80.6

UPPER TRIASSIC(?):
Kayenta Formation:

3. Claystone: Pale-brown (5YR 5/2), weathering grayish orange pink (5YR 7/2), abundant pale-blue-green (5BG 7/2) bands; massive; laminated; weathers rounded; forms a covered slope; quiet fluviatile environment; base is sharp and irregular. 128.8

Moenave Formation:
Dinosaur Canyon Sandstone Member:

2. Limestone: Light-olive-gray (5Y 6/1), weathering brownish gray (5YR 4/1); crystalline; gnarly, thin-bedded; weathers blocky; forms a ledge; contains abundant pale-reddish-brown (10R 5/4) chert stringers; still-water environment; base is sharp and irregular. 3.0

1. Sandstone: Pale-red (10R 6/2) to pale-red-purple (5RP 6/2); fine- to medium-grained; fair- to well-sorted; composed of subangular quartz, of which one-half is clear and one-fourth is white; feldspar and black accessory minerals; firmly cemented, calcareous and siliceous; massive; simple and wedge trough crossbedding, high-angle and large-scale crossbeds; weathers rounded, etched along crossbedding planes; forms a rounded cliff; eolian environment; base is concealed. 15+

Total incomplete Moenave Formation 18+

26.—Indian Wells

Bidahochi Butte, 1½ miles east of Indian Wells Trading Post
128-3.2-6.5

[Measured by C. A. Repenning and J. H. Irwin]

TERTIARY:
Bidahochi Formation:
Volcanic member:

17. Monchiquite: Aphanitic groundmass containing abundant augite phenocrysts; weathers blocky; forms an irregular cliff and caps mesas; lava flow; base is sharp and irregular, overlying old soils in places. 20+

Unconformity: Erosional; great relief, as much as 100 feet, along surface.

Lower member:

16. Mudstone: Moderate-reddish-brown (10R 4/6); weakly cemented, calcareous; flat, laminated; weathers smooth; forms a regular slope; base is gradational. 50.4

15. Conglomerate: Weakly cemented, calcareous; weathers smooth; forms a regular slope; fluviatile environment; base is sharp and even.
   Matrix: Light-brown (5YR 6/4); clay to very fine grained sand; poorly sorted; composed of subangular amber quartz and argillaceous material.
   Gravel: Light-brownish-gray (5YR 6/1); composed of subangular quartzite and chert pebbles, 4 to 30 mm in diameter. .8

Total lower member 51.2
Total Bidahochi Formation 71.2+

UNCONFORMITY: Angular, no relief.
UPPER TRIASSIC:
Wingate Sandstone:
Lukachukai Member:

14. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; composed of subangular, stained quartz; common black accessory minerals; firmly cemented, calcareous; massive; simple and trough crossbedding, high-angle and large-scale crossbeds as much as 70 feet long; weathers rounded; forms a rounded cliff; eolian environment; base is sharp and flat. 53.4

Rock Point Member:

13. Sandstone: Dark-grayish-orange (10R 6/4) and light-brown (5YR 5/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, frosted quartz; common clear and amber quartz and black accessory minerals; firmly cemented, calcareous; flat, laminated; weathers smooth and knobby; forms an irregular cliff or a regular slope; base is flat and gradational. 134.4

15. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; poorly sorted; composed of subangular, stained quartz; abundant black accessory minerals; firmly cemented; simple and trough crossbedding, low-angle and medium-scale crossbeds; weathers knobby and hoodoo; forms a rounded, irregular cliff; base is sharp. 67

14. Siltstone: Same as unit 8. 73.8

13. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; poorly sorted; composed of subangular, clear and stained quartz; abundant black accessory minerals; firmly cemented; simple and trough crossbedding, low-angle and medium-scale crossbeds; weathers knobby and hoodoo; forms a rounded, irregular ledge; base is gradational. 22

12. Siltstone: Same as unit 8. 36

11. Sandstone: Same as unit 9. 6.5

10. Siltstone: Same as unit 8. 18.5

9. Sandstone: Pale-reddish-brown (10R 5/4); silt to medium-grained sand; poorly sorted; composed of subangular, stained quartz; common black accessory minerals; well-cemented; massive; weathers knobby and hoodoo; forms a rounded, irregular ledge; base is sharp and irregular. 3.0

8. Siltstone: Light-brown (5YR 6/4 to 5YR 5/6); composed of stained quartz; common black accessory minerals; well-cemented; massive, flat-bedded; partly laminated; weathers smooth and rounded; forms regular ledges and slopes; contains lenses and stringers of very light gray (N 8) siltstone; base is sharp and irregular. 89

7. Sandstone: Dark-reddish-brown (10R 3/4); silt to medium-grained sand; poorly sorted; composed of subangular, stained quartz; common black accessory minerals; well-cemented; massive; weathers blocky; forms a regular slope; commonly contains calcite inclusions; base is sharp. 8.5

6. Mudstone: Moderate-brown (5YR 4/4 to 5YR 3/4); common black accessory minerals; firmly cemented; irregular, flat-bedded; weathers smooth and rounded; forms a rolling slope; base is concealed. 31

5. Covered interval: Forms a rolling slope. 22

4. Sandstone: Light-gray (N 7); very fine to medium-grained; poorly sorted; composed of subangular, clear and frosted quartz; rare mica, common green, and rare red and black accessory minerals; common argillaceous material; weakly to firmly cemented; simple and trough crossbedding, low- to high-angle and small- to medium-scale crossbeds; weathers blocky; forms a prominent, irregular ledge; contains minor beds of pale-reddish-brown (10R 5/4) siltstone; base is sharp. 40

3. Siltstone: Pale-reddish-brown (10R 5/4); composed of clear and stained quartz; rare black accessory minerals; firmly cemented; massive; weathers smooth, rounded, and blocky; forms an irregular ledge; base is irregular. 8.5

Total Wingate Sandstone 425.8

Unconformity: Erosional, relief ranges from 10 to 25 feet.
Chinle Formation:
Owl Rock Member:

2. Siltstone: Light-brown (5YR 6/4 to 5YR 5/6); composed of clear and stained quartz; rare black accessory minerals; weakly cemented; laminated, flat-bedded; weathers into badlands; forms an irregular and rolling slope; base is sharp. 24

1. Sandy limestone: Light-olive-gray (5Y 6/1); aphanitic, includes very fine grained sand; irregular, flat-bedded; weathers blocky; forms a poorly developed ledge; base is sharp and flat. 1.5

Total incomplete Chinle Formation 25.5

28.—Chimney Rock

10 miles northwest of Castle Butte Trading Post,
28 miles east-northeast of Leupp
129-14.0-6.5

[Measured by J. W. Harshbarger, H. A. Whitcomb, and C. A. Repenning]

UNCONFORMITY: Erosional; moderate relief; overlain by the Bidahochi Formation; from stratigraphic projection as much as 100 feet of Lukachukai Member has been removed by pre-Bidahochi Formation erosion.
UPPER TRIASSIC:
Wingate Sandstone:
Lukachukai Member:

10. Sandstone: Light-orange; fine- to medium-grained; fair-sorted; composed of subangular, clear quartz; firmly cemented, calcareous; trough crossbedding, high-angle and medium- to large-scale crossbeds; weathers rounded and pitted; forms a vertical cliff that is rounded at the top; lower quarter of unit consists of fine-grained sandstone and some siltstone; eolian environment; base is sharp and is a flat erosion surface. 123

Rock Point Member:

9. Sandstone: Very pale green (10G 8/2), weathering white (N 9); silt and fine- to medium-grained sand; fair-sorted; composed of subangular, clear and amber quartz; common ferromagnesian accessory minerals; weakly cemented, calcareous; simple and trough crossbedding, high-angle and medium-scale crossbeds; weathers knobby; forms a vertical cliff; eolian(?) environment; base is flat and gradational. 100

8. Sandstone: Grayish-red (5R 4/2 to 10R 4/2); very fine grained; silty; fair-sorted; composed chiefly of subangular, amber quartz; weakly cemented, calcareous;

UPPER TRIASSIC—Continued
Wingate Sandstone—Continued
Rock Point Member—Continued

	Feet
simple crossbedding, low- to high-angle and large-scale crossbeds; weathers knobby; forms an irregular cliff; contains some clear quartz; fluviatile environment; base is sharp and flat.	89.6
7. Siltstone: Dark-reddish-brown (10R 3/4); silt and very fine grained sand; well-sorted; composed of quartz; weakly cemented, calcareous; flat, laminated to thick-bedded; weathers rounded and knobby; forms an irregular cliff; contains tubular chert stringers; base is sharp and flat.	56
6. Sandstone: Grayish-red (5R 4/2 to 10R 4/2); fine-grained; well-sorted; composed chiefly of subrounded, amber quartz; weakly cemented, calcareous; flat, thick-bedded; wedge trough crossbedding, low-angle and medium-scale crossbeds; weathers rounded and knobby; forms an irregular slope; contains some clear quartz; base is sharp and flat.	11.2
5. Sandstone: Light-greenish-gray (5G 8/1 to 5GY 8/1) and dark-reddish-brown (10R 3/4); very fine grained; well-sorted; composed of rounded, white quartz; firmly cemented, calcareous; flat, very thin to thin-bedded; weathers knobby; forms a rounded slope; base is flat and gradational.	28
4. Siltstone: Light-brown (5YR 6/4 to 5YR 5/6) banded with dark reddish brown (10R 3/4); chiefly silt, some clay and very fine grained sand; well-sorted; composed of quartz; weakly cemented, calcareous; flat, laminated to thick-bedded; weathers smooth and knobby; forms an irregular slope; contains claystone, which splits fissile; weakly cemented zones grade laterally into firmly cemented siltstone that weathers into hoodoos; base is sharp and flat.	33.6
3. Sandstone: Same as unit 5; contains stringers of tubular chert.	19.8
2. Siltstone: Same as unit 4; contains stringers of tubular chert.	56
1. Covered interval: Several exposures of siltstone similar to unit 4; measured with plane table.	410
Total Rock Point Member	804.2
Total Wingate Sandstone	927.2

29.—Montezuma's Chair

28 miles east-northeast of Leupp
130-1.2-3.7

[Measured by C. A. Repenning and J. H. Irwin]

UPPER AND LOWER CRETACEOUS:	
Dakota Sandstone:	
20. Sandstone: Grayish-yellow (5Y 8/4); medium-grained; fair-sorted; composed of subangular, stained quartz; well-cemented, siliceous and ferruginous; massive; simple and trough crossbedding, low-angle and small-scale crossbeds; weathers blocky; forms an irregular cliff and ledge; contains plant impressions; fluviatile environment; base is sharp and irregular.	14.2
19. Coal and carbonaceous shale: Dark-gray (N 3); clay and silt; weakly cemented, argillaceous; flat, gnarly, laminated to thick-bedded, beds as much as 2 feet thick; weathers smooth; forms a ledge or regular slope; contains leaf impressions; flood-plain environment; base is sharp and irregular.	30
Total incomplete Dakota Sandstone	44.2
UNCONFORMITY: Erosional, 5 feet of relief.	
JURASSIC AND TRIASSIC(?):	
Navajo Sandstone:	
18. Sandstone: White (N 9) to grayish-yellow (5Y 8/4); medium-grained; well-sorted; composed of subrounded, stained and frosted quartz; weakly cemented, calcareous; flat, very thick bedded, beds as much as 10 feet thick; simple and trough crossbedding, low-angle and small-scale crossbeds; weathers smooth to rounded; forms a ledge or regular slope; fluviatile environment; base is sharp and flat.	26.4
UPPER TRIASSIC(?):	
Kayenta Formation:	
17. Claystone and sandstone: Banded greenish-gray (5GY 6/1) and light-brownish-gray (5YR 6/1); medium- to coarse-grained; poorly sorted; composed of subangular, stained quartz; rare black accessory minerals; weakly cemented, argillaceous; flat, laminated to very thin bedded; weathers smooth to blocky; forms a regular and covered slope; contains abundant lime pellets and calcite veins and vugs; fluviatile environment; base is covered.	102.8
16. Siltstone: Pale-brown (5YR 5/2); weakly cemented, argillaceous; massive, laminated; weathers smooth; forms a regular and covered slope; fluviatile environment; base is sharp and irregular.	24.4
Total Kayenta Formation	127.2
Moenave Formation:	
Dinosaur Canyon Sandstone Member:	
15. Cherty limestone: Light-olive-gray (5Y 6/1), weathering yellowish gray (5Y 8/1); aphanitic; massive, gnarly; weathers blocky; forms a ledge; contains abundant moderate-brown (5YR 4/4) stringers of chert; unit lenses out laterally; fluviatile environment in part; base is gradational.	1.0

UPPER TRIASSIC—Continued
Wingate Sandstone—Continued
Rock Point Member—Continued

	Feet
grained; poorly sorted; composed of subangular, stained quartz; common feldspar and black accessory minerals; weakly cemented, calcareous; laminated, flat-bedded; trough crossbedding, low-angle and medium-scale crossbeds; weathers rounded and knobby; forms an irregular, rolling slope; fluviatile environment; base is concealed.	33.6
Total incomplete Wingate Sandstone	169.4

DISTRICT 8

30.—Grand Gulch

Mouth of Grand Gulch, north side of San Juan River,
23 miles northwest of Mexican Hat
4-12.0-13.5

[Measured by M. E. Cooley, B. L. McGregor, and J. F. Wright]

PERMIAN:	
Cutler Formation:	
Cedar Mesa Sandstone Member:	
10B. Sandstone: Moderate-orange-pink (10R 7/4) and moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4); fine-grained, some very fine grained sand; well-sorted; composed of subrounded to subangular, frosted and amber quartz; muscovite and black accessory minerals; firmly cemented, siliceous and slightly calcareous; splits flaggy; lenticular, thick to very thick bedded; lenticular trough crossbedding, low- to high-angle and very large scale crossbeds; weathers blocky; forms a vertical cliff; eolian environment; base is gradational.	100+
10A. Sandstone: Yellowish-gray (5Y 8/1) and pale-red (10R 6/2); very fine to fine-grained, some silt; fair-sorted; composed of subrounded to subangular, clear and stained quartz; muscovite and black accessory minerals; weakly to firmly cemented, calcareous; splits flaggy and platy; flat, thin- to thick-bedded; weathers blocky; forms an irregular ledge and slope; bleached spots; transitional unit; quiet fluviatile, flood-plain, and eolian environment; base is sharp and flat.	7.0
Total incomplete Cedar Mesa Sandstone Member	107+
Halgaito Tongue:	
9D. Sandy siltstone and silty sandstone: Pale-red (10R 6/2) to pale-reddish-brown (10R 5/4); silt to very fine grained sand; poorly sorted; composed of stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; bedding same as unit 5B; pseudocrossbedding; contains more silt than unit 5B; flood-plain environment.	12
9C. Sandy limestone and sandstone: Light-brownish-gray (5YR 6/1) and grayish-red (10R 4/2); silt to fine-grained sand; nodular; poorly sorted; composed of subrounded to subangular, clear and stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; grades laterally into sandstone same as unit 9B; flood-plain environment.	3.0
9B. Sandstone: Pale-red (10R 6/2); silt to fine-grained sand; poorly sorted; composed of rounded to subangular, clear and stained quartz; muscovite and black accessory minerals; splits flaggy; lenticularly bedded; lenticular planar and trough crossbedding, low- to medium-angle and medium-scale crossbeds; weathers blocky; forms an irregular ledge; quiet fluviatile and flood-plain environment; base is sharp and irregular.	5.0
9A. Silty sandstone: Pale-reddish-brown (10R 5/4); silt to very fine grained sand; poorly sorted; composed of stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; bedding same as unit 5B; flood-plain environment.	28.5
8. Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; fair- to well-sorted; composed of subrounded to subangular, stained and amber quartz; muscovite and biotite accessory minerals; weakly to firmly cemented, calcareous; lenticular, thin- to thick-bedded; poorly developed lenticular and tabular trough crossbedding, low- to medium-angle and small- to large-scale crossbeds; pseudocrossbedding; weathers blocky; forms an irregular ledge; limestone-filled sticks or burrows; quiet fluviatile, flood-plain, and eolian environment; base is gradational, flat, and irregular, with $1\frac{1}{2}$ feet of relief.	14
7G. Sandstone: Pale-reddish-brown (10R 5/4); silt to fine-grained sand; fair to poorly sorted; composed of subrounded to subangular, stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; bedding same as unit 5B; pseudocrossbedding; top of unit contains silty sandstone that is fine grained and very thin bedded.	62.5
7F. Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; well-sorted; composed of subrounded to subangular, stained and amber quartz; muscovite and black accessory minerals; weakly to firmly cemented, calcareous; bedding same as unit 6.	3.5
7E. Silty sandstone: Pale-reddish-brown (10R 5/4); silt to fine-grained sand; poorly sorted; composed of stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; bedding same as unit 5B; pseudocrossbedding; nodular limestone bed at 9 feet.	31

14. Sandstone: Light-greenish-gray (5GY 8/1); fine-grained; well-sorted; composed of subangular, frosted quartz; common black accessory minerals; weakly cemented, calcareous; massive; trough crossbedding, low-angle and medium-scale crossbeds; weathers smooth; forms a regular slope; fluviatile environment; base is flat and gradational. 13.2

13. Siltstone: Pale-brown (5YR 5/2); weakly cemented, calcareous and argillaceous; massive, laminated; weathers smooth; forms a regular slope; fluviatile environment; base is sharp and irregular. 2.5

12. Cherty limestone: Light-olive-gray (5Y 6/1), weathering yellowish gray (5Y 8/1); aphanitic; gnarly, irregular, thick-bedded; weathers blocky; forms a ledge; contains moderate-brown (5YR 4/4) fragments and stringers of chert; unit grades downward into sandstone of unit 11; fluviatile environment in part; base is irregular and is in a 6-foot-thick gradational zone. 11.2

11. Sandstone: Pale-greenish-yellow (10Y 8/2), weathering moderate greenish yellow (10Y 7/4); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare black accessory minerals; firmly cemented, siliceous; massive, flat-bedded; simple and trough crossbedding, low- to high-angle and medium- to large-scale crossbeds; weathers rounded to blocky; forms a vertical cliff; most of the grains are obscured by cement; one 7-inch cherty limestone bed deposited along crossbedding plane has a dip of 20°; eolian or fluviatile environment; base is gradational. 18.8

10. Sandstone: Yellowish-gray (5Y 8/1); medium- to coarse-grained; fair-sorted; composed of subangular, clear quartz; rare black accessory minerals; firmly cemented, calcareous; massive; simple and trough crossbedding, low-angle and small-scale crossbeds; weathers blocky, etched along crossbedding planes; forms a ledge; base is sharp and flat. 3.0

9. Sandstone: Pale-greenish-yellow (10Y 8/2), weathering moderate greenish yellow (10Y 7/4); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare black accessory minerals; firmly cemented, siliceous; massive, flat-bedded; trough crossbedding, low- to high-angle and medium- to large-scale crossbeds; weathers rounded to blocky; forms a vertical cliff; eolian or fluviatile environment; base is flat and sharp, forms an erosion surface. 17.8

8. Sandstone: Light-greenish-gray (5GY 8/1) and some moderate-reddish-brown (10R 4/6); fine-grained; fair-sorted; composed of subrounded to subangular, clear quartz; rare black accessory minerals; weakly cemented, calcareous; flat, very thick bedded; wedge trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers smooth; forms a regular slope; fluviatile environment; base is gradational. 125.2

7. Sandstone: Moderate-reddish-brown (10R 4/6) banded with light greenish gray (5GY 8/1); fine-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; rare black accessory minerals; calcareous cement; flat, very thick bedded; wedge trough crossbedding, low-angle and small-scale crossbeds; weathers smooth; forms a regular slope; fluviatile environment; base is flat and gradational. 64.6

6. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; well-sorted; composed of subrounded to subangular, stained quartz; rare black accessory minerals; weakly cemented, calcareous; massive; low-angle and small- to medium-scale crossbeds; weathers smooth; forms a regular slope; base is sharp and flat. 105.8

Total Moenave Formation 363.1

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member:

5. Sandstone: Dark-yellowish-orange (10YR 6/6); fine-grained; well-sorted; composed of subrounded, clear quartz; common black accessory minerals; firmly cemented, calcareous; massive; wedge trough crossbedding, high-angle and large-scale crossbeds; weathers rounded; forms a rounded cliff; eolian environment; base is sharp and flat. 58

4. Sandstone: Grayish-red (10R 4/2), weathering pale red purple (5RP 6/2); very fine to coarse-grained; poorly sorted; composed of subrounded, frosted quartz; common black accessory minerals; firmly cemented, calcareous; massive, flat-bedded; weathers ledgy; forms a niche in a cliff; contains abundant shrinkage cracks; fluviatile environment; base is sharp and irregular. 3.0

3. Sandstone: Light-brown (5YR 5/6); fine- to medium-grained; well-sorted; composed of subrounded, frosted quartz; rare black accessory minerals; firmly cemented, calcareous; massive; trough crossbedding, high-angle and large-scale crossbeds; weathers rounded; forms a rounded cliff or an irregular rolling slope; base is sharp and flat. 24.4

2. Sandstone: Light-brown (5YR 6/4); very fine grained; well-sorted; composed of subangular, clear quartz; rare black accessory minerals; well-cemented, calcareous; massive; trough crossbedding, high-angle and large-scale crossbeds as much as 40 feet long; weathers blocky, knobby, and hoodoo; forms an irregular cliff; commonly contains mudstone lenses; eolian environment with fluviatile incursions; base is sharp and irregular, forms an erosion surface. 50.4

Total Lukachukai Member 135.8

Rock Point Member:

1. Sandstone: Dark-reddish-brown (10R 3/4), weathering pale reddish brown (10R 5/4); very fine to medium-

7D. Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, stained and amber quartz; muscovite and black accessory minerals; weakly to firmly cemented, calcareous; bedding same as unit 6. 3.0

7C. Silty sandstone: Pale-reddish-brown (10R 5/4); silt to fine-grained sand; composed of subrounded to subangular, clear and stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; bedding same as unit 5B; pseudocrossbedding. 20

7B. Sandstone: Moderate-orange-pink (10R 7/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, stained and amber quartz; muscovite and black accessory minerals; weakly to firmly cemented, calcareous; bedding same as unit 6; poorly developed crossbeds. 4.0

7A. Silty sandstone: Pale-reddish-brown (10R 5/4); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; splits platy; bedding same as unit 5B; pseudocrossbedding; several thin beds of nodular limestone; bleached spots. 22

6. Sandstone: Moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4); fine-grained, some very fine grained sand; well-sorted; composed of subrounded to subangular, stained and amber quartz; muscovite and black accessory minerals; weakly to firmly cemented, calcareous; splits massive and flaggy; lenticular, thick to very thick bedded; poorly developed lenticular crossbedding, low- to medium-angle and medium- to large-scale crossbeds; weathers rounded and blocky; forms an irregular ledge; flood-plain and eolian environment; base is gradational, sharp, and irregular, with 1 foot of relief. 9.0

5B. Sandstone: Moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4); silt to fine-grained sand; fair to poorly sorted; composed of subrounded to subangular, stained quartz; muscovite and black accessory minerals; splits flaggy, platy, and shaly; flat, lenticular, very thin to thick-bedded; weathers hackly; forms an irregular ledge and slope; 1-foot-thick bed of nodular limy sandstone 25 feet above bottom, which grades laterally into sandstone within 50 feet; bleached spots; flood-plain environment; base is gradational. 44

5A. Silty sandstone: Pale-reddish-brown (10R 5/4); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, stained quartz; muscovite and black accessory minerals; bedding same as unit 3C. 6.5

4. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, stained and amber quartz; muscovite and black accessory minerals; weakly to firmly cemented, calcareous; splits massive; lenticular, very thick bedded; lenticular crossbedding, low- to medium-angle and large-scale crossbeds; weathers smooth and rounded; forms an irregular ledge; hard, limy spots; flood-plain and eolian environment; base is sharp and irregular, with half a foot of relief. 9.0

3J. Silty sandstone: Same as unit 3B. 1.0

3I. Sandstone: Pale-red (10R 6/2) to pale-reddish-brown (10R 5/4); silt to very fine grained sand, some fine-grained sand; poorly sorted; composed of stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; splits flaggy and platy; flat, irregular, very thin to thin-bedded; lenticular crossbedding, low-angle and small- to medium-scale crossbeds; some pseudocrossbedding; weathers blocky and hackly; forms an irregular ledge; contains shrinkage cracks; flood-plain environment. 9.0

3H. Silty sandstone: Pale-reddish-brown (10R 5/4); silt to very fine grained sand, some fine-grained sand; poorly sorted; composed of stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; splits platy; flat, lenticular, very thin bedded; some crossbedding; weathers hackly; forms an irregular slope; contains shrinkage cracks, worm burrows, and poorly formed plant impressions; quiet fluviatile and flood-plain environment; base is gradational. 20

3G. Sandstone: Pale-red (10R 6/2); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, stained quartz; muscovite and black and green accessory minerals; weakly cemented, calcareous; splits shaly and crumbly; bedding same as unit 3C; flood-plain environment. 6.0

3F. Silty sandstone: Same as unit 3B. 1.0

3E. Sandstone: Pale-red (10R 6/2); very fine to fine-grained; fair to poorly sorted; composed of subrounded to subangular, clear and stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; bedding similar to unit 3C; contains hard, limy areas that obscure bedding features. 2.0

3D. Silty sandstone: Pale-reddish-brown (10R 5/4); silt to fine-grained sand; muscovite and black accessory minerals; weakly cemented, calcareous; bedding same as unit 3B; some pseudocrossbedding; flood-plain environment. 3.0

3C. Sandstone: Pale-red (10R 6/2); silt to fine-grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; splits flaggy and platy; lenticular, thin-bedded; lenticular planar and trough crossbedding, low- to medium-angle and small- to medium-scale crossbeds; weathers blocky and hackly; forms an irregular ledge; quiet fluviatile and flood-plain environment; base is sharp and irregular, with one-third of a foot of relief. 2.0

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah--Continued

PERMIAN--Continued — Feet

Cutler Formation--Continued

Halgaito Tongue--Continued

3B. Silty sandstone: Pale-reddish-brown (10R 5/4) to moderate-reddish-brown (10R 4/6); very fine to fine-grained; poorly sorted; composed of stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous; splits platy and shaly; flat, very thin bedded; some pseudocrossbedding; weathers hackly; forms an irregular, recessed slope; flood-plain and soil-residual environment; base is gradational. 2.0

3A. Silty sandstone: Pale-red (10R 6/2) to grayish-red (10R 4/2); silt to very fine grained, some fine-grained sand; composed of clear and stained quartz; muscovite and black accessory minerals; weakly to firmly cemented, calcareous; splits platy; flat, lenticular, very thin to thick-bedded; weathers hackly; forms an irregular ledge and slope; contains mud chips and poorly developed ripple and current marks; some hoodoo weathering, dependent upon amount of limy material present; some organic imprints of plants(?), raindrops(?), etc.; several bleached spots; flood-plain and tidal-flat environment; base is gradational. 23.5

Total Halgaito Tongue 346.5

Total incomplete Cutler Formation 453.5+

PERMIAN AND PENNSYLVANIAN:

Rico Formation:

2D. Sandy limy siltstone: Greenish-gray (5G 6/1) and grayish-red (10R 4/2); silt to very fine grained sand; muscovite and black accessory minerals; weakly cemented, calcareous; splits platy and shaly; flat, irregular, lenticular, very thin bedded; weathers hackly; forms an irregular niche and slope; residual weathered-zone environment. 0.5

2C. Silty limy sandstone: Grayish-red (5R 4/2); silt to very fine grained sand; composed of clear quartz; black accessory minerals; firmly cemented; bedding same as unit 2B; flood-plain and tidal-flat environment. 1.5

2B. Sandstone: Light-greenish-gray (5GY 8/1), grayish-blue (5PB 5/2), and medium-gray (N 5); silt to fine-grained sand; composed of clear quartz; black accessory minerals; weakly cemented, calcareous; splits platy and shaly; flat, very thin to thin-bedded; weathers hackly; flood-plain and tidal-flat environment; base is gradational. 2.0

2A. Sandstone and limy sandstone: Yellowish-gray (5Y 8/1) to light-greenish-gray (5GY 8/1) and medium-gray (N 5); very fine to fine-grained; well-sorted; black accessory minerals; firmly cemented, calcareous; flat, thin- to thick-bedded; partly structureless; weathers blocky, knobby, and hackly; forms an irregular ledge and slope; tidal-flat environment. 4.0

1J. Cherty sandy limestone: Yellowish-gray (5Y 8/1); fragmental, very fine to medium-grained; sand is composed of fine, subrounded to subangular, clear quartz grains; well to firmly cemented, calcareous and siliceous; splits flaggy; flat, lenticular, thin- to thick-bedded; weathers blocky and pitted; forms an irregular ledge; irregular honeycomb structures common; contains flat coiled forms--cephalopods or gastropods, pelecypods, and brachiopods(?)--and shell fragments; marine environment, perhaps a reef; base is gradational. 4.0

1I. Limy sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; fair- to well-sorted; composed of subrounded to subangular, clear and stained quartz; black and green accessory minerals; irregular, lenticular, gnarly, thick-bedded; lenticular crossbedding, low- to medium-angle and small- to medium-scale crossbeds; weathers blocky and knobby; forms an irregular ledge; partly bleached at bottom; tidal-flat environment; base is sharp and flat. 12.5

1H. Silty sandstone: Grayish-red (5R 4/2); clay to fine-grained sand; composed of subrounded to subangular, clear and stained quartz; muscovite and black accessory minerals; weakly cemented, calcareous and argillaceous; splits shaly and crumbly; flat, lenticular, very thin bedded; weathers hackly; forms an irregular niche and slope; several bleached spots; residual weathered-zone environment; base is gradational. .5

1G. Sandstone: Light-brownish-gray (5YR 6/1) and pale-red (10R 6/2); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; muscovite and black accessory minerals; firmly cemented, calcareous; flat, thin-bedded; some very small scale crossbeds; weathers blocky; forms an irregular ledge; bleached zone at bottom; contains some mud chips; flood-plain and tidal-flat environment; base is sharp and flat. 3.0

1F. Silty sandstone and limy sandstone: Medium-light-gray (N 6) to light-olive-gray (5Y 6/1) and grayish-red (10R 4/2); silt to very fine grained sand, some fine-grained sand; poorly sorted; composed of clear and stained quartz; muscovite and black accessory minerals; weakly to firmly cemented, calcareous; splits platy and shaly; flat, lenticular, very thin to thin-bedded; weathers hackly; forms an irregular, recessed slope; limy in places; bleached in lower 3 feet; contains abundant mud chips; tidal-flat environment; base is flat and concealed. 9.0

1E. Sandstone: Light-olive-gray (5Y 6/1); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; black accessory minerals; firmly cemented, calcareous and dolomitic; splits massive; forms a rounded ledge; rare limonite stains. 14.3

2. Sandstone: Dark-reddish-brown (10R 3/4), weathering grayish red (10R 4/2); fine-grained; fair-sorted; composed of subrounded, clear quartz; rare black accessory minerals; firmly cemented, argillaceous; lenticular unit of thin trough sets of low-angle and medium-scale crossbeds and possibly thin to very thick horizontal beds; splits slabby to massive; forms prominent re-entrants in massive sandstone cliffs; contains argillaceous material and rare limestone masses. 5.2

Total transition interval 98.1

Cedar Mesa Sandstone Member (incomplete):

1. Sandstone: Yellowish-gray (5Y 8/1), weathering grayish orange (10YR 7/4); fine- to medium-grained; fair-sorted; composed of subrounded, clear quartz; rare orange, green, and black accessory minerals; weakly cemented, calcareous; tabular unit of thick to very thick, trough sets of medium- to large-scale crossbeds; splits massive; forms a vertical cliff; rare irregular masses of limestone; common limonite spots. 23

Total incomplete Cutler Formation 515.5

Base of section at river's edge; base of exposure.

sive and flaggy; flat, lenticular, thin- to thick-bedded; lenticular and tabular crossbedding, very low to low-angle and small- to large-scale crossbeds; weathers blocky and knobby; forms an irregular ledge; units 1C, 1D, and 1E usually form a ledge; near-shore marine and tidal-flat environment; base is sharp and flat. 12

1D. Cherty dolomite: Light-gray (N 7); fine- to coarse-grained; fragmental; well to firmly cemented; splits flaggy; flat, lenticular, thin- to thick-bedded; weathers blocky; forms an irregular ledge; grades laterally into limy sandstone; irregular chert masses; limy along fractures; contains crinoid stems, fusulinids, and fragmental fossil material; near-shore marine environment, perhaps a reef; base is gradational. 13.5

1C. Limy sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained; fair- to well-sorted; composed of subrounded to subangular, clear quartz; muscovite and black and green accessory minerals; weakly to firmly cemented, calcareous; splits flaggy; irregular, lenticular, gnarly, thick-bedded; lenticular and wedge crossbedding, low- to medium-angle and medium-scale crossbeds; weathers rounded and knobby; forms an irregular ledge; more limy at bottom; near-shore marine environment; base is flat and irregular, with 1 foot of relief. 4.0

1B. Limy sandstone and cherty limestone: Very light gray (N 8) to medium-light-gray (N 6); very fine to fine-grained; composed of subrounded to subangular, clear and stained quartz; black accessory minerals; firmly cemented, calcareous and dolomitic; splits massive and flaggy; flat, lenticular, thick to very thick bedded; lenticular and tabular planar and trough crossbedding, very low to medium-angle and small- to medium-scale crossbeds; weathers blocky; forms an irregular ledge; limy sandstone grades laterally in and out with limestone and sandy limestone; limestone is mostly fragmental; near-shore marine environment, perhaps a reef; base is sharp and flat, with a niche formed between units 1A and 1B.

Unit consists, in descending order, of:

f.	Limy sandstone.	2.0
e.	Cherty limestone.	1.0
d.	Limy sandstone.	8.5
c.	Cherty limestone.	1.0
b.	Limy sandstone.	6.0
a.	Cherty limestone.	1.0

19.5

1A. Limy sandstone and sandy limestone: Pale-greenish-yellow (10Y 8/2) to medium-light-gray (N 6); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, clear quartz; muscovite and black and green accessory minerals; firmly cemented, calcareous; splits massive and flaggy; flat, irregular, gnarly, thick-bedded; lenticular and wedge crossbedding, very low to low-angle and small- to medium-scale crossbeds; forms an irregular ledge; near-shore marine environment; base is concealed. 6.0

Total incomplete Rico Formation 92

31.—Clay Hills Crossing

Clay Hills, north side of San Juan River, 32 miles west-northwest of Mexican Hat
5-8.5-15.0

[Measured by J. H. Stewart and G. A. Williams]

TRIASSIC(?):
Moenkopi Formation:
Hoskinnini Member:

10. Gypsum: White (N 9), weathering grayish orange pink (10R 8/2); composed of needle-shaped crystals of gypsum; weakly cemented; tabular unit; bedding concealed; splits slabby to massive; forms a prominent ledge; unmeasured.

9. Siltstone and sandstone: Pale-reddish-brown (10R 5/4), weathering pale reddish brown (10R 5/4); silt to very fine grained sand; poorly sorted; firmly cemented, argillaceous; tabular unit of thin to thick, horizontal beds; splits slabby to massive; forms a vertical cliff or in places a steep slope; coarse grains of well-rounded amber quartz common. 95.2

Total incomplete Hoskinnini Member 95.2

PERMIAN:
Cutler Formation:
Organ Rock Tongue:

8. Siltstone: Pale-reddish-brown (10R 5/4), weathering pale reddish brown (10R 5/4); predominantly silt but commonly contains abundant very fine grained sand; common mica accessory mineral; firmly cemented, calcareous and argillaceous; tabular unit of thin to very thick, horizontal beds; splits shaly to massive; forms a steep slope and locally a vertical cliff; thin beds of light-greenish-gray (5GY 8/1) siltstone occur at 13.5 feet, 29.5 feet, and about every 10 feet above 221.4 feet above base of unit; grades into fine-grained sandstone locally; rare thin bleached zone along fractures that transect bedding; channel about 20 feet wide and 4 feet deep noted at 210 feet. 354.5

7. Siltstone and sandstone: Sandstone interbedded with siltstone; unit as a whole is tabular; prominent sandstone ledge from 37.8 to 39.9 feet above base of unit weathers to form gentle slope, with small ledges common.
Siltstone (85 percent of unit): Pale-reddish-brown (10R 5/4) and grayish-red (10R 4/2), weathering pale reddish brown (10R 5/4); contains abundant very fine grained sand; poorly sorted; common

32.—Monitor Mesa

A.—Northeast side of Monitor Mesa, 33 miles west of Mexican Hat
12-10.5-1.7

[Measured by M. E. Cooley and J. P. Akers]

UPPER TRIASSIC:
Wingate Sandstone:
Rock Point Member:

26. Sandy conglomerate: Fine to very coarse grained; fair-sorted; firmly cemented, calcareous; composed of stained and frosted quartz; thin- to thick-bedded; low-angle crossbeds; weathers blocky; forms an irregular ledge; contains some sandstone pebbles as much as 4 inches in diameter; base is sharp. 5.0

25. Limy sandstone: Pale-red (10R 6/2); very fine grained; fair-sorted; firmly cemented, calcareous; composed of quartz; flat, irregular, thick-bedded; weathers blocky; forms an irregular ledge; base is gradational. 6.0

Total incomplete Wingate Sandstone 11

Chinle Formation:
Owl Rock Member:

24. Silty limestone: Similar to unit 19 but contains more silt. 39

23. Sandstone: Moderate-reddish-orange (10R 6/6); silt to very fine grained sand; fair to poorly sorted; composed of stained and frosted quartz; firmly cemented, calcareous; massive, flat-bedded; weathers blocky; forms an irregular ledge; base is sharp. 5.5

22. Limy sandy siltstone: Similar to unit 18 but more sandy. 13.5

21. Siltstone: Same as unit 18. 19

20. Limestone and siltstone, alternating: Limestone is same as unit 19 and siltstone is same as unit 18; three limestone and two siltstone beds. 13.5

19. Limestone: Pale-red (10R 6/2) and grayish-red (10R 4/2); well-cemented; irregular, lenticularly bedded; weathers blocky; forms an irregular ledge; contains two 1-foot silt beds; base is gradational. 25.5

Total Owl Rock Member 116

Petrified Forest Member:

18. Siltstone: Grayish-orange-pink (10R 8/2); abundant limestone nodules; weakly to firmly cemented, calcareous; irregular, flat-bedded; weathers blocky to hackly; lower part of unit contains several thin blocky ledges of cherty limestone; base is gradational. 16

17. Siltstone: Same as unit 13; base is gradational. 27

16. Conglomerate: Light-greenish-gray (5G 8/1); medium to very coarse grained sand; poorly sorted; composed of subrounded to subangular, frosted quartz; rare $\frac{1}{8}$-inch mud pebbles; irregular, lenticular, thin- to thick-bedded; wedge simple, planar, and trough crossbedding, low- to high-angle and small- to medium-scale crossbeds; weathers blocky; forms an irregular ledge; base is sharp. 5.5

15. Siltstone: Same as unit 13; base is gradational. 42

14. Conglomerate: Same as unit 12; base is gradational. 12

13. Sandy siltstone: Pale-red (10R 6/2) and light-greenish-gray (5G 8/1) bleached zones; very fine grained sand; composed of clear and stained quartz; black and micaceous accessory minerals; weakly to firmly cemented, calcareous; massive, flat-bedded; forms a rolling slope; base is gradational. 94.5

12. Conglomerate: Light-brownish-gray (5YR 6/1); medium to very coarse grained sand, pebbles as much as three-quarters of an inch in diameter; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; micaceous accessory minerals; weakly to firmly cemented, calcareous; irregular, lenticular, thin- to thick-bedded; wedge simple, planar, and trough crossbedding, high-angle and medium-scale crossbeds; weathers blocky to hackly; forms an irregular ledge; contains poorly preserved Unio fossil; base is gradational. 11

11. Sandy siltstone: Grayish-red (5R 4/2); very fine grained sand; abundant dolomitic limestone nodules; micaceous accessory minerals; weakly to firmly cemented, calcareous; massive, flat-bedded; simple and planar crossbedding, large-scale crossbeds; weathers fluffy; forms an irregular slope; bottom of unit is marked by an irregular zone of lenticular gray limestone conglomerate about 1 foot thick; two sandy ledges near top; unit is more firmly cemented near top; base is gradational. 227

Total Petrified Forest Member 435

Monitor Butte Member:

10. Mudstone: Grayish-yellow-green (5GY 7/2) near bottom, grayish-green (5G 5/2) near top, some zones of very pale blue (5B 8/2) and pale purple (5P 6/2); massive, flat-bedded; weathers smooth to fluffy; forms a rolling slope; some horizons contain numerous limestone nodules averaging 1 inch in diameter and occasionally measuring as much as 10 inches; base is gradational. 184

Shinarump Member:

9. Sandstone: Light-olive-gray (5Y 5/2); silt to very coarse grained sand; poorly sorted; composed of subrounded, clear and frosted quartz; black accessory minerals; lenticular, thick to very thick bedded; lenticular and wedge trough crossbedding, low- to high-angle and medium- to large-scale crossbeds; pseudocrossbedding; weathers blocky; forms an irregular cliff; contains beds of very fine grained, light-bluish-gray (5B 7/1) sandstone; a few pebbles as much as three-quarters of an inch in diameter. 92

Total Chinle Formation 827

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Feet
UNCONFORMITY: Erosional; channels cut through unit 8 in places; siltstone deposited in some channels.	
MIDDLE(?) AND LOWER TRIASSIC:	
Moenkopi Formation:	
Upper siltstone member:	
8F. Siltstone: Pale-reddish-brown (10R 5/4); silt to very fine grained sand; poorly sorted; weakly cemented, calcareous; irregular, lenticularly bedded; weathers into hoodoos; forms an irregular slope; contains gypsum stringers; upper 2 feet is bleached; base is gradational.	7.0
8E. Siltstone: Same as unit 8C.	104
8D. Sandstone: Same as unit 8A.	2.0
8C. Siltstone: Pale-reddish-brown (10R 5/4); silt to very fine grained sand; fair-sorted; weakly cemented, calcareous; flat, very thin to thin-bedded; weathers fluffy; forms an irregular to rolling slope; base is gradational.	37
8B. Sandstone and siltstone, alternating: Sandstone is same as unit 8A and siltstone is same as unit 8C; silt and sand beds are as much as 4 inches thick.	5.0
Total upper siltstone member	155
Middle sandstone member:	
8A. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; poorly sorted; composed of subrounded to subangular, clear and stained quartz; weakly cemented; flat, irregular, lenticular, very thin to thin-bedded; pseudocrossbedding; weathers hackly; forms an irregular slope; base is gradational.	13
7. Sandstone: Light-brown (5YR 6/4); silt to fine-grained sand; composed of subrounded to subangular, clear and stained quartz; black accessory minerals; firmly cemented; flat, thin to very thick bedded; wedge crossbedding; trough crossbedding, small- to medium-scale crossbeds; weathers blocky; forms a vertical and irregular cliff; contains mud pellets along bedding planes; upper third of unit contains more silt; base is sharp and flat.	20
Total middle sandstone member	33
Lower siltstone member:	
6B. Sandy siltstone: Same as unit 4; pseudocrossbedding.	6.0
6A. Siltstone and sandy siltstone, alternating: Same as unit 4.	24
Total lower siltstone member	30
TRIASSIC(?):	
Moenkopi Formation:	
Hoskinnini Member:	
5B. Sandstone: Light-moderate-brown (5YR 5/4); very fine to fine-grained; fair-sorted; weakly to firmly cemented, calcareous; composed of clear and stained quartz; black accessory minerals; flat, lenticular, thin- to thick-bedded; simple and trough crossbedding, low-angle and medium-scale crossbeds; weathers rounded to blocky; forms an irregular ledge; becomes flat bedded in top third of unit; base is sharp and irregular.	14.5
5A. Sandstone: Light-moderate-brown (5YR 5/4) and pale-reddish-brown (10R 5/4); silt to very fine grained sand; fair-sorted; composed of subangular, clear and stained quartz; micaceous accessory minerals; weakly to firmly cemented; flat, irregular, lenticular, very thin to thick-bedded; some trough crossbedding, low-angle crossbeds; contains siltstone lenses as much as half a foot thick; base is sharp and irregular.	19
4. Siltstone and silty sandstone, alternating: Pale-reddish-brown (10R 5/4) and grayish-red (10R 4/2); silt to very fine grained sand; poorly sorted; composed of clear quartz; weakly cemented, calcareous; irregular, lenticular, very thin to thick-bedded; sandstone is pseudocrossbedded and exhibits cusp ripple marks and mud cracks; silt beds are a foot thick and sandstone beds are half a foot thick; base is gradational.	3.0
3. Sandstone: Moderate-brown (5YR 4/4); silt to very fine grained sand; poorly sorted; composed of stained quartz; weakly to firmly cemented; irregular, lenticular, thin- to thick-bedded; weathers blocky; forms an irregular ledge; base is gradational.	6.0
2. Sandstone: Pale-reddish-brown (10R 5/4); silt to very fine grained; poorly sorted; weakly cemented; irregular, lenticular, very thin to thick-bedded; weathers hackly and forms subdued hoodoos; forms an irregular slope; contains some silt beds as much as 6 inches thick.	4.0
Total Hoskinnini Member	46.5
Total Moenkopi Formation	264.5
Contact is conformable.	
PERMIAN:	
Cutler Formation:	
Organ Rock Tongue:	
1. Sandstone: Light-brown (5YR 6/4) to grayish-red (10R 4/2); silt to very fine grained sand; poorly sorted; composed of stained quartz; weakly to firmly cemented; flat, irregular, very thin to thick-bedded; forms an irregular slope; weakly cemented sandstone alternates with firmly cemented sandstone; bleached 6-inch bed of coarse-grained sand and fine gravel at top.	50+

	Feet
UPPER JURASSIC—Continued	
Morrison Formation—Continued	
Salt Wash Sandstone Member—Continued	
29. Sandstone: Light-greenish-gray (5GY 8/1); fine- to medium-grained; poorly sorted; composed of subangular, clear quartz; red quartz and ferromagnesian accessory minerals; firmly cemented, calcareous; flat, gnarly; simple and trough crossbedding, low- to high-angle and small-scale crossbeds; weathers rounded; forms a ledge; shaly in middle part; contains abundant oscillatory and current ripple marks; fluviatile environment; base is sharp and irregular.	11.2
28. Claystone: Very dusky red (10R 2/2); clay and silt; flat, laminated; forms a regular and covered slope; contains abundant ironstone lenses; fluviatile environment; base is sharp and flat.	3.5
27. Sandstone: Light-brown (5YR 6/4); medium-grained; poorly sorted; composed of angular, clear quartz; firmly cemented, calcareous; gnarly; simple and trough crossbedding, low- to high-angle and small-scale crossbeds; weathers rounded, etched along crossbedding planes; forms a ledge; contains abundant lenses of very dusky red (10R 2/2) shale; fluviatile environment; base is sharp and flat with no apparent channeling, but contains some reworked sand from unit 26.	4.0
Total incomplete Salt Wash Sandstone Member	89.4
Summerville Formation:	
26. Sandstone: Moderate-reddish-brown (10R 4/6), weathering pale reddish brown (10R 5/4); fine-grained; poorly sorted; composed of subangular, clear quartz; amber quartz, feldspar, and ferromagnesian accessory minerals; firmly cemented, calcareous; flat, laminated to thick-bedded; weathers blocky, knobby in more silty parts; forms a vertical cliff that is horizontally ribbed by many niches or forms a regular and covered slope; contains siltstone and claystone partings that weather into niches; maximum thickness of silty beds is 3 feet; still-water environment; base is flat and gradational.	95.2
25. Sandstone: Moderate-reddish-brown (10R 4/6); very fine grained; well-sorted; composed of subangular, clear and amber quartz; weakly cemented, calcareous; flat, laminated; weathers hackly, local etching of shrinkage cracks; forms a ledge and covered slope; contains much argillaceous material; quiet shallow-water environment; partly subaerial; base is sharp and flat.	30
Total Summerville Formation	125.2
Entrada Sandstone:	
Medial silty member:	
24. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; well-sorted; composed of subangular, clear and rust-stained quartz; ferromagnesian accessory minerals; firmly cemented, calcareous; massive, flat-bedded; weathers knobby and forms hoodoos; forms a rounded cliff; lower 5 feet contains simple and trough crossbedding, low-angle and small-scale crossbeds; contains primary slumpage features; fluviatile environment; base is sharp and flat.	84
23. Sandstone: Moderate-reddish-brown (10R 4/6); fine- to medium-grained; poorly sorted; composed of subangular, clear and amber quartz; white quartz accessory mineral; firmly cemented, siliceous and calcareous; massive; simple and trough crossbedding, high-angle and small-scale crossbeds; forms a rounded cliff and rolling slope; white line (bleached zone) at top of unit; fluviatile environment; base is gradational.	50.4
22. Siltstone: Light-brown (5YR 5/6); poorly sorted; composed of subangular quartz; firmly cemented, calcareous; massive; weathers into hoodoos; forms a rounded cliff; contains abundant argillaceous material; fluviatile environment; base is gradational.	15.2
21. Sandstone: Light-brown (5YR 5/6), weathering light olive gray (5Y 6/1); fine-grained; well-sorted; composed of subangular, clear quartz; well to firmly cemented, calcareous; gnarly; forms a ledge; weathers into abundant pellets the size of BB shot; fluviatile environment; base is sharp and flat.	2.0
Total medial silty member	151.6
Lower sandy member:	
20. Sandstone: Light-brown (5YR 5/6); fine-grained; well-sorted; composed of rounded, clear quartz; weakly cemented, siliceous; massive; simple and trough crossbedding, low-angle and large-scale crossbeds; weathers rounded; forms a rounded cliff or rolling slope; lower 2 to 3 feet is flat bedded; eolian environment; base is sharp and flat.	43.4
Total Entrada Sandstone	195
UPPER AND MIDDLE JURASSIC:	
Carmel Formation:	
19. Siltstone: Grayish-red (10R 4/2), weathering pale reddish brown (10R 5/4); mica and quartz accessory minerals; flat, laminated; weathers smooth; forms a regular slope; fluviatile environment; base is sharp.	8.2
18. Sandstone: Light-greenish-gray (5G 8/1), weathering pale yellowish brown (10YR 6/2); fine-grained; poorly sorted; composed of subangular, clear quartz; black accessory	

B.—East side of Monitor Mesa, 33 miles west of Mexican Hat
12-11.0-5.0 A

[Measured by C. B. Read]

UNCONFORMITY(?).
TRIASSIC(?):
Moenkopi Formation:
Hoskinnini Member:

6. Sandstone: Grayish-orange-pink (10R 8/2) to pale-reddish-brown (10R 5/4); medium-grained; calcareous and ferruginous cement; thin-bedded; crossbedding; forms vertical ledges.	2
5. Sandstone: Pale-reddish-brown (10R 5/4) to moderate-reddish-brown (10R 4/6); fine- to medium-grained matrix containing abundant coarse subrounded quartz grains; calcareous, ferruginous, and argillaceous cement; even, thick-bedded; nonrhythmic sequence of beds; weathers into irregular cliffs; thin silty intervals intercalated with sandstone; mottling common.	49
4. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained matrix containing abundant coarse, subrounded to subangular, quartz grains; well-cemented, calcareous, ferruginous, and argillaceous; medium- to thick-bedded; crossbedding; basal unit of Hoskinnini Member rests unconformably upon De Chelly Sandstone Member.	11
Total Moenkopi Formation	62

PERMIAN:
Cutler Formation:
De Chelly Sandstone Member:

3. Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); medium-grained matrix containing occasional coarse, rounded, quartz grains; well-cemented, calcareous; thin- to medium-bedded; small-scale crossbedding; weathers into irregular cliffs; considerable calcite veining in sandstone beds; upper part of unit is leached and fractured; De Chelly Sandstone Member thins to vanishing point 100 yards away.	25

Organ Rock Tongue:

2. Siltstone: Pale-reddish-brown (10R 5/4); very fine grained; calcareous, ferruginous, and argillaceous cement; even, thin- to thick-bedded; weathers into irregular cliffs; top of unit is mud cracked and filled with apophyses of De Chelly Sandstone Member.	27
1. Siltstone and mudstone, interbedded: Very fine grained; calcareous, ferruginous, and argillaceous cement; even, thin- to medium-bedded; rhythmic sequence of beds; weathers into slopes and ledges; occasional float of lime-pellet conglomerate; mottling and banding very common.	500
Total Organ Rock Tongue	527
Total Cutler Formation	552

33.—Dennehotso

A.—6 miles southwest of Dennehotso,
19 miles east of Kayenta
22-10.5-15.0

[Measured by C. A. Repenning and J. H. Irwin]

UPPER JURASSIC:
Morrison Formation:
Salt Wash Sandstone Member:

35. Sandstone: Very pale orange (10YR 8/2); medium-grained; poorly sorted; composed of subangular, clear quartz; ferromagnesian accessory minerals; well-cemented, calcareous; massive; simple and trough crossbedding, low- to high-angle and medium- to large-scale crossbeds; weathers rounded to blocky; forms a ledge in the cliff face and an irregular rolling surface on mesa; contains abundant lenses and stringers of pebble conglomerate and a few lenses of argillaceous material; apparent fluviatile environment, or possible beach sand, with some eolian material in upper part of section; base is flat and gradational.	20+
34. Claystone: Very pale blue (5B 8/2) and pale-reddish-brown (10R 5/4); clay and some silt; flat, laminated; forms a niche in cliff; fluviatile environment; base is sharp and unit intertongues with unit 33.	5.0
33. Sandstone: Very pale orange (10YR 8/2), weathering pale yellowish brown (10YR 6/2); poorly sorted; composed of subangular, clear quartz; feldspar accessory mineral; firmly cemented, calcareous; massive; simple and trough crossbedding, low-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; fluviatile environment; base is sharp and irregular, an erosion surface.	16.8
32. Siltstone: Very pale blue (5B 8/2) and pale-reddish-brown (10R 5/4); flat, laminated; forms a niche; fluviatile environment; base is sharp and flat.	2.5
31. Sandstone: Pale-greenish-yellow (10Y 8/2) to grayish-yellow (5Y 8/4); fine- to medium-grained; poorly sorted; composed of subrounded to subangular, clear quartz; feldspar and ferromagnesian accessory minerals; firmly cemented, calcareous and ferruginous; massive; simple and trough crossbedding, low- to high-angle and small-scale crossbeds; weathers rounded and pitted; forms a ledge; fluviatile environment; base is sharp and flat.	12.2
30. Claystone: Medium-bluish-gray (5B 5/1), weathering light bluish gray (5B 7/1); flat, laminated; forms a regular and covered slope; contains lenses of small-scale crossbedded sandstone; base is sharp and flat.	14.2
minerals; firmly cemented, calcareous; flat, gnarly, thin- to thick-bedded; weathers blocky; forms a ledge; contains ripple marks and shrinkage cracks; fluviatile environment; base is sharp and irregular.	1.0
17. Siltstone: Grayish-red (10R 4/2), weathering pale reddish brown (10R 5/4); composed of quartz; mica accessory minerals; flat, laminated; forms a regular slope; base is sharp.	6.0
16. Sandstone: Light-greenish-gray (5G 8/1), weathering pale yellowish brown (10YR 6/2); fine-grained; well-sorted; composed of subangular, clear quartz; firmly cemented, calcareous; flat, gnarly; weathers blocky; forms a ledge; contains ripple marks; fluviatile environment.	1.5

(Section continued on Garnet Ridge, 4 miles north of Dennehotso, 27 miles east-northeast of Kayenta, 22-5.6-6.0.)

