# Geology and Ground-Water Features of the Butte Valley Region Siskiyou County California

By P. R. WOOD

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# CONTENTS

## ILLUSTRATIONS

[All plates in pocket]



## TABLES

# GEOLOGY AND GROUND-WATER FEATURES OF THE BUTTE VALLEY REGION, SISKIYOU COUNTY, CALIFORNIA

By P. R. Wood

**ABSTRACT**

The Butte Valley region includes an area of about 600 square miles, between long 121°37′ and 122°10′ W. and lat 41°38′ and 42° N., in northern Siskiyou County, Calif. U.S. Highway 97, connecting Weed with Klamath Falls, traverses the region in a northeasterly direction, and the Southern Pacific railroad serves several small farming communities in Butte Valley.

The region is near the west edge of the Modoc plateau. It includes along its western border a part of the Cascade Range, Butte and Red Rock Valleys, the Oklahoma district, and a prominent northwestward-trending fault block (the Mahogany Mountain ridge) which separates Butte Valley from the Oklahoma district and the Lower Klamath Lake marshland.

Geologic units have been divided into two groups: Volcanic rocks which range in age from Eocene to Recent; and sedimentary rocks which range in age from Pliocene to Recent.

From oldest to youngest the volcanic rocks include: (a) Predominantly andesitic lavas and pyroclastic rocks comprising the volcanic rocks of the "Western Cascades"; (b) older volcanic rocks of the "High Cascades"; (c) basaltic flows and pyroclastic rocks east of the Cascade Range; and (d) younger volcanic rocks of the "High Cascades."

Volcanic rocks of the "Western Cascades" are the oldest rocks in the region. They range in age from late Eocene to late Miocene. These rocks are chiefly pyroxene andesite, and andesitic tuff-breccia, but include lesser amounts of basalt, rhyolite, and associated pyroclastic rocks. In most places they are badly decomposed and less permeable than the younger volcanic rocks. They are best exposed in the Klamath River canyon, where the prevailing dips are to the east and northeast. The angle of dip diminishes in these directions from about 15° near the base of the series to nearly zero where the rocks disappear beneath a younger series of volcanic rocks designated on plate 1 as the older volcanic rocks of the "High Cascades." The volcanic rocks of the "Western Cascades" are at least 12,000 feet thick.

The older volcanic rocks of the "High Cascades," which unconformably overlie the volcanic rocks of the "Western Cascades," are Pliocene and Pleistocene(?) in age. They consist chiefly of basalt and basaltic andesite that spread out in successive sheets from a chain of northward-trending shield volcanoes built along the crest of the Cascade Range. Here the topography is almost wholly constructional, and even the oldest cones retain much of their original shape. East of the Cascade Range several large dome-shaped lava cones and most of the northwestward-trending fault block called Mahogany

Mountain ridge are composed of volcanic rocks of similar lithology. In most places the older volcanic rocks of the "High Cascades" are highly fractured and moderately permeable; they serve as a large intake area and ground-water reservoir.

East of the Cascade Range, basalt of Pleistocene and Recent age issued from vents and fissures and spread out over alluvial deposits and lake sediments in the southern parts of Butte and Red Rock Valleys and the Lower Klamath Lake marshland. One of these flows—the Butte Valley basalt—forms the most productive water-bearing formation in the region. In the southwestern part of Butte Valley, where it is overlain by about 20 to 60 feet of alluvial materials and lake deposits, this basaltic flow is an excellent aquifer. Yields of more than 100 gpm (gallons per minute) for each foot of drawdown are common and yields of 1,000 gpm for each foot of drawdown have been recorded.

Late Pleistocene and Recent lava flows and cinder cones in the Cascade Range and extensive basaltic extrusions near Sharp Mountain are important chiefly as recharge (intake) areas for ground water.

Sedimentary deposits range in age from Pliocene to Recent. The oldest of these deposits is a massive fresh-water diatomite which underlies a large part of the Oklahoma district. The diatomite is impermeable, but wells penetrating interbedded sand or cindery lapilli lenses in the diatomite may yield moderate quantities of water. Glacial moraines and fluvioglacial outwash deposits of late Pleistocene age occur near the mouth of Butte Creek canyon. These deposits are unstratified or poorly sorted and commonly are only slightly permeable.

Semiconsolidated lake deposits, ranging in age from Pleistocene to Recent, underlie most of the Butte Valley plain. West of U.S. Highway 97 these deposits are composed principally of impermeable layers of clay, diatomaceous clay, and volcanic ash. However, east of U.S. Highway 97, and especially near the eastern border of the valley, the lake deposits contain a larger percentage of sand, and permeabilities range from about 50 to 230 gpd per square foot as determined from tests made in 3 pumped wells.

Alluvial-fan deposits on the west side of Butte Valley range from Pleistocene to Recent in age. They are composed of poorly sorted rock debris derived from the Cascade Range and are only slightly permeable.

Areas mapped as alluvium include thin beds of gravel, sand, clay, and peat covering older lake deposits in Butte Valley and the area around Lower Klamath Lake. They include also small playa deposits, poorly sorted alluvium collected in broad, shallow basins and depressions, and alluvium in present intermittent stream channels. In most places alluvium forms a thin cover resting on lava flows or lake deposits. In general the alluvium is slightly permeable and of little hydrologic importance except in the southwestern part of Butte Valley, where it consists of sand and gravel, ranging in thickness from 20 to 60 feet and rests on the Butte Valley basalt. In this area the alluvium probably yields moderate quantities of water to wells. Elsewhere the alluvium is largely above the saturated zone and is important chiefly because of its ability to absorb precipitation and surface runoff which percolate through it into underlying rocks.

Linear wedge-shaped talus strips, formed at the foot of precipitous fault scarps, are partly concealed beneath and probably interfinger with alluvium and lake deposits. The blocky talus debris is very permeable and, where saturated, yields water readily to wells.

East of the Cascade Range, block faulting is the dominant structural feature. The faults are normal and displacement is almost wholly vertical. Vertical displacements range from a few feet along minor faults to perhaps several thousand feet along major faults; there are no appreciable horizontal displacements.

Butte Valley is a complexly downfaulted basin nearly surrounded by well-preserved fault scarps of late Pleistocene and Recent age. Ground water moves eastward and northeastward across the valley into the buried talus and volcanic rocks that compose the Mahogany Mountain ridge, and may flow through that ridge to supply recharge to the area to the east. The direction of water movement in Red Rock Valley and in the Oklahoma district was not determined.

Records of water-level fluctuations in observation wells show that water levels recover each winter, and during the period 1951–54 there was little overall change in the height of yearly recovery.

Ground-water recharge in the southern part of the region occurs mainly by seepage loss from perennial spring-fed streams and unlined canals along the western margin of Butte Valley, by seepage loss from small spring-fed streams that discharge onto alluvial fans, and along the north, west, and south sides of the valley by lateral movement from the volcanic rocks. In irrigated tracts throughout the area some recharge probably occurs by deep percolation of irrigation water.

Ground water is discharged by natural means and by pumping. In Butte Valley about 21,000 acre-feet of ground water was used for irrigation in 1953. In Red Rock Valley pumping of ground water for irrigation purposes was negligible. In the Oklahoma district ground water for irrigation and domestic requirements is supplied by springs and flowing and pumped wells.

The quality of most of the ground water in the region is satisfactory for most uses, but in the east-central part of Butte Valley some wells yield water containing high percentages of sodium, probably derived from buried playa deposits.

The chemical quality of the surface water is such that it can be used for most purposes. However, analyses of water from Meiss Lake show high concentrations of dissolved solids, ranging from 473 to 1,380 ppm, and high percentages of sodium, ranging from 75 to 91. Here the salts have been concentrated by evaporation of the lake water.

## INTRODUCTION

### PURPOSE AND SCOPE OF THE WORK

This investigation was begun by the U.S. Geological Survey in June 1953 in cooperation with the California Division (now Department) of Water Resources to investigate the geology and ground-water features in the California part of the upper Klamath River basin. The investigation was to include: (a) Mapping the extent and thickness of the water-bearing rocks; (b) examining the physical character and hydrologic properties of the rocks; (c) studying the occurrence and movement of ground water; (d) determining the chemical character of the ground water and its relation to occurrence, movement, and use; and (e) estimating the ground-water storage capacity. The last phase—estimating ground-water storage capacity—was abandoned because of the difficulty in assigning reasonable specific-yield values to the volcanic rocks from which much of the ground water is pumped.

The investigation was made under the general supervision of J. F. Poland, district geologist in charge of the ground-water investigations in California, and under the direct supervision of A. R. Leonard, geologist. The report was reviewed and revised by G. F. Worts, Jr., who succeeded Mr. Poland as district geologist.

## LOCATION OF AREA

The Butte Valley region is bounded by long 122°10′ and 121°37′ W. and lat 41°38′ and 42° N. in northern Siskiyou County, Calif. (fig. 1). This report relates primarily to the geology and ground-water features of Butte Valley, but includes a reconnaissance examination of the geology and hydrology in Red Rock Valley and the Oklahoma district. Red Rock Valley is a small closed basin adjoining Butte Valley on the southeast; the Oklahoma district is an elongate structural depression east of Butte Valley. The reconnaissance was made to relate ground-water conditions in these areas with those in Butte Valley. For convenience the entire area shown on plates 1, 2, and 3 is called the Butte Valley region.

## CULTURE AND ACCESSIBILITY

The largest town in the Butte Valley region is Dorris, an important sawmill and farming center at the northeast end of Butte Valley (pl. 1). The two small villages of Macdoel and Mount Hebron lie a few miles south of Dorris. Small groups of buildings are clustered around the railroad sidings at Penoyar, Leaf, and Bray on the Southern Pacific railroad.

The region is served by the main line of the Southern Pacific railroad. U.S. Highway 97 links Weed with Dorris and Klamath Falls, Oreg., and crosses the region from southwest to northeast, roughly parallel to the railroad north of Macdoel. A somewhat inferior but passable road extends eastward from Macdoel through Red Rock Valley to the Lava Beds National Monument and the Medicine Lake highland. Other secondary roads branch from U.S. Highway 97 and provide access to points in Butte Valley. Well-graded roads branching from Dorris lead to the Oklahoma district and the mountainous area west and northwest of Butte Valley.

## PREVIOUS INVESTIGATIONS

In 1909 Mackie described the soils of Butte Valley and discussed briefly the agricultural development. Diller (Diller and others,

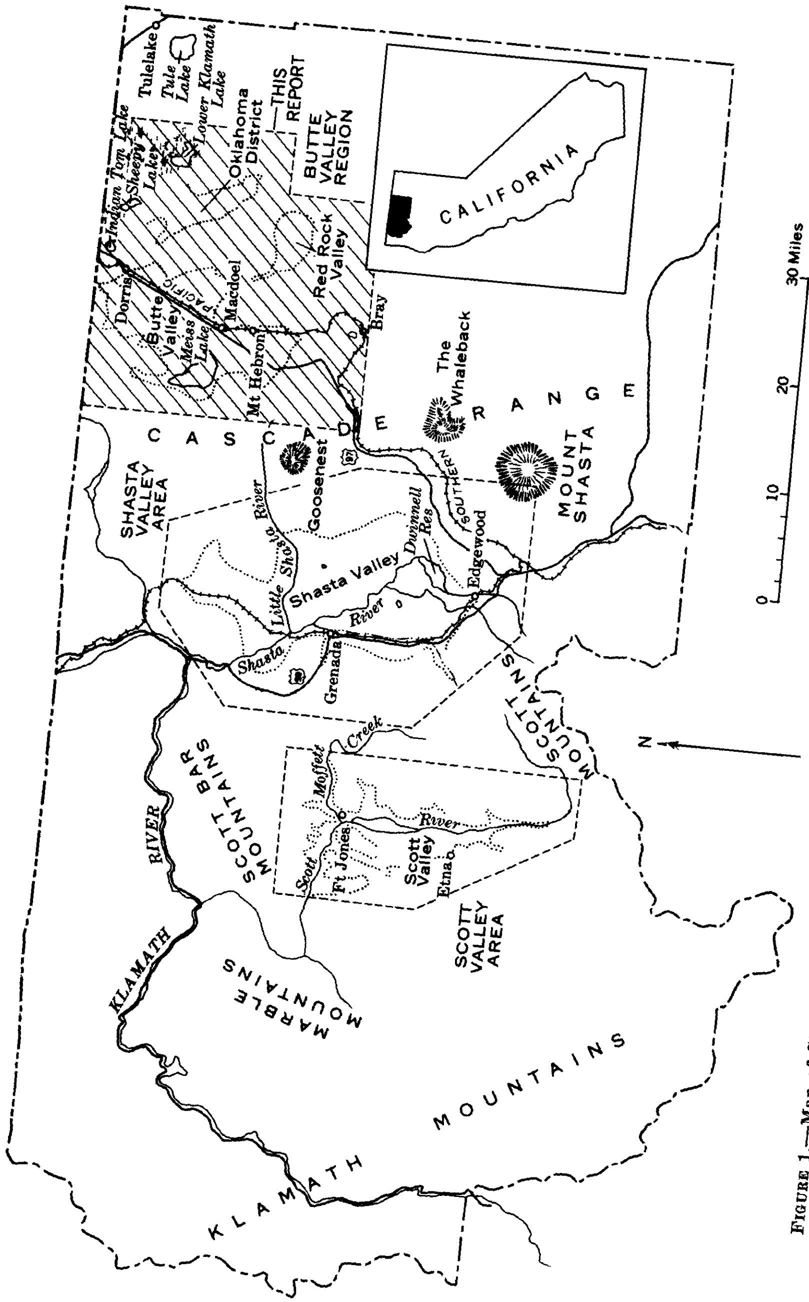



FIGURE 1.—Map of Siskiyou County showing location of valleys investigated for upper Klamath basi

1916, p. 54–55) briefly discussed the geology and geography of the area traversed by the Southern Pacific railroad. Adams (1929) described the irrigation development and water supply of Butte Valley. Powers (1932), the first geologist to make a systematic study of the geology of the region, prepared a generalized geologic map and briefly described the geology and structure of an area bounded by the long 121° and 122° W. and lat 41° and 42° N.

Callaghan (1933) and Callaghan and Buddington (1938) briefly described the structure and stratigraphy of the Cascade Range in Oregon, an area similar geologically to the western and northwestern parts of the Butte Valley region.

Moore (1937, p. 34–51) prepared a generalized geologic map and briefly described the geology and structure of the Klamath diatomite district, in the Klamath Falls area. The diatomite deposits described by Moore may be the equivalent of deposits exposed in the northeastern part of the Butte Valley region.

In 1941, C. A. Anderson prepared a geologic map and described in some detail the history, structure, and petrography of the volcanoes of the Medicine Lake highland, 30 to 40 miles southeast of Macdoel.

Williams (1949) made a systematic study of the Cascade Range, which lies west of the Butte Valley region. He first mapped and described many of the geologic units recognized in this report.

## ACKNOWLEDGMENTS

The writer is grateful to the many persons and agencies who cooperated and assisted in the collection of field data used in this report. The U.S. Bureau of Reclamation made available well-location maps, records of water-level measurements, drillers' logs, chemical analyses, logs of test wells, and other valuable information. The California Department of Water Resources furnished many drillers' logs and all of the recent chemical analyses and assisted in many other ways. The Butte Valley Irrigation District made available drillers' logs, logs of test holes, and other pertinent data. The Southern Pacific railroad, Shasta Division, furnished data on wells. Residents and well drillers cooperated by furnishing valuable information on wells.

The part of the geologic map (pl. 1) west of long 122° W. is in large part after that of Williams (1949).

## WELL-NUMBERING SYSTEM

The well-numbering system used by the Geological Survey in California since 1940 shows the locations of wells and springs according to the rectangular system for the subdivision of public land. For example, in the number 46/2W–15Q1, which was assigned to a well about 4 miles west of Macdoel, the part of the number preceding the bar indicates the township (T. 46 N.); the part between the bar and the hyphen shows the range (R. 2 W.); the digits between the hyphen and the letter indicate the section (sec. 15); and the letter indicates the 40-acre subdivision of the section as shown in the accompanying diagram (fig. 2). Within each 40-acre tract the

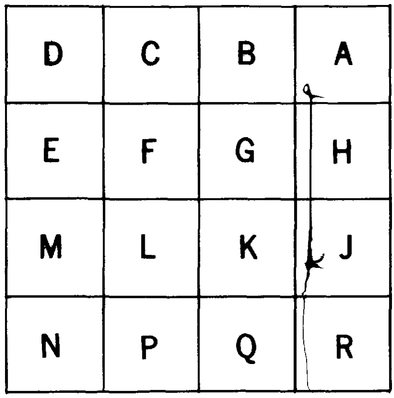



FIGURE 2.—Subdivision of a section showing well-numbering system.

wells are numbered serially, as indicated by the final digit of the number. Thus, well 46/2W–15Q1 is the first well to be listed in the SW¼SE¼ sec. 15, T. 46 N., R. 2 W. As all the Butte Valley area is north of the Mount Diablo base line, the township letter designation (N.) has been omitted. Inasmuch as the Mount Diablo meridian traverses the area of investigation, the range-letter designation (E. or W.) has been included in the well number. Wells in townships east of the Mount Diablo meridian include the range-letter designation (E.) in their location numbers; wells to the west include the range-letter designation (W.) in their location numbers.

Location of objects other than wells or springs may be described conveniently by a number similar to a well-location number, but without the final digit. For example, a rock outcrop in the NW¼ SW¼ sec. 31, T. 46 N. R. 2 W., on Ikes Mountain may be described as being in 46/2W–31M.

## METHOD OF INVESTIGATION

This investigation was started in June 1953. The initial phase included the collection of drillers' logs, water-level measurements, and other pertinent data in the files of the Klamath Falls office of the U.S. Bureau of Reclamation, and drillers' logs and chemical analyses obtained by the California Department of Water Resources. Well logs, other well data, and information on local ground-water conditions were also obtained during interviews with local residents and well drillers.

During October and November 1953, the writer visited and recorded data on the irrigation wells and most domestic and stock wells in Butte Valley. During June and July 1954, K. S. Muir, of the Geological Survey, visited and recorded data on wells in Red Rock Valley and the Oklahoma district.

Locations of wells were obtained by measuring distances from wells to section lines, roads, or other easily identified cultural features shown on the base maps.

All depth-to-water measurements were made from a fixed measuring point at the top of each well, using a steel tape graduated to hundredths of a foot. The altitudes of many of the wells in Butte Valley were determined by leveling to relate the ground-water surface to mean sea-level datum. The altitude of the masuring point for each well shown in table 11 was determined by the U.S. Bureau of Reclamation. Altitudes of measuring points for other wells in Butte Valley were determined between June 9, and June 18, 1954, with an engineer's level and stadia rod by E. J. Barnes, junior civil engineer, California Department of Water Resources, assisted by the writer. All level circuits consisted of closed loops tied to bench marks established by the Geological Survey and the Bureau of Reclamation.

Field geologic mapping was done on aerial photographs of the Geological Survey. East of long 122° W. the scale of the photographs was about 1:31,680. West of that meridian the scale of the photographs was about 1:48,000. Data were transferred from the photographs to a base map made from the Geological Survey's topographic maps of the Mount Dome, Dorris, Macdoel, Bray, and The Whaleback quadrangles, scale 1:62,500.

Samples of water from 17 wells in Butte and Red Rock Valleys were collected by the Quality of Water Section, California Department of Water Resources, during the 1953 field season. Samples of water from 3 wells in Butte Valley and 3 springs and 2 wells in the Oklahoma district were collected by the writer in July 1954. Sixteen analyses of ground water in the region were supplied by the U.S. Bureau of Reclamation.

Analyses of surface water include the analyses of 11 samples collected in 1953–54 by the Quality of Water Section, California Department of Water Resources; 1 sample collected by the U.S. Geological Survey in 1954 from Indian Tom Lake; and 5 samples collected by the U.S. Bureau of Reclamation.

Data shown in tables 5 and 6 were obtained in the field; the following definitions were used:

*Yield.*—Well discharge, in gallons per minute (gpm) was obtained from drillers' records or estimated by the trajectory method.

*Drawdown.*—Drawdown is the difference between the "static" or nonpumping water level and the pumping water level in a well. For example, if the static level in a well is 42.3 feet below the measuring point and the pumping level is 75.7 feet, the drawdown is 33.4 feet.

*Specific capacity.*—Specific capacity is the ratio of the yield of a well to the drawdown and commonly is expressed in gallons per minute per foot of drawdown. Specific capacity is useful in comparing the yield of one well to another. If the yield and the pumping level are measured after the pump has been operating long enough for the pumping level to have become nearly stabilized, the specific capacity will remain fairly constant and will furnish a better comparison of yields.

*Saturated thickness.*—Saturated thickness was obtained by subtracting the well depth from the static water level. Most wells in Butte Valley do not completely penetrate the aquifers in which they were drilled. Hence, the saturated thickness as shown in the tables may be too low if a well receives part of its supply from sedimentary or volcanic rocks underlying the well bore. For instance, a well penetrating only 40 feet of a 60-foot aquifer might receive a large part of its water supply from the 20-foot section not penetrated by the well. Water moves from areas of higher hydrostatic pressure toward areas of lower hydrostatic pressure, and where a well is pumped the pressure is lowered in its vicinity and water will move toward it from all directions.

*Yield factor.*—As originally introduced by Poland (1959, p. 32), yield factor was defined as the specific capacity of a well multiplied by 100 and divided by the thickness of the water-bearing material yielding water to the well. In this report the yield factor was obtained by multiplying the specific capacity by 100 and dividing by the saturated thickness of all the deposits tapped by the well (depth of well minus static water level).

$$\text{Yield factor} = \frac{\text{Specific capacity} \times 100}{\text{Saturated thickness}}$$

The yield factor is an approximation of the permeability of the water-bearing material tapped by a well. It is a convenient index that can be used in comparing wells and the saturated materials penetrated by wells, regardless of variations in size of powerplants, size and type of pumps, drawdown, or well depths. By comparing yield factors in one area to those in another, much information can be obtained regarding the relative permeability of the water-bearing materials.

The permeability of the lake deposits was estimated by use of brief drawdown and recovery tests made by the writer in August 1954, in pumped wells. Data obtained from these tests were analyzed by P. C. Sun, engineer of the Geological Survey, and the results have been included in the section on water-bearing properties of the lake deposits.

## PHYSICAL FEATURES OF THE AREA

### TOPOGRAPHY AND DRAINAGE

The Butte Valley region is within the Cascade Range and Modoc plateau geomorphic provinces of Jenkins (1943, figs. 36 and 37). The principal topographic units discussed below include a part of the eastern slope of the Cascade Range, Butte and Red Rock Valleys, the Oklahoma district, and the Mahogany Mountain ridge.

#### CASCADE RANGE

The Cascade Range in California, Oregon, and Washington is a deeply dissected, heavily forested range, composed almost wholly of volcanic rocks. That part of the range south of Mount Hood, in Oregon, and north of Mount Shasta, in California, has been divided longitudinally into two physiographic subprovinces, which have been designated "Western Cascades" and "High Cascades" (Callaghan, 1933, p. 243; Williams, 1949, p. 13, 20).

The "Western Cascades" include the western and larger part of the range, composed of older Tertiary lava and pyroclastic rocks. The topography is entirely erosional and bears no relation to the shape of the original cones from which the lava and pyroclastic rocks were erupted. The stream pattern is dendritic and drainage is toward the west.

North of Mount Shasta the "High Cascades" consist of a narrow belt along the east side of the range. They are characterized by a series of giant volcanic cones and remnants of cones ranging in altitude from 7,000 to more than 14,000 feet. The topography is almost wholly constructional, the landforms resulting chiefly from the outpouring of lava and the eruption of minor amounts of pyroclastic rocks during Pliocene and later time. The drainage pattern is poorly defined, and streams that descend from this section of the range drain eastward where they lose much of their volume by infiltration into the porous lavas.

That part of the Cascade Range within the Butte Valley region consists of a series of northward- to northwestward-trending lava domes and volcanic ridges whose outlines have been altered by faulting and erosion. Volcanic vents, such as Mount Hebron (6,147 feet), Ball Mountain (7,776 feet), Ikes Mountain (5,508 feet), McGavin Peak (5,478 feet), and Secret Spring Mountain (5,674 feet) rise conspicuously above their connecting ridges. These ridges range in altitude from 4,700 feet in the saddle between Ikes Mountain and McGavin Peak to more than 5,600 feet west of U.S. Highway 97 northwest of Mount Hebron (pl. 1). Four small spring-fed perennial streams, Prather, Muskgrave, Harris, and Ikes Creeks, head on the steep, talus-covered slopes of Ball Mountain and either discharge to alluvial fans built up by the streams at the valley margins or drain into Meiss Lake by way of shallow canals.

### BUTTE VALLEY

Butte Valley, east of the Cascade Range, is a large structural depression nearly surrounded by youthful fault scarps. The valley floor is a featureless plain covering more than 130 square miles at an altitude of about 4,200 feet. Several flat-floored grabens, including Sams Neck and Pleasant Valley, project northward beyond the main valley depression.

The valley occupies a closed drainage basin. Meiss Lake, in the west-central part of the valley, is the remnant of a lake that occupied much of the depression during Pleistocene time. Several small playas can be seen in the eastern part of the valley near Inlow Butte and Cedar Point. The surfaces of these playas are smooth and hard, and the absence of any alkali crust on or around them indicates that these are dry-type playas—that is, there is no groundwater discharge by upward movement from the water table through the capillary fringe to the playa surface.

Butte Creek, the largest stream draining into Butte Valley, rises in rugged mountains northeast of Mount Shasta, flows northward through a glaciated valley, and enters the area of investigation at 44/2W–26F at an altitude of about 4,800 feet. After leaving its glaciated canyon the stream flows eastward through a marshy plain, near Bray (44/1W–21J) it cascades over a basalt escarpment, turns northward near Orr Mountain, and enters the south end of Butte Valley near Jerome (45/1W–19H). The water not diverted for irrigation sinks into fractures in the porous lava underlying this part of the area.

### RED ROCK VALLEY AREA

Red Rock Valley, which adjoins Butte Valley on the southeast, is a shallow closed basin or depression covering about 20 square miles and ranging in altitude from 4,300 to 4,400 feet. The valley is separated from Butte Valley by a rough, northward-sloping basalt-covered surface. Unintegrated ephemeral streams drain into Russel Lake, a dry-type playa.

South of Red Rock Valley and southeast of Butte Valley, an area comprising several hundred square miles is covered by rough, broken basaltic lava. Orr, Cedar, Sharp, and Wild Horse Mountains are older, faulted lava cones that rise above this basalt surface.

Antelope Creek heads in the rugged mountains northeast of Mount Shasta, near the headwaters of Butte Creek, and flows northward past Tennant (about 9 miles south of Cedar Mountain), and disappears in Antelope Sink (44/1E–6) just south of Cedar Mountain.

## OKLAHOMA DISTRICT

The Oklahoma district, east of Butte Valley and northeast of Red Rock Valley, is an elongate depression covering about 25 square miles and ranging in altitude from 4,100 feet on Oklahoma Flat (47/2E–18) to more than 4,200 feet near Willow Creek spring (46/2E–22R1) in the southern part of the district. At Oklahoma Flat the depression opens northward onto a wide, marshy plain surrounding Lower Klamath Lake. The western border of the depression is formed by a steep-sided northwestward-trending volcanic ridge called the Mahogany Mountain ridge in this report. The Oklahoma district is bordered on the east by steep-sided, basalt-capped plateaus known as Big Tableland and Little Tableland. South of this plateau, Mount Dome, a faulted lava dome (called Van Bremmer mountain by oldtime residents) rises steeply to an altitude of 6,512 feet.

Willow Creek rises on a volcanic plateau south of Mount Dome, flows northward along the east side of the Oklahoma district, and discharges into the marshy plain surrounding Lower Klamath Lake. North of Willow Creek spring (46/2E–22R1) the stream is perennial and its water is diverted for irrigation.

Cottonwood Creek, a perennial stream in the northwestern part of the Oklahoma district, is fed by many springs (47/1E–23H1) which rise near the base of the steep-sided Mahogany Mountain ridge at the Porterfield Ranch headquarters. Water from this spring-fed stream, after diversions for the irrigation of several hundred acres of farmland, drains northward into the marshy plain north of Oklahoma Flat. Hot Creek and Sheepy Creek, north of the Oklahoma district and near the western margin of the marshland surrounding Lower Klamath Lake, are also fed by many springs. Sheepy Creek rises in a swampy lake (47/1E–1M1) near the base of a faulted volcanic ridge and flows northward into Sheepy Lake. Hot Creek is fed by a spring rising from faulted volcanic rocks and talus near the *D* Ranch (47/1E–10B1). Water discharging from this spring is ponded in a small reservoir and used to irrigate hay and pasturelands. When not used for irrigation, the water drains northward through a shallow canal into Indian Tom Lake.

### MAHOGANY MOUNTAIN RIDGE

One of the most prominent topographic features in the area is a long northwestward-trending fault block that rises conspicuously above the east side of Butte Valley. This fault block, which separates Butte Valley from the Oklahoma district and the low, flat marshland surrounding Lower Klamath Lake, is called the Mahogany Mountain ridge (pl. 1). The name is derived from Mahogany Mountain (47/1E-34), an old faulted volcanic cone, 6,255 feet in altitude, which has a precipitous westward-facing scarp that plunges nearly 2,000 feet to the floor of Butte Valley.

Mahogany Mountain ridge is about 20 miles long and ranges from 1 to 3 miles in width. Throughout much of its length the ridge is bordered by steep, slightly dissected talus-covered fault scarps. North of Mahogany Mountain differential movement along several in echelon faults has given the ridge a broken, serrated outline. South of Mahogany Mountain the ridge flattens and forms an irregular southwestward-sloping plateau.

In contrast to the comparatively fresh fault scarps, the upland area is much more eroded and seems to represent topography that predates the faulting. Partly disintegrated angular to subrounded boulders and cobbles are scattered freely over the surface. Vegetation is sparse and in most places the soil is thin and rocky.

Another conspicuous feature related to the ridge is Sheep Mountain, a large lava dome surmounted by a flat-topped cinder cone more than 500 feet high.

### CLIMATE

The Butte Valley region has a semiarid climate, characterized by warm, dry summers and cool, humid winters. Precipitation data from three U.S. Weather Bureau stations in and near the area of investigation are summarized in tables 1 and 2. The Macdoel station, in the town of Macdoel at an altitude of 4,260 feet, is no longer in operation. The Mount Hebron station is at the U.S. Forest Service ranger station in Mount Hebron, at an altitude of 4,250 feet. The Tule Lake station was formerly about 5 miles west-southwest of the city of Tule Lake (in later references to this former station, 5WSW is used). In 1948 the station was moved to a new location, altitude 4,036 feet, about 1.2 miles southeast of Tule Lake.

The major factor in the distribution of precipitation is the periodic movement of cyclonic storms from west to east across the region. The precipitation is greatest during the winter and least during the summer (table 2). Altitude also is a contributing factor, as precipitation, mostly in the form of snow, increases with altitude.

The average precipitation during the period of record at three stations is shown in table 1. This table shows clearly that precipitation totals vary greatly from season to season. The average seasonal precipitation at Tule Lake (5WSW) for the 17 years of record is 10.15 inches, but only 4.78 inches of precipitation was recorded in 1932–33, whereas 13.97 inches was recorded in 1944–45.

TABLE 1.—*Seasonal precipitation, in inches, at Macdoel, Mount Hebron, and Tule Lake, Calif.*

[Records from U.S. Weather Bureau]

| Year ending June 30 | Macdoel | Mount Hebron | Tule Lake 5WSW | Tule Lake |
|---|---|---|---|---|
| 1907–08 | 11.23 | | | |
| 1908–09 | 10.62 | | | |
| 1909–10 | 24.45 | | | |
| 1910–11 | 12.33 | | | |
| 1911–12 | 11.64 | | | |
| 1912–13 | 12.76 | | | |
| 1913–14 | 21.17 | | | |
| 1914–15 | 7.43 | | | |
| 1932–33 | | | 4.78 | |
| 1933–34 | | | 6.26 | |
| 1934–35 | | | 10.09 | |
| 1935–36 | | | 9.28 | |
| 1936–37 | | | 5.84 | |
| 1937–38 | | | 12.34 | |
| 1938–39 | | | 5.32 | |
| 1939–40 | | | 14.18 | |
| 1940–41 | | | 12.13 | |
| 1941–42 | | | 13.03 | |
| 1942–43 | | | 12.19 | |
| 1943–44 | | | 9.02 | |
| 1944–45 | | | 13.97 | |
| 1945–46 | | | 9.41 | |
| 1946–47 | | 8.35 | 9.77 | |
| 1947–48 | | 11.51 | 13.51 | |
| 1948–49 | | 8.68 | 11.43 | 11.93 |
| 1949–50 | | | | 6.65 |
| 1950–51 | | | | |
| 1951–52 | | 12.74 | | 12.69 |
| 1952–53 | | 9.68 | | 11.95 |
| 1953–54 | | 11.00 | | 12.38 |
| 1954–55 | | 4.37 | | 5.02 |

NOTE.—Macdoel, 1907–08 to 1914–15 average: 13.94.
Tule Lake 5WSW, 1932–33 to 1948–49 average: 10.15.
Tule Lake, 1948–49 to 1953–54 average: 10.10.
Mount Hebron, 1946–47 to 1953–54 average: 9.48.

TABLE 2.—*Average monthly precipitation, in inches, at Macdoel, Mount Hebron, and Tule Lake, Calif.*

[Records from U.S. Weather Bureau]

| | Macdoel 1908–15 | Mount Hebron 1946–55 | Tule Lake 5WSW 1932–49 | Tule Lake 1948–55 |
|---|---|---|---|---|
| January | 2.37 | 0.97 | 0.91 | 1.10 |
| February | 1.34 | .74 | .97 | .80 |
| March | .52 | .99 | .89 | .92 |
| April | .82 | .52 | .87 | .48 |
| May | .84 | .81 | 1.31 | 1.11 |
| June | .54 | 1.08 | 1.05 | 1.46 |
| July | .76 | .34 | .32 | .21 |
| August | .42 | .12 | .15 | .35 |
| September | .47 | .49 | .57 | .55 |
| October | .90 | .59 | .97 | .63 |
| November | 2.53 | 1.26 | 1.00 | .94 |
| December | 2.43 | 1.57 | 1.14 | 1.55 |
| Average yearly total | 13.94 | 9.48 | 10.15 | 10.10 |

The period of minimum precipitation begins in July and continues through September. The averages at the 3 stations for this 3-month "dry" period are: Macdoel, 0.55 inch; Mount Hebron, 0.32 inch; Tule Lake (5WSW), 0.35 inch; and Tule Lake, 0.37 inch.

The average monthly temperatures recorded at Macdoel, Mount Hebron, and Tule Lake are summarized in table 3. These data indicate that the mean annual temperature in the Butte Valley region (Macdoel and Mount Hebron stations) is 43.8° F. From June through September, the average temperatures at the 3 stations are: Macdoel, 57.8° F; Mount Hebron, 58.5° F; Tule Lake, 61.1° F. The average temperatures from November through March for these stations are: Macdoel, 31.6° F; Mount Hebron, 30.6° F; Tule Lake, 34.1° F.

The length of the average growing season, or frost-free period, varies greatly. During 1946–55 at Mount Hebron, the frost-free period ranged from 36 days in 1948 to 1 day in 1952. During 1932–55 at Tule Lake, the frost-free period ranged from 144 days in 1949 to 36 days in 1934.

The short growing season and the danger of frost during the summer limits field crops to the most hardy grains, quickly maturing row crops, and foliage plants.

TABLE 3.—*Average monthly temperatures, in degrees Fahrenheit, at Macdoel, Mount Hebron, and Tule Lake, Calif.*

[Length of record at Macdoel: 9 years; at Mount Hebron: 5 years; at Tule Lake: 21 years]

| | Macdoel | Mount Hebron | Tule Lake |
|---|---|---|---|
| January | 27. 8 | 24. 0 | 28. 4 |
| February | 30. 2 | 30. 3 | 32. 9 |
| March | 36. 4 | 34. 5 | 39. 3 |
| April | 41. 9 | 43. 3 | 45. 7 |
| May | 47. 8 | 48. 4 | 52. 5 |
| June | 53. 6 | 53. 3 | 58. 5 |
| July | 63. 0 | 62. 7 | 65. 4 |
| August | 61. 6 | 60. 4 | 63. 5 |
| September | 53. 2 | 57. 6 | 57. 1 |
| October | 45. 5 | 46. 2 | 48. 1 |
| November | 36. 5 | 37. 4 | 38. 0 |
| December | 27. 4 | 27. 0 | 32. 2 |
| Annual | 43. 8 | 43. 8 | 46. 8 |

## GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

### GENERAL CHARACTER AND AGE OF THE ROCKS

For the purpose of this report the rocks in the Butte Valley region have been divided into two groups: Volcanic rocks, which range in age from Eocene to Recent, and sedimentary rocks, which range in age from Pliocene to Recent. Locally the sedimentary rocks mask older volcanic rocks and are intercalated with younger lava flows and associated pyroclastic deposits.

Volcanic rocks discussed in this report include, from oldest to youngest, the following: (a) Volcanic rocks of the "Western Cascades," predominantly massive, andesitic flows and tuff breccia, exposed only in the steep-walled canyons of the Klamath River and Shovel Creek; (b) older volcanic rocks of the "High Cascades," principally basalt and basaltic andesite which form large shield volcanoes in the Cascade Range and which compose long block-faulted ridges and faulted lava domes east of the Cascade Range; (c) pyroclastic rocks, principally tuff and tuff-breccia exposed near Macdoel; (d) younger volcanic rocks of the "High Cascades," principally andesitic and basaltic lava flows and associated cinder cones; (e) the Butte Valley basalt, which forms one of the principal aquifers in Butte Valley; and (f) basaltic lava flows, which include a gray olivine basalt near Lower Klamath Lake, a black olivine basalt from Sheep Mountain, and an extensive basaltic flow of late Pleistocene and Recent age which enters the region in two places—near Sharp Mountain and near Mount Dome.

Sedimentary deposits include massive diatomite, present chiefly in the Oklahoma district; glacial moraines and fluvioglacial deposits at the mouth of Butte Creek canyon; lake deposits, unconsolidated alluvial-fan deposits, and alluvium, including local playa deposits; talus debris at the base of steep fault scarps; and dune sand (pl. 1).

Plate 1 shows the areal distribution and topographic expression of the rocks. Plate 3 shows stratigraphic relations and detailed lithology of the water-bearing units as determined from drillers' logs of water wells, and also shows the general structural relation of the rocks; table 4 summarizes their geologic sequence, general lithology, and water-bearing properties.

## VOLCANIC ROCKS AND THEIR WATER-BEARING PROPERTIES

Most of the Butte Valley region is underlain by lava flows and associated pyroclastic rocks ranging in age from Eocene to Recent. The oldest rocks are the lava flows and pyroclastic rocks of the "Western Cascades," ranging in age from late Eocene to late Miocene. In most places these older rocks are badly decomposed and, in comparison with the younger volcanic rocks, are poorly permeable. The volcanic rocks of the "Western Cascades" are unconformably overlain by the older volcanic rocks of the "High Cascades." According to Williams (1949, p. 9, 35), the Cascade Range was greatly uplifted and tilted at the close of the Miocene epoch. This upheaval was accompanied by the formation of several faults trending slightly northwestward and by the opening of northward-trending fissures along and near the crest of the range. It was from these fissures that fluid basalt and basaltic andesite were issued to build the giant cones of the "High Cascades." In most places the volcanic rocks of the "High Cascades" are highly fractured and very permeable, and they serve chiefly as a large intake area and ground-water storage reservoir.

East of the Cascade Range other basaltic flows issued from fissures and spread out over alluvial deposits and lake sediments in the southern parts of Butte Valley, Red Rock Valley, and the Lower Klamath Lake marshland. One of these—the Butte Valley basalt—forms the most important aquifer in Butte Valley.

Beginning in late Pleistocene time and continuing into the Recent epoch, volcanic materials again issued from vents and fissures. In the Cascade Range, the Whaleback, Deer, Little Deer, Goosenest, and Willow Creek lava cones form mountains built upon the older Pliocene and Pleistocene shield volcanoes. Several of these volcanoes are capped by large cinder cones, some of which have well-preserved craters. Along the eastern border of the range and on the Mahogany Mountain ridge, other cinder cones or scoria mounds protrude through older Pliocene and Pleistocene volcanic rocks.