15. Siltstone: Grayish-red (10R 4/2), weathering pale reddish brown (10R 5/4); composed of quartz; mica accessory mineral; flat, laminated; weathers smooth; forms a regular slope; fluviatile environment; base is sharp and irregular.	16
14. Sandstone: Light-greenish-gray (5G 8/1), weathering pale yellowish brown (10YR 6/2); fine-grained; fair-sorted; composed of subangular, clear quartz; black accessory minerals; firmly cemented, calcareous; flat, gnarly; weathers blocky; forms a ledge; contains large shrinkage cracks that are roughly hexagonal and 4 to 6 feet in size; fillings of these cracks extend into the adjoining units; contains ripple marks; fluviatile environment.	5.6
13. Siltstone: Same as unit 15.	10.7
12. Sandstone: Same as unit 14.	.5
11. Siltstone: Same as unit 15.	7.4
10. Sandstone: Same as unit 14.	1.0
9. Siltstone: Same as unit 15.	21
8. Sandstone: Same as unit 14.	7.0
7. Siltstone: Same as unit 15.	12
6. Sandstone: Same as unit 14.	2.0
5. Siltstone: Same as unit 15.	16.8
Total Carmel Formation	116.7

JURASSIC AND TRIASSIC(?):
Navajo Sandstone:

4. Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; composed of subrounded to subangular, clear quartz; black accessory minerals; weakly to firmly cemented, calcareous; massive; trough crossbedding, high-angle and large-scale crossbeds; weathers rounded; forms a regular and rolling slope; one 2-foot-thick lens of limestone in upper part of unit; eolian environment; base is gradational.	478

UPPER TRIASSIC(?):
Kayenta Formation:

3. Sandstone and mudstone: Forms a ledgy slope.	
Sandstone: Pale-red-purple (5RP 6/2); fine-grained; flat-bedded; trough crossbedding, small- to medium-scale crossbeds.	
Mudstone: Grayish-red (10R 4/2); flat, laminated.	89.6

UPPER TRIASSIC:
Wingate Sandstone:
Lukachukai Member:

2. Sandstone: Undescribed.	416

Rock Point Member:

1. Sandstone and siltstone: Undescribed.	140
Total Wingate Sandstone	556

B.—Along Mexican Hat-Mexican Water road at Comb Ridge,
12 miles north of Dennehotso,
12 miles south of Mexican Hat
22-4.8-1.5

[Measured by M. E. Cooley and J. P. Akers]

UPPER TRIASSIC:
Wingate Sandstone:
Rock Point Member:

18. Sandstone: Moderate-reddish-orange (10R 6/6); silt to medium-grained sand; flat, lenticular, thin to very thick bedded; weathers blocky; forms an irregular ledge; base is gradational.	50+

Chinle Formation:
Owl Rock Member:

17. Limestone: Grayish-pink (5R 8/2); well to firmly cemented; flat, irregular, thick to very thick bedded; weathers blocky; pebble conglomerate occurs at top; base is sharp.	5
16. Limy siltstone: Same as unit 12.	55
15. Limestone and siltstone: Pale-reddish-brown (10R 5/4); silt; weakly cemented, calcareous; flat, thick to very thick bedded; weathers blocky; forms an irregular ledge; base is sharp.	7
14. Limy siltstone: Same as unit 12.	8
13. Limestone: Very pale blue (5B 8/2).	2
12. Limy siltstone: Moderate-orange-pink (10R 7/4); silt to very fine grained sand; fair-sorted; weakly cemented, calcareous; flat, lenticular, very thin to thick-bedded; weathers smooth and fluffy; forms an irregular slope; contains a few silty limestone beds as much as 1 foot thick.	49
Total Owl Rock Member	126

Petrified Forest Member:

11. Mud-pellet conglomerate: Gray; silt to very fine grained sand; poorly sorted; weakly cemented, calcareous; irregular, lenticular, thick to very thick bedded; lenticular trough crossbedding; weathers blocky; forms an irregular ledge; contains mud pellets as much as half an inch in diameter; base is sharp.	8

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Feet
UPPER TRIASSIC—Continued	
Chinle Formation—Continued	
Petrified Forest Member—Continued	
10. Sandstone and mudstone, alternating: Moderate-orange-pink (10R 7/4); clay to fine-grained sand; poorly sorted; weakly cemented, calcareous; lenticular, thick to very thick bedded; lenticular and wedge simple and trough crossbedding, high-angle and large-scale crossbeds; some pseudocrossbedding in more sandy horizons; weathers smooth to hackly; forms a rolling slope; base is gradational.	188
9. Mudstone, siltstone, sandstone, claystone: Pale-red-purple (5RP 6/2); clay to medium-grained sand; poorly sorted; weakly cemented, calcareous; irregular, lenticular, thin to very thick bedded; lenticular and wedge simple and trough crossbedding, low-angle and large-scale crossbeds; large-scale wedge crossbedded channels contain sandstone, siltstone, and claystone, each channel containing different material; weathers smooth; forms an irregular, rolling slope; unit is partially covered; base is sharp.	780
Total Petrified Forest Member	976
Lower red member:	
8. Sandstone: Very pale orange (10YR 8/2); fine- to medium-grained; fair-sorted; mica accessory mineral; well to firmly cemented; flat, irregular, lenticular, thin to very thick bedded; unit is a gradational set; lenticular and wedge trough crossbedding; some surfaces exhibit manganese staining and iron concretions; weathers rounded to blocky; forms an irregular ledge; base is concealed.	70
7. Covered interval.	86
Total lower red member	156
Shinarump Member:	
6. Conglomeratic sandstone: Very pale orange (10YR 8/2); very fine to very coarse grained; composed of rounded to subangular, clear and frosted quartz; firmly cemented, siliceous; irregular, lenticular, thick to very thick bedded; lenticular and wedge trough crossbedding, medium- to large-scale crossbeds; weathers blocky; forms irregular ledges; contains rounded pebbles as much as 2 inches in diameter; base is sharp and irregular.	40
Total Chinle Formation	1,298
UNCONFORMITY.	
MIDDLE(?) AND LOWER TRIASSIC:	
Moenkopi Formation:	
Upper siltstone, middle sandstone, and lower siltstone members undifferentiated:	
5. Siltstone: Pale-reddish-brown (10R 5/4); weakly to firmly cemented, calcareous; flat, irregular, lenticular, thin to very thin bedded; forms a ledge and slope due to alternating weak and firm cementing; partly covered; base is gradational.	20
4. Sandy limestone: Very pale orange (10YR 8/2) to pale-reddish-brown (10R 5/4); very fine grained sand; well to firmly cemented; flat, lenticular, very thin to thick-bedded; lenticular pseudocrossbedding; weathers blocky and hackly; forms an irregular ledge; base is flat.	3
3. Siltstone and limy sandstone, alternating:	
Siltstone: Pale-reddish-brown (10R 5/4); mica accessory mineral; weakly cemented, calcareous; irregular, lenticular, gnarly, very thin to thin-bedded; weathers hackly; forms a partly covered, irregular slope; base is gradational.	
Limy sandstone: Very pale orange (10YR 8/2) to pale-reddish-brown (10R 5/4); fine to very fine grained; poorly sorted; firmly cemented, calcareous; flat, irregular, very thin to thick-bedded; weathers blocky; forms an irregular ledge; base is flat.	27
Total upper siltstone, middle sandstone, and lower siltstone members undifferentiated	50
UNCONFORMITY: Concealed; flat.	
TRIASSIC(?):	
Moenkopi Formation:	
Hoskinnini Member:	
2. Silty sandstone and sandstone, alternating:	
Silty sandstone: Grayish-red (10R 4/2); silt to fine-grained sand; poorly sorted; flat, irregular, thin to very thin bedded; weathers hackly; forms an irregular slope; base is gradational. 1	
Sandstone: Very pale orange (10YR 8/2); fine- to medium-grained; composed of subrounded to subangular, clear and stained quartz; firmly cemented; flat, irregular, thin- to thick-bedded; weathers blocky; forms an irregular ledge; base is gradational. 16	17
Total Moenkopi Formation	67
PERMIAN:	
Cutler Formation:	
De Chelly Sandstone Member:	
1. Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained, some coarse grains; fair-sorted; composed of clear, stained, and frosted quartz; firmly cemented; unit is a set; lenticularly bedded; lenticular and wedge simple and trough crossbedding, low- to regular slope; common limestone nodules as much as 2 inches in size; chips of petrified wood; contains some sandy zones composed of medium-grained, clear, stained and frosted quartz with mica accessory mineral; base is gradational.	302
Total Petrified Forest Member	746.5
Lower red member:	
16. Sandstone and mudstone, alternating: Pale-red (10R 6/2); sandstone is medium grained, fair-sorted, and composed of subrounded to subangular, clear, stained, and frosted quartz; firmly cemented, siliceous; irregularly bedded; unit is a coset; trough crossbedding, small-scale crossbeds; contains rare fragments of petrified wood; mudstone is same as unit 15; weathers hackly; forms an irregular slope; base is sharp.	60.5
15. Mudstone: Very dusky red (10R 2/2); weakly cemented; massive, flat-bedded; weathers fluffy; forms a regular slope; base is sharp.	13
Total lower red member	73.5
Shinarump Member:	
14. Sandstone: White (N 9); coarse- to medium-grained; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; black accessory minerals; firmly cemented, siliceous; unit is a coset; lenticular and wedge simple and trough crossbedding, small- to medium-scale crossbeds; forms an irregular ledge; contains rare limonite concretions; base is sharp.	40
13. Siltstone: Same as unit 10A.	8.0
12. Sandstone: Same as unit 10B.	5.5
11. Siltstone: Same as unit 10A.	21.5
10B. Silty sandstone: Grayish-orange (10YR 7/4); silt to very fine grained sand; fair-sorted; composed of subrounded to subangular quartz; firmly cemented, calcareous; very thin to thick-bedded; pseudocrossbedding; weathers hackly; forms an irregular ledge; base is gradational.	5.5
10A. Sandy siltstone: Grayish-red (10R 4/2); mica accessory mineral; weakly cemented, calcareous; very thin to thin-bedded; pseudocrossbedding; weathers hackly; forms an irregular slope; base is gradational.	16.5
9B. Sandstone: Grayish-red (10R 4/2); silt to very fine grained sand; composed of subrounded to subangular quartz; mica accessory mineral; weakly to firmly cemented, calcareous; flat, very thin to thin-bedded; pseudocrossbedding; weathers hackly; forms an irregular slope; base is gradational.	13
9A. Sandstone: Grayish-orange (10YR 7/4); very fine to fine-grained; composed of clear and frosted quartz; firmly cemented, calcareous; massive, thick to very thick bedded; unit is a coset; wedge planar and trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers rounded; forms a rounded ledge; base is sharp.	5.5
8. Silty limestone: Yellowish-gray (5Y 8/1) on fresh surface; firmly cemented; thin to very thin bedded; weathers blocky; forms an irregular ledge; upper part of unit is limy siltstone; base is gradational.	14
7. Limy siltstone: Pale-reddish-brown (10R 5/4); mica accessory mineral; weakly to firmly cemented, calcareous; flat, fissile to very thin bedded; pseudocrossbedding; weathers hackly; forms an irregular slope; base is gradational.	22
6B. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; fair-sorted; composed of rounded to subrounded quartz; weakly cemented, calcareous; thin- to thick-bedded; weathers hackly; forms an irregular slope; base is gradational.	11
6A. Sandstone: Pale-reddish-brown (10R 5/4); silt to very fine grained sand; fair-sorted; composed of subrounded to subangular quartz; weakly to firmly cemented, calcareous; flat, thick to very thick bedded; weathers blocky; forms an irregular ledge; base is sharp.	5.5
5. Siltstone and minor amount of sandstone: Pale-reddish-brown (10R 5/4); mica accessory mineral; weakly to firmly cemented, calcareous; very thin to thick-bedded; wedge crossbedding, small-scale crossbeds; pseudocrossbedding; weathers hackly; forms an irregular slope; base is gradational.	20
4. Sandstone: Light-brown (5YR 6/4); coarse to very coarse grained; fair-sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; weakly cemented, siliceous; irregular, thin- to thick-bedded; weathers blocky; forms an irregular ledge; base is sharp.	11
Total Shinarump Member	199
Total Chinle Formation	1,150.5+
(Section continued 4 miles north of Owl Rock, 10 miles north of Kayenta, 23-13.7-8.2.)	
TRIASSIC(?):	
Moenkopi Formation:	
Hoskinnini Member:	
3. Sandstone and minor amount of siltstone: Pale-reddish-brown (10R 5/4); medium to very coarse grained; poorly sorted; composed of subrounded to subangular, stained and frosted quartz; firmly cemented, siliceous; irregular, very thick bedded; weathers hackly; forms an irregular ledge; contains some bleached lenses; base is gradational.	16
2. Sandstone: Grayish-red (10R 4/2); fine- to medium-	

high-angle and large-scale crossbeds; weathers rounded and blocky; forms an irregular ledge; some silty areas; base is concealed. 100+

34.—Owl Rock

Owl Rock, 7½ miles north of Kayenta
24-1.2-10.8

[Measured by M. E. Cooley and J. P. Akers]

UPPER TRIASSIC:
Wingate Sandstone:
Lukachukai Member:
32. Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; composed of stained and frosted quartz; firmly cemented; flat, massive, very thick bedded; wedge planar crossbedding, low- to high-angle and medium- to large-scale crossbeds; forms a vertical cliff; base is sharp. 80+

Rock Point Member:
31. Sandstone and minor amount of siltstone: Silt to coarse-grained sand; composed of stained and frosted quartz; weakly to firmly cemented, calcareous; irregular, lenticular, thin- to thick-bedded; wedge crossbedding, low-angle and medium- to large-scale crossbeds; weathers rounded; forms an irregular slope; base is gradational. 42.5
30. Sandstone and siltstone, alternating: Moderate-reddish-orange (10R 6/6); very fine grained; well-sorted; composed of stained and frosted quartz; firmly cemented, calcareous; flat, thin to very thick bedded; weathers blocky; forms an irregular ledge; contains abundant vertical joints; some beds weather into subdued hoodoos; an 8-foot limy zone occurs near bottom of unit; base is gradational. 191

Total Rock Point Member 233.5
Total Wingate Sandstone 313.5+

Chinle Formation:
Owl Rock Member:
29. Limestone and siltstone, alternating: Limestone is same as unit 27 and siltstone same as unit 24; irregular, lenticular, thick to very thick bedded; weathers blocky; forms an irregular ledge; base is gradational. 36.5
28. Siltstone: Undescribed; unmeasured. -----
27. Limestone: Very pale blue (5B 8/2); well-cemented; irregular, thick-bedded, separated by very thin silty layers; some beds are composed of concretionary structures; weathers hackly and blocky; forms an irregular ledge; contains common chert nodules; zone of seeps along strike in localized areas; base is sharp. 10
26. Siltstone: Same as unit 24. 16
25. Limestone: Same as unit 23; more silty part of unit is composed of concretionary forms. 11
24. Limy siltstone: Moderate-orange-pink (10R 7/4); firmly cemented; massive, flat-bedded; weathers hackly; forms an irregular slope; upper part of unit is more silty and less firmly cemented; several horizons are bleached to a light green; base is sharp. 37
23. Limestone and siltstone: Grayish-pink (5R 8/2); well-cemented; flat, irregular, thin to very thick bedded; limestone as much as 6 feet thick is separated by siltstone as much as 6 inches thick; weathers blocky; forms an irregular ledge; limestone contains common angular mud pellets and green bleached spots; numerous silt zones are bleached to light green; base is sharp. 21

Total Owl Rock Member 131.5+

Petrified Forest Member:
22. Siltstone: Pale-red (10R 6/2); some sandy zones; firmly cemented, calcareous; forms an irregular slope; contains numerous sandy lenses about 4 inches thick and as much as 10 feet long; some sandy streaks meet at low angles; bottom 20 feet of unit is silty mudstone; base is gradational. 214
21. Limy siltstone: Pale-red (5R 6/2); firmly cemented; massive, flat-bedded; weathers hackly; forms an irregular ledge; abundant light-green spots average three-eighths of an inch in diameter; base is gradational. 28.5
20. Sandy siltstone: Same as unit 18. 127
19. Conglomerate and mudstone, alternating.
Conglomerate: Grayish-pink (5R 8/2).
Matrix: Medium to very coarse grained sand; composed of subrounded to subangular, clear and frosted quartz; weakly to firmly cemented, calcareous; irregular, thin to very thick bedded; wedge crossbedding, low-angle and medium-scale crossbeds.
Pebbles: Composed of subrounded limestone and very calcareous mudstone; maximum size, half an inch.
Mudstone: Grayish-pink (5R 8/2); massive, flat-bedded; unit forms an irregular slope; base is gradational. 32
18. Sandy siltstone: Pale-red-purple (5RP 6/2); silt to medium-grained sand; composed of subrounded to subangular, stained and frosted quartz; mica accessory mineral; weakly cemented, calcareous; massive; unit is a coset; wedge crossbedding, low-angle and medium- to large-scale crossbeds; weathers fluffy; forms an irregular slope; commonly contains limestone nodules; one very calcareous zone; base is gradational. 43
17. Mudstone: Moderate-greenish-yellow (10Y 7/4) and grayish-red (5R 4/2); weakly cemented, calcareous; massive; wedge trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers fluffy; forms a grained; fair-sorted; composed of stained and frosted quartz; firmly cemented, siliceous; flat, massive, very thick bedded; weathers rounded; forms an irregular ledge; coarse-grained sand stringers common; base is irregular and gradational. 9.5

Total Moenkopi Formation 25.5

UNCONFORMITY.
PERMIAN:
Cutler Formation:
De Chelly Sandstone Member (incomplete):
1. Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; well-sorted; composed of clear, stained, and frosted quartz; firmly cemented, siliceous; massive, very thick bedded; unit is a coset; asymmetrical and symmetrical trough crossbedding, large-scale crossbeds; weathers smooth; forms a rounded slope; base is concealed. 50

35.—Chilchinbito

Northeast side of Black Mesa, 10 miles north-northwest of Chilchinbito, 8 miles southeast of Kayenta
38-8.0-6.5

[Measured by L. C. Craig and V. L. Freeman]

UPPER JURASSIC:
Morrison Formation:
Salt Wash Sandstone Member:
Top of section, near top of exposure.
13. Sandstone: White (N 9) to greenish-white (5G 9/1); medium to very coarse grained; wedge crossbedding; occasional shaly partings and angular chert pebbles suggest fluviatile deposition; unmeasured. -----
12. Claystone: Grayish-red (10R 4/2); slightly silty; weathers chippy to earthy. 5.8
11. Sandstone: Light-greenish-gray (5GY 8/1); fine-grained; composed of subangular, clear quartz; rare green, orange, black, and red accessory minerals; crossbedding; channeled. 2.7
10. Claystone: Grayish-red (10R 4/2); slightly silty to very sandy; weathers chippy to earthy; thin, nodular, yellowish-gray (5Y 8/1) limestone lenses as much as 3 inches thick contain abundant spiral gastropods and Chara. 21.1

Total incomplete Morrison Formation 29.6+

Cow Springs Sandstone:
9. Sandstone: Yellowish-gray (5Y 8/1) to moderate-reddish-brown (10R 4/6), banded and mottled; very fine grained; composed of subangular, clear and stained quartz; common orange and black accessory minerals; upper 4.1 feet is structureless white (N 9) sandstone, well cemented into slabby calcareous beds in upper 1 foot. 22.5
8. Sandstone: Moderate-reddish-brown (10R 4/6); very fine grained; composed of subangular to angular, clear and amber-stained quartz; common black accessory minerals; forms an unbroken vertical cliff; upper one-third of unit is horizontally bedded, middle one-third is wedge crossbedded, and lower one-third is interbedded with both types of bedding. 43

Total Cow Springs Sandstone 65.5

Summerville Formation:
7. Sandstone: Light-brown (5YR 6/4) in upper half of unit, grayish-red (10R 4/2) in lower half; very fine grained; composed of subangular to angular, clear and amber-stained quartz; faint, wavy, flat-bedded. 3.5
6. Claystone: Very dark red (5R 2/6); very slightly sandy; forms a prominent reentrant. .4
5. Sandstone: Moderate-reddish-orange (10R 6/6) in lower two-thirds of unit, light-brown (5YR 6/4) in upper one-third; very fine grained; rare orange and black accessory minerals; upper one-third of unit contains prominent reentrants, giving banded appearance. 46.2
4. Claystone: Pale-red (5R 6/2) to light-red (5R 6/6); slightly sandy; nonresistant. .5
3. Sandstone: Light-reddish-brown (10R 5/6); very fine grained; composition same as unit 2; beds are uncontorted; forms an unbroken cliff. 14.4
2. Sandstone: Light-reddish-brown (10R 5/6); very fine grained; composed of subangular to angular, clear and amber-stained quartz; very calcareous; unit is contorted on a broad scale; weathers massive; some zones contain dusky-red (5R 3/4), fine, horizontal, wavy laminae and common yellowish-gray (5Y 7/2) spots and bands; rare disseminated medium-grained sand. 70.7

Total Summerville Formation 135.7

Entrada Sandstone (incomplete):
1. Sandstone: Very pale orange (10YR 8/2); very fine grained; composed of clear and amber-stained quartz; rare orange and black accessory minerals; wedge crossbedding; weathers massive; contains common medium-grained, well-rounded quartz. 3.0

Base of measured section; base of local exposure.

36.—Tsegi Trading Post

North side of Black Mesa, 11 miles southwest of Kayenta
39-10.2-7.3

[Measured by J. W. Harshbarger]

UPPER AND LOWER CRETACEOUS:
Dakota(?) Sandstone:
16. Sandstone: Yellowish-orange (10YR 7/6); fine-grained;

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER AND LOWER CRETACEOUS—Continued — Feet

Dakota(?) Sandstone—Continued

firmly cemented, calcareous and ferruginous; flat, thin-bedded, beds $\frac{1}{8}$ to $\frac{3}{4}$ inch thick; forms a pitted cliff; contains abundant black iron specks. 42

UNCONFORMITY: Not apparent.

UPPER JURASSIC:

Morrison Formation:

Westwater Canyon Member:

Slope: Concealed by talus; appears to be similar to unit 15; alternating red shale beds. 27

15. Sandstone: Pale-yellowish-gray (5Y 8/2); fine-grained; firmly cemented, calcareous; thick-bedded, beds 4 to 6 feet thick; massive; forms a rough, vertical-jointed cliff; contains abundant kaolin specks. 22

Slope: Talus-covered; appears to be similar to unit 14; alternating reddish-brown shale beds. 41

14. Sandstone: Yellowish-gray (5Y 7/2); fine-grained; firmly cemented, calcareous; thin-bedded, beds $\frac{1}{2}$ to 2 inches thick; crossbedded, small-scale crossbeds; forms a rough, pitted, vertical-jointed cliff; contains limonite nodules and abundant kaolin specks. 71

13. Sandstone and shale: Same as unit 11; poorly exposed blocky slope. 64

12. Sandstone: Light-gray (N 7); very fine grained; firmly cemented, calcareous cement; flat, thick-bedded, beds 4 to 6 feet thick; forms a pitted cliff; contains common kaolin specks. 17

Total Westwater Canyon Member 242

Recapture Shale Member:

11. Shale and sandstone, alternating: Reddish-brown shale, very fine grained, thin-bedded; light-gray (N 7) sandstone similar to that of unit 9; twice as much shale as sandstone; calcareous cement; forms a smooth, banded slope. 109

10. Sandstone: Light-gray (N 7); fine-grained; firmly cemented, calcareous; flat, thin-bedded, beds $\frac{1}{2}$ to 2 inches thick; forms a resistant ledge; contains limonite specks. 4

9. Sandstone: Very light gray (N 8); fine-grained; very weakly cemented, calcareous; flat, thin-bedded, beds $\frac{1}{8}$ to 1 inch thick; forms a friable, smooth, banded slope; contains several resistant ledges; alternates with thin-bedded, aphanitic, pale-red (5R 6/2) shale. 76

Total Recapture Shale Member 189

Salt Wash Sandstone Member:

8. Sandstone: Same as unit 7; contains abundant limonite and hematite nodules; irregular, lenticular granule conglomerate. 54

7. Sandstone: Yellowish-gray (5Y 7/2); fine-grained; weakly cemented, calcareous; thin-bedded, beds $\frac{1}{8}$ to 2 inches thick; crossbedded, small-scale crossbeds; forms a rough, pitted cliff; commonly contains black iron specks. 47

6. Sandstone: Light-gray (N 7); very fine grained; weakly cemented, calcareous; thin-bedded, beds $\frac{1}{8}$ to 1 inch thick; crossbedded; forms a rough, pitted cliff; contains abundant limonite specks and nodules. 23

Total Salt Wash Sandstone Member 124

Total Morrison Formation 555

Cow Springs Sandstone:

5. Sandstone: Yellowish-gray (5Y 7/2); very fine grained; firmly cemented, calcareous; thin-bedded, beds $\frac{1}{4}$ to 2 inches thick; crossbedded, small- to large-scale crossbeds; forms a rounded cliff; contains pale-red (5R 6/2) shale lenses (1 x 8 feet) and small, irregular, sandy limestone lenses 3 to 5 inches thick and 5 to 10 feet long. 36

Slope: Concealed by talus and vegetation; appears to contain beds similar to unit 5 at top and beds similar to unit 4 at bottom. 24

Total Cow Springs Sandstone 60

Entrada Sandstone:

4. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; firmly cemented, calcareous; flat, thin-bedded, beds $\frac{1}{4}$ to 1 inch thick; partially crossbedded; forms a smooth, rounded cliff; contains abundant crisscross, mottled, light-gray (N 7) streaks. 27

Slope: Talus-covered; occasional small outcrops indicate beds are similar to units 3 and 4. 206

3. Sandstone: Light-brown (5YR 6/4); very fine grained; firmly cemented, calcareous; massive; thick-bedded; partially crossbedded, large-scale crossbeds; forms a smooth, rounded cliff; contains abundant crisscross, irregular, light-gray (N 7) streaks or bands. 60

Total Entrada Sandstone 293

UPPER AND MIDDLE JURASSIC:

Carmel Formation:

Slope: Talus-covered; occasional outcrops of pale-red (5R 6/2) sandy shale and flat-bedded yellowish-gray (5Y 7/2) sandstone; boundary between Carmel Formation and Entrada Sandstone appears to be near top third of unit. 87

2. Sandstone: Yellowish-orange (10YR 7/6); fine-grained; very weakly cemented, calcareous; flat, thin-bedded, beds $\frac{1}{4}$ to 1 inch thick; forms a smooth ledge; contains abundant iron specks. 9

Slope: Covered by landslide; poorly exposed outcrop of reddish-brown shale near base. 195

Total Carmel Formation 291

DISTRICT 9

38.—Comb Wash

Comb Ridge, half a mile north of State Highway 74, 16 miles east-northeast of Mexican Hat
3-6.4-16.0

[Measured by C. A. Repenning and P. R. Stevens]

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member: — Feet

6. Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; composed of subrounded to subangular, clear and amber quartz; well-cemented; massive; unit is a coset; asymmetrical and plunging trough crossbedding, medium- to large-scale crossbeds; weathers rounded; forms a vertical cliff; contains abundant medium- to coarse-grained sand composed of quartz that is concentrated along bedding planes; eolian environment; base is sharp and flat. 270

Tongue of Rock Point Member:

5. Sandstone: Pale-red (5R 6/2); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, white and amber quartz; mica accessory mineral (5 percent); well-cemented; massive, laminated; weathers blocky; forms an irregular cliff; contains mud galls, especially near the top; fluviatile environment; base is sharp and flat. 59

Lukachukai Member continued:

4. Sandstone: Same as unit 6; small- to medium-scale crossbeds; weathers rounded; forms a vertical and rounded cliff; base is sharp and flat. 73

Total Lukachukai Member, including tongue of Rock Point Member 402

Rock Point Member:

3. Siltstone: Silt and some very fine grained sand; composed of clear and amber quartz; black accessory minerals (about 5 percent); weakly cemented; flat, laminated; unit is a set; weathers smooth; forms a regular slope; base is sharp and irregular. 5

Total Wingate Sandstone 407

Chinle Formation:

Owl Rock Member:

2. Siltstone: Moderate-reddish-brown (10R 4/6); silt, clay, and very fine grained sand; weakly cemented; laminated; weathers rounded to hackly; forms a regular and covered slope; base is sharp and irregular. 24

1. Limestone: Light-brownish-gray (5YR 6/1); silt and very fine grained sand; composed of clear quartz; well-cemented; weathers blocky; forms a ledge; contains abundant light-greenish-gray (5GY 8/1) spots; base is gradational and irregular. 5

Total incomplete Chinle Formation 29

39.—Mexican Water

On butte 2 miles east of Mexican Water Trading Post
21-5.8-2.6

[Measured by J. D. Strobell, Jr.]

Top of section, top of hill at southern edge of mesa.

UPPER JURASSIC:

Morrison Formation:

Recapture Shale Member:

52. Sandstone: Light-brown (5YR 6/4 to 5YR 5/6); crossbedded in channels; contains small amount of claystone; contact between Recapture Shale and Salt Wash Sandstone Members is not clear-cut. 42

Salt Wash Sandstone Member:

51. Sandstone: Very light gray (N 8) and pinkish-gray (5YR 8/1); channeled; contains small amounts of siltstone and claystone. 93.6

50. Sandstone: Greenish-gray (5GY 6/1 to 5G 6/1) and brown; very fine grained; argillaceous cement; somewhat laminated. 3.0

49. Sandstone: White (N 9); very fine grained; highly calcareous cement; contorted laminae at base, laminated at top. 1.1

48. Sandstone: Greenish-gray (5GY 6/1 to 5G 6/1) and gray; very fine grained; argillaceous cement; somewhat laminated. .6

47. Sandstone: White (N 9); fine-grained; composed of subangular, clear quartz; very calcareous cement; flat-bedded. 1.4

46. Siltstone: Gray; argillaceous cement. .8

45. Sandstone: White (N 9); well-cemented, calcareous; composed of reworked Bluff Sandstone. .4

44. Sandstone: Grayish-yellow (5Y 8/4); very fine grained; weakly cemented; purple manganese stains. .4

43. Sandstone: Well-cemented, calcareous; flat-bedded; manganese stains. 1.1

42. Sandstone: Well-cemented, calcareous; concretionary. .4

Total Salt Wash Sandstone Member 102.8

Total Morrison Formation 144.8

Bluff Sandstone:

41. Sandstone: Same as unit 40 but lighter in color and somewhat finer grained; crossbedded. 22.5

40. Sandstone: Moderate-orange-pink (5YR 8/4); medium-grained; composed of well-rounded frosted quartz and

UNCONFORMITY: Poorly exposed; light-brown (5YR 6/4) sandstone; crossbedded, large-scale crossbeds; truncated by flat-bedded reddish-brown shale.

JURASSIC AND TRIASSIC(?):

Navajo Sandstone (incomplete):

1. Sandstone: Light-brown (5YR 6/4); fine-grained; weakly cemented; thin- to thick-bedded; crossbedded, large-scale crossbeds; forms a smooth, rounded slope; contains sandy limestone stringers.

37.—Betatakin

Tsegi Point, Laguna Canyon, ½ mile east of Betatakin Ruin and 15 miles west-southwest of Kayenta
40-0.8-4.3

[Measured by C. A. Repenning and J. R. Howard]

JURASSIC AND TRIASSIC(?):

Navajo Sandstone:

9. Sandstone: Undescribed. 275+

UPPER TRIASSIC(?):

Kayenta Formation:

8. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; well-cemented; massive; unit is a coset; asymmetrical and symmetrical trough crossbedding, concave low-angle and small- to medium-scale crossbeds; weathers blocky; forms an irregular ledge; fluviatile environment; base is sharp and irregular. 28
7. Covered interval, includes sandstone same as unit 6: Pale-red (5R 6/2) to moderate-reddish-orange (10R 6/6); fine- to medium-grained; fair-sorted; planar and trough crossbedding, small- to medium-scale crossbeds; contains claystone lenses. 93

Total Kayenta Formation 121

Moenave Formation:

Springdale Sandstone Member:

6. Sandstone: Pale-red (5R 6/2); medium-grained; well-sorted; composed of subangular, clear quartz; mica accessory mineral (1 percent); well-cemented; massive; unit is a coset; lenticular, asymmetrical, and symmetrical trough crossbedding, concave low-angle and small- to medium-scale crossbeds; weathers blocky; forms a vertical cliff; contains lenses of claystone; fluviatile environment; base is sharp and irregular. 80

Dinosaur Canyon Sandstone Member:

5. Sandstone: Pale-red (5R 6/2); clay to coarse-grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common black, red, and white accessory minerals; weakly to firmly cemented; flat, lenticular, laminated to thin-bedded; lenticular trough crossbedding, concave low-angle and small-scale crossbeds; weathers flaggy; forms an irregular and covered slope; contains abundant lenses of mudstone, 2 to 3 feet thick; fluviatile environment; base is sharp and irregular. 45

Total Moenave Formation 125

UNCONFORMITY: Erosional, 3 feet of relief.

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member:

4. Sandstone: Grayish-orange (10YR 7/4) to dark-yellowish-orange (10YR 6/6); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, clear and frosted quartz; medium-grained sand is composed of white and red quartz; well-cemented; massive; unit is a coset; tabular planar and asymmetrical wedge trough crossbedding, concave high-angle and large-scale crossbeds; weathers rounded; forms a rounded cliff; contains abundant white (N 9) chert grains along bedding planes; eolian environment; base is sharp and irregular. 192

Rock Point Member:

3. Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained, some silt; well-sorted; composed of subrounded to subangular, amber and white quartz; firmly cemented; flat, lenticular, very thin to thin-bedded; lenticular and asymmetrical trough crossbedding, concave low-angle and small-scale crossbeds; weathers hackly to flaggy; forms an irregular slope; contains abundant white (N 9) spots; deltaic environment; base is sharp and irregular. 11
2. Sandstone: Moderate-reddish-brown (10R 4/6); very fine to coarse-grained; poorly sorted; composed of subangular, clear, stained, amber, and white quartz; black accessory minerals (1 percent); firmly cemented; flat, lenticular, very thin to thin-bedded; unit is a coset; lenticular and asymmetrical trough crossbedding, concave low-angle and small- to medium-scale crossbeds; weathers hackly; forms an irregular slope; fluviatile environment; base is concealed. 43

Total Rock Point Member 54
Total Wingate Sandstone 246

Unconformity: Mostly covered.

Chinle Formation:

Owl Rock Member:

1. Shale and marl: About 20 feet exposed above bed of Laguna Creek. 20

angular white (N 9) chert; flat-bedded, but bedding is disturbed; friable; laminar concentrations of coarse grains. 22

39. Sandstone: Same as unit 38 but weathers grayish red (10R 4/2); very calcareous cement. 1.0
38. Sandstone: White (N 9), weathering moderate-orange-pink (5YR 8/4); fine-grained; composed of well-rounded to subangular, clear and frosted quartz; black, red, and rare green accessory minerals; calcareous cement; bedding obscured but apparently parallel; contains abundant angular white chert; base is a very poorly defined parting. 1.3

Total Bluff Sandstone 46.8

Summerville Formation:

37. Sandstone: Same as unit 36 but not deformed. 65.3
36. Sandstone and siltstone: Grayish-orange-pink (5YR 7/2) to pale-brown (5YR 5/2), spotted with white (N 9); very fine grained; crinkled, contorted; weathers rounded; contains some highly calcareous layers; blocky joints. 49.1
35. Sandstone: Moderate-reddish-brown (10R 4/6); well-cemented, calcareous; bedding disturbed, more deformed in upper half conforming to unit 36; white (N 9) spots in discontinuous sinuous bands have "folds" 1 foot high and "wave lengths" 8 to 10 feet wide; well-defined parting at base. 10.4

Total Summerville Formation 124.8

Entrada Sandstone:

34. Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; well-cemented, calcareous; 1-foot, horizontal, white (N 9) band at top. 4.0
33. Sandstone: Dusky-brown (5YR 2/2); well-cemented, calcareous. 1.0
32. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; composed of quartz; black accessory minerals; bedding obscured; contains rare "Entrada berries"; lower 10 feet of unit is somewhat darker and contains white (N 9) spots. 15.5
31. Sandstone: Dusky-brown (5YR 2/2); well-cemented, calcareous. .4
30. Sandstone: White (N 9); very fine grained; well-sorted; flat-bedded; friable. 2.0
29. Sandstone: Moderate-reddish-brown (10R 4/6); very fine grained; well-cemented, calcareous; thin, wavy, obscured, flat-bedded; tends to weather into rounded forms, but hoodoos are not well developed; contains white (N 9) spots, thin bands, and scattered "Entrada berries"; 8 feet above base is a prominent parting with white (N 9) zone above and below it. 34.8
28. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; composed of clear quartz; black accessory minerals; well-cemented, calcareous; upper three-fifths of unit is crossbedded and contains laminar concentrations of coarse grains; lower two-fifths of unit is darker and bedding is obscured; distinct parting at top scalloped with white (N 9) zone below it; contains frosted "Entrada berries." 11.4
27. Sandstone: Brownish-orange-pink (5YR 7/4); fine-grained; composed of clear quartz; black accessory minerals; calcareous cement; intricately crossbedded, laminar concentrations of coarse grains; forms a cliff; distinctly lighter and more yellow than adjacent units and also coarser grained; contains "Entrada berries." 9.7
26. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; composed of clear quartz; black accessory minerals; well-cemented, calcareous; obscured, flat-bedded; contains white (N 9) spots and "Entrada berries"; base is irregular and marked by white (N 9) bands. 3.0
25. Sandstone: Grayish-orange-pink (5YR 7/2) to light-brown (5YR 6/4); very fine grained; composed of clear quartz; black accessory minerals; calcareous cement; thin-bedded near bottom, disturbed and obscured in upper two-thirds of unit; contains some large, well-rounded, frosted quartz. 5.9

Total Entrada Sandstone 87.7

UPPER AND MIDDLE JURASSIC:

Carmel Formation:

24. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; well-cemented, calcareous; contains scattered larger quartz and chert grains; caps bench at foot of massive Entrada Sandstone cliff. 1.0
23. Siltstone: Pale-reddish-brown (10R 5/4); sandy; calcareous cement; mud-crack fillings are composed of three thin sandstone layers. 16
22. Siltstone: Pale-reddish-brown (10R 5/4); shaly and sandy; partly crossbedded; contains white (N 9) spots. 12
21. Sandstone: White (N 9), moderate-reddish-orange (10R 6/6), and pale-brown (5YR 5/2); very fine grained, a few larger grains; well-cemented, calcareous. 3.9
20. Claystone: Pale-reddish-brown (10R 5/4); some silt. 2.2
19. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; ½-foot, white (N 9) layers at top and bottom; jointed, concretionary outcrop. 3.0
18. Claystone: Pale-reddish-brown (10R 5/4); contains sandstone nodules. 2.2
17. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained, some larger "berries"; poorly sorted; well-cemented, calcareous. 1.2
16. Claystone: Pale-reddish-brown (10R 5/4); laminated; a few quartz grains. 2.9

120

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER AND MIDDLE JURASSIC—Continued — Feet

Carmel Formation—Continued

15. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; calcareous cement; blocky joints; contains white (N 9) spots and quartz "Entrada berries." 0.4
14. Claystone: Pale-reddish-brown (10R 5/4); silt and very fine grained sand; biotite accessory mineral; contains white (N 9) spots. 3.5
13. Sandstone: White (N 9), weathering brown; well-cemented, calcareous. .9
12. Siltstone: Pale-reddish-brown (10R 5/4); shaly; calcareous. 2.0
11. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; calcareous cement; lenticular crossbedding; unit is white (N 9) on fresh surface. .7
10. Siltstone: Pale-reddish-brown (10R 5/4); silt to fine-grained sand; sandy and shaly; calcareous cement; contains white (N 9) spots and concretionary beds. 28
9. Sandstone: Very fine grained; well-cemented, calcareous. .5
8. Siltstone: Shaly. 2.4
7. Sandstone: Yellowish-gray (5Y 8/1) and pale-reddish-brown (10R 5/4), mottled; very fine grained; poorly sorted and tightly packed; composed of clear quartz; black accessory minerals; well-cemented, calcareous; scattered "berries," 0.25 mm in diameter. 1.1
6. Siltstone: Pale-reddish-brown (10R 5/4); some very fine grained sand; weakly cemented; laminated; friable; contains white (N 9) spots. 17.1
5. Sandstone: Grayish-orange-pink (10R 8/2), moderate-reddish-orange (10R 6/6), and pale-reddish-brown (10R 5/4); very fine to fine-grained; poorly sorted; composed of well-rounded to subangular, clear quartz; well-cemented, calcareous. 1.2
4. Siltstone: Pale-reddish-brown (10R 5/4); sandy; argillaceous cement; contains sandstone casts of mud cracks. 5.2
3. Sandstone: A mud-crack cast. 1.0
2. Siltstone: Pale-reddish-brown (10R 5/4); sandy; composed of well-rounded quartz; argillaceous cement; contains mud-crack casts composed of fine-grained sandstone that is gray and pale reddish brown (10R 5/4); some dark-reddish-brown (10R 3/4) clay. 5.0

Total Carmel Formation 113.4

JURASSIC AND TRIASSIC(?):

Navajo Sandstone (incomplete):

1. Sandstone: Very pale orange (10YR 8/2) to moderate-orange-pink (5YR 8/4), weathering grayish orange pink (5YR 7/2) to light brown (5YR 6/4); silt to very fine grained sand; large-scale crossbeds; upper surface is rolling, with 10 feet of relief; sporadic angular white chert pebbles as much as 1 inch in diameter.

40.—Los Gigantes

12 miles northeast of Round Rock Trading Post
35-5.5-8.0

[Measured by J. W. Harshbarger, C. A. Repenning, and J. H. Irwin]

JURASSIC AND TRIASSIC(?):

Navajo Sandstone:

12. Sandstone: Undescribed; base is sharp and irregular.

UPPER TRIASSIC(?):

Kayenta Formation:

Sandy facies:

11. Sandstone: Pale-red (5R 6/2); very fine to coarse-grained; poorly sorted; composed of subrounded to subangular, clear and stained quartz; well-cemented, calcareous; flat, gnarly, thin to very thick bedded; unit is a coset; weathers rounded; forms an irregular slope; contains abundant gravel stringers; fluviatile environment; base is gradational. 18
10. Conglomerate: Light-bluish-gray (5B 7/1); splits massive; unit is a set; irregular, thick-bedded; weathers rounded; forms a rounded ledge; fluviatile environment; base is sharp and irregular.
    Matrix: Fine- to coarse-grained; poorly sorted; composed of rounded to subrounded, clear quartz; well-cemented, calcareous.
    Gravel: Limestone and sandstone pebbles. 2

Total Kayenta Formation 20

UNCONFORMITY: 3 feet of relief on the weathered surface of the Wingate Sandstone.

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member:

9. Siltstone: Pale-red (5R 6/2) in top of unit, grading downward into a moderate red (5R 5/4); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; well-cemented, calcareous; splits massive; structureless, bedding originally present is apparently masked by weathering; weathers rounded; forms a rounded cliff; contains abundant limestone nodules, stringers, and filled cracks; entire unit contains cracks that are either filled with limestone or bleached; possible fluviatile environment; base is gradational. 10
8. Sandstone: Very pale orange (10YR 8/2) to grayish-orange (10YR 7/4); fine-grained; well-sorted; composed of well-rounded to subangular, clear and amber quartz; firmly cemented, calcareous; splits massive and flaggy; unit is a coset; very thick bedded; lenticular and symmetrical trough crossbedding, medium- to

UPPER TRIASSIC(?)—Continued — Feet

Kayenta Formation—Continued

4. Sandstone: Grayish-orange (10YR 7/4); very fine grained; composed of quartz; firmly cemented, calcareous; tabular crossbedding, small-scale crossbeds; forms an irregular slope; base is gradational. 17

Total Kayenta Formation 74

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member:

3. Sandstone: Light-brown (5YR 6/4); very fine grained; composed of quartz; firmly cemented, calcareous; laminated; tabular crossbedding, large-scale crossbeds; forms a rounded and vertical cliff or domed slope; spring zone at base of unit issues from niche; base is sharp and irregular. 117
2. Sandstone: Light-brown (5YR 6/4); very fine grained; composed of quartz; firmly cemented, calcareous; laminated; large-scale crossbeds; forms a vertical cliff or domed slope; contains scattered white (N 9) specks; borings are locally abundant; bleached zone at base; base is sharp and even. 235

Total Lukachukai Member 352

Rock Point Member:

1. Siltstone: Moderate-reddish-brown (10R 4/6). 15

42.—Rock Point

West of Chinle Wash, 3 miles northwest of Rock Point Trading Post
36-10.0-0.2

[Measured by C. A. Repenning]

UPPER AND MIDDLE JURASSIC:

Carmel Formation: Undescribed.

UNCONFORMITY: Concealed.

JURASSIC AND TRIASSIC(?):

Navajo Sandstone:

36. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; composed of subrounded, clear quartz; firmly cemented, calcareous; wedge planar crossbedding, trough type toward base, high-angle and large-scale crossbeds; weathers massive; forms a rounded cliff; base is sharp and flat. 61
35. Limestone: Light-bluish-gray (5B 7/1); finely crystalline; flat, gnarly, very thin bedded; weathers flaggy; forms a ledge; unit is broadly lenticular; base is sharp and flat. 2
34. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; well-sorted; composed of subrounded, clear quartz; firmly cemented, calcareous; laminated; tabular planar crossbedding, high-angle and large-scale crossbeds; weathers massive; forms a rounded cliff; conspicuous parting plane 117 feet below top of unit. 221
33. Sandstone: Dark-yellowish-orange (10YR 6/6); very fine grained; well-sorted; composed of subrounded, clear quartz; firmly cemented, calcareous; laminated; trough crossbedding, low- to high-angle and large-scale crossbeds; weathers massive; forms a rounded cliff that projects over top unit of the Kayenta Formation; base is sharp and irregular with about 6 inches of relief. 51

Total Navajo Sandstone 335

UPPER TRIASSIC(?):

Kayenta Formation:

Sandy facies:

32. Sandstone: Very light gray (N 8); fine-grained; well-sorted; composed of subrounded to subangular, stained quartz; poorly cemented, calcareous; structureless; weathers massive; forms a vertical cliff; base is sharp and flat. 6
31. Mudstone: Very dusky red (10R 2/2); flat, gnarly, very thin bedded; weathers shaly; forms a covered slope; base is sharp and flat. 2
30. Sandstone: Medium-bluish-gray (5B 5/1); very fine grained; well-sorted; composed of subangular, stained quartz; well-cemented, siliceous; flat, thin-bedded; weathers massive; forms a ledge; contains ripple marks and invertebrate trails; base is sharp and flat. 5
29. Limestone: Very light gray (N 8); sandy in some parts and cherty in others; 50 percent of unit is composed of quartz; gnarly, thin-bedded; weathers flaggy; forms a ledge; unit is lenticular; base is sharp and irregular. 3
28. Sandstone: Very pale orange (10YR 8/2); very fine grained; well-sorted; composed of subangular, stained quartz; poorly cemented, calcareous; flat, very thin bedded; weathers massive; forms a ledge; base is gradational. 12
27. Sandstone: Pale-red (10R 6/2), speckled with pale reddish brown (10R 5/4); very fine grained; well-sorted; composed of subrounded, clear quartz; well-cemented, calcareous; trough crossbedding, low-angle and small-scale crossbeds; weathers massive; forms a rounded cliff; unit commonly contains well-rounded boulders along its base derived from underlying Wingate Sandstone; base is sharp and irregular with 20 feet of relief. 26

Total Kayenta Formation 54

(Section continued 5 miles south of Rock Point Trading Post.)

UNCONFORMITY: Erosional, 20-foot relief.

high-angle and large-scale crossbeds; weathers smooth; forms a rounded cliff; eolian environment; base is sharp and irregular. 47

7. Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; poorly sorted; composed of subrounded to subangular, clear and amber quartz; firmly cemented, calcareous; splits massive; flat, slightly wavy, very thin to thin-bedded; weathers rounded; forms a rounded ledge; commonly contains coarse, well-rounded, quartz grains along the bedding; possible fluviatile or lacustrine environment; base is sharp and irregular. 3

6. Sandstone: Very pale orange (10YR 8/2) and grayish-orange (10YR 7/4); fine- to medium-grained; well-sorted; composed of well-rounded to subangular, clear and amber quartz; firmly cemented, calcareous; splits massive and flaggy; very thick bedded; unit is a coset; lenticular and symmetrical trough crossbedding, medium- to high-angle and large-scale crossbeds (as much as 300 feet lateral extent of individual crossbeds); crossbeds dip east and southeast; weathers smooth; forms a vertical cliff; crossbed surfaces are often marked by parallel wind ripples or by slump ridges on foreset slope; worm trails common; one exposure contains small-vertebrate tracks that traverse dune slope obliquely and cross smaller tracks suggestive of large-insect trail; these smaller tracks lie in trough between ripple marks; eolian environment; base is sharp and irregular. 286

5. Siltstone: Pale-reddish-brown (10R 5/4), weathering moderate reddish orange (10R 6/6); silt and very fine grained sand; well-sorted; composed of clear and amber quartz; weakly cemented, calcareous and argillaceous; splits shaly to crumbly; laminated to very thin bedded; weathers hackly; forms a regular slope; unit is lenticular and disappears laterally along strike; still-water environment; base is sharp and irregular. 16

4. Sandstone: Moderate-reddish-orange (10R 6/6), weathering moderate orange pink (10R 7/4); very fine grained; well-sorted; composed of subrounded to subangular, clear, white, and amber quartz; black accessory minerals, approximately 2 percent; firmly cemented, calcareous; splits massive; thin- to thick-bedded; tabular and wedge planar crossbedding, very low to medium-angle and small-scale crossbeds; upper part of unit contains some lenticular trough crossbedding that dips generally to the north; weathers smooth; forms a vertical cliff; contains longitudinal ripple marks in some horizons; beach or deltaic environment; base is sharp and irregular. 62

3. Sandstone: Same as unit 4; splits massive; very thick bedded; lenticular trough crossbedding, low- to medium-angle and large-scale crossbeds; crossbeds dip generally to the south; weathers smooth; forms a vertical cliff; eolian or beach environment; base is sharp and irregular. 31

2. Sandstone: Same as unit 4; thin- to thick-bedded; tabular planar crossbedding, low- to medium-angle and small-scale crossbeds dipping to the south; trough crossbedding in upper part; weathers smooth; forms a vertical cliff; beach and deltaic environment; base is sharp and flat. 24

Total Lukachukai Member 479

Rock Point Member (incomplete):

1. Sandstone: Pale-reddish-brown (10R 5/4), weathering moderate reddish orange (10R 6/6); silt and very fine grained sand; well-sorted; composed of clear and amber quartz; well-cemented, calcareous; splits massive; irregular, flat, very thin to thin-bedded; weathers knobby or hackly; forms an irregular cliff; commonly contains white (N 9) spots and streaks; still-water environment; base is concealed.

41.—Cathedral Rock

West side of Chinle Wash, 13 miles northwest of Round Rock Trading Post
36-7.7-7.2

[Measured by C. A. Repenning]

JURASSIC AND TRIASSIC(?):

Navajo Sandstone:

9. Sandstone: Grayish-orange (10YR 7/4); very fine grained; composed of quartz; weakly cemented, calcareous; flat, thin-bedded; tabular crossbedding; forms a covered slope; base is sharp and even. 15

8. Limestone: Light-gray (N 7); finely crystalline; flat, thick-bedded; forms the capping ledge of mesa; base is sharp and even. 5

7. Sandstone: Moderate-reddish-brown (10R 4/6); very fine grained; composed of quartz; weakly cemented, calcareous; flat-bedded; tabular crossbedding, small-scale crossbeds; forms a covered slope; base is covered. 15

Total incomplete Navajo Sandstone 35

UPPER TRIASSIC(?):

Kayenta Formation:

6. Sandstone: Very light gray (N 8); very fine grained; composed of quartz; feldspar accessory mineral, about 1 percent; weakly cemented, calcareous; flat, thin-bedded; tabular crossbedding; forms a ledgy slope; base is sharp and even. 35

5. Sandstone: Moderate-orange-pink (10R 7/4); fine-grained; 75 percent of sandstone is composed of quartz and 25 percent of feldspar; firmly cemented, siliceous; thick-bedded; tabular crossbedding, small-scale crossbeds; forms a ledgy slope; contains rounded sandstone pebbles and boulders; base is gradational. 22

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member:

26. Sandstone: Light-brown (5YR 6/4); very fine grained; well-sorted; composed of subrounded, clear quartz; firmly cemented, calcareous; trough crossbedding, high-angle and large-scale crossbeds; weathers massive; forms a rounded cliff; base is sharp and irregular, a prominent spring horizon. 117

25. Sandstone: Similar to unit 26 except that crossbeds are somewhat smaller in size but still large; base is sharp and flat beneath thin bleached zone. 235

Total Lukachukai Member 352

(Section continued on the slope of Little Round Rock, 14 miles south of Rock Point Trading Post.)

Rock Point Member:

24. Siltstone: Light-brown (5YR 6/4); silt, clay, and very fine grained sand; well-sorted; firmly cemented, calcareous; flat, gnarly, laminated; weathers shaly to hackly; forms a niche below vertical cliff of the Lukachukai Member; base is gradational. 7

23. Silty sandstone: Light-brown (5YR 6/4); silt and very fine grained sand; well-sorted; well-cemented, calcareous; flat, thin-bedded; weathers massive; forms a cliff; unit is lenticular; base is sharp and irregular. 18

22. Silty sandstone: Moderate-reddish-brown (10R 4/6); silt and very fine grained sand; well-sorted; firmly cemented, calcareous; flat, laminated; weathers flaggy to shaly, tends to weather massive in places due to cementing variation; forms a series of ledges of either flagstone or rounded forms; unit is lenticular; base is gradational. 33

21. Mudstone: Moderate-reddish-brown (10R 4/6); silt, clay, and very fine grained sand; well-sorted; weakly cemented, calcareous; flat, laminated; weathers shaly; forms a regular slope; unit is lenticular; base is sharp and irregular. 5

20. Silty sandstone: Same as unit 22; weathers flaggy at base and massive at top. 17

19. Mudstone: Same as unit 21. 13

18. Silty sandstone: Same as unit 23. 38

17. Silty sandstone: Same as unit 22. 38

16. Mudstone: Same as unit 21. 33

15. Silty sandstone: Same as unit 20. 11

14. Mudstone: Same as unit 21. 11

13. Silty sandstone: Same as unit 20. 8

12. Mudstone: Same as unit 21. 13

11. Silty sandstone: Same as unit 22. 19

10. Mudstone: Same as unit 21; white (N 9) line at top. 11

9. Silty sandstone: Same as unit 22. 5

8. Mudstone: Same as unit 21. 10

7. Silty sandstone: Same as unit 22. 19

6. Mudstone: Same as unit 21. 10

5. Silty sandstone: Same as unit 22. 3

4. Mudstone: Same as unit 21. 13

3. Silty sandstone: Same as unit 22. 3

2. Mudstone: Same as unit 21. 6

Total Rock Point Member 344

Total Wingate Sandstone 696

Arbitrary contact.

Chinle Formation (incomplete):

1. Sandy limestone: Very pale green (10G 8/2) and grayish-orange-pink (5YR 7/2); gnarly, thin-bedded; conglomeratic at top.

43.—Tyende Creek

Along Dennehotso-Many Farms road, 20 miles west-northwest of Round Rock Trading Post
37-3.0-11.2

[Measured by C. A. Repenning and J. H. Irwin]

UPPER JURASSIC:

Morrison Formation:

Salt Wash Sandstone Member:

15. Sandstone: Undescribed; forms top of mesa; base is sharp and even.

Cow Springs Sandstone:

14. Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; well-sorted; composed of subrounded, frosted quartz; common feldspar accessory mineral; weakly cemented, calcareous; tabular and wedge planar and asymmetrical trough crossbedding, high-angle and large-scale crossbeds; weathers rounded; forms a rounded cliff or a rolling slope; contains lenses of argillaceous material; eolian environment; base is sharp and irregular with large symmetrical channels. 63.6

Summerville Formation:

Sandy facies:

13. Sandstone: Very pale orange (10YR 8/2) banded with moderate reddish brown (10R 4/6); very fine to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; common black accessory minerals; firmly cemented, calcareous; flat, thin- to thick-bedded; weathers blocky; forms a vertical cliff; base is sharp and flat. 31

Entrada Sandstone:

Medial silty member:

12. Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; well-sorted; composed of subrounded, clear and amber quartz; common black accessory minerals; firmly cemented, calcareous; flat, irregular, very thin to thick-bedded; weathers knobby; forms an irregular cliff or a regular slope; contains abundant barite veins near bottom; includes some mudstone beds and a few beds of

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah--Continued

UPPER JURASSIC--Continued — Feet

Entrada Sandstone--Continued

Medial silty member--Continued

grayish-brown (5YR 3/2) sandstone, 1 foot thick, which form blocky ledges; preconsolidation slumpage features; still-water environment; base is sharp and irregular. 81.4

Lower sandy member:

11. Sandstone: Light-brown (5YR 6/4); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear and amber quartz; common black accessory minerals; firmly cemented, calcareous; massive; inclined wedge crossbedding, high-angle and large-scale crossbeds; weathers rounded; forms a rolling slope; primary slumpage features; probable eolian environment; base is sharp and irregular. 64.6

10. Sandstone: Pale-reddish-brown (10R 5/4); silt to medium-grained sand; poorly sorted; composed of subrounded to subangular, amber quartz; rare black accessory minerals; well-cemented, calcareous; flat, gnarly, massive; weathers knobby; forms a ledge; probable fluviatile environment; base is gradational and irregular. 13.2

Total lower sandy member 77.8

Total Entrada Sandstone 159.2

UPPER AND MIDDLE JURASSIC:

Carmel Formation:

9. Sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare black accessory minerals; firmly cemented, calcareous; gnarly, thick-bedded; weathers blocky; forms a ledge; base is sharp and irregular and is a channeled surface. 3.0

8. Mudstone: Pale-reddish-brown (10R 5/4) banded with pinkish gray (5YR 8/1); fair-sorted; composed of clear and amber quartz; weakly cemented, calcareous; gnarly, laminated to thin-bedded; weathers hackly; forms an irregular slope; contains lenses of sandstone and claystone; channeling occurs throughout unit; fluviatile environment; base is sharp and irregular. 78.4

7. Mudstone: Pale-reddish-brown (10R 5/4); weakly cemented, calcareous; forms an irregular slope or ledge; contains gigantic shrinkage cracks that outline crude hexagons 8 to 10 feet in size; shrinkage cracks are 1 foot wide, 1 to 2 feet deep, and filled with sandstone same as composition of unit 5; mudstone weathers out and leaves the sandstone fillings in the form of interlaced walls; entire unit grades laterally into sandstone; fluviatile environment; base is sharp and irregular and is a channeled surface. 11.7

6. Mudstone: Pale-reddish-brown (10R 5/4); clay to very fine grained sand; fair-sorted; composed of subrounded to subangular, amber quartz; weakly cemented, calcareous; gnarly, laminated; weathers smooth; forms a regular slope; fluviatile environment; base is sharp and irregular. 9.6

5. Sandstone: Yellowish-gray (5Y 8/1), weathering grayish orange pink (5YR 7/2); very fine grained; well-sorted; composed of subrounded to subangular, clear quartz; rare black accessory minerals; firmly cemented, calcareous; gnarly, thick-bedded; weathers blocky; forms a ledge; fluviatile environment; base is sharp and irregular and is a channeled surface. 3.0

4. Siltstone and claystone: Pale-reddish-brown (10R 5/4); weakly cemented, calcareous; flat, laminated; weathers smooth; forms a regular slope; fluviatile environment; base is sharp and irregular and is a channeled surface. 16.8

3. Sandstone: Light-brownish-orange (5YR 6/6); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, clear, stained, and amber quartz; rare black accessory minerals; weathers rounded; forms a rounded ledge; fluviatile environment; base is sharp and irregular. 7.6

2. Siltstone and claystone: Pinkish-gray (5YR 8/1) siltstone and pale-reddish-brown (10R 5/4) claystone; fair-sorted; composed of subrounded to subangular, clear quartz; common red accessory minerals; weakly cemented, calcareous; flat, irregular, laminated to thick-bedded; weathers smooth; forms a regular banded slope; highly channeled; unit consists of many lenses; siltstone lenses become more sandy in upper part; fluviatile environment; base is sharp and flat. 11.7

Total Carmel Formation 141.8

JURASSIC AND TRIASSIC(?):

Navajo Sandstone (incomplete):

1. Sandstone: Light-brownish-orange (5YR 6/6); medium-grained; well-sorted; composed of rounded to subrounded, clear quartz; rare black and white accessory minerals; weakly cemented, siliceous; massive; wedge planar crossbedding, high-angle and large-scale crossbeds; weathers rounded, crossbedding planes etched; forms a rolling slope; eolian environment.

UPPER CRETACEOUS--Continued — Feet

Toreva Formation--Continued

9. Covered interval: Sandstone same as unit 8 but very weakly cemented; forms a regular covered slope; contains a few silty beds and a few conglomeratic and firmly cemented ledges; to the south this unit becomes more firmly cemented and probably is the white sandstone just below the top of the mesas in the Hopi country; base is gradational and flat. 45

8. Sandstone: Yellowish-gray (5Y 8/1), weathering dark yellowish orange (10YR 6/6); fine- to coarse-grained; fair to poorly sorted; composed of subrounded to subangular, clear and stained quartz; common mica accessory mineral; well-cemented, calcareous; flat, lenticular, thin- to thick-bedded; unit is a coset; tabular planar and asymmetrical trough crossbedding, concave low-angle and small-scale crossbeds; weathers blocky; forms a vertical cliff; commonly contains silty lenses; upper half of unit contains abundant granule stringers and lenses with common feldspar and a few pebbles of white quartz; fluviatile environment; base is sharp and gradational. 35

Total Toreva Formation 278

Mancos Shale:

7. Covered interval: Mostly siltstone similar to unit 4; increasing amount of flat, thin-bedded sandstone toward top of unit. 185

6. Siltstone: Same as unit 4; contains abundant gypsum 168 feet above base; Prionotropis woolgari between 123 and 146 feet above base. 246

5. Covered interval. 22

4. Siltstone: Light-gray (N 7) to medium-dark-gray (N 4) and some yellowish-gray (5Y 8/1), banded; clay, silt, and some very fine grained sand; well-sorted; weakly cemented; laminated, flat-bedded; weathers smooth; forms a regular slope; bottom 10 feet contains abundant Gryphaea newberryi(?) and Ostrea sp.; Inoceramus labiatus common at several horizons; base is gradational. 213

Total Mancos Shale 666

UPPER AND LOWER CRETACEOUS:

Dakota Sandstone:

3. Sandstone: Same as unit 1; firmly cemented, calcareous; flat, thin- to thick-bedded; thins laterally; unit is a coset; trough crossbedding, low-angle crossbeds; contains ripple laminations; fluviatile environment; base is sharp and irregular. 8

2. Carbonaceous siltstone and coal: Dark-gray (N 3), weathering medium light gray (N 6); clay, silt, and very fine grained sand; poorly sorted; composed of subangular, clear quartz; weakly cemented; flat, laminated, very thin bedded; weathers smooth and rounded; forms a regular slope; contains abundant gypsum; more sandy at top; carbonized plant remains; base is flat and gradational. 36

1. Sandstone: Very pale orange (10YR 8/2), weathering very pale orange (10YR 8/2); fine-grained; composed of subrounded, clear and stained quartz; black accessory minerals; flat, irregular, thick-bedded; unit is a coset; asymmetrical trough crossbedding, concave low-angle and small- to medium-scale crossbeds; weathers blocky; forms a vertical cliff; contains abundant iron-rich concretions; base is sharp and irregular, with 10 feet of relief. 60

Total Dakota Sandstone 104

45.--Yale Point

A.--East side of Black Mesa at Yale Point, 19 miles northwest of Chinle
54-4.0-12.2

[Measured by M. E. Cooley and H. G. Page]

UPPER CRETACEOUS:

Yale Point Sandstone:

13C. Sandstone: Light-buff; fine- to medium-grained; poorly sorted; well to firmly cemented; lenticular, very thick bedded, as much as 20 feet thick; unit is a coset; upper 40 feet has trough crossbedding, high-angle and medium-scale crossbeds; lower 25 feet has lenticular and wedge planar crossbedding, low-angle and large-scale crossbeds; weathers blocky; forms a vertical cliff; shark's teeth, pelecypods, and fragments of large pelecypods [Inoceramus(?)]; fossils are concentrated along crossbedding planes within 10 feet of base; top of unit is top of mesa; base is gradational. 64

13B. Siltstone and sandstone, alternating: Siltstone as much as 5 feet thick alternates with sandstone as much as 2 feet thick; most siltstone lenses are 1 foot thick; base is gradational.

Siltstone: Olive-buff; silt to very fine grained sand;

DISTRICT 10

44. — Rough Rock

Northeast side of Black Mesa, 3 miles west-southwest of Rough Rock Trading Post
54-9, 5-7, 5

[Measured by C. A. Repenning and H. G. Page]

Top of Black Mesa, highest exposure of Cretaceous beds known.
UPPER CRETACEOUS:
Yale Point(?) Sandstone:
19. Sandstone: Yellowish-gray (5Y 8/1), weathering grayish orange (10YR 7/4); medium- to coarse-grained; fair- to well-sorted; composed of subrounded to subangular, clear quartz; common feldspar and mica accessory minerals; firmly to very well cemented, calcareous; lenticularly bedded; unit is a coset; asymmetrical and symmetrical trough crossbedding, concave low-angle and small- to medium-scale crossbeds; weathers blocky; forms an irregular cliff; contains shark's teeth 31 feet (in place), 129 feet (float), and 151 feet (in place and with carbonaceous plant remains) above base of unit; one block found near Mancos Shale contact apparently originated from this unit and contained a shark's tooth as well as abundant marine mollusks, although such were not found in place; fluviatile and marine environment; base is sharp and flat. 162

Wepo Formation:
18. Sandstone and siltstone, alternating: Sandstone is same as unit 16 and siltstone is same as unit 17; sandstone is 1 to 4 feet thick; laminated, lenticularly bedded; weathers smooth; forms a regular covered slope; contains plant fragments; base is sharp and irregular. 52
17. Covered interval: Medium-light-gray (N 6) shaly siltstone with a few sandstone ledges similar to unit 16 and a few firmly cemented, light-gray (N 7) siltstone ledges; laminated, flat-bedded; weathers fissile; forms a regular slope; carbonaceous siltstone locally common; base is concealed. 120
16. Sandstone: Very pale orange (10YR 8/2), weathering dark yellowish orange (10YR 6/6) in upper 3 feet and very pale orange (10YR 8/2); medium- to coarse-grained; fair- to well-sorted; composed of stained and frosted quartz; rare mica and black accessory minerals; firmly cemented, calcareous; lenticular, thin- to thick-bedded; unit is a coset; asymmetrical trough crossbedding, concave low-angle and small-scale crossbeds; weathers blocky; forms an irregular cliff; commonly contains silty beds and lenses, especially towards top of unit; unit becomes conglomeratic at bottom; fluviatile environment; base is concealed. 42
15. Covered interval: Carbonaceous siltstone with thin lignite beds; weathers smooth; forms a regular covered slope; contains septarian concretions and a few sandstone beds similar to unit 16; plant remains common; swamp and fluviatile environment; base is gradational and irregular. 104

Total Wepo Formation 318

Toreva Formation:
14. Sandstone: Yellowish-gray (5Y 8/1), weathering grayish yellow (5Y 8/4); medium to very coarse grained; poorly sorted; composed of stained quartz; white feldspar accessory mineral; well-cemented, calcareous; flat, thick to very thick bedded; unit is a coset; asymmetrical trough crossbedding, concave low-angle and small-scale crossbeds; weathers blocky; forms a vertical cliff; commonly contains silty niches; fucoid marks on upper surface; fluviatile environment; base is sharp and flat. 56
13. Mostly covered interval: Carbonaceous siltstone and carbonaceous sandstone, alternating; flat, laminated to thin-bedded; weathers smooth to blocky; forms an irregular slope; upper half of unit contains beds of fine to very fine grained, moderate-yellowish-brown (10YR 5/4) sandstone ranging from 6 inches to 3 feet in thickness—thicker toward top—and containing casts of small pelecypods; commonly contains lignite beds 1 to 6 inches thick; swamp environment.
Carbonaceous siltstone: 5 to 15 feet thick.
Carbonaceous sandstone: Brownish-gray (5YR 4/1), weathering very light gray (N 8); very fine grained; contains many plant remains. 78
12. Sandstone: White (N 9); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; white feldspar accessory mineral; well-cemented, calcareous; thin- to thick-bedded; unit is a coset; asymmetrical trough crossbedding, concave low-angle and small-scale crossbeds; weathers blocky; forms a vertical cliff; contains flakes of carbonaceous material; fluviatile environment; base is sharp and irregular. 8
11. Carbonaceous siltstone and sandstone: Very light gray (N 8), weathering very light gray (N 8); silt to fine-grained sand; well-sorted; composed of subrounded to subangular, stained quartz; weakly cemented, calcareous and argillaceous; lenticular, laminated, thin-bedded; weathers smooth; forms a regular slope; 2-foot bed of lignite at top of unit; commonly contains carbonaceous material; swamp environment; base is sharp and flat. 19
10. Sandstone: Same as unit 8; contains lenses of carbonaceous shale; base is sharp and irregular, an erosion surface. 37
poorly sorted; lenticular, very thin bedded; weathers hackly; forms a partly covered, irregular slope.
Sandstone: Light-buff; very fine to fine-grained; poorly sorted; firmly cemented; weathers blocky; forms an irregular ledge. 27
13A. Sandstone: Light-buff; fine- to medium-grained; poorly sorted; well to firmly cemented; lenticular, very thick bedded, as much as 20 feet thick; unit is a set; lenticular and wedge trough crossbedding, low-angle and large-scale crossbeds; weathers blocky; forms a vertical cliff; base is sharp and irregular with as much as 3 feet of relief. 113

Total Yale Point Sandstone 204

Wepo Formation:
12C. Sandstone: Light-buff; very fine to fine-grained; poorly sorted; weakly to firmly cemented; flat, lenticular, thick to very thick bedded; unit is a coset; lenticular and wedge trough crossbedding, low-angle and large-scale crossbeds; weathers blocky; forms an irregular ledge and slope; top of unit contains some carbonaceous material; base is gradational. 30
12B. Sandy siltstone and carbonaceous siltstone, alternating: Sandy siltstone as much as 6 feet thick alternates with carbonaceous siltstone as much as 8 feet thick; a few lenticular lignite beds in carbonaceous siltstone; base is gradational.
Sandy siltstone: Similar to unit 12A.
Carbonaceous siltstone: Gray; clay to silt; poorly sorted; flat, thick to very thick bedded, as much as 8 feet thick; weathers hackly; forms an irregular ledge and slope. 102
12A. Silty sandstone: Light-buff; silt to fine-grained sand; poorly sorted; weakly cemented; flat, very thick bedded; weathers smooth; forms a regular slope; base is gradational. 32
11. Sandstone: Light-buff; fine- to medium-grained; poorly sorted; firmly cemented; lenticular, thin to very thick bedded, as much as 4 feet thick; unit is a set; lenticular and wedge trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers blocky; forms an irregular ledge; unit contains lenticular, 1-foot-thick beds of carbonaceous siltstone; sandstone contains siltstone fragments as much as 1 foot in diameter, limonite concretions, and petrified logs replaced by limonite; base is gradational. 86
10C. Silty sandstone and lignite, alternating: Silty sandstone less than 4 feet thick alternates with lignite less than 2 feet thick; base is gradational.
Silty sandstone: Same as unit 10A.
Lignite: Dark-gray (N 3) to black (N 1); clay to silt; poorly sorted; weakly cemented; flat, thick-bedded; weathers hackly; forms an irregular slope. 27
10B. Sandstone: Buff; very fine to medium-grained; poorly sorted; black accessory minerals; firmly cemented; flat, thick-bedded; weathers blocky; forms an irregular ledge; base is gradational. 3
10A. Silty sandstone: Light-buff; silt to fine-grained sand; poorly sorted; weakly cemented; flat, irregular, very thin to thin-bedded; weathers hackly; forms an irregular slope; a 3-foot lignite bed is at top of unit; base is gradational. 24

Total Wepo Formation 304

Toreva Formation:
9. Sandstone: Buff; very fine to fine-grained; fair-sorted; well to firmly cemented; flat, lenticular, very thick bedded, as much as 20 feet thick; unit is a set; lenticular and wedge crossbedding, low-angle and large-scale crossbeds; weathers blocky; forms a vertical cliff; concentrated along crossbedding planes are fragments of large pelecypods [Inoceramus(?)]; most fossils are in basal 25 feet of unit; one 3-inch-long quartz pebble found; parallel ripple marks, measuring about 14 inches from crest to crest, are present 15 feet from base; base is gradational. 70
8. Sandy siltstone and sandstone, alternating: Sandy siltstone as much as 8 feet thick alternates with sandstone ledges less than 2 feet thick; contains small pelecypods, Inoceramus, and an ammonite; base is gradational.
Sandy siltstone: Buff; silt to fine-grained sand; poorly sorted; weakly cemented; flat, lenticular, very thin bedded; weathers hackly; forms a partly covered, irregular slope.
Sandstone: Light-buff; very fine to fine-grained; fair-sorted; well to firmly cemented; flat, very thin to thin-bedded; unit is a set; lenticular and wedge planar crossbedding, low-angle and medium-scale crossbeds; weathers pitted and hackly; forms an irregular ledge. 35
7D. Sandstone: Light-buff; fine- to coarse-grained; poorly sorted; composed of subrounded to angular grains; well to firmly cemented; lenticular, very thick bedded, as much as 6 feet thick; unit is a set; lenticular and wedge trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers blocky; forms an irregular ledge; some clear quartz sand; base is gradational. 8
7C. Siltstone: Same as unit 7A. 31
7B. Sandstone: Light-buff; very fine to fine-grained; fair-sorted; well to firmly cemented; flat, irregular, gnarly, thin- to thick-bedded; some pseudocrossbedding or low-angle and small-scale crossbeds; weathers hackly; forms an irregular ledge; contains a few pebbles less than 1½ inches in diameter; base is gradational. 5
7A. Limy siltstone: Clay to silt; poorly sorted; weakly

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Feet
UPPER CRETACEOUS—Continued	
Toreva Formation—Continued	
cemented, calcareous; flat, very thin bedded; weathers hackly; forms an irregular slope; base is gradational.	9
6B. Sandstone: Buff; very fine to very coarse grained; poorly sorted; composed of subrounded to subangular, clear quartz; well to firmly cemented; lenticular, very thick bedded; unit is a set; lenticular and wedge trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers blocky and knobby; upper half of unit is flat bedded containing thin beds of siltstone 2 to 6 feet apart; contains a few quartz pebbles as much as half an inch in diameter and small lenses of fine conglomerate; crossbedding is not well defined; 6 feet above base is a 4-foot bed of lignite and brown siltstone; base is gradational.	81
6A. Sandstone: Light-buff; very fine to fine-grained; fair to poorly sorted; well to firmly cemented; flat, lenticular, thick to very thick bedded, as much as 10 feet thick; unit is a coset; lenticular, wedge, and tabular planar and trough crossbedding, convex low-angle and small- to large-scale crossbeds; weathers blocky; forms a vertical and irregular cliff; contains some lenticular siltstone beds less than 2 feet thick near base; base is gradational.	86
Total Toreva Formation	325
Mancos Shale:	
5G. Sandy siltstone and silty sandstone, alternating: Light-olive-buff; silt to fine-grained sand; poorly sorted; weakly to firmly cemented; flat, thin to very thick bedded; weathers blocky and hackly; forms an irregular slope; unit becomes more sandy toward top; siltstone less than 4 feet thick alternates with sandstone as much as 6 feet thick; some of the sandstone beds form ledges that are trough crossbedded with small-scale crossbeds; contains septaria covered with gypsum; base is gradational.	198
5F. Mudstone: Dark-greenish-gray (5GY 4/1); clay and silt; fair to poorly sorted; weakly cemented, calcareous; flat, very thick bedded; weathers hackly; forms a rolling slope; a limy sandstone bed, 6 inches thick, is 15 feet above base; unit contains a few thin bentonite beds; contains nodular, cone-in-cone structures; base is gradational.	94
5E. Limy mudstone: Light-buff to light-bluish-gray (5B 7/1); clay and silt; fair-sorted; weakly cemented, calcareous; flat, very thin bedded; weathers hackly; forms an irregular and rolling slope; a few 1-inch-thick bentonite beds that contain selenite crystals; more thick bedded in upper third of unit; 1-foot-thick limestone bed with cone-in-cone structure at top of unit; base is gradational.	184
5D. Siltstone and bentonite, alternating: Siltstone is similar to that in unit 5A; weakly cemented; flat, thin to very thick bedded; weathers hackly; forms an irregular slope; siltstone as much as 6 feet thick alternates with bentonite less than ½ foot thick; spring on top of last bentonite layer has a discharge of about 0.5 gph (gallons per hour); base is gradational.	27
5C. Mudstone and siltstone: Same as 5A.	54
5B. Siltstone and silty limestone, alternating: Siltstone beds less than 2 feet thick alternate with silty limestone beds less than 1 foot thick; fossil oysters and fragments of pelecypods; base is gradational.	
Siltstone: Same as that in unit 5A.	
Silty limestone: Light-gray (N 7); clay to silt; poorly sorted; weakly cemented, calcareous; flat, thin- to thick-bedded; weathers hackly; forms an irregular ledge and slope.	16
5A. Mudstone and siltstone: Light-bluish-gray (5B 7/1); clay to silt; fair to poorly sorted; weakly cemented, calcareous; flat, very thick bedded; weathers hackly; forms a rolling slope; contains gypsum and limonite nodules; partly iron-stained bentonite beds less than 6 inches thick are scattered throughout unit; a few calcite nodules and selenite crystals; Gryphaea newberryi at 55 feet and Gryphaea present in a 4-foot zone at base of unit; base is gradational.	62
Total Mancos Shale	635
UPPER AND LOWER CRETACEOUS:	
Dakota Sandstone:	
4. Sandstone: Buff; very fine to fine-grained; poorly sorted: well-cemented; lenticular, very thick bedded, as much as 6 feet thick; unit is a set; lenticular and wedge trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers blocky; forms an irregular cliff; units 4 and 2 coalesce 200 yards northwest of section; base is sharp.	22
3C. Mudstone: Grayish-olive-green (5GY 3/2); clay and silt; poorly sorted; weakly cemented; very thick bedded; weathers hackly; forms an irregular slope; contains selenite crystals and secondary gypsum veins; base is gradational.	8
3B. Carbonaceous siltstone: Clay and silt; poorly sorted; weakly cemented; flat, very thin bedded; weathers hackly; forms an irregular ledge and slope; a 4-foot-thick lignite bed forms a ledge at top of unit; base is gradational.	11
3A. Siltstone: Olive-gray (5Y 4/1); clay to silt; fair-sorted; weakly cemented; flat, very thin to thin-bedded; weathers smooth; forms a rolling and partly covered slope; contains selenite crystals; base is gradational.	5
UPPER JURASSIC—Continued	Feet
Morrison Formation—Continued	
Westwater Canyon Member—Continued	
brown (10YR 6/2); contains a few zones of gravel; base chosen arbitrarily at base of cliff.	130
Total Westwater Canyon Member	396
Recapture Shale Member:	
18. Sandstone and sandy shale: Very light gray (N 8), pale-green (10G 6/2), and grayish-red (5R 4/2 to 10R 4/2); fine-grained; composed of quartz; very weakly cemented, calcareous; partly crossbedded, small-scale crossbeds; weathers into badlands and demoiselles capped by very thin beds of dusky-green (5G 3/2) resistant sandstone; forms a slope; contains grayish-red (5R 4/2 to 10R 4/2) shaly zones.	117
17. Sandstone: Pale-greenish-yellow (10Y 8/2) to moderate-greenish-yellow (10Y 7/4); fine-grained; firmly cemented, calcareous; large-scale crossbeds; weathers into an assortment of rounded shapes and pitted surfaces; forms a cliff and rounded slope; contains grayish-brown (5YR 3/2) sandstone concretions, ovoid to spherical in shape and ranging from 1 to 20 feet in size; larger concretions are generally flat or lenticular; concretions occur 106 feet above base and form the caprock on demoiselles.	151
16. Sandstone: Pale-greenish-yellow (10Y 8/2); silt and fine-grained sand; weakly cemented, calcareous; weathers into hoodoos; lenses of brown sandstone cap many of the hoodoos; forms a slope; contains grayish-brown (5YR 3/2) lenses of shale.	22
15. Shale: Very dusky red (10R 2/2); weathers into badlands; contains sandy zones and some gray limestone; commonly contains concretions ranging from ¼ to 2 inches in diameter.	39
Total Recapture Shale Member	329
Total Morrison Formation	725
Cow Springs Sandstone:	
14. Sandstone: Moderate-yellow (5Y 7/6); fine-grained; composed of rounded quartz; firmly cemented, calcareous; medium-scale crossbeds; weathers into rounded domes showing etched crossbedding features.	33
13. Sandstone: Moderate-yellow (5Y 7/6) to moderate-yellowish-green (10GY 6/4); same as unit 14 except flat bedded; silty in lower part; weathers into a slope.	56
12. Shale and sandstone: Dusky-red (5R 3/4) shale and moderate-red (5R 5/4) sandstone; fine-grained; firmly cemented, calcareous; flat-bedded; sandstone has siliceous concretions and calcite crystals that weather into knobs on the surface.	17
Unconformity: Erosional, 3 feet of relief; forms base of spring zone; springs are highly gypsiferous.	
Cow Springs Sandstone continued:	
11. Sandstone: Same as unit 13 but more firmly cemented and containing larger scale crossbeds; forms a cliff; contains vertical joints; base is gradational and was arbitrarily selected.	84
Total Cow Springs Sandstone	190
Summerville Formation:	
Sandy facies:	
10. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; large-scale crossbeds; base is gradational and arbitrary, contact chosen at point where there are no large-scale crossbeds.	17
9. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; flat, thin-bedded; partly crossbedded, small-scale crossbeds; forms a massive cliff below the Cow Springs Sandstone; contains white (N 9) spots and streaks; vertical jointing.	56
Total Summerville Formation	73
Entrada Sandstone:	
Medial silty member:	
8. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; flat-bedded; weathers into hoodoos; forms a cliff and covered slope; rocks along shaly zones and joints weather into mammillary shapes; contains white (N 9) spots and streaks.	56
UPPER AND MIDDLE JURASSIC:	
Carmel Formation:	
7. Sandstone: Yellowish-gray (5Y 8/1); fine-grained; poorly cemented; forms a slope; contains red streaks.	5
6. Sandstone: Dark-yellowish-orange (10YR 6/6); fine-grained; large-scale crossbeds.	10
5. Shale: Dark-reddish-brown (10R 3/4); forms a covered slope; contains friable sandstone beds 1 to 2 feet thick; gradations of shaly and sandy phases; dark-reddish-brown (10R 3/4) sandstone 1 foot thick at base of unit.	33
4. Sandstone: Very pale orange (10YR 8/2); fine-grained; composed of subrounded, clear and stained quartz; firmly cemented, calcareous; wavy, flat-bedded; forms a poorly developed ledge; contains oscillation ripple marks that were deposited on horizontal bedding planes; large-scale shrinkage cracks form rough hexagonal patterns 6 to 10 feet across; cracks are filled with sandstone and are similar to shrinkage cracks exposed in Carmel Formation 50 miles to the north.	3
3. Shale: Dark-reddish-brown (10R 3/4), weathering moderate reddish brown (10R 4/6); forms a poorly exposed slope; contains a 2-foot-thick bed of fine-grained, pale-greenish-yellow (10Y 8/2) silty sandstone.	11
2. Shale: Forms a partly covered ledge and slope; contains lenses of flat-bedded sandstone.	22

2. Sandstone: Buff; very fine to fine-grained; poorly sorted; firmly cemented; lenticular, thick to very thick bedded, as much as 10 feet thick; unit is a set; lenticular trough crossbedding, concave and convex low- to high-angle and medium-scale crossbeds; some pseudocrossbedding; weathers blocky; forms an irregular cliff; contains iron-stained streaks and a few fragments of iron-stained wood and plants; base is sharp and irregular. 32

Total Dakota Sandstone 78

UNCONFORMITY: Topmost 2 or 3 feet of Westwater Canyon Member is leached; some deposition of alkali at contact of Dakota Sandstone and Morrison Formation; channels at base of Dakota Sandstone contain sandstone boulders as much as 1 foot long derived from the Westwater Canyon Member and lenticular clay pellets as much as 1 inch long which are oriented with the crossbedding; some pebbles less than 1 inch in diameter are composed of quartz, chert, and quartzite; channeled surface, as much as 15 feet of relief.

UPPER JURASSIC:

Morrison Formation:

Westwater Canyon Member:

1. Sandstone: Pinkish-gray (5YR 8/1); lenticular, flat, thin to very thick bedded; lenticular and wedge trough crossbedding, low-angle and medium-scale crossbeds; weathers blocky and knobby; forms a vertical cliff; contains a few boulders as much as 3 feet in diameter. 50+

B.—East side of Black Mesa at Yale Point, 16 miles northwest of Chinle
54-1.5-14.2

[Measured by C. A. Repenning]

UPPER CRETACEOUS:

Mancos Shale:

29. Shale: Medium-gray (N 5) to dark-gray (N 3), sandy part is light olive gray (5Y 6/1); weathers into badland topography; septarian concretions with calcite-filled cracks; contains well-preserved Prionotropis woolgari, contact is gradational and arbitrarily chosen at top of unit 28. 400+

UPPER AND LOWER CRETACEOUS:

Dakota Sandstone:

28. Sandstone: Yellowish-gray (5Y 7/2); fine-grained, clayey in lower part; firmly cemented, calcareous; small-scale crossbeds in middle of unit; weathers into a smooth surface; forms a ledge; commonly contains concentrations of iron concretions that weather rusty; joints filled with gypsum crystals. 4

27. Coal: Dark-gray (N 3), grayish-black (N 2), and black (N 1); clayey; flat-bedded; forms a slope and recess; unit thins and thickens along outcrop, in places forming all the Dakota Sandstone; contains a few casts of branches; much sulfur and gypsum deposited in joints. 34

26. Sandstone: Very light gray (N 8), weathering light brown (5YR 6/4 to 5YR 5/6); fine-grained; firmly cemented, calcareous; very thin bedded; weathers into a pitted surface; forms a cap on cliffs; upper 2 feet is dark gray (N 3) and very carbonaceous. 75

Total Dakota Sandstone 113

UNCONFORMITY: Erosional, 40 feet of relief; gravel at base of Dakota Sandstone is composed of subrounded quartz pebbles, less than 1 inch in diameter.

UPPER JURASSIC:

Morrison Formation:

Westwater Canyon Member:

25. Sandy shale: Grayish-green (10GY 5/2 to 5G 5/2); weathers into a slope; unit is not present everywhere because it has been partly removed by pre-Dakota Sandstone erosion. 17

24. Sandstone: Very pale orange (10YR 8/2); medium-grained; weakly cemented, calcareous; weathers into rounded domes; forms a slope below unit 25 or forms a cliff below the Dakota Sandstone; contains some lenses of coarse-grained sandstone; grades laterally into units 23 and 25. 45

23. Shale and sandstone: Very pale orange (10YR 8/2), pale-yellowish-orange (10YR 8/6), moderate-orange-pink (5YR 8/4 to 10R 7/4), pale-olive (10Y 6/2), and dark-yellowish-orange (10YR 6/6); clay to fine-grained sand; composed of subrounded quartz; weakly cemented, calcareous; mostly flat-bedded; some small-scale crossbeds; forms a slope and badlands; a $\frac{1}{2}$-foot, well-cemented, ledge-forming sandstone occurs near base and is composed of pea-size balls cemented with lime; contains iron stains; lenses are separated by interformational erosion surfaces ranging from 1 to 6 feet apart; green parts are more shaly. 95

22. Sandstone: Pale-yellowish-orange (10YR 8/6); medium-grained; weakly cemented, calcareous; small-scale crossbeds; weathers into rounded knobs; forms a ledge. 66

21. Shale and sandstone: Same as unit 23. 16

20. Sandstone: Light-olive-gray (5Y 5/2); medium- to coarse-grained; weakly cemented, calcareous; weathers into knobs; forms a slope. 27

19. Sandstone: Pale-green (10G 6/2), grayish-green (5G 5/2 to 10GY 5/2), and moderate-green (5G 5/6), weathering paler green; medium-grained; firmly cemented, calcareous; flat-bedded, partly massive; small-scale crossbeds; weathers into a pitted surface in uppermost 10 feet and weathers rough in rest of unit; forms a cliff; contains lenses less than 2 feet thick of very dusky red (10R 2/2) shale; because of staining from the shale lenses, overall color of cliff is pale yellowish

Total Carmel Formation 84

UNCONFORMITY: Probably erosional; basal units of the Carmel Formation contain sandstone reworked from the Navajo Sandstone; contact mostly covered but can be located within a 5-foot interval by distinct lithologic differences between the Carmel Formation and Navajo Sandstone.

JURASSIC AND TRIASSIC(?):

Navajo Sandstone:

1. Sandstone: Undescribed.

46.—Lohali Point

A.—2 miles north of Lohali Point, 16 miles west of Chinle
72-4.9-6.0

[Measured by M. E. Cooley and H. G. Page]

Top of Black Mesa

UPPER CRETACEOUS:

Toreva Formation:

8. Arkosic sandstone: Medium to very coarse grained; poorly sorted; composed of subangular quartz and feldspar; well to firmly cemented; irregular, lenticular, thick to very thick bedded, as much as 8 feet thick; unit is a set; wedge trough crossbedding, low- to high-angle and small- to medium-scale crossbeds; weathers rounded and blocky; forms an irregular ledge; contains lenses of siltstone less than $\frac{1}{2}$ foot thick; lenses of conglomerate contain pebbles less than $\frac{1}{4}$ inch in diameter; limonite concretions; a few limestone pebbles less than 1 inch in diameter at top of unit; base is gradational. 15

7G. Carbonaceous siltstone: Same as unit 7A. 2

7F. Conglomeratic sandstone: Buff; lenticular, very thick bedded, as much as 6 feet thick; unit is a set; lenticular crossbedding, low- to high-angle and small- to medium-scale crossbeds; weathers blocky; forms an irregular ledge; base is sharp.
Matrix: Fine to very coarse grained; poorly sorted; subangular grains.
Pebbles: Less than three-eighths of an inch in diameter; composed of subangular, clear quartz. 10

7E. Carbonaceous siltstone: Same as unit 7A. 2

7D. Sandstone: Buff; very fine to medium-grained; poorly sorted; well-cemented; flat, lenticular, very thin to thick-bedded; weathers blocky; forms an irregular ledge; base is gradational. 8

7C. Carbonaceous siltstone: Same as unit 7A. 2

7B. Conglomerate: Buff; lenticular, very thick bedded, as much as 6 feet thick; unit is a set; lenticular trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers blocky; forms a vertical cliff; base is sharp.
Matrix: Medium to very coarse grained; poorly sorted.
Pebbles: Less than a quarter of an inch in diameter; composed of subrounded to subangular quartz. 15

7A. Carbonaceous siltstone: Gray; clay to silt; poorly sorted; weakly cemented; flat-bedded; weathers hackly; forms an irregular slope; base is gradational. 5

6C. Sandstone: Light-buff; very fine to medium-grained; poorly sorted; well to firmly cemented; lenticular, gnarly, thin- to thick-bedded; unit is a coset; planar and trough crossbedding, low-angle and medium-scale crossbeds; weathers blocky; forms an irregular ledge; base is gradational. 13

6B. Lignite: Dark-gray (N 3); clay to silt; poorly sorted; weakly cemented; flat, very thin to thin-bedded; weathers hackly; forms an irregular slope; base is gradational. 1

6A. Sandstone: Light-buff; fine- to medium-grained; fair- to well-sorted; well-cemented; flat, lenticular, thin to very thick bedded, as much as 10 feet thick; unit is a set; lenticular and wedge planar crossbedding, low-angle and large-scale crossbeds; weathers blocky; forms a vertical cliff; parallel ripple marks; base is gradational. 68

Total Toreva Formation 141

Mancos Shale:

5J. Silty sandstone, sandy siltstone, and siltstone, alternating: Silty sandstone less than 1 foot thick alternates with sandy siltstone less than 8 inches thick and with siltstone less than 2 inches thick; some carbonaceous material in siltstone in upper third of unit; base is gradational.
Silty sandstone: Silt to very fine grained sand; poorly sorted; firmly cemented; flat, irregular, lenticular, thin- to thick-bedded; unit is a set; lenticular and wedge crossbedding, low-angle and small- to medium-scale crossbeds; weathers blocky; forms an irregular ledge.
Sandy siltstone: Buff; silt to very fine grained sand; poorly sorted; weakly cemented; flat, lenticular, thin- to thick-bedded; weathers hackly; forms an irregular slope.
Siltstone: Dark-greenish-gray (5G 4/1); bedding features same as sandy siltstone. 32

5I. Mudstone: Dark-greenish-gray (5G 4/1); clay to silt; poorly sorted; weakly cemented; flat, irregular, lenticular, very thin to thin-bedded; weathers hackly; forms an irregular and a partly covered slope; contains a few thin bentonite beds, some cone-in-cone structures, and selenite crystals; contains septaria composed chiefly of calcite and aragonite; base is gradational. 302

5H. Limy claystone and some mudstone: Dark-greenish-gray (5G 4/1) to dark-bluish-gray (5B 4/1); clay to silt; fair to poorly sorted; weakly cemented, calcareous;

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER CRETACEOUS—Continued — Feet

Mancos Shale—Continued

flat, irregular, gnarly, very thin to thin-bedded; weathers hackly; forms a rolling slope; some olive-green layers; rains cause small mudflows to form in stream channels; limonite concretions and gypsum incrustations; ammonite fossils at about 110 feet above base; a few thin bentonite beds; base is gradational. 135

5G. Siltstone: Light-bluish-gray (5B 7/1); clay to silt; poorly sorted; weakly cemented; flat, thin- to thick-bedded; weathers hackly; forms an irregular slope; contains selenite crystals; top half of unit contains thin bentonite beds 4 feet apart; base is gradational. 54

5F. Silty limestone: Light-bluish-gray (5B 7/1); clay to silt; poorly sorted; weakly to firmly cemented, calcareous; flat, thin- to thick-bedded; weathers blocky and hackly; forms an irregular ledge and slope; contains fossil oysters and fragments of pelecypods; base is gradational. 16

5E. Siltstone and bentonite, alternating: Siltstone same as unit 5D and as much as 10 feet thick alternates with bentonite less than 1 foot thick; siltstone is usually 2 to 3 feet thick and bentonite is usually 3 to 6 inches thick; 5-foot zone of limestone contains fossil oysters; base is gradational. 16

5D. Siltstone: Light-bluish-gray (5B 7/1); silt; fair-sorted; weakly cemented; flat, very thin bedded; weathers hackly; forms a rolling slope; base is gradational. 46

5C. Siltstone: Light-bluish-gray (5B 7/1); clay to silt; poorly sorted; weakly cemented; flat, thin- to thick-bedded; weathers hackly; forms a rolling slope; contains Gryphaea newberryi, baculites, small pelecypods, gastropods, and cephalopods; some fossils are preserved in a 2-inch bed of limestone; base is gradational. 14

5B. Bentonite: Fair-sorted; weakly cemented; flat, thick-bedded; weathers fluffy; forms a rolling slope; base is gradational. 3

5A. Siltstone: Light-bluish-gray (5B 7/1); clay to silt; poorly sorted; weakly cemented; flat, thin to very thick bedded; weathers hackly; forms a rolling slope; contains a few thin beds of bentonite; fossil Gryphaea; base is gradational. 22

Total Mancos Shale 640

UPPER AND LOWER CRETACEOUS:

Dakota Sandstone:

4. Sand[illegible]one and lignite, alternating: Sandstone is buff, fi[illegible] to medium-grained, and poorly sorted; well to f[illegible]ly cemented; lenticular, thick-bedded; unit is a [illegible]; lenticular and wedge trough crossbedding, low- to [illegible]gh-angle and large-scale crossbeds; weathers blocky; [illegible]orms a vertical and irregular cliff; unit 200 yards away is 25 feet thick and contains no coal.

Unit consists, in descending order, of:

Sandstone.	7
Lignite.	2
Sandstone.	8

17

3. Carbonaceous siltstone and lignite, alternating: Base is gradational.

Carbonaceous siltstone: Medium-bluish-gray (5B 5/1) to black (N 1); clay to very fine grained sand; poorly sorted; weakly cemented; flat, thin- to thick-bedded; weathers hackly; forms an irregular slope.

Lignite: Black (N 1); clay to silt; fair-sorted; weakly cemented; flat, very thin bedded; weathers hackly; forms an irregular ledge.

Unit consists, in descending order, of:

Lignite.	3
Carbonaceous siltstone.	2
Lignite.	2
Carbonaceous siltstone.	5
Sandstone: Same as unit 2.	1
Carbonaceous siltstone.	10
Lignite.	2
Carbonaceous siltstone.	6

31

2. Sandstone: Buff; very fine to medium-grained; poorly sorted; well to firmly cemented; lenticular, thin- to thick-bedded; unit is a set; lenticular trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers blocky and hackly; forms an irregular ledge; contains carbonized wood and plant fragments; base is sharp and irregular. 3

Total Dakota Sandstone 51

[illegible]NCONFORMITY: Erosional, with channeling as much as 20 feet.