TABLE 4.—*Generalized stratigraphic section showing geologic units and their water-bearing properties*

| System | Series | Geologic unit and map symbol | Thickness (feet) | General character | Water-bearing properties |
|---|---|---|---|---|---|
| Quaternary | Recent | Dune sand (Qds) | 0–20± | Sand, light-brown, windblown. Consists chiefly of subrounded quartz grains and rock fragments. | Deposits generally above the water table and not a source of water to wells. |
| | Pleistocene and Recent | Talus (Qt) | 0–360+ | Jumbled blocks and fragments of rock intermixed with slope wash and windblown sand. Talus forms sloping wedge-shaped deposits at the base of steep fault scarps. | Highly permeable, and where talus cones interfinger with saturated sediments may act as storage reservoirs, or may serve as ground-water conduits or drains. |
| | | Alluvium (Qal) | 0–60+ | Thin, lenticular beds of gravel, sand, clay and peat covering lake deposits in Butte Valley and the area around Lower Klamath Lake; poorly sorted gravel, sand, and silt collected in broad, shallow basins and underlying present stream channels; and beds of clay and silt deposited in temporary (playa) lakes. | In the southwestern part of Butte Valley, sand and gravel overlying the Butte Valley basalt yield moderate quantities of water to wells. Elsewhere the alluvium is poorly permeable and yields only small quantities of water to wells. |
| | | Alluvial-fan deposits (Qf) | 0–350+ | Deposits consist of poorly sorted lenticular beds of clay, fine- to coarse-grained sand, gravel, and smoothly rounded cobbles of volcanic origin. Include several isolated remnants of alluvial-terrace deposits southwest of Bray, old dissected alluvial-fan deposits near Dorris and on Oklahoma Flat, and alluvial fans along the west side of Butte Valley. | Older deposits are mostly above the zone of saturation. Alluvial fans are generally saturated, but are poorly permeable and yield water slowly. |
| | | Lake deposits (Ql) | 0–900+ | Clay, volcanic ash, diatomite, diatomaceous clay, sand, and local stringers of gravelly sand. Along the east side of Butte Valley beach sand and talus debris interfinger with fine-grained deposits. South of Macdoel the lake deposits are interstratified with the Butte Valley basalt, and between Butte Valley and Red Rock Valley they underlie the basalt. | Impermeable fine-grained beds predominate. Sand layers yield water sufficient for stock requirements. Sandy section along east side of Butte Valley is a source of water to many irrigation wells of moderate capacity. Permeability of sand is about 200 gpd per square foot near Cedar Point, but probably much greater in the area just northwest of Inlow Butte. |
| | | Basaltic lava flows northeast of Sharp Mountain (Qbs) | Unknown | Olivine basalt near Sharp Mountain. Also a long, narrow tongue of basalt just east of Mount Dome. | Very permeable, with many interconnected openings. Much of the outcrop area is above the saturated zone but serves as intake area for goundwater recharge. |
| | | Younger volcanic rocks of the "High Cascades" ($Qv_1, Qv_2, Qv_3$) | 0–500± | Andesitic and olivine-rich basaltic flows. Their surfaces are rough, broken, and commonly scoriaceous. In many places parts of the flows are concealed by volcanic ash and cinders. Near their terminus they are covered by sandy outwash from adjacent hills of fluviolglacial debris. | Highly permeable, with numerous fractures, tubes, channels, and other openings of diverse kinds. These rocks absorb precipitation readily and serve as intake area for ground-water recharge. |

TABLE 4.—*Generalized stratigraphic section showing geologic units and their water-bearing properties*—Continued

| System | Series | Geologic unit and map symbol | Thickness (feet) | General character | Water-bearing properties |
|---|---|---|---|---|---|
| Quaternary | Pleistocene and Recent | Butte Valley basalt (Qb) | 0-80+ | Vesicular gray basalt containing tiny crystals of olivine and plagioclase. It is interstratified with lake deposits in Butte Valley and covers at least 75 square miles south of Butte and Red Rock Valleys. | Highly permeable because of numerous openings. South of Butte Valley the rough, broken surface serves as a large intake area for ground-water recharge. In Butte Valley the buried section of the flow is an excellent aquifer. |
| | | Pyroclastic rocks (Qp) | 0-300± | Lapilli tuff and tuff-breccia, well-consolidated, massive to thin-bedded, locally crossbedded. Probably include tuff deposits both younger and older than the Butte Valley basalt. | In much of the outcrop area the water-bearing properties are above the saturated zone. Important chiefly as intake facility for recharge. |
| | Pleistocene | Glacial moraines (Qm) and fluvioglacial deposits (Qfo) | 0-400± | Moraines consist of unstratified, unconsolidated bouldery deposits having a clayey matrix. Fluvioglacial (outwash) deposits consist of poorly sorted rounded to angular fragments and boulders, sand, silt, and clay. | Mostly above the saturated zone. Moderate supplies of water may be obtained from wells penetrating outwash deposits bordering streams where recharge is available. |
| Tertiary and Quaternary | Pliocene(?) and Pleistocene | Basaltic lava flows ($QTb_1$, $QTb_2$) | 0-300+ | Massive coarsely vesicular gray olivine-basalt flows ($QTb_1$); include extensive basaltic flows south of Lower Klamath Lake and a basaltic flow about 20 ft thick capping Big and Little Tablelands. A coarsely vesicular black aphanitic basalt ($QTb_2$) containing conspicuous anhedral phenocrysts of yellowish-green olivine covers a small area northeast of Sheep Mountain. | Probably permeable because of numerous interconnected openings. Flows occur on elevated lands and in barren underdeveloped areas, and serve mainly as intake areas for ground-water recharge. |
| | Pliocene and Pleistocene(?) | Older volcanic rocks of the "High Cascades" (QTb) | Unknown | Evenly bedded flows of pale-gray olivine basalt and basaltic andesite. Include massive poorly sorted, partly altered basaltic tuff-breccia, and lenticular layers of varicolored, partly decomposed lapilli tuff near Ikes Mountain; discontinuous layers of yellowish tuff and tuff-breccia north and northwest of Ikes Mountain. | Many of the basaltic rocks are highly fractured and quite permeable. Tuffaceous beds are essentially not water-bearing, except for water in fractures and small perched ground-water bodies contained in fractured basaltic flows intercalated with the larger tuffaceous masses. The highly fractured basaltic rocks serve chiefly as a large intake facility and ground-water storage reservoir. Tapped by wells along margin of Butte Valley. |
| | | ——Unconformity | | | |
| Tertiary | Pliocene | Diatomite (Td) | 400+ | Diatomite, gray to white, massive. Locally interbedded with volcanic ash, cindery lapilli, pumice, and sand. Underlies much of the Oklahoma district and unconformably underlies basalt capping Big and Little Tablelands. | Virtually not water bearing, except for local beds of sand, cindery lapilli, or fractured parts. In the Oklahoma district most irrigation wells are developed in sedimentary and volcanic rocks underlying the diatomite. |
| | | Major — unconformity — | | | |
| | Eocene through Miocene | Volcanic rocks of the "Western Cascades" (Tvw) | 0-15,000± | Chiefly hypersthene-augite andesites and lesser amounts of andesitic tuff and tuff-breccia. Locally contain lenticular masses of rhyolitic tuff. | Not tapped by wells. Probably poorly permeable, except where highly fractured. |

East of the Cascade Range the lava flows and pyroclastic rocks belonging to this period of volcanic activity were mostly discharged from the northern flank of the Medicine Lake highland. The younger lava flows are all highly permeable, but they are commonly above the saturated zone and serve chiefly as intake areas for ground-water recharge.

## VOLCANIC ROCKS OF THE "WESTERN CASCADES" (EOCENE THROUGH MIOCENE)

### CHARACTER AND DISTRIBUTION

Volcanic rocks of the "Western Cascades" underlie a large area on the western flank of the Cascade Range and are well exposed in the steep-walled canyon of the Klamath River where they are overlain by basalt and basaltic andesite of the "High Cascades." Williams (1942, 1948, 1949) summarized the available evidence relating to the volcanic rocks of the "Western Cascades" and concluded that they range in age from late Eocene to late Miocene. Most of the rocks are pyroxene andesite and andesitic tuff-breccia, although basaltic and rhyolitic extrusive and associated pyroclastic rocks are common. Williams (1949, p. 20) reports:

> * * * lavas and pyroclastic ejecta show prevailing dips to the east and northeast, the angle of dip diminishing in these directions from approximately 15° to almost zero where the series disappears beneath the cones of the High Cascades.

Near the California-Oregon boundary these volcanic rocks have a visible thickness of 12,000 to 15,000 feet.

In the Butte Valley region volcanic rocks of the "Western Cascades" have been recognized in the canyon of the Klamath River north and west of Secret Spring Mountain (48/2W-30) and along Shovel Creek north of Ikes Mountain (47/2W-31) (pl. 1). Along Shovel Creek Williams (1949) mapped a thick series of andesitic flows containing a rhyolite tuff lens (47/2W-18) and about 2 miles west of Secret Spring Mountain, a semicircular mass of andesitic tuff-breccia (48/3W-25). Most of the flows are hypersthene-augite andesite. Williams (1949, p. 21) distinguishes two types:

> * * * one a pale-gray, pilotaxitic variety rich in large phenocrysts of basic plagioclase and pyroxene, and the other a much finer grained, dark-gray to black variety with fewer phenocrysts and a glassy matrix. * * * Few andesites are notably vesicular, and scoriaceous tops and bottoms of flows are exceptional. * * * Some of the more glassy flows exhibit crude columnar jointing, but typically the lavas are marked either by widely spaced, blocky joints or by closely set, platy joints that curve upward from the horizontal to the vertical. The latter are to be ascribed to shearing of the flows during the final stages of advance.

The rhyolite tuff exposed in Shovel Creek cañyon (47/2W–18) was described by Williams (1949, p. 25) as follows:

* * * well-bedded white lapilli-tuffs * * * carry abundant lumps of rhyolite pumice and angular fragments of andesite in a matrix of crystal-vitric tuff. Their maximum thickness approximates 500 feet. These ejecta cannot have been laid down by glowing avalanches for they exhibit gravity sorting within individual layers, while successive layers vary greatly in coarseness and there is an almost complete lack of fine dust. Besides, the tuffs show a large-scale cross-bedding suggestive of the influence of shifting winds on falling ejecta. These features, taken together, suggest that the Shovel Creek tuffs were not discharged from fissures but by eruptions of vulcanian type from volcanic cones.

The andesitic tuff breccia about 2 miles west of Secret Spring Mountain was described by Williams (1949, p. 23, 24) as follows:

* * * well-stratified, coarse andesitic tuff-breccias and lapilli-tuffs * * * Most of the larger fragments measure a few inches across, but some reach a yard in greatest dimension; all are angular and lie in a groundmass of tuff. The outcrop of these beds is almost semicircular * * * and their quaquaversal dips range up to 50°. To some extent this curvature results from deformation, since it is shared by the associated lavas, but in the main it is a primary feature and indicates the former existence of a steep-sided fragmental cone at this locality.

#### WATER-BEARING PROPERTIES

In the Butte Valley region volcanic rocks of the "Western Cascades" probably have not been penetrated by wells. However, the rocks probably would yield water in quantities sufficient to supply domestic or stock requirements. Larger yields are unlikely because the rocks are decomposed. Wells penetrating similar rocks along the northeastern border of Shasta Valley (west of the Butte Valley region) yielded about 10 gpm.

### OLDER VOLCANIC ROCKS OF THE "HIGH CASCADES" (PLIOCENE AND PLEISTOCENE?)

#### CHARACTER AND DISTRIBUTION

Older volcanic rocks of the "High Cascades" are predominantly basalt and basaltic andesite which were spread out in successive sheets over large areas. They unconformably overlie the volcanic rocks of the "Western Cascades" and locally are overlain by younger volcanic rocks, glacial deposits, lake deposits, and alluvium.

The older volcanic rocks of the "High Cascades" may be Pliocene in age (Callaghan and Buddington, 1938; Williams, 1949), although it is generally conceded that some of the last flows may be early Pleistocene.

In California, north of Mount Shasta, the principal volcanoes of the "High Cascades" are west of the area shown on plate 1. The basaltic rocks were erupted by Miller Mountain, the partly buried shields beneath the Quaternary lava cones of Willow Creek Mountain, known as the Goosenest, and Ball, Eagle Rock, and Secret

Spring Mountains, and McGavin Peak. East of these mountains, several smaller coeval basaltic volcanoes, much modified by faulting, form the western border of Butte Valley.

East of the Cascade Range, lithologically similar volcanic rocks compose most of the Mahogany Mountain ridge. Powers (1932, p. 258) referred to these volcanic rocks as the Cedarville andesite and included them with more extensive outcrops east and northeast of the Butte Valley region.

The rocks composing the Mahogany Mountain ridge consist mostly of massive flows of basalt and basaltic andesite. In many places, especially north of Mahogany mountain (47/1E–34), the flows have been broken and tilted by differential movement along several faults in echelon. The trace of these faults and any geologic contacts exposed on the steep scarps have been concealed by talus. A narrow, steep-sided ravine (47/1E–33J) carved in the steep westward-facing Mahogany Mountain fault scarp has exposed a massive, well-compacted, poorly sorted, friable, gray-green volcanic sand containing angular fragments of vesicular basalt ranging in greatest dimension from less than 1 inch to about 1 foot. This sand unit dips about 20° SW. and strikes N. 40° W. As it was not noted elsewhere along the westward-facing fault scarps bordering Butte Valley, the author believes the sedimentary material was carried up between faults that are parallel to the main fault.

Inlow Butte (46/1E–5) and the northward-trending ridge between Red Rock Lakes (46/1E–14) and Sheep Mountain (46/1E–29) are composed of a pale-red porphyritic andesite. The rock is glassy and contains anhedral phenocrysts of plagioclase and hornblende. Further study may show that these rocks are correlative with the andesitic rocks of Miocene(?) age in the Sprague River area (Moore, 1937, p. 36).

In the southern part of the Butte Valley region the large dome-shaped lava cones surrounded by younger basaltic rocks were referred to by Powers (1932, p. 259) as the "massive lava group." The surfaces of these lava cones are badly eroded and heavily forested. The rock comprising these cones is nearly everywhere porphyritic, with conspicuous phenocrysts of white plagioclase and altered reddish-brown olivine. The flows are massive and poorly jointed, breaking into irregular blocks 10 to 15 feet in longest dimension. In this report these two groups of volcanic rocks are included with the volcanic rocks of the "High Cascades."

In discussing the origin of the older volcanic rocks of the "High Cascades" Williams (1949, p. 35) states:

> Throughout the southern part of the High Cascades in Oregon and California, Pliocene and early Pleistocene times were characterized by the growth of a north-south chain of large, flattish shield volcanoes built by quiet effusions

of fluid olivine basalt and basaltic andesite * * * the volcanoes * * * were extremely uniform in their activity; fragmental explosions seldom interrupted the quiet outflow of lava, and the flows themselves varied only slightly in composition despite their wide extent.

The volcanic rocks consist almost entirely of evenly bedded massive flows of basalt and basaltic andesite. Williams (1949, p. 37) reports:

By far the dominant lava of all the shields is a massive, pale grey, micro-vesicular, holocrystalline basalt liberally sprinkled with granules of olivine. Flows that contain a little glass are generally darker and more coarsely vesicular, while the glass-rich tops and bottoms of a few flows are black and scoriaceous. Most of the flows vary in thickness between 10 and 50 feet; exceptionally they reach a thickness of 100 feet. Few are auto-brecciated and the crusts of most are smooth.

The flows commonly are broken by expansion joints into irregular polygonal or cuboidal blocks. The major faces of the blocks often are marked by secondary expansion joints and by fractures resulting from the various weathering processes.

In places north and northeast of Ikes Mountain (47/2W–33M) thin, partly altered (palagonitized)[1] layers of yellow-brown to gray tuff and tuff-breccia crop out between basaltic flows; most of the exposures are poor. At Ikes Mountain the tuffaceous rocks are extensive and are best exposed in grade cuts of old logging roads traversing the mountain. Their extent and thickness are not known.

Near the mouth of Ikes Creek (46/2W–6B) and along the northeastward-trending escarpment north of Harris Creek the lower part of an exposed section consists of massive, poorly sorted, well-consolidated, basaltic tuff-breccia, cut by irregular dikes and discontinuous globular masses of dark-colored fine-grained basalt. The breccia is composed of dense, fine-grained black basalt containing scattered phenocrysts of white plagioclase. Most of the fragments are a few inches across but some reach a foot or more in greatest dimension; all are angular and firmly embedded in a matrix of partly altered, palagonitized yellowish-green-to-brown tuff.

This basaltic tuff-breccia is overlain by badly weathered cindery tuff-breccia, reddish agglomerate, highly vesicular to scoriaceous basalt, and lenticular masses of varicolored, partly decomposed lapilli tuff. Near the summit of Ikes Mountain these rocks have been intruded by several red brecciated basaltic dikes similar in composition to the agglomerate and intercalated basalt mentioned above. The features described here suggest that a large volcanic

[1] Palagonite. Yellow or orange, isotropic mineraloid formed by hydration and other alterations of sideromelane (basaltic glass), and constituting a characteristic part of palagonite tuffs. (Wentworth-Williams).

Palagonite tuff. An altered basaltic tuff containing inclusions of basaltic glass (Fay). (Definitions from C. M. Rice, "Dictionary of Geological Terms," 1953, p. 290).

vent filled with fragmental rock probably existed beneath the red scoriaceous basalt that caps the summit of Ikes Mountain.

South of Meiss Ranch (46/2W–9Q) and east of Ball Mountain a large, massive, somewhat porphyritic basaltic flow of unknown thickness extends into Butte Valley. Its source was probably a vent or fissure in the peak near 46/2W–29A. The rock is a fine-grained gray to black plagioclase-rich basalt or basaltic andesite containing subhedral plagioclase laths and a few scattered pale-green anhedral grains of olivine. Most of the flow is massive and contains scattered, irregularly shaped vesicles; locally, especially near its lower margin, the flow is platy, the individual plates ranging from less than 1, to more than 4 inches in thickness.

The steep front of this flow, facing Butte Valley, terminates so abruptly that it suggests faulting. However, a thick, viscous flow might have come to rest with a similarly steep front. The presence of the fault shown (pl. 1) along the edge of the flow, south of BM 4255 (46/2W–15Q), is based on the following evidence: (a) The edges of the basalt lobes terminate abruptly in nearly straight, steep-sided escarpments, as though the frontal lobes had been sliced off, and (b) the flows or flow units exposed in these escarpments seem to be hanging and very little talus has accumulated at the base of the scarps. North of bench mark 4255 the edges of the basalt lobes are rounded and do not seem to have been broken.

#### WATER-BEARING PROPERTIES

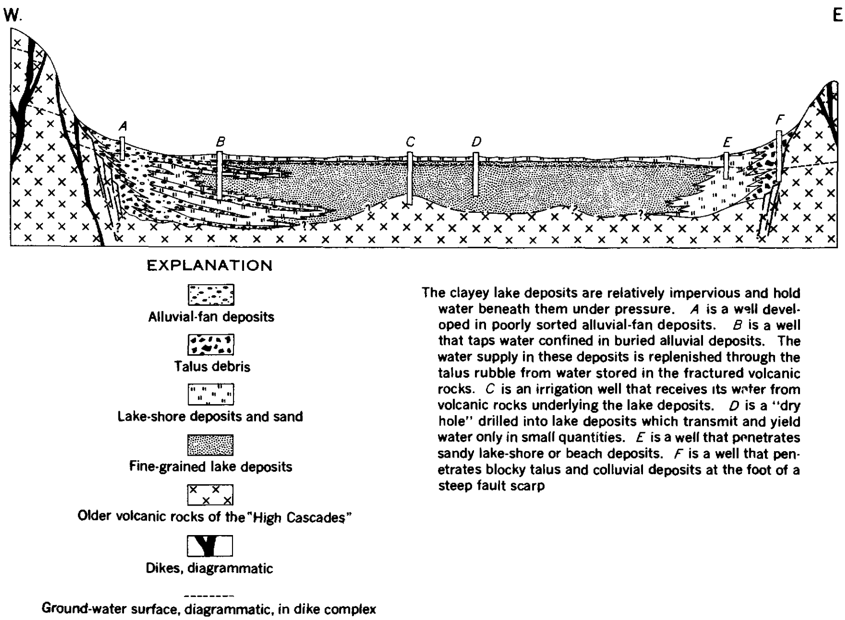
The older volcanic rocks of the "High Cascades" are exposed over most of the Cascade Range and serve as a large catchment area for rain and snow. Most of the catchment area is mantled with thin, rocky soils overlying highly fractured volcanic rocks and can readily absorb large quantities of water. Much of the precipitation absorbed seeps downward below the reach of native plants to the zone of saturation in the fractures and crevices within and between the interbedded lava flows. (For a more complete discussion of openings that allow ground water to move through lavas see the section on the water-bearing properties of the Butte Valley basalt.) Part of the water in the volcanic rocks is transmitted laterally to the alluvium and lake-bed sediments in Butte Valley, where it contributes to the ground-water supply. Small streams along the west side of Butte Valley such as Prather, Muskgrave, Harris, and Ikes Creeks, derive much of their perennial flow from springs and seeps issuing from the volcanic rocks. Butte and Antelope Creeks, the two principal streams in the region, derive much of their perennial flow from springs issuing from older volcanic rocks of the "High Cascades" southwest of the area investigated.

In the Cascade Range, swarms of "feeder dikes" become progressively more abundant toward the hearts of the volcanoes. The fine-grained, impermeable dikes cut through permeable beds of basalt and scoria and trap ground water at high levels in the intervening compartments. The surface of the ground-water body in a dike-enclosed compartment may be at a different height from the one next to it (fig. 3). Large supplies of ground water may be stored in some of these reservoirs.

Most dikes contain sufficient crevices to allow water to move transversely through them. Even small cracks in dikes would allow the passage of a large amount of water to ground-water reservoirs having a much lower hydrostatic head. Water moves from the volcanic rocks into the sedimentary rocks, and the rate of movement is governed chiefly by the transmissibility of the rocks. The older volcanic rocks of the "High Cascades" extend across Butte Valley beneath the lake deposits, consequently water probably moves upward and laterally into the sediments beneath the valley (fig. 3).

Fine-grained lake deposits overlie volcanic rocks throughout much of Butte Valley and are less permeable than the porous lava. Ground water is confined beneath the lake deposits, and where it is tapped by wells, the water level will rise to the regional piezometric surface.

Wells that probably tap the volcanic rocks underlying the lake deposits are shown on plate 2. According to the owner, irrigation well 46/2W-26F3 tapped confined water in the volcanic bedrock.




The clayey lake deposits are relatively impervious and hold water beneath them under pressure. *A* is a well developed in poorly sorted alluvial-fan deposits. *B* is a well that taps water confined in buried alluvial deposits. The water supply in these deposits is replenished through the talus rubble from water stored in the fractured volcanic rocks. *C* is an irrigation well that receives its water from volcanic rocks underlying the lake deposits. *D* is a "dry hole" drilled into lake deposits which transmit and yield water only in small quantities. *E* is a well that penetrates sandy lake-shore or beach deposits. *F* is a well that penetrates blocky talus and colluvial deposits at the foot of a steep fault scarp

**Figure 3.**—Diagrammatic section across Butte Valley from west to east showing some typical conditions that govern the occurrence of ground water.

(See table 8.) The well reportedly provided large quantities of water without excessive drawdown until the casing collapsed and the well was destroyed. Well 47/1E–32A1, near the base of Mahogany Mountain, just reaches the volcanic rocks (table 8). According to the driller, this well yielded more than 3,100 gpm with about 22 feet of drawdown. Based on these data, the specific capacity of the well was about 140 gpm per foot of drawdown and the yield factor was 60 (p. 9). Yield factors obtained for wells penetrating alluvium and lake deposits (table 5) to the west are lower, suggesting that this well receives a large part of its supply from the underlying bedrock or from talus debris, or from both.

Water in the basalt south of Meiss Ranch (46/2W–9Q) probably is confined by fine-grained lake-bed sediments deposited around the lower end of the flow. Near the Meiss Ranch headquarters, 4 wells penetrating this basalt obtained artesian flows after being drilled 65 to 150 feet in alluvium. This alluvium consisted of gravel, sand, clay, and rubble derived from the basaltic flow. In 1954, the estimated natural discharge of the wells ranged from about 15 gpm in well 46/2W–9R2 to more than 500 gpm in wells 46/2W–9R1 and 16A1. Well 46/2W–9Q1 flowed about 100 gpm. According to the driller, well 46/2W–9Q1 entered basalt at a depth of 150 feet. When pumped, this well reportedly yielded 3,000 to 4,000 gpm; the drawdown was unknown. Well 46/2W–9R1 entered the basalt at a depth of 65 feet and when pumped reportedly yielded about 1,300 gpm with a drawdown of about 30 feet.

The pyroclastic rocks near Ikes Mountain (47/2W–33M) are largely above the water table and are of little hydrologic importance. Locally, impermeable altered or welded pyroclastic rocks may cause springs in areas where these rocks are extensive and overlain by fractured basaltic rocks. Ground water moves down gradient through the basaltic rocks and discharges at places where both the perched water table and the underlying impermeable layer intersect the land surface.

In 47/2W–31L, 46/2W–6B and 6G three small springs issue from rock debris, which mantles the steep slopes. Although their source was not determined, these springs are probably outlets for small perched ground-water bodies in local basaltic flows that are intercalated with altered, impermeable pyroclastic rocks.

## PYROCLASTIC ROCKS (PLEISTOCENE AND RECENT)

### CHARACTER AND DISTRIBUTION

Pyroclastic accumulations, mostly lithic tuff and cindery tuff-breccia, underlie a large area east and southeast of Macdoel. These rocks probably range in thickness from 0 to about 400 feet near Juniper Knoll (46/1W–16). Their areal distribution is shown on plate 1.

Drillers' logs of water wells indicate that in most places the pyroclastic rocks rest upon lake deposits of Pleistocene(?) age. In secs. 11, 14, and 21 (46/1W) the pyroclastic rocks seem to be overlapped by the Butte Valley basalt. In secs. 26, 27, 34, and 35 (46/1W) the basalt may have been deflected around a chain of tuff cones which are alined over a northward-trending fissure. However, the presence of northwestward-trending cracks or fissures (pl. 1) formed in the basalt during its cooling period, suggest that the flow extends across this area beneath the pyroclastic rocks. Near the point where a northeastward-trending trail turns northwest (46/1W–27H) part of the basalt containing a crack or fissure ranging from a few inches to about 4 feet across, is overlain by tuff and cindery tuff-breccia. Farther to the southeast (46/1W–27J) a small exposure of basalt (too small to be shown on pl. 1) was completely surrounded by tuffaceous material.

Thus, it seems that two widely spaced periods of volcanic activity may have contributed to the deposition of the pyroclastic rocks. The first period of explosive activity may be represented by the large saucer-shaped depression or crater about 200 feet deep and one-half mile in diameter in 46/1W–16. This crater, which now contains a shallow ephemeral lake (pl. 1), is probably the source vent for much of the tuff and tuff-breccia. The second period of explosive activity, which may have occurred after the eruption of the Butte Valley basalt, probably is represented by the chain of hills in 46/1W–15, 22, 27, and 34. These hills are tuff cones built over a series of vents alined along a northward-trending fissure.

Two periods of explosive activity may have resulted from phreatomagmatic explosions of the type described by Stearns (1954, p. 599), that occur where hot magma comes suddenly into contact with surface or ground water. In discussing the origin of pyroclastic deposits and tuff cones, Stearns (Stearns and Clark, 1930, p. 156; Stearns and Vaksvik, 1935, p. 16, 135–136; Stearns and others, 1939, p. 32–36) theorized that rising magma, if abnormally charged with gas, could have exploded wherever it reached the surface as a result of rapid gas expansion. This gas soon would have been dissipated and would have been followed by a normal outflow of lava. According to Stearns the absence of any lava flow necessitates a search for a supplemental cause for the explosion. For example, if the magma rose slowly, ground water in the rocks surrounding the rising magma column would be quietly dissipated as steam, and the water would be forced to recede from the rising magma. On the other hand, if the magma rose rapidly and if the supply of ground water were plentiful, as in coarse gravel or fractured, brecciated, basaltic rocks, then great quantities of superheated steam might generate sufficient pressure to blast a vent. Immediately, all the superheated water and large masses of rock overlying the magma body would be hurled from the vent. After this initial blast the consequent sudden relief of pressure on the gases in the magma column probably would cause the magma to froth or explode violently. Material collapsing from the walls of the newly formed crater, supplemented by cooled magma falling back into it, would tend to make temporary talus plugs which would retard the explosive forces intermittently; water rushing into the crater then would cause new explosive spasms (Stearns and others, 1939, p. 32–38).

A third period of explosive activity is indicated at Juniper Knoll by a low dome-shaped mound of black basaltic cinders. Dips measured in the semiconsolidated tuff layers around the periphery of the dome-shaped mound reveal that the tuff layers slope outward 30° to 40° in all directions, which indicates that the cinders were extruded through older pyroclastic rocks.

The pyroclastic rocks generally are composed of well-bedded to massive, gray-to-brown, lithic tuff and massive, poorly sorted, well-consolidated, tuff-breccia containing abundant fragments of dark basalt and black scoria firmly embedded in a fine-grained tuffaceous matrix.

In 46/1W–3R borrow pit, dug to provide road metal, revealed cross-laminated beds composed of alternating layers of gray-to-brown lithic tuff and black, cindery, lapilli-tuff. Individual beds range in thickness from less than 1 to about 6 inches and from less than 1 to several feet in length. The cross-laminated beds probably were constructed by shallow-water currents reworking pyroclastic debris during or immediately after the three periods of volcanic activity mentioned above. This cross-laminated section is capped by evenly bedded, slightly consolidated brownish tuff alternating with black cindery lapilli-tuff in layers ranging in thickness from a few inches to about 1 foot.

Numerous angular blocks, slabs, and fragments, of black olivine-rich fine-grained basalt cover the surface around the large crater in 46/1W–16. As these basaltic rocks cannot be correlated with basaltic flows in that area, they probably were blown out of the crater during explosive activity.

#### WATER-BEARING PROPERTIES

The coarse-grained beds of lithic tuff and the cindery lapilli-tuff layers are moderately permeable and can store large quantities of water. Many of these units are separated by thin layers of fine-grained tuff, hence they probably can neither transmit water readily nor yield much water to wells. Most of the outcrop area lies above the saturated zone and is mantled by coarse sand and cindery lapilli; it is important chiefly as catchment area for rain and snow.

### BUTTE VALLEY BASALT (LATE PLEISTOCENE AND RECENT)

#### CHARACTER AND DISTRIBUTION

A uniform sheet of gray vesicular olivine basalt occupies a large area in the southern and southeastern parts of Butte Valley and in Red Rock Valley. It is exposed over a 75-square-mile area in the Butte Valley region (pl. 1). Its probable subsurface extent in Butte Valley is about 27 square miles as determined from logs of wells (pl. 2), and thus, it covers a total area of about 102 square miles. It was named the Butte Valley basalt by Williams (1949, p. 44) for exposures near Jerome (45/1W–19) at the south end of Butte Valley. Because of its extent and its importance as an aquifer, the name Butte Valley basalt is adopted in this report.

The Butte Valley basalt overlies lake deposits of Pleistocene(?) age in Butte and Red Rock Valleys. In Butte Valley several extended lobes or tongues of the flow seem to be interstratified with the lake deposits (pl. 3). South and southwest of the town of Mount Hebron and along Butte and Antelope Creeks the basalt is overlain by alluvium. Locally in Red Rock Valley the basalt is overlain by alluvial and playa deposits, and locally northeast of the town of Mount Hebron it seems to lie between the older and younger units of the pyroclastic rocks. Accordingly, the age of the Butte Valley basalt probably is late Pleistocene or possible early Recent.

Wells in the lower end of the flow in Butte Valley (pl. 2) penetrated from about 6 to more than 80 feet of basalt. The average thickness was about 40 feet. In Red Rock Valley a driller's log for well 45/1E–16P1 (table 9) showed about 60 feet of basalt overlying lake deposits.

Basalt commonly flows over the land as a viscous fluid and moves down slopes and along stream channels or ravines often disrupting the drainage pattern. Frequently, thick basaltic flows completely obliterate preexisting topography. A flow may be many tens of feet thick where it fills an old canyon and a short distance away the same flow may be absent or only a few feet thick. Stratigraphic correlation is therefore difficult and the thickness varies as recorded in well logs within a small area.

Topographically the Butte Valley basalt is characterized by numerous northward- to northwestward-trending cracks or surface fissures and their accompanying scarps, and tumuli (also known as pressure domes or schollendomes), pressure ridges, and collapse depressions. Collapse depressions are distributed sporadically over the flow. Some are elongated trenches bordered by low cliffs or ridges; others are irregular in outline and contain thin alluvial deposits. The majority of the depressions probably were formed by the collapse of lava crusts over drained or partly drained lava tubes.

According to Wentworth and MacDonald (1953, p. 45) tumuli are domical upbowings of the flow surface, typically elliptical in plan, which grade into elongated structures that are termed pressure ridges. These ridges commonly have gaping cracks or fissures on their crests. The cracks parallel the long axes of the structures and are several feet deep. Other, less regular, cracks extend down the flanks of the ridges.

Wentworth and MacDonald (1953, p. 49) report that although some tumuli were formed by hydrostatic pressure of liquid lava under a congealed crust, many of them (particularly those with a very elongate form) and the majority of pressure ridges apparently were formed by the horizontal thrusting and buckling of the flow crust caused by the pressure of fluid lava.

The northward- to northwestward-trending cracks or fissures range in width from a few inches to about 30 feet and frequently can be sounded or are visible to depths of 20 feet; many probably are open to much greater depths. The cracks range from less than 1 to more than 15 miles in length (pl. 1). In many places the cracks or fissures blend into nearly vertical scarps. The scarps and the walls of the wider fissures are marked by numerous subparallel cracks of incipient landslides.

The origin of the large cracks is uncertain. They may be caused by shrinkage along marginal "levees" paralleling the main channels of the flow, or slump scarps (Finch, 1933) and tension cracks formed by subsidence of the general flow surface due to draining away of fluid lava from beneath a congealed crust as the still fluid lower part of the lava continued to move along established channels. They may be the surface expression of buried faults or shear zones in the volcanic bedrock beneath the semiconsolidated lake sediments which underlie the brittle basalt-covered surface. However, there is little evidence of shearing movement along the cracks; flow units (Nichols, 1936) ranging in thickness from a few inches to about 10 feet revealed in the walls of the cracks or fissures show little or no offset. Where the walls have not been greatly modified by collapse, projections on one wall commonly correspond with concavities in the opposite wall.

The faulting hypothesis is strengthened by the observation that faults in the older volcanic rocks at Orr Mountain (44/1W–16) and at Cedar Mountain (45/1E–36) are continued as breaks, scarps, or fissures in the basalt-covered surface. East and northeast of the town of Mount Hebron a chain of cones alined along one of the longer cracks clearly indicates a deep-seated fissure or series of vents from which cindery tuffs and lapilli-tuffs issued.

Whatever may be their origin, the numerous cracks or fissures in this extensive basalt-covered surface now serve as excellent avenues through which precipitation and surface water may enter the ground-water body.

The basalt is a highly vesicular gray olivine-rich augite basalt. Discontinuous patches of dark glassy, pahoehoe skins are common, and have a semicircular wavelike (festooned) or, sometimes a ropy surface.

As revealed in the many gaping cracks and fissures previously described, the basaltic flow consists of many parts or successive gushes of lava emitted during the course of a single eruption. These nearly contemporaneous subdivisions of basaltic flows have been called flow units (Nichols, 1936). The flow units range from less than 1 to about 10 feet in thickness. They range from local gushes that moved a few tens of feet to sheets that flowed for thousands of feet partly or entirely over other flow units. The tops and bottoms of the flow units are generally rough, broken, and often clinkery or scoriaceous.

#### WATER-BEARING PROPERTIES

The Butte Valley basalt is the most productive aquifer in the region, because it consists of a series of comparatively thin flow units that have clinkery, slaggy, or cavernous contacts and that are broken by a system of nearly vertical joints or shrinkage cracks. Wells in these rocks generally yield abundant quantities of water. Specific capacities of more than 100 gpm per foot of drawdown are common, and specific capacities of 1,000 gpm per foot of drawdown have been recorded (table 6).

The following discussion relating to the movement of ground water through basaltic rocks is adapted from Stearns' discussion (Stearns and others, 1938, p. 58–61) of the relative importance of the openings and cavities in extrusive basaltic rocks through which ground water can move.

The upper crust of a lava flow is generally rough and broken because of movement within the flow after the crust has congealed. Inundation by later flows never completely fills these irregularities. Consequently many openings, some of which are extensive and capable of holding or transmitting large quantities of water, occur between successive flows. Nearly vertical cooling joints of varying widths intersect the flows and are the means by which ground water percolates readily downward to the zone of saturation.

In many places the basaltic flow has a subaqueous phase at its base. Drillers report that many of the more productive wells penetrate a layer of glassy clinker and cindery fragments at the base of the flow and that these clinkery layers yield large quantities of water. The glassy clinker and cindery fragments probably were formed by rapid cooling and brecciation as the flow advanced over a water-saturated surface.

Vesicles caused by the expansion of gases during the cooling process give the crust a spongy appearance. These cavities generally are disconnected, and the vesicular lava does not yield large quantities of water as is commonly believed. Instead, its presence in a well core indicates that the drill has passed from one flow to the top of another, and the water is obtained from cavities which occur at the contact between the flows.

### BASALTIC LAVA FLOWS (LATE PLIOCENE? AND PLEISTOCENE)

Basaltic flows, east and southeast of Butte Valley include a massive, coarsely vesicular, gray olivine basalt about 20 feet thick that caps Big and Little Tablelands and covers an extensive area south of Lower Klamath Lake; and a black, coarsely vesicular, porphyritic basalt containing conspicuous anhedral phenocrysts of yellowish-green olivine in a fine-grained matrix, from Sheep Mountain. On Big and Little Tablelands the basalt unconformably overlies diatomite of Pliocene age. South of Lower Klamath Lake basaltic flows of similar lithology and texture are overlapped by basaltic flows of Recent age.

These older basaltic flows were described by Powers (1932, p. 266) as the Warner basalt, which he traced eastward to the Warner Range where Russell (1928, p. 416) first applied the term "Warner basalt." If this correlation is valid, then according to Anderson (1941, p. 354) who summarized the available evidence relating to the age of the Warner basalt, it may be Pliocene or early Pleistocene in age.

The basalt in a small area northeast of Sheep Mountain apparently issued from a vent or fissure in 46/1E–20. In outcrops the basalt is fresh and ragged looking. In most places the rock is broken into rough cuboidal or hexagonal blocks by shrinkage cracks formed during cooling.

The flow ranges in thickness from a few feet to more than 300 feet. In 46/1E–10 about 200 feet of basalt is exposed in a nearly vertical fault scarp. The owner of a dug well in 46/1E–10D reported that he penetrated 20 or 30 feet of alluvium and then "black rock" to the bottom of the hole at a depth of 85 feet. He reported finding many nearly horizontal "cracks" ranging from a few inches to 1 foot or more across and extending inward as far as he could see. Deep irrigation wells north of Inlow Butte did not enter basalt. Owing to the appreciable thickness of the basalt in 46/1E–10D, evidence suggests that this flow was ponded in a depression between Inlow Butte and Mahogany Mountain. If the topography east of Inlow Butte at the time of the basaltic eruption was similar to that of today (pl. 1) the flow would have spread out over the floor of Butte Valley. Because the evidence suggests that the flow did not enter the valley north of Inlow Butte, there probably was a topographic high between the butte and the western part of Mahogany Mountain that blocked the flow before late Pleistocene or Recent crustal displacements and erosion altered the topography.

#### WATER-BEARING PROPERTIES

These basaltic flows generally are highly permeable, but they are commonly above the zone of saturation. They serve chiefly as intake areas for ground water.

### BASALTIC FLOWS NORTHEAST OF SHARP MOUNTAIN (LATE PLEISTOCENE AND RECENT)

The youngest volcanic rocks in the Butte Valley region are a group of basaltic flows and associated cinder cones east and northeast of Sharp Mountain (45/2E–32), including the long, narrow northwestward-trending tongue of basalt northeast of Mount Dome (46/2E–24). These rocks are the northernmost extension of the widespread basaltic flows that were discharged mostly from the north flank of the Medicine Lake highland. This large area of flows, which includes the lavas of the Lava Beds National Monument, was described by Powers (1932) as the Modoc basalt. Subsequent workers have used the term when discussing basalts of late Pleistocene and Recent age in this area.

The Recent age of the youngest of these rocks is indicated by the thin soil cover, the constructional nature of the lava surfaces, and by the association of the rocks with cones having well-preserved craters. The group of flows near Sharp Mountain all terminate with steep, blocky fronts. Their rough surfaces in many places have irregular, steep-sided channels or gutters, separated by branching ridges. One small flow in 45/2E–17N has well-defined crescentic ridges on its surface.

The vents or fissures from which some of these basaltic flows issued are capped by five cinder cones. One of the cones (45/2E–16N) has a well-preserved summit crater. In three other cones (not shown on the geologic map) the crater walls have been breached on one side.

The long, narrow, tongue of basalt east of Mount Dome is the northernmost extension of the main mass of the Modoc basalt of Powers (1932). Its surface is rough, broken, and marked in many places by collapse depressions.

#### WATER-BEARING PROPERTIES

The rough, broken flows have a poorly developed soil cover, and the chaotic masses of blocky to clinkery lavas, the fissured, broken, cavernous lavas similar to the Butte Valley basalt, and the loose angular cinders form a highly permeable unit. They are generally above the saturated zone but serve as intake areas for ground water.

### YOUNGER VOLCANIC ROCKS OF THE "HIGH CASCADES" (LATE PLEISTOCENE AND RECENT)

The younger volcanic rocks of the "High Cascades" probably are of late Pleistocene and Recent age. In the Butte Valley region they include andesitic flows of Deer Mountain (south of the area shown on pl. 1), basaltic flows of Little Deer Mountain, and a narrow basaltic flow in Butte Creek canyon.

The andesitic flows of Deer Mountain are south of the Southern Pacific railroad and west of the glacial moraines in the southwest corner of the region (pl. 1). The flows were described by Williams (1949, p. 41) as hypersthene-rich hyalopilitic andesite containing abundant large phenocrysts of olivine and plagioclase. In most places the flows are heavily mantled with basaltic cinders and coarse ash blown from nearby vents.

The basaltic flows of Little Deer Mountain surround the Little Deer Mountain cinder cone and cover an area of more than 10 square miles. Near the eastward-trending trail south of the Southern Pacific railroad the basalt overlaps andesitic flows of Deer Mountain. According to Williams (1949, p. 45):

> The first flows spread eastward beyond Penoyar for about 5 miles. These are thin sheets of black vesicular olivine-augite basalt with smooth to gently undulating crusts dotted with sporadic schollendomes * * * Most of the flows are concealed by a mantle of fine ash, and close to their snouts they are also covered by sandy outwash from the adjacent hills of fluvioglacial debris.
>
> The principal flows were then discharged, accumulating to a depth of 500 feet. Most of these issued from the breach on the south side of the cone, but some escaped from vents on the opposite side. Being more viscous than the earlier flows they only spread half as far and all terminated with steep, blocky fronts. Their rough surfaces are marked by high crags and pinnacles and by irregular channels dividing branching ridges, and their scoriaceous, clinkery interiors are strongly autobrecciated * * * Like the first flows, they are rich in phenocrysts of olivine but contain only sparse phenocrysts of plagioclase. Porphyritic augite is lacking, but the mineral is abundant as minute granules between the microliths of labradorite in the groundmass.

Only the lower end of the narrow basaltic flow in Butte Creek canyon is shown on the geologic map (pl. 1). According to Williams (1949, p. 45–46), a flow of black vesicular olivine basalt issued from a fissure in the eastern wall of Butte Creek canyon at an altitude of about 6,000 feet, moved northward along the canyon floor for 10 miles, and terminated near the Soule Ranch (44/2W–24P).

The lower part of the flow is largely concealed by fluvioglacial outwash and cinders. The best exposures can be seen below Mount Shasta Woods (outside the area shown on pl. 1), where Butte Creek has incised a youthful gorge between the east margin of the flow and the adjoining moraine. In this area the lava ranges in thickness from 10 to 150 feet. Most of the flow moved down the canyon through lava tubes beneath a smooth to gently undulating crust. Near Mount Shasta Woods and on the Grenada Ranch, copious springs of cold water now issue from the empty lava tubes.

The younger volcanic rocks of the "High Cascades" occur in rugged terrain, generally more than 5,000 feet in altitude. They constitute an important catchment area for rain and snow. The rough, broken, scoriaceous flows absorb precipitation readily and transmit water downward into the older volcanic rocks of the "High Cascades." Where geologic conditions and the ground-water gradient are favorable, part of this precipitation probably enters Butte Creek as water from subsurface seepage and springs.

## SEDIMENTARY DEPOSITS AND THEIR WATER-BEARING PROPERTIES

Sedimentary deposits in the Butte Valley region range from Pliocene to Recent in age. From oldest to youngest these deposits include: (a) An impermeable fresh-water diatomite which crops out over a large area east of the Mahogany Mountain ridge; (b) glacial moraines and fluvioglacial outwash deposits of low permeability near the mouth of Butte Creek canyon; (c) semiconsolidated lake deposits which underlie most of the Butte Valley plain and Red Rock Valley; (d) unconsolidated, poorly sorted, rock debris deposited in the form of alluvial fans along the west side of Butte Valley; (e) alluvium which in most places forms a thin cover resting on lava flows or lake deposits; (f) talus debris which forms linear wedge-shaped deposits along the foot of precipitous fault scarps; and (g) dune sand near the east edge of Butte Valley.

In general the sedimentary deposits are only slightly permeable and of little hydrologic importance, except along the eastern border of Butte Valley where the lake deposits contain large quantities of sand and probably yield moderate supplies of water to irrigation wells, and in the southwestern part of the valley where alluvium overlying the Butte Valley basalt probably yields moderate quantities of water to wells.