[illegible]PPER JURASSIC:

Morrison Formation:

Westwater Canyon Member:

1. Sandstone: Grayish-orange-pink (10R 8/2); fine- to medium-grained; poorly sorted; firmly cemented; lenticular, thick to very thick bedded; low- to high-angle crossbeds; weathers blocky; forms an irregular ledge. 20+

B.—4 miles northeast of Lohali Point, 15 miles west of Chinle
72-3.4-8.0

[Units 1 to 16 measured by R. L. Jackson and V. L. Freeman, and units 17 to 45 measured by J. W. Harshbarger and L. C. Craig]

UPPER CRETACEOUS:

Mancos Shale:

45. Claystone: Gray; top of section, not top of exposure. 100+

UPPER JURASSIC—Continued — Feet

Morrison Formation—Continued

Recapture Shale Member continued:

34. Sandstone: Yellowish-gray (5Y 8/1) to grayish-yellow (5Y 8/4); fine- to medium-grained; fair-sorted; composed of rounded to subrounded, clear quartz; common black accessory minerals; weakly to firmly cemented, calcareous; bedding same as unit 17; upper 2 feet of unit is composed of very fine grained, pale-green (5G 7/2 to 10G 6/2) sandstone, the grains of which are masked by a clay matrix or by the cement; eolian environment; 1-foot-thick layer of claystone at base. 27.9

Tongue of Cow Springs Sandstone:

33. Sandstone: Pinkish-gray (5YR 8/1) to yellowish-gray (5Y 8/1) in lower part and yellowish-gray (5YR 7/2) in upper part; fine- to medium-grained; fair-sorted; composed chiefly of clear quartz with minor amount of frosted quartz; common black and rare green and orange accessory minerals; weakly to firmly cemented, calcareous; wedge trough crossbedding, medium- to large-scale crossbeds; forms a steep slope or fluted cliff; contains a few parallel bedding planes that are nearly flat; unit has several resistant lenses that are well cemented with calcareous material; eolian environment. 111.2

Recapture Shale Member continued:

32. Sandstone: White (N 9) to very light gray (N 8) and yellowish-gray (5Y 8/1); fine- to medium-grained in lower 21.6 feet and very fine to fine-grained in upper 50.9 feet; fair-sorted; composed of rounded to subrounded, clear quartz; common to abundant black and rare green and orange accessory minerals; firmly cemented, calcareous; structureless, flat-bedded; forms a fluted cliff; contains 30 to 40 percent of red and green claystone chips derived from unit 15, indicating that part of the unit was deposited by water; 3-foot-thick bed of yellowish-gray (5Y 8/1) sandstone, medium- to coarse-grained in a matrix of clay, at base. 72.5

31. Claystone: Grayish-red (10R 4/2); clay and silt; weathers flaky to earthy; forms a minor bench; fluviatile, flood-plain, or still-water environment. 2.8

30. Sandstone: Grayish-orange-pink (10R 8/2); very fine to fine-grained; fair-sorted; composed of rounded, clear quartz; common black and rare green and orange accessory minerals; firmly cemented, calcareous; flat, thin- to thick-bedded; crossbedded within the beds; forms badlands, steep slopes, or vertical cliffs; contains a few undulating claystone partings less than 2 inches thick; quiet fluviatile, shallow lacustrine, or both types of environment. 28.5

29. Sandstone and claystone: Forms a minor bench; quiet fluviatile or shallow lacustrine environment.

Sandstone (60 percent): Grayish-orange-pink (10R 8/2) and pinkish-gray (5YR 8/1); fine-grained; well-sorted; composed of rounded to subangular, clear quartz; rare black and green accessory minerals; weakly cemented, calcareous; thin, indistinctly bedded.

Claystone (40 percent): Grayish-red (10R 4/2); silty in part; laminated, flat, lenticularly bedded. 13

Tongue of Cow Springs Sandstone:

28. Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; fair-sorted; composed of rounded to subangular, clear quartz; rare black and orange accessory minerals; weakly cemented, calcareous; laminated, thin to very thick bedded; medium- to large-scale crossbeds; forms an irregular and smooth cliff; eolian environment. 55.2

Recapture Shale Member continued:

27. Sandstone: White (N 9) to very light gray (N 8); very fine grained; fair-sorted; composed chiefly of rounded to subangular, clear quartz with some frosted quartz; common black accessory minerals; firmly cemented, calcareous; structureless, with suggestion of flat bedding features; forms a prominent knobby ledge; patches of ferruginous material; quiet fluviatile environment. 4.[illegible]

26. Siltstone and sandstone: Sandstone occurs as crossbedded lenses, less than 7 inches thick, in the siltstone; fluviatile environment.

Siltstone: Pale-reddish-brown (10R 5/4) to grayish-red (10R 4/2); composed of clear quartz; black and green accessory minerals; clay matrix; calcareous cement; structureless and faintly bedded.

Sandstone: White (N 9) to yellowish-gray (5Y 8/1); very fine to fine-grained; composed of rounded to subangular, clear quartz; common black accessory minerals; firmly cemented, calcareous. 14.3

25. Sandstone: White (N 9) to grayish-yellow (5Y 8/4); fine- to medium-grained; poorly sorted; composed of well-rounded to subrounded, clear quartz; common orange, black, and red accessory minerals; firmly cemented, calcareous; flat, gnarly, thin-bedded; weathers slabby; forms an irregular ledge and prominent bench; unit is a lens; fluviatile or shallow lacustrine environment. 3.0

Total Recapture Shale Member (including tongues of Cow Springs Sandstone) 480.[illegible]

Total Morrison Formation 641.[illegible]

Cow Springs Sandstone:

24. Sandstone: Yellowish-gray (5Y 8/1 to 5Y 7/2); silt to fine-grained sand; fair-sorted; composed of rounded to subrounded, clear quartz; abundant black and rare white and orange accessory minerals; weakly to firmly cemented, calcareous; flat-bedded; flat beds alternate

UPPER AND LOWER CRETACEOUS:

Dakota Sandstone:

44. Carbonaceous shale: Contains sandstone beds; weathers platy to slabby. 15

43. Sandstone: Basal unit of Dakota Sandstone; undescribed. 30

Total Dakota Sandstone 45

UNCONFORMITY: Erosional and channeled.

UPPER JURASSIC:

Morrison Formation:

Westwater Canyon Member:

42. Sandstone: White (N 9); locally cut out by pre-Dakota erosion; appears to be same white unit that underlies the Dakota Sandstone at the Salina Trading Post section 15 miles to the south. 20

41. Sandstone, partly conglomeratic: Very pale orange (10YR 8/2) to yellowish-gray (5Y 8/1 to 5Y 7/2); fine- to coarse-grained; fair-sorted; composed of rounded to subangular, clear quartz; feldspar, abundant black, and rare orange and green accessory minerals; firmly cemented, calcareous and ferruginous; structureless and massive in lower half of unit, with faint indications of crossbedding; wedge and asymmetrical trough crossbedding in upper half of unit, with medium- to large-scale crossbeds; forms a blocky cliff; scours are present throughout unit; contains several 1-foot-thick beds of greenish-gray (5G 6/1 to 5GY 6/1) siltstone and claystone; contains indistinct lenses of granule to pebble conglomerate, with pebbles less than 2 inches in diameter composed of gray and white chert, pink feldspar, and clear and cloudy quartz; conglomerate at base of unit contains sandstone pebbles composed of material from unit 40; upper part of unit inaccessible and not observed in detail. 74

40. Sandstone and siltstone, interbedded: Maximum thickness of beds is 6 inches; unit weathers knobby; forms a cliff.

Sandstone (75 percent): Yellowish-gray (5Y 8/1) to grayish-yellow (5Y 8/4); fine- to medium-grained; fair-sorted; composed of rounded to subangular, clear quartz; common black and rare green and orange accessory minerals; thin-bedded; wedge trough crossbedding, small- to medium-scale crossbeds; contains a few disseminated granules.

Siltstone (25 percent): Light-greenish-gray (5GY 8/1); silt to very fine grained sand; flat, thin- to thick-bedded. 26.6

39. Sandstone, partly conglomeratic: Yellowish-gray (5Y 8/1) to grayish-yellow (5Y 8/4); fine- to coarse-grained; fair-sorted; composed of rounded to subangular, clear quartz; abundant black and rare red, orange, and green accessory minerals; weakly to firmly cemented, calcareous and ferruginous; medium- to large-scale crossbeds; forms a slope, ledge, or vertical cliff; lenses of granule to pebble conglomerate; pebbles are composed of subrounded to subangular, gray and white chert, pink feldspar, and a minor amount of cloudy quartz; maximum diameter of pebbles is 1 inch; fluviatile scouring at base. 40.4

Total Westwater Canyon Member 161

Recapture Shale Member:

38. Sandstone and claystone: Two hundred feet northwest of section lenses of sandstone in upper third of unit increase in thickness and intertongue with the Westwater Canyon Member.

Sandstone (60 percent): Yellowish-gray (5Y 8/1); very fine to fine-grained; composed chiefly of rounded to subrounded, clear quartz and a minor amount of frosted quartz; common black and rare orange accessory minerals; flat-bedded.

Claystone (40 percent): Grayish-red (10R 4/2); silty; structureless; weathers hackly; forms a slope. 29.5

Tongue of Cow Springs Sandstone:

37. Sandstone: Yellowish-gray (5Y 8/1) to grayish-yellow (5Y 8/4); fine- to coarse-grained; fair-sorted; composed of rounded to subangular, clear quartz; common black accessory minerals, feldspar may be present; firmly cemented, calcareous and ferruginous; high-angle and medium- to large-scale crossbeds; forms upper part of fluted, vertical cliff; abundant cement partly masks composition; eolian environment. 42

Recapture Shale Member continued:

36. Sandstone and sandy siltstone: Lenticular and irregular unit; possible fluviatile environment.

Sandstone: Yellowish-gray (5Y 8/1); fine- to medium-grained; fair-sorted; composed of rounded to subangular, clear quartz; rare black accessory minerals.

Sandy siltstone: Greenish-gray (5GY 6/1) and grayish-red (10R 4/2); clay to very fine grained sand; grains masked by clay matrix; bedding features masked. 5.4

Tongue of Cow Springs Sandstone:

35. Sandstone: Yellowish-gray (5Y 8/1) to light-greenish-gray (5GY 8/1); fine- to medium-grained; fair-sorted; composed of rounded to subangular, clear quartz; rare black and green accessory minerals; firmly cemented, calcareous; indistinctly bedded; locally crossbedded, medium- to large-scale crossbeds; weathers smooth; forms a smooth, fluted cliff; contains ferruginous and calcareous concretions 2 to 4 feet in diameter; a few parting planes in upper 30 feet of unit may be flat and parallel, suggesting quiet shallow water or fluviatile environment, although 50 percent or more of unit was deposited in an eolian environment. 70.2

with medium-scale crossbedded layers; forms a smooth, sandy slope; crossbedded material is of fluviatile or shallow lacustrine environment. 14.4

23. Sandstone: Grayish-yellow (5Y 8/4) to moderate-yellow (5Y 7/6); very fine to fine-grained; well-sorted; composed of well-rounded to rounded, stained quartz; rare orange and black accessory minerals; firmly cemented, noncalcareous; flat, very thin bedded; weathers smooth; forms a steep slope and minor bench. 21.3

(Section continued 800 feet to the northwest.)

22. Sandstone: Same as unit 21 except no medium-grained sand noted; low- to high-angle and medium-scale crossbeds. 10.8

21. Sandstone: Grayish-yellow (5Y 8/4) to moderate-yellow (5Y 7/6), rare yellowish-gray (5Y 8/1) streaks; fine- to medium-grained; composed of rounded, clear and frosted quartz; common to abundant angular white and common rounded to subangular pink, black, and orange accessory minerals; very weakly cemented, noncalcareous; wedge trough crossbedding, low- to high-angle and very large scale crossbeds; forms a rounded top on vertical cliffs; grains are coated with ferruginous film. 33.9

20. Sandstone: White (N 9) to yellowish-gray (5Y 8/1) and pale-greenish-yellow (10Y 8/2); very fine to fine-grained, some medium grains; well-sorted; composed of well-rounded to rounded, clear quartz; common orange, black, and white accessory minerals; firmly cemented, calcareous; flat beds alternate with low- to high-angle and medium-scale crossbedded layers; weathers pitted, smooth, and fluted; forms a cliff with units 19 and 21; contains ovoid and spherical ferruginous concretions with manganiferous centers, $\frac{1}{4}$ to 6 inches in diameter; coarse grains are concentrated along lamination planes. 29.5

19. Sandstone: Same as unit 20 except composed of wedge trough crossbedding with medium- to high-angle and medium- to large-scale crossbeds. 29

Total Cow Springs Sandstone 138.9

Summerville Formation:

Sandy facies:

18. Sandstone: Same as unit 17. 38.4

17. Sandstone: Yellowish-gray (5Y 8/1), weathering yellowish-gray (5Y 7/2); very fine grained; well-sorted; composed of well-rounded to rounded, clear quartz; rare black and orange accessory minerals; weakly cemented, calcareous; flat, thin-bedded; wedge trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers smooth and pitted; forms a fluted and vertical cliff; contains ovoid, yellow-brown, ferruginous concretions 1 to 4 inches in diameter, some of which have a manganese core. 62.2

Total Summerville Formation 100.6

Entrada Sandstone:

Medial silty member:

16. Sandstone: Light-grayish-red (5R 5/2); fine-grained; composed of subangular to angular quartz; abundant black and orange accessory minerals; well-cemented; mostly massive; minor amount of small-scale crossbeds; spheroidal weathering obscures structure; grades upward into unit 17; 10 feet below top of unit is a 1-inch-thick, weakly cemented, purple zone; clayey at base. 21.2

15. Covered interval. 1.9

14. Sandstone: Moderate-reddish-orange (10R 6/6) and moderate-reddish-brown (10R 4/6); fine-grained; subangular grains; white, black, and orange accessory minerals; structureless; friable; interstitial clay present; contains streaks composed of medium- to coarse-grained, well-rounded, white and gray chert and quartz. 32

Total Entrada Sandstone 55.1

UPPER AND MIDDLE JURASSIC:

Carmel Formation:

13. Sandstone: White (N 9), pale-red (10R 6/2), and moderate-reddish-orange (10R 6/6); fine-grained; composed of subangular, clear and amber-coated quartz; common orange and black accessory minerals; weathers platy; contains several laminated, sandy, slightly micaceous, grayish-red (5R 4/2) claystone partings. 23.3

12. Sandstone: White (N 9) to light-brown (5YR 6/4 to 5Y 5/6); fine-grained; composed of subangular, clear quartz; common orange, black, and green accessory minerals; flat-bedded; contains discontinuous lenses of small-scale crossbeds; forms two ledges and a recess; middle of unit contains a 1-foot-thick, grayish-red (5R 4/2) bed of sandy claystone. 12.1

11. Clayey sandstone: Grayish-red (5R 4/2); very fine to fine-grained; composed of subangular, clay-coated, amber quartz; forms a slope; contains several thin-bedded, platy sandstone layers. 26.3

10. Sandstone: White (N 9); fine- to medium-grained; subangular grains; common orange and black accessory minerals; flat-bedded in lower 3 feet; small-scale crossbeds in upper 2 feet; slightly friable; forms a cliff. 5.0

9. Claystone: Grayish-red (5R 4/2); clay and silt; rare orange, black, and green accessory minerals; laminated; rare low-angle crossbeds; weathers platy; contains thin beds of fine-grained, subangular, white (N 9) sandstone. 10.5

8. Sandstone: Same as unit 7; contains small-scale crossbeds in upper part; white (N 9) zone at top of unit; forms a ledge. 4.2

7. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; composed of subangular, amber quartz; common black and rare orange and green accessory minerals; flat-bedded; contains seams of claystone. 3.0

6. Covered interval: A few outcrops, mostly claystone same as unit 5. 84.4

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER AND MIDDLE JURASSIC—Continued — Feet

Carmel Formation—Continued

5. Claystone: Grayish-red (5R 4/2); silty and slightly sandy; very fine to fine-grained; laminated; weathers hackly; contains four thin and irregular beds of sandstone; sandstone is white (N 9) to grayish orange (10YR 7/4), fine to medium grained, and is composed of subrounded to subangular clear quartz with common black and orange and rare red and green accessory minerals; other sandstone fills very large shrinkage cracks; sandstone has a few scattered medium to coarse, well-rounded, quartz grains. — 15.7

Total Carmel Formation — 184.5

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member:

4. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; composed of subangular, clear and amber quartz; common white, black, and orange, and rare green and red accessory minerals; well to firmly cemented; medium to very large scale crossbeds; forms rounded features or cliffs; contains some medium grains composed mostly of white, orange, and black minerals; grains are disseminated and concentrated in streaks. — 210

3. Sandstone: Moderate-reddish-orange (10R 6/6), slightly lighter and darker streaks; upper part is fine to medium grained with a few coarse grains, and lower part is very fine grained with a few fine grains; composed of subangular, clay-coated and amber quartz; common white, black, and orange, and rare green accessory minerals; well to firmly cemented; medium- to large-scale crossbeds; weathers spheroidal; upper 70 feet has bleached white areas along joints and crossbedding planes. — 150.8

Total Lukachukai Member — 360.8

Rock Point Member:

2. Covered interval. — 42.5

1. Sandy siltstone: Moderate-reddish-brown (10R 4/6), spotted with greenish white; very fine grained; splits shaly; weathers spheroidal and hackly; contains fine-grained sandstone, which forms a 4-foot vertical ledge; base of local exposure, base of section, not base of Wingate Sandstone. — 48.2

Total incomplete Rock Point Member — 90.7

Total incomplete Wingate Sandstone — 451.5

47.—Nazlini

1½ miles southeast of Nazlini Trading Post,
18 miles south-southeast of Chinle
90-10.5-7.5

[Measured by M. E. Cooley and J. R. Howard]

UPPER TRIASSIC:

Chinle Formation:

Petrified Forest Member, upper part:

16. Sandstone: Very fine to fine-grained; poorly sorted; well to firmly cemented, calcareous; black accessory minerals; lenticular, thin- to thick-bedded; lenticular and wedge crossbedding, low-angle crossbeds; weathers blocky to hackly; forms an irregular ledge; contains mud pellets less than half an inch in diameter. — 10

15. Claystone: Grayish-red-purple (5RP 4/2); fair to poorly sorted; weakly cemented, calcareous; flat-bedded; weathers smooth; forms a regular slope; base is gradational. — 18

14. Sandstone: Pale-red (5R 6/2); very fine to fine-grained; poorly sorted; composed of clear and stained quartz; black accessory minerals; firmly cemented; irregular, lenticular, thin- to thick-bedded; lenticular and wedge simple and trough crossbedding, low-angle and medium-scale crossbeds; weathers knobby; forms an irregular ledge; contains some conglomerate lenses with sandstone pebbles as much as 1 inch in diameter; base is irregular. — 11

13. Mudstone: Moderate-reddish-orange (10R 6/6); poorly sorted; weakly cemented, calcareous; weathers smooth or fluffy; forms a regular slope; lower part of unit is more firmly cemented and contains limestone nodules and more clayey material; base is gradational. — 221.5

Total incomplete upper part of the Petrified Forest Member — 260.5

Petrified Forest Member, Sonsela Sandstone Bed:

12B. Sandstone: Pale-red (5R 6/2); silt and very fine grained sand; poorly sorted; composed of clear quartz; black accessory minerals; weakly to firmly cemented; flat, irregular, lenticular, very thin to thin-bedded; lenticular and wedge simple crossbedding, low-angle and small- to medium-scale crossbeds; weathers rounded, blocky, or hackly; forms an irregular ledge; base is gradational. — 16

12A. Sandstone and conglomerate: Fine- to coarse-grained; poorly sorted; rounded to subangular grains; irregular, lenticular, thick-bedded; lenticular and wedge simple crossbedding; weathers blocky; forms an irregular ledge; grades in and out with conglomerate of limestone and mud pellets as much as 1 inch in diameter, one 4-inch piece has calcareous cement; contains

DISTRICT 11

48.—Little Round Rock

4 miles west of Round Rock Trading Post
36-2.7-15.7

[Measured by C. A. Repenning]

UPPER TRIASSIC:

Wingate Sandstone:

Lukachukai Member: — Feet

25. Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; 80 percent composed of quartz and 10 percent feldspar; firmly cemented, calcareous; thin-bedded; tabular crossbedding, large-scale crossbeds; forms a vertical cliff; base is sharp and even, a slight erosion surface. — 300

Rock Point Member:

24. Siltstone: Light-brown (5YR 6/4); clay, silt, and some very fine grained sand; composed of quartz; firmly cemented, calcareous; splits shaly; gnarly, flat-bedded; forms a niche in cliff. — 7

23. Siltstone: Light-brown (5YR 6/4); clay, silt, and some very fine grained sand; composed of quartz; firmly cemented, calcareous; massive, flat-bedded; forms an irregular cliff; unit is lenticular; base is sharp and irregular. — 18

22. Siltstone: Moderate-reddish-brown (10R 4/6); clay, silt, and very fine grained sand; composed of quartz; weakly cemented, calcareous; splits shaly; lenticular, flat-bedded; weathers flaggy; forms a ledge; base is gradational and irregular. — 33

21. Siltstone: Moderate-reddish-brown (10R 4/6); clay and silt; composed of quartz; weakly cemented, calcareous; splits shaly; lenticularly bedded; forms a regular slope; contains very pale green (10G 8/2) blotches; base is sharp and irregular. — 5

20. Siltstone: Same as unit 22; weathers into balls at top and into flagstone at base. — 17

19. Siltstone: Same as unit 21. — 13

18. Siltstone: Same as unit 23. — 38

17. Siltstone: Same as unit 22; lenticularly bedded; weathers into balls. — 38

16. Siltstone: Same as unit 21. — 33

15. Siltstone: Same as unit 22. — 11

14. Siltstone: Same as unit 21. — 11

13. Siltstone: Same as unit 22. — 8

12. Siltstone: Same as unit 21. — 13

11. Siltstone: Same as unit 22. — 19

10. Siltstone: Same as unit 21; white (N 9) line at top of unit. — 11

9. Siltstone: Same as unit 22. — 5

8. Siltstone: Same as unit 21. — 10

7. Siltstone: Same as unit 22. — 19

6. Siltstone: Same as unit 21. — 10

5. Siltstone: Same as unit 22. — 3

4. Siltstone: Same as unit 21. — 13

3. Siltstone: Same as unit 22. — 3

2. Siltstone: Same as unit 21. — 6

Total Rock Point Member — 344

Total Wingate Sandstone — 644

Chinle Formation:

Owl Rock Member (incomplete):

1. Limestone: Very pale green (10G 8/2) and grayish-orange-pink (5YR 7/2); finely crystalline; composed of calcium carbonate; gnarly, lenticularly bedded; forms a ledge; sandy in part; limestone conglomerate at top of unit; contains possible borings; base is sharp and irregular.

49.—Tsaile

North side of Tsaile Creek,
9 miles south-southeast of Lukachukai
51-7.9-13.0

[Measured by C. A. Repenning and W. A. Belden]

TERTIARY:

Chuska Sandstone:

13. Estimated stratigraphic interval to highest visible part of mountain. — 180

12. Sandstone: Yellowish-gray (5Y 8/1); medium- to coarse-grained; fair-sorted; composed of rounded to subrounded, clear and stained quartz; black, red, and white accessory minerals; well-cemented, calcareous; splits flaggy; lenticular, very thick bedded; unit is a coset; wedge trough and tabular planar crossbedding, low- to medium-angle and large-scale crossbeds dip to the northeast; weathers blocky; forms a vertical cliff; eolian environment; base is concealed. — 47.3

11. Covered interval: Forms slopes and ledges. — 288.5

10. Sandstone: Very pale orange (10YR 8/2); medium- to coarse-grained; well-sorted; composed of rounded to subrounded, stained quartz; black, red, and white accessory minerals; well-cemented, calcareous; friable; flat, very thick bedded; unit is a coset; tabular planar crossbedding, high-angle and large-scale crossbeds dip to the northeast, very low angle and large-scale crossbeds dip to the southwest; weathers blocky; forms a vertical cliff; eolian and fluvial environment; base is concealed. — 35

9. Sandstone: Similar to unit 10; well-sorted; black, red, and white accessory minerals; well-cemented, calcar-

pelecypod, possibly Unio; base is irregular. 7.5

11. Siltstone: Very light gray (N 8) and pale-purple (5P 6/2); weakly cemented, calcareous; flat, irregular, very thin to thin-bedded; weathers blocky; forms an irregular slope; contains sandstone similar to unit 12; base is gradational. 22.5

10. Sandstone: Very pale orange (10YR 8/2) and light-brownish-gray (5YR 6/1), mottled; very fine to medium-grained; poorly sorted; composed of subrounded to subangular, clear and stained quartz; mica and black accessory minerals; firmly cemented; irregular, lenticular, thin- to thick-bedded; lenticular and wedge trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers blocky to hackly; forms an irregular ledge; base is gradational. 8.5

9. Claystone: Grayish-red (10R 4/2); weakly cemented; flat, massive, very thick bedded; weathers smooth; forms a partly covered, regular slope; base is gradational. 21.5

8. Sandstone: Grayish-orange-pink (10R 8/2); fine-grained; well-sorted; composed of subangular, clear and frosted quartz; black accessory minerals; firmly cemented; irregular, lenticular, thick to very thick bedded; lenticular and wedge simple and trough crossbedding, low-angle and medium-scale crossbeds; weathers blocky; forms an irregular ledge; base is concealed. 35.5

Total Sonsela Sandstone Bed of the Petrified Forest Member 111.5

Petrified Forest Member, lower part:

7D. Mudstone: Same as unit 7B; contains faint crossbedding, large-scale crossbeds; forms a partly covered slope. 154

7C. Sandstone: Grayish-orange-pink (10R 8/2) and pale-red (5R 6/2); fine- to coarse-grained; composed of subrounded to subangular, clear and stained quartz; black accessory minerals; weakly cemented, calcareous; lenticular, thin- to thick-bedded; wedge trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers blocky; forms an irregular ledge; unit is a large-scale wedge into 7B and 7D and becomes thicker to the south—as much as 30 feet thick; base is gradational. 11

7B. Mudstone: Grayish-red (5R 4/2); clay and silt; poorly sorted; weakly cemented; massive, very thick bedded; weathers smooth; forms a rolling slope; base is gradational. 65

7C. Mudstone: Pale-red (5R 6/2); clay to silt; poorly sorted; weakly cemented, calcareous; massive, very thick bedded; weathers smooth; forms an irregular slope; some sandstone lenses as much as 2 feet thick contain pseudocrossbedding; base is gradational. 8.5

Total lower part of the Petrified Forest Member 238.5
Total incomplete Petrified Forest Member 610.5

Lower red member:

6. Limestone conglomerate: Light-olive-gray (5Y 5/2); very fine to medium-grained; poorly sorted; subrounded to subangular grains; well to firmly cemented, calcareous; irregular, lenticular, thin to very thick bedded; wedge trough crossbedding, low-angle and small- to medium-scale crossbeds; pseudocrossbedding; weathers blocky; forms an irregular ledge; ½-inch mud pellets; conglomerate lenses as much as 2 feet thick; sandstone as much as 3 feet thick; base is gradational. 12

5. Mudstone: Pale-reddish-brown (10R 5/4) to grayish-red (5R 4/2); silt to very fine grained sand; poorly sorted; weakly cemented, calcareous; irregular, flat-bedded; weathers blocky to smooth; contains a few thin sandstone ledges and abundant limestone nodules as much as 1½ inches in diameter; base is gradational. 95

4. Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; poorly sorted; composed of subrounded to subangular, clear and stained quartz; mica and black accessory minerals; firmly cemented; irregular, lenticular, thin- to thick-bedded; wedge simple crossbedding, low- to high-angle and medium-scale crossbeds; pseudocrossbedding; weathers blocky to hackly; forms an irregular ledge; unit is a large channel; base is gradational. 18

3. Sandy siltstone: Grayish-yellow (5Y 8/4); silt to very fine grained sand; poorly sorted; mica accessory mineral; flat, irregular, very thin to thick-bedded; weathers blocky; forms a regular slope; lower 8 feet is covered; base is concealed. 46

Total lower red member 171

Shinarump Member:

2. Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; fair-sorted; composed of clear and frosted quartz; firmly cemented; irregular, lenticular, thin- to thick-bedded; lenticular and wedge trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers knobby to blocky; forms an irregular ledge; base is irregular. 4.0

Total incomplete Chinle Formation 785.5

UNCONFORMITY: Local relief of 1 foot.

PERMIAN:

De Chelly Sandstone:

1. Sandstone: Very fine to fine-grained; very thick bedded; simple crossbedding, large-scale crossbeds; pseudocrossbedding. 50+

eous; unit is a coset; tabular planar crossbedding, medium- to high-angle and large-scale crossbeds dip to the east; forms a series of cliffs and slopes; base is concealed. 68.2

8. Covered interval. 68.2

7. Sandstone: Same as unit 3; forms a ledge; base is concealed. 4.0

6. Covered interval: Composed mostly of friable sandstone similar to unit 2. 36.8

5. Sandstone: Same as unit 3; tabular planar crossbedding, low- to medium-angle and medium-scale crossbeds dip to the east-northeast; forms a ledge; eolian and fluvial environment; base is concealed. 4.0

4. Covered interval: Composed mostly of friable sandstone similar to unit 2. 273

3. Sandstone: Very pale orange (10YR 8/2); medium- to coarse-grained; well-sorted; composed of rounded to subrounded, stained quartz; black, red, and white accessory minerals; firmly cemented, calcareous; flat, very thick bedded; unit is a coset; high-angle and large-scale crossbeds dip to the northeast; very low angle, tabular planar (fluvial) crossbeds dip to the southwest; weathers blocky; forms a vertical cliff; fluvial sandstone is friable; base is concealed. 27.2

2. Covered interval, chiefly sandstone: Very pale orange (10YR 8/2); very fine grained; well-sorted; composed of rounded to subrounded, clear and stained quartz; black and red accessory minerals; weakly cemented, calcareous; friable; lenticular, laminated to very thin bedded; partly crossbedded with trough crossbedding, very low to low-angle and small- to medium-scale crossbeds; weathers smooth; forms a covered slope; base is concealed. 245

Total Chuska Sandstone 1,277.2

UNCONFORMITY: Mostly concealed; marked by pebbles in the basal 1-foot layer of the Chuska Sandstone; pebbles derived from the Chinle Formation.

UPPER TRIASSIC:

Chinle Formation:

Owl Rock Member:

1. Siltstone: Red; undescribed. 10+

50.—Round Rock

5 miles east of Chinle Wash below Round Rock,
4 miles south-southwest of Round Rock Trading Post
53-3.0-0.5

[Measured by C. A. Repenning]

UPPER TRIASSIC:

Wingate Sandstone:

Rock Point Member (incomplete):

43. Silty sandstone and sandy shale, alternating: Moderate-reddish-brown (10R 4/6); sandstone beds form ledges and are less than 10 feet thick; shale forms a slope and is less than 10 feet thick; basal contact is arbitrarily placed at base of lowest sandstone.

Chinle Formation:

Owl Rock Member:

42. Sandy shale: Pale-reddish-brown (10R 5/4); contains scattered lenses of pale-red-purple (5RP 6/2) limestone-pellet conglomerate and some moderate-reddish-brown (10R 4/6) sandstone that is fine grained and thin bedded. 23

41. Limestone: Light-brownish-gray (5YR 6/1); laminated; contains fine-grained sand. 13

40. Limestone: Light-brownish-gray (5YR 6/1); massive; forms a ledge and caps the cuesta near base of Round Rock. 5.5

39. Sandy shale: Moderate-reddish-brown (10R 4/6); thin-bedded; forms a slope. 17

38. Limestone: Pale-red-purple (5RP 6/2); massive; forms a ledge. 9.0

37. Sandy shale: Moderate-reddish-brown (10R 4/6); thin-bedded; forms a slope. 10

36. Limestone: Pale-red-purple (5RP 6/2); massive; forms a ledge. 3.0

35. Shale: Pale-reddish-brown (10R 5/4); thin-bedded; forms a slope. 25

34. Limestone: Pale-red-purple (5RP 6/2); massive; weathers into rounded boulders; forms a ledge. 4.0

33. Shale: Pale-reddish-brown (10R 5/4); thin-bedded; forms a slope. 33

32. Limestone: Pale-red (5R 6/2); massive; forms a ledge; contains a moderate amount of chert. 6.0

31. Shale: Moderate-reddish-brown (10R 4/6); thin-bedded; forms a slope. 19

30. Limestone: Pale-red (5R 6/2); massive; forms two ledges; contains a small amount of chert. 10

29. Shale: Moderate-reddish-brown (10R 4/6); thin-bedded; forms a slope. 36

28. Limestone: Pale-red-purple (5RP 6/2); massive; forms a ledge. 2.0

27. Shale: Moderate-reddish-brown (10R 4/6); forms a slope; contains a few thin beds (3 inches thick) of sandstone. 7.0

26. Sandy limestone: Pale-red-purple (5RP 6/2); very fine grained sand; very thin bedded; forms a ledge; contains grayish-orange-pink (10R 8/2) spots. 5.5

25. Limestone: Pale-red (5R 6/2); forms a slope; mostly pebble conglomerate. 2.0

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER TRIASSIC—Continued	Feet
Chinle Formation—Continued	
Owl Rock Member—Continued	
24. Sandy shale: Moderate-reddish-brown (10R 4/6); forms a slope.	6.0
23. Sandstone: Pale-red (10R 6/2); very fine grained; forms a ledge; contains grayish-orange-pink (10R 8/2) spots.	3.0
22. Sandy shale: Moderate-reddish-brown (10R 4/6); forms a slope; contains light-colored spots.	4.0
21. Limestone: Pale-red-purple (5RP 6/2); forms a ledge.	1.0
20. Shale: Moderate-reddish-brown (10R 4/6); forms a slope; contains dark-reddish-brown (10R 3/4) sandstone dikes.	27
19. Sandstone: Dark-reddish-brown (10R 3/4); silt to very fine grained sand; weakly cemented, calcareous; forms a poorly developed ledge.	6.0
18. Shale: Moderate-reddish-brown (10R 4/6); forms badlands; contains a lime-pellet zone that is 2 feet thick; crisscrossed with dark-reddish-brown (10R 3/4) sandstone dikes; both the sandstone and shale contain small pale-blue-green (5BG 7/2) spots.	17
17. Limestone: Pale-red-purple (5RP 6/2); very fine grained; forms a nodular ledge; grades laterally into moderate-red (5R 4/6) sandstone and shale; clusters of calcite crystals scattered throughout unit; contains pale-blue-green (5BG 7/2) spots.	5.0
Total Owl Rock Member	299
Petrified Forest Member, upper part:	
16. Shale: Moderate-red (5R 4/6); lenticular, very thin bedded; forms badlands; contains very thin bedded, pale-reddish-brown (10R 5/4) sandy zones; sandstone lenses near top of unit; contains limestone nodules; pale-green (5G 7/2) spots in sandy zones.	214
15. Shale: Light-greenish-gray (5GY 8/1) and grayish-red-purple (5RP 4/2), alternating; forms badlands.	50
14. Sandstone: Medium-bluish-gray (5B 5/1); fine-grained; thick-bedded; forms a ledge; grades laterally into silty sandstone and shale.	15
13. Shale: Light-greenish-gray (5GY 8/1) and grayish-red-purple (5RP 4/2), alternating; forms badlands; contains petrified logs throughout unit.	66
Total upper part of the Petrified Forest Member	345
Petrified Forest Member, Sonsela Sandstone Bed:	
12. Sandstone: Yellowish-gray (5Y 8/1), weathering brownish gray (5YR 4/1); fine-grained; thin-bedded; small-scale crossbeds; contains limestone nodules that are so abundant at top they make up almost the entire lithology; petrified logs at base; grades laterally into sandy shale of same color.	10
Petrified Forest Member, lower part:	
11. Shale: Light-greenish-gray (5GY 8/1) and grayish-red-purple (5RP 4/2), alternating; forms badlands; contains gypsum veins throughout unit; surface covered with limestone nodules; abundant petrified logs in lower part.	137
10. Shale: Pale-greenish-yellow (10Y 8/2) and grayish-red (10R 4/2); very lenticular with abrupt thickening and thinning of beds; forms badlands; outcrops are covered with lag material composed of limestone nodules and sandstone fragments; many local sandstone lenses containing limestone nodules; sandstone is coarse to very coarse grained and yellowish gray (5Y 7/2), weathering brownish gray (5YR 4/1); limestone nodules are grayish yellow (5Y 8/4), weathering dusky yellow (5Y 6/4), and are mammillary shaped with dendrites in fractures; basal contact arbitrarily placed at top of preconsolidation slumpage features of lower red member.	50
Total lower part of the Petrified Forest Member	187
Total Petrified Forest Member	542
Lower red member:	
9. Sandstone: Grayish-orange (10YR 7/4); fine-grained; composed of quartz; firmly cemented, calcareous; flat, thin- to thick-bedded; small-scale crossbeds; forms a blocky cliff; beds contorted by preconsolidation slumpage and warped between lenses of mottled gray sandy shale.	53
8. Sandy shale: Grayish-red (5R 4/2) to dusky-red (5R 3/4); flat, thin-bedded; forms a ledgy slope; contains some medium-light-gray (N 6) shale at top of unit; some fine-grained, grayish-red (10R 4/2) sandstone.	27
7. Sandstone: Grayish-red (5R 4/2); very fine grained; firmly cemented, ferruginous; flat, thin-bedded; forms ledgy and steep slopes; basal contact is sharp and irregular with 15 feet of relief.	16
Total lower red member	96
Shinarump Member:	
6. Sandstone: Yellowish-gray (5Y 7/2); very coarse grained; massive; medium-scale crossbeds; forms a ledge; contains some granule-size material and large fragments of petrified wood.	28
5. Sandstone: Grayish-orange-pink (5YR 7/2); medium-grained; flat, thick-bedded; forms a ledge or covered slope.	22
4. Sandstone: Same as unit 5; forms a massive cliff; base is sharp.	15
3. Conglomerate: Yellowish-gray (5Y 7/2) with lenses of grayish olive (10Y 4/2), weathering moderate yellow (5Y 7/6); granules to cobbles; firmly cemented, calcareous; massive; medium-scale crossbeds; weathers rough and pitted; forms a ledge and cliff; contains fragments to subangular, clear and amber quartz; rare black accessory minerals; firmly cemented; massive; asymmetrical and plunging trough crossbedding, low- to high-angle and small- to medium-scale crossbeds; forms a rounded cliff; eolian environment; base is sharp and flat.	146
Total Lukachukai Member (including tongue of Rock Point Member)	302
Rock Point Member:	
12. Siltstone: Moderate-red (5R 5/4); clay, silt, and very fine grained sand; fair-sorted; weakly cemented; laminated; forms an irregular and covered slope; contains shrinkage cracks and worm trails; sandstone beds form ledges.	73
11. Sandy and conglomeratic limestone: Brownish-gray (5YR 4/1); lenticular, thin-bedded; weathers blocky and flaggy; forms a ledge; conglomeratic parts contain gray limestone cobbles as large as 8 inches in diameter; unit grades laterally into limy sandstone; commonly contains reptile teeth, bone fragments, and pieces of petrified wood; bones are concentrated in limy and conglomeratic parts; base is sharp and irregular.	3
10. Sandstone: Grayish-red-purple (5RP 4/2); fine-grained; well-sorted; composed of white and purple quartz; about 5 percent mica accessory mineral; well-cemented; flat, very thin to thin-bedded; unit is a coset; asymmetrical and plunging trough crossbedding, low-angle and medium-scale crossbeds; weathers flaggy; forms a ledgy slope; commonly contains pebbles; fluviatile environment.	38
9. Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear and amber quartz; about 5 percent black accessory minerals; firmly cemented; flat, lenticular, very thin to thin-bedded; unit is a set; weathers blocky; forms a ledgy slope; commonly contains siltstone beds; contains shrinkage cracks, worm borings, raindrop impressions, and ripple marks; base is sharp and irregular.	14
8. Conglomeratic marl: Light-brownish-gray (5YR 6/1); clay to very fine grained sand; subrounded to subangular grains; well-cemented; lenticularly bedded; unit is a coset; forms a ledge; contains limestone.	17
7. Siltstone: Moderate-red (5R 5/4); clay, silt, and very fine grained sand; fair-sorted; weakly cemented; forms mostly a covered slope.	73
6. Sandstone: Grayish-red-purple (5RP 4/2); fine- to medium-grained; composed of white and purple quartz; about 5 percent mica accessory mineral; well-cemented; flat, very thin to thin-bedded; asymmetrical and plunging trough crossbedding, low-angle and medium-scale crossbeds; weathers blocky; forms a ledge; commonly contains pebbles; joints filled with shale; fluviatile environment; base is sharp and irregular.	12
5. Conglomerate: Pale-yellowish-orange (10YR 8/6); lenticularly bedded; weathers blocky; forms a ledge; fills channels at base of unit 6; unit thins and thickens along strike due to channeled surface on top of Chinle Formation; contains a few bone fragments; base is sharp and irregular.	
Matrix: Fine- to medium-grained; composed of subrounded to subangular, stained quartz; firmly cemented.	
Gravel: Composed of limestone pebbles.	2
Total Rock Point Member	232
Total Wingate Sandstone	534
Chinle Formation:	
Owl Rock Member:	
4. Sandstone: Pale-red (10R 6/2); silt to fine-grained sand; well-sorted; composed of subangular to angular, clear and amber quartz; weakly cemented; flat-bedded; unit is a coset; weathers hackly; forms a regular slope; unit becomes increasingly silty towards top; contains limestone concretions; 9 feet below top is a limestone bed 1 foot thick and flat bedded, similar to unit 1; fluviatile environment; base is gradational.	32
3. Limestone conglomerate: Light-brownish-gray (5YR 6/1); granules and pebbles of limestone in a limestone matrix; lenticular, thick to very thick bedded; unit is a coset; weathers blocky; forms a ledge; contains silty lenses which increase in number towards top; contains Machaeroprosopus sp.; fluviatile environment; base is sharp and irregular, a channeled surface.	17
2. Sandstone: Pale-reddish-brown (10R 5/4); silt and very fine grained sand; well-sorted; composed of subangular, amber quartz; weakly cemented; laminated; forms mostly a covered interval; fluviatile environment; base is sharp and irregular.	21
1. Sandy limestone: Pale-red (10R 6/2); finely crystalline, about 50 percent sand; flat, irregularly bedded; weathers blocky; forms a ledge; contains abundant yellowish-gray (5Y 8/1) spots and streaks; base is concealed.	2
Total incomplete Chinle Formation	72

ments of petrified wood; base is sharp and forms a prominent contact. 16

2. Sandstone: Grayish-orange-pink (5YR 7/2); medium-grained; composed of quartz; firmly cemented, calcareous and ferruginous; massive; medium-scale crossbeds; weathers blocky; forms a ledge; contains lenses of conglomerate with pebbles measuring as much as 2 inches in diameter. 11

Total Shinarump Member 92
Total Chinle Formation 1,029

UNCONFORMITY: Erosional, prominent in face of cliff, 10 feet of relief.

PERMIAN:
De Chelly Sandstone:

1. Sandstone: Grayish-yellow (5Y 8/4); fine-grained; composed of quartz; firmly cemented, calcareous and ferruginous; large-scale crossbeds; forms a rounded and smooth cliff. 25+

51.—Sonsela

$3\frac{1}{2}$ miles northwest of Sonsela Buttes,
19 miles south-southeast of Lukachukai
69-7.8-7.2

[Measured by M. E. Cooley and J. P. Akers]

UPPER TRIASSIC:
Chinle Formation:
Petrified Forest Member, Sonsela Sandstone Bed:

6. Sandstone: White (N 9); fine- to medium-grained; fair- to well-sorted; composed of subrounded, clear and frosted quartz; rare black accessory minerals; weakly to firmly cemented; irregular, lenticularly bedded; lenticular trough crossbedding; weathers blocky; forms an irregular ledge; contains a few scattered quartz and limestone pebbles concentrated along crossbedding planes; average diameter of pebbles is three-eighths of an inch and maximum diameter is three-quarters of an inch; base is sharp and irregular. 61
5. Siltstone: Light-bluish-gray (5B 7/1); clay and silt; forms an irregular and covered slope; blue shale crops out near top; base is concealed. 25
4. Sandstone: Very light gray (N 8); very fine to very coarse grained; composed of subrounded to subangular, clear, stained, frosted, and amber quartz; weakly to firmly cemented; lenticular, irregularly bedded; lenticular trough crossbedding, small- to medium-scale crossbeds; weathers blocky; forms an irregular ledge; contains a few quartz and limestone pebbles concentrated along crossbedding planes; average diameter of pebbles is three-eighths of an inch; contains lenses of very coarse grained to granule sandstone as much as 1 foot thick and 15 feet long; middle of unit contains a 1-foot-thick lens of limestone conglomerate; base is sharp and irregular. 28

Total Sonsela Sandstone Bed of the Petrified Forest Member 114

Petrified Forest Member, lower part:

3. Siltstone: Bluish-purple; clay and silt; weakly cemented; massive; forms a regular slope; bone fragments and phytosaur teeth common on weathered slope; base is gradational. 44
2. Sandstone: Pale-red-purple (5RP 6/2); clay to coarse-grained sand; fair to poorly sorted; subrounded to subangular grains; abundant mica accessory mineral; weakly to firmly cemented; irregular, lenticularly bedded; lenticular trough crossbedding, small- to medium-scale crossbeds; forms an irregular ledge; base is gradational. 17
1. Siltstone: Light-bluish-gray (5B 7/1); clay, silt, and very fine grained sand; poorly sorted; weakly cemented; massive; forms a slope; abundant limestone nodules on weathered slope; base is concealed. 89

Total incomplete lower part of the Petrified Forest Member 150

DISTRICT 12

52.—Red Rock

Southeast of Carrizo Mountains,
6 miles north-northwest of Red Rock Trading Post
34-5.4-3.0

[Measured by C. A. Repenning and P. R. Stevens]

UPPER TRIASSIC:
Wingate Sandstone:
Lukachukai Member:

15. Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear and amber quartz; well-cemented; massive; unit is a coset; plunging trough crossbedding, high-angle and large-scale crossbeds; weathers rounded; forms a rounded and vertical cliff; contains abundant coarse-grained, white (N 9) quartz concentrated along laminations; base is sharp and irregular. 128

Tongue of Rock Point Member:

14. Silty sandstone: Moderate-reddish-orange (10R 6/6); silt to very fine grained sand; subrounded to subangular grains; about 5 percent black accessory minerals; flat, laminated to thick-bedded; weathers blocky to smooth; forms a ledgy slope; base is sharp and flat. 28

Lukachukai Member continued:

13. Sandstone: Moderate-reddish-brown (10R 4/6); very fine to medium-grained; well-sorted; composed of subrounded

53.—Cove

$1\frac{1}{2}$ miles west of Cove, N. Mex.,
north end of Chuska Mountains
35-0.5-13.0

[Measured by M. E. Cooley and P. R. Stevens]

UPPER TRIASSIC:
Wingate Sandstone:
Rock Point Member:

9. Silty sandstone: Undescribed. 50+

Chinle Formation:
Owl Rock Member:

8. Silty limestone, limy siltstone, silty sandstone, and siltstone: Flat, lenticular, thin- to thick-bedded; weathers blocky and hackly; forms alternating ledges and slopes; base is gradational.

Unit consists, in descending order, of:

o. Silty limestone: Grayish-red (10R 4/2); weakly cemented, calcareous; splits crumbly; forms an irregular ledge. 3.0
n. Siltstone: Pale-reddish-brown (10R 5/4); weakly cemented, argillaceous; splits shaly and crumbly; forms an irregular slope. 7.5
m. Silty limestone: Grayish-red (10R 4/2); weakly to firmly cemented, calcareous; splits crumbly; forms an irregular ledge; grades laterally into material same as subunit b. 6.5
l. Silty limestone: Same as subunit f. 1.0
k. Limy siltstone: Pale-red (5R 6/2); weakly cemented, calcareous; splits crumbly; forms an irregular slope. 5.0
j. Silty limestone: Same as subunit f. 2.0
i. Silty limestone: Weakly cemented; splits shaly and crumbly; forms an irregular ledge. 22
h. Silty limestone: Same as subunit f. 14
g. Silty sandstone: Same as subunit b. 10
f. Silty limestone: Pale-red (10R 6/2); weakly to firmly cemented, calcareous; splits shaly; forms an irregular ledge. 6.0
e. Limy siltstone: Pale-red (10R 6/2); weakly cemented, calcareous; splits crumbly; forms an irregular slope. 13
d. Limy siltstone: Moderate-red (5R 5/4); silt and some very fine grained sand; weakly to firmly cemented, calcareous; splits platy and crumbly; forms an irregular ledge. 6.0
c. Siltstone: Grayish-red (10R 4/2); weakly cemented, calcareous; splits shaly and crumbly; forms an irregular slope. 4.0
b. Silty sandstone: Moderate-reddish-orange (10R 6/6); silt and very fine grained sand; weakly to firmly cemented, calcareous; splits platy and shaly; forms an irregular ledge. 7.0
a. Limy siltstone: Pale-red (10R 6/2); weakly to firmly cemented, calcareous; splits shaly; forms an irregular slope. 27 134

7. Limestone conglomerate: Lenticular, thick-bedded; weathers blocky; forms an irregular ledge; grades out laterally into unit 11; contains Unio(?) and reptile teeth, including phytosaur; base is sharp and irregular. 10
6. Silty sandstone: Moderate-reddish-brown (10R 4/6); silt and very fine grained sand; weakly cemented, calcareous; splits flaggy and platy; gnarly, very thin to thin-bedded; weathers blocky; forms an irregular cliff; 1-foot limestone bed at base of unit; base is sharp and flat. 44
5. Siltstone, limy siltstone, mudstone, and silty sandstone: Flat, very thin bedded; unit forms a slope; base is gradational.

Unit consists, in descending order, of:

i. Siltstone: Pale-red (10R 6/2); weakly cemented, calcareous; splits crum-

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER TRIASSIC—Continued

Chinle Formation—Continued

Owl Rock Member—Continued

		Feet
bly; forms an irregular slope.	23	
h. Limy siltstone: Pale-reddish-brown (10R 5/4); weakly to firmly cemented, calcareous; splits platy; forms an irregular ledge.	3.0	
g. Siltstone: Grayish-red (10R 4/2); weakly cemented, calcareous; splits shaly and crumbly; forms an irregular slope.	14	
f. Limy siltstone: Pale-reddish-brown (10R 5/4); weakly cemented, calcareous; splits shaly; forms an irregular ledge.	2.0	
e. Mudstone: Grayish-red (10R 4/2); clay and silt; weakly cemented, calcareous; splits shaly and crumbly; forms an irregular slope.	11	
d. Siltstone: Pale-red (10R 6/2); weakly cemented, calcareous; splits crumbly; forms an irregular ledge.	9.0	
c. Mudstone: Moderate-reddish-brown (10R 4/6); clay and silt; weakly cemented, argillaceous; splits shaly and crumbly; forms an irregular slope.	29.5	
b. Silty sandstone and siltstone, alternating. Silty sandstone: Pale-red (5R 6/2); fine- to coarse-grained; well-rounded to subrounded grains; weakly cemented, calcareous; splits crumbly; flat, lenticular, thin-bedded; forms an irregular slope. Siltstone is same as subunit a.	13	
a. Limy siltstone: Pale-reddish-brown (10R 5/4); weakly cemented, calcareous; splits shaly and crumbly; forms an irregular and covered slope.	33	137.5
Total Owl Rock Member		325.5

Petrified Forest Member, upper part:

4. Mudstone and siltstone: Splits shaly; flat, lenticular, thin-bedded; forms an irregular slope; concretions and calcite geodes common. Unit consists, in descending order, of:		
d. Mudstone: Pale-reddish-brown (10R 5/4); clay and silt; weakly cemented, calcareous; partly covered; sample taken at 105 feet.	65	
c. Mudstone: Grayish-red (10R 4/2); clay and silt; weakly cemented; sample taken at 55 feet.	10	
b. Limy siltstone: Pale-reddish-brown (10R 5/4); weakly cemented, calcareous; sample taken at 44 feet.	16	
a. Siltstone: Weakly cemented, calcareous; sample taken at 25 feet.	34	125
3. Siltstone: Pale-red (5R 6/2); weakly cemented, calcareous; splits flaggy and shaly; flat, thin-bedded; weathers blocky; forms an irregular ledge; base is gradational.		9.0
2. Siltstone: Same as unit 4.		42
1. Siltstone: Pale-red (5R 6/2); weakly cemented, calcareous; splits crumbly; flat, lenticular, very thin to thick-bedded; weathers rounded and hackly; forms an irregular and partly covered slope; base is concealed.		43
Total upper part of the incomplete Petrified Forest Member		219
Total incomplete Chinle Formation		544.5

B.—In major reentrant on south face of Beautiful Mountain, north of Sanostee Wash

[Measured by L. C. Craig and V. L. Freeman]

UPPER JURASSIC:

Morrison Formation:

Brushy Basin Member:

	Feet
Top of section, not top of exposure; next overlying unit is channeling sandstone of Dakota Sandstone.	
29. Claystone and some sandstone: Oxidized soil may be represented by a 6-inch red band at top. Claystone (90 percent): Greenish-gray (5GY 6/1), pale-red-purple (5RP 6/2), pale-brown (5YR 5/2), and minor amount of grayish red (5R 4/2) in lower third of unit; contains some silt and medium-grained sand; weathers hackly to earthy. Sandstone (10 percent): Grayish-yellow-green (5GY 7/2); clay and fine- to medium-grained sand; composed of subrounded to subangular, clear quartz; biotite flakes and masked accessory minerals; forms thin, narrow, lenticular ledges as much as 1 foot thick.	83.7
28. Sandstone: Light-greenish-gray (5GY 8/1); fine- to medium-grained; composed of subrounded to subangular, clear quartz; rare orange and black accessory minerals; weakly to firmly cemented; crossbedded; contains clay-coated grains.	10
27. Claystone: Mottled light-greenish-gray (5G 8/1), and pale-red (5R 6/2); some silt and fine-grained sand; weathers hackly, concretionary, and earthy.	6.5
Total Brushy Basin Member	100.2

Westwater Canyon Member:

26. Sandstone: Pale-yellowish-orange (10YR 8/6), grayish-orange (10YR 7/4), and minor amount of white (N 9) with some pink mottling; fine- to coarse-grained; composed of well-rounded to subrounded, clear quartz; gray, white, tan, pink, and rare green accessory minerals; friable; crossbedded; forms prominent cliff at head of reentrant along line of section, but where unit lenses out to the southeast forms only a thin ledge; laterally, this unit and underlying one would be considered as part of the Brushy Basin Member.	20.5
25. Sandy claystone: Dusky-yellow (5Y 6/4), some red streaks; some fine- to medium-grained quartz and accessory minerals; forms a minor slope.	10.4
24. Sandstone: Pale-yellowish-orange (10YR 8/6), grayish-orange (10YR 7/4), and minor amount of white (N 9) with some pink mottling; fine- to coarse-grained; composed of well-rounded to subrounded, clear quartz; white, tan, gray, pink, and rare green accessory minerals; friable; crossbedded; forms a prominent cliff around reentrant.	46.4
23B. Claystone and sandy claystone: Grayish-pink (5R 8/2) to moderate-pink (5R 7/4); splits fissile; weathers shaly; poorly exposed.	2.0
23A. Claystone and sandy claystone: Light-greenish-gray (5G 8/1) to greenish-gray (5G 6/1); weathers hackly to earthy; poorly exposed.	12.2
22. Sandstone: Yellowish-gray (5Y 8/1) to grayish-yellow (5Y 8/4), and some white (N 9) and very light gray (N 8); fine- to coarse-grained; composed of subrounded, clear quartz; white, orange, and black accessory minerals; crossbedded; contains abundant interstitial clay; very local light-greenish-gray (5G 8/1) to grayish-red (5R 4/2) claystone partings as much as 1 foot thick; channeled; unit is very poorly exposed in lower part.	110.2
21. Sandstone: Dark-grayish-orange (10YR 6/4) and some pink, weathering moderate yellowish brown (10YR 5/4); fine- to medium-grained; composed of subrounded, clear and clay-coated quartz; rare white, orange, and black accessory minerals; crossbedded; contains well-rounded pebbles of light-gray (N 7) to tan chert as much as 1 inch in diameter along stringers or disseminated.	28
20. Claystone and sandstone: Poorly exposed. Claystone (60 percent): Grayish-red (5R 4/2); some very fine to fine-grained sand; slightly micaceous. Sandstone (40 percent): White (N 9) to very light gray (N 8); very fine to fine-grained; forms thin, slabby beds.	24.5
19. Sandstone: Pale-yellowish-brown (10YR 6/2), weathering yellowish brown; fine- to medium-grained, some coarse grains; composed of well-rounded to subrounded, clear quartz; abundant black, orange, tan, green, and gray accessory minerals; crossbedded; local stringers of granules and rare pebbles composed of gray, black, white, and red chert as much as three-quarters of an inch in diameter; channeled.	22
18. Sandstone and some claystone: Contact of Westwater Canyon and Recapture Shale Members is difficult to place, but most satisfactory appears to be at base of this unit, which separates the highly sandy and more resistant sequence of the Westwater Canyon Member above from the less resistant interval of the Recapture Shale Member below. This sequence seems to prevail through western New Mexico and eastern Arizona; however, at the time this section was measured an alternate contact was selected at 53.9 feet (unit 20) above base of this unit. Sandstone: Very pale yellowish brown (10YR 7/2),	

54. —Sanostee Wash

A. —North side of Sanostee Wash where Todilto Limestone crosses wash

[Measured by L. C. Craig, J. D. Strobell, Jr., and V. L. Freeman]

UPPER JURASSIC:
Summerville Formation:
Sandy facies:
Top of section, not top of exposure; next overlying unit is Salt Wash Sandstone Member of the Morrison Formation, which is composed of grayish-red (5R 4/2) sandy claystone.

9. Sandstone: Moderate-orange-pink (5YR 8/4), weathering light brown (5YR 6/4); very fine to medium-grained; composed of rounded to subangular, clear, dull, and smooth quartz; white chert and orange and black accessory minerals; calcareous cement; parallel bedding, with indistinct parallel wavy bedding; minor small-scale crossbeds; top 1 foot is white (N 9); contains crossbedded sandstone bed, 3 feet thick, lateral to section. 49.4

8. Sandstone: Pale-reddish-orange (10R 7/6), weathering moderate reddish orange (10R 6/6); very fine grained; composed of subangular to angular, clear quartz; rare black and other masked accessory minerals; calcareous and ferruginous cement; parallel wavy bedding suggested; weathers massive and spheroidal, with exfoliated rinds; contains pale-reddish-brown (10R 5/4) clayey sandstone that forms thin, even, parallel partings 2 to 6 inches thick. A 3.9-foot-thick ledge of sandstone is 67.7 feet above base, described as follows: moderate-orange-pink (5YR 8/4), weathering light brown (5YR 6/4); fine-grained; composed of subrounded to subangular, clear quartz; white chert and orange and black accessory minerals; friable. 86.8

7. Sandstone: Moderate-orange-pink (5YR 8/4), weathering light brown (5YR 6/4); very fine grained; composed of subangular, clear quartz; common orange and black accessory minerals; parallel wavy bedding suggested; forms a massive "slick rim" with three thin, irregular, red bands and numerous white (N 9) spots; contains scattered well-rounded, dull quartz grains and rare angular, white (N 9) chert grains. 28.3

Total Summerville Formation 164.5

(Section continued a quarter of a mile east of units 7 to 9.)
Top of Todilto Limestone has broad rolls that appear to be the result of penecontemporaneous slumping.

Todilto Limestone:

6. Limestone: Medium-dark-gray (N 4), weathering very light gray (N 8) to light gray (N 7); fine-grained; crystalline; irregular, laminated to thick-bedded; weathers slabby. 10.8

Entrada Sandstone:

5. Sandstone: Grayish-pink (5R 8/2); fine-grained; well-sorted; composed of subangular, clear quartz; black and orange accessory minerals; friable, nonresistant; parallel bedding; unit thins laterally to 1 foot and has a wavy upper surface. 2.3

4. Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; composed of subangular, clear and amber-stained quartz; common orange and common to abundant black accessory minerals; contains one band of very pale orange (10YR 8/2) near top; abundant medium- to coarse-grained white (N 9) chert and clear and amber-stained quartz disseminated and concentrated along laminae; bedding is predominantly parallel and lamination is predominantly parallel and wavy; no crossbedding observed; forms a vertical and partly rounded cliff. 82

3. Sandstone and siltstone, interbedded: Moderate-reddish-orange (10R 6/6) to moderate-reddish-brown (10R 4/6); very fine to medium-grained; composed mostly of subangular to angular, clear and amber-stained quartz; common black and orange accessory minerals; appears generally massive, almost structureless, but probably is parallel bedded and laminated; weathers hackly to earthy; forms a small bench; contains some coarse, well-rounded, frosted quartz grains and locally abundant very fine grained white (N 9) chert; a few irregular white (N 9) to light-greenish-gray (5GY 8/1) mottlings and bands. 32.9

2. Siltstone to sandstone: Moderate-reddish-brown (10R 4/6); silt to very fine grained sand; composed of clear and amber-stained quartz; rare black accessory minerals; massive, structureless; basal part of unit contains material reworked from the Wingate Sandstone; top surface appears to have an irregular relief of 1 foot; contains small white (N 9) spots; common crystalline calcite blebs that are white (N 9) and imperfectly spherical. 5.4

Total incomplete Entrada Sandstone 122.6

UNCONFORMITY: Top of Wingate Sandstone is a sharp and irregular surface and is probably parallel to the bedding of the enclosing strata; surface truncates the underlying crossbedded sandstone.

UPPER TRIASSIC:
Wingate Sandstone (incomplete):

1. Sandstone: Large-scale crossbeds; unmeasured.

weathering yellowish brown; fine- to medium-grained; composed of well-rounded, clear and slightly frosted quartz; common orange and rare red and black accessory minerals; highly friable; low- to medium-angle crossbeds; channeled; color of unit is in contrast to underlying unit.

Claystone: Light-greenish-gray (5G 8/1) and grayish-red (5R 4/2), mottled; forms ½-inch partings along bedding; basal surface is channeling contact. 7.4

Total Westwater Canyon Member 283.6

Recapture Shale Member:

17. Sandstone: Grayish-orange-pink (5YR 7/2), moderate-orange-pink (5YR 8/4), and streaks of moderate reddish brown (10R 4/6); fine- to coarse-grained; composed of well-rounded to subrounded, clear quartz; common black, orange, pink, white, and green accessory minerals; highly friable; medium-scale crossbeds; contains stringers of granules composed of quartz and chert, scattered concretionary limestone knots, and granules of grayish-red (10R 4/2) claystone; several claystone beds less than 2 feet thick are lateral to the section; unit is not prominently channeled at base but has channeling within. 113

16. Claystone and sandstone.
Claystone (50 percent): Grayish-red (10R 4/2) to very dusky red (10R 2/2); some disseminated very fine to fine-grained sand; weathers hackly to earthy; contains dense limestone nodules, which cover surface of slope.
Sandstone (50 percent): Very light gray (N 8); very fine grained; composed of angular, clear quartz; abundant black, orange, and green accessory minerals; forms thin, slabby ledges. 11.9

15. Sandstone: Yellowish-gray (5Y 8/1) to very pale orange (10YR 8/2); fine- to medium-grained; composed of well-rounded to subrounded, clear quartz; rare black, orange, and white accessory minerals; highly friable; crossbedded; occasional concentrations of black accessory minerals along laminae. 8.8

14. Claystone and some sandstone.
Claystone (80 percent): Grayish-red (10R 4/2) to very dusky red (10R 2/2); some very fine to fine-grained sand; weathers hackly to earthy; contains dense limestone nodules, which cover slope.
Sandstone (20 percent): Very light gray (N 8); very fine grained; composed of angular, clear quartz; abundant black, orange, and green accessory minerals; forms thin, slabby ledges. 24.1

13. Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; composed of well-rounded to subrounded, clear quartz; abundant black, common white, and rare green accessory minerals; friable; crossbedded; weathers rounded; channeled; contains concretionary limestone knots and local red claystone granules. 13.5

12. Claystone: Dark-reddish-brown (10R 3/4); some very fine to fine-grained sand; slightly micaceous; weathers hackly to earthy; contains black streaks that are probably manganese oxide. 2.4

11. Sandstone: Grayish-orange-pink (5YR 7/2); medium- to coarse-grained; composed of rounded to subrounded, clear quartz; white, orange, black, red, and rare green accessory minerals; very friable; crossbedded; forms a minor ledge in bottom 15 feet and covered slope above; upper part becomes mottled white (N 9), grayish orange pink (5YR 7/2), and pale red (5R 6/2); channeled; poorly exposed. 41.1

10. Claystone and sandstone: Very poorly exposed.
Claystone: Grayish-red (5R 4/2); some sand; weathers earthy.
Sandstone: Moderate-reddish-brown (10R 4/6); very fine to fine-grained, some clay; composed of clear quartz; common orange and black accessory minerals; structureless; weathers spheroidal. 16.2

9. Sandstone: A twofold unit.
Upper one-third: Light-brown (5YR 6/4), weathering pink; fine-grained; composed of subrounded, clear quartz; abundant orange, black, and white accessory minerals; crossbedded; channeled; has a cap composed of calcareous sandstone that weathers nodular.
Lower two-thirds: Pale-reddish-brown (10R 5/4); composed of clear and amber-stained quartz; common black, orange, red, and green accessory minerals; massive and structureless except for some parallel banding; forms a rounded or vertical cliff; thin, white (N 9) band at base. 85

8. Claystone and sandstone: Forms a sloping bench.
Claystone: Grayish-red (5R 4/2); some fine-grained sand.
Clayey sandstone: Moderate-orange-pink (5YR 8/4); clay and very fine to fine-grained sand; composed of subangular, clear quartz; common black and other masked accessory minerals. 29.5

7. Sandstone: Light-brown (5YR 6/4); fine-grained; composed of subrounded, clear quartz; abundant orange, black, and white accessory minerals; slightly calcareous cement; very friable; low-angle crossbeds; forms a vertical cliff; contains claystone seams. 18.7

6. Clayey sandstone: Pale-reddish-brown (10R 5/4); clay and very fine grained sand; structureless; forms a slope. 2.0

5. Sandstone: Light-brown (5YR 6/4); fine-grained; composed of subrounded, clear quartz; abundant orange,

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah--Continued

UPPER JURASSIC--Continued
Morrison Formation--Continued
Recapture Shale Member--Continued

	Feet
black, and white accessory minerals; slightly calcareous cement; very friable; low-angle crossbeds; lower 54 feet forms a vertical cliff, top 9.6 feet forms a slope; a large log in middle of this unit appears to be the source of carnotite-covered silicified wood float that is on slope below; channeled.	63.6
4. Sandstone: Moderate-reddish-orange (10R 6/6) to light-brown (5YR 5/6); very fine to medium-grained, some disseminated very coarse grains; poorly sorted; composed chiefly of clear quartz; abundant orange and black accessory minerals; mostly parallel bedding and banding, bedding generally masked; forms a single prominent ledge in lower half of unit and a covered slope in upper half; contains some interstitial clay, clear and cloudy quartz grains, and white and red claystone granules; granules of feldspar and granite were noted lateral to this section.	42.4
3. Sandstone and claystone.	
Sandstone (50 percent): Grayish-orange-pink (10R 8/2) to grayish-orange (10YR 7/4); very fine to fine-grained; composed of clear and amber-stained quartz; common to abundant black and orange accessory minerals; ripple bedded; weathers slabby and hackly; forms an irregular slope.	
Claystone (50 percent): Light-greenish-gray (5G 8/1) and grayish-red (5R 4/2), interbanded; some fine-grained sand; weathers hackly to earthy.	12.8
2. Sandstone: White (N 9) to moderate-orange-pink (5YR 8/4), mottled; very fine to medium-grained; composed of rounded to subangular, clear quartz; common black, orange, amber, and red accessory minerals; medium-scale crossbeds; some ripple bedding; pseudocrossbedding; forms a massive ledge.	14.8
1. Claystone and sandstone.	
Claystone (80 percent): Light-greenish-gray (5G 8/1) and grayish-red (5R 4/2), interbanded; some fine-grained sand; weathers hackly to earthy.	
Sandstone (20 percent): Grayish-orange-pink (10R 8/2) to grayish-orange (10YR 7/4); very fine to fine-grained; composed of clear and amber-stained quartz; common to abundant black and orange accessory minerals; ripple bedded; slabby ledges are common in upper part of unit.	24.8
Total Recapture Shale Member	524.6
Total Morrison Formation	908.4

Base of section, not base of exposure; underlain by sandy facies of the Summerville Formation.

C.--North side of Sanostee Wash, 4½ miles west of Sanostee
50-13.0-4.5

[Measured by L. C. Craig, V. L. Freeman, and C. W. Weir]

UPPER CRETACEOUS:
Mancos Shale:

Top of section, not top of exposure.	
8. Claystone: Light-olive-brown (5Y 5/6); weathers earthy; contains fine-grained sand; float of Gryphaea or related genus noted.	10
7. Bentonite: Very light gray (N 8), stained yellow and brown; not silty.	1.0
6. Claystone: Dark-gray (N 3); splits fissile and shaly; weathers hackly.	1.0
Total Mancos Shale	12

Dakota Sandstone:

5. Sandstone: Very pale orange (10YR 8/2) to pale-yellow, weathering yellowish brown; very fine to fine-grained; composed of subangular, clear quartz; red, orange, and black accessory minerals; ripple bedded; well-exposed ripple marks; forms a ledge.	6.0
4. Claystone and sandstone.	
Claystone: Light-olive-gray (5Y 6/1) to medium-gray (N 5); silt to fine-grained sand; weathers hackly, slabby, and earthy; abundant carbonaceous fragments.	
Sandstone: Dark-greenish-gray (5G 4/1); very fine to fine-grained; forms beds 1 to 2 feet thick; weathers slabby; abundant carbonaceous fragments; common gypsum flakes.	64.2
3. Sandstone: Pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4); fine- to medium-grained; composed of subrounded to subangular, clear quartz; rare orange, black, and white accessory minerals; small-scale crossbeds; some ripple bedding noted at top.	15.6
2. Claystone and sandstone (2 types): Carbonaceous seams as much as 2 feet thick in upper third of unit.	
Claystone: Light-olive-gray (5Y 6/1) to medium-gray (N 5); silt to fine-grained sand; weathers hackly, slabby, and earthy; contains abundant carbonaceous fragments.	
Sandstone: Dark-greenish-gray (5G 4/1); very fine to fine-grained; weathers slabby; abundant carbonaceous material.	
Sandstone: Grayish-orange (10YR 7/4); very fine to fine-grained; composed of clear quartz; rare white and black accessory minerals; ripple bedded; abundant interstitial clay.	77.2
1. Sandstone: Very pale orange (10YR 8/2) to grayish-orange-pink (5YR 7/2), weathering yellowish brown; fine- to coarse-grained; composed of well-rounded to subrounded, clear quartz; rare black, white, and or-	

UPPER JURASSIC--Continued
Morrison Formation--Continued
Recapture Shale Member--Continued

	Feet
Claystone (40 percent): Grayish-red (5R 4/2) to dark-reddish-brown (10R 3/4); contains fine- to medium-grained sand; splits fissile in parts; weathers hackly to earthy.	235.8
19. Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; composed of subrounded to subangular, clear quartz; common orange and black accessory minerals; very gentle to parallel crossbedding with local medium-scale channeling; a few granule chips of dark-reddish-brown (10R 3/4) clay; thin partings of dark-reddish-brown (10R 3/4) claystone contain some subrounded, fine- to medium-grained sand; 65 feet above base a thin conglomerate stringer contains pebbles as much as half an inch in diameter that are composed of subrounded cloudy quartz, gray chert, granite, and abundant pink feldspar; upper half of unit consists of a series of ledges which combine to form a prominent scarp; lower half is weakly cemented and poorly exposed.	84.4
18. Sandstone: Light-reddish-brown (10R 5/6); fine- to medium-grained; composed of well-rounded to subrounded, clear quartz; common coarse-grained quartz and white and black accessory minerals; friable; parallel bedding; masked structure; some clay-coated grains; unit contains local thin partings of grayish-red (5R 4/2) to dark-reddish-brown (10R 3/4) claystone and stringers of disseminated grayish-red (5R 4/2) clay pellets; subrounded, very coarse grains and granules of white, tan, gray, and black chert and clear quartz; a 6-inch bed of claystone is at top of unit, and lateral to the section a 4-foot lensing claystone is 15 feet below top of unit.	94.3
17. Claystone: Grayish-red (5R 4/2) to dark-reddish-brown (10R 3/4) banded with 1 foot of medium gray (N 5) at top of unit; clay and some fine-grained sand; composed of subrounded quartz; to the south unit thins to 6 inches.	4.0
Total Recapture Shale Member	418.5
Total Morrison Formation	825.5

Bluff Sandstone:

16. Sandstone: Light-brown (5YR 6/4) banded with red; very fine to fine-grained; composed of subangular, clear quartz; rare white, orange, black, and red accessory minerals; parallel bedding with indication of parallel wavy laminations; forms a massive, rounded ledge; unit contains rare disseminated, well-rounded, medium grains; a 6-inch-thick bed of white (N 9) calcareous sandstone is at top of unit.	15.8
15. Sandstone: Grayish-orange (10YR 7/4); fine- to medium-grained; well-sorted; composed of well-rounded to subrounded, clear quartz; rare white, orange, black, and red accessory minerals; friable; wedge crossbedding; sweeping, medium-scale crossbeds; middle of unit contains parallel wavy lamination in 2-foot-thick bed.	12.4
Total Bluff Sandstone	28.2

Summerville Formation:

14. Sandstone, interbedded: Unit compares in sandiness with the Summerville Formation at Todilto Park, but it may include a 20-foot zone at top that should be assigned to the Bluff Sandstone.	
Sandstone: Light-brown (5YR 6/4 and 5YR 5/6) and light-reddish-brown (10R 5/6), banded; fine- to medium-grained, common coarse grains; composed of well-rounded, clear quartz; rare white, orange, and black accessory minerals.	
Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; composed of subrounded, clear and amber-stained quartz; rare orange, black, red, and green accessory minerals; parallel bedding, beds as much as 2 feet thick; contains abundant interstitial clay.	63.4
13. Sandstone: Upper 33.6 feet is same as unit 14; 1 foot of grayish-red-purple (5RP 4/2) claystone at base; lower 52.5 feet is moderate reddish orange (10R 6/6) banded with white (N 9); very fine to fine-grained; composed of subrounded to subangular, clear quartz; common orange, black, and red accessory minerals.	86.1
Total Summerville Formation	149.5

Todilto Limestone:

12. Limestone and sandy limestone, interbedded.	
Limestone: Medium-gray (N 5); dense, rare disseminated sand grains; very fine clay laminae; parallel bedding; weathers platy to slabby.	
Sandy limestone: Very fine to fine-grained; thin, lenticular, parallel bedding; pseudocrossbedding.	11
11. Sandstone: Greenish-gray (5G 6/1) tinged with purple and yellow; fine-grained; composed of subangular, clear quartz; common orange, black, and rare red accessory minerals; weakly cemented; weathers platy to earthy; contains a few disseminated, well-rounded, coarse quartz grains.	2.2
Total Todilto Limestone	13.2

Entrada Sandstone:
Upper sandy member:

10. Sandstone: Moderate-reddish-orange (10R 6/6) to light-brown (5YR 5/6); very fine to fine-grained; composed of well-rounded to subangular, clear and amber-stained quartz; common orange and black accessory minerals; parallel bedding; small-scale crossbeds interbedded with 5-foot-thick, sweeping, medium-scale crossbeds	

ange accessory minerals; fine- to medium-scale crossbeds; channeled; abundant white (N 9) interstitial calcareous material. 29.8

Total Dakota Sandstone 192.8

Base of section, not base of exposure. Unit 1 channels into the underlying light-greenish-gray (5G 8/1) claystone of the Brushy Basin Member of the Morrison Formation.

55.—Toadlena

East side of Chuska Mountains, 4 miles southwest of Toadlena
68-11.0-12.5
[Measured by L. C. Craig and V. L. Freeman]

UPPER CRETACEOUS:
Dakota Sandstone:
Top of section: One foot of gray sandstone with carbonaceous flecks is exposed at top; believed to mark top of the Dakota Sandstone; short covered interval lies above, then Mancos Shale crops out.

30. Sandstone: Grayish-orange-pink (10R 8/2) to grayish-orange (10YR 7/4); fine- to medium-grained; composed of subrounded to subangular, clear quartz; rare white accessory minerals; well-cemented, calcareous; parallel bedding; minor small-scale crossbeds; forms main hogback in wash; abundant crescentic and oscillation ripples; small amount of interstitial clay noted. 37
29. Claystone and sandstone.
Claystone: Olive-gray (5Y 3/2) to black (N 1); clay to fine-grained sand; thin carbonaceous and coaly beds.
Sandstone: Yellowish-gray (5Y 7/2); very fine to fine-grained; parallel, lenticularly bedded; crossbedded; weathers slabby; locally contains abundant carbonaceous fragments; beds are as much as 2 feet thick. 58.1
28. Sandstone: Grayish-orange-pink (5YR 7/2) to pale-yellowish-brown (10YR 6/2); fine- to medium-grained; composed of subrounded, clay-coated quartz; rare gray accessory minerals; parallel bedding; small-scale crossbeds; forms a massive ledge. 15.1
27. Shale, coal, claystone, and sandstone, interbedded: Shale is black (N 1) and carbonaceous, coal is black (N 1), and claystone and sandstone are greenish gray (5GY 6/1); beds are as much as 3 feet thick. 34.4
26. Sandstone and claystone, interbedded: Pale-red (10R 6/2) to dark-gray (N 3). 11
25. Sandstone: Grayish-red (10R 4/2); medium- to coarse-grained; composed of well-rounded to rounded, clay-coated quartz; rare gray accessory minerals; small-scale crossbeds; weathers platy at top; forms a massive ledge; top contact is gradational. 26
24. Shale: Black (N 1); carbonaceous. 1.4
23. Sandstone: Light-greenish-gray (5G 8/1) to yellowish-gray (5Y 7/2); fine to very coarse grained; poorly sorted; composed of clear quartz; rare gray and black accessory minerals; crossbedded; channeled; unit is silicified in top 1 foot; contains abundant carbonaceous fragments. 3.0

Total Dakota Sandstone 186

UPPER JURASSIC:
Morrison Formation:
Brushy Basin Member:

22. Claystone and sandstone: Unit described from exposures north of main wash and measured along bottom of main wash.
Claystone (70 percent): Light-greenish-gray (5GY 8/1), medium-dark-gray (N 4), and minor amount of grayish red purple (5RP 4/2); some fine- to medium-grained sand; weathers hackly to fluffy.
Sandstone (30 percent): White (N 9) to yellowish-gray (5Y 7/2); medium- to coarse-grained; composed of well-rounded, clear quartz; rare to common white, orange, black, red, and green accessory minerals; friable; no bedding exposed. 148

Westwater Canyon Member:

21. Sandstone and claystone, interbedded.
Sandstone (80 percent): Moderate-orange-pink (5YR 8/4), moderate-reddish-orange (10R 6/6), pale-red (5R 6/2), and pale-red-purple (5RP 6/2); very fine to medium-grained, partly conglomeratic; poorly sorted; composed of well-rounded to subangular, clear and pink-stained quartz; common white, gray, tan, and rare red accessory minerals; structure poorly exposed; medium-scale crossbedding in places; partly channeled; contains pale-red (5R 6/2) stringers and lenses of disseminated granules and pebbles as much as 1 inch in diameter; well-rounded inclusions of silicified sandy claystone that contains rare white (N 9) and gray chert, abundant cloudy quartz, and tan to pink feldspar; 5 to 10 feet from top, sandstone is light greenish gray (5G 8/1); fluviatile environment.
Claystone: Dark-reddish-brown (10R 3/4) to very dusky red (10R 2/2); commonly contains fine- to medium-grained sand; weakly cemented; forms lenticular beds as much as 5 feet thick. 259

Recapture Shale Member:

20. Sandstone and claystone: Unit forms a broad slope; sandstone beds 5 to 20 feet thick interbed with claystone beds 2 to 10 feet thick.
Sandstone (60 percent): Moderate-orange-pink (5YR 8/4) and grayish-orange-pink (5YR 7/2); fine- to medium-grained; poorly sorted; composed of subrounded to subangular, clear quartz; common to abundant orange, black, red, and rare green accessory minerals; locally preserved small- to medium-scale crossbeds; of wedge crossbedding; forms a buff cliff; contains concentration of medium grains along laminae. 98.9

Medial silty member:

9. Sandstone: Moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4); very fine to fine-grained; composed of clear and amber-stained quartz; common orange, black, and rare green accessory minerals; weakly cemented; part of unit contains pseudocrossbedding and small-scale crossbeds; weathers platy, shaly, earthy, and spheroidal; contains some thin clayey bands; weathered face suggests 2- to 3-foot banding; similarity to underlying units may be the result of reworking, although in this steeply dipping section all of the sandstone is somewhat alike. 68.2

Total Entrada Sandstone 167.1

UPPER TRIASSIC:
Wingate Sandstone:
Lukachukai Member:
Contact is poorly defined and poorly exposed.

8. Sandstone: Interbedded in 5- to 15-foot beds; unit corresponds in position with the massive, sweeping, crossbedded unit at top of the Wingate Sandstone in the Sanostee Wash and Red Rock areas.
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; composed of subangular, clear and amber-stained quartz; rare white and black accessory minerals; structure masked, but some medium-scale crossbeds noted; forms massive cliff or ledge.
Sandstone: Moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4); very fine grained, probably clayey; composed of clear and amber-stained quartz; rare orange and black accessory minerals; weakly cemented; weathers hackly to earthy; middle of unit contains a 6-inch to 1-foot parting of dark-reddish-brown (10R 3/4) sandy claystone that is fine-grained and micaceous. 103.2
7. Sandstone: Light-brown (5YR 5/6); very fine to fine-grained; composed of subangular, clear and amber-stained quartz; rare white and black accessory minerals; structure masked, but some medium-scale crossbeds noted; forms a massive cliff or ledge. 17.8

Total Lukachukai Member 121

Rock Point Member:

6. Sandstone: Pale-reddish-orange (10R 7/6) to moderate-reddish-brown (10R 4/6); very fine grained, probably clayey; composed of clear, amber-stained quartz; rare orange and black accessory minerals; parallel, thick-bedded, 5 to 15 feet thick; weathers hackly; forms badlands, except for rare ledges of slightly more resistant sandstone of local extent; top 15 feet usually forms a massive, rounded to irregular ledge; fine streaks of white (N 9) along joints and some bedding planes. 324.4
5. Claystone: Pale-reddish-brown (10R 5/4); contains some disseminated, medium- to coarse-grained sand; predominantly composed of clear quartz; rare black accessory minerals; fragments of white (N 9) chert; weathers hackly. 4.2

Total Rock Point Member 328.6
Total Wingate Sandstone 449.6

Chinle Formation:
Owl Rock Member:

4. Sandy claystone and some limestone.
Sandy claystone: Grayish-red (5R 4/2); silt to very fine grained sand; weathers hackly.
Limestone: Same as unit 3; forms a thin platy bed. 1.5
3. Limestone: Very light gray (N 8) to yellowish-gray (5Y 8/1); very finely crystalline; variably sandy; weathers slabby; forms a capping ledge on a prominent hogback. 1.0
2. Siltstone: Moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4), mottled with yellowish gray (5Y 8/1); highly calcareous; weathers hackly; forms a ledge. 5.5
1. Limestone: Pale-yellowish-green (10GY 7/2) and pale-red-purple (5RP 6/2), mottled; contains some clay, silt, and very fine grained sand; weathers nodular to knobby; prominent 3-foot bed of resistant limestone at top of unit grades northward laterally into a knobby weathering unit; base of section, not base of exposure. 10

Total Chinle Formation 18

DISTRICT 14

56.—Todilto Park

A.—East of Todilto Park, 17 miles northeast of Fort Defiance
88-9.0-4.0
[Measured by W. S. Pike, Jr. Lithologic description by M. E. Cooley and H. G. Page]

UPPER CRETACEOUS:
Menefee Formation:

10. Lignite, carbonaceous siltstone, and sandstone, interbedded: Poorly sorted; flat, thick to very thick bedded; weathers hackly; forms an irregular slope; base is gradational. 50+

Point Lookout Sandstone:

9. Sandstone: Deep pink; fine- to medium-grained; poorly sorted; well to firmly cemented; lenticular, very thick bedded, as much as 30 feet thick; unit is a set; lenticular and wedge trough crossbedding; concave and convex, low-angle and large-scale crossbeds; weathers blocky and partly pitted; forms a vertical and irregular cliff; contains pebbles of siltstone along crossbedding planes;

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Feet
UPPER CRETACEOUS—Continued	
Point Lookout Sandstone—Continued	
contains fossil pelecypods and fish scales; base is gradational.	100
Satan Tongue of Mancos Shale:	
8. Sandstone and siltstone, interbedded: Buff; clay to medium-grained sand; poorly sorted; weakly to firmly cemented; flat, lenticular, thin- to thick-bedded; weathers blocky and hackly; forms an irregular slope and ledge; sandstone as much as 3 feet thick alternates with siltstone as much as 2 feet thick; parallel ripple marks at top of unit are about 8 inches from crest to crest; unit contains small pelecypods, a shark's tooth, and an ammonite(?) about 4 inches in diameter; base is gradational.	84
Hosta Tongue of Point Lookout Sandstone:	
7. Sandstone (forms upper part of Hosta Tongue): Buff to pink; fine- to medium-grained; poorly sorted; well to firmly cemented; lenticular, very thick bedded, as much as 25 feet thick; unit is a set; lenticular trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers blocky and pitted; forms a vertical and irregular cliff; base is gradational.	---
6. Sandstone (forms lower part of Hosta Tongue): Buff to pink; fine- to coarse-grained; poorly sorted; well to firmly cemented; lenticular, very thick bedded, as much as 15 feet thick; unit is a set; lenticular and wedge planar crossbedding, low-angle and large-scale crossbeds; weathers blocky and pitted; forms a vertical and irregular cliff; siltstone pebbles and fossils concentrated in lenses along crossbedding planes near base; fossils consist of pelecypods and shark's teeth; base is concealed.	---
Total Hosta Tongue of Point Lookout Sandstone	164
Crevasse Canyon Formation:	
Gibson Coal Member:	
5. Lignite, carbonaceous siltstone, and sandstone: Unit covered and base concealed.	390
Dalton Sandstone Member:	
4. Sandstone: Pink; fine- to medium-grained; poorly sorted; well-cemented; lenticular, thick to very thick bedded, as much as 15 feet thick; unit is a set; lenticular and wedge planar crossbedding, low-angle and medium-scale crossbeds; weathers blocky and round; forms an irregular cliff; contains Inoceramus sp., I. labiatus, I. unabundus, I. dimidius, baculites, and small pelecypods; fossils are in "gunky" zones in lower 20 feet of unit; base is gradational.	69
Mulatto Tongue of Mancos Shale:	
3. Sandstone and siltstone, alternating: Buff; silt to medium-grained sand; poorly sorted; weakly to firmly cemented; flat, lenticular, thin- to thick-bedded; weathers blocky and hackly; forms an irregular ledge and slope; parallel ripple marks near top of unit; contains small pelecypods and Inoceramus dimidius; base is gradational.	144
Dilco Coal Member:	
2. Carbonaceous siltstone, sandstone, and lignite, alternating: Undescribed.	80
Total Crevasse Canyon Formation	683
Gallup Sandstone:	
1C. Sandstone and sandy conglomerate (forms upper part of Gallup Sandstone): Medium to very coarse grained; poorly sorted; well to firmly cemented; lenticular, thick to very thick bedded; unit is a set; lenticular trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers blocky; forms a vertical and irregular cliff; contains some gravel; part of unit is iron stained; base is gradational.	---
1B. Sandstone (forms middle half of Gallup Sandstone): Fine to very coarse grained; poorly sorted; well to firmly cemented; irregular, lenticular, thin to very thick bedded; unit is a set; trough crossbedding, low- to high-angle and medium-scale crossbeds; weathers blocky; forms a vertical and irregular cliff; contains a 2-foot-thick bed of lignite at base; base is gradational.	---
1A. Sandstone (forms lower part of Gallup Sandstone): Fine- to medium-grained; fair to poorly sorted; well to firmly cemented; lenticular, thick to very thick bedded; unit is a set; lenticular and wedge planar crossbedding, low-angle and medium- to large-scale crossbeds; weathers blocky; forms a vertical and irregular cliff; base is covered.	---
Total Gallup Sandstone	150
Mancos Shale: Undescribed.	738.5
UPPER AND LOWER CRETACEOUS:	
Dakota Sandstone: Undescribed.	

B.—East side of Todilto Park, 16 miles northeast of Fort Defiance
88-10.0-4.6

[Measured by C. A. Repenning and J. H. Irwin]

	Feet
UPPER AND LOWER CRETACEOUS:	
Dakota Sandstone: Undescribed.	
UNCONFORMITY: Relief of 2 to 3 feet.	
UPPER JURASSIC:	
Morrison Formation:	
Westwater Canyon Member:	
32. Sandstone: Light-bluish-gray (5B 7/1), banded with bluish-white (5B 9/1) and pinkish-gray (5YR 8/1); medium- to	
UPPER JURASSIC—Continued	
Todilto Limestone—Continued	
17. Mudstone and sandstone: Dusky-yellowish-brown (10YR 2/2) to dark-yellowish-orange (10YR 6/6); clay to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear and amber-stained quartz; white accessory minerals; weakly cemented; lenticular, flat-bedded; weathers smooth; forms a regular slope; base is sharp and irregular.	16
Total Todilto Limestone	25
Entrada Sandstone:	
Upper sandy member:	
16. Sandstone: Dark-yellowish-orange (10YR 6/6); medium-grained; fair-sorted; composed of rounded to subrounded, clear quartz; black and red accessory minerals; firmly cemented; massive; unit is a coset; asymmetrical trough crossbedding; concave, low- to high-angle and large-scale crossbeds; weathers rounded; forms a rounded cliff; eolian environment; base is sharp and flat.	178
Medial silty member:	
15. Sandstone: Moderate-reddish-brown (10R 4/5); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, amber quartz; white chert accessory mineral; firmly cemented; very thin bedded; weathers blocky and knobby; forms a vertical cliff; abundant calcite geodes, $\frac{1}{4}$ to 3 inches in diameter; base is sharp and flat.	33
14. Sandstone: Moderate-reddish-brown (10R 4/5); medium-grained; well-sorted; composed of subrounded to subangular, clear and stained quartz; white chert accessory mineral; firmly cemented; lenticularly bedded; unit is a set; wedge planar crossbedding; concave, low-angle and large-scale crossbeds; weathers rounded; forms a rounded ledge; rare calcite geodes, a quarter of an inch in diameter; bleached white (N 9) zones; eolian environment; base is sharp and flat.	8.0
13. Sandstone: Moderate-reddish-brown (10R 4/5); fine-grained; well-sorted; composed of subrounded to subangular, amber quartz; white chert accessory mineral; firmly cemented; massive; weathers rounded; forms a regular slope; contains calcite geodes, $\frac{1}{4}$ to 1 inch in diameter; bleached white (N 9) spots; base is sharp and flat.	12
12. Sandstone: Grayish-orange-pink (5YR 7/2); medium- to coarse-grained; fair-sorted; composed of subrounded to subangular, clear and amber quartz; white chert accessory mineral; firmly cemented; flat, lenticular, thick-bedded; unit is a set; tabular planar crossbedding; concave, low-angle and medium-scale crossbeds; weathers flaggy; forms a ledge; fluviatile environment; base is gradational.	2.0
11. Sandstone: Moderate-reddish-brown (10R 4/6) to dark-reddish-brown (10R 3/4); bimodal, very fine to fine-grained and coarse to very coarse grained; poorly sorted; composed of subrounded to subangular, stained and amber quartz; white chert and black and white accessory minerals; firmly cemented; flat, irregular, very thin to thick-bedded; unit is a coset; lenticular trough crossbedding; concave, low-angle and medium-scale crossbeds; weathers flaggy; forms a ledge; contains abundant granules and pebbles composed chiefly of chert and quartz; fluviatile environment; base is sharp and irregular, forms a channeled surface with 3 feet of relief.	5.0
Total medial silty member	60
Total Entrada Sandstone	238
UPPER TRIASSIC:	
Wingate Sandstone:	
Rock Point Member:	
10. Sandstone: Moderate-reddish-brown (10R 4/5); very fine grained; well-sorted; composed of subrounded to subangular, amber quartz; weakly cemented; massive; flat-bedded; weathers smooth and rounded; forms a rounded cliff; contains bleached spots; still-water environment; base is sharp and flat.	28
Tongue of Lukachukai Member:	
9. Sandstone: Moderate-reddish-brown (10R 4/5); very fine grained; well-sorted; composed of subrounded to subangular, amber quartz; weakly cemented; massive; simple crossbedding; concave, low-angle and large-scale crossbeds; forms a rounded cliff; eolian environment; base is sharp and flat.	35
8. Sandstone: Moderate-reddish-brown (10R 4/5); very fine grained; well-sorted; composed of subrounded to subangular, amber quartz; weakly cemented; flat, lenticular, laminated to thick-bedded; weathers smooth; forms a rolling, covered, ledgy slope; bleached spots common; base is sharp and flat.	9.0
Rock Point Member continued:	
7. Sandstone: Grayish-orange-pink (5YR 7/2) to moderate-reddish-brown (10R 4/5); very fine grained; well-sorted; composed of subrounded to subangular, clear and amber quartz; black accessory minerals; firmly cemented; lenticular, thick-bedded; lenticular and asymmetrical trough crossbedding; concave, low-angle and small-scale crossbeds; weathers flaggy; forms a ledge; contains worm trails and borings; coastal environment; base is sharp and irregular, forms a channeled surface.	3.0
6. Sandstone: Moderate-reddish-brown (10R 4/5); very fine grained; well-sorted; composed of subrounded to subangular, amber quartz; weakly cemented; flat, lenticular, laminated to thick-bedded; unit is a coset; weath-	

coarse-grained, some granules; fair-sorted; composed of subangular, stained quartz; 5 percent feldspar accessory mineral; weakly cemented; massive; unit is a coset; asymmetrical trough crossbedding; concave, low-angle and medium-scale crossbeds; weathers rounded; forms a rolling slope and niche below the Dakota Sandstone; fluviatile environment. 15

31. Covered interval. 11

30. Sandstone: Very pale orange (10YR 8/2); medium to very coarse grained; poorly sorted; composed of subangular, clear and white-stained quartz; feldspar accessory mineral; massive; unit is a coset; asymmetrical trough crossbedding; concave, low-angle and small- to medium-scale crossbeds; weathers rounded; forms a rolling slope; abundant granite pebbles and clay galls; fluviatile environment; base is sharp and gradational. 56

29. Sandy claystone: Same as sandy claystone in unit 25; banded; forms a regular slope; base is gradational. 25

28. Sandy conglomerate: Grayish-yellow (5Y 8/4); lenticularly bedded; unit is a coset; asymmetrical trough crossbedding; concave, low-angle and small- to medium-scale crossbeds; weathers rounded and blocky; forms an irregular, rounded cliff; fluviatile environment; base is flat and gradational.
   Matrix: Coarse-grained; poorly sorted; composed of subangular, clear, white, and frosted quartz; 2 percent feldspar accessory mineral; well to firmly cemented.
   Pebbles: Granule to 3 inches in diameter; composed of gray quartzite, pink and gray feldspar, granite, and white quartz. 119

27. Sandy claystone: Same as sandy claystone in unit 25; lenticularly bedded; forms a niche at base of cliff; fluviatile environment; base is gradational. 2.0

26. Sandstone: Grayish-yellow (5Y 8/4); medium-grained; well-sorted; composed of subangular, clear, white, and frosted quartz; massive; unit is a coset; asymmetrical trough crossbedding; concave, low-angle and small-scale crossbeds; weathers rounded; forms a rolling slope; fluviatile environment; base is concealed. 49

Total Westwater Canyon Member 277

Recapture Shale Member:

25. Sandy claystone and clayey sandstone: Unit is a coset; weathers smooth; forms a regular slope, mostly covered; base is sharp and irregular with 10 feet of relief.
   Sandy claystone: Dark-reddish-brown (10R 3/4); poorly sorted; composed of subangular, clear, white, and frosted quartz; weakly cemented; flat, lenticular, thick to very thick bedded; contains abundant lime concretions.
   Clayey sandstone: Light-yellowish-gray (5Y 8/2); clay, silt, and fine- to medium-grained sand; fair- to well-sorted; clear and white quartz and black accessory minerals; weakly cemented; flat, thick-bedded. 212

Total Morrison Formation 489

Cow Springs Sandstone:

24. Sandstone: Pale-yellowish-orange (10YR 8/6); fine- to medium-grained; well-sorted; composed of subangular, clear quartz; black accessory minerals; firmly cemented; massive; unit is a coset; wedge planar crossbedding; concave, high-angle and large-scale crossbeds; weathers rounded; forms a rounded slope; eolian environment; base is sharp and flat. 55

23. Sandstone: Same as unit 21 except contains no clay galls; abundant granules of white (N 9) chert. 36

22. Sandstone: Pale-yellowish-orange (10YR 8/6); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; red and white accessory minerals; firmly cemented; massive; unit is a coset; asymmetrical and symmetrical trough crossbedding; concave, low- to high-angle and medium- to large-scale crossbeds; weathers rounded; forms a rounded slope; eolian environment; base is sharp and flat. 18

21. Sandstone: Grayish-orange-pink (5YR 7/2); fine- to medium-grained; fair to poorly sorted; composed of subangular quartz; black and white accessory minerals; firmly cemented, calcareous and argillaceous; irregular, flat-bedded; weathers rounded; forms a rounded slope; abundant clay galls and sand pellets; base is sharp and flat. 38

Total Cow Springs Sandstone 147

Summerville Formation:
Sandy facies:

20. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; well-sorted; composed of subrounded to subangular, white and amber quartz; black accessory minerals; wavy, flat-bedded; unit is a coset; tabular planar crossbedding; concave, low- to high-angle and medium-scale crossbeds; weathers rounded; forms a rounded cliff; unit contains occasional slumpage and frequent slumpage faults; still-water environment; base is sharp and irregular, an erosion surface with 3 feet of relief. 213

Todilto Limestone:

19. Mudstone: Pale-red-purple (5RP 6/2); weakly cemented; gnarly, laminated; splits fissile; forms an irregular slope; abundant lime and clay pellets; base is sharp and irregular with a pitted surface of limestone. 5.0

18. Limestone: Light-olive-gray (5Y 6/1); aphanitic; flat, irregular, thin- to thick-bedded; weathers blocky and pitted; forms a ledge; common white (N 9) crystalline zones; contains rare white (N 9) quartz grains; upper surface is marked with solution pits; red, white, and black quartzite pebbles common at base; base is sharp and irregular. 4.0

ers smooth; forms a rolling, covered, ledgy slope; contains bleached spots; still-water environment; base is sharp and flat. 75

5. Sandstone: Very pale green (10G 8/2) to yellowish-gray (5Y 8/1); very fine grained; composed of subrounded to subangular, clear quartz; red and black accessory minerals; firmly cemented, calcareous; flat, lenticular, thick-bedded; weathers pitted; forms a ledge; base is sharp and flat. .2

4. Sandstone: Grayish-orange-pink (5YR 7/2) to moderate-reddish-brown (10R 4/5); very fine grained; fair- to well-sorted; composed of subrounded to subangular, clear and amber quartz; black accessory minerals; firmly cemented; irregular, thin- to thick-bedded; lenticular and asymmetrical trough crossbedding; concave, low-angle and medium-scale crossbeds; weathers flaggy; forms a ledge; worm trails and borings on mud-film surfaces; near base contains a granule conglomerate bed, 1 inch thick, composed of siltstone granules; base is irregular and sharp, forms a channeled surface. 11

3. Sandstone: Moderate-reddish-brown (10R 4/5); very fine grained; well-sorted; composed of subrounded to subangular, amber quartz; weakly cemented; flat, lenticular, laminated to thick-bedded; unit is a coset; contains siltstone beds; ripple marks; weathers smooth; forms a rolling, covered, ledgy slope; leached spots common; fluviatile and still-water environment; base is sharp and flat. 112

Total Wingate Sandstone 273.2

Chinle Formation:
Owl Rock Member:

2. Siltstone: Grayish-red (10R 4/2); clay and silt; weakly cemented; splits fissile; laminated; unit is a set; weathers rounded; forms a regular slope; limestone lenses common; base is sharp and irregular. 7.0

1. Siltstone: Grayish-orange-pink (5YR 7/2) to moderate-reddish-orange (10R 6/6); silt and very fine grained sand; well-sorted; composed of subangular, amber quartz; firmly cemented, calcareous and argillaceous; flat, irregular, thin- to thick-bedded; unit is a set; weathers flaggy; forms a ledge; ripple marks and mud cracks; worm trails and borings on mud slicks; coastal environment; base is concealed. 5.0

Total Chinle Formation 12

DISTRICT 16

57.—Staple

1½ miles northwest of Staple, 19 miles east of Gallup
105-6.0-17.0

[Measured by R. L. Jackson and S. A. Johnson]

UPPER AND LOWER CRETACEOUS:
Dakota Sandstone:

43. Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; poorly sorted; composed of subangular, clear quartz; rare red and black accessory minerals; weakly to firmly cemented, calcareous; massive; thick to very thick bedded; partly crossbedded with simple and trough crossbedding, small-scale crossbeds; weathers blocky; forms an irregular and vertical cliff; commonly contains clay galls and clay lenses; argillaceous material; base is sharp and irregular. 65

42. Carbonaceous shale and coal: Black (N 1); flat, laminated; weathers hackly; forms a recess below cliff composed of unit 43; abundant limonite stains along bedding planes and small joints; base is concealed. 6.0

41. Covered interval: Forms an irregular and talus-covered slope; some pale-green (5G 7/2) claystone exposed on slope; probably includes part of Morrison Formation. 52

Total Dakota Sandstone 123

UPPER JURASSIC:
Morrison Formation:
Brushy Basin Member:

40. Sandstone: Pale-olive (10Y 6/2); fine- to medium-grained; poorly sorted; composed of subangular, clear quartz; rare red and common yellow and black accessory minerals; weakly cemented, calcareous; massive; weathers blocky; forms a poorly developed ledge; contains abundant quartz granules; commonly contains argillaceous material; base is sharp and irregular. 11

39. Claystone: Variegated pale-green (5G 7/2), medium-light-gray (N 6), grayish-red (5R 4/2), and grayish-red-purple (5RP 4/2); flat, laminated; weathers hackly; forms a regular slope; base is flat. 16.5

38. Sandstone: Grayish-orange-pink (5YR 7/2); very fine to medium-grained; poorly sorted; composed of subrounded to subangular, clear quartz; rare green, red, and black accessory minerals; weakly cemented, calcareous; simple and trough crossbedding, high-angle and medium-scale crossbeds; forms a regular slope; contains abundant zones of quartz granules; base is flat. 14

37. Sandstone: Grayish-olive-green (5GY 3/2); fine- to medium-grained; poorly sorted; composed of subangular, clear and green-stained quartz; abundant yellow and rare red and black accessory minerals; well-cemented, calcareous; flat, very thin bedded; weathers blocky; forms a ledge; commonly contains quartz granules and argillaceous material; base is irregular. 1.0