### DIATOMITE (PLIOCENE)

#### CHARACTER AND DISTRIBUTION

Massive diatomite deposits crop out over a large area east of the Mahogany Mountain ridge. The outcrop interpreted from aerial photographs and from a brief geologic reconnaissance is shown in plate 1.

Diatomite is composed of the microscopic siliceous cells, or frustules, of diatoms and, rarely the shells of other silica-secreting organisms. The diatomite in the Butte Valley area is of fresh-water origin. It is gray to dead white and forms beds ranging from a few inches to about 50 feet in thickness. Locally the diatomite is interbedded with volcanic ash, cindery lapilli, pumice, and sand.

Because the diatomite was deposited in the bed of an ancient Klamath basin lake, the area of outcrop (pl. 1) is a continuation of the diatomite in the Klamath diatomite district (Moore, 1937, p. 34–51). Near Klamath Falls, Oreg. (north of the area shown in pl. 1), diatomite is interbedded with older volcanic rocks of the "High Cascades" (Moore, 1937, p. 35–40). There the diatomite was assigned to the Pliocene on the basis of its stratigraphic position (Moore, 1937, p. 35–40) and vertebrate and invertebrate fossil content (Meyers and Newcomb, 1952, p. 39–40).

Diatoms collected by the writer from two localities [2] in a prospect pit on a hillside (altitude about 4,280 feet) east of Willow Creek (46/2E–9F) were identified by K. E. Lohman of the Geological Survey (written communication, Aug. 31, 1955) as follows:

Frequency of diatom occurrence is indicated by: A, abundant; C, common; F, frequent; R, rare.

| | *USGS diatom localities* | |
|---|---|---|
| | *4076* | *4077* |
| *Achnanthes* sp | R | |
| *Amphora lybica* Ehrenberg | | R |
| cf. *A. ovalis* Kutzing | R | |
| *Cocconeis placentula* Ehrenberg | F | |
| *placentula* var. *euglýpta* (Ehrenberg) Cleve | R | R |
| *Cyclotella* aff. *C. compta* (Ehrenberg) Kutzing | A | A |
| spp | C | C |
| cf. *C. meneghiana* Kutzing | F | |
| *ocellata* Pantocsek | F | F |
| *Cymbella* cf. *C. affinis* Kutzing | | R |
| *ventricosa* Kutzing | R | |
| *Diatoma* cf. *D. vulgare* Bory | R | |
| *Diploneis elliptica* var. *ostracodarum* (Pantocsek) Cleve | F | |
| *Epithemia turgida* (Ehrenberg) Kutzing | R | |
| *Fragilaria* sp | | R |
| *Gomphoneis elegans* (Grunow) Cleve | R | |
| *Gomphonema* sp | | R |
| *Melosira distans* var. *lyrate* (Ehrenberg) Bethge | F | F |
| cf. *M. solida* Eulenstein | | R |
| *Nitzechia angustata* (Wm. Smith) Grunow | R | R |
| *Opephora martyi* Heribaud | R | R |
| sp | R | |
| *Rhoicosphenia curvata* (Kutzing) Grunow | R | |
| *Stephanodiscus astreaea* (Ehrenberg) Grunow | | F |
| *carconensis* var. *minor* Grunow | C | |
| *carconensis* var. *pusilla* Grunow | C | C |

[2] Locality 4076 is 20 feet below the contact with the overlying cindery tuff-breccia, and locality 4077 is 20 feet stratigraphically below locality 4076.

The diatom assemblages from the two collections are, in general, dominated by the same species, principally several hitherto unnamed species of the genus *Cyclotella*. For this reason, the most abundant species present have little value (at present) for age determination. Several other species, among which are *Diploneis elliptica* var. *ostracodarum*, *Gomphoneis elegans*, *Stephanodiscus caronensis* var. *minor* *S. carconensis* var. *pusilla* are strongly indicative of late Pliocene age. *Melosira solida* is another species which became extinct in late Pliocene time, but is given less weight in the present instance, as only one doubtful specimen was found.

Most of the definitive species in these assemblages are also found in the diatomite exposed near the town of Sprague River, Oregon, immediately to the north of the Swan Lake–Yonna valley, a short distance to the north in Oregon (U.S.G.S. Diatom Locality 1061). It seems probable that your diatomite near Willow Creek in the Dorris Quadrangle may be correlated with the sedimentary beds between the lower and upper lava rocks in the Swan Lake–Yonna valleys in Oregon, although the Willow Creek diatomite may be slightly younger.

This is based on the fact that the dominant species in the Sprague River locality are *Stephanodiscus carconensis* and *Melosira solida*, both of which reached their heyday in the middle Pliocene. Only the two varieties of the former, var. *minor* and var. *pusilla* were found in the Willow Creek material and these are known to extend to the top of the Pliocene. *Melosira solida* occurred in the Willow Creek collections as one doubtful specimen.

The diatom assemblages identified by Mr. Lohman and vertebrate and invertebrate fossils collected from interbedded sedimentary deposits and diatomite in the Klamath Falls area suggest that the diatomite in this area is late Pliocene in age.

In the Butte Valley region the relation between the diatomite and the older volcanic rocks of the "High Cascades" is complicated by faulting. Exposures in 47/1E–12 and 13 and along the westward-facing scarp in 48/1E–27 and 34 suggest that the diatomite may be interbedded with the older volcanic rocks of the "High Cascades."

Local residents report that a well drilled on Oklahoma Flat near the east quarter corner of 47/2E–18 passed through about 1,000 feet of "chalk" (diatomite and ash) without entering other rock units. In the Oklahoma district the log of well 46/2E–7E1 (table 10) shows that 396 feet of diatomite unconformably overlies older volcanic rocks of the "High Cascades." The log of well 47/1E–25K1 (table 10) indicates that diatomite in this area is interbedded with many feet of sedimentary deposits. On Big and Little Tablelands the diatomite is unconformably overlain by a nearly horizontal flow of coarsely vesicular gray olivine basalt. West of Little Tableland in 46/2E–4 and 9 the diatomite is overlain by well-bedded to massive cindery lapilli-tuff and tuff-breccia which in turn are overlain by interbedded quartzitic sand and cindery lapilli. The interbedded sand and lapilli are capped by a peculiarly weathering, cliff-forming, quartz sandstone, in which the bonding silica cement has been deposited from solution. Quartz sandstone and lapilli-tuff deposits overlying the diatomite are similarly exposed on the hilltop near 47/2E–31R, and lapilli-tuff-breccia was noted near the top of the conical hill northeast of the Fogle Ranch in 46/2E–7. Southwest of Mount Dome in 46/2E–33, 34, 35, and 36 the diatomite seems to be interbedded with basaltic and rhyolitic tuff-breccia.

#### WATER-BEARING PROPERTIES

The diatomite is friable and extremely porous, but because it is composed of minute siliceous particles, it has a low permeability. Wells penetrating these deposits enter sand or gravel lenses that supply moderate amounts of water in some areas. Water also occurs in ashy partings or layers between beds or in crevices.

### GLACIAL MORAINES AND FLUVIOGLACIAL DEPOSITS (LATE PLEISTOCENE)

#### CHARACTER AND DISTRIBUTION

The glacial moraines and fluvioglacial deposits along Butte Creek in the southwest corner of the Butte Valley region (pl. 1) were laid down during the last extensive glaciation (Wisconsin(?) stage) of the Pleistocene epoch. Williams (1949, p. 51) reports that:

> An imposing Pleistocene glacier flowed down the canyons of Butte and Alder Creeks for a distance of approximately 12 miles. Although its source lay in cirques on the sides of Haight Mountain at elevations of little more than 7,000 feet, its snout extended down to 4,800 feet, in the vicinity of the Soule Ranch. For most of its course, the glacier was only a mile wide, and it varied in thickness between 400 and 500 feet. It overflowed the western rim of the canyon near Grenada Ranch, and it crossed the opposite rim near Mount Shasta Woods. Below these points it left huge lateral moraines in its wake.

A hummocky terrace of coarse, bouldery, fluvioglacial outwash joins the end moraines at the mouth of Butte Creek canyon near the Soule Ranch (44/2W–24P). Near the end moraines the outwash deposits are a heterogeneous mixture in a matrix of gravel, sand, and clay. To the north and northeast the coarse bouldery terrace grades into a gravelly cinder covered plain. In some places many stone circles, 75 to 100 feet in diameter, appear on the surface of the outwash deposits. Similar stone circles or circular soil structures were noted on the surface of outwash deposits near Edgewood in Shasta Valley and elsewhere in northeastern Siskiyou County. As described by Masson (1949, p. 64) the processes in the formation of these stone circles are: (a) The concentration of clay into local centers; (b) the upfreezing of stones to the surface; and (c) radial or centrifugal movement of stones away from the clay centers during freezing and thawing.

#### WATER-BEARING PROPERTIES

No data are available regarding the potential yield of water from glacial moraines and fluvioglacial deposits. Moderate supplies of water probably can be obtained from wells penerating the fluvioglacial deposits bordering Butte Creek where recharge is available. The glacial moraines probably are poorly water bearing.

### LAKE DEPOSITS (PLEISTOCENE AND RECENT)

#### CHARACTER AND DISTRIBUTION

Lake deposits underlie most of the Butte Valley plain and Red Rock Valley, indicating that at one time a large lake or lakes covered most of the Butte Valley region. Because of the scarcity of surface exposures, the extent and character of these deposits were determined almost wholly from well logs, and the water-bearing properties by pumping tests. Drillers report that wells drilled in 45/1W–10A and 46/1W–34K entered "chalk," clay, and sand after passing through a thick basaltic flow. Also a log of well 46/1W–22K2 (table 8) east of Macdoel and the logs of wells (45/1E–11C2, 45/1E–16P1, table 9) in Red Rock Valley shows that the lake once extended over that area. Later the lake may have been displaced by the advance of the Butte Valley basalt.

The lake deposits rest unconformably on the older volcanic rocks of the "High Cascades." In the southern part of Butte Valley they are overlain by the Butte Valley basalt. Along the eastern and western margins of the Valley they interfinger with alluvial fans and talus. In the central part of the valley much of the surface is underlain by a layer of hardpan which in most places is exposed or is within 2 or 3 feet of the land surface. The hardpan consists of cemented clayey deposits in which the cement is principally calcium carbonate ($CaCO_3$).

The maximum thickness of the lake deposits is not known. However, well 45/2W–3Q1, at the south end of Butte Valley, entered volcanic rock at a depth of 350 feet. North of Macdoel test well 47/1W–31G1 bottomed in lake deposits at a depth of 498 feet. Near Inlow Butte, test well 46/1W–1A1 bottomed in lake deposits at a depth of 735 feet. West of Dorris, test well 47/1W–4D1 entered welded basaltic tuff at a depth of 390 feet. At Dorris a well drilled in 1908 for the California Northeastern Railroad passed through 947 feet of alluvium and lake deposits before entering hard lava. The presence of Meiss Lake on the west side of this basin and the predominance of clay in the area west of U.S. Highway 97 suggest that the lake deposits thicken westward and probably reach a maximum thickness north of Meiss Ranch (46/2W–9Q).

Most of the lake deposits are of Pleistocene age, although sediments now being deposited in Meiss Lake (a remnant of the lake in which the deposits accumulated) indicate that, locally at least, deposition has continued to the present. Williams (1949, p. 45) believes that the structural basin in which these beds were deposited was formed in late Pleistocene time. The following invertebrate fossils were collected by the writer from a highly fossiliferous volcanic sand in the lake deposits in 47/1E–8A, and identified as follows, by J. P. E. Morrison (written communication, Oct. 29, 1954) of the U.S. National Museum:

Gastropods:

*Lanx* (*Lanx*) sp. cf. *moribundus* Hanna 1922
—— (*Walkerola*) sp. cf. *patelloides* (Lea) (with some color spots remaining)
?*Carinifex newberryi* (Lea)
*Parapholyx packardi* Hannibal
—— sp. (large, costate)
—— sp. (small, high-spired)

NOTE.—All three of these "Parapholyx" species are intermediate in umbilication between the Recent *Parapholyx* species and the Pleistocene *Pompholopsis*. I suspect they may eventually all be put together under the oldest valid name—*Pompholopsis*.

Pelecypods:

*Pisidium* sp. cf. *liljeborgi* Clessin

Ostracodes from this same fossil locality were identified by I. G. Sohn (written communication, Jan. 13, 1955) of the Geological Survey, who states:

The ostracodes are mostly internal casts, but identifications of genera are possible on gross shape. Pliocene(?) age determination is based on the presence of one carapace and an additional cast of *Tuberocyproides*? sp., a genus described from the Salt Lake formation (Pliocene) of Utah, of which I have an additional species from Idaho determined as Pliocene(?).
The following forms are represented:

*Candona* sp.
*Limnocythere*? sp.
*Tuberocyproides*? sp.
Genus indet.

In a memorandum (Jan. 13, 1955) accompanying these reports, E. L. Yochelson of the Geological Survey states:

The age difference between Pliocene(?) in this report [I. G. Sohn] and Pleistocene(?) in Mr. Morrison's report of Oct. 29, 1954 should not be taken as a statement of disagreement, but rather as an indication of the extent of our knowledge of the stratigraphic ranges of late Tertiary fresh-water invertebrates.

The character of the lake deposits penetrated by wells is shown on the geologic sections *A–A′*, *B–B′*, and *C–C′* (pl. 3) and described in tables 8 and 9. In general, the lake deposits are composed of partly consolidated clay, silt, and sand and a few thin lenses or stringers of coarse to gravelly sand.

In the southern part of Butte Valley, about 90 feet below the land surface, a thick basaltic flow overlies the lake deposits. Near the lower end of the flow, extended lobes or tongues seem to be interstratified with the lake deposits (pl. 3, section *A–A′*). In the southwestern part of the valley, south of Macdoel, the basalt is overlain by 20 to 60 feet of poorly sorted volcanic sand and gravel. In the northwestern part of the valley, west of U.S. Highway 97 and north of the eastward-trending road along the south line of secs. 23 and 24, T. 46 N., R. 2 W., logs of test wells drilled by the U.S. Bureau of Reclamation and drillers' logs of test holes and water wells indicate that the lake deposits are predominantly silt and clay. The log of test well 47/1W–31G1 (table 8), drilled by the Bureau of Reclamation, revealed that after passing through about 60 feet of fine sand and silt the drill bit entered clay and continued in clay to the point where the test well bottomed at a depth of 498 feet. In the northern part of the valley, west of Dorris, the log of test well 47/1W–4D1 (table 8) indicates that about 390 feet of silt and clay overlie welded basaltic tuff and lava, which may be the older volcanic rocks of the "High Cascades."

Logs of wells drilled in the northeastern part of Butte Valley, mostly east of U.S. Highway 97, indicate that the lake deposits are moderately permeable sand interbedded with silt, clay, and diatomaceous clay. Test well 46/1W–1A1 (table 8), drilled by the Bureau of Reclamation, penetrated three separate sand sections, separated by thick silt or clay sections.

Logs of irrigation wells and outcrop studies show that the percentage of sand in the lake deposits is highest near the eastern border of the valley. Some of this sand probably represents old lakeshore or beach deposits formed during the lake-filling period. Some of the sand may represent old dune sand which was reworked and redeposited during an advancing stage of the lake which formerly occupied the valley.

### WATER-BEARING PROPERTIES

The lake deposits vary widely in their ability to transmit water. The fine-grained clayey deposits in the northwestern part of the valley, generally west of U.S. Highway 97, although saturated, yield limited quantities of water to wells. Lake deposits in the northeastern part of the valley, east of U.S. Highway 97, contain a higher percentage of sand and supply moderate quantities of water to wells. The yield and drawdown figures in table 5 are based on drillers' logs and field measurements.

TABLE 5.—*Summary of yield characteristics for wells tapping the lake deposits in the eastern half of Butte Valley*

[Yield and drawdown data from U.S. Bureau of Reclamation, except as indicated]

| Well | Yield (gpm) | Drawdown (feet) | Specific capacity (gpm per foot of drawdown) | Saturated thickness (feet) | Yield factor [1] |
|---|---|---|---|---|---|
| 46/1W- 2F1 | 1,500 | 100 | 15 | 280 | 5 |
| 2G1 | 1,600 | 105 | 15 | 365 | 4 |
| 47/1E-29N1 | 2,500 | 40 | 62 | 275 | 23 |
| 30R1 | 2,500 | 50 | 50 | 300 | 17 |
| 31A1 [2] | 3,000 | 70 | 43 | 300 | 14 |
| 31J1 | 2,000 | 47 | 42 | 300 | 14 |
| 47/1W-13P1 [2] | 2,000 | 58 | 34 | 140 | 24 |
| 23A1 | 970 | 62 | 16 | 114 | 14 |
| 23H1 | 1,100 | 35 | 31 | 190 | 16 |
| 24C1 | 940 | 49 | 19 | 166 | 11 |
| 34Q1 [2] | 1,800 | 124 | 15 | 342 | 4 |
| 34R1 | 1,400 | 100 | 14 | 272 | 5 |
| 34H1 | 1,000 | 108 | 9 | ---------- | ---------- |

[1] Specific capacity divided by saturated thickness, times 100.
[2] Data from driller's log.

Drawdown and recovery tests as described by Wenzel (1942, p. 87–91) were made on three wells, 47/1W–23A1, 23H1, and 24C1, to estimate the permeability of the lake deposits southwest of Cedar Point. These tests yielded only approximate results because they were short, because regional water-level trends could not be closely determined, and because pumping of nearby wells could not be controlled. The permeabilities obtained ranged from about 140 to 230 gpd per square foot and averaged about 200 gpd per square foot. The yield factors for these 3 wells average nearly 14 (table 5). For these wells the ratio of permeability to yield factor is about 15 to 1. Wells along the eastern margin of the valley between Cedar Point and Inlow Butte have an average yield factor of 17 (table 5), which suggests that permeabilities in this area may be about 200 to 250 gpd per square foot. Yield factors for wells in the area between Inlow Butte and U.S. Highway 97 range between 4 and 5, suggesting that in this area the lake deposits may be about one-third as permeable as the deposits along the eastern margin of the valley.

In the southern part of the valley the Butte Valley basalt is interstratified with the lake deposits and yields large quantities of water to wells. Many of the wells in this area pass through the basalt and receive moderate supplies of water from the underlying lake sediments. Table 6 summarizes the yield characteristics for wells penetrating the lake deposits and Butte Valley basalt.

In the eastern part of the valley, wells 46/1E–6J1, 6N1, 7D1, 46/1W–1G1 and 12H1, penetrate the easternmost lobe of the Butte Valley basalt (pl. 2) but probably draw most of their water from the alluvium and the underlying lake deposits because the basalt in

TABLE 6.—*Summary of yield characteristics for wells tapping the lake deposits and Butte Valley basalt*

[Yield and drawdown data from U.S. Bureau of Reclamation, except as indicated]

| Well | Yield (gpm) | Drawdown (feet) | Specific capacity (gpm per foot of drawdown) | Saturated thickness (feet) | Yield factor [1] |
|---|---|---|---|---|---|
| 45/2W- 1Q1 | 1, 400 | 7 | 200 | 45 | 444 |
| 3Q1 | 800 | 63 | 13 | [2] 398 | 3 |
| 46/1E—6J1 [3] | 3, 000 | 64 | 47 | 177 | 26 |
| 6N1 [3] | 2, 600 | 68 | 38 | 176 | 22 |
| 7D1 | 1, 800 | 43 | 42 | 177 | 24 |
| 46/1W- 1G1 | 1, 100 | [4] 70 | [4] 16 | 190 | [4] 8 |
| 12H1 [3] | 1, 300 | 43 | 30 | 146 | 20 |
| 17B1 | [4] 2, 000 | 7 | [4] 300 | 40 | [4] 750 |
| 17B2 | [4] 4, 000 | [4] 10 | [4] 400 | [4] 45 | [4] 900 |
| 17G1 | 1, 500 | [4] 22 | [4] 68 | ---------- | ---------- |
| 18Q1 | 2, 000 | 16 | 125 | 76 | 164 |
| 18Q2 | 1, 900 | 6 | 317 | 60 | 528 |
| 19G1 | 1, 300 | 4 | 325 | ---------- | ---------- |
| 19H1 | 1, 700 | 20 | 85 | ---------- | ---------- |
| 20B1 [3] | 1, 500 | 63 | 24 | 130 | 18 |
| 28D1 | 1, 600 | 34 | 47 | ---------- | ---------- |
| 28F1 | 2, 000 | 27 | 74 | ---------- | ---------- |
| 29G1 [3] | 2, 000 | 30 | 67 | 74 | 90 |
| 31J1 | 1, 400 | 12 | 117 | 56 | 209 |
| 31J2 [3] | 1, 100 | 1 | 1, 100 | 56 | 1, 960 |
| 46/2W-12Q1 | 1, 300 | 30 | 43 | 63 | 68 |
| 13A1 [3] | 1, 900 | 36 | 53 | 86 | 62 |
| 25R1 | 1, 300 | 23 | 56 | 61 | 92 |
| 25R2 | 2, 500 | 14 | 179 | 83 | 215 |
| 36A1 | 975 | 30 | 32 | ---------- | ---------- |
| 36H1 | 4, 100 | 15 | 273 | 51 | 535 |
| 36L1 [3] | 1, 000 | 1 | 1, 000 | 113 | 885 |

[1] Specific capacity divided by saturated thickness, times 100.
[2] Lake deposits largely clay in lower 330 feet of saturated section beneath the basalt, leaving 68 feet of water-yielding thickness.
[3] Data from driller's log.
[4] Estimated by author from field observation and from data on nearby wells.

the area is thin and commonly above the saturated zone (pl. 3, section *B–B′*). The average yield factor for these wells is about 20 (table 6) and compares reasonably well with the average yield factor of about 14 (table 5) for wells on which the reconnaissance permeability tests were made.

South of Macdoel the yields of irrigation wells range from about 1,000 gpm to 4,000 gpm or more. In that area the interstratified basalt is largely within the saturated zone (pl. 3, section *A–A′*) and yields large quantities of water to wells.

The low yield factor of well 45/2W–3Q1 was based on the total saturated thickness of 398 feet. Most of the materials penetrated which were below a depth of 96 feet consisted of poorly permeable, clayey lake deposits (table 8). These materials probably furnish little water to the well and most of the water is supplied from the overlying Butte Valley basalt. Thus, using a saturated thickness of 68 feet for the upper 96 feet of the section penetrated by the well, a yield factor of 19 is obtained for the water-yielding basalt, which is comparable with the yield factors of wells penetrating the less-fractured flows of the interstratified basalt.

Wells 46/1W–17B1, 17B2, 18Q1, and 18Q2 near Macdoel and wells 45/2W–1Q1, 46/1W–31J1, 31J2, 46/2W–25R2, 36H1, and 36L1 near the town of Mount Hebron have yield factors greater than 100. Wells having high yield factors that average more than 600 (table 6) probably penetrate highly fractured or scoriaceous basalt. Wells having yield factors of less than 100 (average 65) probably enter more solid, less broken sections of the basalt and receive much of their water supply from ground water moving along the base of the flow and from the fine-grained lake deposits underlying the basalt.

### ALLUVIAL-FAN DEPOSITS (PLEISTOCENE AND RECENT)

The alluvial-fan deposits shown on plate 1 include fan deposits of Recent age being built by Prather, Muskgrave, Harris, and Ikes Creeks on the west side of Butte Valley and the isolated remnants of older alluvial-terrace deposits and older dissected alluvial-fan deposits of Pleistocene age.

#### OLDER TERRACE REMNANTS AND DISSECTED ALLUVIAL-FAN DEPOSITS

Older terrace remnants and dissected alluvial-fan deposits include several isolated bodies of clay, sand, and gravel that occur above the present floor of Butte Valley and above present stream grades. These deposits are thin and of small extent, and locally they cover older rock units on which they lie unconformably. No fossils were found in these beds, and based on stratigraphic position, they are probably Pleistocene in age.

The isolated terrace deposit southwest of Bray (44/1W–21J) may be a remnant of a flood-plain deposit built by Butte Creek when it was dammed by the Butte Valley basalt near Bray. The small terrace deposits near Cedar Point (47/1E–7) are probably remnants of former lake shore deposits which have been disturbed and uplifted by recent faulting along the steep scarps in this area. The deposit northwest of Dorris, largely in 48/1W–15, and the deposit on Oklahoma Flat in 47/2E–16 are older alluvial-fan deposits.

The deposits near Dorris and Oklahoma Flat consist of gray, unconsolidated, poorly sorted, locally crossbedded, lenticular beds of fine- to coarse-grained sand, gravel, and smoothly rounded cobbles of volcanic origin. Their thickness probably does not exceed 30 feet. Near Cedar Point the terrace remnants are composed of unconsolidated brown sand and well-rounded basaltic cobbles. Loose, smoothly rounded basaltic cobbles, ranging from less than 1 to about 3 inches in diameter, were noted at several places along the foot of the steep westward-facing scarp east of Dorris. These cobbles, and the well-rounded "pea" gravel exposed in a small gravel pit a short distance southeast of well 48/1E–32Q1, are probably remnants of a former lakeshore or beach deposit. The terrace deposit southwest of Bray consists of fine- to medium-grained sand, silt, and volcanic ash. It is at least 15 feet thick, as grade cuts of that depth along the Southern Pacific railroad do not reveal the underlying material.

These older deposits are unconsolidated and moderately permeable. However, because they are commonly thin, are of limited extent, and commonly occur above the saturated zone, they are of little significance as a source of ground water.

### ALLUVIAL-FAN DEPOSITS

Alluvial materials deposited on the Prather Creek fan and on the three coalescing fans of Muskgrave, Harris, and Ikes Creeks consist of a heterogeneous mixture of volcanic boulders, cobbles, and fragments in a matrix of poorly sorted gravel, sand, and ashy clay. Alluvial-fan deposits are coarse near the mountain front and grade into fine materials in the lower parts of the fans. Most of the material is angular or subangular and poorly consolidated.

Although the maximum thickness of the alluvial-fan deposits is not known, the log of well 46/2W–5C1 (table 8) shows that the coalescing fans of Harris and Ikes Creeks are at least 346 feet thick. The log shows also, by the beds of blue clay and shells, that the alluvial-fan deposits interfinger with lake deposits. The age of these deposits is not known. However, the beds of blue clay and shells indicate that deposition may have been continuous since Pleistocene time.

Alluvial-fan deposits commonly are deposited under erratic conditions of streamflow—at one time the fan may receive coarse materials carried by a raging flood and soon after may receive only the fine-grained sediments of a dissipated stream. Alluvial-fan deposits in the Butte Valley region are being laid down where streams emerge from confined channels in the older volcanic rocks of the High Cascades and enter the flat floor of Butte Valley. There the channels widen, the velocity of the water decreases, the streams lose their carrying power, and most of the bouldery debris is distributed over the head of the fan. As deposition proceeds downstream, poorly sorted alluvial debris is spread outward in a fan whose apex is the canyon from which the stream emerges. The stream channels become choked with alluvial debris and change course frequently. During flood new channels are formed, and the gravel beds of the abandoned channels become covered with poorly sorted alluvium from sheetflooding and rill wash. Hence, the alluvial-fan deposits consist of a thick mass of ill-sorted material containing a branching network of moderately sorted gravel. Meinzer (1923, p. 130) stated that these branching deposits of gravel serve as the principal conduits for ground-water movement.

#### WATER-BEARING PROPERTIES

The alluvial-fan deposits absorb most of the low flow of their respective spring-fed streams. However, because the deposits are poorly sorted and highly lenticular, they are poorly permeable and transmit water slowly, except along buried channels or gravel stringers. The low permeability is demonstrated by well 46/2W-5C1, which did not obtain an appreciable quantity of water from more than 300 feet of saturated material.

### ALLUVIUM (PLEISTOCENE AND RECENT)

#### CHARACTER AND DISTRIBUTION

Material mapped as alluvium includes the following: Thin beds of gravel, sand, clay, and peat overlying older lake deposits in Butte Valley and the area surrounding Lower Klamath Lake; evenly stratified beds of clay and silt deposited in playa lakes; poorly sorted alluvium in the broad, shallow basins or depressions of Red Rock Valley, Long Prairie, and Round Valley, collected through the action of sheetflood, slope wash, and other types of erosion; and alluvial deposits underlying present stream channels.

The alluvium along the eastern border of Butte Valley consists mainly of fine- to coarse-grained sand of volcanic origin, deposited by sheetfloods, slope wash, rill wash, and other colluvial processes. Some of it probably represents lakeshore or beach deposits. In some places alluvium in this area has been redeposited as windblown or dune sand mantling parts of the steep fault scarps along the east side of Butte Valley. In the northern part of the valley the alluvium has been deposited chiefly by sheetfloods, slope wash, and other agents of erosion.

Volcanic sand and gravel exposed in the southwestern part of the valley probably were deposited by flood waters of Butte Creek; in part they may represent a delta built by Butte Creek during high stages of the lake which formerly occupied the valley. Near Macdoel, volcanic sand seems to have been reworked by the wind and redeposited as dune sand. The dunes, stabilized long ago by native vegetation, are being leveled by power equipment and cultivated.

These sand and gravel deposits rest unconformably on the Butte Valley basalt and locally interfinger with the lake deposits (pl. 3). Along the margins of the valley they range in thickness from 0 to a maximum of about 60 feet.

The nearly flat surface surrounding Lower Klamath Lake is underlain by varying thicknesses of unconsolidated sand, silt, clay, and carbonaceous materials. Near Laird Landing (47/2E-35E), Lower Klamath Lake is bordered by an undetermined thickness of peat.

Sediments are being deposited in playas in many parts of the region. These sediments consist of clay, silt, and minor amounts of sand. They occupy the lowest parts of small closed basins and merge laterally into alluvial-slope deposits. The log of well 45/1E-16P1 (table 9), near Russell Lake in Red Rock Valley, indicated that the playa deposits are at least 23 feet thick.

Elsewhere in the Butte Valley region, deposits mapped as alluvium consist of gravel, sand, and silt. Most of the material is poorly sorted and unconsolidated.

These deposits were derived from the decomposition and erosion of volcanic material in adjacent mountain areas and were collected in basins or depressions through the action of streams, sheetfloods, slope wash, and other agents of erosion.

The nearly flat floors of the basins occupied by Long Prairie, Round Valley, and the area south of Antelope Sink, suggest that in these areas the poorly sorted alluvium may be underlain by playa or lake deposits.

#### WATER-BEARING PROPERTIES

In the southwestern part of Butte Valley, sand and gravel overlying the Butte Valley basalt probably yield moderate quantities of water to wells.

Fine-grained playa deposits have low permeability and will yield only small quantities of water to wells. The water from these beds would probably be highly saline.

The unconsolidated, coarse-grained alluvium in shallow basins is important because it absorbs precipitation and runoff and transmits the water to underlying permeable beds.

### TALUS (PLEISTOCENE AND RECENT)

#### CHARACTER AND DISTRIBUTION

Talus along the foot of precipitous fault scarps forms narrow, linear, wedge-shaped deposits which in places are concealed beneath and probably interfinger with alluvial and lake-bed deposits. The talus covers geologic contacts and traces of faults along the base of the steep escarpments. In places, for example along the westward-facing scarps, the talus is covered by windblown sand.

The talus consists of unsorted, uncemented, angular blocks, boulders, and fragments of volcanic rocks that range in size from a few inches to more than 6 feet. In places, the openings between the coarse material have been filled by sand. The thickness and lateral extent of the talus are not known. Well 48/1E-31A1 at the base of the steep escarpment bordering Butte Valley, near Dorris, penetrates at least 143 feet of talus. Well 48/1W–28C1, at the base of the steep escarpment facing Picard Cemetery, penetrates at least 360 feet of talus.

#### WATER-BEARING PROPERTIES

The talus deposits are elongate, porous, highly permeable and are formed along fault scarps. East of Dorris, along the northeast side of Butte Valley, these permeable deposits are conduits for the movement of ground water from the lake deposits to the volcanic rocks of the Mahogany Mountain ridge, and thence to the valleys to the east (pl. 2).

#### DUNE SAND (RECENT)

Dune sand covers a small area in the eastern part of Butte Valley near Inlow Butte (pl. 1). It is composed primarily of fine-to-coarse, massive, loosely compacted crossbedded quartz sand. It has a maximum thickness of about 20 feet. In most places the dunes support a sparse cover of vegetation and seem to be stabilized, but in the W½ sec. 20 and in the SW¼ sec. 32, T. 47 N., R. 1 E., sand is advancing upon older dunes, talus, and older volcanic rocks of the "High Cascades." The dune sand in this area was derived from the lake and alluvial deposits and has migrated eastward and northeastward from the abandoned shoreline in 47/1E–19, 30, and 31.

Elsewhere in the Butte Valley region, either the dune sand is too thin, or it occurs in scattered dunes too small, to be shown on the geologic map. Along the westward-facing escarpments bordering Butte Valley, dune sand mantles the older volcanic rocks of the "High Cascades," and east of Dorris the sand has blown over the Mahogany Mountain ridge and mantles the steep eastern slope in 48/1E–29 and 32. Dune sand occurs also along the northeastern shore of Indian Tom Lake.

#### WATER-BEARING PROPERTIES

The dune sand is above the zone of saturation and not a source of ground-water supply. Wherever it overlies permeable older rocks, however, it facilitates their recharge by readily absorbing precipitation and transmitting it downward.

## STRUCTURE

According to Callaghan (Callaghan and Buddington, 1938, p. 18), the volcanic rocks of the "Western Cascades" were deformed, probably in late Miocene time, by tilting, broad folding and minor normal faulting. Williams (1949, p. 35, 52) suggested that the entire Cascade belt was greatly upheaved at the close of the Miocene epoch and this upheaval was accompanied by the formation of several faults trending slightly northwestward. Although Williams stated that there is no evidence of faulting of the volcanic rocks of the "Western Cascades" in the gorge of the Klamath River, he pointed out (1949, p. 52) that northward-trending faults may underlie lava cones of the "High Cascades" farther south. In this area, along the western border of these cones the volcanic rocks of the "Western Cascades" rise to altitudes 1,000 to 1,500 feet higher than those along the east side of the range. This suggestion seems valid, because volcanic rocks of the "Western Cascades" have not been recognized on the east side of the range. More detailed work in the Ikes Mountain area may disclose lavas or pyroclastic rocks equivalent to the rocks of the "Western Cascades."

The most easily recognized structural feature in the "Western Cascades" is the gentle eastward or northeastward dip. Williams (1949, p. 52) reports that for the most part the beds in the "Western Cascades" dip at angles that range from about 15° near the west edge of the outcrop area to about 5° where they disappear beneath the lavas of the "High Cascades." Williams (1949, p. 52) reports:

> Only in one place, near the Hessig Ranch on the Klamath River, is this regional dip interrupted by a flexure. There the volcanic rocks are arched into a gentle anticline pitching to the southeast, precisely where initial dips denote the former presence of a steep volcanic cone. [See the section on volcanic rocks of the "Western Cascades."]

The belt of volcanoes of the "High Cascades" trends north-northwestward from Mount Lassen in California to Mount McLoughlin in southern Oregon, then northeastward toward Mount Hood, Oreg. Williams (1949) believes that the Pliocene and younger lavas comprising the volcanoes of the "High Cascades" issued from fissures which were alined along fault zones near the crest of the range.

East of the Cascade Range, block faulting is the dominant structural feature (pl. 3). The faults are normal and have only a minor horizontal component. Vertical displacements range from a few feet along minor faults to perhaps several thousand feet along major faults, such as those along the foot of the Mahogany Mountain ridge. In most places, especially near Cedar Point (47/1E–7), the major faults comprise a number of subparallel slippage planes that divide the fault zones into "splinter" blocks. East of Cedar Point, nearly flat flows have been broken and tilted eastward and northeastward by differential movement along several in echelon faults.

The well-marked scarps follow two principal directions, one north and the other about northeast. In several places, such as near Meiss Ranch, the scarps show abrupt changes in trend where the northeastward-trending faults meet those which trend northward.

Northward- to northwestward-trending cracks or fissures, ranging in width from a few inches to about 30 feet and in length from less than 1 to more than 15 miles, are prominent features in the surface of the Butte Valley basalt south and southeast of Butte Valley. To the north the cracks are concealed by alluvium. Although their origin is uncertain, the cracks may represent buried faults or shear zones in the volcanic bedrock, or tensional cracks developed during solidification of the basaltic rocks.

Butte Valley is a complexly downfaulted basin which probably is deepest along its western side. Although the total thickness of the valley fill is not known, well logs indicate that it exceeds 900 feet. Wells penetrating volcanic bedrock are shown on plate 2.

Sams Neck and Pleasant Valley are grabens that project northward beyond the main structural depression of Butte Valley. Also, the area around Dorris may be a graben between horsts formed by Cedar Point and the Mahogany Mountain ridge.

The Oklahoma district and the marshland surrounding Lower Klamath Lake are part of a complexly downfaulted basin which structurally as well as topographically may be considered a part of the Klamath Lake basin.

## GROUND WATER

### OCCURRENCE AND MOVEMENT OF GROUND WATER

In the Butte Valley region all the voids in the rocks below a certain level, known as the water table or upper surface of the zone of saturation, are filled with water. This water is derived chiefly from precipitation that falls within the drainage area. However, not all the precipitation that falls on this or any other area reaches the ground-water body; some returns to the atmosphere by evaporation from exposed water and soil surfaces and by transpiration from the leaves and stems of plants; and some runs off directly at the surface. A part of the water that becomes surface runoff reaches the ground-water body by seepage loss from streams. The water supplied from these sources seeps down to the water table and then percolates laterally through openings or interstices in the water-bearing formations, in conformance with the hydraulic gradient, from areas of replenishment to points of discharge. Eventually part of the water is evaporated and transpired, and the rest seeps into streams, helping to maintain their base flow.

Most of the formations that are shown on the geologic map (pl. 1) and described in this report contain ground water, but they differ greatly in extent, thickness, and lithologic character and, hence, in their ability to transmit and yield water. The water-bearing character of these formations is summarized on pages 18–48.

In sedimentary and alluvial deposits, the water table may be defined as the upper surface of the zone of saturation. If anywhere within the zone of saturation an extensive impermeable bed is situated so as to form a confining layer, water contained in deposits beneath the confining layer is said to be under artesian pressure. Under these circumstances the water is under sufficient pressure to cause water levels in tightly cased wells to rise above the base of the confining layer. Below the water table all openings in the rocks are filled with ground water. Thus, the part of a well that extends into the zone of saturation is filled with water, and the water surface in the well may be regarded either as the water table, or as the pressure surface if the water is confined.

In fractured, impervious rocks, such as the Butte Valley basalt and other volcanic rocks, the water table has been defined by Tolman (1937, p. 291) as:

* * * the surface at the contact between the water body in the fractures and the overlying ground air. This surface is interrupted by the impervious rock between fractures and constitutes only a small portion of the plane projected through the water-air contact in the network of fractures.

The open fractures in volcanic rocks may be regularly spaced and part of an oriented joint system, such as in columnar basalt. More commonly, the fractures are irregular and are caused by stresses developed by the fluid part acting on the solidified or partially solidified part of the flow, and by contraction due to differential cooling of the upper and lower surfaces. In general, the fractures are nearly vertical to the bedded flows and are an important factor in the development of the vertical permeability of basaltic flows.

The water table in fractured rocks generally slopes from the intake areas to points of discharge. The principal ground-water movement takes place in enlarged parts of fractures and along scoriaceous contacts between flows. The effective fractures and contact zones are large enough to permit ground-water movement with small frictional resistance. Thus, rocks having large openings in the interconnected fissure systems have high permeabilities and are capable of transmitting large quantities of water under a low hydraulic gradient.

According to Tolman (1937, p. 309):

* * * the characteristic features governing ground-water movements and accumulation in lava are (1) vertical permeability due to fractures, (2) horizontal porosity and permeability in zones containing openings due to flow and gas expansion during solidification, and (3) occurrence of impervious horizons and dikes.

Some of these characteristics are discussed in more detail in the section on the water-bearing properties of the Butte Valley basalt.

Plate 2 shows the location of all water wells and test wells in which the depth to water was measured. The water-level contours in Butte Valley are based on water-level measurements made during the first week in May 1954. Ground-water contours are not shown in Red Rock Valley, the Oklahoma district, or elsewhere in the region, because of inadequate data. Most of the wells in Red Rock Valley are stock wells whose casings have been covered with heavy metal plates and so are not accessible for measurements

The shape and slope of the surface of the ground-water body in Butte Valley is shown by the water-level contours (contour interval 5 feet) on plate 2. Ground-water contours show the configuration of the ground-water surface in much the same way that topographic contours show the shape of a land surface. The direction of ground-water movement is always down the hydraulic gradient, or slope of the ground-water surface, at right angles to the contour lines.

Ground water moves northeastward across Butte Valley and discharges into buried talus material and volcanic rocks along the northeastern border of the valley near Dorris. Southwest of the town of Mount Hebron the ground-water gradient is about 20 feet per mile northeastward. Between the towns of Mount Hebron and Macdoel the ground-water surface is nearly flat as the water moves through the highly permeable Butte Valley basalt.

In the west-central part of the valley the ground-water surface slopes gently away from Meiss Lake. This lake originally occupied a topographic depression west of its present location. The depression was below the general ground-water level, hence the original lake was supplied in large part by ground-water seepage, and its surface reflected the general level of the adjacent ground-water surface. In recent years an earthen dike has been constructed on higher ground east of the lake, and water has been pumped from the lake and allowed to spread over poorly productive land. The original lake bed now is cultivated, but being an area of natural ground-water discharge, it must be kept drained to prevent waterlogging. Seepage loss from the present Meiss Lake is restricted by clayey lake deposits which underlie this part of the valley.

Northeast of Meiss Lake, ground water moves through the fine-grained lake deposits under a gradient that ranges from less than 2 to about 5 feet per mile. Near Cedar Point the gradient increases to about 10 feet per mile.

East of Dorris, ground water moves toward Mahogany Mountain ridge at gradients ranging from 30 to more than 70 feet per mile (pl. 2). The geologic map suggests that one or more of the northwestward-trending faults between Cedar Point and Mahogany Mountain ridge may extend across this part of the valley. One or more of these faults may cut the lake deposits at depth and create barriers to the eastward movement of ground water. Or, these sub-

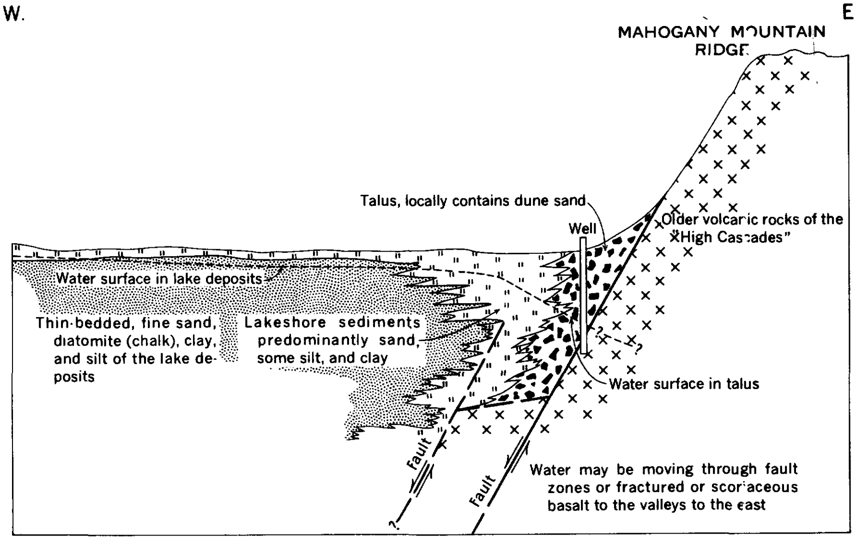



FIGURE 4.—Diagrammatic section showing the steepened hydraulic gradient at the northeast side of Butte Valley near Dorris.

siding faults may have uplifted sliver blocks and decreased the effective cross-sectional area through which the ground water could move, which also would cause a steepening of the gradient. The steepened gradient may also be caused by a sudden increase in the vertical permeability as water moves from stratified deposits to vertically fractured rocks adjacent to the ridge. Drillers' logs and other geologic evidence (pl. 1) suggest that in the eastern part of the valley, clayey lake deposits interfinger with sandy lakeshore deposits, and near the eastern border of the valley the lakeshore deposits interfinger with blocky talus debris adjoining the steep fault scarps.