36. Siltstone: Light-gray (N 7); poorly sorted; composed of subrounded to subangular, clear quartz; rare red and black accessory minerals; weakly cemented, calcareous; flat, irregular, very thin bedded; weathers blocky;

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah--Continued

	Feet
UPPER JURASSIC--Continued	
Morrison Formation--Continued	
Brushy Basin Member--Continued	
forms a regular slope; base is gradational.	15.5
35. Limy sandstone: Light-greenish-gray (5G 8/1); very fine to coarse-grained; composed of subangular, clear quartz; rare green and red-stained accessory minerals; weakly cemented; massive; weathers rounded; forms a regular slope; commonly contains argillaceous material; common to abundant quartz granules; base is sharp.	7.5
Total Brushy Basin Member	65.5
Westwater Canyon Member:	
34. Sandstone: Moderate-reddish-brown (10R 4/6); fine- to coarse-grained; poorly sorted; composed of subrounded to subangular, clear and frosted quartz; rare red and black accessory minerals; firmly cemented; massive; weathers blocky; forms a vertical and irregular cliff; contains small pebbles that are concentrated along bedding planes and in pockets; some fragments of feldspar; base is sharp and irregular.	83.5
33. Claystone and sandstone: Same as unit 26.	20
32. Sandstone: Dusky-red (5R 3/4); fine to very coarse grained; poorly sorted; composed of subrounded to subangular, stained quartz; rare feldspar and white and black accessory minerals; weakly cemented, calcareous; trough crossbedding, low-angle and large-scale crossbeds; weathers smooth and rounded; forms a rounded cliff; contains rare quartz pebbles, which are more numerous at base; base is flat.	25
31. Sandstone: Moderate-reddish-brown (10R 4/6); fine-grained; poorly sorted; composed of subrounded to subangular, stained quartz; rare white and black accessory minerals; weakly cemented; simple and trough crossbedding, medium-scale crossbeds; weathers blocky; forms a vertical and irregular cliff; contains abundant quartz granules; a mottled mudstone lens, 4 feet thick, is 30.5 feet above base; base is sharp and irregular.	37
Total Westwater Canyon Member	165.5
Recapture Shale Member:	
30. Claystone and sandstone: Same as unit 26; becomes predominantly sandstone near top.	142
Tongue of Cow Springs Sandstone:	
29. Sandstone: Grayish-yellow-green (5GY 7/2); fine-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare black accessory minerals; well-cemented, highly calcareous; massive; partly crossbedded with simple and trough crossbedding, high-angle and large-scale crossbeds; weathers smooth, rounded, and knobby; forms a rounded cliff; contains a few lenses of well-rounded, medium, clear quartz grains embedded in a claystone matrix; base is sharp and flat.	88
Recapture Shale Member continued:	
28. Claystone and sandstone: Same as unit 26.	5.5
27. Sandstone: Same as unit 24.	13.5
26. Claystone and sandstone, alternating.	
Claystone: Dark-reddish-brown (10R 3/4); flat, laminated; weathers hackly; forms an irregular slope; base is sharp and flat.	
Sandstone: Light-gray (N 7); fine-grained; fair-sorted; composed of subrounded to subangular, clear quartz; rare black accessory minerals; weakly cemented, highly calcareous; flat, very thin bedded; weathers blocky; forms a poorly developed ledge; contains rare zones of red-stained quartz; base is irregular.	8.5
25. Sandstone: Very light gray (N 8); fine-grained; poorly sorted; composed of subrounded to subangular, clear quartz; common black accessory minerals; flat, irregular, very thin bedded units alternate with units containing simple and trough crossbedding, medium-scale crossbeds; weathers smooth, lamination planes are etched; forms an irregular and rounded cliff; base is sharp and flat.	47.5
24. Sandstone: Pale-yellowish-brown (10YR 6/2); fine-grained; fair-sorted; composed of subangular, clear and stained quartz; rare purple and black accessory minerals; weakly cemented; simple and trough crossbedding, high-angle and medium-scale crossbeds.	-----
23. Sandstone: Light-brown (5YR 6/4); very fine grained; fair-sorted; composed of subangular, stained quartz; common black accessory minerals; weakly cemented, calcareous; flat, very thick bedded; weathers smooth and rounded; forms a vertical and rounded cliff; base is flat.	63.5
22. Sandstone: Same as unit 21; simple crossbedding, medium- to large-scale crossbeds.	40
21. Sandstone: Moderate-reddish-brown (10R 4/6) and light-brown (5YR 6/4), alternating.	
Sandstone: Moderate-reddish-brown (10R 4/6); silt to very fine grained sand; poorly sorted; composed of subangular, clear and stained quartz; common black accessory minerals; weakly cemented, calcareous; massive; weathers smooth and rounded; forms a rounded cliff; color bands; base is concealed.	
Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; rare black accessory minerals; weakly cemented, calcareous; massive; weathers smooth and rounded;	

	Feet
UPPER JURASSIC:	
Morrison Formation:	
Westwater Canyon Member:	
51. Sandstone: Very light gray (N 8); very fine to coarse-grained; poorly sorted; composed of subrounded to subangular, frosted quartz; rare red accessory minerals; poorly cemented; trough crossbedding, low-angle and large-scale crossbeds; forms a rounded, vertical cliff; commonly contains argillaceous material and lenses of rounded pebbles composed of chalcedony, jasper, and quartz; base is flat.	29
50. Siltstone: Light-olive (10Y 5/4); poorly sorted; composed of frosted and amber quartz; rare red accessory minerals; firmly cemented, highly calcareous; flat, very thin bedded; forms a ledge; contains rare argillaceous material; base is gradational.	1
49. Siltstone and mudstone: Pale-red-purple (5RP 6/2), dark-yellowish-green (10GY 4/4), and grayish-red-purple (5RP 4/2); poorly cemented; laminated to very thin bedded; forms an irregular slope; base is irregular.	11
48. Sandstone: Moderate-reddish-brown (10R 5/6); very fine to coarse-grained; poorly sorted; composed of subrounded to subangular, white and red-stained quartz; rare black accessory minerals; poorly cemented; trough crossbedding, low-angle and large-scale crossbeds; forms a rounded cliff; contains lenses of rounded pebbles composed of chalcedony, jasper, and quartz, and subrounded siltstone pebbles; contains large boulders of pale-reddish-purple (5RP 6/2) conglomerate with random arrangement throughout the unit, 1 to 4 feet in diameter, and described as follows:	
Matrix: Sandstone; very fine to coarse-grained; poorly sorted; composed of subrounded to subangular quartz; common red and black accessory minerals.	
Gravel: Subrounded to subangular pebbles composed of quartz, chalcedony, and jasper; pebbles are $\frac{1}{4}$ to 1 inch in diameter.	
Base is irregular.	120
47. Sandstone: Moderate-reddish-brown (10R 5/6); contains granite pebbles.	34
46. Sandstone: Pale-reddish-brown (10R 5/4); very fine to very coarse grained; poorly sorted; composed of subrounded to subangular quartz; poorly cemented; flat, irregular, very thin bedded; forms a parting between massive units; contains random clay galls and irregular mudstone pockets; base is irregular.	4
45. Sandstone: Pale-reddish-brown (10R 5/4); fine- to medium-grained; poorly sorted; composed of subangular, frosted and red-stained quartz which is spotted white by argillaceous material; poorly cemented; trough crossbedding, small-scale crossbeds; forms a vertical, irregular cliff; base is flat.	11
44. Sandstone: Pale-red-purple (5RP 6/2); very fine to medium-grained; poorly sorted; composed of subrounded quartz; common black accessory minerals; poorly cemented; gnarly, irregularly bedded; forms a rounded ledge; commonly contains argillaceous material; rare rounded pebbles of white and black quartz, $\frac{1}{2}$ to $1\frac{1}{2}$ inches in diameter; abundant carbonaceous plant material and common petrified wood; base is irregular.	8
Total Westwater Canyon Member	218
Tongue of Cow Springs Sandstone:	
43. Sandstone: Moderate-pink (5R 7/4); very fine to fine-grained; poorly sorted; composed of subrounded, frosted quartz; rare black accessory minerals; poorly cemented; trough crossbedding, low-angle and large-scale crossbeds; forms a rounded to vertical cliff; commonly contains argillaceous material; base is flat.	104
42. Sandstone: Pale-greenish-yellow (10Y 8/2); very fine to fine-grained; poorly sorted; composed of subangular, frosted quartz; rare red and black accessory minerals; poorly cemented; unit is a coset; flat-bedded; trough crossbedding, large-scale crossbeds near base; forms a rounded cliff; contains a zone of nodules, $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter, near top; base is flat.	126
Total tongue of Cow Springs Sandstone	230
Recapture Shale Member:	
41. Mudstone: Dark-reddish-brown (10R 3/4); firmly cemented; structureless; weathers massive; forms a slope; base is flat.	3
40. Sandy limestone: Light-greenish-gray (5GY 8/1); aphanitic to medium crystalline; limestone matrix contains quartz and rare black accessory minerals; firmly cemented; irregular, flat-bedded; forms a weak ledge; base is irregular.	3
39. Siltstone: Dark-reddish-brown (10R 3/4); composed of quartz; firmly cemented; laminated, flat-bedded; forms a slope.	8
38. Sandy limestone: Grayish-red (5R 4/2); medium crystalline; limestone matrix contains quartz; forms a weak ledge.	11
37. Siltstone: Same as unit 39.	7
36. Silty sandstone: Dark-gray (N 3); silt to very fine grained sand; poorly sorted; composed of rounded, green-stained quartz; rare red and black accessory minerals; firmly cemented; weathers massive; forms a slope; base is flat.	1
35. Sandstone: White (N 9), weathering pale brown (5YR 5/2); fine-grained; fair-sorted; composed of subangular, clear and frosted quartz; common red and black accessory minerals; low-angle and medium-scale crossbeds;	

forms a rounded cliff; base is sharp and flat. 46
20. Covered interval: Forms a regular slope. 27

Total Recapture Shale Member (including tongue of Cow Springs Sandstone) 481.5+
Total Morrison Formation 712.5+

Summerville Formation:
Sandy facies:
19. Sandstone: Moderate-brown (5YR 4/4); very fine to fine-grained; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare red and common black accessory minerals; firmly cemented, calcareous; massive; weathers smooth and rounded; forms a rolling slope; commonly contains angular magnetite; base is concealed. 27.5
18. Covered interval: Forms an irregular slope. 27

Total Summerville Formation 54.5

Todilto Limestone:
17. Limestone: Olive-gray (5Y 4/1); coarsely crystalline; flat, irregular, very thin bedded; weathers pitted; forms an irregular ledge; base is irregular. .5
16. Limestone: Light-olive-gray (5Y 6/1); aphanitic; flat, irregular, very thin bedded; weathers flaggy; forms an irregular and vertical ledge; caps mesas and buttes; base is irregular. 10
15. Limy sandstone: Yellowish-gray (5Y 7/2); fine-grained; poorly sorted; composed of subangular, clear quartz; rare red and black accessory minerals; weakly cemented, highly calcareous; flat, irregular, very thin bedded; weathers blocky; forms a slight recess below units 16 and 17; base is irregular. .5

Total Todilto Limestone 11

Entrada Sandstone:
Upper sandy member:
14. Sandstone: Same as unit 6. 12
13. Sandstone: Same as unit 5. 30.5
12. Sandstone: Same as unit 6. 22
11. Sandstone: Same as unit 5. 11
10. Sandstone: Same as unit 6. 10
9. Sandstone: Same as unit 5. 36.5
8. Sandstone: Same as unit 6; simple and trough crossbedding, small-scale crossbeds in upper part of unit. 27.5
7. Sandstone: Same as unit 5. 38.3
6. Sandstone: Same as unit 5; splits fissile; lenticular, flat-bedded. 5.5
5. Sandstone: Light-brown (5YR 6/4), weathering light brown (5YR 5/6); very fine to fine-grained; fair-sorted; composed of subrounded, stained quartz; rare black accessory minerals; weakly cemented, calcareous; simple and trough crossbedding, medium- to large-scale crossbeds; weathers smooth and rounded; forms a rounded cliff with units 6 to 14; contains rare quartz granules; base is flat and irregular. 40.4

Total upper sandy member 233.7

Medial silty member:
4. Sandstone: Moderate-brown (5YR 4/4); silt to very fine grained sand; poorly sorted; composed of subangular, clear and stained quartz; common black accessory minerals; firmly cemented, calcareous; massive; weathers knobby and into hoodoos; forms a vertical and rounded cliff; mottled with streaks of light gray (N 7); contains a light-gray (N 7) band, half a foot wide, at top of unit; base is flat. 60.9

Total Entrada Sandstone 294.6

UPPER TRIASSIC:
Wingate Sandstone:
Lukachukai Member:
3. Sandstone: Light-brown (5YR 6/4); fine- to medium-grained; fair-sorted; composed of subrounded, clear and stained quartz; rare black accessory minerals; weakly cemented; simple and trough crossbedding, medium- to large-scale crossbeds; weathers smooth and rounded; forms a rounded cliff; weathering of calcite-filled joints gives a boxlike effect; base is concealed. 59
2. Covered interval: Forms a rolling slope. 16

Total Wingate Sandstone 75

Chinle Formation:
Owl Rock Member:
1. Limestone: Mottled pale-red-purple (5RP 6/2) and light-greenish-gray (5G 8/1); aphanitic; gnarly, irregular, very thin bedded; weathers blocky; forms an irregular ledge; base is concealed. 2.0

58.—Fort Wingate

A.—1 mile north of Fort Wingate Station, 11 miles east of Gallup

[Measured by J. W. Harshbarger, R. L. Jackson, and S. A. Johnson]

UPPER AND LOWER CRETACEOUS:
Dakota Sandstone (incomplete):
52. Sandstone: Dark-yellowish-orange (10YR 6/6); fine- to medium-grained; poorly sorted; composed of subrounded to subangular, frosted quartz; rare white accessory minerals; poorly cemented; unit is a coset; irregular, flat-bedded; trough crossbedding, low-angle and small-scale crossbeds; forms an irregular cliff; commonly contains quartz granules and plant and carbonaceous material. 50

UNCONFORMITY: Concealed.

forms a ledge; contains some argillaceous material; base is irregular. 7
34. Sandstone: Mottled light-gray (N 7), green, and red; very fine grained; poorly sorted; composed of subrounded, clear and frosted quartz; abundant green and red, and rare black accessory minerals; weakly cemented; very thin bedded; forms a steep slope; base is flat. 19
33. Silty sandstone: Same as unit 36. 1

Total Recapture Shale Member 60
Total Morrison Formation (including tongue of Cow Springs Sandstone) 508

Cow Springs Sandstone:
32. Sandstone: Very light gray (N 8) and pale-reddish-brown (10R 5/4), weathering light olive gray (5Y 6/1) and pale brown (5YR 5/2) respectively; very fine grained; fair-sorted; composed of subrounded quartz; common amber and black accessory minerals; weakly cemented; unit is a flat, very thin to thick-bedded coset; sets contain trough crossbedding, low-angle and small- to medium-scale crossbeds; forms a rounded to vertical cliff; base is irregular. 9
31. Sandstone: Light-brown (5YR 6/4); very fine grained; fair-sorted; composed of subrounded to subangular, clear and frosted quartz; rare red and black accessory minerals; weakly cemented; laminated; trough crossbedding, large-scale crossbeds; forms a ledgy slope; base is irregular. 6
30. Sandstone: Same as unit 32. 14
29. Sandstone: Same as unit 31. 29
28. Sandstone: Same as unit 32. 137

Total Cow Springs Sandstone 195

Summerville Formation:
Sandy facies:
27. Sandstone: Light-brown (5YR 6/4); very fine grained; poorly sorted; composed of subangular, clear and amber quartz; common black accessory minerals; weakly cemented; weathers massive; unit is capped by a 6-inch, highly calcareous, sandstone ledge; similar ledge, 8 inches thick, is 9 feet below top of unit; base is irregular. 40
26. Sandstone: Light-brown (5YR 6/4); very fine grained; poorly sorted; composed of subrounded, clear and amber quartz; common black and rare red accessory minerals; weakly cemented; flat-bedded; unit is a coset; sets of small-scale crossbeds; forms a prominent ledge; base is irregular. 3
25. Sandstone: Light-brown (5YR 6/4); very fine to fine-grained; fair-sorted; composed of subrounded, white and amber quartz; common black accessory minerals; weakly cemented; weathers massive; forms a rounded cliff; base is irregular. 7
24. Sandstone: Dark-reddish-brown (10R 3/4); very fine grained; poorly sorted; composed of subrounded to subangular, amber quartz; common black accessory minerals; weakly to firmly cemented; flat, irregular, thin-bedded; weathers shaly and hackly; forms a slope; base is irregular. 7

Total Summerville Formation 57

Todilto Limestone:
23. Limestone: Light-olive-gray (5Y 6/1); medium crystalline; firmly cemented; flat, irregular, very thin to thin-bedded; forms a ledge which caps mesa; unit is sandy toward base, described as follows:
Basal sandy zone (1 inch thick): Light-gray (N 7) limestone; fine-grained; poorly sorted; subrounded grains; contains common amber quartz and rare black accessory minerals. 5

Entrada Sandstone:
Upper sandy member:
22. Sandstone: Light-brown (5YR 6/4); very fine grained; fair to poorly sorted; composed of subangular quartz; common black accessory minerals; firmly cemented; asymmetrical trough crossbedding, large-scale crossbeds; forms a rounded and vertical cliff. 31
21. Sandstone: Light-brown (5YR 6/4); very fine grained; fair to poorly sorted; composed of subangular quartz; common black accessory minerals; unit is a coset; flat-bedded; sets of very small scale crossbeds, about 3 inches long; forms a rounded and vertical cliff. 10
20. Sandstone: Same as unit 22. 4
19. Sandstone: Same as unit 21; contains conspicuous niche 6 feet above base. 21
18. Sandstone: Same as unit 22. 3
17. Sandstone: Same as unit 21. 7
16. Sandstone: Same as unit 22. 7
15. Sandstone: Same as unit 21. 18
14. Sandstone: Light-brown (5YR 6/4); very fine grained; poorly sorted; composed of subangular quartz; rare black accessory minerals; weakly cemented; trough crossbedding, medium-scale crossbeds. 2
13. Sandstone: Same as unit 21. 32
12. Sandstone: Same as unit 22 but contains a bleached zone about 1 foot thick at base; base is irregular. 118

Total upper sandy member 253

Medial silty member:
11. Siltstone: Pale-reddish-brown (10R 5/4); poorly sorted; composed of subangular quartz; common black accessory minerals; firmly cemented; very thin bedded; weathers fissile to shaly; forms a hoodoo cliff; 1-inch layer of mudstone near base; 4-inch band 8 feet above base, described as follows:
Sandstone: Yellowish-gray (5Y 7/2); firmly cemented, siliceous; very thin bedded; forms a

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Feet
UPPER JURASSIC—Continued	
Entrada Sandstone—Continued	
Medial silty member—Continued	
ledge; base is irregular.	
Base of entire unit is flat.	50
Total Entrada Sandstone	303
UNCONFORMITY: Not apparent in most areas.	
UPPER TRIASSIC:	
Wingate Sandstone:	
Lukachukai Member:	
10. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; fair-sorted; composed of subangular, white and amber quartz; rare green and black accessory minerals; weakly cemented; unit is a coset; parallel, flat-bedded; upper part of unit contains wedge planar crossbedding, high-angle and medium-scale crossbeds; forms a rounded cliff; contains a thin claystone parting ($\frac{1}{4}$ to $\frac{1}{2}$ inch thick) 21 feet above base that forms conspicuous niche; base is flat.	39
9. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; fair-sorted; composed of subangular, white and amber quartz; rare green and black accessory minerals; weakly cemented; wedge planar crossbedding, high-angle and large-scale crossbeds; forms a rounded cliff; base is flat.	4
8. Sandstone: Same as unit 9; flat-bedded.	24
7. Sandstone: Same as unit 9.	245
6. Sandstone: Same as unit 9; flat-bedded coset with occasional low-angle crossbedded sets.	14
5. Sandstone: Same as unit 9.	29
4. Sandstone: Very light gray (N 8); very fine grained; poorly sorted; composed of subrounded quartz; rare red and black accessory minerals; weakly cemented; friable; flat, irregular, very thin bedded; forms a slope; base is flat.	1
3. Sandstone: Pale-reddish-brown (10R 5/4); fine- to coarse-grained; poorly sorted; composed of subrounded to subangular, clear and white quartz in a matrix of very fine grained, red-stained sand; firmly cemented; irregular, flat-bedded; forms a weak ledge; base is irregular.	3
Total Wingate Sandstone	359
Unconformity: Erosional relief, 3 feet; overlain by pebbles of reworked Chinle Formation.	
Chinle Formation:	
2. Mudstone: Banded light-greenish-gray (5GY 8/1) and grayish-red (5R 4/2); composed of clay and silt; weakly cemented; irregular, flat-bedded; forms a slope; base is irregular.	8
1. Limestone: Pale-red-purple (5RP 6/2); contains some medium crystalline calcite and silt; irregular, flat-bedded; weathers blocky; forms a ledgy slope.	10
Total incomplete Chinle Formation	18
B.—Fort Wingate Ordnance Depot, 9 miles east-southeast of Gallup	
[Measured by J. W. Harshbarger, R. L. Jackson, and S. A. Johnson]	
UPPER TRIASSIC:	
Chinle Formation:	
Owl Rock Member:	
33. Limestone: Light-brownish-gray (5YR 6/1); finely crystalline; flat, irregular, very thin to thick-bedded; forms a prominent ledge; base is irregular.	4.0
32. Mudstone: Same as unit 26.	8.7
31. Limestone: Mottled light-gray (N 7) and pale-red-purple (5RP 6/2); aphanitic; irregular, flat-bedded; weathers knobby; forms a poorly developed ledge.	2.0
Total incomplete Owl Rock Member	14.7
Petrified Forest Member, upper part:	
30. Mudstone: Same as unit 26.	440.2
29. Sandy limestone: Same as unit 27.	2.0
28. Mudstone: Same as unit 26.	37.8
27. Sandy limestone: Pale-red-purple (5RP 6/2); finely crystalline, some silt; flat-bedded; weathers blocky; forms an irregular ledge; base is flat.	2.0
26. Mudstone: Mottled light-greenish-gray (5G 8/1) and dark-reddish-brown (10R 3/4); massive; gnarly; weathers hackly; forms an irregular slope; base is flat.	10.7
25. Sandstone: Grayish-red-purple (5RP 4/2); very fine grained; poorly sorted; composed of subangular, stained quartz; mica and black accessory minerals; firmly cemented, slightly calcareous; simple and trough crossbedding, low-angle and medium-scale crossbeds; weathers blocky; forms a poorly developed ledge; contains rare argillaceous material; base is flat.	9.8
24. Covered interval.	45.4
23. Sandstone: Light-olive-gray (5Y 6/1); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, frosted quartz; abundant black and rare red accessory minerals; firmly cemented, slightly calcareous; simple and trough crossbedding, low-angle and medium-scale crossbeds; weathers blocky; forms an irregular ledge; commonly contains argillaceous material; a few siltstone and claystone granules along bedding planes; more calcareous in upper part of unit; base is gradational.	19.6
22. Silty conglomerate: Irregular, flat-bedded; weathers rounded and pitted; base is gradational.	
UPPER TRIASSIC—Continued	
Chinle Formation—Continued	
Petrified Forest Member, lower part—Continued	
3. Claystone: Mottled grayish-yellow-green (5GY 7/2) and dark-reddish-brown (10R 3/4); flat, irregular, laminated; weathers hackly; forms a steep slope; green mottling gives effect of very poor banding; base is flat.	89
2. Siltstone: Yellowish-gray (5Y 7/2); poorly sorted; subangular grains; rare red and common black accessory minerals; firmly cemented, slightly calcareous; flat, irregular, laminated; forms a poorly developed ledge; base is concealed.	3.0
1. Covered interval: Forms an irregular and smooth slope.	69.5
Total lower part of the Petrified Forest Member	290.8
Total Petrified Forest Member	1,163
Total incomplete Chinle Formation	1,177.7
C.—2 miles south of Fort Wingate Station, 10 miles east-southeast of Gallup	
[Measured by J. W. Harshbarger, R. L. Jackson, and S. A. Johnson]	
UPPER TRIASSIC:	
Chinle Formation:	
Lower red member:	
12. Sandstone: Grayish-orange-pink (5YR 7/2), weathering light brown (5YR 5/6); very fine grained; fair-sorted; composed of subrounded, clear quartz; common black accessory minerals; firmly cemented, siliceous; simple and trough crossbedding, high-angle and medium-scale crossbeds; weathers smooth and rounded; forms a rounded ledge; base is irregular.	33
11. Conglomerate: Unit is massive; weathers knobby; forms an irregular ledge; base is irregular.	
Matrix: Very fine to medium-grained; poorly sorted; composed of subangular, clear and frosted quartz; common black accessory minerals.	
Gravel: Composed of subangular limestone and siltstone pebbles, $\frac{1}{4}$ to 1 inch in diameter.	7.0
10. Claystone: Dark-reddish-brown (10R 3/4); flat, laminated; weathers hackly; forms a rolling slope; base is gradational.	35
9. Claystone: Reddish-brown; flat, laminated; weathers hackly; forms a rolling slope; base is concealed.	41
8. Covered interval: Forms a long, gentle, and irregular slope.	83
Total lower red member	199
Shinarump Member:	
7. Conglomerate: Very pale orange (10YR 8/2), weathering dark reddish brown (10R 3/4); massive; lenticular; weathers smooth, rounded, and blocky; forms a ledge and slope; base is irregular.	
Matrix: Very fine to very coarse grained; poorly sorted; composed of subrounded to subangular, clear, frosted, and stained quartz; rare feldspar and red accessory minerals; firmly cemented, noncalcareous.	
Gravel: Composed of subrounded to subangular quartz, jasper, chalcedony, and feldspar pebbles, $\frac{1}{2}$ to $2\frac{1}{2}$ inches in diameter; pebble surfaces are smooth, frosted, and pitted.	13
6. Mudstone: Mottled light-brown (5YR 6/4) and grayish-purple (5P 4/2); clay and silt; firmly cemented; massive; irregularly bedded; weathers hackly; forms a ledge and slope; base is irregular.	12
Total Shinarump Member	25
Total Chinle Formation	224
MIDDLE(?) AND LOWER TRIASSIC:	
Moenkopi Formation:	
5. Sandstone: Yellowish-gray (5Y 7/2), weathering reddish brown; silt to very fine grained sand; poorly sorted; composed of subrounded to subangular, clear quartz; rare red and common black accessory minerals; firmly cemented, noncalcareous; wedge trough crossbedding, low-angle and small-scale crossbeds; weathers smooth to rounded; forms a poorly developed ledge; base is sharp and irregular.	27.4
4. Claystone: Dark-reddish-brown (10R 3/4); flat, laminated; weathers hackly; forms an irregular slope; base is irregular.	5.0
Total Moenkopi Formation	32.4
PERMIAN:	
San Andres Limestone:	
3. Limestone: Grayish-orange-pink (5YR 7/2), weathering gray; finely crystalline; rare manganese accessory minerals; thick to very thick bedded; weathers pitted; forms an irregular and vertical cliff; well-developed jointing; rare molluscan fauna, fossils are poorly preserved; base is flat.	86.4
2. Silty dolomitic limestone: Light-brown (5YR 6/4), weathering light brown (5YR 6/4); aphanitic; massive; weathers blocky; forms a vertical and irregular ledge; contains calcite geodes, half an inch in diameter; base is irregular.	10.5
Total San Andres Limestone	96.9
Glorieta Sandstone:	
1. Sandstone: Moderate-orange-pink (10R 7/4), weathering moderate brown (5YR 4/4); very fine grained; well-sorted; composed of rounded to subrounded, clear	

Matrix: Light-greenish-gray (5G 8/1); silt to medium-grained sand; poorly sorted; composed of subangular, frosted quartz; common black and red accessory minerals; firmly cemented, calcareous; commonly contains argillaceous material.
Gravel: Composed of subangular to angular, pale-reddish-brown (10R 5/4) to dark-reddish-brown (10R 3/4) siltstone and claystone pebbles, $\frac{1}{8}$ to $\frac{1}{2}$ inch in diameter. 2.0

21. Claystone: Dark-reddish-brown (10R 3/4). .8
20. Claystone: Same as unit 18. 54.4
19. Mudstone: Grayish-red (5R 4/2); clay, silt, and some very fine grained sand; composed of white and amber quartz; common mica and rare black accessory minerals; weakly cemented, highly calcareous; laminated, flat-bedded; weathers smooth; forms a slope; base is irregular. 1.0
18. Claystone: Mottled light-greenish-gray (5G 8/1) and grayish-red-purple (5RP 4/2); some fine-grained sand; irregular, laminated; weathers hackly; forms an irregular slope; base is gradational. 54.4
17. Mudstone: Mottled light-greenish-gray (5G 8/1) and grayish-red-purple (5RP 4/2); clay and silt; trough crossbedding, low-angle and small-scale crossbeds; weathers hackly; forms an irregular slope; base is gradational. 18.3
16. Conglomerate: Unit is massive; weathers gnarly; forms an irregular slope; to the south of section unit includes lenticular sandstone beds 5 feet thick and 25 to 200 feet long, which beds have fluviatile characteristics; base is irregular.
Matrix: Clay to fine-grained sand; poorly sorted; composed of subangular, white, amber, and clear quartz; rare black accessory minerals; weakly cemented, calcareous; abundant argillaceous material.
Gravel: Composed of subangular to angular siltstone, limestone, and quartz pebbles, $\frac{1}{8}$ to 1 inch in diameter; siltstone and limestone pebbles predominate. 5.0
15. Claystone: Mottled light-greenish-gray (5G 8/1) and moderate-reddish-brown (10R 4/6); irregular, laminated; weathers hackly; forms an irregular slope; contains subangular quartz granules; base is irregular and gradational. 18.8
14. Claystone: Variegated light-greenish-gray (5G 8/1) and grayish-red-purple (5RP 4/2); irregular, laminated; weathers hackly; forms an irregular slope; base is irregular. 30.2
13. Limy sandstone: Variegated light-greenish-gray (5G 8/1) and pale-red-purple (5RP 6/2); silt and very fine grained sand; poorly sorted; composed of subangular to angular, white and amber quartz; common black accessory minerals; well-cemented, highly calcareous; irregular, flat-bedded; weathers blocky; forms a poorly developed ledge; commonly contains argillaceous material; base is irregular. 24.5
12. Claystone: Grayish-red-purple (5RP 4/2); irregularly bedded; weathers hackly; forms an irregular slope; base is concealed. 5.5
11. Covered interval. 7.8
10. Sandstone: Pale-red-purple (5RP 6/2), weathering light brown (5YR 6/4); very fine to fine-grained; poorly sorted; composed of subangular, amber, clear, and smoky quartz; abundant black and rare green accessory minerals; well-cemented; flat, irregular, thin-bedded; weathers blocky; forms an irregular ledge; commonly contains argillaceous material; base is gradational. 6.0
9. Mudstone: Grayish-red-purple (5RP 4/2); clay and silt; common mica accessory mineral; firmly cemented, noncalcareous; irregular, laminated; weathers hackly; forms a ledge and slope; base is irregular. 18.3

Total upper part of the Petrified Forest Member 814.5

Petrified Forest Member, Sonsela Sandstone Bed:
8. Sandstone: Grayish-orange-pink (5YR 7/2); fine-grained; well-sorted; composed of rounded to subrounded, clear and frosted quartz; rare green accessory minerals; weakly cemented, siliceous; simple and trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers blocky; forms a vertical cliff; contains quartz granules concentrated along crossbedding planes; some secondary quartz growth in lower part; rare argillaceous material; base is irregular. 29.1
7. Limestone: Pale-olive (10Y 6/2); medium-grained; flat, thin-bedded; weathers blocky; forms a ledge; base is flat. 17.8
6. Silty sandstone: Pinkish-gray (5YR 8/1); silt to coarse-grained sand; poorly sorted; composed of subangular to angular, clear and frosted quartz; massive; weathers smooth and rounded; forms a poorly developed ledge; contains abundant quartz granules; conglomeratic at base with pebbles $\frac{1}{4}$ to 1 inch in diameter; base is irregular and gradational. 10.8

Total Sonsela Sandstone Bed of the Petrified Forest Member 57.7

Petrified Forest Member, lower part:
5. Claystone: Light-gray (N 7) and very dusky red purple (5RP 2/2); massive; weathers hackly; forms a steep, rolling slope; base is sharp. 98.3
4. Mudstone: Mottled pale-red-purple (5RP 6/2) and grayish-green (5G 5/2); clay and silt; irregular, laminated; forms a steep, rolling slope; contains pale-greenish-gray (5G 6/1) siltstone that has trough crossbedding with low-angle crossbeds; siltstone forms ledges and occurs at base and 15 feet above base; base is sharp and flat. 31

quartz; rare black accessory minerals; well-cemented, siliceous; flat, thin- to thick-bedded; weathers blocky; forms a vertical cliff; base is concealed. 100

59.—Thoreau

A.—2 miles northwest of Thoreau
120-9.0-0.6
[Measured by R. L. Jackson and S. A. Johnson]

UPPER AND LOWER CRETACEOUS:
Dakota Sandstone:
28. Sandstone: Yellowish-gray (5Y 7/2), weathering moderate brown (5YR 4/4); fine- to medium-grained; fair-sorted; composed of subangular, clear quartz; firmly cemented, noncalcareous; trough crossbedding, high-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; contains rare clay galls; rare red-stained quartz; base is flat. 50
27. Carbonaceous shale and coal: Gray and black (N 1); flat, laminated; weathers hackly; forms a regular slope; base is concealed. 3.0

Total incomplete Dakota Sandstone 53

UPPER JURASSIC:
Morrison Formation:
Brushy Basin Member:
26. Covered interval: Forms an irregular and talus-covered slope. 30
25. Sandstone: Yellowish-gray (5Y 7/2); fine- to medium-grained; poorly sorted; composed of subrounded to subangular, clear and stained quartz; rare red, green, white, and black accessory minerals; weakly to firmly cemented, calcareous; massive; weathers smooth and rounded; forms a rounded ledge; commonly contains argillaceous material; base is concealed. 5.5
24. Covered interval: Forms an irregular and talus-covered slope. 33
23. Claystone: Very pale green (10G 8/2), medium-light-gray (N 6), grayish-red-purple (5RP 4/2), and grayish-red (5R 4/2), variegated; flat, laminated; weathers hackly; forms an irregular slope; base is irregular. 13

Total Brushy Basin Member 81.5

Westwater Canyon Member:
22. Sandstone: Grayish-orange-pink (5YR 7/2); very fine to coarse-grained; poorly sorted; composed of subrounded to subangular, clear, white, and stained quartz; rare red and black accessory minerals; massive; simple and trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers blocky; forms an irregular and vertical cliff; contains abundant feldspar granules; pockets of conglomerate composed of subangular feldspar, quartz, and jasper pebbles, $\frac{1}{8}$ to 1 inch in diameter; commonly contains argillaceous material; base is irregular. 127

Recapture Shale Member:
21. Sandstone and claystone, interbedded: Forms an irregular cliff; claystone is prominent at base and grades upward into sandstone which is predominant at top.
Sandstone: Very light gray (N 8); very fine to fine-grained; poorly sorted; composed of subangular, clear quartz; rare red and black accessory minerals; weakly cemented, calcareous; flat-bedded; trough crossbedding, low-angle and small-scale crossbeds; weathers blocky; base is irregular.
Claystone: Dark-reddish-brown (10R 3/4); flat, laminated; weathers hackly. 207

Total Morrison Formation 415.5

Cow Springs Sandstone:
20. Sandstone: Light-greenish-gray (5G 8/1); fine-grained; fair-sorted; composed of subangular, clear quartz; rare mica and red and black accessory minerals; firmly cemented, calcareous; massive; very thick bedded; simple and trough crossbedding, high-angle and medium-scale crossbeds; weathers smooth and rounded; forms a vertical and rounded cliff; base is sharp. 189.5

Summerville Formation:
Sandy facies:
19. Sandstone: Very light gray (N 8); very fine grained; fair-sorted; composed of subangular, clear quartz; rare red and black accessory minerals; weakly cemented, slightly calcareous; massive; thin to very thick bedded; partly crossbedded; 20 percent simple and trough crossbedding, low-angle and medium-scale crossbeds; weathers knobby; forms a vertical and rounded cliff; contains thin purple mudstone at base; base is flat. 132
18. Sandstone: Light-brown (5YR 6/4); very fine grained; fair-sorted; composed of subrounded to subangular, clear and stained quartz; common black and rare red accessory minerals; firmly cemented, calcareous; massive; weathers smooth and rounded; forms a rounded ledge; contains calcite geodes; base is concealed. 18.5
17. Covered interval: Forms an irregular slope. 15.5
16. Sandstone: Light-brown (5YR 6/4); silt and very fine grained sand; poorly sorted; composed of subangular, clear and stained quartz; common black accessory minerals; well-cemented, slightly calcareous; weathers smooth and rounded; forms a rounded and irregular ledge; base is concealed. 11
15. Covered interval: Forms an irregular slope. 9.0

Total Summerville Formation 186

Todilto Limestone:
14. Limestone: Dark-gray (N 3); coarsely crystalline; irregular, very thin bedded; weathers pitted; forms an irregular ledge; base is irregular. 1.0

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Feet
UPPER JURASSIC—Continued	
Todilto Limestone—Continued	
13. Limestone: Olive-gray (5Y 4/1); finely crystalline; flat, irregular, very thin bedded; weathers flaggy; forms a prominent and stripped dip slope; base is gradational.	11.5
12. Limy sandstone: Light-brownish-gray (5YR 6/1); very fine to fine-grained; fair-sorted; composed of subangular, clear and stained quartz; rare black accessory minerals; well-cemented, highly calcareous; splits fissile; flat, irregular; weathers blocky; forms a recess below limestone ledge; base is flat.	4.0
Total Todilto Limestone	16.5
Entrada Sandstone:	
Upper sandy member:	
11. Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; poorly sorted; composed of subangular, clear and stained quartz; common black accessory minerals; weakly cemented, calcareous; splits fissile; flat, irregular, very thin bedded; weathers rounded; forms a rounded cliff; contains rare argillaceous material; base is irregular.	15
10. Sandstone: Same as unit 8.	33
9. Sandstone: Same as unit 5; contains no granules.	24
8. Sandstone: Light-brown (5YR 6/4); very fine grained; fair-sorted; composed of subangular, clear and stained quartz; black accessory minerals; weakly cemented, noncalcareous; thick-bedded; simple and trough crossbedding, medium- to large-scale crossbeds; top of crossbeds are truncated by flat planes; weathers smooth and rounded; forms a vertical and rounded cliff; base is irregular.	66
7. Sandstone: Same as unit 5; contains fewer granule zones.	6.0
6. Sandstone: Same as unit 5; simple and trough crossbedding, medium-scale crossbeds.	6.0
5. Sandstone: Light-brown (5YR 6/4); very fine grained; fair-sorted; composed of subangular, clear and stained quartz; common black accessory minerals; weakly cemented; flat, laminated; weathers smooth and rounded; forms a vertical cliff; contains zones of quartz granules in stringers and small lenses; base is sharp and flat.	4.0
Total upper sandy member	154
Medial silty member:	
4. Sandstone: Pale-reddish-brown (10R 5/4), weathering moderate reddish brown (10R 4/6); silt and very fine grained sand; poorly sorted; composed of subrounded, stained quartz; common black and rare white accessory minerals; well-cemented, noncalcareous; massive; irregular, flat-bedded; weathers knobby and forms hoodoos; forms a rounded cliff; base is irregular.	45.5
Total Entrada Sandstone	199.5
UPPER TRIASSIC:	
Wingate Sandstone:	
Lukachukai Member:	
3. Sandstone: Light-brown (5YR 6/4); fine-grained; fair to poorly sorted; composed of subrounded, clear and stained quartz; green and black accessory minerals; weakly cemented; wedge trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers smooth and rounded; forms a ledge and slope; contains rare argillaceous material; calcite veins cut across bedding planes; base is flat.	86.5
2. Grit: Moderate-reddish-brown (10R 4/6); very fine to very coarse grained; poorly sorted; composed of rounded, frosted and stained quartz; rare white and black accessory minerals; weakly cemented, noncalcareous; small- to medium-scale crossbeds; forms a regular slope; commonly contains argillaceous material; abundant quartz granules; base is irregular.	8.5
Total Wingate Sandstone	95
Chinle Formation:	
Owl Rock Member:	
1. Limestone: Greenish-gray (5G 6/1) and grayish-red-purple (5RP 4/2), mottled; aphanitic; irregular, very thin to thin-bedded; weathers blocky; forms an irregular ledge; base is concealed.	2.0

B.—3 miles northeast of Thoreau
120-12.0-5.0 A

[Measured by M. E. Cooley]

UPPER JURASSIC:	
Entrada Sandstone:	
Medial silty member (incomplete):	
10. Hoodoo sandstone: Undescribed.	
UPPER TRIASSIC:	
Wingate Sandstone:	
Lukachukai Member:	
9. Siltstone and sandstone: Orange-red; silt and medium-grained sand; weakly cemented; forms a covered slope.	22
8. Sandstone and conglomerate: Orange-red; fine- to medium-grained; poorly sorted; composed of clear and stained quartz sand; weakly to firmly cemented; flat, irregular, thin- to thick-bedded; weathers blocky; forms an irregular ledge; base is gradational.	1.0
Total Wingate Sandstone	23
UPPER TRIASSIC—Continued	
Chinle Formation—Continued	
Petrified Forest Member, upper part—Continued	
4. Silty limestone: Flat, lenticular, thick-bedded; weathers blocky; forms an irregular ledge; splits conchoidal; base is gradational.	1.0
3B. Siltstone, chiefly (slope unit): Flat, lenticular, thin to very thick bedded; weathers hackly and fluffy; forms an irregular, rolling, and partly covered slope; contains some sandstone channels.	
Unit consists, in descending order, of:	
d. Mudstone (221 feet above base): Pale-red (5R 6/2); clay and silt; weakly cemented; splits fissile and crumbly. 17.5±	
c. Siltstone (205 feet above base): Grayish-red (5R 4/2); silt and some very fine grained sand; weakly cemented. 21±	
b. Sandy siltstone (178 feet above base): Light-brownish-gray (5YR 6/1); silt to very fine grained sand; clear quartz; black accessory minerals; weakly cemented; splits crumbly. 19±	
a. Siltstone (167 feet above base): Light-brownish-gray (5YR 6/1); silt and some very fine grained sand; weakly cemented; splits fissile and crumbly. 27±	84.5±
3A. Covered interval: Base is covered.	146
Correo(?) Sandstone Member:	
2. Sandstone and siltstone: Pale-red (5R 6/2); silt to medium-grained sand; composed of rounded to subrounded, clear and stained quartz; black accessory minerals; flat, irregular, lenticular, thin to very thick bedded; lenticular trough crossbedding, low-angle and small- to medium-scale crossbeds; laminated to very thin bedded; weathers blocky; forms an irregular and covered ledge and slope; contains some thin to thick beds of limestone conglomerate, which are scattered throughout unit; also contains thin flagstones; upper 27 feet is exposed; base is concealed.	38.3
Petrified Forest Member, upper part continued:	
1. Covered interval: Mudstone and siltstone, chiefly.	30
Total upper part of the Petrified Forest Member [including Correo(?) Sandstone Member]	391.8±
Total incomplete Chinle Formation	425.3±

C.—5 miles east of Thoreau
120-8.0-7.0 A

[Measured by M. E. Cooley]

UPPER TRIASSIC:	
Chinle Formation:	
Correo(?) Sandstone Member:	
5. Silty sandstone and limestone conglomerate: Flat, irregular, lenticular, thin to very thick bedded; lenticular and wedge trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers blocky; forms an irregular ledge; some mudstone lenses; measured to top of hogback, which may not be top of unit.	
Silty sandstone: Pale-red (5R 6/2); silt to fine-grained sand; composed of subrounded to subangular quartz; black accessory minerals; firmly cemented; splits platy.	
Limestone conglomerate: Firmly cemented; contains some siltstone pebbles.	20.5
Petrified Forest Member, upper part:	
4. Mudstone and siltstone (slope unit): Flat, irregular, lenticular, thin to very thick bedded; weathers hackly; forms an irregular slope; contains 1-foot-thick lenticular beds of nodular limestone throughout unit.	
Unit consists, in descending order, of:	
h. Sandy siltstone (92 feet above base): Moderate-red (5R 5/4); silt to fine-grained sand; mica and black accessory minerals; weakly cemented; splits shaly and crumbly. 15±	
g. Siltstone (76 feet above base): Pale-reddish-brown (10R 5/4); mica accessory mineral; weakly cemented; splits shaly. 20.5±	
f. Siltstone and limestone conglomerate (62 feet above base): Pale-reddish-brown (10R 5/4); silt to very	

Chinle Formation:
Owl Rock Member:

7. Siltstone and limy siltstone: Flat, lenticular, thin- to thick-bedded; weathers hackly; forms an irregular slope; base is gradational.
   Unit consists, in descending order, of:
   e. Limy siltstone (22 feet above base): Pale-red (10R 6/2); silt and some medium-grained sand; weakly cemented; splits fissile; contains "sandstone dikes" composed of basal Wingate Sandstone; dikes are in vertical position and are shaped like large wedges, with sharp end down; maximum thickness of dikes is $\frac{1}{2}$ foot and maximum depth is 4 to 5 feet; sandstone of dikes is fine to coarse grained, composed of well-rounded clear quartz sand, contains black accessory minerals, and is firmly cemented. 8.5±
   d. Silty sandy limestone (16 feet above base): Pale-red (10R 6/2); silt to fine-grained sand; composed of subangular, clear quartz; black accessory minerals; weakly cemented; splits shaly. 7.0±
   c. Sandy siltstone (11 feet above base): Pale-red-purple (5RP 6/2); silt to medium-grained sand; composed of subrounded to subangular, clear and stained quartz sand; black accessory minerals; weakly cemented; splits shaly and fissile. 5.0±
   b. Silty nodular limestone (7 feet above base): Pale-red (10R 6/2); firmly cemented; splits conchoidal. 3.0±
   a. Limy siltstone (5 feet above base): Pale-red (10R 6/2); weakly cemented; splits platy and shaly. 6.0± — 29.5±
6. Siliceous limestone: Pale-red-purple (5RP 6/2); well-cemented; flat, thick to very thick bedded; weathers blocky; forms an irregular ledge; splits flaggy; contains chert; base is gradational. — 4.0

Total Owl Rock Member — 33.5±

Petrified Forest Member, upper part:

5. Siltstone and mudstone (slope unit): Flat, lenticular, thin to very thick bedded; weathers hackly; forms an irregular slope; base is gradational.
   Unit consists, in descending order, of:
   g. Siltstone (98 feet above base): Pale-red (5R 6/2); silt and some fine to very fine grained sand; composed of well-rounded to rounded, clear and stained quartz; black accessory minerals; weakly cemented; splits shaly and fissile. 4.5±
   f. Limestone (97 feet above base): Firmly cemented; splits conchoidal. 2.5±
   e. Limy siltstone (92 feet above base): Pale-red (10R 6/2); weakly cemented, calcareous; splits shaly; contains a few bleached spots and some limestone nodules. 11±
   d. Sandy siltstone (76 feet above base): Pale-reddish-brown (10R 5/4); silt and fine-grained sand; composed of rounded to subangular, clear and stained quartz sand; black accessory minerals; weakly cemented; splits shaly and fissile; contains a few bleached spots. 19±
   c. Siltstone (54 feet above base): Moderate-pink (5R 7/4); silt and some clay; weakly cemented; splits shaly and crumbly. 19±
   b. Mudstone (38 feet above base): Grayish-red (5R 4/2 and 10R 4/2); clay and silt; weakly cemented; splits shaly. 11±
   a. Siltstone (11 feet above base): Pale-reddish-brown (10R 5/4); weakly cemented; splits fissile. 25± — 92±

4. Siltstone (59 feet above base): Grayish-red (5R 4/2); clay to silt; weakly cemented; splits shaly. 6.5±
   d. Sandy siltstone (49 feet above base): Pale-reddish-brown (10R 5/4); silt to very fine grained sand; mica and black accessory minerals; weakly cemented; splits platy. 10±
   c. Siltstone (38 feet above base): Pale-reddish-brown (10R 5/4); clay and silt; weakly cemented; splits shaly and crumbly. 19±
   b. Limestone conglomerate (24 feet above base): Grayish-red (5R 4/2 and 10R 4/2); silt to fine-grained sand; composed of clear and stained quartz; mica and black accessory minerals; weakly to firmly cemented; splits crumbly. 2.0±
   a. Siltstone (22 feet above base): Grayish-red (5R 4/2); silt and some very fine grained sand; black accessory minerals; weakly cemented; splits fissile. 23± — 99±

3. Sandstone: Irregular, lenticular, thin to very thick bedded; lenticular, wedge, and tabular trough crossbedding; low-angle and small- to medium-scale crossbeds; laminated to thin-bedded; weathers blocky; forms an irregular ledge; contains mud cracks with blocks as much as 4 inches across and cracks $\frac{1}{8}$ inch wide; current ripple marks, very flat; flagstone at top of unit is quarried; base of unit contains mudstone pebbles as much as 2 inches in diameter; base is irregular.
   Unit consists, in descending order, of:
   b. Silty sandstone: Pale-red (5R 6/2); silt to fine-grained sand; composed of clear and stained quartz sand; mica and black accessory minerals; firmly cemented; splits platy. 16.5±
   a. Sandy siltstone and limestone conglomerate: Grayish-red (5R 4/2); clay to fine-grained sand; weakly cemented; splits fissile and crumbly; mudstone pebbles; forms a transition zone between unit 2 and subunit 3b. 2.0± — 18.5±

2. Mudstone and siltstone (slope unit): Irregular, lenticular, thin to very thick bedded; lenticular and wedge trough crossbedding, very large scale crossbeds; weathers hackly; forms an irregular ledge and slope; contains some sandstone that forms small knobs at base of unit.
   Unit consists, in descending order, of:
   f. Silty sandstone and mudstone (81 feet above base): Pale-reddish-brown (10R 5/4); clay to very fine grained sand; composed of clear and stained quartz; mica and black accessory minerals; weakly cemented; splits fissile and crumbly. 5.5±
   e. Sandy siltstone (76 feet above base): Pale-reddish-brown (10R 5/4); silt to fine-grained sand; composed of subrounded to subangular, clear and stained quartz; weakly cemented; splits shaly. 5.0±
   d. Sandy siltstone (70 feet above base): Pale-reddish-brown (10R 5/4); silt to very fine grained sand; black accessory minerals; weakly cemented; splits platy and shaly. 6.0±
   c. Siltstone (38 feet above base): Pale-reddish-brown (10R 5/4); weakly

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER TRIASSIC—Continued

Chinle Formation—Continued

Petrified Forest Member, upper part—Continued

		Feet
cemented; splits massive and fissile.	42±	
b. Siltstone (22 feet above base): Pale-reddish-brown (10R 5/4); silt and some fine-grained sand; black accessory minerals; weakly cemented; splits massive.	25±	
a. Silty sandstone (3 feet above base): Grayish-red (10R 4/2); silt to very fine grained sand, some fine-grained sand; composed of subrounded to subangular, clear and stained quartz; black accessory minerals; splits platy.	5.0±	88.5±
1. Covered interval.		50
Total incomplete upper part of the Petrified Forest Member		256±
Total incomplete Chinle Formation		276.5±

60.—Cheechilgeetho

2 miles south of Cheechilgeetho Day School, New Mexico
136-9.0-2.5

[Measured by R. L. Jackson and S. A. Johnson]

UPPER JURASSIC:

Entrada Sandstone:

Upper sandy member:

	Feet
19. Sandstone: Same as unit 16; very fine to medium-grained; weathers pitted; forms a rounded cliff; base is irregular.	25.5
18. Sandstone: Moderate-brown (5YR 4/4) and light-gray (N 7), variegated; silt to very fine grained sand; poorly sorted; composed of subrounded to subangular, clear and stained quartz; common black accessory minerals; weakly cemented, calcareous; wedge simple and trough crossbedding, medium-scale crossbeds; forms a rounded cliff; crossbedding planes etched out; base is flat.	22
17. Sandstone: Same as unit 16; irregular, flat-bedded; trough crossbedding, low-angle and small- to medium-scale crossbeds.	11
16. Sandstone: Light-gray (N 7); fine- to coarse-grained; poorly sorted; composed of rounded to subrounded, clear and frosted quartz; rare red and black accessory minerals; weakly cemented, highly calcareous; high-angle and medium- to large-scale crossbeds; weathers pitted; forms a poorly developed ledge; abundant quartz granules along crossbedding planes; base is irregular.	25
Total incomplete upper sandy member	83.5

Medial silty member:

15. Siltstone: Moderate-brown (5YR 4/4) and light-gray (N 7); fair-sorted; composed of subangular, stained quartz; common black accessory minerals; weakly cemented, highly calcareous; irregular, laminated; weathers smooth and rounded; forms a rolling slope; forms a prominent band along cliff faces and on hill exposures; unit is variegated above 8 feet; base is irregular.	16.5
Total incomplete Entrada Sandstone	100

UPPER TRIASSIC:

Wingate Sandstone:

Rock Point Member:

14. Sandstone: Grayish-orange-pink (10YR 8/2); fine- to medium-grained; fair-sorted; composed of subrounded, clear and stained quartz; rare black and red accessory minerals; weakly cemented, highly calcareous; simple and trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers smooth and rounded; forms a rounded or irregular ledge; base is flat.	53.5
13. Claystone: Dark-reddish-brown (10R 3/4); flat, laminated; weathers hackly; forms a recess; contains shrinkage cracks filled with sandstone same as unit 14; cracks are 1 inch wide.	1.0
12. Sandstone: Same as unit 10.	35
11. Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; poorly sorted; composed of subangular, clear and stained quartz; black accessory minerals; simple and trough crossbedding, large-scale crossbeds; weathers smooth and rounded; forms a rounded ledge; contains rare argillaceous material; unit is lenticular and thins and thickens laterally; base is irregular.	2.5
10. Sandstone: Light-brown (5YR 6/4); very fine grained; poorly sorted; composed of subangular, clear and stained quartz; rare green and common black accessory minerals; weakly cemented, calcareous; simple and trough crossbedding, low-angle and large-scale crossbeds; weathers smooth and rounded; forms a rounded ledge; contains rare argillaceous material; lenses of very light gray (N 8) sandstone; base is irregular.	17.5
9. Sandstone: Light-brown (5YR 6/4); very fine to medium-grained; poorly sorted; composed of rounded to subrounded, clear and stained quartz; black accessory forms an irregular slope; a sandstone bed 2 miles west of section and 10 feet below top of unit contains bone fragments, vertebrae, teeth, and ganoin scales of fish, shark's teeth, small clams, and gastropods; base is gradational and irregular.	34
7A. Carbonaceous mudstone: Clay and silt; fair-sorted; weakly cemented; very thin bedded; weathers hackly; forms an irregular slope; base is gradational and irregular.	49
6. Sandstone: Grayish-buff; fine- to coarse-grained; poorly sorted; firmly cemented; lenticular, thin- to thick-bedded; lenticular and wedge trough crossbedding, high-angle and medium-scale crossbeds; weathers blocky; forms an irregular cliff; to the east unit thins from 11 to 3 feet; unit is lenticular and not present except locally; base is gradational, irregular, and channeled with about 25 feet of relief.	11
Total Toreva Formation	307

Mancos Shale:

5G. Claystone: Brown to dark-gray (N 3); clay and very fine grained sand; poorly sorted; weakly cemented; very thin bedded; weathers hackly; forms an irregular slope; contains a few thin sandstone beds and common carbonaceous material; base is gradational and irregular.	67
5F. Sandstone and siltstone: Buff to brown; clay to fine-grained sand; poorly sorted; weakly to firmly cemented; flat, thin-bedded; weathers hackly and blocky; forms an irregular slope and small sandstone ledges; sandstone beds are less than 1 foot thick; commonly contains large fragments of Inoceramus sp.; base is gradational and irregular.	14
5E. Claystone and siltstone: Grayish-brown (5YR 3/2); clay to very fine grained sand; fair-sorted; weakly cemented; flat, very thin bedded; weathers hackly; forms a rolling slope; splits fissile; 48 feet above base contains abundant ammonites in a 3-foot bed of limy shale; base is gradational and irregular.	227
5D. Siltstone and bentonite, alternating: Dark-bluish-gray (5B 4/1) siltstone and brown bentonite; clay and silt; fair-sorted; weakly cemented; very thin bedded; weathers hackly; forms a rolling slope; bentonitic layers thicken upward from approximately 2 inches near base to a bed 8 feet thick 92 feet above base; unit is fossiliferous; base is gradational and irregular.	130
5C. Claystone and siltstone: Dark-gray (N 3) claystone and buff siltstone; clay to very fine grained sand; poorly sorted; weakly cemented; flat, very thin bedded; weathers hackly; forms a rolling slope; a 3-inch limestone bed at 22 feet contains abundant Ostrea sp.; limestone beds in claystone are less pronounced than in sections farther north; base is gradational and irregular.	92
5B. Claystone and bentonite: Dark-bluish-gray (5B 4/1) to brown claystone and light-buff bentonite; fair-sorted; weakly cemented; irregular, very thin to thin-bedded; weathers hackly; forms a rolling slope; contains abundant fossils—Gryphaea newberryi, Baculites gracilis, Exogyra columbella, Turritella sp., shark's teeth, echinoids, and mollusks; bentonite beds less than 2 inches thick; contains abundant selenite crystals; base is gradational and irregular.	32
5A. Carbonaceous claystone and siltstone: Dark-bluish-gray (5B 4/1) to brown; clay to very fine grained sand; poorly sorted; weakly cemented; flat, very thin bedded; weathers hackly; forms an irregular slope; contains a few fossil shell fragments, probably Gryphaea newberryi, and one shell-crushing shark's tooth; base is gradational and irregular.	11
Total Mancos Shale	573

UPPER AND LOWER CRETACEOUS:

Dakota Sandstone:

4. Sandstone: Light-buff; clay to fine-grained sand; poorly sorted; firmly cemented; flat, very thin to thick-bedded; wedge trough crossbedding, high-angle and medium-scale crossbeds; weathers hackly; forms an irregular ledge; contains carbonaceous siltstone layers less than 3 feet thick; at top of unit a hard limonitic layer, 1 inch thick, contains abundant fucoids; base is gradational and irregular.	22
3. Carbonaceous mudstone: Buff to violet; clay, silt, and fine-grained sand; poorly sorted; weakly cemented; flat, very thin to thin-bedded; weathers hackly; forms an irregular slope; a few fine-grained sandstone beds 1 inch thick; base is gradational and irregular.	17
2. Sandstone: Grayish-buff; fine- to medium-grained; fair-sorted; firmly cemented; lenticular, thin- to thick-bedded; wedge planar crossbedding, high-angle and large-scale crossbeds; weathers blocky; forms a vertical cliff; contains coal beds as much as 1 foot thick at base and in lower part of unit; also contains carbonaceous siltstone lenses ½ foot thick scattered throughout the unit; base is sharp and irregular.	61
Total Dakota Sandstone	100

UNCONFORMITY: Erosional and channeled, 10 feet of relief.

UPPER JURASSIC:

Morrison Formation:

Westwater Canyon Member:

1. Sandstone: Buff, weathering white; fine- to coarse-grained; poorly sorted; firmly cemented; flat, thick-bedded; weathers blocky; forms a vertical cliff; base is concealed.	50+

minerals; weakly cemented, calcareous; simple and trough crossbedding, medium-scale crossbeds; weathers smooth and rounded; forms a rounded cliff; commonly contains argillaceous material; base is flat. 32

8. Sandstone: Moderate-brown (5YR 4/4); very fine grained; fair-sorted; composed of subangular, clear and stained quartz; rare black accessory minerals; well-cemented, calcareous; flat, thin- to thick-bedded; weathers blocky; forms an irregular cliff; contains lenticular, small- to medium-scale crossbeds of pinkish-gray (5YR 8/1) sandstone, which thin visibly to north and south; ripple marks; rare clay galls; base is flat. 52.5

7. Claystone: Dark-reddish-brown (10R 3/4); splits fissile; flat-bedded; weathers hackly; forms a recess; contains thin beds of variegated yellowish-gray (5Y 7/2) and pale-brown (5YR 5/2) sandstone; base is flat. 8.4

6. Sandstone: Yellowish-gray (5Y 7/2) and pale-brown (5YR 5/2), variegated; silt to very fine grained sand; fair-sorted; composed of subangular, clear quartz; rare black accessory minerals; well-cemented, calcareous; flat, thin- to thick-bedded; weathers blocky; forms a prominent vertical and irregular ledge; contains partings of claystone similar to that of unit 5; base is sharp. 30

5. Sandstone and claystone, alternating: Beds range in thickness from 1 to 1½ feet.
   Sandstone: Light-greenish-gray (5G 8/1) and light-brown (5YR 6/4), mottled; very fine grained; fair-sorted; composed of subangular, clear and stained quartz; rare black accessory minerals; flat, very thin bedded; weathers blocky; forms an irregular ledge; contains ripple marks and borings; base is irregular.
   Claystone: Grayish-green (10GY 5/2) and dark-reddish-brown (10R 3/4); flat, irregular, laminated; weathers hackly; forms an irregular ledge; base is sharp. 48

4. Grit: Light-greenish-gray (5G 8/1); silt to very fine grained sand; poorly sorted; composed of subangular, stained quartz; rare black accessory minerals; weakly cemented, calcareous; irregular, very thin to thin-bedded; weathers knobby; forms an irregular slope; commonly contains argillaceous material; abundant quartz granules; base is irregular. 1.0

Total Wingate Sandstone 281.4

Chinle Formation:
Owl Rock Member:

3. Claystone: Same as unit 1; base is gradational. 25.5

2. Mudstone: Light-bluish-gray (5B 7/1) and grayish-red (5R 4/2); clay and silt; flat, laminated; weathers hackly; forms a rolling slope; commonly contains clay galls; base is gradational. 11

1. Claystone: Dark-reddish-brown (10R 3/4); flat, laminated; weathers hackly; forms a rolling slope; base is concealed. 15

Total incomplete Owl Rock Member 51.5

DISTRICT 17

61.—Balakai

Balakai Point, east side of Black Mesa,
16 miles northwest of Ganado
92-4.7-10.5

[Measured by H. G. Page and M. E. Cooley]

UPPER CRETACEOUS:
Toreva Formation:

12. Sandstone: Light-gray (N 7), weathering pinkish orange; fine to very coarse grained; poorly sorted; firmly cemented, apparently calcareous; massive; thick to very thick bedded; wedge trough crossbedding, high-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; partly conglomeratic; pebbles, as much as 1 inch in diameter, are composed of quartzite; pebbles become smaller in upper part of unit; base is sharp. 16

11. Sandstone: Yellowish-buff; fine to very coarse grained; poorly sorted; firmly cemented, apparently calcareous; irregular, thick to very thick bedded; lenticular trough crossbedding, high-angle and medium-scale crossbeds; weathers blocky; forms a vertical cliff; base is sharp and irregular. 94

10B. Carbonaceous siltstone and sandstone: Fine-grained; most of unit is covered. 20

10A. Sandstone: Pinkish-buff; fine- to coarse-grained; poorly sorted; firmly cemented; thick-bedded; lenticular trough crossbedding, high-angle and small- to large-scale crossbeds; weathers blocky; forms a vertical cliff; grades laterally eastward into a series of siltstone and sandstone beds; base is sharp and irregular. 34

9. Coal and carbonaceous siltstone: Brown to black (N 1); clay and silt; poorly sorted; weakly cemented; flat, very thin bedded; weathers hackly; forms an irregular slope; contains abundant plant fragments; base is gradational and irregular. 14

8. Sandstone: Grayish-buff; fine- to medium-grained; fair-sorted; firmly cemented; flat, thick-bedded; tabular trough crossbedding in upper 25 feet, high-angle and medium-scale crossbeds; tabular inclined crossbedding in lower 10 feet, high-angle and large-scale crossbeds; weathers blocky; forms a vertical cliff; contains a 6-inch layer of titaniferous sandstone at top of unit; base is sharp. 35

7B. Coal: Brown to black (N 1); clay and silt; fair-sorted; weakly cemented; very thin bedded; weathers hackly;

62.—Steamboat

6 miles northeast of Steamboat Trading Post
92-1.0-15.0 A

[Measured by R. L. Jackson, S. A. Johnson, C. A. Repenning, L. C. Craig, J. W. Harshbarger, and F. L. Freeman]

UPPER AND LOWER CRETACEOUS:
Dakota Sandstone:

43. Sandstone: Grayish-brown (5YR 3/2); very fine grained; fair-sorted; composed of subrounded, clear and frosted quartz; rare black accessory minerals; firmly cemented; irregular, flat-bedded; contains some small- to medium-scale crossbeds; forms top of prominent cliff; lower contact bevels unit 42. 96

UNCONFORMITY: Forms an irregular erosion surface; as much as 4 feet of relief; channeled into the Morrison Formation.
UPPER JURASSIC:
Morrison Formation:
Westwater Canyon Member:

42. Sandstone: Grayish-pink (5R 8/2); fine-grained; poorly sorted; composed of subrounded to subangular, frosted quartz; rare black accessory minerals; weakly cemented; partly massive; some small-scale crossbeds; forms a vertical cliff that is continuous with unit 43; base is even. 37.5

41. Sandstone: Yellowish-gray (5Y 7/2); fine-grained; poorly sorted; composed of subrounded to subangular quartz; weakly cemented; contains large-scale crossbeds at base which grade upward into massive sandstone; forms a rounded, regular, and steep slope; near base contains brownish-gray (5YR 4/1) nodules ranging in size from 1 to 4 inches. 82.5

Total Westwater Canyon Member 120

Tongue of Cow Springs Sandstone:

40. Sandstone: Gray, yellow, and pink, variegated; medium-grained; fair-sorted; composed of subrounded, clear and frosted quartz; rare yellow, green, and black accessory minerals; weakly cemented; medium- to large-scale crossbeds; forms a rounded and irregular slope. 110

Recapture Shale Member:

39. Sandstone: Light-greenish-gray (5G 8/1); very fine grained; poorly sorted; composed of subrounded, clear, frosted, and iron-stained (40 to 50 percent) quartz; rare black accessory minerals; weakly cemented; flat, irregular, very thin to thin-bedded; forms a ledge and slope. 18

Total Morrison Formation (including tongue of Cow Springs Sandstone) 248

Cow Springs Sandstone:

38. Sandstone: Same as unit 36; poorly sorted; rare green and slight increase in black accessory minerals. 76

37. Sandstone: Same as unit 36. 13.5

36. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; fair-sorted; composed of subrounded to subangular quartz; rare well-rounded, black accessory minerals; weakly cemented; flat, very thin bedded in lower part; flat beds grade upward into large-scale crossbeds; forms a smooth, rounded cliff; contains a few red-coated quartz grains; base is sharp. 22

35. Sandstone: Moderate-reddish-brown (10R 4/6); very fine to fine-grained; 70 percent composed of subangular, red-stained quartz; rare black accessory minerals; small- to medium-scale crossbeds; forms rounded cliffs with units 33 and 34; base is sharp. 9.5

34. Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; poorly sorted; composed of subrounded to subangular, clear, frosted, and red-coated quartz; rare black accessory minerals; firmly cemented; flat, irregular, very thin bedded; forms a rounded cliff continuous with unit 33; base of unit truncates crossbeds of unit 33. 3.5

33. Undescribed; unmeasured. -----

(Section continued 15 miles west of Ganado, 111-2.0-4.0 A.)

32. Sandstone: Pale-greenish-yellow (10Y 8/2), very pale orange (10YR 8/2), and some grayish-orange-pink (5YR 7/2); fine-grained; composed of subrounded, clear quartz; firmly cemented; large-scale crossbeds; forms a rounded cliff; base is a sharp horizontal plane. 54.4

31. Sandstone: Yellowish-gray (5Y 7/2); fine-grained; composed of subrounded, clear quartz; firmly cemented; medium-scale crossbeds with haphazard orientation; forms a rounded ledge; base is gradational. 3.0

30. Sandstone: Same as unit 31; forms a rounded cliff; base is flat. 33.6

29. Sandstone: Same as unit 31; base is flat. 4.0

28. Sandstone: Same as unit 31. 8.0

27. Sandstone: Yellowish-gray (5Y 7/2); fine-grained; composed of subrounded, clear quartz; weakly cemented; flat-bedded; forms a ledge; base is gradational. 6.0

26. Sandstone: Same as unit 31. 28

25. Sandstone: Same as unit 27. 1.0

24. Sandstone: Same as unit 31. 11.2

23. Sandstone: Same as unit 27. 3.0

22. Sandstone: Same as unit 31. 8.5

21. Sandstone: Grayish-yellow-green (5GY 7/2); fine-grained; composed of subrounded, clear quartz; firmly cemented; forms a ledge; contains interstitial clay; base is sharp. .8

Total Cow Springs Sandstone 286+

(Section continued 12.7 miles west of Ganado, 111-1.0-4.0 A.)

Summerville Formation:
Sandy facies:

20. Sandstone: Yellowish-green (10GY 7/2); fine-grained;

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah--Continued

	Feet
UPPER JURASSIC--Continued	
Summerville Formation--Continued	
Sandy facies--Continued	
composed of subrounded, clear quartz; weakly cemented; flat-bedded, small-scale crossbedding within beds; forms rounded cliffs; contains laminated orange concretions; also contains green concretionary zones of clayey sandstone; base is gradational.	33.6
19. Sandstone: Pale-green (5G 7/2) and light-brown (5YR 6/4); very fine grained; composed of subrounded, clear quartz; rare black accessory minerals; weakly cemented; flat-bedded; small-scale crossbeds, more strongly crossbedded at top; forms rounded cliffs; contains orange limonite concretions in bed 4 feet above base; base is gradational.	14.2
Total Summerville Formation	47.8
Entrada Sandstone:	
Medial silty member:	
18. Sandstone: Light-brown (5YR 6/4); very fine grained; poorly sorted; composed of subrounded, clear and amber quartz; weakly cemented; flat-bedded; small-scale crossbeds at top; forms a rounded cliff and covered slope; base is gradational.	100.5
17. Sandstone: Very pale orange (10YR 8/2), banded with light brown (5YR 6/4); medium-grained; composed of subrounded, clear quartz; weakly cemented; flat-bedded; forms a covered slope; base is sharp.	38.6
Total Entrada Sandstone	139.1
UPPER AND MIDDLE JURASSIC:	
Carmel Formation:	
16. Claystone: Dark-reddish-brown (10R 3/4); silt, clay, and 10 percent very fine grained quartz sand; laminated; forms a covered slope; base is sharp.	8.6
15. Sandstone: White (N 9); very fine grained; composed of clear quartz; rare black accessory minerals; firmly cemented; flat, very thin bedded; forms a ledge; base is sharp.	2.0
14. Claystone: Same as unit 12; base is even.	20
13. Sandstone: Light-gray (N 7); fine-grained; fair-sorted; composed of rounded to subrounded, clear and frosted quartz; rare black accessory minerals; weakly cemented; massive; forms an irregular slope; base is even.	6.0
12. Claystone and thin partings of siltstone: Base is irregular.	
Claystone: Moderate-brown (5YR 4/4); laminated; forms an irregular slope.	
Siltstone: Light-gray (N 7); poorly sorted; subangular.	27
Total Carmel Formation	63.6
UPPER TRIASSIC(?):	
Moenave Formation:	
Dinosaur Canyon Sandstone Member:	
11. Sandstone: Light-gray (N 7); fine-grained; well-sorted; composed of rounded to subrounded, clear quartz; rare pink accessory minerals; weakly cemented; medium-scale crossbeds; forms a vertical and rounded cliff continuous with unit 10; base is sharp.	20
10. Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; fair-sorted; composed of subrounded, clear quartz; rare black accessory minerals; weakly cemented; flat, very thick bedded; thin layer 10 feet above base contains small-scale crossbeds; forms a vertical cliff; joints filled with calcite.	24
9. Sandstone: Same as unit 2.	3.0
8. Sandstone: Same as unit 4; base is irregular.	7.0
7. Sandstone: Same as unit 2.	4.0
6. Sandstone: Same as unit 4; base is irregular.	3.0
5. Sandstone: Same as unit 2.	3.0
4. Sandstone: Very pale orange (10YR 8/2); very fine to fine-grained; poorly sorted; composed of subrounded, white and frosted quartz; rare black accessory minerals; firmly cemented; flat, thin-bedded; forms an irregular cliff; base is even.	15.5
3. Sandstone: Light-gray (N 7); fine- to medium-grained; fair-sorted; composed of rounded to subrounded, white and frosted quartz; rare black accessory minerals; weakly cemented; small-scale crossbeds; forms an irregular cliff.	2.0
2. Sandstone: Moderate-reddish-brown (10R 4/6) and greenish-gray (5GY 6/1), variegated; very fine to fine-grained; poorly sorted; composed of subrounded, white and frosted quartz; rare black accessory minerals; weakly cemented; flat-bedded; forms a vertical cliff; unit thins and thickens visibly laterally; base is irregular.	2.0
1. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; fair-sorted; composed of subrounded, clear, frosted, and iron-coated (40 percent) quartz; rare black accessory minerals; firmly cemented; massive; forms rounded and steep slopes; banded with thin grayish-green (10GY 5/2) reduced zones, which are 1 to 4 inches thick and average 3 zones per 10 feet of thickness.	121
Total incomplete Dinosaur Canyon Sandstone Member	204.5
Base of exposure.	
Covered interval.	

	Feet
TERTIARY--Continued	
Bidahochi Formation--Continued	
Upper member--Continued	
Matrix: Fine- to medium-grained; poorly sorted; composed of rounded to subrounded, clear and colored quartz; common black accessory minerals; contains argillaceous material.	
Gravel: Composed of subangular to angular quartzite, 5 to 15 mm in diameter.	5.3
Total upper member	282.2
Lower member:	
14. Claystone: Dark-reddish-brown (10R 3/4); weakly cemented; flat, laminated to thick-bedded; weathers smooth; forms a regular slope; contains some silt; worm borings(?) and primary slumpage features; lacustrine environment; base is sharp and flat.	48.8
13. Claystone: Light-greenish-gray (5GY 8/1); weakly cemented; massive; flat-bedded; weathers smooth; forms a regular ledge; contains limy stringers; quiet fluviatile environment; base is sharp and irregular.	12.6
12. Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; fair-sorted; subrounded to subangular grains; common red and black accessory minerals; weakly cemented, calcareous; flat, laminated; weathers smooth to rounded; forms a rounded cliff; commonly contains argillaceous material; primary slumpage features; many of the quartz grains are coated; lacustrine environment; base is sharp and flat.	45.5
11. Volcanic ash: White (N 9) to bluish-white (5B 9/1); very fine grained; well-sorted; composed of angular glass shards; rare black accessory minerals; weakly cemented; gnarly, laminated; weathers smooth and bedding planes are etched; forms a ledge; primary slumpage features; lacustrine environment; base is sharp and irregular.	1.2
10. Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, stained quartz; common red and black accessory minerals; weakly cemented, calcareous; flat, irregularly bedded; weathers smooth and blocky; forms an irregular cliff and slope; commonly contains argillaceous material; contains two beds of volcanic ash; primary slumpage features; lacustrine environment; base is flat and gradational.	32.9
9. Clayey sandstone: Yellowish-gray (5Y 8/1); clay to fine-grained sand; poorly sorted; composed of stained quartz; common red and black accessory minerals; weakly cemented, calcareous; massive; laminated; wedge trough crossbedding, low-angle and small-scale crossbeds; weathers smooth; forms a regular slope; contains yellow spots; lacustrine environment; base is flat and gradational.	13.1
8. Sandstone: Grayish-brown (10YR 3/2); fine-grained; well-sorted; composed of subrounded to subangular, clear and frosted quartz; common red and black accessory minerals; weakly cemented, calcareous; massive; flat-bedded; forms a slope; contains two volcanic ash beds, 3 inches thick; base is sharp and flat.	15.9
7. Mudstone: Light-olive-gray (5Y 6/1) and pale-yellowish-brown (10YR 6/2); fine- to medium-grained; poorly sorted; quartz accessory mineral; weakly cemented; flat, laminated; weathers smooth; forms a regular slope; contains several 1-inch-thick beds of ash; base is flat and gradational.	42.5
6. Conglomerate: Pale-red (5R 6/2), weathering dark-yellowish-brown (10YR 4/2); firmly cemented, calcareous; gnarly, very thin to thick-bedded; wedge trough crossbedding, low-angle and small-scale crossbeds; weathers blocky; forms a ledge; contains plant impressions and petrified wood, petrified wood probably derived from Cretaceous rocks; contains vertebrate bone fragments; fluviatile environment; base is sharp and irregular.	
Matrix: Very fine to medium-grained; poorly sorted; composed of subangular, clear and red quartz; rare black accessory minerals.	
Gravel: Composed of rounded to subrounded limestone and siltstone pebbles and granules, 2 mm to 3 inches in diameter.	5.0
Total lower member	217.5
Total Bidahochi Formation	499.7
UNCONFORMITY: Angular; erosional, 2 feet of relief.	
UPPER TRIASSIC:	
Wingate Sandstone:	
Rock Point Member:	
5. Sandstone: Moderate-reddish-brown (10R 4/6); very fine to fine-grained; fair-sorted; composed of subrounded to subangular, stained quartz; common black accessory minerals; weakly cemented, calcareous; flat, laminated to thick-bedded; weathers smooth and knobby; forms a regular slope; abundant stringers composed of selenite; still-water environment; base is flat and gradational.	33.1
4. Sandstone: Bluish-white (5B 9/1) and moderate-light-bluish-gray (5B 6/1); fine- to medium-grained; fair-sorted; composed of subangular, clear and colored	

63.—Klagetoh

3 miles southeast of Klagetoh
125-13.0-1.2

[Measured by J. P. Akers]

UPPER TRIASSIC:
Chinle Formation:
Shinarump Member:
6. Conglomerate: Gray to purplish-blue; very fine to very coarse grained; poorly sorted; composed of rounded to subangular, clear, stained, and frosted quartz; weakly to firmly cemented; irregularly bedded; forms an irregular ledge; contains subrounded to subangular pebbles as much as 1 inch in diameter; base is sharp. 6+

UNCONFORMITY.
MIDDLE(?) AND LOWER TRIASSIC:
Moenkopi Formation:
Holbrook Member:
5. Siltstone: Pale-reddish-brown (10R 5/4); weakly cemented; forms a slope; a few thin sandstone ledges; grades into mudstone at top of unit. 13
4. Sandstone and siltstone: Shaly sandstone in beds less than 3 feet thick alternate with thicker siltstone beds; silt to medium-grained sand; unit contains numerous silty limestone lenses that are ripple marked; mica flakes are concentrated on ripple-laminated planes; contains some small-scale trough crossbedding. 11
3. Siltstone: Pale-reddish-brown (10R 5/4); clay to very fine grained sand; numerous lenticular limestone beds, 1 inch to 2 feet thick, which form ledges; several sandstone beds contain medium-grained sand and small-scale trough crossbedding. 94
2. Silty sandstone: Light-gray (N 7); silt to fine-grained sand; fair-sorted; weakly to firmly cemented; gnarly, irregularly bedded; weathers pitted and knobby; forms a slope; ripple marks; base is sharp and irregular. 6

Total Moenkopi Formation 124

UNCONFORMITY: Erosional; base of Moenkopi Formation truncates crossbeds of the De Chelly Sandstone.
PERMIAN:
De Chelly Sandstone:
1. Sandstone: Light-grayish-orange (10YR 8/4); fine-grained; well-sorted; composed of clear and frosted quartz; firmly cemented; trough crossbedding; forms a vertical cliff. 25+

64.—Twin Buttes

5 miles east of Twin Buttes Trading Post,
12 miles east-southeast of Indian Wells
127-6.5-8.0

[Measured by C. A. Repenning and J. H. Irwin]

TERTIARY:
Bidahochi Formation:
Upper member:
22. Clayey sandstone: Yellowish-gray (5Y 8/1); clay, silt, and fine- to medium-grained sand; well-sorted; composed of rounded to subrounded, clear quartz; common black accessory minerals; weakly to firmly cemented, calcareous; flat, thin- to thick-bedded; wedge trough crossbedding, low-angle and medium-scale crossbeds; weathers smooth to blocky; forms a series of ledges and slopes; caps the mesa; ripple marks; some grains are coated with calcium carbonate; unit contains argillaceous zones; fluviatile environment; base is sharp and flat. 212.8
21. Volcanic ash: White (N 9); very fine grained; well-sorted; composed of angular glass shards and some sand; rare black accessory minerals; weakly cemented; massive; flat-bedded; weathers blocky; forms a ledge; unit has been prospected; base is sharp and flat. 2.5
20. Claystone: Light-greenish-gray (5GY 8/1); weakly cemented; flat, laminated; weathers smooth; forms a regular slope; base is sharp and flat. 12.1
19. Clayey sandstone: Light-greenish-gray (5GY 8/1); clay, silt, and coarse-grained sand; poorly sorted; subrounded to subangular grains; common black volcanic material; weakly cemented, argillaceous; flat, thin- to thick-bedded; weathers blocky to knobby; forms a ledge; contains volcanic particles less than 2 mm in diameter; more argillaceous at base; base is flat and gradational. 7.3
18. Claystone: Light-greenish-gray (5GY 8/1); weakly cemented; flat, laminated; forms a regular slope; contains sandy zones and volcanic material; base is sharp and irregular. 31.9
17. Clayey sandstone: Light-greenish-gray (5GY 8/1); clay, silt, and coarse-grained sand; poorly sorted; subrounded to subangular grains; weakly cemented; flat, thin- to thick-bedded; weathers blocky and knobby; forms a ledge; contains volcanic material; fluviatile environment; base is flat and gradational. 5.0
16. Claystone: Same as unit 20. 5.3
15. Conglomerate: Pale-yellowish-brown (10YR 6/2) to light-brown (5YR 6/4); weakly cemented, calcareous; flat, thick-bedded; wedge trough crossbedding, low-angle and small-scale crossbeds; weathers rounded; forms an irregular slope; fluviatile environment; base is sharp and irregular. quartz; common mica and black accessory minerals; firmly cemented, calcareous; flat, thin-bedded; trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers rounded to blocky; forms a cliff; contains abundant mud galls; fluviatile environment; base is sharp and flat. 18.4
3. Sandstone: Pale-red-purple (5RP 6/2); silt to very fine grained sand; fair-sorted; composed of subangular to angular, white and clear quartz; common mica and black accessory minerals; firmly cemented, calcareous; flat, laminated; simple and trough crossbedding, low-angle and very small scale crossbeds; weathers rounded; forms an irregular ledge; contains abundant clay galls; unit is present mostly as channel deposits; fluviatile environment; base is sharp and irregular with 15 feet of relief. 16.9
2. Siltstone: Moderate-reddish-brown (10R 4/6), weathering pale reddish brown (10R 5/4); composed of stained quartz; weakly cemented, calcareous; flat, laminated; weathers smooth; forms a covered slope; still-water environment; base is sharp and flat. 135.9

Total Wingate Sandstone 204.3

Chinle Formation:
Petrified Forest Member:
1. Shale: Undescribed. 25+

DISTRICT 18

65.—Chee Dodge

East Sonsela Butte, 24 miles south-southeast of Lukachukai
69-3.0-11.0

[Measured by C. A. Repenning, P. R. Stevens, and W. B. Hoover]

UPPER JURASSIC:
Todilto Limestone:
20. Limestone: Quartzite pebbles at base. 10
19. Silty sandstone: Weathers smooth and rounded; forms a regular slope; base is sharp and flat. 15

Total Todilto Limestone 25

Entrada Sandstone:
Upper sandy member:
18. Sandstone: Dark-yellowish-orange (10YR 6/6); bimodal, very fine to fine-grained and medium- to coarse-grained; well-sorted; composed of subrounded to subangular quartz; well-cemented; massive; unit is a coset; wedge and tabular planar crossbedding, concave low-angle and medium-scale crossbeds; weathers rounded; forms a rounded cliff; contains 10 percent coarse-grained white (N 9) chert; eolian or fluviatile environment; base is irregular and gradational. 130
Medial silty member:
17. Sandstone: Moderate-reddish-brown (10R 4/6); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, amber quartz; black accessory minerals; well-cemented; massive; flat, laminated; weathers knobby; forms an irregular cliff; near top contains calcite geodes as much as 1 inch in size; fluviatile environment; base is concealed. 39

Total Entrada Sandstone 169

UPPER AND MIDDLE JURASSIC:
Carmel Formation:
16. Siltstone and mudstone: Dusky-red (5R 3/4) and some grayish-orange-pink (10R 8/2); clay, silt, and some very fine grained sand; poorly sorted; composed of subrounded to subangular, amber quartz; mica accessory mineral; weakly cemented; gnarly, laminated; weathers smooth; forms a regular and covered slope; unit is partly banded; fluviatile environment; base is sharp and irregular. 45
15. Sandstone: White (N 9); fine-grained; well-sorted; composed of subrounded to subangular, clear and amber quartz; firmly cemented; flat, laminated; unit is a coset; trough crossbedding, low-angle and small-scale crossbeds; weathers blocky; forms a ledge; fluviatile environment; base is sharp and irregular. 3
14. Sandstone: Light-brown (5YR 6/4) and pale-reddish-brown (10R 5/4); very fine grained; well-sorted; composed of subrounded to subangular, clear and amber quartz; firmly cemented; flat, laminated; unit is a set; weathers hackly; forms a regular slope; fluviatile environment; base is sharp and irregular. 7

Total Carmel Formation 55

UPPER TRIASSIC:
Wingate Sandstone:
Rock Point Member:
13. Sandstone: Same as unit 7; contains siltstone lenses; forms a ledge and slope. 40
12. Siltstone: Same as unit 2; forms an irregular slope. 52
11. Sandstone: Same as unit 7; forms a rounded cliff. 50
10. Siltstone: Same as unit 2; forms a regular slope. 58
9. Sandstone: Same as unit 7; forms a rounded cliff. 42
8. Siltstone: Same as unit 2; contains lenses of sandstone same as unit 7; forms an irregular slope. 72
7. Sandstone: Moderate-reddish-brown (10R 4/6); very fine to fine-grained; well-sorted; composed of subrounded, white and amber quartz; black accessory minerals; well-cemented; massive; unit is a coset; lenticular and asymmetrical trough crossbedding, concave high-angle and medium-scale crossbeds; weathers rounded; forms a rounded cliff; eolian environment; base is

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER TRIASSIC—Continued — Feet
Wingate Sandstone—Continued
Rock Point Member—Continued
sharp and irregular. 33
6. Siltstone: Same as unit 2; forms a rolling slope; still-water environment. 42
5. Sandstone: Same as unit 3; forms a ledge; still-water environment. 8
4. Siltstone: Same as unit 2; forms a regular slope; still-water environment. 18
3. Sandstone: Pale-red (10R 6/2) and moderate-reddish-brown (10R 4/6); very fine grained; well-sorted; composed of subrounded to subangular, clear and amber quartz; rare black accessory minerals; well-cemented; flat, gnarly, thick-bedded; unit is a set; weathers blocky; forms a ledge; still-water environment; base is sharp and flat. 2
2. Siltstone: Moderate-reddish-brown (10R 4/6); silt and some fine-grained sand; fair-sorted; composed of subrounded to subangular, clear and amber quartz; mica accessory mineral; lenticular, gnarly, laminated to thin-bedded; unit is a coset; weathers hackly to flaggy; forms a rolling and covered slope; still-water environment; base is gradational. 135

Total Wingate Sandstone 552

Chinle Formation:
Owl Rock Member:
1. Limestone and marl: Undescribed. 25+

66.—Whisky Creek

North side of Whisky Creek,
22 miles south-southeast of Lukachukai
69-0.1-6.0

[Measured by C. A. Repenning]

TERTIARY:
Chuska Sandstone:
12. Sandstone: Pinkish-gray (5YR 8/1), weathering yellowish gray (5Y 7/2); fine- to medium-grained, some coarse grains; well-sorted; composed of well-rounded to subrounded, clear quartz; common red and black accessory minerals; well-cemented; flat, lenticular, thick to very thick bedded; unit is a coset; asymmetrical and plunging trough crossbedding, concave medium-angle and medium-scale crossbeds; weathers blocky; forms an irregular cliff; borings; fluviatile environment; base is concealed. 45
11. Sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained, some clay; well-sorted; composed of subrounded to subangular, clear quartz; common red and black accessory minerals; weakly cemented, argillaceous; friable; flat, laminated to thin-bedded; weathers smooth; forms a regular and mostly covered slope; contains very thin beds of mudstone; fluviatile environment; base is gradational. 136
10. Sandstone: Same as unit 12; forms two prominent cliffs. 91
9. Sandstone: Same as unit 11; forms a regular and concealed slope. 112
8. Sandstone: Same as unit 12; lenticular, thick to very thick bedded; unit is a coset; asymmetrical and plunging trough crossbedding, concave low-angle and medium-scale crossbeds and some large-scale crossbeds; weathers blocky; forms an irregular cliff; borings; fluviatile environment. 85
7. Covered interval: Similar to unit 12; about 150 feet above base contains one small sandstone ledge that is same as unit 12; base is concealed. 210
6. Sandstone: Pinkish-gray (5YR 8/1), weathering yellowish gray (5Y 7/2); fine- to medium-grained, some coarse grains; well-sorted; composed of well-rounded to subrounded, clear quartz; common red and black accessory minerals; very well cemented, siliceous; flat, lenticular, thick to very thick bedded; unit is a coset; asymmetrical and plunging trough crossbedding, concave medium-angle and medium-scale crossbeds; weathers blocky; forms an irregular cliff; borings; fluviatile environment; base is gradational and concealed. 68
5. Covered interval: Similar to unit 11. 222
4. Sandstone: Same as unit 11; forms a partly covered, regular slope; base is sharp and flat. 34
3. Bentonitic claystone: Pale-yellowish-brown (10YR 6/2); structureless; weathers smooth; forms a covered slope; base is sharp and flat. .2
2. Silty sandstone: Pale-yellowish-brown (10YR 6/2), banded; clay to very fine grained sand; poorly sorted; composed of subrounded to subangular, amber quartz; lenticularly bedded; weathers smooth; forms a covered slope; base is sharp and irregular. .3
1. Sandstone: Moderate-reddish-orange (10R 6/6); very fine to fine-grained; well-sorted; composed of subrounded to subangular, stained and amber quartz; rare black accessory minerals; weakly cemented; structureless; weathers smooth; forms a covered slope; unit is lenticular; contains abundant quartz pebbles less than 10 mm in diameter and occasional limestone pebbles and cobbles as much as 70 mm in diameter; base is sharp and irregular. .5

Total Chuska Sandstone 1,004

UNCONFORMITY: Angular, about 4° angularity between the Rock Point Member of the Wingate Sandstone and the Chuska Sandstone; channeled surface, 6 inches of relief.

UPPER JURASSIC—Continued — Feet
Entrada Sandstone—Continued
Upper sandy member—Continued
marked by bleached lines 3 feet apart and separated by a structureless zone. 224
Medial silty member:
5. Sandstone: Pale-reddish-brown (10R 5/4); very fine grained; well-sorted; composed of subrounded to subangular, amber quartz; well-cemented; irregularly bedded; crossbedded; weathers rounded; forms an irregular cliff; contains calcite geodes less than ½ inch in size; crossbedding features generally are obscured by primary slumpage; unit is more sandy and does not weather into as many hoodoos as does interval farther to the north; base is concealed and it is believed that the upper 30 feet of covered interval below, unit 4, should be included as part of medial silty member. 34

Total Entrada Sandstone 258

UPPER TRIASSIC:
Wingate Sandstone:
Rock Point Member:
4. Covered interval: Probably same as unit 2 except for upper 30 feet. 143
3. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; mostly well-sorted; composed of rounded to subrounded, amber quartz; red and white accessory minerals; well-cemented; very thin to thin-bedded; unit is a coset; lenticular and tabular planar crossbedding; concave, low- to high-angle and medium- to large-scale crossbeds; weathers rounded; forms a rounded cliff; contains several flat-bedded and crinkled zones 2 feet thick; coarse-grained sand concentrated along bedding planes; eolian and fluviatile environment; base is sharp and flat with some small cusplike irregularities. 34
2. Siltstone: Pale-reddish-brown (10R 5/4); clay, silt, and some very fine grained sand; well-sorted; firmly cemented; massive; weathers hackly; forms a rolling and covered slope; contains limy zones; more sandy beds form poorly developed ledges; unit is darker in upper part; contains shrinkage cracks, as much as 10 inches thick and 5 feet deep, that are filled with pale-green (5G 7/2) sandstone; a 3-inch-thick bleached zone borders the shrinkage cracks and is at the upper contact of unit; base is gradational. 58

Total Rock Point Member 235

Chinle Formation:
Owl Rock Member:
1. Calcareous siltstone and limestone: Undescribed. 25+

68.—St. Michaels School

3 miles southeast of St. Michaels School,
11 miles south of Fort Defiance
108-4.47-10.20

[Measured by J. P. Akers and P. R. Stevens]

UPPER AND LOWER CRETACEOUS:
Dakota Sandstone:
11. Conglomeratic sandstone: Moderate-orange-pink (5YR 8/4); medium- to coarse-grained; pebbles are less than 1 inch in diameter and are concentrated near bottom of unit; thick to very thick bedded; unit is a coset; trough crossbedding, small- to medium-scale crossbeds; forms cap of hogback; ripple marks; abundant vertical joints. 99

UNCONFORMITY: Erosional, 6 feet of relief; channels filled with pebbles.

UPPER JURASSIC:
Morrison Formation:
Westwater Canyon Member:
10. Sandstone: Pale-red (5R 6/2) and streaks of grayish yellow green (5GY 7/2); medium to very coarse grained; poorly sorted; composed of subrounded to subangular, stained and frosted quartz; unit is a coset; lenticular and wedge crossbedding, small- to medium-scale crossbeds; forms a rounded slope; contains abundant pebbles of quartz, chert, jasper, and silty sandstone; pebbles occur in stringers, along crossbedding planes, and in small flat lenses; base is gradational. 67
Recapture Shale Member:
9. Silty sandstone: Light-red (5R 6/6), some zones are bleached grayish yellow green (5GY 7/2); silt to fine-grained sand; poorly sorted; composed of stained quartz; weakly cemented; very thin to thin-bedded; weathers fluffy; forms a slope; base is sharp. 71
Tongue of Cow Springs Sandstone:
8. Sandstone: Light-red (5R 6/6); very fine to fine-grained; composed of rounded to subrounded, stained and frosted quartz; firmly cemented; unit is a coset; wedge trough crossbedding; concave, low-angle and medium-scale crossbeds; forms a ledge; contains silty lenses and pockets; near middle of unit are numerous lenses and irregular pockets of resistant sandstone that is more coarse and contains angular mud pellets. 229
Recapture Shale Member continued:
7. Siltstone: Moderate-reddish-orange (10R 6/6); thin-bedded; weathers fluffy; forms a slope; base is probably gradational. 41

Total Recapture Shale Member (including tongue of Cow Springs Sandstone) 341
Total Morrison Formation 408

67.—Fort Defiance

3 miles east of Fort Defiance
89-2.0-17.0

[Measured by C. A. Repenning and J. P. Akers]

UPPER AND LOWER CRETACEOUS:

Dakota Sandstone:

22. Sandstone and carbonaceous shale: Bed of gravel at base. 25+

UNCONFORMITY: Erosional, 4 feet of relief.

UPPER JURASSIC:

Morrison Formation:

Westwater Canyon Member:

21. Conglomerate: Moderate-orange-pink (5YR 8/4) to grayish-orange (10YR 7/4); medium to very coarse grained; poorly sorted; firmly cemented; unit is a coset; asymmetrical, plunging, and wedge trough crossbedding; concave, low-angle and small- to medium-scale crossbeds; forms a vertical cliff; base is covered.
    Matrix: Composed of subangular to angular, clear quartz and feldspar.
    Gravel: Composed of many types of igneous and metamorphic rocks as much as 3 inches in diameter. 14
20. Covered interval: Near section conglomerate similar to unit 20 is estimated to occupy upper two-thirds of unit; silty sandstone similar to unit 14 is exposed at base; about 90 percent covered; forms a tree-covered slope. 82
19. Conglomeratic sandstone: Grayish-orange-pink (5YR 7/2); fine- to coarse-grained; poorly sorted; composed of subangular, stained quartz; about 5 percent feldspar accessory mineral; stringers of pebbles, $\frac{1}{4}$ to 2 inches in diameter; very thick bedded; unit is a coset; asymmetrical and wedge trough crossbedding; concave, low-angle and small- to medium-scale crossbeds; weathers rounded and blocky; forms a vertical cliff; fluviatile environment; base is gradational. 82

Total Westwater Canyon Member 178

Recapture Shale Member:

18. Silty sandstone: Same as unit 14; upper 20 feet contains much coarse material and some fresh feldspar; brown silty beds common in lower part; about 10 percent covered; forms a rolling slope; base is sharp and irregular. 92
17. Sandstone: Same as unit 15; grayish-orange-pink (5YR 7/2); forms a ledge; base is gradational. 36
16. Silty sandstone: Same as unit 14; interval mostly covered; forms a rolling slope; base is concealed. 39

Tongue of Cow Springs Sandstone:

15. Sandstone: Very pale green (10G 8/2); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; weakly cemented; unit is a coset; wedge and trough crossbedding; concave, low- to high-angle and small- to medium-scale crossbeds; weathers rounded; forms a rolling slope; eolian and partly fluviatile environment; base is gradational. 100

Recapture Shale Member continued:

14. Silty sandstone: Very pale green (10G 8/2) and pale-reddish-brown (10R 5/4), banded; clay to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; flat-bedded; weathers smooth; forms an irregular slope; base is sharp and flat. 45

Total Recapture Shale Member (including tongue of Cow Springs Sandstone) 312
Total Morrison Formation 490

Summerville Formation:

Sandy facies and tongues of Cow Springs Sandstone undifferentiated:

13. Sandstone: Very pale orange (10YR 8/2); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear and frosted quartz; well-cemented; thick to very thick bedded; asymmetrical trough crossbedding; concave, low- to high-angle and small- to medium-scale crossbeds; forms a vertical cliff; eolian environment; base is sharp. 56
12. Sandstone: Same as unit 13. 16
11. Sandstone: Same as unit 13; flat, very thin to thin-bedded; asymmetrical trough crossbedding; concave, low-angle and small-scale crossbeds; forms a vertical cliff; probable still-water environment. 8
10. Sandstone: Same as unit 13; eolian environment. 39
9. Sandstone: Same as unit 11; still-water environment. 53
8. Sandstone: Same as unit 13; eolian environment. 144
7. Sandstone: Same as unit 11; still-water environment; base is sharp and flat. 23

Total Summerville Formation (including tongues of Cow Springs Sandstone) 339

Entrada Sandstone:

Upper sandy member:

6. Sandstone: Grayish-orange-pink (10R 8/2) to moderate-reddish-orange (10R 6/6); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear and frosted quartz; well-cemented; thick to very thick bedded; unit is a coset; lenticular planar and trough crossbedding; concave, low- to high-angle and small- to large-scale crossbeds; weathers rounded; forms a vertical and rounded cliff; trough crossbedding more prominent in upper part of unit; ripple marked, one slab contains ripples that are 8 inches from crest to crest and $\frac{1}{2}$ inch deep; eolian and still-water environment; base is sharp and irregular.