The water-level profile (fig. 4) shows the steep slope formed when ground water contained in the lake deposits cascades to the water table of a lower body of ground water contained in the fractured volcanic rocks composing the Mahogany Mountain ridge. A similar ground-water cascade was described by Meyers (Meyers and Newcomb, 1952) near the foot of Swan Lake ridge in Oregon. Ground water discharged from Butte Valley may move eastward through the fractured volcanic rocks composing the Mahogany Mountain ridge, or along northward-trending fault zones which might provide conduits to the valleys east of the ridge. Ground water may enter the flat plain bordering Lower Klamath Lake as subsurface inflow, possibly supplying the flow of springs 47/1E–1M1, 10B1, and 23H1.

Wells that draw large quantities of water from the ground-water reservoir often cause local depressions in the water table or in the piezometric surface. In Butte Valley, depressions have formed in two areas, one near Macdoel and another west of Inlow Butte. The depression near Macdoel was caused by heavy pumping of three closely spaced irrigation wells (46/1W–17B1, B2, and G1). The hydraulic gradient toward the pumped wells increased to about 10 feet per mile. West of Inlow Butte a shallow depression was caused by pumping seven closely spaced irrigation wells.

The ground-water depression west of the present Meiss Lake probably was formed after drainage ditches were constructed in the original lake bed. (See p. 52.) Ground water collected by the drainage ditches moves toward a pumping station located near the E¼ cor. sec. 2, T. 47 N., R. 2 W. and is pumped over an earthen dike into the present Meiss Lake. When additional water is needed for irrigation, it is caused to flow from the lake back into the drainage ditches on the former lake floor and is pumped from these ditches into shallow canals for distribution to irrigated areas.

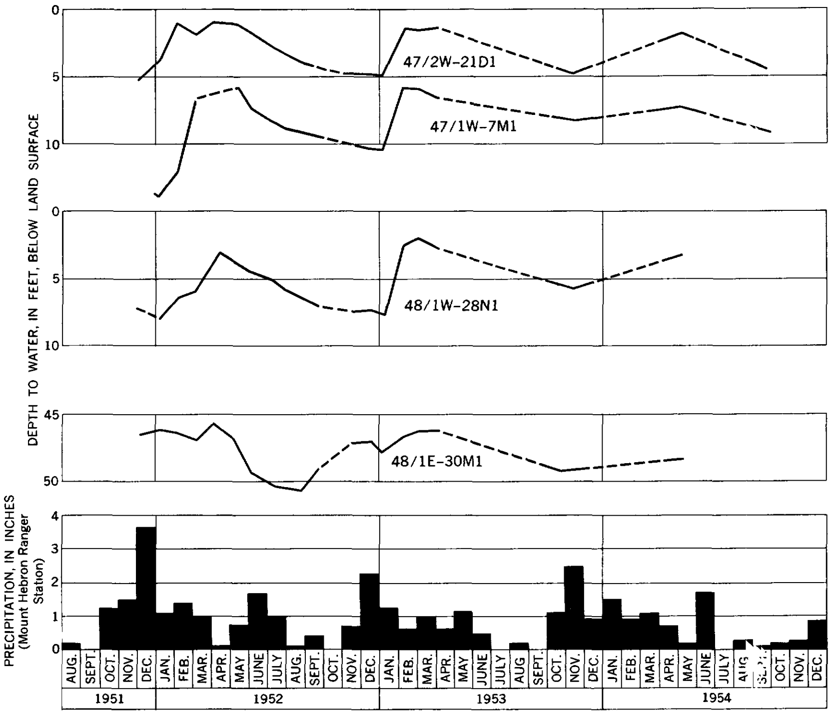
In Red Rock Valley, the direction of movement and points of discharge of ground water were not determined. The depth to water in measurable wells, given in plate 2, was obtained in June 1954. The altitudes of the land surface and the water levels were interpolated from topographic contours.

In the Oklahoma district the shape of the ground-water body and direction of ground-water movement were not determined.

## FLUCTUATIONS OF WATER LEVELS

The ground-water surface fluctuates in response to changes in the ground-water regimen. The rise or decline of this surface depends upon the relation between recharge into and discharge from the ground-water reservoir. Where withdrawal exceeds inflow the ground-water surface declines, and conversely, where inflow exceeds withdrawal, the ground-water surface rises. As pointed out by Stearns (Stearns and others, 1930, p. 116–117), the fluctuations of water levels in wells are an index to the inflow and outflow of water from the ground-water reservoir, somewhat as the fluctuation of the water level in a surface reservoir indicates the amount of water in it. However, in response to recharge or discharge of a given number of acre-feet of water the ground-water surface fluctuates through a larger range than does the water level in a surface reservoir.

The rate at which the ground-water surface rises or declines depends on the rate at which the underground supply is replenished or withdrawn. Some of the causes of a rise in the ground-water surface of Butte Valley are: (a) The precipitation that percolates downward through the soil to the ground-water body, (b) recharge by lateral movement of ground water from the fractured volcanic rocks of the Cascade Range west of Butte Valley, and (c) recharge by seepage loss from streams in the southern and western parts of




47/2W-21D1

Use: U. S. Bureau of Reclamation test well
Altitude: 4237 ft
Depth: 81 ft
Casing size: 2 in.; 6 in. hole cinder packed
Perforations: 60-81 ft

47/1W-7M1

Use: U. S. Bureau of Reclamation test well
Altitude: 4242 ft
Depth: 50 ft
Casing size: 2 in.; 6 in. hole cinder packed
Perforations: 26-50 ft

48/1W-28N1

Use: U. S. Bureau of Reclamation test well
Altitude: 4245 ft
Depth: 50 ft
Casing size: 2 in.; 6 in. hole cinder packed
Perforations: 40-50 ft

48/1E-30M1

Use: Domestic well
Altitude: 4246 ft
Depth: 415 ft
Not cased; 6 in. hole cinder packed
Hydrograph represents a composite head between two water bodies; water flows into an old dug well from the uncased 6 in. well

FIGURE 5.—Fluctuations of water levels in wells along the north side of Butte Valley and monthly precipitation at Mount Hebron ranger station, 1951–54.

the valley. The principal causes of a decline in the ground-water surface of Butte Valley are: (a) The water lost through transpiration where the water table is within reach of plants, (b) the evaporation directly from the ground-water reservoir where it lies near the land surface, as near Meiss Lake, (c) the extractions from the ground-water reservoir by pumping, and (d) the discharge of water from the valley on the northeast near Dorris.

To determine the character and magnitude of the water-level fluctuations in Butte Valley the U.S. Bureau of Reclamation made monthly measurements of the depth to water in about 45 wells from November and December 1951 to April 1953. Semiannual measurements of depth to water in most measurable wells were made during the same period. The Geological Survey continued semiannual

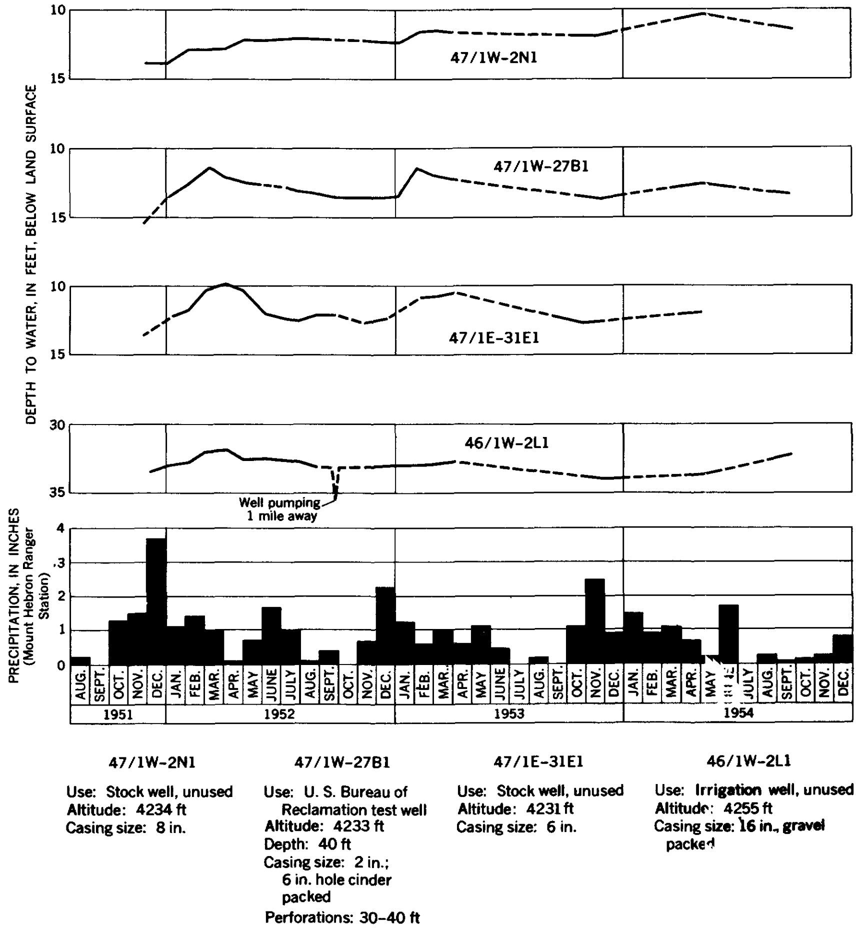
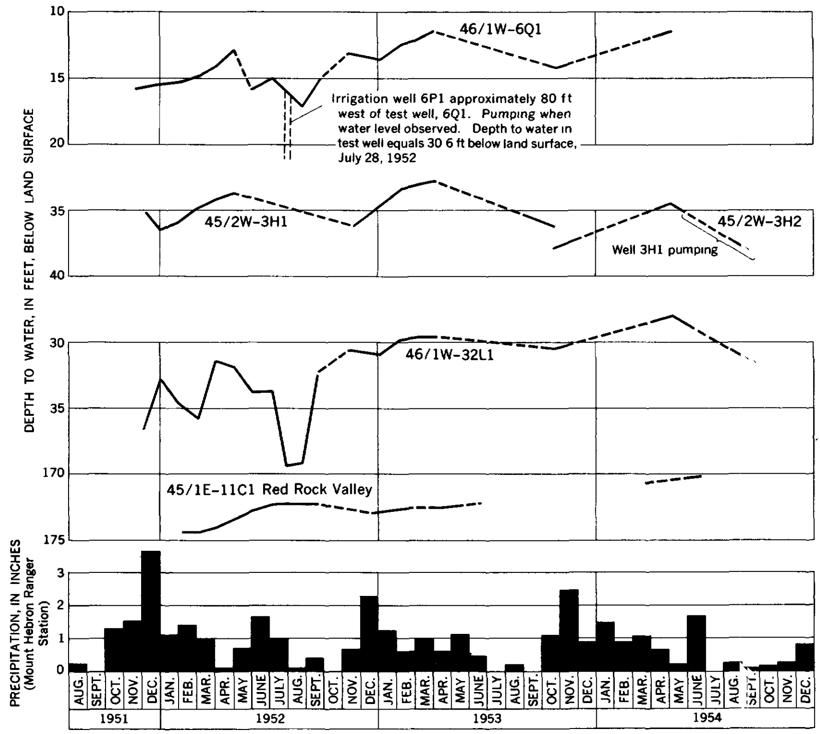



FIGURE 6.—Fluctuations of water levels in wells in the central and eastern parts of Butte Valley and monthly precipitation at Mount Hebron ranger station, 1951–54.

measurements in most measurable wells in Butte Valley from the autumn of 1953 to that of 1954. The available records of water levels in these wells are given in table 11. The well locations are shown on plate 1.

Records of water-level fluctuations are useful for the interpretation of past and present hydrologic conditions. By comparing the water levels measured during late winter or early spring in successive years, the net rise or net decline of the ground-water surface can be determined. The records obtained for Butte Valley show little net change in water levels from year to year.

At the beginning of each irrigation season the water levels start to decline. In general they continue to decline until the end of the pumping season in late summer or autumn, indicating the effect




| 46/1W-6Q1 | 45/2W-3H1 | 45/2W-3H2 | 46/1W-32L1 | 45/1E-11C1 |
|---|---|---|---|---|
| Use: U. S. Bureau of Reclamation test well | Use: Irrigation well | Use: Unused test well | Use: Domestic well | Use: Domestic and stock well |
| Altitude: 4237 ft | Altitude: 4260 ft | Altitude: 4262 ft | Altitude: 4254 ft | Altitude: 4395.7 ft |
| Depth: 36 ft | Depth: 270 ft | Depth: 238 ft | Casing size: 6 in. | Depth: 221 ft |
| Casing size: 2 in.; 6 in. hole cinder packed | Casing size: 18 in.; gravel packed | Casing size: 12 in. | | Casing size: 12 in. |
| Perforations: 26-36 ft | Perforations: 15-270 ft | | | |

**Figure 7.—Fluctuations of water levels in wells in the southern part of Butte Valley and in Red Rock Valley and monthly precipitation at Mount Hebron ranger station, 1951–54.**

both of pumping and of deficient precipitation. At the end of the irrigation season the water levels start to rise and continue upward until the following spring, indicating both recovery from pumping and recharge from winter precipitation. Hydrographs drawn from water-level measurements indicate that the average range between summer and winter water levels varies greatly throughout the valley.

Figures 5, 6, and 7 show fluctuations of water levels in 13 selected wells and monthly precipitation at the Mount Hebron ranger station (46/1W-32K) for the period 1951–54. The hydrographs on figure 5 are for wells along the northern border of Butte Valley and indicate that the seasonal water-level fluctuations range from about 2 to 8 feet; the wells represented on figure 6 are in the central and eastern parts of the valley and indicate that the seasonal fluctuations range from less than 1 to about 10 feet; those represented on figure 7 are in the southern part of Butte Valley and in Red Rock Valley and indicate that the seasonal fluctuations range from about 1 to 5 feet. The well locations are shown on plates 1 and 2.

### RECHARGE

Recharge is the addition of water to the ground-water reservoir. In the Butte Valley region ground water is replenished from precipitation, either directly through percolation of rain or melting snow in the catchment areas or indirectly by seepage loss from stream beds or canals crossing the valley floors.

Much of the water from rain and melted snow that is absorbed by the soil is later returned to the atmosphere by evaporation or is consumed by vegetation, but virtually all the water that penetrates below the root zone reaches the ground-water body.

A large amount of recharge is supplied by seepage loss from perennial streams and unlined canals in the southern part of the region and from small spring-fed streams discharging onto alluvial fans along the western border of Butte Valley.

Owing to the low permeability of the deposits, recharge by subsurface inflow from the alluvial fans probably is low. Subsurface inflow from Butte and Antelope Creeks probably is high because much of the water either sinks into fractured volcanic rocks or is absorbed by coarse alluvial materials mantling the volcanic rocks near the mouths of the streams.

Because water levels in wells rise during periods of winter precipitation (figs. 5–7) and because water-level contours (pl. 2) indicate that recharge is supplied to Butte Valley from the volcanic rocks along the north, west, and south sides of the valley, the ground-water reservoir is probably recharged in part by the deep percolation of local precipitation. This precipitation seeps down through the fractures to the zone of saturation and then moves laterally into the sedimentary deposits beneath the valley floor.

### DISCHARGE

#### BUTTE VALLEY

In most closed basins in the semiarid parts of the West all excess ground water is discharged by evaporation and transpiration from shallow lakes or swampy tracts in the lowest parts of the valleys. Although Butte Valley is a closed basin, it has an underground outlet, through the fractured, permeable, volcanic rocks forming the eastern border of the valley.

Before wells were drilled in the valley the ground-water reservoir was in equilibrium. The annual inflow or recharge to the reservoir was balanced by the annual outflow or discharge, and except for small seasonal fluctuations, the water table remained moderately stable. Discharge took place by subsurface outflow through the Mahogany Mountain ridge, by evaporation from the surface of Meiss Lake and the shallow water table in its vicinity, and by transpiration from vegetation.

To the natural discharge of ground water from Butte Valley now must be added a substantial quantity of water pumped from wells. No records are available of the amounts of water pumped for irrigation in the area, but the California Division of Water Resources (Horn and others, 1954, table 22) estimated that the mean seasonal water requirements in 1953, including supplies used for agricultural, industrial, domestic, and stock use, amounted to about 30,000 acre-feet. The pumping is balanced by a decrease in natural discharge, by a reduction in storage, and perhaps in part by an increase in recharge. The latter would occur locally where abundant water is available from precipitation or streamflow, and where the lowering of the water table by pumping increases the opportunity for infiltration of water that formerly ran off or evaporated.

### RED ROCK VALLEY AND OKLAHOMA DISTRICT

Although Red Rock Valley topographically is a closed basin, there is no evidence of surface discharge of ground water. As the depth to water ranges from 166 to 184 feet below the land surface, there is no discharge by evaporation and transpiration. No data were obtained regarding the recharge or the discharge which probably occurs by subsurface outflow from the valley. In the past, ground-water discharge by pumping has been restricted to that needed for domestic and stock requirements. During the summer of 1954, however, wells 45/1E–2L1, 9C2, and 11C2 were drilled to provide ground water for irrigation.

No estimates of ground-water discharge were made in the Oklahoma district. Natural discharge includes discharge from springs, losses from evaporation and transpiration, and discharge of "rising" ground water in the marshlands around Lower Klamath Lake. Artificial discharge includes ground water pumped for irrigation, domestic and stock requirements, and discharge from flowing wells.

### FLOWING WELLS

Butte Valley has four flowing wells near the Meiss Ranch headquarters (46/2W–9Q). When visited in 1954, their estimated natural discharge ranged from about 15 gpm (46/2W–9R2) to more

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than 500 gpm (46/2W-9R1, 16A1). Well 46/2W-9Q1 flowed about 100 gpm (p. 24).

The Oklahoma district has three flowing wells. Well 46/2E-22Q1, just west of Mount Dome, discharged about 11 gpm on August 23, 1954, from a 2-inch pipe 2 feet above the ground surface. The temperature of the water was 52°F. This well penetrates about 100 feet of "shale" and bottoms in sand. Water under sufficient hydrostatic head to flow was found at the base of the shale section.

On August 23, 1954, well 47/1E-14L1, north of the Porterfield Ranch, was discharging a small quantity of water from beneath the deep-well turbine pump base. The temperature of the water was 56°F. Although the log of this well is not available, the water is probably derived from fractured volcanic rocks or talus debris associated with the extensive fault that forms the eastern border of Mahogany Mountain ridge.

Well 47/2E-7N1 at the Langer Ranch headquarters flows about 40 gpm. When pumped this well yields about 925 gpm with a draw-down of 140 feet. According to the driller's log (table 10), the well penetrated about 180 feet of sedimentary material containing a few intercalated beds of lava and cinders before entering volcanic rocks which may be the older volcanic rocks of the "High Cascades." From 180 to 290 feet the well was drilled in volcanic rocks and probably most of the water is yielded from fractured zones in these rocks.

## SPRINGS

Many small springs in the Cascade Range feed the streams that recharge the ground-water body in the Butte Valley region. In the Oklahoma district four springs discharge large quantities of water.

### WILLOW CREEK SPRING

Willow Creek spring (46/2E-22R1) issues from an elongate U-shaped area between two drainage canals as shown on plate 1. The turf in this area is water saturated and "springy" to the step. Water trickles through shallow channels, collects in pools, and moves through shallow drains into the main drainage ditches. The material from which the springs issue consists of gray poorly sorted gravelly sand of volcanic origin.

On July 30, 1954, the temperature of the water ranged from 52°F for water flowing from 1 of 2 old 12-inch well casings to 60°F for water flowing from a small vent in the east bank of the easternmost drainage ditch. The discharge, measured at the bridge where the main access road crossed Willow Creek (46/2E-9K, near BM 4156), is shown below.

*Discharge of Willow Creek spring*

[Data from California Division of Water Resources]

| Date | Discharge (cfs) | Remarks |
|---|---|---|
| Dec. 3, 1954 | 7.1 | Figures may not represent total discharge. Some water may have been stored in a small reservoir upstream from measuring point. |
| Dec. 30, 1954 | 5.4 | |
| Feb. 26, 1955 | 6.1 | |
| Mar. 31, 1955 | 4.7 | |

Most of the water flowing from this spring is used either for irrigation or for stock. The remainder of the flow runs off in Willow Creek and discharges into the marshy area north of Oklahoma Flat.

### COTTONWOOD CREEK SPRINGS

Cottonwood Creek springs (47/1E–23H1), at the head of Cottonwood Creek near the Porterfield Ranch headquarters, issue from sand and talus debris at the base of the Mahogany Mountain ridge. Two small reservoirs and several short ditches collect water from several openings and distribute it to canals for use in irrigating farm and pasturelands. The discharge of these springs, measured near the source, is shown in the following table.

*Discharge of Cottonwood Creek springs*

[Data from California Division of Water Resources]

| Date | Discharge (cfs) | Remarks |
|---|---|---|
| Nov. 19, 1954 | 5.2 | One vent measured. |
| Dec. 30, 1954 | 9.7 | Collective measurement of 3 vents. |
| Feb. 26, 1955 | 10.0 | Collective measurement of 4 vents. |
| Mar. 31, 1955 | 10.5 | Do. |
| May 25, 1955 | 10.4 | Do. |

The temperature of the water ranged from 61°F on August 23, 1954, to 55°F on February 26, 1955. An analysis of this water is given in table 12.

### SHEEPY CREEK SPRING

Sheepy Creek spring (47/1E–1M1) issues from a flat marshy area north and east of two low outcrops of volcanic rocks. Water flows northward from several shallow interconnected ponds. Water does not seem to enter the ponds from the surrounding "springy" turf, as no small channelways have been developed. Apparently the water rises in the bottom of the ponds. The water is very clear, the ponds seem to be shallow, and only the waving of mossy plants gives an indication of water moving beneath the surface. The temperature on July 29, 1954, was 68°F, on February 26, 1955, it was 50°F, and March 26, 1955, it was 62°F. The discharge measured at the point where the road to Sheepy Creek island crosses Sheepy Creek (48/1E–35R) is shown below.

*Discharge of Sheepy Creek spring*

[Data from California Division of Water Resources]

| *Date* | *Discharge (cfs)* |
|---|---|
| Nov. 19, 1954 | 15. 6 |
| Dec. 30, 1954 | 17. 7 |
| Feb. 26, 1955 | 17. 6 |
| Mar. 31, 1955 | 17. 3 |
| May 25, 1955 | 12. 4 |

Analysis of the water from Sheepy Creek spring (47/1E–1M1) is shown in table 12.

### HOT CREEK SPRINGS

Hot Creek springs (47/1E–10B1) issue at the head of Hot Creek, near the old D Ranch headquarters. The springs discharge into a small, elongate, earth-filled reservoir from many outlets in the sand and talus debris near the base of the canyon wall in the headwater amphitheater. Four wells, three of which flow, have been drilled in the spring area. The easternmost well—nearest the ranch buildings—has an 8-inch casing which protrudes about 5 feet above the ground. On June 29, 1954, this well was discharging about 150 gpm. The water temperature on that date was 67°F. The chemical analysis shown in table 12 was made of water from this well. A 6-inch well, about 40 feet west of the above well, was discharging about 470 gpm from an open casing extending about 28 inches above the ground. Another 6-inch well, the casing extending about 2 feet above the land surface, is about 40 feet west of the flowing 6-inch well and about 80 feet west of the 8-inch well. When visited on June 29, 1954, this well was not flowing, but water in the casing stood about 1 foot above the land surface. The water temperature was 86°F. The air temperature near the casing was 76°F. The westernmost well of this group is at the southwest end of the reservoir, about 300 feet west of the other 3 wells. This well has a 6-inch casing which protrudes about 4 feet above the ground, and when visited the well was flowing about 370 gpm. The temperature of the water was 69°F.

The combined discharge of wells, springs, and seeps, measured at the outlet control gate in the empty reservoir by the California Division of Water Resources on December 30, 1954, was 5.6 cfs.

Water discharged by the flowing wells and springs in the north end of the Oklahoma district probably is derived from water in fractured volcanic rocks underlying Mahogany Mountain ridge. Furthermore, it is possible that these springs are outlets for a part of the ground water moving into the ridge from Butte Valley (pl. 2; fig. 4).

## WATER UTILIZATION

The California Division of Water Resources interim report on the Klamath River basin (Horn and others, 1954) contains data on water utilization and the present land-use pattern in relation to water requirements in Butte Valley. Three categories of land use are listed:

1. Irrigated lands which include all agricultural lands dependent upon surface application of water, as well as those agricultural lands utilizing water from a shallow water table or from winter flooding.
2. Urban lands, which include the developed areas of towns within the valley.
3. Miscellaneous water-service areas, which include farmsteads, cemeteries, airports, and industrial sites where such places were not within urban boundaries.

In 1953 the mean seasonal consumptive requirement for the above three uses totaled about 30,000 acre-feet. Of this, about 29,100 acre-feet was for the irrigated land group, about 300 acre-feet was for urban lands, and about 200 acre-feet was for miscellaneous water-service areas (Horn and others, 1954, p. 76). Horn reported that in 1953 irrigated areas in the valley totaled 10,440 acres (1954, p. 34) and that the irrigation water-service area efficiency was estimated to be about 45 percent (1954, p. 74).

During the 1953 irrigation season about 7,800 acre-feet of water was diverted from Butte and Antelope Creeks to provide part of the required water for a service area of about 4,000 acres at the south end of the valley. The remainder of the required water was pumped from wells (Horn and others, 1954, p. 21–22).

The above information suggests that pumpage of ground water for irrigation of 10,400 acres in 1953 was the total mean consumptive water requirement of 29,100 acre-feet less the 7,800 acre-feet diverted from surface sources or about 21,000 acre-feet. Applying the irrigation efficiency of 45 percent the net draft was about 10,000 acre-feet.

Subirrigated lands in Butte Valley constituted about 1,000 acres in 1953, and the estimated surface and ground water consumed was about 1,600 acre-feet.

## QUALITY OF WATER

Rocks, minerals, and organic substances are dissolved wholly or in part by: (a) Water at the land surface, (b) water that infiltrates the soil and seeps downward to the zone of saturation, and (c) water moving through the interstices in rocks and deposits within the zone of saturation. The solvent action of water is assisted by the presence in solution of carbon dioxide, dissolved from the atmosphere and the soil and by organic substances dissolved from the soil. The character and concentration of the dissolved mineral matter are thus closely related to the mineral composition of the soils and bedrock through which the water moves, although they are affected also by the precipitation and rate of recharge and by the geomorphic and geologic history of the area.

The relation of the mineral content of ground water to the mineral composition of the rocks through which the water moves depends on such factors as the chemical character of the influent water, the chemical character of the rocks, and the rate of movement.

The principal cations in natural waters are calcium, magnesium, sodium, and potassium; the principal anions are bicarbonate, sulfate, and chloride. Anions that generally occur in only minor amounts are carbonate, nitrate, and fluoride. Silicon commonly is found in natural waters and is reported as the dioxide, $SiO_2$. Iron is a necessary element in plant nutrition and generally is present in most soils. In natural waters iron in concentrations that exceed 0.3 ppm (part per million) causes reddish-brown stains on fixtures and clothing. Boron, too, is a necessary element for normal plant growth, but at concentrations only slightly above optimum it is exceedingly toxic to many plants. Natural waters containing more than 2 ppm are likely to cause injury to most plants.

Chemical analyses of waters are expressed quantitatively in: (a) Parts per million (ppm), (b) equivalents per million (epm), and (c) percentage equivalents per million. A part per million is a unit weight of the constituent in a million unit weights of water. An equivalent per million is a unit equivalent weight of an element, ion, or a compound in a million unit weights of water. The equivalent weight, in any unit, of an element or compound is the quantity that will exactly react with 8 units of oxygen, or its equivalent. Thus, 23 parts, or 1 equivalent, of sodium combines with 35.5 parts, or 1 equivalent, of chloride to form sodium chloride (ordinary table salt). To change an analysis reported in parts per million to equivalents per million, the concentration of each ion in parts per million is divided by its equivalent weight. The equivalent weights of the common constituents are as follows:

| Cation, or basic radical | Equivalent weight | Anion, or acidic radical | Equivalent weight |
|---|---|---|---|
| Calcium (Ca) | 20. 04 | Bicarbonate ($HCO_3$) | 61. 018 |
| Magnesium (Mg) | 12. 16 | Carbonate ($CO_3$) | 30. 005 |
| Sodium (Na) | 22. 991 | Sulfate ($SO_4$) | 48. 03 |
| Potassium (K) | 39. 100 | Chloride (Cl) | 35. 457 |
| | | Nitrate ($NO_3$) | 62. 008 |

The third method of expressing chemical analyses is in terms of the percentage equivalents per million of the cations and anions. This value is calculated from the equivalents per million of the individual anion or cation and the sum of the equivalents of the anions or cations.

For example:

$$\text{Percentage epm of calcium} = \frac{\text{Ca (expressed as epm)}}{\text{Ca+Mg+Na+K (expressed as epm)}}$$

## WATER QUALITY IN RELATION TO USE

The chemical character of the ground and surface water in the Butte Valley region is indicated in tables 12 and 13. The analyses show only the dissolved mineral content and do not indicate the sanitary condition of the water. In general the analyses show that the water is chemically and physically satisfactory for domestic and irrigation purposes.

The physical, chemical, and bacterial quality of drinking water in the United States is judged in relation to the U.S. Public Health Service Drinking Water Standards of 1946. Although these standards apply only to drinking water and water-supply systems used by interstate carriers and others subject to Federal quarantine regulations, they have been accepted voluntarily by most of the State departments of public health as criteria for all public water supplies. The recommended limits in concentration for the more common mineral constituents are shown below:

| | *Parts per million* |
|---|---|
| Iron and manganese together (Fe and Mn) | 0.3 |
| Magnesium (Mg) | 125 |
| Chloride (Cl) | 250 |
| Sulfate ($SO_4$) | 250 |
| Dissolved solids | [1] 500 |

[1] In water of good chemical quality dissolved solids should not exceed 500 ppm; if such water is not available a content of 1,000 ppm is permissible.

According to the Public Health standards, the mandatory upper limit in concentration of fluoride is 1.5 ppm.

Systems for classifying waters in terms of their effects on soils and growing crops have been proposed by Scofield (1936), Wilcox (1948, 1955), Thorne and Thorne (1951), the California Water Pollution Control Board (1952), Doneen (1954), and the U.S. Salinity Laboratory (1954). In using these methods for classifying ground waters of the Butte Valley region it was determined that most of the waters were satisfactory for domestic and irrigation purposes.

The characteristics of water that generally determine its suitability for irrigation are total concentration of soluble salts; relative proportion of sodium to other cations; concentration of boron or other elements that may be toxic; and, under some conditions, the bicarbonate concentration as related to the concentration of calcium plus magnesium (U.S. Salinity Laboratory, 1954, p. 69).

Ground-water samples from the Butte Valley region had a calcium content of 7.4 to 36 ppm and a magnesium content of 4.5 to 39 ppm. Hardness, as $CaCO_3$, ranged from 42 to 243 ppm.

Concentrations of sodium ranged from 6 to 602 ppm and of potassium, from 1.9 to 42 ppm. The percent sodium ranged from 15 to 82. In 30 samples the percent sodium was 36 or less, in 9 samples it was between 36 and 70, and in 2 samples it was 80 and 82.

The concentration of dissolved solids (sum of determined constituents) ranged from 109 to 1,890 ppm; in all but 3 samples the concentration of dissolved solids was less than 360 ppm. A sample from well 48/1E–31R1 contained 510 ppm and samples from wells 47/1W–23G1 and 23A1 contained 1,200 and 1,890 ppm, respectively. The high content of dissolved solids in these latter two samples, together with the large amounts of sodium, potassium, bicarbonate, sulfate, and chloride, indicates that these wells receive their supplies from waters passing through local playa deposits.

Bicarbonate, the predominant anion in the ground water, ranged in concentration from 70 to 1,310 ppm. The range in concentration of the remaining anions was as follows: Sulfate, 1 to 379 ppm; chloride, 0.2 to 174 ppm; and nitrate, 0.1 to 44 ppm.

The specific conductance ranged from 134 to 2,640 micromhos, and the boron content from 0 to 1.1 ppm. Samples from wells 47N/1W–23A1 and 23G1 were relatively high in dissolved minerals, having a specific conductance of 1,940 and 2,640, respectively. These waters are predominantly of the sodium bicarbonate type; the boron content was 0.91 and 1.1 ppm, respectively. Water from these wells probably is derived from buried playa deposits similar to the ones found presently along the eastern border of the valley between Cedar Point and Inlow Butte.

Analyses of 17 surface-water samples from the Butte Valley region indicate that the water except for that of Meiss and Indian Tom Lakes is satisfactory for most purposes.

The analyses of samples from Antelope, Butte, Prather, and Shovel Creeks showed that the percent sodium ranged from 13 to 26, boron content from 0 to 0.1 ppm, the specific conductance from 55 to 144 micromhos; and the dissolved solids from 60 to 125 ppm.

The water samples from Meiss and Indian Tom Lakes were of the sodium bicarbonate type. Percent sodium ranged from 75 to 91, boron content from 0 to 3.4 ppm, specific conductance from 747 to 4,110 micromhos, and dissolved solids from 473 to 2,540 ppm.

*Ranges of specific conductance, percent sodium, and boron of surface and ground waters in the Butte Valley region*

| | Specific conductance (micromhos at 25°C) | Percent sodium | Boron (ppm) |
|---|---|---|---|
| Surface streams | 55–144 | 13–26 | 0. 0 –0. 1 |
| Meiss and Indian Tom Lakes | 747–4, 110 | 75–91 | . 0 –3. 4 |
| Normal ground water in Butte Valley | 159–615 | 15–55 | . 0 –0. 2 |
| More highly mineralized ground waters in Butte Valley | 1, 940–2, 640 | 80–82 | . 91–1. 1 |
| Red Rock Valley | 150–153 | 32–44 | . 03 |
| Oklahoma district | 134–348 | 34–68 | . 0 –0. 23 |

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## BASIC DATA

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*

Well locations shown on plate 2, for explanation see text.

Type of well and casing diameter: D, dug; P, drilled by percussion or cable-tool method; R, drilled by rotary method; G, gravel packed. The casing diameter is in feet for dug wells and is in inches for drilled wells.

Type of pump, and power: L, lift; T, deep-well turbine; J, jet; Wm, windmill; numbers indicate rated power of electric motor.

Use: D, domestic; I, irrigation; PS, public supply; O, observation; S, stock; U, unused; RR, railroad.

Discharge or drawdown and depth to water: a, measurement by U. S. Bureau of Reclamation; b, well 45-2W-1P1 pumping; c, well 45-2W-3H1 pumping; d, pumping level; e, driller's report; f, owner's report; g, test well, two 1-inch piezometer tubes; h, well 46-1W-17B1 pumping; i, wells 46-1W-17B1 and 17B2 pumping; j, well 46-1W-18Q2 pumping; k, well 46-1W-29D1 pumping; m, 12-in. casing 0-22 ft., 10-in. casing 22–82 ft; n, pump turned off 20 minutes before measurement; p, well 30M2 drilled close to 30M1 and water allowed to flow from 30M2 into 30M1 through a short connecting conduit extending from the bottom of 30M1; q, well plugged at 163 feet.

Other data available: C, chemical analyses shown in table 12; L, driller's log; W, periodic water-level measurements shown in table 11.

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | | BUTTE VALLEY | | | | | | | | | |
| | | | | | | | | T. 45 N., R. 1 W. | | | | | | | | | |
| 5L1 | John Starr | 1952 | P, 8 | 70 | 24 | ...... | ...... | Wm | S | ........ | ..... | No access | ....... | ........ | ........ | ........ | L |
| 7Q1 | Butte Valley Irrigation District. | ....... | P, 6 | 64 | ..... | ...... | ...... | ....... | U | ........ | ..... | Top of casing | 0.0 | ........ | 50.45 | 10-21-53 | |
| | | | | | | | | | | | | | | | 43.6 | 5- 4 54 | |
| | | | | | | | | | | | | | | | 56.0 | 9-27-54 | |
| 19H1 | Ralph Lutz | ....... | P, 6 | ....... | ..... | ...... | ...... | ....... | U | ........ | ..... | .....do | 1 | 4,314.8 | 39.1 | 10-21-53 | W |

T. 45 N., R. 2 W.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1G1 | Butte Valley Irrigation District. | 1947 | P, 16 | 80 | ..... | ...... | ...... | T, 25 | I | ......... | ..... | Top of casing, east side. | 0.0 | 4,259.7 | a33.5 | 11- -52 | L |
| | | | | | | | | | | | | | | | a33.3 | 4- -53 | |
| | | | | | | | | | | | | | | | 35.1 | 10-21-53 | |
| | | | | | | | | | | | | | | | 33.2 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 36.3 | 9-27-54 | |
| 1G2 | Ralph Lutz ......... | 1928 | P, 8 | 77½ | ..... | ...... | ...... | ...... | U | ......... | ..... | No access ........... | ...... | .......... | .......... | ........... | L |
| 1L1 | Delos Mills ........ | 1953 | P, 12 | 130 | 18 | ...... | ...... | ...... | U | ......... | ..... | Top of casing ....... | 1 | 4,266.2 | 42.58 | 10-20-53 | L |
| | | | | | | | | | | | | | | | 37.55 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 45.35 | 9-27-54 | |
| 1P1 | .....do................ | 1953 | P,G, 16 | 140 | ..... | ...... | ...... | T, 75 | I | ......... | ..... | .....do................ | 3 | 4,268.4 | 48.85 | 10-20-53 | L |
| | | | | | | | | | | | | | | | 39.18 | 5- 4-54 | |
| 1P2 | .....do................ | 1953 | P, 18 | 170 | 18 | ...... | ...... | ...... | U | ......... | ..... | .....do................ | 1.3 | 4,266.7 | 37.8 | 5- 4-54 | L |
| | | | | | | | | | | | | | | | b46.0 | 9-27-54 | |
| 1Q1 | Butte Valley Irrigation District. | 1929 | P, 16 | 80 | 35 | ...... | ...... | ...... | U | ......... | ..... | .....do................ | -2 | .......... | 39.45 | 10-21-53 | L |
| | | | | | | | | | | | | | | | 34.63 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 40.70 | 9-27-54 | |
| 2G1 | Delos Mills ........ | 1949 | P | 130 | Not cased | | | ...... | O | ......... | ..... | Ground at well ..... | .0 | 4,264 | a40.6 | 11- -52 | L |
| | | | | | | | | | | | | | | | a38.8 | 4- -53 | |
| | | | | | | | | | | | | | | | 41.3 | 10-20-53 | |
| | | | | | | | | | | | | | | | 37.0 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 32.5 | 9-27-54 | |
| 2P1 | .....do................ | 1953 | P, 16 | 145 | 22 | ...... | ...... | ...... | U | ......... | ..... | Top of casing ....... | 1 | 4,268.4 | 42.63 | 10-20-53 | L |
| | | | | | | | | | | | | | | | 39.90 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 43.80 | 9-27-54 | |
| 3H1 | .....do................ | 1948 | P,G, 18 | 270 | 270 | 15 | 270 | T, 50 | I | e1,240 | ..... | Top of casing, north side. | 2.5 | 4,262.6 | a38.7 | 11- 7-52 | L,W, C |
| | | | | | | | | | | | | | | | a35.0 | 4- 3-53 | |
| | | | | | | | | | | | | | | | 38.43 | 10-20-53 | |
| 3H2 | .....do................ | 1948 | P, 12 | 238 | ..... | ...... | ...... | ...... | U | ......... | ..... | Top of casing ....... | 1 | 4,262.9 | 38.6 | 10-20-53 | L |
| | | | | | | | | | | | | | | | c35.5 | 5- 4-54 | |
| | | | | | | | | | | | | | | | c39.4 | 9-27-54 | |
| 3J1 | .....do................ | 1948 | P, 12 | 400 | ..... | ...... | ...... | ...... | D | ......... | ..... | No access ........... | ...... | .......... | .......... | ........... | L |
| 3P1 | .....do................ | 1953 | P, 16 | 140 | 18 | ...... | ...... | ...... | U | ......... | ..... | Top of casing ...... | 1 | 4,262.7 | 23.54 | 10-20-53 | L |
| | | | | | | | | | | | | | | | 21.67 | 5- 4-54 | |
| 3Q1 | .....do................ | 1948 | P, 22 | 425 | 28 | ...... | ...... | T, 30 | I | ......... | ..... | Top of casing, west side. | 1 | 4,263.5 | 27.55 | 10-20-53 | L, C |
| | | | | | | | | | | | | | | | d48.15 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 26.87 | 9-27-54 | |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of Measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | | | | | | | | | | | |
| **T. 45 N., R. 2 W.—Continued** | | | | | | | | | | | | | | | | | |
| 10F1 | Delos Mills ......... | 1952 | P, 12 | 125 | 20 | ...... | ...... | ...... | U | ......... | ..... | Top of casing ....... | 1 | 4,262.0 | 16.60 | 10-20-53 | L |
| | | | | | | | | | | | | | | | 12.19 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 16.20 | 9-27-54 | |
| 10M1 | Mrs. J. O'Kane .... | 1939 | P, 6 | 182½ | 182½ | ...... | ...... | L, g | D | ......... | ..... | No access .......... | ...... | ......... | e45 | 9- 6-39 | L |
| 12C1 | Delos Mills ........ | 1953 | P, 16 | 120 | 6 | ...... | ...... | ...... | U | ......... | ..... | Top of casing ....... | .0 | 4,266.4 | 43.22 | 10-20-53 | L |
| | | | | | | | | | | | | | | | 37.33 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 47.50 | 9-27-54 | |
| 24A1 | Ralph Lutz ......... | ...... | P, 6 | 105 | ..... | ...... | ...... | ...... | U | ......... | ..... | .....do................ | 1 | 4,314.9 | 93.10 | 10-21-53 | W |
| 24A2 | .....do................ | ...... | P | 232 | 60 | ...... | ...... | [1]T | I | f3,000 | [2]4 | Hole in pump base, west side. | 2 | ......... | 93.5 | 10-21-53 | |
| **T. 46 N., R. 1 E.** | | | | | | | | | | | | | | | | | |
| 3N1 | K. Holbrook ....... | ...... | P, 6 | ...... | ..... | ...... | ...... | ...... | U | ......... | ..... | Top of casing ...... | 0.0 | ......... | 166.4 | 11-21-53 | |
| | | | | | | | | | | | | | | | 167.5 | 5- 5-54 | |
| 5M1 | M. Cross ........... | ...... | P, 6 | 50–60 | ..... | ...... | ...... | L, g | S | ......... | ..... | Top of casing, north side. | .3 | 4,239.7 | 18.26 | 5- 5-54 | W |
| 5M2 | .....do................ | 1937 | P, 12 | 160 | 160 | 100 | 160 | T, 30 | I | f1,700 | 12 | Top of concrete pump base, south side. | .0 | 4,244.4 | 29.14 | 9-28-54 | L |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6J1 | .....do.......... | 1953 | P, 18 | 200 | 200 | 60 | 200 | T, 60 | I | e3,150 | 64 | Air line only (altitude, top concrete pump base, south side). | ....... | 4,244.2 | 23.5 | 1- -53 | L |
| 6N1 | L. Luzzi .......... | 1950 | P,G,18 | 200 | 150 | 30 | 150 | T, 60 | I | e2,600 | 68 | Top concrete pump base, east side. | .0 | 4,242.4 | a22.9 | 11- -52 | L |
| | | | | | | | | | | | | | | | a23.2 | 4- -53 | |
| | | | | | | | | | | | | | | | 24.10 | 10-30-53 | |
| | | | | | | | | | | | | | | | 22.71 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 24.80 | 9-28-54 | |
| 7D1 | R. L. Meglasson .. | 1950 | P, 18 | 200 | 200 | 20 | 180 | T, 50 | I | ......... | ..... | Hole in pump base, west side. | 1 | 4,242.5 | a20.6 | 11- -52 | L |
| | | | | | | | | | | | | | | | a22.0 | 4- -53 | |
| | | | | | | | | | | | | | | | 23.86 | 11- 2-53 | |
| | | | | | | | | | | | | | | | 23.00 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 24.70 | 9-28-54 | |
| 7H1 | .....do.......... | ....... | P, 8 | ....... | ..... | ...... | ...... | ....... | D | ......... | ..... | Top of casing (well in concrete-lined pit, south of house). | -5 | 4,241.5 | 23.00 | 11- 2-53 | |
| | | | | | | | | | | | | | | | 22.29 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 21.80 | 9-28-54 | |
| 8C1 | M. Cross .......... | 1949 | P, 12 | 118 | ..... | ...... | ...... | J, 1 | D,S | e1,200 | 40 | Top of casing, east side. | .0 | 4,264.4 | 45.44 | 11- 2-53 | L |
| | | | | | | | | | | | | | | | 47.72 | 5- 5-54 | |
| 8E1 | .....do.......... | 1937 | P, 10 | 200 | 12 | ...... | ...... | J, 1 | D,S | e700 | ..... | Top of casing, north side. | 2 | 4,256.5 | a37.2 | 11- -52 | L,C |
| | | | | | | | | | | | | | | | a38.1 | 4- -53 | |
| | | | | | | | | | | | | | | | 36.54 | 9-28-54 | |

T. 46 N., R. 1 W.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g1A1 | U. S. Bureau of Reclamation. | 1954 | R | 735 | 80 | ...... | ...... | ....... | O | ......... | ..... | Top of tube ......... | 1.5 | .......... | a21.1 | 9-28-54 | L |
| g1A2 | .....do.......... | ....... | ......... | ....... | 300 | ...... | ...... | ....... | O | ......... | ..... | .....do.......... | 1.5 | .......... | a21.6 | 9-28-54 | |
| 1G1 | C. Cross .......... | 1951 | P,G,18 | 207 | 192 | ...... | ...... | T, 40 | I | e2,000 | 60 | Top metal pump base, west side. | .5 | 4,236.0 | a16.5 | 11- -52 | L,C |
| | | | | | | | | | | | | | | | a15.8 | 4- -53 | |
| | | | | | | | | | | | | | | | 17.70 | 10-29-53 | |
| | | | | | | | | | | | | | | | 19.30 | 9-28-54 | |
| 1G2 | .....do.......... | 1947 | P,G,14 | 250 | 250 | 150 | 250 | Wm | S | e2,000 | 55 | Top of casing, hole east side. | .0 | 4,235.3 | a16.0 | 11- -52 | L |
| | | | | | | | | | | | | | | | a15.3 | 4- -53 | |
| | | | | | | | | | | | | | | | 16.40 | 10-29-53 | |
| | | | | | | | | | | | | | | | 15.84 | 5- 5-54 | |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (*feet*) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | | T. 46 N., R. 1 W.—Continued | | | | | | | | | |
| 1P1 | Johnson .... | 1952 | R,G,16 | 311 | .... | .... | .... | T, 75 | I | f2,100 | .... | No access (altitude top concrete pump base, south side). | 2 | 4,252.0 | a31.3 | 11- -52 | L |
| 1Q1 | C. Cross .... | 1953 | R,G,18 | .... | .... | .... | .... | T, 75 | I | .... | .... | Access hole, top concrete pump base, east side. | 2 | 4,248.9 | 31.10 | 10-30-53 | |
| | | | | | | | | | | | | | | | 29.30 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 33.07 | 9-28-54 | |
| 2F1 | Mettler and Sheyne. | 1953 | R,G,18 | 300 | 300 | 100 | 300 | T,100 | I | .... | .... | Top of casing .... | .0 | 4,241.6 | 20.94 | 10-30-53 | |
| | | | | | | | | | | | | | | | 26.14 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 22.28 | 9-28-54 | |
| 2G1 | ....do.... | 1953 | R,G,18 | 380 | 380 | 100 | 380 | T,100 | I | .... | .... | ....do.... | .0 | 4,235.5 | 14.32 | 10-30-53 | |
| | | | | | | | | | | | | | | | 17.0 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 15.27 | 9-28-54 | |
| 2L1 | ....do.... | .... | G, 16 | .... | .... | .... | .... | .... | U | .... | .... | ....do.... | 1 | 4,255.9 | 34.75 | 5- 5-54 | W |
| 4N1 | L. Logan .... | .... | P, 12 | .... | .... | .... | .... | T, 20 | I | .... | .... | ....do.... | .5 | 4,237.3 | 14.14 | 10-27-53 | W |
| 4N2 | ....do.... | .... | P, 6 | 220 | .... | .... | .... | .... | U | .... | .... | ....do.... | 1 | 4,238.1 | 13.87 | 5- 5-54 | W |
| 5H1 | U. S. Dept. Agriculture, Soil Conservation Service. | 1951 | P, 6 | 100 | .... | .... | .... | J, 1 | S | e20 | 16 | Access hole, top of casing. | 1 | 4,238.6 | 14.28 | 10-27-53 | |
| | | | | | | | | | | | | | | | 13.77 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 14.74 | 9-27-54 | |
| 6P1 | Farnum Bros.... | 1949 | P, 16 | 65 | .... | .... | .... | T, 40 | I | e3,250 | 28 | No access .... | .... | .... | .... | .... | C |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6Q1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 36 | 36 | 26 | 36 | ...... | O | ...... | ...... | Top of casing ...... | 1 | 4,238.6 | 12.04 | 5- 5-54 | W |
| 9A1 | U. S. Dept. Agriculture, Soil Conservation Service. | ...... | P, 6 | 100 | ...... | ...... | ...... | ...... | U | ...... | ...... | .....do.......... | .0 | ...... | 14.31 | 10-20-53 | |
| | | | | | | | | | | | | | | | 14.0 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 14.80 | 9-28-54 | |
| 12B1 | Johnson ............ | ...... | P, 8 | ...... | ...... | ...... | ...... | L | D | ...... | ...... | No access .......... | .5 | 4,250.2 | ...... | ...... | W |
| 12H1 | L. Luzzi ............ | 1951 | P,G, 18 | 189 | 152 | 44 | 152 | ...... | U | e1,350 | 43 | Top of casing ...... | 2 | 4,262.6 | a42.6 | 11- -52 | L |
| | | | | | | | | | | | | | | | a43.6 | 4- -53 | |
| | | | | | | | | | | | | | | | 44.44 | 11- 2-53 | |
| | | | | | | | | | | | | | | | 43.27 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 44.85 | 9-28-54 | |
| 17B1 | G. W. Osborn & Sons. | 1949 | P, 20 | 80 | 60 | ...... | ...... | T, 50 | I | e3,500 | 8 | Top of casing, east side. | 2 | 4,246.2 | a31.8 | 11- 52 | L,C |
| | | | | | | | | | | | | | | | a28.5 | 4- -53 | |
| | | | | | | | | | | | | | | | 35.11 | 10-27-53 | |
| | | | | | | | | | | | | | | | d40.0 | 5- 4-54 | |
| | | | | | | | | | | | | | | | d42.3 | 6-23-54 | |
| 17B2 | .....do.......... | 1953 | P, 20 | ...... | ...... | ...... | ...... | T, 75 | I | ...... | ...... | Top concrete pump base, east side. | 1 | 4,246.0 | 35.00 | 10-27-53 | |
| | | | | | | | | | | | | | | | d38.8 | 5- 4-54 | |
| | | | | | | | | | | | | | | | d45.1 | 6-23-54 | |
| | | | | | | | | | | | | | | | h45.4 | 9-27-54 | |
| 17G1 | .....do.......... | ...... | P, 20 | ...... | ...... | ...... | ...... | T, 30 | I | ...... | ...... | Top of casing, south side. | 2 | 4,251.6 | 40.42 | 10-27-53 | |
| | | | | | | | | | | | | | | | i41.08 | 5- 4-54 | |
| | | | | | | | | | | | | | | | d62.0 | 6-23-54 | |
| 17L1 | Dr. Sturgis ......... | 1947 | P | 84 | ...... | ...... | ...... | ...... | D | ...... | ...... | No access .......... | ...... | ...... | ...... | ...... | L |
| 17Q1 | ...................... | 1926 | P | 51 | 51 | 31 | 51 | ...... | D | ...... | ...... | ...................... | ...... | ...... | e15 | 9- -26 | L |
| 18Q1 | Butte Valley Irrigation District. | 1948 | P | 98 | ...... | ...... | ...... | T, 25 | I | ...... | ...... | Top of casing ....... | 1 | 4,247.7 | a22.7 | 11- -52 | L |
| | | | | | | | | | | | | | | | a21.9 | 4- -53 | |
| | | | | | | | | | | | | | | | 23.45 | 10-23-53 | |
| | | | | | | | | | | | | | | | j21.84 | 5- 4-54 | |
| 18Q2 | .....do.......... | 1931 | P, 16 | 82 | 40 | ...... | ...... | T, 30 | I | ...... | ...... | Access pipe, north side pump base. | .0 | 4,248.3 | a23.2 | 11- -52 | L,C |
| | | | | | | | | | | | | | | | a22.7 | 4- -53 | |
| | | | | | | | | | | | | | | | 24.65 | 10-23-53 | |
| | | | | | | | | | | | | | | | d33.7 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 25.8 | 9-27-54 | |

See footnotes at end of table.

546199 O—60——6

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | | T. 46 N., R. 1 W.—Continued | | | | | | | | | |
| 18Q3 | Elementary School | .... | P, 6 | .... | .... | .... | .... | J, 1 | D | .... | .... | Top of casing, east side. | 0.0 | 4,246.9 | 23.40 | 10-23-53 | |
| | | | | | | | | | | | | | | | 21.9 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 25.74 | 9-27-54 | |
| 19B1 | Butte Valley Irrigation District. | .... | P, 16 | .... | .... | .... | .... | .... | U | .... | .... | No access .... | .... | .... | .... | .... | L |
| 19G1 | ....do.... | .... | P, 18 | .... | .... | .... | .... | T, 30 | I | .... | .... | Top concrete pump base, east side. | 1 | 4,249.0 | 25.40 | 10-23-53 | |
| | | | | | | | | | | | | | | | d29.5 | 6-22-54 | |
| | | | | | | | | | | | | | | | 27.73 | 9-27-54 | |
| 19G2 | ....do.... | .... | P, 6 | 55 | .... | .... | .... | .... | O | .... | .... | Top of casing .... | 1 | 4,249.3 | 24.85 | 10-23-53 | |
| | | | | | | | | | | | | | | | 27.34 | 9-27-54 | |
| 19H1 | ....do.... | 1949 | P | .... | .... | .... | .... | T, 30 | I | .... | .... | No access .... | .... | .... | .... | .... | |
| 19H2 | ....do.... | 1931 | P, 16 | 70 | 28 | .... | .... | .... | U | .... | .... | Top of casing .... | 1 | 4,251.8 | 27.60 | 11- 4-53 | L |
| | | | | | | | | | | | | | | | 26.0 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 29.47 | 9-27-54 | |
| 19J1 | ....do.... | 1931 | P, 16 | 61 | 36 | .... | .... | T, 25 | I | e1,400 | .... | Top of casing, east side. | 1 | 4,251.4 | a27.0 | 11- -52 | L, C |
| | | | | | | | | | | | | | | | 27.49 | 10-27-53 | |
| | | | | | | | | | | | | | | | d32.65 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 29.45 | 9-27-54 | |
| 19J2 | ....do.... | 1945 | P, 18 | .... | .... | .... | .... | T, 25 | I | e1,400 | .... | Top of casing .... | .5 | 4,251.5 | 28.3 | 10-27-53 | |
| | | | | | | | | | | | | | | | 26.8 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 30.3 | 9-27-54 | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20B1 | R. Tucker ... | 1951 | P, 14 | 165 | 161 | 20 | 161 | T, 40 | I | e1,500 | 63 | Access hole in pump base, west side. | .0 | ... | a35.2 | 11- -52 | L |
| | | | | | | | | | | | | | | | 36.3 | 10-23-53 | |
| | | | | | | | | | | | | | | | 34.0 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 37.0 | 9-27-54 | |
| 20D1 | H. Andrus ... | 1946 | P, 6 | 65 | ... | ... | ... | ... | D | ... | ... | No access ... | ... | ... | ... | ... | L |
| 20D2 | ...do... | 1948 | P, 10 | 115 | 40 | ... | ... | T, 15 | I | e1,200 | 30–40 | Top of casing, south side. | .0 | 4,244.7 | 29.20 | 10-23-53 | L |
| | | | | | | | | | | | | | | | 19.7 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 22.9 | 9-27-54 | |
| 20N1 | Butte Valley Irrigation District. | 1948 | P, 18 | 115 | ... | ... | ... | T | I | e2,000 | ... | Access pipe, south side pump base. | .5 | 4,258.0 | a34.2 | 11- -52 | L, C |
| | | | | | | | | | | | | | | | a33.1 | 4- -53 | |
| | | | | | | | | | | | | | | | 35.4 | 10-22-53 | |
| | | | | | | | | | | | | | | | k33.4 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 36.4 | 9-27-54 | |
| 21F1 | C. Drew, Jr. ... | 1954 | P,G,18 | 182 | 182 | 162 | 182 | ... | I | ... | ... | Top of casing ... | 1 | ... | 63.13 | 9-27-54 | L |
| 22K1 | M. Goode ... | ... | P, 6 | 56 | ... | ... | ... | ... | U | ... | ... | ...do... | .5 | 4,272.6 | 51.65 | 5- 6-54 | W |
| 22K2 | ...do... | 1937 | P, 6 | 113 | ... | ... | ... | Wm | S | ... | ... | No access ... | ... | ... | e51 | 1937 | L, C |
| 28D1 | Smith ... | ... | P,G,18 | ... | ... | ... | ... | T, 50 | I | ... | ... | Top of casing, west side. | 4 | 4,265 | 41.9 | 10-21-53 | |
| | | | | | | | | | | | | | | | 39.18 | 5- 4-54 | |
| | | | | | | | | | | | | | | | d76.0 | 7-28-54 | |
| | | | | | | | | | | | | | | | 42.85 | 9-27-54 | |
| 28F1 | ...do... | ... | P, G | ... | ... | ... | ... | T, 75 | I | ... | ... | Access pipe, east side pump base. | 2 | 4,256 | 33.95 | 10-21-53 | |
| | | | | | | | | | | | | | | | 31.48 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 33.3 | 6-23-54 | |
| | | | | | | | | | | | | | | | d60.4 | 7-28-54 | |
| | | | | | | | | | | | | | | | 34.25 | 9-27-54 | |
| 28L1 | W. Kandra ... | ... | P | ... | ... | ... | ... | T | I | ... | ... | No access ... | ... | ... | ... | ... | |
| 29D1 | Butte Valley Irrigation District. | ... | P | ... | ... | ... | ... | T, 25 | I | ... | ... | Access pipe, east side pump base. | .0 | 4,254.2 | a30.4 | 11- -52 | |
| | | | | | | | | | | | | | | | a29.5 | 4- -53 | |
| | | | | | | | | | | | | | | | 32.24 | 10-22-53 | |
| | | | | | | | | | | | | | | | d30.35 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 32.28 | 9-27-54 | |
| 29G1 | W. Kandra ... | 1953 | P,G,18 | 104 | 82 | 10 | 82 | T | I | e2,000 | 30 | Top of casing ... | 2 | 4,260.7 | 37.30 | 10-22-53 | L |
| | | | | | | | | | | | | | | | 35.08 | 5- 4-54 | |
| 31B1 | Butte Valley Irrigation District. | 1947 | P, 18 | 101 | ... | ... | ... | T, 25 | I | e2,000 | ... | No access ... | ... | ... | ... | ... | |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | | T. 46 N., R. 1 W.—Continued | | | | | | | | | |
| 31C1 | G. W. Osborn & Sons. | 1947 | P, 18 | 91 | ..... | ....... | ....... | T, 50 | I | e2,000 | ..... | Top of concrete pump base. | 0.0 | 4,258.2 | 34.65 | 10-22-53 | L |
| | | | | | | | | | | | | | | | 32.42 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 36.15 | 9-27-54 | |
| 31H1 | Butte Valley Irrigation District. | 1937 | P, 18 | 83½ | 52 | ....... | ....... | T, 25 | I | f1,475 | 1 | No access ........... | ....... | ........... | ........... | ............. | L |
| 31J1 | .....do................ | 1931 | P, 16 | 88 | 52 | 32 | 52 | T, 30 | I | f1,400 | 1 | Access hole in pump base, east side. | 1 | 4,257.5 | 34.80 | 10-22-53 | L |
| | | | | | | | | | | | | | | | 32.32 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 37.5 | 6-23-54 | |
| | | | | | | | | | | | | | | | 36.1 | 9-27-54 | |
| 31J2 | .....do................ | 1937 | P, 16 | 88 | 48 | ....... | ....... | T, 30 | I | f1,125 | 1 | Top concrete pump base, north side. | 1 | 4,258.4 | 35.2 | 10-22-53 | L |
| | | | | | | | | | | | | | | | 32.84 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 36.5 | 9-27-54 | |
| 31J3 | .....do................ | 1947 | P, 18 | 90 | ..... | ....... | ....... | T, 30 | I | ......... | ..... | Top of casing, east side. | 1 | 4,258.1 | a31.8 | 11- -52 | L |
| | | | | | | | | | | | | | | | a33.2 | 4- -53 | |
| | | | | | | | | | | | | | | | 34.8 | 10-22-53 | |
| | | | | | | | | | | | | | | | 32.38 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 36.5 | 9-27-54 | |
| 31J4 | .....do................ | 1947 | P, 18 | 115 | ..... | ....... | ....... | ....... | ....... | ......... | ..... | Destroyed ........... | ....... | ........... | e41.5 | 9- 7-51 | L |
| 32C1 | Oliver ............... | ....... | P | ....... | ..... | ....... | ....... | T, 20 | I | ......... | ..... | Access hole in casing, north side. | 3 | 4,259 | 35.65 | 10-22-53 | |
| | | | | | | | | | | | | | | | 33.08 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 37.5 | 6-23-54 | |
| | | | | | | | | | | | | | | | 36.75 | 9-27-54 | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32K1 | U. S. Forest Service. | ...... | P, 10 | 214 | ..... | ...... | ...... | L | D | ........ | ..... | No access .......... | ...... | .......... | .......... | ........... | L |
| 32L1 | W. Sturgess ........ | ...... | P, 6 | ...... | ..... | ...... | ...... | J, 1 | D | ........ | ..... | Top of casing ...... | 1 | 4,255.0 | 29.03 | 5- 4-54 | W,C |
| 32R1 | Southern Pacific Co. | 1926–1927 | P, 12 | 215 | 200 | 35<br>135 | 105<br>190 | ...... | RR | ........ | ..... | No access .......... | ...... | .......... | .......... | ........... | L |
| | | | | | | | T. 46 N., R. 2W. | | | | | | | | | | |
| 4E1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 41 | 41 | 20 | 41 | ...... | O | ........ | ..... | Top of casing ...... | 1 | 4,234.2 | 4.8 | 5- 6-54 | L,W |
| 5C1 | Farnum Bros ...... | 1946 | P, 12 | 346 | 335 | ...... | ...... | ...... | U | ........ | ..... | .....do.............. | 1 | .......... | a6.9<br>6.24<br>3.75 | 11- -52<br>10-29-53<br>5- 6-54 | L |
| 9Q1 | .....do............. | 1947 | P, 12 | 180 | 38 | ...... | ...... | T, 30 | I | ........ | ..... | Water flows from a 3-in. pipe set about 4 ft below land surface. | ...... | .......... | Flowing<br>Flowing<br>Flowing | 10-29-53<br>5- 6-54<br>9-28-54 | L |
| 9R1 | .....do............. | 1945 | P, 12 | 90 | 44 | ...... | ...... | T, 25 | I | f1,270 | 33 | Water flows from a hole in casing about 1 ft below land surface. | ...... | .......... | Flowing<br>Flowing<br>Flowing | 10-29-53<br>5- 6-54<br>9-28-54 | L,C |
| 9R2 | .....do............. | 1944 | P, 8 | 93 | ..... | ...... | ...... | ...... | I | ........ | ..... | Water flowing from a 3-in. pipe at land surface. | ...... | .......... | Flowing<br>Flowing<br>Flowing | 10-29-53<br>5- 6-54<br>9-28-54 | C |
| 12Q1 | .....do............. | 1947 | P, 12 | 93 | m82 | ...... | ...... | T, 30 | I | ........ | ..... | Top of casing, east side. | .0 | .......... | a14.6<br>11.97<br>12.68<br>d43.3<br>15.36 | 11- -52<br>10-28-53<br>5- 5-54<br>7- 6-54<br>9-28-54 | L,C |
| 13A1 | .....do............. | 1948 | P, 16 | 278 | 62 | ...... | ...... | T, 40 | I | f1,900 | 50 | No access .......... | ...... | .......... | .......... | ........... | L |
| 14Q1 | Gritzmaker ........ | ...... | P, 6 | ...... | ..... | ...... | ...... | ...... | U | ........ | ..... | Top of casing ...... | .5 | 4,238.0 | 4.3 | 5- 4-54 | W |
| 15Q1 | H. Andrus .......... | 1947 | P, 12 | 345 | 80 | ...... | ...... | T, 20 | I | e1,100 | 1 | Top of casing, east side. | .0 | .......... | 17.1 | 9-28-54 | L,C |
| 16A1 | Farnum Bros....... | 1947 | P, 16 | 93 | ..... | ...... | ...... | T, 15 | I | e1,350 | ..... | Water flowing from hole in casing about 3 ft below land surface. | ...... | .......... | Flowing<br>Flowing<br>Flowing | 10-29-53<br>5- 6-54<br>9-28-54 | |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | | T. 46 N., R. 2 W.—Continued | | | | | | | | | |
| 23C1 | W. Dixon | ...... | P | 212 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | Destroyed | ...... | ...... | ...... | ...... | L |
| 23R1 | D. Dysert | 1948 | P, 16 | 262 | ...... | ...... | ...... | ...... | U | e500 | ...... | Top of casing | 1 | ...... | 10.02 | 10-28-53 | |
| | | | | | | | | | | | | | | | 9.1 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 10.14 | 9-27-54 | |
| 25H1 | L. Naught | ...... | P, 12 | 96 | ...... | ...... | ...... | ...... | I | ...... | ...... | No access | ...... | ...... | ...... | ...... | L |
| 25R1 | M. Criss & Sons | 1952 | P, 20 | 94 | ...... | ...... | ...... | T, 30 | I | e5,000 | 60 | Access pipe, north side pump base. | 1 | 4,257.3 | a32.6 | 11- -52 | L |
| | | | | | | | | | | | | | | | a32.0 | 4- -53 | |
| | | | | | | | | | | | | | | | 33.32 | 10-22-53 | |
| | | | | | | | | | | | | | | | 31.67 | 5- 4-54 | |
| | | | | | | | | | | | | | | | d56.3 | 7- 6-54 | |
| | | | | | | | | | | | | | | | 35.26 | 9-28-54 | |
| 25R2 | Butte Valley Irrigation District. | 1950 | P, 18 | 116 | ...... | ...... | ...... | T, 50 | I | e5,600 | 56 | Access pipe, top concrete pump base, east side. | .0 | 4,256.2 | a33.1 | 11- -52 | L,C |
| | | | | | | | | | | | | | | | 33.70 | 10-22-53 | |
| | | | | | | | | | | | | | | | 30.44 | 5- 4-54 | |
| | | | | | | | | | | | | | | | d46.3 | 7- 7-54 | |
| | | | | | | | | | | | | | | | 33.8 | 9-27-54 | |
| 26F1 | Sump (not shown on map). | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | |
| 26F2 | W. Dixon | 1948 | P, 6 | 60 | 40 | ...... | ...... | ...... | D | ...... | ...... | ...... | ...... | ...... | ...... | ...... | L |
| 26F3 | .....do | 1948 | P, 12 | 480 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | Destroyed | ...... | ...... | ...... | ...... | L |
| 26F4 | .....do | 1954 | P | ...... | ...... | ...... | ...... | ...... | I | ...... | ...... | ...... | ...... | ...... | ...... | ...... | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26J1 | Caruthers .......... | 1952 | P, 12 | 315 | ..... | ....... | ....... | T | I | e1,300 | ..... | Top of concrete pump base. | 1 | 4,250.9 | a12.1 | 11- -52 | L |
| | | | | | | | | | | | | | | | 13.06 | 10-28-53 | |
| | | | | | | | | | | | | | | | 9.37 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 25.4 | 9-27-54 | |
| 26N1 | Edsell .............. | ....... | P, 8 | 300 | ..... | ....... | ....... | ....... | U | ......... | ..... | Top of casing ....... | 1 | ........... | 34.53 | 10-28-53 | |
| | | | | | | | | | | | | | | | 29.50 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 33.35 | 9-27-54 | |
| 26Q1 | ...................... | 1944 | P, 12 | 120 | 100 | ....... | ....... | ....... | U | ......... | ..... | .....do.................. | 1 | 4,254.7 | a27.5 | 11- -52 | L |
| | | | | | | | | | | | | | | | a22.0 | 4- -53 | |
| | | | | | | | | | | | | | | | 24.80 | 10-23-53 | |
| | | | | | | | | | | | | | | | 20.75 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 30.9 | 9-27-54 | |
| 27H1 | Edsell ............... | ....... | P, 10 | 55 | ..... | ....... | ....... | Wm | S | ......... | ..... | .....do.................. | .0 | ........... | 14.3 | 10-28-53 | |
| | | | | | | | | | | | | | | | 9.7 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 12.6 | 9-27-54 | |
| 35B1 | .....do................ | 1946 | P, 12 | 100 | ..... | ....... | ....... | T, 15 | I | e1,100 | 60 | Top of casing, north side. | .5 | 4,255.4 | a26.3 | 11- -52 | L |
| | | | | | | | | | | | | | | | a22.8 | 4- -52 | |
| | | | | | | | | | | | | | | | 25.7 | 10-23-53 | |
| | | | | | | | | | | | | | | | 21.7 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 31.7 | 9-27-54 | |
| 35C1 | .....do................ | 1946 | P, 16 | 104 | 80 | ....... | ....... | T, 30 | I | e1,100 | 80 | Top of casing ....... | .0 | 4,256.6 | a26.4 | 11- -52 | L |
| | | | | | | | | | | | | | | | a23.2 | 4- -53 | |
| | | | | | | | | | | | | | | | 26.80 | 10-23-54 | |
| | | | | | | | | | | | | | | | 23.05 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 34.5 | 9-27-54 | |
| 35C2 | .....do................ | 1949 | P, 12 | 194 | 24 | ....... | ....... | T, 20 | I | e700 | 100 | .....do.................. | .0 | 4,258.4 | a29.1 | 11- -52 | L |
| | | | | | | | | | | | | | | | 28.84 | 10-23-53 | |
| | | | | | | | | | | | | | | | 24.78 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 33.5 | 9-27-54 | |
| 35G1 | A. Hoyt ............. | 1954 | P, 10 | 107 | 95 | 0<br>50 | 10<br>95 | T, 20 | I | ......... | ..... | No access; altitude, top of casing. | ....... | 4,257.5 | ........... | ............. | L |
| 35R1 | .....do................ | ....... | P, 6 | 110 | ..... | ....... | ....... | ....... | U | ......... | ..... | Top of casing ....... | 3 | 4,259.7 | 31.94 | 10-23-53 | |
| | | | | | | | | | | | | | | | 29.44 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 34.15 | 9-27-54 | |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) Top | Perforated interval (feet) Bottom | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point: Description | Measuring point: Distance above or below(-) land-surface datum (feet) | Measuring point: Altitude of measuring point (feet) | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | T. 46 N., R. 2 W.—Continued | | | | | | | | | |
| 36A1 | M. Criss & Sons | ...... | P | ...... | ...... | ...... | ...... | T | I | ...... | ...... | Access hole, pump base, north side. | 0.0 | 4,258.5 | a34.5 | 11- -52 | |
| | | | | | | | | | | | | | | | a34.77 | 10-22-53 | |
| | | | | | | | | | | | | | | | 32.74 | 5- 4-54 | |
| | | | | | | | | | | | | | | | d64.5 | 7- 7-54 | |
| | | | | | | | | | | | | | | | 36.35 | 9-27-54 | |
| 36H1 | Butte Valley Irrigation District. | ...... | P | ...... | ...... | ...... | ...... | T, 50 | I | ...... | ...... | Access pipe, east side pump base. | 1 | 4,257.7 | 34.12 | 10-22-53 | |
| | | | | | | | | | | | | | | | d46.2 | 6-25-54 | |
| 36F1 | M. Criss & Sons | ...... | P | ...... | ...... | ...... | ...... | T | I | e3,000 | ...... | No access | ...... | ...... | ...... | ...... | |
| 36L1 | P. Robinson | 1948 | P, 16 | 150 | ...... | ...... | ...... | T, 50 | I | e2,100 | 1 | Top of casing | 1 | ...... | 37.7 | 10-25-53 | L |
| | | | | | | | | | | | | | | | 33.5 | 5- 4-54 | |
| | | | | | | | | | | | | | | | 39.4 | 9-27-54 | |
| 36L2 | ....do | 1948 | P, 8 | 110 | ...... | ...... | ...... | J, 1 | D | ...... | ...... | No access | ...... | ...... | ...... | ...... | L |
| | | | | | | | | T. 47 N., R. 1 E. | | | | | | | | | |
| 5P1 | G. A. Stewart | ...... | P, 11 | .60 | 20 | ...... | ...... | ...... | U | ...... | ...... | Top of casing | 2.5 | 4,258.2 | 64.0 | 11-10-53 | |
| | | | | | | | | | | | | | | | 64.9 | 5- 5-54 | |
| 6A1 | ....do | ...... | P | ...... | ...... | ...... | ...... | T | I | ...... | ...... | No access | ...... | ...... | ...... | ...... | |
| 6D1 | R. Wilkinson | ...... | P | ...... | ...... | ...... | ...... | T, 30 | I | ...... | ...... | Access hole, pump base, east side. | 2 | 4,240.0 | a41.5 | 4- -53 | |
| | | | | | | | | | | | | | | | a35.35 | 11-10-53 | |
| | | | | | | | | | | | | | | | 34.5 | 5- 5-54 | |
| | | | | | | | | | | | | | | | a36.4 | 9-28-54 | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6H1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 60 | 60 | 40 | 60 | ...... | O | ...... | ..... | Top of casing ...... | 1 | 4,246.3 | 44.6 | 5- 5-54 | L,W |
| 17N1 | C. Green ...... | ...... | P, 8 | 97 | ..... | ...... | ...... | Wm | S | ...... | ..... | .....do...... | .64 | 4,241.4 | a35.8 | 11- -52 | W |
| | | | | | | | | | | | | | | | a35.4 | 4- -53 | |
| | | | | | | | | | | | | | | | 36.52 | 11- 4-53 | |
| | | | | | | | | | | | | | | | 35.30 | 5- 5-54 | |
| | | | | | | | | | | | | | | | a36.1 | 9-28-54 | |
| 19M1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 46 | 46 | 36 | 46 | ...... | O | ...... | ..... | .....do...... | .5 | 4,236.9 | 21.4 | 5- 5-54 | L,W |
| 29H1 | K. Holbrook ...... | ...... | D, 3 ft | 26 | ..... | ...... | ...... | L | U | ...... | ..... | Top of wooden platform, south side. | 2 | 4,241.0 | 25.25 | 11- 2-53 | |
| | | | | | | | | | | | | | | | 25.7 | 5- 5-54 | |
| 29H2 | .....do...... | 1926 | P, 8 | 60 | ..... | ...... | ...... | Wm | S | ...... | ..... | Top of casing ...... | 1 | 4,238± | 20.93 | 5- 5-54 | C,W |
| 29N1 | F. Johnson ...... | 1952 | R,G,18 | 300 | 300 | 100 | 300 | T, 75 | I | e3,200 | 80 | Top of concrete pump house. | 4 | 4,242.9 | 24.1 | 11- 2-53 | L |
| | | | | | | | | | | | | | | | d71 | 5- 5-54 | |
| | | | | | | | | | | | | | | | a21.2 | 9-28-54 | |
| 30R1 | Dalton and Wilkerson. | 1952 | R,G,18 | 320 | 300 | 70 | 300 | T, 75 | I | ...... | ..... | .....do...... | ...... | 4,240 | 19.2 | 9-28-54 | L |
| 31A1 | .....do...... | 1952 | R,G,18 | 320 | 300 | 70 | 300 | T, 75 | I | e3,000 | 95 | No access ...... | ...... | 4,246 | ...... | ...... | L |
| 31E1 | Cross ...... | ...... | P, 6 | ...... | ..... | ...... | ...... | ...... | U | ...... | ..... | Top of casing ...... | 2 | 4,233.1 | 13.95 | 5- 5-54 | W |
| 31J1 | J. Horn ...... | 1952 | R,G,18 | 320 | 300 | 70 | 300 | T, 75 | I | e3,000 | 90 | Access pipe, north side pump base. | 2 | 4,245 | 24.45 | 11- 4-53 | L |
| | | | | | | | | | | | | | | | 28.02 | 5- 5-54 | |
| | | | | | | | | | | | | | | | a23.3 | 9-28-54 | |
| 32A1 | K. Holbrook ...... | 1952 | R,G,18 | 265 | 265 | 65 | 265 | T, 50 | I | e3,150 | 54 | Access pipe, south side pump base. | 2 | ...... | 29.7 | 11- 2-53 | L |
| | | | | | | | | | | | | | | | 29.7 | 5- 5-54 | |

T. 47 N., R. 1 W.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1A1 | R. Wilkinson ...... | ...... | P | ...... | ..... | ...... | ...... | T | I | ...... | ..... | No access ...... | ...... | ...... | ...... | ...... | |
| 1A2 | Southern Pacific Co. | 1926–1927 | P, 12 | 250 | 250 | 90 | 250 | ...... | U | ...... | ..... | Plugged ...... | ...... | ...... | ...... | ...... | L |
| 1D1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 60 | 60 | 40 | 60 | ...... | O | ...... | ..... | Top of casing ...... | 1 | 4,239.9 | 25.92 | 5- 5-54 | L,W |
| 2N1 | E. Marshall ...... | ...... | P, 8 | ...... | ..... | ...... | ...... | Wm | S | ...... | ..... | .....do...... | 1 | 4,235.2 | 11.4 | 5- 5-54 | W |
| 3D1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 50 | 50 | 35 | 50 | ...... | O | ...... | ..... | .....do...... | 1 | 4,241.9 | 13.77 | 5- 5-54 | L,W |
| g4D1 | .....do...... | 1954 | R | 460 | 80 | ...... | ...... | ...... | O | ...... | ..... | .....do...... | .5 | ...... | a8.4 | 9-28-54 | L |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | | T. 47 N., R. 1 W.—Continued | | | | | | | | | |
| 4D2 | U. S. Bureau of Reclamation. | ....... | R | ....... | 200 | ....... | ....... | ....... | O | ......... | ..... | Top of casing ....... | 0.5 | ........... | a10.3 | 9-28-54 | |
| 6A1 | .....do................ | 1951 | P, 2 | 52 | 52 | 40 | 52 | ....... | O | ......... | ..... | .....do................. | 1 | 4,244.8 | 4.44 | 5- 5-54 | L,W |
| 7M1 | .....do................ | 1951 | P, 2 | 50 | 50 | 35 | 50 | ....... | O | ......... | ..... | .....do................. | .5 | 4,242.3 | 7.4 | 5- 5-54 | L,W |
| 8H1 | U. S. Department Agriculture, Soil Conservation Service. | ....... | P, 8 | 100 | ..... | ....... | ....... | J, 1 | S | ......... | ..... | Access hole, top of casing. | ....... | ........... | 15.1 | 11-12-53 | |
| | | | | | | | | | | | | | | | 14.6 | 5- 5-54 | |
| g9D1 | U. S. Bureau of Reclamation. | 1954 | R | 126 | 100 | ....... | ....... | ....... | O | ......... | ..... | Top of casing ....... | 1 | ........... | a13.0 | 9-28-54 | L |
| 9J1 | .....do................ | 1951 | P, 2 | 40 | 40 | 30 | 40 | ....... | O | ......... | ..... | .....do................. | 1.5 | 4,239.9 | 15.55 | 5- 5-54 | L,W |
| 13G1 | E. Harrison ........ | 1952 | P,G,20 | 207 | 207 | 36 | 48 | ....... | U | ......... | ..... | .....do................. | 1 | 4,236.8 | a21.0 | 11- -52 | L |
| | | | | | | 60 | 72 | | | | | | | | a21.5 | 4- -53 | |
| | | | | | | 108 | 207 | | | | | | | | 21.77 | 11- 4-53 | |
| | | | | | | | | | | | | | | | 22.60 | 5- 5-54 | |
| | | | | | | | | | | | | | | | a22.1 | 9-28-54 | |
| 13P1 | .....do................ | 1952 | P,G,20 | 160 | 160 | 88 | 160 | ....... | U | e2,000 | 58 | .....do................. | 1 | 4,238.8 | 23.48 | 11- 4-53 | L |
| | | | | | | | | | | | | | | | 22.94 | 5- 5-54 | |
| 14B1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 50 | 50 | 35 | 50 | ....... | O | ......... | ..... | .....do................. | .5 | 4,234.3 | 14.42 | 5- 5-54 | L,W |
| 17R1 | .....do................ | 1951 | P, 2 | 45 | 45 | 35 | 45 | ....... | O | ......... | ..... | .....do................. | .5 | 4,240.3 | 16.10 | 5- 5-54 | L,W |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19L1 | U. S. Department Agriculture, Soil Conservation Service. | ...... | P | ...... | ..... | ...... | ...... | Wm | S | ........ | ..... | ....do.................. | .5 | 4,238.2 | 10.9 | 5- 5-54 | W |
| 20R1 | ....do................ | 1950 | P, 8 | 100 | ..... | ...... | ...... | J, 1 | S | ........ | ..... | Access hole, top of casing. | 1 | .......... | 16.15 | 11-27-53 | |
| | | | | | | | | | | | | | | | 16.05 | 5- 5-54 | |
| | | | | | | | | | | | | | | | a16.2 | 9-28-54 | |
| 22P1 | ........................ | ...... | P, 10 | 23 | ..... | ...... | ...... | Wm | S | ........ | ..... | Top of casing ....... | 1 | 4,237.8 | 16.42 | 10-26-54 | |
| | | | | | | | | | | | | | | | 15.82 | 5- 5-54 | |
| 23A1 | E. Harrison ........ | 1952 | P,G,16 | 136 | 136 | 60 | 136 | T, 40 | I | ........ | ..... | Access hole, west side pump base. | 1 | 4,236.8 | a18.4 | 11- -52 | L,C |
| | | | | | | | | | | | | | | | a18.2 | 4- -53 | |
| | | | | | | | | | | | | | | | 20.30 | 11- 4-53 | |
| | | | | | | | | | | | | | | | 19.27 | 5- 5-54 | |
| | | | | | | | | | | | | | | | d84.7 | 7-15-54 | |
| | | | | | | | | | | | | | | | a31.5 | 9-28-54 | |
| 23G1 | ....do................ | 1952 | P, 8 | 107 | 100 | ...... | ...... | J, 1 | D | ........ | ..... | No access ........... | ...... | .......... | .......... | ............ | L,C |
| 23H1 | ....do................ | 1949 | P, 16 | 210 | 110 | ...... | ...... | T, 30 | I | e1,500 | ..... | Top of casing, west side. | 1 | 4,237.1 | a18.5 | 11- -52 | |
| | | | | | | | | | | | | | | | 19.79 | 11- 4-53 | |
| | | | | | | | | | | | | | | | 18.66 | 5- 5-54 | |
| | | | | | | | | | | | | | | | an44.0 | 9-28-54 | |
| 23M1 | ....do................ | 1952 | P, 20 | 198 | 110 | ...... | ...... | ...... | U | e2,000 | 86 | Top of casing ....... | 1 | 4,238.5 | 19.35 | 11- 4-53 | |
| | | | | | | | | | | | | | | | 18.75 | 5- 5-54 | |
| | | | | | | | | | | | | | | | a21.2 | 9-28-54 | |
| 24C1 | A. Hardman ........ | 1953 | P,G,18 | 190 | 190 | 18 | 190 | T, 50 | I | e1,600 | 97 | Top of casing, east side. | .0 | 4,238.5 | 23.30 | 11- 4-53 | L |
| | | | | | | | | | | | | | | | 22.8 | 5- 5-54 | |
| | | | | | | | | | | | | | | | d73.5 | 7-15-54 | |
| | | | | | | | | | | | | | | | 25.3 | 9-28-54 | |
| 27B1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 40 | 40 | 30 | 40 | ...... | O | ........ | ..... | Top of casing ....... | .5 | 4,233.8 | 12.67 | 5- 5-54 | L,W |
| 28M1 | ....do................ | 1951 | P, 2 | 50 | 50 | 35 | 50 | ...... | O | ........ | ..... | ....do.................. | .5 | 4,238.2 | 15.60 | 5- 5-54 | L,W |
| g31G1 | ....do................ | 1954 | R | 498 | 180 | ...... | ...... | ...... | O | ........ | ..... | ....do.................. | 1.2 | .......... | 14.7 | 9-29-54 | L |
| 31N1 | Farnum Bros....... | ...... | P, 8 | 18 | ..... | ...... | ...... | Wm | S | ........ | ..... | ....do.................. | .0 | .......... | a4.4 | 11- -52 | |
| | | | | | | | | | | | | | | | a2.9 | 4- -53 | |
| | | | | | | | | | | | | | | | 5.1 | 10-27-53 | |
| | | | | | | | | | | | | | | | 3.3 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 5.2 | 9-28-54 | |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | | | | T. 47 N., R. 1 W.—Continued | | | | | | | |
| 31N2 | Farnum Bros....... | 1952 | P, 20 | 87 | 52 | ....... | ....... | ....... | U | e4,000 | ..... | Top of casing ....... | 2 | ........... | 5.93 | 10-27-53 | L |
| | | | | | | | | | | | | | | | 3.99 | 5- 5-54 | |
| | | | | | | | | | | | | | | | 5.9 | 9-28-54 | |
| g32R1 | U. S. Bureau of Reclamation. | 1954 | R | 198 | 60 | ....... | ....... | ....... | O | ......... | ..... | .....do.................. | 1.3 | ........... | a14.9 | 9-28-54 | L |
| g32R2 | .....do................ | ....... | ......... | ....... | 180 | ....... | ....... | ....... | O | ......... | ..... | .....do.................. | .9 | ........... | a17.5 | 9-28-54 | |
| 33Q1 | .....do................ | 1951 | P, 2 | 70 | 70 | 50 | 70 | ....... | O | ......... | ..... | .....do.................. | .5 | 4,239.9 | 16.46 | 5- 5-54 | L,W |
| 34H1 | ....................... | ....... | P,G,18 | ....... | ..... | ....... | ....... | T | I | ......... | ..... | No access ........... | ....... | ........... | ........... | ............ | |
| 34Q1 | W. Edwards ........ | 1953 | P,G,18 | 358 | 304 | 60 | 304 | T, 40 | I | e1,800 | 124 | Top of concrete pump base. | 2 | 4,239.2 | 17.73 | 10-30-53 | L |
| | | | | | | | | | | | | | | | 21.48 | 5- 5-54 | |
| 34R1 | .....do................ | 1952 | P,G,16 | 334 | 320 | 40 | 320 | T, 75 | I | e2,600 | 114 | .....do.................. | 1 | 4,239.4 | 17.07 | 10-30-53 | L |
| | | | | | | | | | | | | | | | 21.30 | 5- 5-54 | |
| | | | | | | | | | | | | | | | a18.0 | 9-29-54 | |
| 35P1 | D. West ............ | 1952 | R,G,20 | 320 | 300 | 100 | 300 | T, 75 | I | e3,000 | 90 | Access pipe, top concrete pump base. | 2 | 4,236.9 | 16.70 | 10-30-53 | L |
| | | | | | | | | | | | | | | | 22.63 | 5- 5-54 | |
| 35Q1 | .....do................ | 1952 | R,G,20 | 320 | 300 | 100 | 300 | T, 125 | I | 3,000 | 90 | .....do.................. | 1 | 4,234.6 | 14.64 | 10-30-53 | L,C |
| | | | | | | | | | | | | | | | a15.4 | 9-29-54 | |
| 36D1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 40 | 40 | 30 | 40 | ....... | O | ......... | ..... | Top of casing ....... | .5 | 4,229.7 | 7.96 | 5- 5-54 | L,W |
| 36L1 | C. Crawford ....... | 1951 | P, 18 | 187 | 187 | ....... | ....... | T, 50 | I | 1,800 | 100 | No access ........... | ....... | ........... | ........... | ............ | L |