Summerville Formation and Entrada Sandstone (upper sandy member) undifferentiated:

6. Sandstone: Pale-orange-pink (10R 7/3); very fine to fine-grained; fair- to well-sorted; composed of rounded to subangular, stained and frosted quartz; unit is a coset; wedge trough crossbedding, small- to large-scale crossbeds; weathers into honeycombs in local areas; forms a hogback; numerous tabular zones contain primary slumpage and wavy bedding in lower part of unit; stringers of coarse material along crossbedding planes; contains rare white (N 9) concretionary sandstone inclusions, $\frac{1}{2}$ to 1 inch in diameter, that resist erosion; near top of unit are several resistant lenses as much as 2 feet thick and 8 feet long. 479

Entrada Sandstone:

Medial silty member:

5. Sandstone: Light-red (5R 6/6); silt to very fine grained sand; fair to poorly sorted; composed of amber and stained quartz; unit is a coset; a few tabular and gnarly zones; zones of trough crossbedding rare; forms a ledge; base appears gradational. 38

UPPER TRIASSIC:

Wingate Sandstone:

Rock Point Member:

4. Sandy siltstone: Dark-reddish-brown (10R 3/4); silt to fine-grained sand; composed of amber and stained quartz; flat, very thin to thin-bedded; forms a slope; unit possibly may be the Carmel Formation. 17
3. Siltstone and silty sandstone: Moderate-brown (5YR 3/4); silt to fine-grained sand; very thin to thin-bedded; tabular crossbedding, low-angle and small-scale crossbeds; forms a slope. 99
2. Sandstone: Light-red (5R 6/6); very fine to fine-grained; composed of rounded to subrounded, amber and stained quartz; weakly to firmly cemented; flat, thin- to thick-bedded; low-angle and small- to medium-scale crossbeds; weathers rounded; forms a ledge; crossbedded parts contain zones of flat-bedded layers; base is concealed. 221

Total Wingate Sandstone 337

Chinle Formation:

Owl Rock Member:

1. Limestone: Gray, pink, and green, mottled; contains chert. 1+

69.—Lupton

South of the Rio Puerco, 1 mile southeast of Lupton
124-3.7-11.6

[Measured by L. C. Craig and V. L. Freeman]

UPPER AND LOWER CRETACEOUS:

Dakota Sandstone (incomplete):

26. Sandstone: Grayish-orange-pink (5YR 7/2) to moderate-orange-pink (10R 7/4); fine- to medium-grained; well-sorted; composed of subrounded to subangular, clear quartz; rare gray accessory minerals; firmly cemented, calcareous; small- to large-scale crossbeds; highly channeled; several thin partings of gray claystone; bottom of unit contains pebbles as much as 1 inch in diameter that are composed of cloudy quartz, white and gray chert, and gray claystone. 66.4

UPPER JURASSIC:

Morrison Formation:

Westwater Canyon(?) Member:

25. Sandstone: Grayish-orange-pink (10R 8/2) and moderate-orange-pink (10R 7/4); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; rare gray, pink, and orange accessory minerals; firmly cemented, noncalcareous; large-scale crossbeds; channeled; abundant interstitial dense white (N 9) material in spots; upper 5 feet contains numerous large worm burrows, 1 inch in diameter. 43.6
24. Sandstone and some claystone: Horizontal bedding; contains rare pebbles.
    Sandstone: Light-greenish-gray (5G 8/1); very fine to fine-grained; fair-sorted; composed of subangular, clear quartz; common white, orange, and black accessory minerals; firmly cemented, calcareous.
    Claystone: Grayish-red (5R 4/2); highly slickensided; forms thin, 2-inch-thick, irregular lenses. 4.2
23. Sandstone: Moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6); fine- to medium-grained; poorly sorted; composed of rounded to subangular, clear quartz; rare white, tan, orange, and black accessory minerals; firmly cemented, calcareous; medium-scale crossbeds; channeled; one stringer composed of very coarse to granule grains; contains scattered rounded clear and cloudy quartz, subangular white (N 9) chert, and rare subrounded pink feldspar. 46.6

Total Westwater Canyon(?) Member 94.4

Recapture Shale Member:

22. Sandstone and sandy claystone.
    Sandstone: White (N 9) to moderate-orange-pink (5YR 8/4); very fine to medium-grained; poorly sorted; composed of rounded to subangular, clear quartz; common orange and black accessory minerals; firmly cemented, calcareous; bedding and lamination obscure, but suggestion of parallel bedding in color bands; abundant interstitial clay.
    Sandy claystone: Pale-reddish-brown (10R 5/4); very fine to medium-grained; forms two partings. 34.8

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

	Feet
UPPER JURASSIC—Continued	
Morrison Formation—Continued	
Recapture Shale Member—Continued	
21. Sandstone: White (N 9) to grayish-pink (5R 8/2); fine- to medium-grained; composed of subrounded to subangular, clear quartz; rare white, orange, and black accessory minerals; weakly cemented, noncalcareous; structures suggest parallel bedding in lower part and channel-type crossbedding in upper part; forms a rounded slope; contains several stringers of moderate-reddish-brown (10R 4/6) sandy claystone.	31.2
20. Sandstone: White (N 9) and moderate-reddish-orange (10R 6/6), banded; fine- to medium-grained; fair-sorted; composed of rounded to subangular, clear quartz; common yellow, red, and black accessory minerals; weakly cemented, calcareous; symmetrical to asymmetrical crossbedding, medium- to large-scale crossbeds; forms a rounded cliff; laterally contains one claystone parting.	38.4
Total Recapture Shale Member	104.4
Total Morrison Formation	198.8
Cow Springs Sandstone:	
19. Sandstone: Grayish-orange-pink (5YR 7/2) and light-brown (5YR 6/4) in lower 88 feet, and white (N 9), grayish-pink (5R 8/2), and light-greenish-gray (5GY 8/1) in upper 85.4 feet; very fine to fine-grained; fair-sorted; composed of subangular, clear quartz; common orange, red, and black accessory minerals; firmly cemented, calcareous; indistinct parallel bedding, probably ranging from 5 to 20 feet in thickness; sweeping medium- to large-scale crossbeds, about 30 percent interbedded with wavy parallel laminations; forms a rounded cliff.	173.4
18. Sandstone: White (N 9), moderate-orange-pink (10R 7/4), and light-greenish-gray (5G 8/1), variegated; very fine to fine-grained; well-sorted; composed of subangular, clear quartz; common orange and black accessory minerals; firmly cemented, calcareous; parallel bedding ranging from 5 to 15 feet in thickness; 60 percent sweeping medium- to large-scale crossbeds, interbedded with 40 percent wavy parallel laminations; three principal bedding planes at 17.4, 43.5, and 80.2 feet; several minor bedding planes in upper 4 feet are of local extent; unit forms a vertical cliff.	106.7
17. Sandy claystone: Light-greenish-gray (5GY 8/1), grayish-red (10R 4/2), and very dusky red (10R 2/2); clay and very fine to fine-grained sand; composed of subangular, amber-stained quartz; forms lowest prominent notch.	.3
Total Cow Springs Sandstone	280.4
Entrada Sandstone:	
16. Sandstone: White (N 9), yellowish-gray (5Y 8/1), and some moderate-orange-pink (5YR 8/4) banding in lower third of unit, weathering white (N 9); very fine to fine-grained; composed of well-rounded to subangular, clear quartz; common orange and black, and rare red accessory minerals; firmly cemented, calcareous; four parallel bedding planes in lower third of unit; one 3-foot, wavy parallel bed 8 feet below top; sweeping, medium- to large-scale crossbeds; forms a rounded cliff.	95.1
15. Sandstone: Moderate-reddish-orange (10R 6/6), pale-reddish-brown (10R 5/4), some white (N 9) streaks, and rare pale-red (10R 6/2) bands; very fine to fine-grained; fair-sorted; composed of subangular, clear and amber-stained quartz; common orange and black accessory minerals; firmly cemented, calcareous; parallel beds, 2 to 8 feet thick, contain wedging medium- to large-scale crossbeds and a few 6-inch- to 1-foot-thick beds of wavy parallel laminations (2 percent of total thickness); forms a rounded cliff with swallow holes on bedding planes.	206.7
14. Sandstone: Moderate-reddish-orange (10R 6/6) and pale-reddish-brown (10R 5/4), interbedded; very fine to medium-grained; fair- to well-sorted; composed of well-rounded to subangular, clear quartz; common white and black, and rare orange and red accessory minerals; parallel beds, 2 to 5 feet thick, contain alternating sweeping medium-scale crossbeds and wavy parallel laminations; tends to weather spheroidally in a vertical cliff.	31.7
13. Sandstone: Moderate-reddish-orange (10R 6/6) and pale-reddish-brown (10R 5/4), weathering pale reddish brown (10R 5/4); very fine to fine-grained; well-sorted; composed of subangular, clear to amber-stained quartz; common black accessory minerals; parallel beds, 6 inches to 3 feet thick, of fine wavy parallel laminations; unit forms a prominent orange-banded vertical cliff with local development of red spheroidal weathering at top.	35.9
Total Entrada Sandstone	369.4
(Section continued half a mile to the south.)	
UPPER TRIASSIC:	
Wingate Sandstone:	
12. Sandstone and some claystone.	
Sandstone: Moderate-orange-pink (5YR 8/4) to light-brown (5YR 6/4); very fine to fine-grained; composed of subangular, clear quartz; rare orange and black accessory minerals; predominantly horizontal and ripple-bedded; forms ledges as much as 2 inches thick in shaly slopes; contains white and gray mica flakes.	

70.—Pine Springs

10 miles northwest of Lupton
124-9.4-2.6

[Measured by J. P. Akers]

UPPER TRIASSIC:	
Chinle Formation:	
Shinarump Member:	
11. Conglomeratic sandstone: Light-gray (N 7); medium- to coarse-grained; subrounded to subangular grains; conglomerate concentrated in 6-inch-thick zones near base; average size of pebbles is $\frac{3}{4}$ inch, maximum size 2 inches.	25+
UNCONFORMITY: Bleached mudstone zone, $\frac{1}{2}$ to 1 foot thick, at base of Shinarump Member.	
MIDDLE(?) AND LOWER TRIASSIC:	
Moenkopi Formation:	
Holbrook Member:	
10. Covered interval.	11
9. Siltstone: Pale-reddish-brown (10R 5/4); forms a slope; contains some sandstone beds less than half a foot thick and a few thin silty limestone beds.	48
8. Siltstone and sandstone.	
Siltstone: Same as unit 9.	
Sandstone: Very fine grained; calcareous cement; forms a ledge and slope; zones less than 2 feet thick contain mud pellets and pebbles as much as 3 inches in diameter and limestone fragments as large as 6 inches.	35
7. Silty sandstone: Pale-reddish-brown (10R 5/4); silt to medium-grained sand; well to firmly cemented; irregular, lenticularly bedded; contains conglomerate seams and stringers, numerous flattened mud pellets, and pebbles less than 2 inches in size; a 6-inch zone at base of unit is composed of angular coarse-grained material.	10
6. Covered interval: Contains some thin sandstone ledges.	28
5. Conglomeratic sandstone: Grayish-purple (5P 4/2); clay to very coarse grained sand; subangular to angular grains; well to firmly cemented; irregular, lenticularly bedded; trough crossbedding, small-scale crossbeds; contains some angular limestone and siltstone pebbles less than half an inch in diameter; bone fragments common.	2
4. Siltstone: Pale-reddish-brown (10R 5/4); same as unit 2.	6
3. Siltstone and sandstone: Pale-reddish-brown (10R 5/4); silt to very fine grained sand; well to firmly cemented, calcareous; irregular, lenticularly bedded; trough crossbedding, small-scale crossbeds; forms a prominent ledge; contains calcite geodes as much as half an inch in size; large shrinkage cracks and a bleached zone.	4
2. Siltstone: Pale-reddish-brown (10R 5/4); weakly to firmly cemented; flat, very thin to thick-bedded; weathers platy and slabby; forms a slope; thick beds are limy; base is sharp.	52
Total Moenkopi Formation	196
UNCONFORMITY: Erosional; base of Moenkopi Formation rests on truncated crossbeds of the De Chelly Sandstone.	
PERMIAN:	
De Chelly Sandstone:	
1. Sandstone: Light-gray (N 7); fine-grained; well-sorted; composed of clear and frosted quartz; trough crossbedding; base is concealed.	25+

71.—Black Creek Canyon

Head of the canyon of Black Creek, 8 miles northwest of Lupton
124-8.0-5.0 A

[Measured by C. B. Read]

UPPER TRIASSIC:	
Chinle Formation:	
Shinarump Member (incomplete):	
19. Sandstone: Undescribed.	
UNCONFORMITY.	
PERMIAN:	
De Chelly Sandstone:	
Upper member:	
18. Sandstone: Grayish-orange-pink (5YR 7/2); fine-grained; well-sorted; well-cemented, calcareous; massive; thick-bedded; nonrhythmic sequence of beds; forms vertical cliffs; small sandy concretions on weathered surface.	180+
Lower member:	
17. Sandstone and siltstone, interbedded: Moderate-reddish-brown (10R 4/6); argillaceous and calcareous cement; nonrhythmic sequence of beds; forms vertical cliffs.	
Sandstone: Fine-grained; even, medium- to thick-bedded.	
Siltstone: Thin-bedded.	44
16. Sandstone and siltstone, interbedded: Moderate-reddish-orange (10R 6/6) to moderate-reddish-brown (10R 4/6); very fine grained; argillaceous, calcareous, and ferruginous cement; even, thin-bedded; forms irregular ledges.	12
15. Sandy limestone: Grayish-pink (5R 8/2); granular, aphanitic, crystalloblastic; even, thin-bedded; forms irregular ledges.	.5
14. Sandstone and siltstone, interbedded: Grayish-orange-pink (5YR 7/2) to moderate-orange-pink (10R 7/4); silt	

Claystone: Pale-reddish-brown (10R 5/4) to dark-reddish-brown (10R 3/4); varies from silt to fine-grained sand; weathers papery to earthy. 24.3

11. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; composed of well-rounded to subrounded, clear and amber quartz; rare orange and black accessory minerals; prominent current marks, horizontal bedding, and local channeling and crossbedding.
    Unit is capped by a 1-foot-thick bed of sandstone described as follows: yellowish-gray (5Y 7/2); medium- to coarse-grained; composed of well-rounded to subrounded, clear quartz; rare white, orange, red, and black accessory minerals; prominent horizontal bedding and gentle crossbedding. 5.2

10. Sandstone, claystone, and siltstone.
    Upper two-thirds of unit: Claystone and sandstone, interbedded. Claystone is same as lower one-third of unit; sandstone is light brown (5YR 6/4), micaceous (muscovite), very fine to fine grained, and weathers platy, shaly, and earthy; upper 20 feet forms thin ledges containing small-scale, wedge crossbedding.
    Lower one-third of unit: Claystone and siltstone, moderate-reddish-orange (10R 6/6) to pale-reddish-brown (10R 5/4); weathers shaly and earthy.
    Base of unit: Light-reddish-orange (10R 7/6) band of sandstone, very fine grained, thin-bedded (6 inches thick); contains abundant disseminated medium to coarse grains of well-rounded, amber-stained quartz. 70.8

9. Sandstone and claystone.
    Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; composed of subangular, amber quartz; irregular, ripple bedding.
    Claystone: Dark-reddish-brown (10R 3/4), and light-greenish-gray (5G 8/1) films and streaks; contains disseminated subangular, fine-grained sand. 17.8

8. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; composed of subangular, clear and amber quartz; rare white and black accessory minerals; predominantly ripple-laminated, locally pseudocrossbedded; several thin, parallel, claystone partings; shallow channeling locally; forms a rounded ledge and slope or a vertical cliff; contains a few stringers of grayish-red (5R 4/2) to dark-reddish-brown (10R 3/4) claystone pebbles. 5.0

7. Sandstone and claystone.
    Sandstone: Moderate-reddish-orange (10R 6/6); very fine grained; composed of subangular, amber quartz; irregular, ripple bedding.
    Claystone: Dark-reddish-brown (10R 3/4), and light-greenish-gray (5G 8/1) films and streaks; contains some disseminated fine-grained sand. 16.7

6. Sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; composed of subangular, clear and amber quartz; rare white and black accessory minerals; predominantly parallel bedding; some crossbedding; ripple marks and mud cracks noted on partings in upper half of unit; most of thin claystone partings predominantly subparallel, but some show shallow channeling; forms a rounded ledge and slope or a vertical cliff; contains local stringers of grayish-red (5R 4/2) to dark-reddish-brown (10R 3/4) claystone pebbles. 36

5. Sandstone and claystone, interbedded.
    Sandstone (75 percent of unit): White (N 9) and moderate-orange-pink (5YR 8/4); very fine to fine-grained; composed of clear quartz; rare orange, green, and black accessory minerals; ripple marks, horizontal bedding; small-scale crossbeds; forms irregular to slabby ledges, 2 inches to 2 feet thick; white zones contain well-rounded, very fine to medium grains in stringers and disseminated sand.
    Claystone: Dark-reddish-brown (10R 3/4), and light-greenish-gray (5G 8/1) films and streaks; contains some disseminated fine-grained, amber-stained sand. 15.7

4. Sandstone: Moderate-orange-pink (5YR 8/4), base contains some grayish orange pink (5YR 7/2); very fine grained; composed of subangular, clear quartz; rare orange and black accessory minerals; parallel bedding; two prominent partings, 1 to 2 inches thick, of dark-reddish-brown (10R 3/4) micaceous sandy claystone; sandstone bed at base is 6 inches to 2½ feet thick, poorly sorted, and composed of well-rounded quartz and subrounded white (N 9) chert grains as much as one-eighth of an inch thick. 12.1

Total Wingate Sandstone 203.6

Chinle Formation:
Owl Rock Member:

3. Claystone and limestone.
    Claystone: Pale-red-purple (5RP 6/2) to grayish-red-purple (5RP 4/2); clay, silt, and very fine grained sand; calcareous cement; weathers hackly and earthy.
    Limestone: Pale-red (5R 6/2); dense; nodular, irregular, thin-bedded. 18.3

2. Limestone: Very light gray (N 8) to light-gray (N 7), mottled with pale red (5R 6/2) and pale red purple (5RP 6/2); dense to very finely crystalline; forms a prominent massive ledge with grayish-red-purple (5RP 4/2) clay laminae. 2.8

1. Claystone and limestone.
    Claystone: Pale-red-purple (5RP 6/2) to grayish-red-purple (5RP 4/2); clay, silt, and very fine grained sand; calcareous cement; weathers hackly to earthy.
    Limestone: Pale-red (5R 6/2); dense; nodular, irregular, thin-bedded. 30

Total incomplete Chinle Formation 51.1

to fine-grained sand; calcareous cement; even, thin- to medium-bedded; rhythmic sequence of beds; forms irregular slopes; unit is more calcareous in upper part. 61+

13. Sandstone: Moderate-orange-pink (10R 7/4) with grayish-orange-pink (5YR 7/2) bands; fine-grained; well-cemented, calcareous, near base; friable toward top; even, thin- to medium-bedded; forms rounded cliffs. 33

12. Clayey siltstone: Grayish-orange-pink (5YR 7/2); calcareous cement; even, thin-bedded; forms a regular slope. 21

11. Siliceous limestone: Grayish-red (10R 4/2), mottled; granular, aphanitic, crystalloblastic; even, thin-bedded; well-jointed; forms vertical cliffs. 7.0

10. Sandstone: Grayish-orange-pink (5YR 7/2); fine-grained; calcareous cement; even to irregular, thin-bedded; forms irregular slopes. 19

9. Sandstone: Moderate-reddish-orange (10R 6/6), mottled; fine-grained; calcareous cement; even, thin-bedded; forms irregular slopes. 27

8. Sandstone: Grayish-orange-pink (5YR 7/2); fine-grained; calcareous cement; even, thin-bedded; forms vertical ledges. 1.0

7. Sandstone: Moderate-reddish-orange (10R 6/6); fine- to medium-grained; calcareous and ferruginous cement; thin-bedded; crossbedded; forms rounded ledges. 14

6. Sandstone: Pale-reddish-brown (10R 5/4); fine-grained; well-cemented, calcareous; even, medium-bedded; forms vertical ledges. 3.0

5. Clayey sandstone: Moderate-reddish-orange (10R 6/6); fine-grained; calcareous and ferruginous cement; even, thin-bedded; forms irregular slopes. 8.0

4. Clayey sandstone: Very pale orange (10YR 8/2); fine-grained; gypsiferous; even, thin-bedded; forms irregular ledges. 1.5

3. Clayey siltstone: Moderate-reddish-orange (10R 6/6), mottled; calcareous and ferruginous cement; even, thin- to medium-bedded; forms regular slopes. 24

2. Sandstone and some siltstone, interbedded: Moderate-reddish-orange (10R 6/6); silt to fine-grained sand; calcareous cement; even, medium- to thick-bedded; forms rounded cliffs; contains several beds of arkosic sandstone. 87

1. Sandstone and siltstone, interbedded: Moderate-reddish-orange (10R 6/6); silt to fine-grained sand; argillaceous, calcareous, and ferruginous cement; even, thin- to medium-bedded; nonrhythmic sequence of beds; forms irregular slopes; strata contain abundant salt cast impressions. 182+

Total lower member 545+
Total De Chelly Sandstone 725+

72.—Sanders

North of the Rio Puerco, west-southwest of Sanders Quadrangle 138

[Measured by M. E. Cooley]

QUATERNARY:
Terrace deposits:
25. Gravel on an early Wupatki surface. 5±

TERTIARY:
Bidahochi Formation:
24. Undescribed. 20±

UNCONFORMITY: Erosional; flat, no observable relief, no bleached or weathered zone at top of Chinle Formation.

UPPER TRIASSIC:
Chinle Formation:
Petrified Forest Member, upper part:

23. Sandstone: Pale-red-purple (5RP 6/2) to light-brownish-gray (5YR 6/1); fine- to medium-grained; poorly sorted; composed of subrounded to subangular, clear and stained quartz; abundant black accessory minerals; firmly cemented, calcareous; splits flaggy; lenticular, thin-bedded; lenticular trough crossbedding, low- to medium-angle and medium- to large-scale crossbeds; weathers blocky; forms an irregular ledge; contains some silt; siltstone lenses and some limestone conglomerate; base is sharp and channeled with 10 feet of relief. 22

22. Mudstone and siltstone: Flat, lenticularly bedded; forms an irregular and covered slope.
    c. Mudstone (44 feet above base): Grayish-red-purple (5RP 4/2); clay, silt, and some very fine grained sand; mica accessory mineral; weakly cemented, calcareous; splits shaly; bleached spots. 17.5±
    b. Siltstone (30 feet above base): Grayish-purple (5P 4/2); silt and some very fine grained sand; mica and black accessory minerals; weakly cemented, calcareous; splits shaly and crumbly. 10±
    a. Mudstone (20 feet above base): Pale-red-purple (5RP 6/2); clay and silt; mica and black accessory minerals; weakly cemented, calcareous; splits shaly; bleached spots. 25± 52.5±

21. Sandstone: Similar to unit 23; contains lenses of limestone conglomerate; grades laterally in places into sandy siltstone; small channels at base of unit;

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah--Continued

	Feet
UPPER TRIASSIC--Continued	
Chinle Formation--Continued	
Petrified Forest Member, upper part--Continued	
base is sharp and irregular with as much as 4 feet of relief.	8.0
20. Mudstone and siltstone: Same as unit 22; forms a slope; a few thin sandstone ledges in upper 15 feet of unit.	40.5
19. Covered interval: Material probably same as unit 22.	20
Total incomplete upper part of the Petrified Forest Member	143±
Petrified Forest Member, Sonsela Sandstone Bed and lower part undifferentiated:	
18. Sandstone: Pinkish-gray (5YR 8/1); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; mica, and green and black accessory minerals; weakly to firmly cemented, calcareous; splits crumbly; bedding same as unit 14.	11
17. Covered interval: Material probably "blue mudstone."	44
16. Sandstone: Light-gray (N 7) and medium-light-gray (N 6), mottled; fine- to coarse-grained sand; fair to poorly sorted; composed of subrounded to subangular, clear quartz; mica and black accessory minerals; firmly cemented; bedding same as unit 14; unit grades laterally into mudstone about half a mile north of section; contains mudstone pebbles.	5.0
15. Covered interval, chiefly: Material probably "blue mudstone"; limestone nodules common; sandstone ledge 5 feet above base.	32.5
14. Sandstone: Light-gray (N 7); fine- to medium-grained; fair-sorted; composed of rounded to subangular, clear quartz; mica, and green and black accessory minerals; firmly cemented, calcareous; lenticular, thin- to thick-bedded; lenticular and wedge trough crossbedding, low-angle and medium-scale crossbeds; weathers blocky; forms an irregular ledge; grades laterally into mudstone; unit is a large channel deposit; base is sharp and channeled with 4 feet of relief.	6.5
13. Covered interval: Material probably "blue mudstone."	51.5
12. Sandstone: Very light gray (N 8); fine- to medium-grained; fair-sorted; composed of subrounded to subangular, clear quartz; black accessory minerals; firmly cemented, calcareous; splits massive and platy; flat, lenticular, thin- to thick-bedded; lenticular and wedge trough crossbedding, low- to medium-angle and medium- to large-scale crossbeds; weathers blocky; forms an irregular ledge; contains mudstone lenses between some of the crossbedding channels; contains quartz and jasper pebbles as much as five-eighths of an inch in diameter; also contains mudstone pebbles, limestone, and petrified logs; base is sharp.	10
Total Sonsela Sandstone Bed and lower part undifferentiated of the Petrified Forest Member	160.5
Petrified Forest Member, lower part:	
11. Covered interval: Material probably "blue mudstone."	145
Total incomplete Petrified Forest Member	448.5±
Lower red member:	
10. Limy sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; well-sorted; composed of subrounded to subangular, clear quartz; mica accessory minerals; firmly cemented, calcareous; splits platy and fissile; lenticular, thin-bedded; pseudocrossbedded; weathers hackly and blocky; forms an irregular ledge; contains ripple marks with worm-burrow(?) markings; black dendritic markings; thin bed of limestone nodules; base is concealed but channeled.	15
9. Mudstone: Greenish-gray (5GY 6/1); clay and silt; black accessory minerals; splits shaly; flat, very thin bedded; weathers hackly; forms an irregular and covered slope; may be a weathered zone; limonite streaks.	4.0
8. Mudstone: Dusky-blue (5PB 3/2); clay and silt; mica accessory mineral; weakly cemented, calcareous; splits crumbly; lenticular, very thin bedded; weathers hackly; forms an irregular and covered slope; base is gradational.	7.5
7. Mudstone: Grayish-red-purple (5RP 4/2); clay and silt; mica and black accessory minerals; weakly cemented, calcareous; splits shaly and crumbly; bedding same as unit 3.	19.5
6. Silty sandstone: Same as unit 4; laterally unit increases in thickness to 4 feet and thins to 0 feet; base is channeled.	1.5
5. Sandy siltstone: Pale-red (5R 6/2); silt to fine-grained sand; composed of clear and stained quartz; mica accessory mineral; weakly cemented, calcareous; splits fissile and crumbly; bedding same as unit 3.	7.5
4. Silty sandstone: Pale-red-purple (5RP 6/2); silt to very fine grained sand; poorly sorted; composed of stained quartz; mica accessory mineral; weakly cemented, calcareous; irregular, lenticular, thin-bedded; lenticular and wedge trough crossbedding, low to very low angle and small- to medium-scale crossbeds; pseudocrossbedding; weathers blocky and hackly; forms a regular ledge; base is sharp and irregular with half a foot of relief.	2.0
3. Sandy siltstone: Pale-red-purple (5RP 6/2); silt to very fine grained sand; mica accessory mineral; weakly cemented, calcareous; splits fissile; flat, lenticular, very thin bedded; weathers smooth and hackly; forms an irregular and covered slope.	28.5

	Feet
UPPER JURASSIC--Continued	
Entrada Sandstone--Continued	
3. Conglomerate: Light-brown (5YR 6/4), weathering light-brown (5YR 5/6); trough crossbedding, low-angle and medium- to large-scale crossbeds; weathers knobby; forms a prominent, irregular ledge; contains variegated red, brown, yellow, black, and green colors; base is irregular.	
Matrix: Very fine to very coarse grained; poorly sorted; composed of subrounded, clear, amber, and smoky quartz; jasper, feldspar, and black accessory minerals.	
Gravel: Composed of chalcedony, jasper, and quartz pebbles, ½ to 3 inches in diameter; pebbles are concentrated along bedding planes.	8.4
Total Entrada Sandstone	246.8
UPPER TRIASSIC:	
Wingate Sandstone:	
Rock Point Member:	
2. Covered interval: Light-brown (5YR 6/4); forms a soil-covered, rolling slope.	161
Chinle Formation:	
Owl Rock Member:	
1. Limestone: Grayish-red (5R 4/2); aphanitic; gnarly, irregularly bedded; weathers blocky; forms an irregular ledge; contains abundant siltstone inclusions; base is concealed.	2.0

74.--Petrified Forest

Point of Bluff, central part of Petrified Forest National Monument, half a mile south of the Rio Puerco

[Measured by M. E. Cooley and J. P. Akers]

		Feet
UPPER TRIASSIC:		
Chinle Formation:		
Petrified Forest Member, upper part:		
13. Silty sandstone: Light-olive-gray (5Y 6/1); silt to fine-grained sand; fair-sorted; composed of subrounded, clear and stained quartz; black accessory minerals; firmly cemented; lenticular, irregular, thin- to thick-bedded; wedge trough and planar crossbedding, low-angle and small- to medium-scale crossbeds; weathers blocky and hackly; forms an irregular ledge; lower part of unit is more massive.		16.5
12. Silty sandstone, siltstone, limestone conglomerate, and mudstone slope unit: Lenticular, very thick bedded; weathers hackly; forms an irregular and rolling slope; base is gradational.		
d. Silty sandstone (49 feet above base): Light-greenish-gray (5GY 8/1); silt to very fine grained sand; fair-sorted; composed of clear quartz; mica and black accessory minerals; firmly cemented.	23.5±	
c. Siltstone (27 feet above base): Pale-greenish-yellow (10Y 8/2); black accessory minerals; weakly cemented, calcareous.	15±	
b. Limestone conglomerate (19 feet above base): White (N 9); silt to very coarse grained sand; poorly sorted; composed of clear and stained quartz; well to firmly cemented.	8.0±	
a. Mudstone (11 feet above base): Medium-gray (N 5); clay and silt; weakly cemented.	15±	61.5±
11. Sandstone: Pinkish-gray (5YR 8/1); silt to coarse-grained sand; poorly sorted; composed of subrounded to subangular, clear, stained, and frosted quartz; black accessory minerals; well-cemented; irregular, lenticular, thick to very thick bedded; wedge simple and trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers blocky; forms an irregular cliff; pebbles less than 2 inches in diameter; some limestone pebbles; coarse-grained material along crossbedding planes and in stringers; base is sharp.		27.5
10. Silty sandstone and mudstone slope unit: Flat, lenticular, thin to very thick bedded; weathers hackly; forms an irregular slope; base is gradational.		
d. Silty sandstone (37 feet above base): Light-greenish-gray (5GY 8/1); silt to very fine grained sand; composed of clear and stained quartz; mica and black accessory minerals; firmly cemented.	24.5±	
c. Limestone conglomerate (28 feet above base): Very fine to medium-grained sand; composed of subrounded to subangular, clear and stained quartz; red and black accessory minerals; firmly cemented; contains Unio(?).	1.0±	

2B. Limy sandstone: Yellowish-gray (5Y 8/1); very fine to fine-grained; fair-sorted; composed of subangular, clear quartz; mica accessory mineral; firmly cemented, calcareous; splits flaggy and platy; lenticular, thin- to thick-bedded; lenticular trough crossbedding, low- to medium-angle and small- to medium-scale crossbeds; weathers hackly; forms an irregular ledge; base is gradational. 9.0

2A. Limestone conglomerate: Well-cemented, calcareous; splits massive; lenticular, very thick bedded; weathers blocky; forms an irregular ledge; contains a quartz pebble 3 inches in diameter; a few hematite nodules; reptile teeth and bone fragments; base is sharp and irregular. 13

1. Covered interval. 25+

Total incomplete lower red member 132.5+
Total incomplete Chinle Formation 581+

OFF RESERVATION

73.—Nutria Springs

1 mile northwest of Nutria, N. Mex.

[Measured by R. L. Jackson, S. A. Johnson, and H. A. Whitcomb]

UPPER AND LOWER CRETACEOUS:
Dakota Sandstone:

16. Sandstone: Grayish-orange-pink (5YR 7/2); very fine to fine-grained; fair-sorted; composed of subangular, clear quartz; rare green accessory minerals; weakly cemented, calcareous; simple and trough crossbedding, small-scale crossbeds; weathers blocky; forms an irregular cliff; commonly contains stringers of calcite; base is sharp and irregular. 6.0

15. Carbonaceous shale and coal: Grayish-black (N 2); flat, irregular, laminated; weathers hackly; forms an irregular slope; base is flat and irregular. 18

14. Covered interval: Forms a talus-covered, regular slope; may include part of the Morrison Formation. 85.2

Total incomplete Dakota Sandstone 109.2

UPPER JURASSIC:
Morrison Formation:
Westwater Canyon Member:

13. Sandstone: Pale-reddish-brown (10R 5/4); very fine to fine-grained; fair-sorted; composed of subrounded, clear and stained quartz; rare green accessory minerals; weakly cemented, noncalcareous; simple and trough crossbedding, medium- to large-scale crossbeds; weathers smooth and rounded; forms a rounded cliff; commonly contains argillaceous material; granules of feldspar, quartz, and jasper occur along crossbedding planes; base is sharp and irregular. 41.2

Cow Springs Sandstone:

12. Sandstone: Same as unit 11; flat, irregularly bedded; commonly contains clay galls; base is sharp and irregular. 29.5

11. Sandstone: Moderate-reddish-brown (10R 4/6); very fine grained; well-sorted; composed of subangular, clear and stained quartz; common mica and rare green accessory minerals; weakly cemented, slightly calcareous; simple and trough crossbedding, low-angle and large-scale crossbeds; weathers smooth and rounded; forms a rounded cliff; contains argillaceous material; surface of rocks is flecked with white spots; base is sharp and irregular. 61.7

10. Sandstone: Grayish-orange-pink (5YR 7/2); very fine grained; fair-sorted; composed of subangular, clear quartz; rare red and black accessory minerals; weakly cemented, slightly calcareous; trough crossbedding, medium-scale crossbeds; weathers smooth and rounded; forms a rounded cliff; contains sandstone inclusions 1 to 3 inches in diameter and thin granule zones near top; poorly formed red banding on gray weathered surface of cliff face; base is sharp. 164.1

Morrison Formation:
Recapture Shale Member:

9. Sandstone: Pale-red (5R 6/2); fine-grained; poorly sorted; composed of subangular, clear quartz; rare black accessory minerals; weakly cemented, slightly calcareous; flat, irregular, thin-bedded; weathers smooth and rounded; forms a rounded cliff; contains argillaceous material; base is sharp. 40

Total Morrison Formation and Cow Springs Sandstone 336.5

Summerville Formation and Cow Springs Sandstone undifferentiated:

8. Sandstone: Same as unit 4; flat, irregularly bedded; forms a prominent niche at top of unit. 44

7. Sandstone: Same as unit 4; simple and trough crossbedding, medium-scale crossbeds. 99.4

Total Summerville Formation and Cow Springs Sandstone undifferentiated 143.4

Entrada Sandstone:

6. Sandstone: Same as unit 4; flat, irregularly bedded. 10

5. Sandstone: Same as unit 4; trough crossbedding, medium- to large-scale crossbeds. 204.2

4. Sandstone: Light-brown (5YR 6/4); fine-grained; fair-sorted; composed of subrounded, clear and stained quartz; rare red and black accessory minerals; firmly cemented, calcareous; flat, irregular, very thin bedded; weathers smooth and rounded; forms a rounded ledge; base is irregular. 24.2

b. Mudstone (27 feet above base): Medium-light-gray (N 6); clay and silt; weakly cemented. 9.0+

a. Silty sandstone (11 feet above base): Light-brownish-gray (5YR 6/1) and grayish-red-purple (5RP 4/2); silt to fine-grained sand; composed of stained quartz; black accessory minerals; firmly cemented. 18+ 52.5+

9. Sandstone and silty sandstone: Grayish-purple (5P 4/2); silt to fine-grained sand; fair-sorted; composed of subrounded to subangular, clear and stained quartz; mica, and green and black accessory minerals; firmly cemented; irregular, lenticular, thin- to thick-bedded; wedge trough and planar crossbedding, low-angle and small- to medium-scale crossbeds; weathers rounded and blocky; forms an irregular ledge; base of unit contains 1-foot-thick conglomerate bed composed of angular limestone fragments and mudstone pellets; base is sharp. 11

8. Siltstone: Grayish-red-purple (5RP 4/2); weakly cemented; massive; flat, very thick bedded; forms an irregular slope; contains limestone nodules; base is gradational. 27.5

Total incomplete upper part of the Petrified Forest Member 196.5+

Petrified Forest Member, Sonsela Sandstone Bed:

7. Silty sandstone, sandstone, and mudstone: Contains pebbles and small cobbles as much as 5 inches in diameter concentrated in channels as much as 4 feet deep; irregular, lenticular, thin to very thick bedded; lenticular and wedge planar and trough crossbedding, low-angle and small- to medium-scale crossbeds; weathers rounded and blocky; forms an irregular cliff and ledge; base is sharp.

c. Silty sandstone (27 feet above base): Very light gray (N 8); silt to medium-grained sand; poorly sorted; composed of rounded to subrounded, clear, stained, and frosted quartz; mica, and green, red, and black accessory minerals; weakly cemented. 22.5+

b. Sandstone and mudstone (11 feet above base): Pinkish-gray (5YR 8/1) to medium-gray (N 5); clay to medium-grained sand; poorly sorted; composed of subangular, clear, stained, and frosted quartz; mica, and green and black accessory minerals; weakly to firmly cemented. 8.0+

a. Sandstone (5 feet above base): Very light gray (N 8); very fine to medium-grained; fair- to well-sorted; composed of rounded to subangular, clear, stained, and frosted quartz; mica and black accessory minerals; well-cemented. 8.0+ 38.5+

Petrified Forest Member, lower part:

6. Sandy mudstone, sandstone, and sandy siltstone slope unit: Flat, lenticular, thin- to thick-bedded; forms an irregular slope; base is gradational.

c. Sandy mudstone (11 feet above base): Medium-gray (N 5); clay to fine-grained sand; composed of clear quartz; mica accessory mineral; weakly cemented; contains bleached spots. 7.0+

b. Sandstone (5 feet above base): Pinkish-gray (5YR 8/1); very fine to fine-grained, a few medium grains; fair-sorted; composed of rounded to subrounded, clear and stained quartz; mica and black accessory minerals; firmly cemented. 4.0+

a. Sandy siltstone (2 feet above base): Grayish-red-purple (5RP 4/2); silt to fine-grained sand; composed of rounded to subangular, clear and stained quartz; mica and black accessory minerals; weakly cemented. 4.0+ 15+

5. Silty sandstone: Pinkish-gray (5YR 8/1) and pale-red-purple (5RP 6/2), mottled; silt to fine-grained sand; fair-sorted; composed of rounded to subrounded, clear and stained quartz; mica and black accessory minerals; firmly cemented; very thick bedded; low-angle and medium- to large-scale crossbeds; weathers rounded and blocky; forms a vertical cliff; contains flat mudstone pebbles as much as three-eighths of an inch in diameter; pebbles are in stringers; base is sharp. 13

4. Sandy siltstone, sandy mudstone, mudstone, and silty

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

UPPER TRIASSIC—Continued — Feet

Chinle Formation—Continued

Petrified Forest Member, lower part—Continued

sandstone slope unit: Flat, lenticular, thick to very thick bedded; weathers smooth and rounded; forms an irregular and rolling slope; base is gradational.

f. Sandy siltstone (59 feet above base): Grayish-red-purple (5RP 4/2); silt to very fine grained sand; mica accessory mineral; weakly cemented. 16±

e. Sandy siltstone (49 feet above base): Light-greenish-gray (5GY 8/1) and pale-red-purple (5RP 6/2), mottled; silt to very fine grained sand; composed of clear and frosted quartz; mica and black accessory minerals; weakly cemented. 18±

d. Sandy mudstone (22 feet above base): Grayish-red-purple (5RP 4/2); clay to fine-grained sand; composed of subangular to angular quartz; mica and black accessory minerals; weakly cemented. 18±

c. Mudstone (14 feet above base): Grayish-red-purple (5RP 4/2); clay and silt; weakly cemented. 5.0±

b. Silty sandstone (8 feet above base): Yellowish-gray (5Y 7/2) to pale-red (5R 6/2); silt to fine-grained sand; poorly sorted; composed of subangular to angular, clear and stained quartz; mica, and red and black accessory minerals; weakly to firmly cemented. 4.0±

a. Mudstone (5 feet above base): Grayish-red (5R 4/2); clay, silt, and very fine grained sand; weakly cemented. 7.0+ — 68±

3. Silty sandstone: White (N 9) to pale-red-purple (5RP 6/2), mottled; silt to very coarse grained sand; poorly sorted; composed of subangular to angular, clear, stained, and frosted quartz; mica and black accessory minerals; weakly to firmly cemented; flat, lenticular, thin- to thick-bedded; wedge trough crossbedding; weathers smooth and rounded; forms a rolling slope; contains pebbles less than three-quarters of an inch in diameter; base is gradational. — 24

2. Mudstone, sandy mudstone, and siltstone slope unit: Flat, very thick bedded; forms an irregular and rolling slope; contains limestone nodules; base is concealed.

d. Mudstone (81 feet above base): Grayish-blue (5PB 5/2); clay, silt, and very fine grained sand; mica and black accessory minerals; weakly cemented. 6.0±

c. Sandy mudstone (38 feet above base): Medium-light-gray (N 6); clay to very fine grained sand; weakly cemented. 51±

b. Siltstone (19 feet above base): Yellowish-gray (5Y 7/2), grayish-blue (5PB 5/2), and grayish-red-purple (5RP 4/2), mottled; weakly cemented; black and brown inclusions with bleached zones around some of them, partly siliceous. 15±

a. Mudstone (5 feet above base): Grayish-red (10R 4/2); clay and silt; mica accessory mineral; weakly cemented; contains bleached zones and spots. 12± — 84+

1. Covered interval. — 50+

Total incomplete lower part of the Petrified Forest Member — 254+

Total incomplete Chinle Formation — 489+

75.—Holbrook

South of the Little Colorado River, 2 miles south of Holbrook

[Measured by M. E. Cooley and J. P. Akers]

UPPER TRIASSIC:

Chinle Formation:

Shinarump Member:

9. Conglomerate: Light-gray (N 7); fine to very coarse grained; composed of subrounded to subangular quartz; rounded pebbles and small cobbles as much as 4 inches in diameter; firmly cemented, siliceous; very thick

TERTIARY—Continued — Feet

Bidahochi(?) Formation—Continued

Lower(?) member—Continued

f. Silty sandstone: Yellowish-gray (5Y 8/1), very light gray (N 8), and light-gray (N 7); clay to coarse-grained sand, a few very coarse grains; poorly sorted; composed chiefly of subangular to angular, clear quartz; muscovite, biotite, and black accessory minerals; weakly cemented, calcareous and argillaceous; splits crumbly; bedding same as unit 6a. 7.0

e. Sandy siltstone and silty sandstone: Pale-red (5R 6/2); clay to fine-grained sand; poorly sorted; composed of subrounded to subangular, stained quartz; muscovite, biotite, and black accessory minerals; weakly cemented, argillaceous and slightly calcareous; splits shaly and crumbly; bleached in upper 4 feet; iron oxide(?) streaks; bedding same as unit 5b. 14

d. Sandstone and conglomerate: Yellowish-gray (5Y 8/1) to light-gray (N 7); splits crumbly and friable; bedding same as unit 4; forms a small ledge; contains a few calcite veins.

Matrix: Clay to very coarse grained sand; poorly sorted; composed chiefly of subangular to angular, clear quartz; muscovite, biotite, and black accessory minerals; weakly to firmly cemented, argillaceous and slightly calcareous.

Gravel: Pebbles composed of chert, quartzite, and other siliceous material. 32

c. Siltstone: Pale-red-purple (5RP 6/2); silt and very fine grained sand; muscovite accessory mineral; weakly cemented, argillaceous; splits shaly. 18

b. Silty sandstone: Pale-red (5R 6/2); clay to medium-grained sand; poorly sorted; composed chiefly of subangular to angular, clear quartz; black accessory minerals; weakly cemented, argillaceous and slightly calcareous; splits crumbly; upper part of unit is lighter in color. 23

a. Silty sandstone, partly conglomeratic: Very pale orange (10YR 8/2), yellowish-gray (5Y 8/1), and grayish-red (10R 4/2); clay to medium-grained sand, some coarse to very coarse grains; poorly sorted; composed chiefly of subangular to angular, clear and stained quartz; biotite(?) and black accessory minerals; weakly cemented, argillaceous and slightly calcareous; bedding same as unit 5a; contains some mudstone; well-rounded to subangular pebbles composed of quartzite, chert, and siliceous material. 8.0 — 172

5. Mudstone, siltstone, claystone, and silty sandstone: Lenticular bedding; base is gradational.

h. Mudstone: Very light gray (N 8), medium-light-gray (N 6), and grayish-blue (5PB 5/2); clay and silt; muscovite or volcanic glass shards accessory mineral; weakly cemented, argillaceous; splits shaly; bedding same as unit 5b. 5.0

g. Siltstone: Very light gray (N 8) to yellowish-gray (5Y 8/1); clay, silt, and

bedded; low- to high-angle and medium- to large-scale crossbeds; weathers blocky; forms a vertical cliff; base is sharp. 32+

UNCONFORMITY: Erosional, 20 feet of relief.

MIDDLE(?) AND LOWER TRIASSIC:

Moenkopi Formation:

Holbrook Member:

8. Sandstone: Light-gray (N 7), weathering pale yellowish brown (10YR 6/2); silt to fine-grained sand; poorly sorted; composed of subangular, clear and stained quartz; firmly cemented; very thin to thin-bedded; weathers blocky; forms an irregular ledge; contains mudstone lenses, mud pellets, current marks, and possible tracks; base is sharp. 10

7. Siltstone: Pale-reddish-brown (10R 5/4); weakly cemented, calcareous; massive; weathers hackly; forms a partly covered and irregular slope; base is gradational. 24

6. Sandstone: Pale-red (10R 6/2); silt to fine-grained sand; poorly sorted; composed of rounded to subangular, clear quartz; mica and black accessory minerals; weakly cemented, calcareous and gypsiferous; irregular, lenticular, thick to very thick bedded; unit is a set; lenticular and wedge trough crossbedding, low-angle and medium-scale crossbeds; weathers blocky and pitted; forms an irregular ledge; base is sharp and irregular with channels as much as 6 feet deep. 14

Total Holbrook Member 48

Moqui Member:

5. Siltstone: Light-brown (5YR 6/4); weakly cemented, gypsiferous and calcareous; flat, lenticular, very thin to thin-bedded; medium- to large-scale crossbeds; forms an irregular slope; contains gypsum beds less than 3 inches thick, a 1-foot-thick bed near top of unit; grades locally into mudstone; upper 6 feet of unit is sandy; bleached streaks common; base is gradational. 85

Wupatki Member:

4B. Silty sandstone: Light-brown (5YR 6/4); silt to very fine grained sand; poorly sorted; composed of subangular quartz; mica and black accessory minerals; weakly cemented, calcareous; irregular, lenticular, very thin bedded; weathers hackly; forms an irregular ledge and slope; base is gradational. 11

4A. Sandstone: Grayish-orange-pink (5YR 7/2), weathering light brown (5YR 6/4); silt to fine-grained sand; fair-sorted; composed of subrounded quartz; black accessory minerals; firmly cemented, calcareous; irregular, lenticular, thick to very thick bedded; unit is a set; lenticular and wedge simple and trough crossbedding; convex, low-angle and medium-scale crossbeds; forms an irregular ledge; base is sharp. 8.5

3. Siltstone: Pale-reddish-brown (10R 5/4); silt and very fine grained sand; poorly sorted; composed of subrounded quartz; weakly cemented, calcareous; flat, irregular, lenticular, very thin to thin-bedded; weathers rounded and hackly; forms a partly covered and regular slope; contains a few thin beds of mudstone and silty sandstone; base is gradational. 3.5

2. Silty sandstone: Very pale orange (10YR 8/2); silt to very fine grained sand; fair to poorly sorted; weakly cemented, calcareous; flat, lenticular, very thin to thin-bedded; weathers hackly; forms a regular slope; contains ripple marks and muscovite flakes concentrated along ripple-laminated planes; base is flat and partly concealed. 2.0

Total Wupatki Member 25

Total Moenkopi Formation 158

PERMIAN:

Coconino Sandstone:

1. Sandstone: Grayish-orange (10YR 7/4); very fine to fine-grained; well-sorted; composed of subrounded, clear quartz; firmly cemented, siliceous; very thick bedded; simple and trough crossbedding, high-angle crossbeds. 10+

76.—Cedar Ranch

24 miles northwest of Flagstaff,
18 miles southwest of Gray Mountain Trading Post

[Measured by M. E. Cooley]

TERTIARY:

Pliocene(?) basalt:

7. Basalt: Undescribed. 20+

Bidahochi(?) Formation:

Lower(?) member:

6. Mudstone, silty sandstone, sandy siltstone, sandstone, conglomerate, and siltstone: Bedding same as unit 5; contains altered volcanic ash; base is gradational.

h. Mudstone: Yellowish-gray (5Y 8/1), medium-light-gray (N 6), and grayish-purple (5P 4/2); clay and silt; weakly cemented, calcareous and argillaceous; splits shaly and crumbly; swells when wet; contains lenses of red mudstone. 51

g. Mudstone: Grayish-red (10R 4/2); clay and silt; muscovite or volcanic glass shards accessory mineral; weakly cemented, argillaceous; splits shaly. 19

very fine grained sand; muscovite or volcanic glass shards and black accessory minerals; weakly cemented, calcareous and argillaceous; splits fissile; bedding same as unit 5c. 8.5

f. Claystone: Medium-light-gray (N 6); clay and some silt; muscovite or volcanic glass shards accessory mineral; weakly cemented, argillaceous and slightly calcareous; splits fissile; bedding same as unit 5b. 17.5

e. Silty sandstone: Light-olive-gray (5Y 6/1); silt to very coarse grained sand; poorly sorted; composed chiefly of subangular to angular, clear quartz; muscovite and black accessory minerals; weakly cemented, calcareous and argillaceous; splits shaly and crumbly; contains chert grains and other unidentified material; bedding same as unit 5c. 5.5

d. Mudstone: Very light gray (N 8); clay and silt; muscovite or volcanic glass shards and black accessory minerals; weakly cemented, argillaceous; splits shaly; bedding same as unit 5b. 8.5

c. Silty sandstone: Very pale orange (10YR 8/2) to yellowish-gray (5Y 8/1); clay to medium-grained sand, a few coarse grains; poorly sorted; composed chiefly of rounded to subangular, clear and stained quartz; black accessory minerals; weakly cemented, argillaceous and slightly calcareous; lenticular bedding; low- to medium-angle and medium- to large-scale crossbeds. 6.5

b. Mudstone: Greenish-gray (5G 6/1) and brownish-gray (5YR 4/1), alternating; clay and silt; muscovite and biotite(?) accessory minerals; weakly cemented, argillaceous and slightly calcareous; flat, lenticular, thick-bedded. 19.5

a. Silty sandstone: Yellowish-gray (5Y 8/1); clay to fine-grained sand; composed of subrounded to angular, clear and rare stained quartz; muscovite, biotite, and black accessory minerals; weakly cemented, argillaceous; splits shaly and crumbly; lenticular, thin to very thick bedded; lenticular and wedge trough crossbedding, very low to low-angle and large to very large scale crossbeds; weathers hackly and puffy; forms a regular, rolling, and covered slope; breaks apart when wet; quiet fluviatile and flood-plain environment; base is gradational. 16 87

4. Silty conglomeratic sandstone: Very pale orange (10YR 8/2) and grayish-orange (10YR 7/4); clay to very coarse grained sand; poorly sorted; composed chiefly of subrounded to subangular, clear quartz; biotite and black accessory minerals; weakly to firmly cemented, calcareous and argillaceous; splits flaggy and crumbly; lenticular, thick to very thick bedded; lenticular trough crossbedding, low- to medium-angle and medium- to large-scale crossbeds; weathers hackly and crumbly; forms an irregular ledge and regular slope; contains rounded to subrounded pebbles and cobbles of yellowish-buff quartzite, chert, porphyritic felsite; a few pebbles less than $\frac{1}{4}$ inch in diameter are composed of very pale orange (10YR 8/2), tuffaceous, fine-grained, igneous rock containing biotite; contains angular fragments of petrified wood, 1 to 2 feet in size; matrix has many sand grains of red jasper and pink and red siltstone; contains a few plates of gypsum, which is iron stained and appears to be weakly mineralized in part; large channels; torrential and quiet fluviatile environment; base is sharp and flat. 18.5

Total Bidahochi(?) Formation 277.5

UNCONFORMITY: Erosional, flat; no relief observed.

Table 3.--Selected stratigraphic sections in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Continued

MIDDLE(?) AND LOWER TRIASSIC:	Feet
Moenkopi Formation:	
Holbrook Member:	
3. Mudstone: Light-greenish-gray (5G 8/1), greenish-gray (5G 6/1), pale-red (5R 6/2), and grayish-red (5R 4/2); clay and silt; splits platy and fissile; flat, very thin bedded; weathers hackly; forms a regular slope; flood-plain environment; base is gradational.	34
2. Sandstone: Pale-red (10R 6/2) to pale-reddish-brown (10R 5/4); silt to fine-grained sand; poorly sorted; composed chiefly of stained quartz, some clear quartz; muscovite and black accessory minerals; weakly to firmly cemented; splits flaggy and crumbly; lenticular, thick-bedded; lenticular wedge trough and planar crossbedding; weathers rounded and blocky; forms an irregular ledge; quiet fluviatile environment; base is sharp and irregular with 1 to 2 feet of relief.	26.5
1. Sandy siltstone: Grayish-red (10R 4/2); silt to very fine grained sand; composed of stained quartz; muscovite accessory mineral; weakly cemented; splits shaly and platy; flat, lenticular, very thin bedded; weathers hackly; forms an irregular slope; flood-plain environment; base is concealed.	50±
Total Moenkopi Formation	110.5±