T. 47 N., R. 2 W.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4G1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 50 | 50 | 40 | 50 | ... | O | ... | ... | Top of casing | 0.5 | 4,251.0 | 8.90 | 5- 6-54 | L,W |
| 9H1 | J. Fleming | ... | D | ... | ... | ... | ... | Wm | S | ... | ... | Top of well platform. | .5 | 4,248.6 | 3.8 | 5- 6-54 | W |
| 13B1 | ... | ... | P, 8 | 34 | ... | ... | ... | ... | U | ... | ... | Top of casing | .6 | 4,253.5 | 11.48 | 5- 6-54 | W |
| 14L1 | R. Fogle | 1929 | P, 6 | 182 | 12 | ... | ... | Wm | D,S | ... | ... | No access | ... | ... | ... | ... | L |
| 16L1 | Rocco | 1946 | P, 12 | 260 | 128 | ... | ... | T | I | ... | ... | Top of casing | 2 | ... | 10.00 | 11-10-53 | L |
| | | | | | | | | | | | | | | | 6.35 | 5- 6-54 | |
| 16P1 | do. | ... | D | 10 | ... | ... | ... | ... | U | ... | ... | Top of well platform. | .3 | 4,238.4 | 2.7 | 5- 6-54 | W,C |
| 20G1 | Spring School | ... | P, 6 | 33 | ... | ... | ... | L | U | ... | ... | Top of casing | 1 | ... | a11.3 | 11- -52 | C |
| | | | | | | | | | | | | | | | a7.8 | 4- -53 | |
| | | | | | | | | | | | | | | | 11.35 | 10-29-53 | |
| | | | | | | | | | | | | | | | 8.37 | 5- 6-54 | |
| 21D1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 81 | 81 | 60 | 81 | ... | O | ... | ... | do. | .5 | 4,237.3 | 1.85 | 5- 6-54 | L,W |
| 21H1 | ... | ... | P, 14 | ... | ... | ... | ... | Wm | S | ... | ... | do. | 1 | ... | 9.40 | 11-11-53 | |
| | | | | | | | | | | | | | | | 5.42 | 5- 6-54 | |
| 22Q1 | H. Holzhouser | ... | P, 6 | 60 | ... | ... | ... | J, 1 | D | ... | ... | do. | 0 | ... | 8.64 | 11-11-53 | |
| | | | | | | | | | | | | | | | 9.0 | 5- 6-54 | |
| 23D1 | R. Fogle | 1951 | P, 18 | 326 | 20 | ... | ... | [1]T | I | e1,000 | 60 | Access hole, well platform north side. | 0 | ... | 34.6 | 8-10-54 | L |
| 23F1 | do. | ... | P, 6 | 35 | ... | ... | ... | L | U | ... | ... | Top of casing | 0 | ... | 10.08 | 11-11-53 | |
| | | | | | | | | | | | | | | | 9.02 | 5- 6-54 | |
| 23L1 | J. Rocco | 1946 | P, 16 | 281 | 150 | ... | ... | T | I | e800 | ... | No access | ... | ... | ... | ... | L |
| 23M1 | ... | ... | D | ... | ... | ... | ... | ... | U | ... | ... | Caved in | ... | 4,239.4 | ... | ... | W |
| 27A1 | Farnum Bros. | ... | P, 6 | ... | ... | ... | ... | Wm | S | ... | ... | Top of casing | 0 | ... | a6.7 | 11- -52 | |
| | | | | | | | | | | | | | | | a3.9 | 4- -53 | |
| | | | | | | | | | | | | | | | 6.2 | 11-11-53 | |
| | | | | | | | | | | | | | | | 4.2 | 5- 6-54 | |
| 28N1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 41 | 41 | 20 | 41 | ... | O | ... | ... | do. | .6 | 4,238.7 | .7 | 4- 3-53 | L,W |
| 29J1 | Voelker | 1946 | P, 12 | 150 | ... | ... | ... | T | I | e600 | ... | do. | .0 | 4,240.6 | .8 | 5- 6-54 | L,W |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet): Top | Perforated interval (feet): Bottom | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point: Description | Measuring point: Distance above or below(-) land-surface datum (feet) | Measuring point: Altitude of measuring point (feet) | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | T. 47 N., R. 2 W.—Continued | | | | | | | | | |
| 32N1 | L. Luzzi | ...... | D | ...... | .... | ...... | ...... | ...... | U | ........ | .... | Top of well platform. | 3 | 4,297.8 | 5.61 | 5- 6-54 | W |
| | | | | | | | | T. 48 N., R. 1 E. | | | | | | | | | |
| 19A1 | Minges | 1949 | P, 16 | 459 | .... | ...... | ...... | T, 30 | I | ........ | .... | No access | ...... | ........ | ........ | ........ | |
| 19F1 | .....do | 1935 | P, | ...... | .... | ...... | ...... | T, 30 | I | ........ | .... | .....do | ...... | ........ | ........ | ........ | |
| 28F1 | J. McKay | ...... | P, 10 | 84 | .... | ...... | ...... | J, 1 | D | ........ | .... | .....do | ...... | ........ | ........ | ........ | |
| 28F2 | .....do | 1953 | P, 20 | 130 | 40 | 28 | 40 | T, 50 | I | ........ | .... | .....do | ...... | ........ | ........ | ........ | |
| 29R1 | L. Logan | 1954 | P | ...... | Not cased | | | ...... | ...... | ........ | .... | Top of hole at ground surface. | ...... | ........ | 37.2 | 8-30-54 | |
| 30M1 | J. Liskey | ...... | D | ...... | .... | ...... | ...... | J, 1 | D | ........ | .... | Top of concrete platform. | 0.0 | 4,246.1 | 48.4 | 5- 5-54 | W |
| p30M2 | ........ | 1941 | P, 6 | 415 | Not cased | | | ...... | ...... | ........ | .... | ........ | ...... | ........ | ........ | ........ | L |
| 30N1 | City of Dorris | 1946 | P, 12 | 201 | 195 | 130 | 195 | T | PS | ........ | .... | No access | ...... | ........ | ........ | ........ | L, C |
| 31A1 | J. Liskey | 1952 | P, 16 | 201 | 132 | ...... | ...... | T, 75 | I | e2,800 | .... | Top of concrete pump base. | -8 | 4,250.4 | 88.5<br>88.3<br>a94.3 | 11-10-53<br>5- 5-54<br>9-28-54 | L |
| 31D1 | City of Dorris | ...... | P | 120 | .... | ...... | ...... | T | PS | e350 | 17 | No access | ...... | ........ | ........ | ........ | |
| 31E1 | .....do | ...... | P | 110 | .... | ...... | ...... | T | PS | e350 | 18 | .....do | ...... | ........ | ........ | ........ | |
| 31J1 | McCollum | 1935 | P | 313 | .... | ...... | ...... | ...... | ...... | ........ | .... | Destroyed | ...... | ........ | ........ | ........ | L |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31K1 | ...do... | 1935 | P, 10 | 126 | ... | ... | ... | J, 1 | D | ... | ... | ... | ... | ... | a42.0 | 11- -52 | L |
| | | | | | | | | | | | | | | | a42.0 | 4- -53 | |
| 31L1 | Barnett ... | 1954 | R,G,18 | 200 | 150 | 50 | 150 | T | I | e1,250 | 80 | Top of concrete pump base. | 1 | 4,240.8 | 34.62 | 5- 5-54 | L |
| 31M1 | ...do... | 1930 | P, 6 | 75 | ... | ... | ... | ... | D | ... | ... | No access ... | ... | ... | ... | ... | L |
| 31R1 | McCollum ... | 1948 | P,G,16 | 150 | 150 | ... | ... | T, 30 | I | e1,200 | ... | ...do... | ... | ... | a36.9 | 11- -52 | L,C |
| 32A1 | ... | ... | D | ... | ... | ... | ... | Wm | U | ... | ... | Top of well platform. | 0 | ... | 16 | 8-30-54 | |
| 32N1 | Moore ... | ... | D | 44 | ... | ... | ... | Wm | U | ... | ... | Metal rim at top well curbing. | 1 | 4,243.7 | a41.6 | 9-28-54 | W |
| 32P1 | ...do... | 1949 | P, 12 | 400 | ... | ... | ... | T, 20 | I | ... | ... | Top of casing ... | .0 | 4,246.4 | 55.30 | 11-10-53 | L |
| | | | | | | | | | | | | | | | 55.5 | 5- 5-54 | |
| 32Q1 | ...do... | ... | P, 6 | 375 | ... | ... | ... | J, 1 | D | ... | ... | ...do... | 2 | 4,257.2 | 86.0 | 11-10-53 | |
| | | | | | | | | | | | | | | | 85.16 | 5- 5-54 | |
| | | | | | | | | T. 48 N., R. 1 W. | | | | | | | | | |
| 25H1 | Humphrey ... | 1937 | P,G,12 | 480 | 120 | 80 | 120 | T, 30 | I | e2,000 | ... | No access ... | ... | ... | ... | ... | L |
| 25Q1 | T. Cavenor ... | 1953 | P,G,16 | 150 | 150 | 30 | 150 | T, 25 | I | ... | ... | Land surface ... | 0 | 4,240 | 34.1 | 11-12-53 | L |
| | | | | | | | | | | | | | | | 38.7 | 5- 5-54 | |
| 26D1 | Fairless ... | ... | P, 16 | ... | ... | ... | ... | ... | U | ... | ... | ...do... | 0 | 4,259 | 15.60 | 11-12-53 | |
| | | | | | | | | | | | | | | | 12.0 | 5- 5-54 | |
| 26N1 | ...do... | ... | P, 10 | 375 | 8 | ... | ... | ... | U | ... | ... | Top of casing ... | 0 | 4,244.2 | 13.74 | 11-12-53 | |
| | | | | | | | | | | | | | | | 9.15 | 5- 5-54 | |
| 26Q1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 50 | 50 | 30 | 50 | ... | O | ... | ... | ...do... | 1 | 4,243.7 | 10.05 | 5- 5-54 | L,W |
| 28C1 | J. Liskey ... | 1952 | P, 12 | 560 | 100 | 60 | 100 | T | I | e900 | 60 | No access ... | ... | ... | ... | ... | L |
| 28F1 | ...do... | 1952 | P, 16 | 632 | 579 | ... | ... | T, 60 | I | e1,200 | 60 | ...do... | ... | ... | ... | ... | L |
| 28J1 | Bentley ... | 1947 | P, 16 | 350 | 240 | 180 | 240 | T, 40 | I | e1,200 | ... | Top of casing ... | 1 | ... | 38.08 | 11-12-53 | L,C |
| 28J2 | Picard Cemetary... | 1951 | P, 6 | 230 | 91 | ... | ... | T, 5 | I | ... | ... | No access ... | ... | ... | ... | ... | L |
| 28N1 | U. S. Bureau of Reclamation. | 1951 | P, 2 | 50 | 50 | 40 | 50 | ... | O | ... | ... | Top of casing ... | .0 | 4,244.9 | 3.27 | 5- 5-54 | L,W |
| 29R1 | ... | ... | P, 6 | 50 | ... | ... | ... | Wm | S | ... | ... | ...do... | 1 | ... | 6.48 | 11-12-53 | |
| | | | | | | | | | | | | | | | 5.1 | 5- 5-54 | |
| 33C1 | Fairless ... | 1953 | P, 12 | ... | ... | ... | ... | T | I | ... | ... | ...do... | .0 | 4,244.1 | 8.5 | 11-12-53 | |
| | | | | | | | | | | | | | | | 6.6 | 5- 5-54 | |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | T. 48 N., R. 1 W.—Continued | | | | | | | | | | |
| 34B1 | Storey ... | 1953 | P, 12 | ... | ... | ... | ... | T | I | ... | ... | Top of casing ... | ... | 4,256.2 | ... | ... | |
| 36D1 | Hendrickson ... | 1953 | P, 6 | 102 | 20 | ... | ... | J, 1 | D | ... | ... | No access ... | ... | ... | ... | ... | L |
| | | | | | | | T. 48 N., R. 2 W. | | | | | | | | | | |
| 33J1 | McKay ... | 1930 | P, 8 | 100 | 10 | ... | ... | Wm | D | ... | ... | No access ... | ... | ... | ... | ... | L |
| | | | | | | | RED ROCK VALLEY | | | | | | | | | | |
| | | | | | | | T. 45 N., R. 1 E. | | | | | | | | | | |
| 2L1 | L. D. Parsons ... | 1954 | P | ... | ... | ... | ... | ... | I | ... | ... | ... | ... | ... | ... | ... | |
| 5L1 | ... | 1918 | P, 6 | 195 | 6 | ... | ... | Wm | S | ... | ... | No access ... | ... | ... | ... | ... | L |
| 9C1 | Beck ... | 1935 | P, 8 | 170 | ... | ... | ... | Wm | D | ... | ... | Top of casing ... | 0.0 | 4,373.4 | a153.0 | 7-30-52 | L |
| | | | | | | | | | | | | | | | a155.6 | 11-17-52 | |
| | | | | | | | | | | | | | | | a156.0 | 12-17-52 | |
| | | | | | | | | | | | | | | | a155.9 | 1- 8-53 | |
| | | | | | | | | | | | | | | | a155.8 | 3- 5-53 | |
| 9C2 | ...do... | 1954 | P, 16 | 197 | 181 | 131 | 181 | ... | I | 1,500 | ... | ...do... | 2.5 | ... | 168.9 | 8-17-54 | L |
| 11C1 | L. D. Parsons ... | 1937 | P | 221 | Not cased | | | Wm | D,S | ... | ... | Access hole, top of casing, south side. | .5 | 4,395.7 | 175.35 | 6-24-54 | L,W, C |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11C2 | do. | 1953 | P | 232 | Not cased | | | [1]T | I | e1,300 | 2 | Top of casing | 1 | | 177.55 | 6-24-54 | L |
| 14J1 | C. Robinson | | P, 10 | | | | | | qU | | | | | | | | |
| 16P1 | L. D. Parsons | 1923 | P, 6 | 155 | 133 | 155 | | Wm | S | | | No access | | | | | L |
| 18G1 | C. Robinson | 1949 | P, 6 | 247 | 8 | | | L, g | S | | | do. | | | | | L |
| 24A1 | do. | | P | 180 | | | | T | D,S | | | do. | | | | | L |

T. 45 N., R. 2 E.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6G1 | | 1927 | P | 367 | | | | | D | | | No access | | | | | L |
| 6N1 | Red Rock School | 1952 | P, 8 | 211 | | | | Wm | D | | | do. | | | | | L |
| 7G1 | C. Robinson | | P, 6 | | | | | L | U | | | Top of casing | 3 | | 184.54 | 6-25-54 | |
| 17D1 | R. Clark | 1926 | P | 199 | | | | L, g | S | | | Access hole, top of casing, east side. | 0 | | 184.6 | 6-25-54 | L |

T. 46 N., R. 1 E.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31P1 | J. L. Truax | 1926 | P, 8 | 172 | | | | Wm | D,S | | | No access | | | | | C |
| 35J1 | R. J. Taylor | 1942 | P, 6 | 237 | 214 | | | L, g | S | | | do. | | | | | L |

T. 46 N., R. 2 E.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31E1 | J. Allen | 1918 | P, 6 | 283 | 17 | | | Wm | S | | | No access | | | | | L |

OKLAHOMA DISTRICT

T. 46 N., R. 2 E.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7E1 | L. H. Fogle | 1951 | P, 12 | 521 | 21 | | | [1]T | I,S | e1,100 | 19 | No access | | | | | L,C |
| 15F1 | Hammond | 1942 | P | 105 | | | | L | D | | | do. | | | | | L |
| 22Q1 | O'Keef | | P, 6 | 100 | | | | | S | | | | | | Flowing | 8-23-54 | C |
| 28Q1 | U. S. Bureau of Land Management. | 1953 | P, 6 | 190 | 101 | | | Wm | S | | | No access | | | | | L |
| 34L1 | Brennan | | D | 72 | | | | | U | | | Top of stone curbing, west side. | 1 | | 40.37 | 6-30-54 | |

See footnotes at end of table.

Table 7.—*Description of wells in the Butte Valley region, Siskiyou County, Calif.*—Continued

| Well | Owner or user | Year completed | Type of well, and casing diameter (inches) | Depth (feet) | Depth of casing (feet) | Perforated interval (feet) | | Type of pump, and power | Use | Discharge (gpm) | Drawdown (feet) | Measuring point | | | Depth to water below measuring point (feet) | Date of measurement | Other data available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Top | Bottom | | | | | Description | Distance above or below(-) land-surface datum (feet) | Altitude of measuring point (feet) | | | |
| | | | | | | | | T. 47 N., R. 1 E. | | | | | | | | | |
| 11M1 | Porterfield | 1952 | P | ...... | ...... | ...... | ...... | T, 40 | I | ...... | ...... | No access | ...... | ...... | ...... | ...... | |
| 14L1 | ....do.... | ...... | P | ...... | ...... | ...... | ...... | T, 30 | I | ...... | ...... | ...... | ...... | ...... | Flowing | 8-23-54 | |
| 25K1 | ....do.... | 1952 | P, 20 | 295 | 20 | ...... | ...... | T, 60 | I | e1,400 | 76 | ...... | ...... | ...... | Flowing | 8-23-54 | L |
| | | | | | | | | T. 47 N., R. 2 E. | | | | | | | | | |
| 7N1 | P. Langer | 1952 | P, 18 | 290 | 20 | ...... | ...... | T, 3 | S | e925 | 140 | ...... | ...... | ...... | Flowing | 6- 7-54 | L |

[1] Diesel.
[2] Inches.

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*

[Stratigraphic correlations by P. R. Wood. Land surface altitudes approximate and with respect to mean sea-level datum of 1929 through the medium of the Pacific Northwest Supplementary Adjustment of 1947]

| | Thickness (feet) | Depth (feet) |
|---|---|---|

45/1W-5L1

[J. Starr. On alluvial plain, about 1.1 miles southeast of Mount Hebron. Altitude 4,270 ft. Drilled by J. A. Van Meter, 1952. Cased to 24 ft, cemented on bottom. Static water level, when drilled, about 41 ft below land surface]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Topsoil | 2.5 | 2.5 |
| "Hardpan" | .5 | 3 |
| Gravel and clay | 12 | 15 |
| Clay | 2.5 | 17.5 |
| Boulders and clay | 1.5 | 19 |
| Clay | 3.5 | 22.5 |
| Butte Valley basalt: | | |
| Lava, broken | 34.5 | 57 |
| Lava, creviced | 13 | 70 |

45/2W-1P2

[D. Mills. On alluvial plain, about 1.5 miles southwest of Mount Hebron. Altitude 4,265 ft. Drilled by George Hartley, 1953. Cased to 18 ft. Static water level when drilled, about 43 ft below land surface]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Soil | 18 | 18 |
| Butte Valley basalt: | | |
| Lava rock | 71 | 89 |
| Lake deposits: | | |
| Rock, broken, gravel and sand | 3 | 92 |
| Clay | 33 | 125 |
| Sand and gravel | 15 | 140 |
| Clay with sand strata | 30 | 170 |

45/2W-3H1

[D. Mills. On alluvial plain, about 2.4 miles west-southwest of Mount Hebron. Altitude 4,260 ft. Drilled by George Hartley, 1948. Casing perforated 15-270 ft, gravel-packed]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Soil, some gravel on lower levels | 50 | 50 |
| Butte Valley basalt: | | |
| Lava rock | 55 | 105 |
| Lake deposits: | | |
| Sand and gravel | 5 | 110 |
| Clay, blue, with sand stratas | 145 | 255 |
| Sand, gravel and pumice | 15 | 270 |

45/2W-3J1

[D. Mills. On alluvial plain, about 2.7 miles west-southwest of Mount Hebron. Altitude 4,261 ft. Drilled by J. S. Wilson, 1948]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Soil | 25 | 25 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 45/2W-3J1—Continued | | |
| Butte Valley basalt: | | |
| Lava rock | 71 | 96 |
| Lake deposits: | | |
| Clay, blue | 29 | 125 |
| Clay, blue, some sand stratas | 65 | 190 |
| Sand | 10 | 200 |
| Clay | 15 | 215 |
| Sand | 20 | 235 |
| Clay | 25 | 260 |
| Sand | 20 | 280 |
| Clay | 5 | 285 |
| Sand | 10 | 295 |
| Clay | 105 | 400 |

45/2W-3P1

[D. Mills. On alluvial plain, about 3.2 miles west-southwest of Mount Hebron. Altitude 4,262 ft. Drilled by George Hartley, 1953. Cased to 18 ft. Static level, when drilled, about 27 ft below land surface]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Soil with under layer of gravel | 18 | 18 |
| Butte Valley basalt: | | |
| Lava rock | 56 | 74 |
| Lake deposits: | | |
| Sand | 2 | 76 |
| Clay | 49 | 125 |
| Sand | 15 | 140 |

45/2W-3Q1

[D. Mills. On alluvial plain, about 2.8 miles west-southwest of Mount Hebron. Altitude 4,263 ft. Drilled by J. S. Wilson, 1948. Cased to 28 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Soil and gravel | 28 | 28 |
| Butte Valley basalt: | | |
| Lava rock | 67 | 95 |
| Lake deposits: | | |
| Sand | 1 | 96 |
| Clay, blue, with sand stratas | 254 | 350 |
| Volcanic rocks of the "High Cascades"(?): | | |
| Basalt, red, hard | 75 | 425 |

45/2W-10F1

[D. Mills. On alluvial plain near mountain front, about 3.5 miles southwest of Mount Hebron. Altitude 4,262 ft. Drilled by George Hartley, 1952]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil | 20 | 20 |
| Lava rock | 53 | 73 |
| Rock, broken, gravel and sand | 2 | 75 |
| Clay and sand stratas | 50 | 125 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **45/2W-10M1** | | |
| [Mrs. J. O'Kane, Juniper Lodge. On alluvial plain, near mountain front, about 3.7 miles southwest of Mount Hebron. Altitude 4,265 ft. Static water level, when drilled, about 45 ft below land surface] | | |
| Butte Valley basalt: | | |
| Lava | 79 | 79 |
| Lake deposits: | | |
| Clay | 6 | 85 |
| Sand, silty, small water flow | 20 | 105 |
| Conglomerate | 72 | 177 |
| Water sand, good | 5.5 | 182.5 |
| **46/1E-6J1** | | |
| [M. Cross. On alluvial plain, near Inlow Butte, about 5.8 miles northeast of Macdoel. Altitude 4,244 ft. Drilled by J. A. Van Meter, 1953. Casing perforated 60-200 ft. Static water level, when drilled, about 23 ft below land surface] | | |
| Alluvium: | | |
| Topsoil | 8 | 8 |
| Sand and clay | 7 | 15 |
| Butte Valley (?) basalt: | | |
| Lava, shattered | 2 | 17 |
| Lava, creviced | 10 | 27 |
| Lake deposits: | | |
| Clay, yellow | 8 | 35 |
| Sand, black | 1 | 36 |
| "Chalk" green | 5 | 41 |
| Sand, black, and thin streaks of clay | 30 | 71 |
| "Quicksand," black, and some gravel | 8 | 79 |
| Sand, coarse, black, and gravel | 13 | 92 |
| Sand, coarse, black, some gravel | 10 | 102 |
| "Quicksand," fine, with thin layers of sandstone | 19 | 121 |
| Clay with streaks of sand | 15 | 136 |
| Sand, packed, and gravel | 2 | 138 |
| "Quicksand" | 62 | 200 |
| **46/1E-6N1** | | |
| [L. M. Luzzi. On alluvial plain, about 4.7 miles northeast of Macdoel. Altitude 4,242 ft. Drilled by F. J. Hilton. Ceased to 150 ft, perforated 30-150 ft. Static level, when drilled, about 24 ft below land surface] | | |
| Topsoil | 3.5 | 3.5 |
| Butte Valley basalt: | | |
| Lava, bubbly (vesicular) | 14 | 17.5 |
| Lake deposits: | | |
| Clay, brown | 16 | 33.5 |
| Sand strata | 1 | 34.5 |
| Clay, brown | 15.5 | 50 |
| Sand | 10 | 60 |
| Clay, blue | 4 | 64 |
| Sand | 23 | 87 |
| Clay, green | 12 | 99 |
| Sand | 46 | 145 |
| Sand strata | 9 | 154 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **46/1E-6N1—Continued** | | |
| Sand | 2 | 156 |
| Sandstone and shale, hard | 16 | 172 |
| Sand | 4 | 176 |
| Sandstone | 24 | 200 |
| **46/1W-1A1** | | |
| [U. S. Bureau of Reclamation. On alluvial plain, about 5 miles northeast of Macdoel. Altitude 4,238 ft. Drilled by U. S. Bureau of Reclamation, 1954. Hole logged by R. J. Rongey, geologist, USBR] | | |
| Sand, very fine to fine, moderately pervious, loose, massive, well-sorted, slight silt content. Moderate brown | 2.5 | 2.5 |
| Sand, very fine to fine, silty; friable, numerous root openings, ill-sorted with a high silt content, very calcareous. Moderate yellowish-brown | 1.5 | 4 |
| Sand, very fine, silty; poorly pervious, friable, ill-sorted. Moderate yellowish-brown | 1.5 | 5.5 |
| Sand, medium; loose, well-sorted, chiefly volcanic glass with some olivine | 1.5 | 7 |
| Silt, clayey; poorly friable to firm, massive ill-sorted. Moderate yellowish-brown | 3.5 | 10.5 |
| Clay, poorly pervious, brittle to slightly plastic, massive, well-sorted, predominantly weathered volcanic ash. Moderate yellowish-brown | 6 | 16.5 |
| Sand, fine to medium; highly pervious, loose, slightly bedded as indicated by variable basaltic glass content. Moderately well-sorted with some olivine. Moderate yellowish-brown | 1 | 17.5 |
| Sand, fine to medium; friable, massive ill-sorted with a silt binder, noncalcareous. Moderate yellowish-brown | 3.5 | 21 |
| Clay and sand, interbedded silty clay and fine to medium sand, clays brittle, sands friable and moderately well-sorted. Interbeds are 0.1 to 0.6 ft thick | 2.5 | 23.5 |
| Sand, fine to medium, highly pervious, loose, slight bedding indicated by dark basaltic glass concentrations, well-sorted. Moderate yellowish-brown | 2.5 | 26 |
| Sand, fine to very fine, silty; poorly to slightly pervious, friable to firm, slight bedding indicated by variable silt content, ill-sorted. Moderate yellowish-brown | 3.5 | 29.5 |
| Sand, fine, moderately pervious, easily friable, bedded with several half-inch medium sand layers, well-sorted, predominantly light volcanic glass shards. Dark greenish-gray | 4.5 | 34 |
| Silt, clayey, fine sandy; poorly pervious, moderately friable, massive, ill-sorted with occasional medium sand grains. Dark greenish-gray | 1.5 | 35.5 |
| Sand, fine to very fine; moderately pervious, easily friable, slightly bedded by short medium sand lenses, moderately well-sorted, predominantly light volcanic glass. Dark greenish-gray | 2.5 | 38 |
| Sand, medium; highly pervious, very loose, massive, well-sorted, predominantly light and dark volcanic glass with much olivine. Dark-gray | 9 | 47 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 46/1W-1A1—Continued | | |
| Sand, fine to very fine, silty; poorly pervious, firm, slightly bedded with loose sand streaks, ill-sorted, well cemented with a glassy silt-binder. Predominantly light volcanic glass with many red and black cinders and olivine. Dark-gray | 10 | 57 |
| Sand, medium to coarse, highly pervious, loose, slight bedding indicated by variable grain size, well-sorted. Dark-gray | 6 | 63 |
| Sand, fine; poor to very pervious, loose to firm, interbedded. Predominantly a friable fine volcanic sand with numerous thin 1/16- to 1-in. interbeds of clay. Dark gray to dark greenish-gray | 10.5 | 73.5 |
| Clay, silty; poorly pervious, firm, nonplastic, massive, moderately well-sorted. Moderate yellowish-brown grading to dark greenish-gray | 1 | 74.5 |
| Sand, very fine; moderately pervious, loose, massive, well-sorted. Dark-gray | 2.5 | 77 |
| Clay and sand, interbedded clay and fine sand; interbeds range from 0.1 to 0.3 ft in thickness | 1 | 78 |
| Sand, fine to very fine; moderately pervious, easily friable, massive, well-sorted, predominantly light volcanic glass with olivine and dark basaltic cinders. Dark-gray | 3 | 81 |
| Sand, fine to medium, highly pervious, loose to easily friable, slight bedding indicated by variable grain size, well-sorted. Dark-gray. A firm silt layer occurs between 83.8–84.0 ft. Grades to medium to coarse sand between 85.2–85.9 ft | 8.5 | 89.5 |
| Sand, fine to medium; loose to easily friable, massive; well-sorted; predominantly light volcanic glass with olivine. Dark-gray. Very fine sand at 89.5–90.1 ft | 4 | 93.5 |
| Sand, fine to very fine; very pervious, easily friable, bedded with occasional 1 in. interbeds of highly pervious granule gravel. Dark-gray. Grades to medium sand at 98 ft. Granule gravel at 93.5–94.2 ft | 11.5 | 105 |
| Clay, sandy or with very thin sandy streaks; poorly pervious, bedded. Predominantly a brittle bentonitic clay. Yellowish-brown | 7 | 112 |
| Sand, coarse; possibly highly pervious, friable | 2 | 114 |
| Clay and sand, interbedded clay and medium sand; clay is bentonitic, brittle, yellowish-brown. Sand is friable, well-sorted. Dark-gray | 6 | 120 |
| Clay and sand, interbedded clay and medium to coarse sand, interbeds range from 1 to 2 ft in thickness | 10 | 130 |
| Clay, poorly pervious, brittle, nonplastic, massive, moderately well-sorted with occasional pumice fragments. Light yellowish-brown. Interval includes a medium to coarse sand bed at 139–140 ft | 9 | 139 |
| Clay and sand, interbedded medium sand and brittle clays. Individual beds range from 1 to 2 ft in thickness | 11 | 150 |
| Clay, poorly pervious, brittle, nonplastic. Contains several thin interbeds of fine to medium sand, moderately well-sorted with occasional pumice fragments. Light yellowish-brown | 10 | 160 |
| Clay, poorly pervious, brittle, nonplastic, moderately well-sorted with occasional pumice fragments. Light yellowish-brown | 7 | 167 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 46/1W-1A1—Continued | | |
| Clay and sand, interbedded brittle clay and medium sand. Sand is predominantly volcanic glass with some olivine | 3 | 170 |
| Clay, poorly pervious, brittle, interbedded gray sandy clay and light yellowish-brown clay | 19 | 189 |
| Sand, fine to medium; highly pervious, loose, massive with only occasional thin interbeds of ash cemented material, well-sorted predominantly volcanic glass with olivine. Dark gray | 45 | 234 |
| Clay, poorly pervious, nonplastic, massive, medium-gray | 6 | 240 |
| Clay, soft, nonplastic to slightly plastic, ill-sorted with a slight fine sand content. Dark greenish-gray | 20 | 260 |
| Clay, soft, nonplastic, massive, ill-sorted, contains a considerable fine sand content. Brownish-gray | 10 | 270 |
| Sand, medium to coarse, highly pervious, friable, massive moderately well-sorted, chiefly volcanic glass with olivine. Several thin clay layers occur between 288–290 ft | 20 | 290 |
| Sand, fine to medium, highly pervious, loose, massive, well sorted with only occasional very coarse sand size grains. Predominantly light and dark volcanic glass with accessory olivine | 20 | 310 |
| Sand, fine; moderately pervious, loose to friable, massive, moderately well-sorted with occasional medium size grains and occasional very coarse size pumice fragment. Dark gray | 20 | 330 |
| Sand, fine to medium; highly pervious, loose to friable, massive, moderately well-sorted | 10 | 340 |
| Clay, poorly pervious, soft, nonplastic, bedded, moderately well-sorted with occasional white pumice fragments. Interbedded grayish-olive and dark gray clay | 10 | 350 |
| Clay, poorly pervious, soft, nonplastic, massive, well-sorted. Grayish-black to black | 10 | 360 |
| Clay, poorly pervious, soft, nonplastic, slightly bedded with occasional thin 1-in. streaks of sand size pumice. Dark-gray becoming interbedded with grayish-olive clay near the base | 20 | 380 |
| Clay, soft, nonplastic, massive, well-sorted with occasional pumice grains. Dark gray to black | 28 | 408 |
| Clay, poorly pervious, soft, nonplastic, ill-sorted with some fine sand. Light brownish-gray | 2 | 410 |
| Clay, poorly pervious, soft, nonplastic, ill-sorted with numerous pumice fragments. Olive-gray | 10 | 420 |
| Clay, poorly pervious, soft, nonplastic, moderately well-sorted with occasional white pumice fragments. Olive-gray to light brownish-gray | 10 | 430 |
| Clay, poorly pervious, soft, massive, moderately well-sorted. Light brownish-gray grading to grayish-black | 10 | 440 |
| Clay, poorly pervious, soft, nonplastic, massive, moderately well-sorted with only occasional pumice fragments. Dark-gray to black | 20 | 460 |
| Clay, poorly pervious, soft, nonplastic, well-sorted. Grades from grayish-black to dark greenish-gray toward the base | 10 | 470 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 46/1W-1A1—Continued | | |
| Clay, poorly pervious, soft, well-sorted. Grayish-black with occasional streaks of dark greenish-gray | 10 | 480 |
| Clay, poorly pervious, soft, well-sorted. Dark-gray to grayish-black | 30 | 510 |
| Clay, poorly pervious with thin pervious pumice streaks, soft, nonplastic. Grayish-black | 10 | 520 |
| Clay, poorly pervious, soft, ill-sorted with many pumice grains. Grayish-black | 10 | 530 |
| Clay, nonplastic, ill-sorted, many pumice fragments. Dark greenish-gray to olive-gray | 20 | 550 |
| Clay, soft, bedded, moderately well-sorted with occasional pumice fragments. Interbedded dark greenish-gray and medium bluish-gray clays | 10 | 560 |
| Clay, poorly pervious, soft, slightly bedded, moderately well-sorted. Interbedded dark greenish-gray and olive-gray clays | 10 | 570 |
| Clay, poorly pervious, soft, moderately well-sorted with some pumice. Dark greenish-gray | 20 | 590 |
| Clay, poorly pervious, nonplastic, massive, ill-sorted with many pumice and basaltic glass fragments. Dark greenish-gray | 20 | 610 |
| Clay, poorly pervious, nonplastic, massive, ill-sorted with many basaltic glass and pumice fragments. Dark greenish-gray | 20 | 630 |
| Clay, poorly pervious, soft to slightly brittle, nonplastic, moderately well-sorted. Dark greenish-gray | 10 | 640 |
| Clay, nonplastic, with occasional layers of slightly brittle clay; moderately well to ill-sorted with pumice fragments. Dark greenish-gray | 30 | 670 |
| Clay, silty; poorly pervious, nonplastic, massive, ill-sorted with considerable silt and some very fine sand. Occasional pumice grains and to probable calcareous shell fragments noted. Dark greenish-gray | 20 | 690 |
| Clay, poorly pervious, soft, nonplastic, massive, moderately well-sorted with many pumice and basaltic glass shards. Olive-gray | 35 | 725 |
| Clay, silty; poorly pervious, firm, nonplastic, massive, moderately well-sorted. Dark greenish-gray. Becomes slightly plastic and color changes to olive-gray between 731.8–733.50 ft | 10 | 735 |

46/1W-1G1

[C. Cross. On alluvial plain about 4.5 miles northeast of Macdoel. Altitude 4,235 ft. Drilled by J. A. Van Meter, 1951]

| | | |
|---|---|---|
| Alluvium: | | |
| Topsoil, mostly wind-blown sand | 3 | 3 |
| Clay, hard, and sand | 5 | 8 |
| Butte Valley basalt: | | |
| Lava rock, broken and porous (vesicular) | 4 | 12 |
| Lake deposits: | | |
| "Quicksand;" water | 80 | 92 |
| Sand, gravel and pumice; water | 95 | 187 |
| Sand, black, and pumice mixed | 20 | 207 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **46/1W-1P1** | | |
| [Johnson. On alluvial plain, about 4 miles northeast of Macdoel. Altitude 4,250 ft. Drilled by Scott Co., 1952] | | |
| Alluvium: | | |
| Soil | 10 | 10 |
| Butte Valley basalt: | | |
| Lava, slightly creviced, rotary lost 800 gal of mud solution before sealing | 30 | 40 |
| Lake deposits: | | |
| "Chalk" | 10 | 50 |
| Sand, black, fine below 200 ft | 2[illegible]1 | 311 |
| **46/1W-12H1** | | |
| [L. M. Luzzi. On alluvial plain, near basalt-covered surface, about 4.5 miles northeast of Macdoel. Altitude 4,260 ft. Drilled by C. F. Enloe, 1951. Cased to 152 ft, perforated 44–152 ft] | | |
| Alluvium: | | |
| Soil | 8 | 8 |
| Butte Valley basalt: | | |
| Rock cap | 22 | 30 |
| Lake deposits: | | |
| Sand and clay | 42 | 72 |
| Sand rock | 8 | 80 |
| Sand and clay with streaks of sand rock | 42 | 122 |
| Sand, coarse | 8 | 130 |
| Sand rock | 10 | 140 |
| Sand, coarse | 3 | 143 |
| Sand and clay | 46 | 189 |
| **46/1W-17B1** | | |
| [Osborn. On alluvial plain about 0.4 mile north of Macdoel. Altitude 4,244 ft. Drilled by George Hartley, 1949] | | |
| Alluvium: | | |
| Topsoil, sand | 10 | 10 |
| Butte Valley basalt: | | |
| Rock, blue, hard | 10 | 20 |
| Lava rock, little water | 35 | 55 |
| Lake deposits: | | |
| Sand, coarse; water | 15 | 70 |
| Clay, blue, mud and muck | 10 | 80 |
| **46/1W-18Q2** | | |
| [Butte Valley Irrigation District (Frothingham well). On alluvial plain, about 1 mile west of Macdoel. Altitude 4,248 ft. Drilled by Van Meter Bros., 1931. Cased to 40 ft. Static water level in February 1931 was about 23 ft below land surface] | | |
| Alluvium: | | |
| Sandy soil | 14 | 14 |
| Lake deposits: | | |
| "Chalk" and clay | 10 | 24 |
| Sand | 1 | 25 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 46/1W-18Q2—Continued | | |
| "Chalk" and clay | 6 | 31 |
| Butte Valley basalt: | | |
| Lava, creviced | 39 | 70 |
| Lava, shattered | 12 | 82 |

46/1W-19J1

[Butte Valley Irrigation District. On alluvial plain, about 1.1 miles south of Macdoel. Altitude 4,250 ft. Drilled by Van Meter Bros., 1931. Cased to 36 ft. Static water level, when drilled, about 26 ft below land surface]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Soil | 13 | 13 |
| Lake deposits: | | |
| "Chalk" | 5 | 18 |
| Sand | 3 | 21 |
| "Chalk" | 5 | 26 |
| Sand | 8 | 34 |
| Gravel | 1 | 35 |
| Butte Valley basalt: | | |
| Lava, creviced | 11 | 46 |
| Lava, shattered | 14 | 60 |
| Lava | 1 | 61 |

46/1W-20D1

[H. M. Andrus. On alluvial plain, about 0.6 mile south of Macdoel. Altitude 4,246 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Soil | 25 | 25 |
| Butte Valley basalt: | | |
| Lava | 40 | 65 |
| Lake deposits: | | |
| Clay | | |

46/1W-21F1

[C. W. Drew, Jr. On gentle hill slope, near ridge, about 1.1 miles southeast of Macdoel. Altitude 4,282 ft. Drilled by C. F. Enloe, 1954. Casing perforated 62-182 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil and "hardpan" | 10 | 10 |
| Rock | 42 | 52 |
| Cinders, black, cemented | 88 | 140 |
| Sand and fine cinders, water-bearing | 35 | 175 |
| Clay | 4 | 179 |
| Not logged | 3 | 182 |

46/1W-22K2

[Merle Goode. On basalt-covered surface, about 2.3 miles southeast of Macdoel. Altitude 4,272 ft. Drilled by Van Meter Bros., 1937]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Soil | 4 | 4 |
| "Hardpan" | 3.5 | 7.5 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

46/1W-22K2—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Butte Valley basalt: | | |
| Lava | 10.5 | 18 |
| Basalt, creviced | 31 | 49 |
| Lake deposits: | | |
| Clay and sand | 9 | 58 |
| "Quicksand" | 24 | 82 |
| "Chalk" | 2 | 84 |
| "Quicksand" | 6 | 90 |
| "Chalk" | .5 | 90.5 |
| "Quicksand" | 6.5 | 97 |
| Rotten tules, burned peat, charcoal and sand | 15 | 112 |
| Water gravel | 1 | 113 |

46/1W-29G1

[Bill Kandra. On low ridge about 1.7 miles south of Macdoel. Altitude 4,2[illegible]9 ft. Drilled by C. F. Enloe, 1953. Cased to 82 ft. Perforated 10–82 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Topsoil | 14 | 14 |
| Sand and clay mixed | 23 | 37 |
| Butte Valley basalt: | | |
| Basalt, gray, extremely hard | 8 | 45 |
| Lava, black, not too hard and water | 21 | 66 |
| Honey-comb lava (vesicular) | 8 | 74 |
| Lake deposits: | | |
| Gravel, fine, and sand | 6 | 80 |
| Clay, no water | 24 | 104 |

46/1W-31J1

[Butte Valley Irrigation District. On alluvial plain, about 0.7 mile southwest of Mount Hebron. Altitude 4,257 ft. Drilled by Van Meter Bros., 1931. Cased to 52 ft. Static water level, when drilled, about 32 ft below land surface]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil | 3 | 3 |
| Lake deposits: | | |
| Sand and gravel, cemented | 13 | 16 |
| "Chalk," sandy | 10 | 26 |
| Sand, water-bearing | 14 | 40 |
| "Chalk" | 8 | 48 |
| Gravel, 1/4- to 1/8-in. size | 3 | 51 |
| Butte Valley basalt: | | |
| Lava, creviced, water-bearing | 16.5 | 67.5 |
| Lava, creviced, fumaroles and clinkers | 6.5 | 74 |
| Lava, creviced, and sand | 5 | 79 |
| Lava, creviced, fumaroles and clinkers | 7 | 86 |
| Lava, shattered | 2 | 88 |

46/1W-32R1

[Southern Pacific Co. On alluvial plain, about 0.6 mile south of Mount Hebron. Altitude 4,255 ft. Drilled by J. Van Meter, 1926–27. Cased to 200 ft. Perforated 35–105 ft, 135–190 ft. Static water level, when drilled, about 26 ft below land surface]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Sandy loam | 28 | 28 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 46/1W-32R1—Continued | | |
| Butte Valley basalt: | | |
| Rock, red | 2 | 30 |
| Lava, black | 50 | 80 |
| Lake deposits: | | |
| Volcanic cinders, black | 22 | 102 |
| Clay, sandy, white | 24 | 126 |
| Clay, hard | 2 | 128 |
| Clay, sandy, white | 17 | 145 |
| Clay, sandy, black, cemented | 39 | 184 |
| Gravel | 10 | 194 |
| Clay | 21 | 215 |
| 46/2W-5C1 | | |
| [Farnum Bros. (Meiss Ranch). On alluvial fan about 6.6 miles west of Macdoel. Drilled by Buckner, 1946] | | |
| Alluvial-fan and lake deposits, undifferentiated: | | |
| Soil | 4 | 4 |
| Clay, yellow | 5 | 9 |
| Boulders | 21 | 30 |
| Clay, yellow | 5 | 35 |
| Boulders | 7 | 42 |
| Mud, blue sandy | 16 | 58 |
| Boulders | 14 | 72 |
| Clay, yellow | 11 | 83 |
| Boulders | 12 | 95 |
| Clay, yellow | 11 | 106 |
| Mud, blue and shells | 6 | 112 |
| Clay, gray | 13 | 125 |
| Boulders | 4 | 129 |
| Sand, brown | 11 | 140 |
| Boulders | 6 | 146 |
| Sand, brown | 16 | 162 |
| Boulders | 22 | 184 |
| Sand, blue and shells | 60 | 244 |
| Boulders | 8 | 252 |
| Clay and boulders | 43 | 295 |
| Boulders | 8 | 303 |
| Clay, red | 18 | 321 |
| Boulders | 6 | 327 |
| Clay, brown | 6 | 333 |
| Boulders, large | 5 | 338 |
| Lava ledge | 2 | 340 |
| Lava boulders, hard | 6 | 346 |
| 46/2W-9R1 | | |
| [Farnum Bros. (Meiss Ranch) near edge of hills, about 4.9 miles west of Macdoel. Altitude 4,245 ft. Drilled by J. S. Wilson, 1945] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Topsoil | 10 | 10 |
| Clay, sandy, little water | 8 | 18 |
| Chalk, blue | 17 | 35 |
| Gravel | 5 | 40 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 46/2W-9R1—Continued | | |
| Gravel, coarse, water | 3 | 43 |
| Gravel, brown | 2 | 45 |
| Older volcanic rocks of the "High Cascades". | | |
| Rock, black | 2 | 47 |
| Lava(?) | 4 | 51 |
| Rock, black | 11 | 62 |
| Red clay and cinders | 3 | 65 |
| Lava, gray | 8 | 73 |
| Lava | 17 | 90 |

46/2W-13A1

[Farnum Bros. (Meiss Ranch). On alluvial plain, about 1.7 miles west of Macdoel. Altitude 4,246 ft. Drilled by J. S. Wilson, 1948]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Topsoil and sand | 40 | 40 |
| Butte Valley basalt: | | |
| Lava rock, very hard | 40 | 80 |
| Lake deposits: | | |
| Sand, coarse and gravel-water | 20 | 100 |
| Gravel, sand and shale | 175 | 275 |

46/2W-23C1

[W. Dixon. On alluvial plain, about 3.1 miles west of Macdoel. Altitude 4,237 ft. Drilled by Van Meter]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium and lake deposits, undifferentiated: | | |
| Soil | 2.5 | 2.5 |
| "Hardpan" | 1 | 3.5 |
| Sand, yellow | 5.5 | 9 |
| Mud, volcanic | 106 | 115 |
| "Chalk" and pumice | 20 | 135 |
| Sand, coarse, and pumice | .5 | 135.5 |
| "Chalk" | 8.5 | 144 |
| Sand | 1 | 145 |
| "Chalk" | 67 | 212 |

46/2W-25H1

[L. Naught. On alluvial plain, about 2.6 miles southwest of Macdoel. Altitude 4,255 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium and lake deposits, undifferentiated: | | |
| Sand, fine | 33 | 33 |
| Water sand, with gravel, fine | 4 | 37 |
| Sand, fine, with gravel, fine | 6 | 43 |
| Water sand, with gravel, fine | 2 | 45 |
| Sand, fine | 6 | 51 |
| "Chalk" and sand | 7 | 58 |
| Water sand, with gravel, fine | 12 | 70 |
| "Chalk" | 26 | 96 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

46/2W-25R2

[Butte Valley Irrigation District. On alluvial plain about 3 miles southwest of Macdoel. Altitude 4,256 ft. Drilled by J. A. Van Meter, 1950]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium and lake deposits, undifferentiated: | | |
| Topsoil | 3 | 3 |
| Sand and gravel | 5 | 8 |
| Sand and gravel | 47 | 55 |
| "Chalk" and sand | 13 | 68 |
| Sand, black, and pumice | 2 | 70 |
| Butte Valley basalt: | | |
| Lava, broken; water-bearing | 12 | 82 |
| Lake deposits: | | |
| "Chalk" | 5 | 87 |
| Sand, black | 3 | 90 |
| "Chalk," yellow | 14 | 104 |
| Mud, black, and sand | 5 | 109 |
| Gravel and sand | 4 | 113 |
| "Chalk" with sand seams | 3 | 116 |

46/2W-26F3

[W. Dixon. On alluvial plain, about 3.6 miles southwest of Macdoel. Altitude 4,246 ft. Drilled by George Hartley, 1945]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium and lake deposits, undifferentiated: | | |
| Soil and clay | 240 | 240 |
| Sand | 5 | 245 |
| Clay | 186 | 431 |
| Older volcanic rocks of the "High Cascades"(?). | | |
| Lava | 56 | 487 |

46/2W-26J1

[Caruthers. Alluvial plain, about 3.8 miles southwest of Macdoel. Altitude 4,250 ft. Drilled by George Hartley, 1952]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Topsoil and sand | 17 | 17 |
| Sand, coarse and pumice, mixed | 20 | 37 |
| Clay, blue, muck | 3 | 40 |
| Clay, blue, thin layers fine sand | 45 | 85 |
| Clay, blue, some sand not too much water | 100 | 185 |
| Clay, blue, muck | 15 | 200 |
| Gravel, some broken lava rock | 50 | 250 |
| Gravel, some porous (vesicular) lava rock, most water here | 65 | 315 |

46/2W-35G1

[A. Hoyt. On alluvial plain about 4 miles southwest of Macdoel. Altitude 4,256 ft. Drilled by J. A. Van Meter 1954. Cased to 95 ft. Perforated 50–95 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium and lake deposits, undifferentiated: | | |
| Topsoil | 5 | 5 |
| Sand and gravel | 17 | 22 |
| Sandstone | 11 | 33 |
| "Quicksand" | 8 | 41 |
| Sand, packed | 14 | 55 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 46/2W-35G1—Continued | | |
| Alluvium and lake deposits, undifferentiated:—Continued | | |
| "Chalk" | 2 | 57 |
| Sand, packed | 6 | 63 |
| "Chalk" | 3 | 66 |
| Sand, packed | 11 | 77 |
| "Chalk" | 12 | 89 |
| Butte Valley basalt: | | |
| Lava, broken | 5 | 94 |
| Lake deposits: | | |
| "Chalk," green | 13 | 107 |

46/2W-36L1

[P. Robinson. On alluvial plain, about 3.6 miles southwest of Macdoel. Altitude 4,257 ft. Drilled by George Hartley, 1946. Static water level, when drilled, about 37 ft below land surface]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium: | | |
| Soil and gravel | 61 | 61 |
| Butte Valley basalt: | | |
| Lava, shattered | 30 | 91 |
| Lake deposits: | | |
| Clay | 39 | 130 |
| Sand, black | 1 | 131 |
| Clay | 19 | 150 |

47/1E-31A1

[Dalton and Wilkerson. On alluvial plain about 6.4 miles northeast of Macdoel. Altitude 4,246 ft. Drilled by C. F. Enloe, 1952. Casing perforated 70–300 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Sand and clay with occasional sand streak | 260 | 260 |
| Sand, coarse, and pumice | 20 | 280 |
| "Quicksand," black | 40 | 320 |

47/1E-32A1

[K. Holbrook. On alluvial plain, near foot of Mahogany Mountain. Altitude 4,250 ft. Drilled by C. F. Enloe, 1952. Casing perforated 65–265 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Sand and clay mixed, more sand than clay, last 60–80 ft coarse sand, bottomed in basalt | 265 | 265 |

47/1W-1A2

[Southern Pacific Co. On alluvial plain, about 1 mile south of Dorris. Altitude 4,238 ft. 12-in. casing 0–201 ft, 8-in. liner 90–250 ft. Perforated at 90–250 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Sandy loam (water surface 26 ft) | 40 | 40 |
| Clay, gray | 83 | 123 |
| Sand, black, fine | 37 | 160 |
| Clay, gray, and streaks of sand | 90 | 250 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1W-4D1 | | |
| [U. S. Bureau of Reclamation. On alluvial plain about 4 miles west of Dorris. Altitude 4,242 ft. Drilled by U. S. Bureau of Reclamation, 1954. Hole logged by R. J. Rongey, geologist, USBR] | | |
| Silt, fine sandy; friable to firm, massive, ill-sorted, slight clay content, noncalcareous. Light brownish-gray | 3 | 3 |
| Clay, silty, fine sandy; firm and locally quite hard, massive with only occasional root holes, ill-sorted, slightly calcareous | 2 | 5 |
| Silt, very fine to fine sandy; moderately pervious, friable, massive, moderately well-sorted, slightly calcareous. Moderate yellowish-brown | 5 | 10 |
| Sand, very fine, silty; moderately pervious, friable, massive, moderately well-sorted, variable clay content. Predominantly grains of light volcanic glass, calcareous. Moderate yellowish-brown | 10 | 20 |
| Silt, very fine sandy; poorly to moderately pervious, friable, massive, ill-sorted, very slight clay content. This section appears to be predominantly volcanic ash. Numerous vertical gas vesicles, slightly calcareous. Light yellowish-brown | 4.5 | 24.5 |
| Clay, poorly pervious, brittle, massive. Light yellowish-brown | 2.5 | 27 |
| Sand, coarse to very coarse; highly pervious, loose, massive, moderately well-sorted. Predominantly light pumice fragments, calcareous. Moderate yellowish-brown | 3.5 | 30.5 |
| Sand, fine to very fine, silty; poorly to moderately pervious, friable, massive, ill-sorted, may have a slight clay content. Appears to be predominantly volcanic glass, calcareous, small vertical gas vesicles present. Light yellowish-brown grading to dark greenish-gray at 30.2 ft | 4 | 34.5 |
| Sand, very fine, silty; poorly to slightly pervious, friable, massive, ill-sorted to moderately well-sorted, variable silt content, occasional pumice fragment to medium sand size, many vertical gas vesicles, calcareous. Dark greenish-gray | 2 | 36.5 |
| Silt, clayey, fine sandy; friable, nonplastic, slightly brecciated near base, ill-sorted. Core indicated the brecciated section was inplace. Occasional gas hole, slightly calcareous to highly calcareous. Dark greenish-gray | 3.5 | 40 |
| Clay, poorly pervious, brittle, brecciated near base, nonplastic, calcareous | 4.5 | 44.5 |
| Silt, poorly pervious, firm,massive, moderately well-sorted, exclusively volcanic glass. Several vertical gas vesicles present. Gastropod valve noted at 42.0 ft. Dark greenish-gray, calcareous | 1 | 45.5 |
| Clay, silty; poorly pervious, brittle, nonplastic, has been brecciated in place then slightly reindurated, moderately well-sorted, calcareous. Dark greenish-gray | 2.5 | 48 |
| Silt, clayey; poorly pervious, massive, brittle to friable, moderately well-sorted, variable clay content, calcareous. Dark greenish-gray | 2 | 50 |
| Clay, silty; massive to slightly brecciated, moderately well-sorted, many medium to coarse size pumice fragments at 49.5 ft, slightly calcareous. Dark greenish-gray | 9 | 59 |
| Clay, silty, poorly pervious, brittle, moderately well-sorted. Medium-gray with streaks of dark greenish-gray | 2 | 61 |
| Silt, very fine, sandy; poorly pervious, firm, massive, moderately well-sorted, slight clay content. Numerous gas holes, slightly calcareous. Medium-gray to dark greenish-gray | 5 | 66 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1W-4D1—Continued | | |
| Clay, silty; poorly pervious, firm, massive, moderately well-sorted, slightly calcareous, gas vesicles present. Medium gray to dark greenish-gray | 4.5 | 70.5 |
| Clay, poorly pervious, firm brittle, nonplastic, massive, well-sorted, slightly calcareous. Light brownish-gray | 3 | 73.5 |
| Clay, silty; poorly pervious, friable to slightly plastic, massive, moderately well-sorted. Slight carbonaceous content, non-calcareous. Medium dark-gray | 6.5 | 81 |
| Silt, very fine sandy; poorly pervious, friable, massive, moderately well-sorted, very slightly calcareous. Grades downward to a soft silt (core loss in this interval). Medium dark-gray | 5 | 86 |
| Silt, interbedded silt, clayey silt and very fine sandy silt. 6-in. to 1-ft interbeds with gradational boundaries. Medium-gray grading to medium dark gray on base | 3.5 | 89.5 |
| Clay, poorly pervious, friable to very slightly plastic, well-sorted. Contains several thin interbeds of black carbonaceous clay. Several half-inch pumice beds. Light brownish-gray | 2 | 91.5 |
| Silt, very fine sandy; poorly pervious, friable, massive, moderately well-sorted | 2.5 | 94 |
| Clay, silty; poorly pervious, massive, well-sorted. Moderate olive-brown grading downward to medium dark-gray | 6 | 100 |
| Clay, interbedded moderate olive-brown and dark greenish-gray clays; poorly pervious. Occasional interbeds of medium-gray, brittle clay. Many pumice fragments noted do not appear to be interbedded | 10 | 110 |
| Clay, bedded, well-sorted. Medium-gray with occasional thin streaks of dark greenish-gray. Several pumice fragments noted | 10 | 120 |
| Clay, massive, well-sorted. Medium-gray with occasional light brownish-gray streaks | 10 | 130 |
| Clay, poorly pervious, bedded with layers of medium-gray and dark greenish-gray clay. Occasional white shell fragment present | 10 | 140 |
| Clay, poorly pervious, massive. Very hard and brittle between 144–146 ft. Medium-gray | 10 | 150 |
| Clay, poorly pervious, well-sorted with occasional pumice fragments of medium to coarse sand size. Interbedded medium-gray and dark greenish-gray | 10 | 160 |
| Clay, very fine sandy; poorly pervious, massive, moderately well-sorted with grains of black basaltic glass. Several thin shell fragments noted. Dark greenish-gray | 10 | 170 |
| Clay, similar to bed at 160–170 | 10 | 180 |
| Clay, poorly pervious, bedded, well-sorted. Olive-gray at 180–182 ft. Dark greenish-gray at 182–186 ft. Medium-gray at 186–190 ft. Numerous shell fragments throughout the interval. | 10 | 190 |
| Clay, poorly pervious, massive, well-sorted. Predominantly light olive-brown becoming interbedded downward with medium-gray | 10 | 200 |
| Clay, soft, plastic, bedded, well-sorted, occasional pumice grains and gastropod shell fragments. Light olive-brown interbedded with medium-gray | 20 | 220 |
| Clay, soft, quite plastic, massive, well-sorted with only occasional pumice fragments to coarse sand size. Numerous thin walled gastropod shell fragments. Light olive brown | 5 | 225 |
| Clay, interbedded clay as at 220–225 ft with medium-gray and dark greenish-gray clays. The latter is quite firm, but brittle. Many shell fragments at this interval | 5 | 230 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1W-4D1—Continued | | |
| Clay, interbedded clay as at 220–225 ft with medium-gray and dark greenish-gray clays. The latter is quite firm, but brittle. Many shell fragments at this interval | 5 | 235 |
| Clay, soft, plastic, fairly massive, well-sorted, occasional pumice fragment present. Olive-green | 25 | 260 |
| Clay, soft, plastic, well-sorted. Many thin walled shell fragments throughout the interval. Light olive-brown at 260–267 ft changing to medium dark-gray between 267–270 ft | 10 | 270 |
| Clay, soft, plastic, massive, well-sorted. Light olive-brown. Appears identical to the previous plastic clays | 20 | 290 |
| Clay, soft, massive, well-sorted with only occasional pumice fragments. Light olive-brown | 10 | 300 |
| Clay, soft, massive, well-sorted, occasional shell and pumice fragments. Light olive-brown | 20 | 320 |
| Clay, soft, bedded, well-sorted, thin interbeds of soft light brownish-gray clay in a section of predominantly light-olive clays | 10 | 330 |
| Clay, 330–336 ft is similar to previous interval, changing to a brittle, well-sorted, medium-gray clay at 336–340 ft | 10 | 340 |
| Clay, as previous interval. Light-olive at 340–342 ft changing to medium-gray at 342–345 ft, changing to dark greenish-gray at 345–350 ft. Cuttings are soft, but their size indicates a firm or brittle clay | 10 | 350 |
| Clay, soft to moderately friable, bedded, well-sorted, many thin walled shell fragments in this interval. Thin interbeds of medium-gray to dark-gray clay in a predominant light-olive section | 10 | 360 |
| Clay, friable, well-sorted, grades from material similar at 350–360 ft downward to a friable to soft medium dark-gray clay. Abundant shell fragments throughout the interval | 10 | 370 |
| Clay, at 370–378 ft medium dark-gray to dark greenish-gray, friable to soft, moderately well-sorted, occasional thin shell fragments. Between 378–380 ft the clay becomes brittle, firm, well-sorted, medium dark-gray | 10 | 380 |
| Clay, friable to slightly brittle, massive, ill-sorted, slight silt and very fine sand content, numerous thin walled shell fragments. Becomes quite soft at 387–390 ft. Dark greenish-gray. | 10 | 390 |
| Basaltic tuff, interlayered hard and soft drilling. Cuttings indicate abundant cinder with dark greenish-gray clay fragments.. | 10 | 400 |
| Basaltic tuff, firm drilling, fragments of volcanic cinders and occasional pieces of dark greenish-gray clay present. Permeabilities are questionable | 10 | 410 |
| Welded basaltic tuff, firm to hard, locally brecciated, considerable pore space. Post-depositional solutions have caused considerable alteration adjacent to all lines of fracture. Alteration products appear to be bluish-green and light greenish-gray clay materials with numerous crystals and crystal clusters of possible chalcoprite. Throughout much of the unaltered areas the vesicular cavities are lined with a thin film of colloidal azure blue material with a slightly reniform structure.. | 30 | 440 |
| Basalt, cuttings indicate hard to brittle fragments of both cinders and firm basalt, drills quite hard. Red cinder types are absent throughout this interval | 10 | 450 |
| Basalt, dark-gray to black; hard, rings when struck. Slightly vesicular. Vesicles occasionally exhibit a mineral lining of probable azurite. Aphanitic with occasional altered crystals of questionable olivine. No visible felspars. Lower part of | | |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1W-4D1—Continued | | |
| interval becomes increasingly vesicular. Vertical fracturing occurs with the fracture surfaces lined with calcareous material | 10 | 460 |
| 47/1W-9D1 | | |
| [U. S. Bureau of Reclamation. On alluvial plain about 4.5 miles southwest of Dorris. Altitude 4,243 ft. Drilled by U. S. Bureau of Reclamation, 1954. Hole logged by R. J. Rongey, geologist, USBR] | | |
| Sand, fine to very fine, silty; easily friable, massive, ill-sorted, slightly calcareous | 2 | 2 |
| Clay, silty, very fine to fine sandy; brittle, thinly bedded. Many small vertical gas vesicles present, ill-sorted, calcareous, grayish-orange | 3 | 5 |
| Sand, fine to very fine, silty; friable, massive, ill-sorted, variable silt content, slightly calcareous, composed of light colored volcanic glass fragments. Moderate yellowish-brown | 5 | 10 |
| Sand, coarse to very coarse, silty; moderately pervious, loose, predominantly fragments of firm clay | .5 | 10.5 |
| Clay, silty; poorly pervious, friable, nonplastic, calcareous. Dusky-yellow | .5 | 11 |
| Sand, very fine; poor to moderately pervious, loose to friable, well-sorted. Moderate yellowish-brown | .5 | 11.5 |
| Silt, fine to very fine sandy; poor to moderately pervious, friable, massive, ill-sorted, calcareous | 3 | 14.5 |
| Silt, friable, nonplastic, massive, well-sorted, very slight clay content. Yellowish-gray | 1.5 | 16 |
| Clay, firm brittle, nonplastic, massive, well-sorted, calcareous, possible diatomaceous. Dusky-yellow | 3.5 | 20.5 |
| Silt, very fine sandy; poorly friable to firm, massive, moderately well to ill-sorted, predominantly shards of volcanic glass, numerous gas vesicles. Moderate yellowish-brown | 1.5 | 22 |
| Clay, silty; friable to very firm and brittle nonplastic, massive, calcareous, moderately well-sorted. Abundant well-preserved gastropod valves, 1/4-in. diam. Dusty-yellow | 3 | 25 |
| Sand, fine to very fine, silty; moderately pervious, friable, massive, moderately well-sorted. Primarily very fine glass shards. Many vertical gas vesicles with some secondary carbonate filling | 5 | 30 |
| Clay, silty; brittle, slightly bedded with streaks of fine sandy clay, moderately well-sorted, slightly calcareous, many gas vesicles. Grades from dusky-yellow to dark greenish-gray at 33 ft | 6.5 | 36.5 |
| Silt, clayey, fine sandy; brittle, slightly bedded, ill-sorted, variable clay content. Occasional narrow-banded concentrations of fine sand. Many small vertical gas vesicles. Gastropod valve fragments and fish scales present. Dark greenish-gray | 3.5 | 40 |
| Clay, silty, sandy; brittle, massive, ill-sorted, variable silt content, calcareous. Considerable fine pumice scattered throughout. Dark greenish-gray | 1.5 | 41.5 |
| Silt, poorly pervious, friable, massive, well-sorted, slightly calcareous. Predominantly very finely divided glass shards with some fish scales noted. Dark greenish-gray | 1.5 | 43 |
| Clay, pumaceous; friable to brittle, massive, ill-sorted. Clay with many granule size pumice grains imbedded. Several fish scales and a small fish vertebrate noted. Dark greenish-gray | .5 | 43.5 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1W-9D1—Continued | | |
| Silt, clayey; friable to slightly brittle, massive, calcareous, moderately well-sorted, variable clay content. Dark greenish-gray. | 2.5 | 46 |
| Clay, poorly pervious, brittle, slightly brecciated, well-sorted, calcareous. Contains a 0.4-ft bed of fine silt at 48.0 ft. Dark greenish-gray | 6.5 | 52.5 |
| Sand, medium; poor to moderately pervious, friable, massive, calcareous, well-sorted. This sand composed entirely of brittle clay fragments which appear to have been slightly water worn. Dark greenish-gray | 1 | 53.5 |
| Clay, silty; poorly pervious, brittle, brecciated, non to slightly calcareous, moderately well-sorted. Dark greenish-gray with a 1-in. reddish-brown oxidized layer on the base | 1.5 | 55 |
| Silt, poor to slightly pervious, friable, massive, well-sorted. Contains several thin 1/32-in. beds of fine volcanic sand. Dark greenish-gray grading to dark-gray near the base | 6.5 | 61.5 |
| Clay, brittle, somewhat brecciated, nonplastic, well-sorted. Dark coloration suggests some carbonaceous material. Light olive-gray to medium-gray | 4.5 | 66 |
| Clay, poorly pervious, brittle, nonplastic, bedded, well-sorted. Contains thin 1/8- to 1/4 in. interbeds of dark-gray and light brownish-gray which probably relate to, a variable bentonite content | 2 | 68 |
| Clay, poorly pervious, brittle nonplastic, brecciated, well-sorted. Dark-gray | 2 | 70 |
| Silt, slightly clayey; friable to brittle, thin bedding indicated by color variations, well-sorted. Appears to be finely divided glass shards. Contains a very coarse sand-size pumice beds at 72–73 ft and 76.6–76.8 ft which have extremely high permeabilities. Occasional fish scales, abundant gas vesicles. Olive-gray to dark greenish-gray | 7 | 77 |
| Sand, very fine, silty; firm to poorly friable, ill-sorted, variable silt content | 3.5 | 80.5 |
| Silt, clayey, very fine sandy; friable, massive, ill-sorted, noncalcareous. Olive-gray | 1.5 | 82 |
| Clay, silty; friable, nonplastic, bedded, well-sorted. Appears to be a thick bed of fine volcanic ash thinly bedded with 1/16- to 1/8-in. bentonitic layers. Light brownish-gray | 4 | 86 |
| Sand, very fine; poor to slightly pervious, friable, well-bedded with silty very fine sand layers and a thin 1/4-in. peat bed at 86.5 ft. Dark-gray | 1 | 87 |
| Clay, poorly pervious, friable, nonplastic, massive, well-sorted. Olive-gray with a dark yellowish-brown bed of clayey silt at 90.2–90.4 ft | 3 | 90 |
| Silt, clayey; friable to slightly plastic, massive on top becoming clayey and brecciated toward the base, moderately well-sorted. Grayish-black | 4.5 | 94.5 |
| Clay, poorly pervious, friable, becoming slightly plastic near the base, massive, calcareous, well-sorted. Greenish-gray | 2 | 96.5 |
| Silt, clayey; friable, nonplastic, bedding indicated by numerous 1/16- to 1/4-in. beds. Silty clay layers, well-sorted. Light brownish-gray grading to greenish-gray toward 100 ft | 3.5 | 100 |
| Clay, firm, brittle, contains numerous pumice fragments and may include several thin pumice beds. Dark greenish-gray to moderate yellowish-brown | 10 | 110 |
| Clay, lost circulation, no cuttings available. Probably as at 120–130 ft with several thin pumice beds | 10 | 120 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **47/1W-9D1—Continued** | | |
| Silt, clayey; bedded, well-sorted, fine sand beds at 120.1–120.2 and 122.5–123.1 ft | 6 | 126 |
| **47/1W-13G1** | | |
| [E. Harrison. On alluvial plain about 3.5 miles south of Dorris. Altitude 4,236 ft. Drilled by J. A. Van Meter, 1952. Casing perforated 36–48 ft, 60–72 ft, 108–208 ft] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Soil | 2 | 2 |
| "Hardpan" | 3.5 | 5.5 |
| "Chalk" and sand | 8.5 | 14 |
| Sand, black | 7 | 21 |
| "Chalk" | 4 | 25 |
| "Chalk" and sand | 73 | 98 |
| Mud, black, sticky | 16 | 114 |
| "Chalk" and sand, small streaks pumice | 22 | 136 |
| Sand, blue, fine, and some clay | 16 | 152 |
| Sand, gray, fine, and some clay | 11 | 163 |
| "Chalk" | 4 | 167 |
| Streaks "chalk" and sand | 10 | 177 |
| Sand, shells, and pumice | 30 | 207 |
| **47/1W-14B1** | | |
| [U. S. Bureau of Reclamation. On alluvial plain, about 3.4 miles south of Dorris. Altitude 4,234 ft. Drilled by George Hartley, 1951. Cased to 50 ft, perforated 35.5 ft. Static level, when drilled, about 19 ft below land surface] | | |
| Soil | 3 | 3 |
| "Hardpan" | 4 | 7 |
| Clay, yellow | 32 | 39 |
| Sand, black, mixed with clay and pumice | .2 | 39.2 |
| Clay, blue and muck | 10.8 | 50 |
| **47/1W-23A1** | | |
| [E. Harrison. On alluvial plain, about 4.3 miles south of Dorris. Altitude 4,236 ft. Drilled by J. A. Van Meter, 1952] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Topsoil | 1 | 1 |
| Clay, hard | 9 | 10 |
| Sand, blue | 6 | 16 |
| Clay, hard | 9 | 25 |
| Clay, green, small streaks sand and pumice | 15 | 40 |
| "Chalk," yellow, and sand | 15 | 55 |
| Sand, blue, and big pumice | 7 | 62 |
| "Chalk" | 6 | 68 |
| Streaks of sand and "chalk" | 4 | 72 |
| Sand, blue and pumice with "chalk" streaks | 12 | 84 |
| Streaks of sand and "chalk" | 12 | 96 |
| "Chalk" green | 9 | 105 |
| Streaks of sand and "chalk" | 15 | 120 |
| Sand, fine | 4 | 124 |
| Streaks of "chalk" and sand | 12 | 136 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **47/1W-24C1** | | |
| [A. L. Hardman. On alluvial plain, about 4.3 miles south of Dorris. Altitude 4,238 ft. Drilled by J. A. Van Meter, 1953. Cased to 172 ft. Static water level, when drilled, about 18 ft below land surface] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Topsoil | 2.5 | 2.5 |
| "Hardpan" | 1.5 | 4 |
| Sand, yellow | 20 | 24 |
| Sand, yellow and pumice | 9 | 33 |
| "Chalk" | 1 | 34 |
| Sand and pumice | 5 | 39 |
| Sand and "chalk" | 9 | 48 |
| Sand | 3 | 51 |
| "Chalk" and sand | 16 | 67 |
| Sand | 56 | 123 |
| Sandstone | 2 | 125 |
| Sand | 42 | 167 |
| "Chalk" | 23 | 190 |
| **47/1W-31G1** | | |
| [U. S. Bureau of Reclamation. On alluvial plain about 3.5 miles northwest of Macdoel. Altitude 4,235 ft. Drilled by U. S. Bureau of Reclamation, 1954. Hole logged by R. J. Rongey, USBR] | | |
| Sand, silty; moderately pervious, easily friable, ill-sorted, sand ranges from medium to very fine size, calcareous. Medium-brownish-gray | 3 | 3 |
| Silt, clayey, sandy; poorly pervious, moderately to poorly friable; ill-sorted, sand ranges to medium size, calcareous. Moderate yellowish-brown | 2 | 5 |
| Sand, fine to very fine; moderately to highly pervious, at 5.0–5.6 ft clayey and moderately friable; at 5.6–7.1 ft loose, moderately well-sorted and composed of dark basaltic glass. Clay layer at 7.1–8.1 ft | 2 | 7 |
| Sand, coarse to very coarse, highly pervious, loose, massive, moderately well-sorted, small amount of fine and medium sand. Predominantly volcanic glass with some felspar, olivine and possible hypersthene | 7.5 | 14.5 |
| Sand, very fine to medium; moderately to highly pervious, interbedded with silty phases, moderately well-sorted, consists of dark basaltic glassy sand. Dark greenish-gray to moderate yellowish-brown | 3.5 | 18 |
| Clay, silty; poorly pervious, brittle, easily brecciated, no plasticity. Appears to be composed of volcanic ash and diatomite, calcareous. Gray | 2.5 | 20.5 |
| Silt and sand, silts are clayey and sands, fine and silty, silts are plastic and sands are easily friable and moderately previous. Interbedded. Occur as interbeds 2 to 4 in. thick. Silty intervals carry much volcanic ash, calcareous | 4 | 24.5 |
| Silt, very fine sandy with occasional clayey interbeds; poorly pervious, bedded, friable, ill-sorted, no volcanic ash, calcareous | 3.5 | 28 |
| Silt, slightly clayey and sandy; poorly pervious, brecciated, nonplastic, ill-sorted with grains of dark glassy basaltic sand. Dark-greenish gray, calcareous | 1 | 29 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1W-31G1—Continued | | |
| Sand, fine to medium; highly pervious, lost considerable drilling fluid at 34.0 ft. No core recovery this interval | 9 | 38 |
| Silt, clayey, fine sandy; poorly pervious, massive, slightly plastic, contains numerous dark-brown fish scales. Medium olive-gray | 1 | 39 |
| Clay, silty, fine sandy; slightly plastic, massive, ill-sorted, contains numerous small freshwater gastropod shells | 1.5 | 40.5 |
| Sand, very fine, silty; moderately pervious, loose, contains many small gas vesicles 1/32-in. diam., occasional thin interbeds of fine sandy silt 1/2 to 2 in. thick with gradational contacts. May contain much carbonaceous material, calcareous. Medium dark-gray | 5 | 45.5 |
| Silt, very fine sandy and clayey; contains much volcanic ash, shell fragments | 1.5 | 47 |
| Sand, fine to very fine; moderately pervious, loose to friable, bedded with silty layers containing gas vesicles, moderately well-sorted, variable silt content, chiefly composed volcanic glass fragments, calcareous. Dark greenish-gray to black. Grades to coarse sand near the base. Calcareous | 10 | 57 |
| Sand, very fine, silty; loose, bedded in 6-in. intervals as indicated by a variable silt content. Many small gastropod shells. Clay at 57.2–57.7 ft | 3.5 | 60.5 |
| Silt, fine and very fine sandy; poorly pervious, friable, ill-sorted, variable clay content. Contains numerous shell fragments; gas vesicles. Dark greenish-gray | 3.5 | 64 |
| Clay, silty; poorly pervious, brittle, nonplastic, massive, moderately well-sorted, occasional thin one-sixteenth-in. streaks of very fine volcanic sand. Clay appears to be predominantly volcanic ash. Many small vertical gas vesicles, calcareous. Dark-gray | 3.5 | 67.5 |
| Silt, very fine sandy; poorly pervious, friable, nonplastic, bedded with occasional thin clayey silt and silty fine sand lenses. Ill-sorted with some clay and fine sand. Occasional fish scales and calcareous shell fragments, calcareous. Dark greenish-gray to medium dark-gray | 6.5 | 74 |
| Clay, silty; poor to moderately pervious, very brittle, highly brecciated, moderately well-sorted, appears diatomaceous, calcareous. Medium dark-gray | 3 | 77 |
| Silt, fine sandy; poorly pervious, friable, well-bedded with thin clayey silt layers 1/4 to 1/2 in. thick, silty very fine sand layers 1 to 2 in. thick. Moderately well-sorted. Appears to contain much volcanic ash at 84.8–85.8 ft. Occasional small, platy, metallic fragments noted. Dark greenish-gray | 8 | 85 |
| Silt, very fine to fine sandy; poorly pervious, friable to brittle, bedded with 2- to 4-in. sandy and clayey intervals. Occasional concentrations of oxidized organic debris. Large fish scales and shell fragments noted at 87.4 ft; 4 in. of volcanic ash at 88 ft. Many small, silver, metallic particles noted throughout the interval. Dark gray grading to dark olive-brown at 91.0 ft. Very fine sand at 85.8–86.5 ft, calcareous | 7 | 92 |
| Clay, silty; firm to brittle, slightly bedded with thin 1/4- to 1/8-in. streaks of light-colored, glassy, volcanic sand. Clay appears to be 100 percent bentonite. Contains many threadlike plant remains (tules?) dark olive-gray | 4 | 96 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1W-31G1—Continued | | |
| Silt, clayey, fine sandy; poorly pervious, slightly plastic, massive, ill-sorted. Contains a 0.3 ft concentration of oxidized organic material at 98 ft. Occasional shell fragment and fish scale present. Many threadlike leaf materials throughout the interval. Slight odor of $H_2S$ noted. Dark-gray | 4 | 100 |
| Clay, silty; poorly pervious, slightly plastic, slight bedding indicated by sandy clay intervals, moderately well-sorted, some fine sand present. May be quite diatomaceous. Note: A determination of the $CaCO_3$ contents of the cutting samples by the HCl test was unsatisfactory because of high degree of drilling-fluid contamination | 3 | 103 |
| Clay, silty, fine sandy; poorly pervious, plastic, moderately well-sorted. Medium-gray | 29 | 132 |
| Sand, fine to very fine, silty; poorly pervious, hard, moderately well-sorted, carbonate cemented | 2 | 134 |
| Clay, silty; poorly pervious, plastic, well-sorted. Medium dark-gray | 4 | 138 |
| Clay, silty; plastic, well-sorted, occasional streaks of light brownish-gray bentonite clay. Dark greenish-gray to light brownish-gray | 20 | 158 |
| Clay, well-sorted. Predominantly light brownish-gray bentonitic material | 10 | 168 |
| Clay, well-sorted. Predominantly light brownish-gray bentonitic material. Becomes interlayered with dark greenish-gray clays at 174–178 ft. Pumice fragments at 176 ft. Occasional shell fragments and fish scales throughout the interval | 10 | 178 |
| Clay, well-sorted bentonitic, occasional pumice fragment. Light brownish-gray | 10 | 188 |
| Clay, interbedded light brownish-gray bentonitic clay and dark greenish-gray clays between 193–197 ft. Dark-gray clay at 197–198 ft | 10 | 198 |
| Clay, soft, bedded, well-sorted. Interlayered light brownish-gray bentonitic clay and dark greenish-gray clay. Occasional pumice fragment | 10 | 208 |
| Clay, soft, well-sorted. Predominantly dark-gray clay in upper part of interval grading to light brownish-gray clay at 212 ft | 10 | 218 |
| Clay, well-sorted, dark-gray to brownish-gray clay with a slight purple tint | 10 | 228 |
| Clay, soft, bedded, moderately well-sorted. Interbedded dark greenish-gray and light brownish-gray clays. Occasional shell and pumice fragment | 20 | 258 |
| Clay, soft, massive, moderately well-sorted, occasional very fine to fine sand grains, fish scales and shell fragments. Few pumice fragments. Medium-gray to medium bluish-gray | 10 | 268 |
| Clay, soft, moderately well-sorted to ill-sorted with scattered sand grains to medium size, chiefly dark basaltic glass fragments. Considerable light brownish-gray bentonitic material in this interval. Few shell fragments and fish scales. Light-gray to light brownish-gray | 10 | 278 |
| Clay, soft, bedded, well-sorted. Interbedded light brownish-gray bentonitic clay and dark greenish-gray clay. Occasional fish scale and shell fragment. Few glassy basalt fragments | 20 | 298 |
| Clay, silty; massive, occasional shell fragment. Dark greenish-gray | 10 | 308 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1W-31G1—Continued | | |
| Clay, soft, bedded, moderately well-sorted with some silt. Occasional shell fragment and fish scale. Greenish-gray to dark greenish-gray | 10 | 318 |
| Clay, soft, bedded, moderately well-sorted with occasional grains of dark basaltic glass. Interlayered greenish-gray and medium light gray clays with the latter becoming predominant toward bottom of interval | 20 | 338 |
| Clay, soft, massive, moderately well-sorted, occasional calcareous shell fragment. Dark greenish-gray | 20 | 358 |
| Clay, slightly plastic, bedded, moderately well-sorted with occasional shell fragments. At 362 ft a 6- to 12-in. layer of white pumice fragments, possibly quite pervious | 10 | 368 |
| Clay, massive, interbedded greenish-gray and light-gray | 10 | 378 |
| Clay, soft, bedded, well-sorted. Dark-gray to black clay with occasional streaks of medium-gray clay. The black clays may or may not be organic; may possibly be finely divided basaltic glass? | 10 | 388 |
| Clay, soft, bedded, well-sorted. Predominantly black sticky clay, but includes thin interbeds of dark greenish-gray clay | 20 | 408 |
| Clay, soft, massive, well-sorted. Contains many white calcareous shell fragments, occasional pumice particle. Black to dark-gray | 30 | 438 |
| Clay, soft, massive, well-sorted. Black clay with occasional shell fragments. Binocular microscope observations suggest that these black clays consist of dark basaltic glass fragments. | 10 | 448 |
| Clay, soft, bedded, moderately well-sorted. Contains occasional pumice and shell fragments. Dark gray to black. Interbedded with dark greenish-gray clays at 468–478 ft | 30 | 478 |
| Clay, slightly plastic, bedded, moderately well-sorted, occasional black basaltic glass fragment and white shell particle. Interlayered black and dark greenish-gray | 20 | 498 |

47/1W-31N2

[Farnum Bros. (Meiss Ranch). On alluvial plain near Meiss Lake, about 3.2 miles northwest of Macdoel. Altitude 4,234 ft. Drilled by C. F. Enloe, 1952. Cased to 52 ft]

| | | |
|---|---|---|
| Alluvium and lake deposits, undifferentiated: | | |
| Soil and clay | 49 | 49 |
| Butte Valley basalt: | | |
| Lava, broken, water-bearing | 32 | 81 |
| Lake deposits: | | |
| Clay | 6 | 87 |

47/1W-32R1

[U. S. Bureau of Reclamation. On alluvial plain, about 3 miles north of Macdoel. Altitude 4,238 ft. Drilled by U. S. Bureau of Reclamation, 1954. Hole logged by R. J. Rongey, geologist, USBR]

| | | |
|---|---|---|
| Sand, fine to very fine; moderately pervious, loose, massive, moderately well-sorted, some silt and occasional medium sand grains. Lower portion is calcareous. Light-gray | 3 | 3 |
| Sand, fine to very fine; silty, poorly pervious, friable to firm, massive, ill-sorted, calcareous. Moderate yellowish-brown | 2 | 5 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1W-32R1—Continued | | |
| Silt, fine to very fine sandy; poor to moderately pervious, friable, massive, ill-sorted. Sand grains are predominantly light volcanic glass. Occasional centers of $MnO_2$ staining. Calcareous. Dusky yellow to moderate yellowish-brown | 5 | 10 |
| Sand, fine to medium; moderately to highly pervious, loose to easily friable, moderately well-sorted. Predominantly volcanic glass fragments. Calcareous. Moderate yellowish-brown | 6 | 16 |
| Clay, silty; poorly pervious, friable to brittle, nonplastic, moderately well-sorted. Appears to be entirely finely divided volcanic ash slightly calcareous in spots. Light brownish-gray | 3.5 | 19.5 |
| Sand, fine to medium; loose, massive, moderately well-sorted, highly pervious. Consists of dark-gray and black volcanic glassy sand, light glassy material and carbonate fragments. Dark greenish-gray | 1 | 20.5 |
| Sand, fine to very fine, silty; poorly pervious, friable, massive, ill-sorted, high silt content, calcareous. Dark greenish-gray | 1 | 21.5 |
| Silt, clayey, fine sandy; poorly pervious, friable to brittle, brecciated, ill-sorted, calcareous. Olive-gray | 1 | 22.5 |
| Sand, fine to medium; highly pervious, loose, massive, well-sorted. Fragments of clear volcanic glass, olivine and possibly hypersthene, occasional felspars, many dark basaltic cinders with a reddish irridescent surface. Calcareous | 3.5 | 26 |
| Silt, clayey; poorly pervious, friable to firm, massive, well to ill-sorted, carries occasional pumice fragments to 1/8-in. diameter. Slightly calcareous | 2 | 30 |
| Sand, fine to very fine. Loose, bedded with slightly silty phases 1 to 2 in. thick, moderately well-sorted, variable silt content. Occasional shell fragment. Olive-gray. Becomes calcareous and well-cemented at 32.2–32.8 ft | 4 | 32 |
| Sand, interbedded fine to very coarse; highly pervious, firm to hard, moderately well-sorted. Consists of interbedded fine to medium and coarse volcanic cinders with large interstitial pore spaces. Black | 8.5 | 40.5 |
| Silt, fine to very fine sandy, clayey; firm, massive, poorly pervious, very ill-sorted, calcareous | 2 | 42.5 |
| Silt, poor to moderately pervious, loose to easily friable, no plasticity, very well-sorted, appears to be a basaltic cinder ash. Dark-gray | 4.5 | 47 |
| Clay, poorly pervious, nonplastic, massive, firm, very well-sorted, no apparent clay minerals, probably only ash and diatomite. Medium-gray | 3 | 50 |
| Sand, medium to very coarse with occasional granules; highly pervious, loose, moderately well-sorted. Consists almost wholly of dark-gray to black volcanic cinders. Dark-gray | 4 | 54 |
| Clay, poorly pervious, firm, nonplastic, well-sorted. Dark-gray. Interbedded very fine sand and clay at 54.5–55.3 | 6 | 60 |
| Silt, clayey, fine sandy; poorly pervious, moderately friable, massive, ill-sorted, calcareous, many shell fragments. Many 1/16- to 1/32-in. gas vesicles. Dark-greenish-gray | 1.5 | 61.5 |
| Clay, poor to moderately pervious, brittle, highly brecciated, well-sorted, calcareous. Dark greenish-gray | 5.5 | 67 |
| Clay, silty, very fine sandy, poorly pervious, non to slightly plastic, bedded with several 1/2- to 1-in fine volcanic sand lenses. Calcareous. Many shell fragments. Several vertical gas holes noted. Dark greenish-gray | 3.5 | 70.5 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **47/1W-32R1—Continued** | | |
| Clay, poorly pervious, loose, highly brecciated and brittle, slightly calcareous. Olive-gray with greenish-gray streaks. Clayey and sandy silt at 70.8 to 72.0 ft | 5.5 | 76 |
| Sand, fine to very fine, silty; poor to moderately pervious, moderately well-sorted, friable, massive. Predominantly fine volcanic ash. Greenish-gray | 2.5 | 78.5 |
| Silt, clayey; poorly pervious, friable, bedded, moderately well-sorted. Few lenses of fine sand 1 to 2 in. thick with a silt matrix. Dark greenish-gray | 2 | 80.5 |
| Clay, poorly pervious, brittle, nonplastic, brecciated, moderately well-sorted. Dark greenish-gray | 1 | 81.5 |
| Silt, fine sandy; poorly pervious, friable to loose, bedded with streaks of fine volcanic sand and well-sorted silt and thin clays. Occasional white pumice fragment to 1/2-in. diameter. Calcareous. Dark greenish-gray | 7.5 | 89 |
| Clay, silty, friable, massive, moderately well-sorted, occasional sand grains, few shell fragments, calcareous. Greenish-gray | 2.5 | 91.5 |
| Silt, fine to very fine sandy, poorly to slightly pervious, friable, bedded with 1- to 3-in. fine to medium sand beds. Occasional white shell fragment. Calcareous. Dark-gray | 1 | 92.5 |
| Silt and clay, interbedded, poorly pervious, friable to firm, well-sorted. Consists of two clay layers on each end with a silty central portion. Dark-gray | 2 | 94.5 |
| Clay, poorly pervious, massive, well-sorted. Nonplastic, but has a slick feel. Light olive-gray | 3.5 | 98 |
| Clay, moderately well-sorted. Contains thin 1- to 2-in. streaks of fine pumice with individual fragments to 1/8-in. diameter. Dark greenish-gray | 20 | 118 |
| Clay, bedded, well-sorted, interbedded medium-gray and dark greenish-gray clays | 10 | 128 |
| Clay, massive, well-sorted, calcareous, several shell fragments noted. Medium-gray | 10 | 138 |
| Clay, bedded, well-sorted, interbedded light brownish-gray pumaceous clay and dark greenish-gray clay. Very soft between 143 and 145 ft. Occasional thin calcareous shell fragments | 20 | 158 |
| Clay, bedded, moderately well-sorted. Interbedded light brownish-gray bentonitic clay and dark greenish-gray clay | 20 | 178 |
| Clay, bedded, moderately well-sorted, occasional basaltic glass grains to medium size. Interbedded dark greenish-gray and light yellowish-brown | 10 | 188 |
| Clay, bedded, brittle, well-sorted. Interbedded dark greenish-gray, light yellowish-brown and dark gray clays | 10 | 198 |

47/1W-34Q1

[W. S. Edwards. On alluvial plain, about 3.4 miles northeast of Macdoel. Altitude 4,237 ft. Drilled by J. A. Van Meter, 1953. Cased to 305 ft. Perforated 60–304 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium and lake deposits, undifferentiated: | | |
| Soil | 5 | 5 |
| "Hardpan" | .5 | 5.5 |
| Sand and clay | 11.5 | 17 |
| Sand and pumice | 1 | 18 |
| "Chalk" | 8 | 26 |
| Sand, packed | 13 | 39 |
| Streaks of "chalk" and sand | 114 | 153 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **47/1W-34Q1—Continued** | | |
| Alluvium and lake deposits, undifferentiated:—Continued | | |
| Mud | 1 | 154 |
| Streaks of "chalk" and sand | 14 | 168 |
| Sand, coarse, pumice and gravel | 5 | 173 |
| "Quicksand," sea shells and fish bones | 19 | 192 |
| Streaks of "chalk" and sand run from 1 to 3 ft in depth | 166 | 358 |
| **47/1W-35Q1** | | |
| [Dale West. On alluvial plain about 4.1 miles northeast of Macdoel. Altitude 4,234 ft. Drilled by C. F. Enloe, 1952. Cased to 300 ft. Perforated 100–300 ft, gravel-packed] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Sand and clay mixed with an occasional sand streak | 260 | 260 |
| Sand, coarse, and pumice | 20 | 280 |
| Sand, black | 40 | 320 |
| **47/1W-36D1** | | |
| [U. S. Bureau of Reclamation. On alluvial plain, about 5 miles northeast of Macdoel. Altitude 4,229 ft. Drilled by George Hartley, 1951. Perforated 30–40 ft. Static water level, when drilled, about 10 ft below land surface] | | |
| Soil, lake sediment, yellow, clay and muck | 28 | 28 |
| Sand, fine gravel, water here | 2 | 30 |
| Lake sediment | 10 | 40 |
| **47/1W-36L1** | | |
| [C. E. Crawford. On alluvial plain, about 5 miles northeast of Macdoel. Altitude 4,230 ft. Drilled by K. Hartley, 1951] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Sand and fine gravel mixed | 170 | 170 |
| Sand and shale mixed | 17 | 187 |
| **47/2W-16L1** | | |
| [Rocco. On alluvial plain about 7.7 miles northwest of Macdoel. Altitude 4,242 ft. Drilled by Buckner, 1946. Cased to 128 ft] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Soil | 6 | 6 |
| Clay, yellow | 2 | 8 |
| Clay, blue | 82 | 90 |
| Clay, blue sandy | 3 | 93 |
| Clay, blue | 147 | 240 |
| Older volcanic rocks of the "High Cascades". | | |
| Lava, hard | 2 | 242 |
| Lava, black cinders | 6 | 248 |
| Lava, hard | 4 | 252 |
| Lava, black cinders | 8 | 260 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **47/2W-29J1** | | |
| [F. Voelker. On alluvial plain near the western border of the valley. About 7.1 miles northwest of Macdoel. Altitude 4,240 ft] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Topsoil and clay | 118 | 118 |
| Sand, black, very fine, water-bearing | 8 | 126 |
| Clay and "chalk" | 12 | 138 |
| Sand, black, very fine and water-bearing | 12 | 150 |
| **47/2W-23L1** | | |
| [J. Rocco. On alluvial plain about 6 miles northwest of Macdoel. Altitude 4,239 ft. Drilled by Buckner, 1946. Cased to 150 ft] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Soil | 3 | 3 |
| Clay, yellow | 17 | 20 |
| Clay, blue | 236 | 256 |
| Older volcanic rocks of the "High Cascades". | | |
| Lava, hard | 3 | 259 |
| Lava, red cinders | 11 | 270 |
| Lava, hard | 11 | 281 |
| **48/1E-30M2** | | |
| [J. Liskey. On alluvial plain, at the north edge of Dorris. Altitude 4,246 ft. Drilled by J. A. Van Meter, 1941. Uncased. Water allowed to flow into old dug well (30M1) located just north of this well. Static water level, when drilled, about 45 ft below land surface] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Topsoil | 1 | 1 |
| Sand and clay | 64 | 65 |
| Quicksand (water-bearing) | 84 | 149 |
| Clay and sand | 29 | 178 |
| Clay | 191 | 369 |
| Sand, black, small water flow | 7 | 376 |
| Clay and sand | 10 | 386 |
| Sand, red, and clay, no water | 19 | 405 |
| Washed gravel and clay, little water | 6 | 411 |
| Older volcanic rocks of the "High Cascades". | | |
| Basalt | 4 | 415 |
| **48/1E-31A1** | | |
| [J. Liskey. On alluvial plain near foot of fault scarp, about 0.7 mile east of Dorris. Altitude 4,258 ft. Drilled by J. A. Van Meter, 1951] | | |
| Talus: | | |
| Sand, wind-blown, blue, and small cinders | 14 | 14 |
| Sand, red and gravel | 5.5 | 19.5 |
| Boulders | 1 | 20.5 |
| Clay, sand, and boulders | 7.5 | 28 |
| Boulders and clay | 20 | 48 |
| Boulders | 3 | 51 |
| Boulders and clay | 8 | 59 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **48/1E-31A1—Continued** | | |
| Talus:—Continued | | |
| Small boulders and clay, soft | 5 | 64 |
| Boulders and clay, hard | 12 | 76 |
| Clay, soft | 5 | 81 |
| Clay and boulders, hard | 24 | 105 |
| Boulders, water-bearing | 23 | 128 |
| Sand, red and boulders, blue | 5 | 133 |
| Sand, fine and boulders | 2 | 135 |
| Sand and boulders | 2.5 | 137.5 |
| Boulders | 5.5 | 143 |
| Older volcanic rocks of "High Cascades". | | |
| Lava, blue, hard | 3 | 146 |
| Rock, red and sand in crevice, some water | 3 | 149 |
| Lava, creviced, hard | 3 | 152 |
| Basalt, green, creviced | 4 | 156 |
| Lava, gray | 4 | 160 |
| Rock, red and cinders | 6 | 166 |
| Lava, red and black, hard, crevices full of fine sand | 8 | 174 |
| Lava, broken and sand; some water | 17 | 191 |
| Rock, red | 8 | 199 |
| Lava, red and blue, hard | 2 | 201 |

48/1E-31J1

[E. A. McCollum. On alluvial plain, about 1 mile southeast of Dorris. Altitude 4,244 ft. Drilled by J. Van Meter, 1935. Test hole, 16-in. hole to 58 ft; 3-in. hole to 313 ft. Static water level, when drilled, about 40 ft below land surface]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Lake deposits: | | |
| Soil | 13 | 13 |
| Clay | 7 | 20 |
| Gravel, cemented | 23 | 43 |
| Sand, packed | 13 | 56 |
| "Quicksand" | 39 | 95 |
| Sand, packed | 1 | 96 |
| Water gravel | 10 | 106 |
| Sand, fine and shells, too fine to screen | 14 | 120 |
| Clay | 193 | 313 |

48/1W-25Q1

[T. Cavenor. On alluvial plain, about 0.7 mile west of Dorris. Altitude 4,240 ft. Drilled by J. A. Van Meter, 1953. Casing perforated 30–150 ft, gravel-packed. Static water level, when drilled, about 32 ft below land surface]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium and lake deposits: | | |
| Topsoil | 15 | 15 |
| "Chalk" and sand | 32 | 47 |
| "Chalk" | 6 | 53 |
| "Chalk" and sand | 24 | 77 |
| Sand, packed | 10 | 87 |
| "Chalk" | 5 | 92 |
| Sand, fine | 26 | 118 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 48/1W-25Q1—Continued | | |
| Alluvium and lake deposits:—Continued | | |
| "Quicksand," fine | 27 | 145 |
| "Chalk" | 5 | 150 |

48/1W-28C1

[J. Liskey. Near foot of steep fault scarp about 3.6 miles northwest of Dorris. Altitude 4,275 ft. Drilled by J. S. Wilson, 1947 from 0–360 ft. Deepened by Kenneth Hartley, 1951, from 360–560 ft]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Alluvium and talus: | | |
| Sand and clay mixed | 20 | 20 |
| Clay and rock formation | 80 | 100 |
| Sand and rock, mixed, water-bearing | 150 | 250 |
| Sand and rock, mixed, and water-bearing | 110 | 360 |
| Older volcanic rocks of "High Cascades". | | |
| Rock formation with layers of red shale | 140 | 500 |
| Mud or clay, red | 60 | 560 |

48/1W-28F1

[J. Liskey. On alluvial plain, about 3.8 miles northwest of Dorris. Altitude 4,260 ft. Drilled by J. A. Van Meter, 1951]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Topsoil | 2.5 | 2.5 |
| "Hardpan" | 4.5 | 7 |
| Sand, brown, fine | 5 | 12 |
| Clay, yellow | 18 | 30 |
| Shale, blue | 128 | 158 |
| Shale, green | 43 | 201 |
| Shale, gray | 17 | 218 |
| Bank sand, fine | 17 | 235 |
| Shale, blue | 43 | 278 |
| Gravel | 5 | 283 |
| Shale, light blue | 18 | 301 |
| Shale, blue | 50 | 351 |
| Gravel | 6 | 357 |
| Bank sand with streaks of gray shale | 22 | 379 |
| Gravel, fine, and sand | 9 | 388 |
| Bank sand | 12 | 400 |
| Gravel | 2 | 402 |
| Shale, gray | 7 | 409 |
| Bentonite clay, very hard and sticky | 9 | 418 |
| Shale, blue | 8 | 426 |
| Shale, gray | 5 | 431 |
| Shale, chocolate-colored | 12 | 443 |
| Bentonite soil or sticky clay | 3 | 446 |
| Clay, brown | 13 | 459 |
| Shale, blue | 35 | 494 |
| Clay, brown | 5 | 499 |
| Shale, blue | 4 | 503 |
| Clay, brown | 32 | 535 |
| Shale, blue sticky | 31 | 566 |
| Streaks of gravel and shale, blue | 7 | 573 |

Table 8.—*Drillers' logs and records of wells in Butte Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 48/1W-28F1—Continued | | |
| Older volcanic rocks of the "High Cascades". | | |
| Lava rock | 5 | 578 |
| Basalt | 3 | 581 |
| Lava rock, very hard | 31 | 612 |
| Mud, blue | 20 | 632 |

546199 O—60——9

Table 9.—*Drillers' logs of wells in Red Rock Valley, Calif.*

[Stratigraphic correlations by P. R. Wood. Land-surface altitudes approximate and with respect to mean sea-level datum of 1929 through the medium of the Pacific Northwest Supplementary Adjustment of 1947]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **45/1E-9C2** | | |
| [A. Beck. On gently sloping hillside, about 6.3 miles east of Mount Hebron. Altitude 4,380 ft. Drilled by J. A. Van Meter, 1954. Cased to 181 ft. Perforated 131–181 ft] | | |
| Topsoil | 3 | 3 |
| Boulders | 2 | 5 |
| Hardpan | 3 | 8 |
| Sand | 11 | 19 |
| Sand and boulders | 2 | 21 |
| Sand | 23 | 44 |
| Sand and boulders | 2 | 46 |
| Sand | 5 | 51 |
| Boulders | 4 | 55 |
| Sand and boulders | 5 | 60 |
| Sand with scattered boulders | 23 | 83 |
| Pumice | 1 | 84 |
| Boulders and sand | 7 | 91 |
| Pumice, pink | 10 | 101 |
| Boulders | 2 | 103 |
| Sand and boulders | 4 | 107 |
| Lava, black, boulders and sand | 15 | 122 |
| Lava, shattered, gravel and sand | 2 | 124 |
| Lava boulders, red and black | 4 | 128 |
| Boulders, red, cinders and clinkers | 12 | 140 |
| Boulders, black and red (very hard) | 19 | 159 |
| Lava, creviced, red | 10 | 169 |
| Sand, cinders and small boulders, water-bearing | 7 | 176 |
| Lava boulders, hard red and black, water-bearing | 8 | 184 |
| Sandstone, volcanic | 4 | 188 |
| Lava, creviced, hard, live water | 9 | 197 |
| **45/1E-11C2** | | |
| [L. D. Parsons. On low flat ridge, about 9.2 miles east of Mount Hebron. Altitude 4,396 ft. Drilled by J. A. Van Meter, 1953. Not cased. Static water level, when drilled, about 178 ft below land surface] | | |
| Alluvium and lake deposits, undifferentiated: | | |
| Topsoil | 1 | 1 |
| Gravel, cemented | 16 | 17 |
| Sand and clay | 16 | 33 |
| Sand, gravel and pumice | 32 | 65 |
| Gravel and sand | 5 | 70 |
| Pumice, pink | 38 | 108 |
| Pumice, white | 3.5 | 111.5 |
| Boulders and sand | 9 | 120.5 |
| Older volcanic rocks of the "High Cascades". | | |
| Creviced lava | 59.5 | 180 |
| Lava, red, creviced | 52 | 232 |

Table 9.—*Drillers' logs of wells in Red Rock Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 45/1E-16P1 | | |
| [L. D. Parsons. Near the shoreline of a small temporary lake or playa (Russell Lake), about 8 miles southeast of Mount Hebron. Altitude 4,347 ft. Drilled by Van Meter, 1923] | | |
| Playa deposits: | | |
| Soil | 5 | 5 |
| "Hardpan" | 3 | 8 |
| Clay | 3 | 11 |
| Boulders and clay | 12 | 23 |
| Butte Valley basalt: | | |
| Basalt | 9 | 32 |
| Lava | 13 | 45 |
| Basalt | 4 | 49 |
| Lava | 36 | 85 |
| Lake deposits: | | |
| "Hardpan" | 37 | 122 |
| Gravel, water | 2 | 124 |
| Gravel and clay with streaks of water gravel | 26 | 150 |
| Good water gravel | 5 | 155 |
| 46/1E-35J1 | | |
| [R. J. Taylor. On alluvial slope near valley margin, about 9.5 miles east of Mount Hebron. Altitude 4,440 ft. Drilled by Van Meter, 1942] | | |
| Soil | 5 | 5 |
| Red rock (basaltic tuff-breccia) | 16 | 21 |
| Boulders | 3 | 24 |
| Red rock (basaltic tuff-breccia) | 4 | 28 |
| Boulders | 4 | 32 |
| "Hardpan" | 29 | 61 |
| Boulders | 7 | 68 |
| Diorite, gray (basalt or andesite?) | 3 | 71 |
| Lava | 11 | 82 |
| Lava, creviced | 25 | 107 |
| "Hardpan" | 4 | 111 |
| "Chalk" (diatomite?) | 19 | 130 |
| Sandstone | 4 | 134 |
| "Chalk" (diatomite?) | 6 | 140 |
| Lava, creviced, mud in seams (cracks) | 8 | 148 |
| Conglomerate, soft | 5 | 153 |
| Boulders and mud | 12 | 165 |
| Basalt | 21 | 186 |
| Lava, red | 8 | 194 |
| Red cinder conglomerate | 3 | 197 |
| Conglomerate, red, hard | 6 | 203 |
| Lava | 3 | 206 |
| Lava, creviced, water-bearing | 5 | 211 |
| Boulders and cinders, water-bearing | 3 | 214 |
| Lava, creviced | 23 | 237 |

Table 9.—*Drillers' logs of wells in Red Rock Valley, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 46/2E-31E1 | | |
| [J. Allen. On gentle slope near hills bordering alluvial plain, about 4.8 miles east of Mount Hebron. Altitude 4,440 ft. Drilled by Van Meter, 1918] | | |
| Soil | 14 | 14 |
| Rock, solid | 56 | 70 |
| "Chalk" (diatomite?) | 50 | 120 |
| Sandstone, volcanic | 75 | 195 |
| Boulders and "hardpan" | 7 | 202 |
| Lava | 21 | 223 |
| (210–223 water in lava) | | |
| Basalt, creviced | 17 | 240 |
| Basalt, solid gray | 13 | 253 |
| Lava | 5 | 258 |
| Sand, coarse, water-bearing | 25 | 283 |

Table 10.—*Drillers' logs of wells in the Oklahoma district, Calif.*

[Stratigraphic correlations by P. R. Wood. Land-surface datum approximate and with reference to mean sea-level datum of 1929. Through the medium of the Pacific Northwest Supplementary Adjustment of 1947]

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **46/2E-7E1** | | |
| [L. H. Fogel. On low hill near foot of steep volcanic ridge, about 10.6 miles east of Macdoel. Altitude 4,200 ft. Drilled by Storey Bros., 1951. Cased to 21 ft. Water first encountered at 510 ft below land surface] | | |
| Topsoil | 1 | 1 |
| "Chalk," white (diatomite) | 19 | 20 |
| "Chalk," blue (diatomite) | 376 | 396 |
| Clay, black, hard | 4 | 400 |
| Rock | 4 | 404 |
| Clay, black, hard | 37 | 441 |
| Rock | 3.5 | 444.5 |
| Clay, black, hard | .5 | 445 |
| Rock | 14 | 459 |
| "Chalk," blue, hard | 1 | 460 |
| Rock | 14 | 474 |
| "Chalk," blue, hard | 2 | 476 |
| Rock | 13 | 489 |
| Rock | 2 | 491 |
| Rock, very hard | 10 | 501 |
| Rock, hard and cinders | 20 | 521 |
| **46/2E-28Q1** | | |
| [U.S. Bureau of Land Management. On alluvial plain of a small valley, about 13.2 miles east of Mount Hebron. Altitude 4,330 ft. Drilled by J. A. Van Meter, 1953. Cased to 101 ft. Water first encountered 178 ft below land surface] | | |
| Soil | 1 | 1 |
| Pumice | 3 | 4 |
| Clay, sand and pumice | 13 | 17 |
| Sand, packed | 4 | 21 |
| Lava and sand, loose | 66 | 87 |
| "Chalk" | 2 | 89 |
| Lava, creviced | 83 | 172 |
| Cinders, hard | 7 | 179 |
| Cinders, water-bearing | 4 | 183 |
| Lava, creviced, water-bearing | 7 | 190 |
| **47/1E-25K1** | | |
| [Porterfield Ranch. On alluvial plain near foot of a steep-sided volcanic ridge, about 10.7 miles northeast of Macdoel. Altitude 4,160 ft. Drilled by J. A. Van Meter, 1951. Cased 20 ft] | | |
| Topsoil | 2.5 | 2.5 |
| Soft mud | 12.5 | 15 |
| Sand and boulders | 2 | 17 |
| "Chalk," (diatomite) | 72 | 89 |
| Sand, black | 23 | 112 |
| Sand, brown | 12 | 124 |
| Layers of "chalk" and sand (diatomite and sand) | 39 | 163 |
| Sand and pumice | 9 | 172 |

Table 10.—*Drillers' logs of wells in the Oklahoma district, Calif.*—Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 47/1E-25K1—Continued | | |
| "Chalk," (diatomite) | 41 | 213 |
| Sandstone | 2 | 215 |
| Sand, gravel, shale and broken lava; live water | 24 | 239 |
| Shale | 3 | 242 |
| Sand | 3 | 245 |
| Conglomerate, hard | 4 | 249 |
| Sandstone | 27 | 276 |
| Clay and sand | 19 | 295 |
| 47/2E-7N1 | | |
| [P. Langer. On alluvial plain near foot of a volcanic ridge, about 6.6 miles southeast of Dorris. Altitude 4,100 ft. Drilled by C. F. Enloe, 1952. Cased 20 ft] | | |
| Boulders | 8 | 8 |
| Rock, black | 32 | 40 |
| Rock, soft, with a streak of cinders | 5 | 45 |
| Lava, black, soft | 25 | 70 |
| Boulders | 7 | 77 |
| Rock, black, soft and clay | 16 | 93 |
| Cinders, red | 3 | 96 |
| Black shell rock (platty lava) | 10 | 106 |
| Basalt, gray, hard | 12 | 118 |
| Rock, red, soft | 7 | 125 |
| Shale, black and sand | 15 | 140 |
| Rock, black, hard | 5 | 145 |
| Rock, black, soft | 35 | 180 |
| Basalt, gray, hard, 1 ft or less per day | 51 | 231 |
| Conglomerate | 7 | 238 |
| Rock, black, soft, 2 ft or more per day | 20 | 258 |
| Basalt | 18 | 276 |
| Lava, broken, soft | 14 | 290 |

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*

[Table 11 contains records of periodic water-level measurements made in 45 observation wells from December 1951 to September 1954. Except where noted, all measurements were by the U. S. Bureau of Reclamation. Water levels are reported as depth below measuring point. Pumping or recovery levels that depart appreciable from static conditions are not shown in this table. Distances of wells from section line, roads, or other cultural features were measured in the field or were scaled from topographic maps]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|

45/1E-11C1

[L. D. Parsons. About 9.2 miles east of Mount Hebron, 0.33 mile east and 0.05 mile south of section line, 175 ft north of ranchhouse, well located in the southwest corner of a large pumphouse. *Domestic and stock well, diam. 12 in., depth reported* 221 ft. Measuring point, access hole in steel plate, south side of pump, 4,395.7 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Feb. 8, 1952 | 179.5 | July 9, 1952 | 177.4 | Jan. 8, 1953 | 177.9 |
| Mar. 8 | 179.5 | 28 | 177.3 | Feb. 12 | 177.7 |
| Apr. 3 | 179.1 | Aug. 29 | 177.4 | Mar. 5 | 177.6 |
| May 13 | 178.4 | Sept. 26 | 177.4 | June 24, 1954 | [1]175.35 |
| June 5 | 177.8 | Dec. 17 | 178.0 | | |

[1] By U. S. Geological Survey.

45/1W-19H1

[R. Lutz. About 3.6 miles south of Mount Hebron, 0.20 mile west and 0.44 mile south of section line, 20 ft west of Butte Creek, 300 ft south of dwelling, beneath an elevated water-storage tank. Unused domestic well, diam. 6 in. Measuring point, top of casing which is 4,314.8 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Jan. 3, 1952 | 26.4 | July 9, 1952 | 26.2 | Jan. 9, 1953 | 28.3 |
| Feb. 6 | 24.0 | 28 | 26.0 | Feb. 10 | 26.1 |
| Mar. 4 | 25.7 | Aug. 27 | 30.5 | Mar. 4 | 39.2 |
| Apr. 2 | 20.1 | Sept. 23 | 32.5 | Apr. 3 | 39.1 |
| May 2 | 21.95 | Nov. 13 | 34.5 | Oct. 21 | [1]39.1 |
| June 4 | 22.8 | Dec. 15 | 39.8 | | |

[1] By U. S. Geological Survey

45/2W-3H1

[Delos Mills. About 2.4 miles west-southwest of Mount Hebron, 0.11 mile west of U. S. Highway 97, 70 ft south of section-line road (Prather Lane). Irrigation well, diam. 18 in., reported depth 270 ft. Measuring point, top of casing which is 4,262.6 ft above mean sea level and about 2.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 10, 1951 | 37.5 | May 2, 1952 | 36.0 | Feb. 10, 1953 | 35.6 |
| Jan. 3, 1952 | 38.8 | Nov. 7 | 38.7 | Mar. 4 | 35.3 |
| Feb. 5 | 38.2 | Dec. 15 | 37.6 | Apr. 3 | 35.0 |
| Mar. 4 | 37.1 | Jan. 9, 1953 | 36.8 | Oct. 20 | [1]38.43 |
| Apr. 2 | 36.5 | | | | |

[1] By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

45/2W-24A1

[R. Lutz. About 6.2 miles south of Mount Hebron, 0.10 mile west and 0.13 mile south of section line, 300 ft southeast of large wooden barn, beneath a steel windmill tower, 200 ft west of an irrigation well. Unused stock well, diam. 6 in., reported depth 105 ft. Measuring point, top of casing which is 4,314.9 ft above mean sea level and about 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 6, 1951 | 97.0 | June 4, 1952 | 93.3 | Dec. 15, 1952 | 94.0 |
| Jan. 3, 1952 | 95.5 | July 9 | 92.6 | Jan. 9, 1953 | 94.1 |
| Feb. 6 | 95.4 | 28 | 92.9 | Feb. 9 | 93.6 |
| Mar. 4 | 95.2 | Aug. 27 | 93.4 | Mar. 4 | 93.45 |
| Apr. 2 | 94.8 | Sept. 23 | 93.7 | Apr. 3 | 93.35 |
| May 2 | 94.1 | Nov. 13 | 94.0 | Oct. 21 | [1]93.1 |

[1]By U. S. Geological Survey.

46/1E-5M1

[M. Cross. About 5.9 miles northeast of Macdoel, 0.12 mile south and 0.15 mile east of section line road, near southwest corner of an old wooden barn. Stock well, diam. 6 in., reported depth 50–60 ft. Measuring point, top of casing which is 4,239.7 ft above mean sea level and 0.3 ft above land surface.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Feb. 18, 1952 | 26.0 | July 28, 1952 | 17.9 | Feb. 9, 1953 | 17.1 |
| Mar. 3 | 20.4 | Aug. 28 | 11.3 | Mar. 5 | 17.5 |
| Apr. 2 | 20.15 | Sept. 25 | 12.3 | Apr. 3 | 18.1 |
| May 1 | 17.9 | Nov. 10 | 12.4 | Nov. 2 | [1]14.22 |
| June 4 | 17.3 | Dec. 18 | 15.1 | May 5, 1954 | [1]18.26 |
| July 9 | 16.8 | Jan. 7, 1953 | 16.3 | Sept. 28 | [1]13.30 |

[1]By U. S. Geological Survey.

46/1W-2L1

[Mettler and Sheen. About 3.4 miles northeast of Macdoel, 0.3 mile east and 0.26 mile north of section-line road, 450 ft northeast of an old barn, 300 ft north of an old machinery shed. Unused irrigation well, diam. 16 in. Measuring point, top of casing which is 4,255.9 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 6, 1951 | 34.5 | July 9, 1952 | 33.6 | Feb. 9, 1953 | 34.0 |
| Jan. 10, 1952 | 34.0 | 28 | 33.7 | Mar. 5 | 33.9 |
| Feb. 11 | 33.8 | Aug. 27 | 34.1 | Apr. 3 | 33.7 |
| Mar. 3 | 34.0 | Sept. 25 | 36.6 | Oct. 30 | [1]33.95 |
| Apr. 2 | 33.9 | Nov. 12 | 34.1 | May 5, 1954 | [1]34.75 |
| May 1 | 33.6 | Dec. 18 | 34.0 | Sept. 28 | [1]33.35 |
| June 4 | 33.5 | Jan. 7, 1953 | 34.0 | | |

[1]By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

46/1W-4N1

[L. Logan. About 1.9 miles north of Macdoel, 0.18 mile north of section line, 40 ft east of section-line road, 200 ft south of well 46/1W-4N2. Irrigation well, diam. 12 in. Measuring point, top of casing which is 4,237.3 ft above mean sea level and about 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 6, 1951 | 14.0 | Apr. 1, 1952 | 13.0 | July 9, 1952 | [1]17.6 |
| Jan. 9, 1952 | 14.5 | May 2 | 12.3 | 28 | [2]19.5 |
| Feb. 6 | 14.4 | June 3 | 14.5 | Oct. 27, 1953 | [3]14.14 |
| Mar. 6 | 14.2 | | | | |

[1]By U. S. Geological Survey.
[2]Pumped recently.
[3]Pumping.

46/1W-4N2

[L. Logan. About 2 miles north of Macdoel, 0.22 mile north and 40 ft east of section line, 200 ft north of well 46/1W-4N1. Unused well, diam. 6 in., reported depth 220 ft. Measuring point, top of casing which is 4,238.1 ft above mean sea level and about 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| June 3, 1952 | 14.5 | Nov. 12, 1952 | 15.6 | Apr. 2, 1953 | 12.5 |
| July 9 | [2]17.6 | Dec. 15 | 13.9 | Oct. 27 | [1]14.35 |
| 28 | [3]19.5 | Jan. 6, 1953 | 13.8 | May 5, 1954 | [1]13.87 |
| Aug. 29 | 15.3 | Feb. 10 | 12.9 | Sept. 28 | [1]8.03 |
| Sept. 23 | [3]19.9 | Mar. 2 | 12.7 | | |

[1]By U. S. Geological Survey.
[2]Well 4N1 pumped recently.
[3]Well 4N1 pumping.

46/1W-6Q1

[U. S. Bureau of Reclamation. About 2 miles northwest of Macdoel, 5 ft east and 60 ft north of a section-line fence, 80 ft east of an irrigation well. Observation well, diam. 2 in., reported depth 36 ft. Measuring point, top of casing which is 4,238.6 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 21, 1951 | 16.8 | July 9, 1952 | 16.0 | Jan. 6, 1953 | 14.5 |
| Jan. 1, 1952 | 16.5 | 28 | [3]31.6 | Feb. 10 | 13.4 |
| Feb. 6 | 16.35 | Aug. 27 | 18.2 | Mar. 2 | 13.1 |
| Mar. 7 | 15.8 | Sept. 23 | 16.1 | Apr. 2 | 12.4 |
| Apr. 1 | 15.2 | Nov. 12 | 14.2 | Oct. 27 | [1]14.24 |
| May 2 | [2]13.8 | Dec. 15 | 14.4 | May 5, 1954 | [1]12.04 |
| June 3 | 16.8 | | | | |

[1]By U. S. Geological Survey.
[2]Well 6P1 pumped recently.
[3]Well 6P1 pumping.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

46/1W-12B1

[Johnson. About 4.3 miles northeast of Macdoel, 200 ft south of section-line road, 200 ft east of half-section-line fence, about 50 ft south of small dwelling. Domestic well, diam. 8 in. Measuring point, top of casing which is 4,250.2 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 10, 1951 | 31.2 | June 4, 1952 | 30.4 | Dec. 18, 1952 | 31.0 |
| Jan. 10, 1952 | 31.1 | July 9 | 30.9 | Jan. 7, 1953 | 29.5 |
| Feb. 4 | 31.1 | 28 | 31.7 | Feb. 9 | 30.6 |
| Mar. 3 | 30.9 | Aug. 27 | 31.9 | Mar. 5 | 30.5 |
| Apr. 2 | 31.5 | Sept. 25 | 31.6 | Apr. 3 | 30.3 |
| May 1 | 30.15 | Nov. 10 | 31.2 | | |

46/1W-22K1

[M. Goode. About 2.3 miles southeast of Macdoel, 0.35 mile west of section line, 400 ft south of half-section-line road (Red Rock Road), 150 ft northeast of 22K2, near southeast corner of an old shed. Unused well, diam. 6 in., reported depth 56 ft. Measuring point, top of casing which is 4,272.6 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| May 29, 1937 | 51 | Dec. 17, 1952 | 52.7 | Apr. 6, 1953 | 35.0 |
| July 30, 1952 | 51.0 | Jan. 8, 1953 | 52.7 | Oct. 21 | [1]52.7 |
| Aug. 29 | 51.0 | Feb. 9 | 35.4 | May 6, 1954 | [1]51.65 |
| Sept. 26 | 53.2 | Mar. 5 | 35.0 | Sept. 28 | [1]56.0 |
| Nov. 17 | 52.9 | | | | |

[1]By U. S. Geological Survey.

46/1W-32L1

[W. Sturgess. About 0.3 mile southwest of Mount Hebron, 0.30 mile east of section line, 0.38 mile north of section-line road (Prather Lane), about 500 ft west of school buildings, 40 ft northwest of the northwest corner of an old wooden house. Domestic well, diam. 6 in. Measuring point, top of casing which is 4,255.0 ft above mean sea level and about 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 6, 1951 | 37.0 | July 9, 1952 | 34.8 | Feb. 10, 1953 | 30.8 |
| Jan. 3, 1952 | 33.8 | 28 | 40.5 | Mar. 4 | 30.6 |
| Feb. 5 | 35.8 | Aug. 27 | 40.2 | Apr. 3 | 30.6 |
| Mar. 4 | 36.8 | Sept. 25 | 34.3 | Oct. 22 | [1]31.55 |
| Apr. 2 | 32.5 | Nov. 14 | 31.6 | May 5, 1954 | [1]29.03 |
| May 2 | 32.9 | Dec. 17 | 31.9 | Sept. 27 | [1]32.7 |
| June 4 | 34.9 | Jan. 9, 1953 | 32.0 | | |

[1]By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

46/2W-4E1

[U. S. Bureau of Reclamation. About 5.9 miles northwest of Macdoel, 0.42 mile south and 0.10 mile east of section line, 50 ft north of junction of north-south drainage canal and an east-west drainage canal. Observation well, diam. 2 in., reported depth 41 ft. Measuring point, top of casing which is 4,234.2 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 10, 1951 | 22.4 | Aug. 26, 1952 | 7.5 | Apr. 6, 1953 | 4.6 |
| Jan. 3, 1952 | 18.4 | Sept. 25 | 8.1 | Oct. 29 | [1]7.57 |
| Feb. 6 | 15.6 | Nov. 7 | 7.9 | May 6, 1954 | [1]4.8 |
| Mar. 4 | 12.5 | Dec. 18 | 7.6 | Sept. 28 | [1]8.56 |
| July 10 | 7.4 | | | | |

[1]By U. S. Geological Survey.

46/2W-14Q1

[Gritzmaker. About 2.8 miles west of Macdoel, 0.26 mile west of section line, 200 ft north of section-line road, 20 ft north of a small dwelling. Unused domestic well, diam. 6 in. Measuring point, top of casing which is 4,238.0 ft above mean sea level and about 0.5 ft above land surface]

| | | | | | |
|---|---|---|---|---|---|
| Dec. 10, 1951 | 6.2 | July 9, 1952 | 6.1 | Feb. 10, 1953 | 4.0 |
| Jan. 3, 1952 | 6.0 | 31 | 6.1 | Mar. 4 | 4.5 |
| Feb. 6 | 4.75 | Sept. 23 | 6.2 | Apr. 2 | 4.1 |
| Mar. 4 | 5.5 | Nov. 20 | 5.7 | Oct. 26 | [1]4.26 |
| Apr. 2 | 5.85 | Dec. 15 | 5.5 | May 4, 1954 | 4.3 |
| May 2 | 5.9 | Jan. 9, 1953 | 5.3 | Sept. 27 | [1]4.37 |
| 27 | 5.9 | | | | |

[1]By U. S. Geological Survey.

47/1E-6H1

[U. S. Bureau of Reclamation. About 1.7 miles southeast of Dorris, 40 ft west of section-line road, 20 ft north of half-section-line fence. Observation well. diam. 2 in., reported depth 60 ft. Measuring point, top of casing which is 4,246.3 ft above mean sea level and 1 ft above land surface]

| | | | | | |
|---|---|---|---|---|---|
| Dec. 6, 1951 | 44.5 | July 9, 1952 | 44.1 | Feb. 8, 1953 | 44.25 |
| Jan. 10, 1952 | 43.9 | 28 | 44.1 | Mar. 5 | 44.25 |
| Feb. 4 | 42.9 | Aug. 27 | 44.2 | Apr. 3 | 44.25 |
| Mar. 7 | 43.85 | Sept. 25 | 44.2 | Nov. 10 | [1]44.77 |
| Apr. 3 | 43.85 | Nov. 10 | 44.3 | May 5, 1954 | [1]44.6 |
| May 1 | 43.95 | Dec. 18 | 44.4 | Sept. 28 | [1]44.7 |
| June 4 | 44.0 | Jan. 7, 1953 | 44.25 | | |

[1]By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

47/1E-17N1

[C. Green. About 3.9 miles south of Dorris, 0.24 mile north and 0.10 mile east of the southwest corner of section 17, beneath a wooden windmill tower. Stock well, diam. 8 in. Measuring point, top of casing which is 4,241.4 ft above mean sea level and 0.64 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 6, 1951 | 33.5 | July 9, 1952 | 35.9 | Feb. 9, 1953 | 35.6 |
| Jan. 10, 1952 | 36.1 | 28 | 35.9 | Mar. 5 | 35.5 |
| Feb. 4 | 36.25 | Aug. 27 | 35.8 | Apr. 3 | 35.4 |
| Mar. 3 | 36.3 | Sept. 25 | 35.8 | Nov. 4 | [1]36.52 |
| Apr. 3 | 36.0 | Nov. 10 | 35.8 | May 5, 1954 | [1]35.30 |
| May 2 | 35.8 | Dec. 18 | 35.8 | Sept. 28 | 36.1 |
| June 3 | 35.8 | Jan. 7, 1953 | 35.6 | | |

[1]By U. S. Geological Survey.

47/1E-19M1

[U. S. Bureau of Reclamation. About 4.6 miles south of Dorris, 0.60 mile south of section-line fence, 35 ft east of section-line fence. Observation well, diam. 2 in., reported depth 46 ft. Measuring point, top of casing which is 4,236.9 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 26, 1951 | 21.0 | July 9, 1952 | 21.1 | Jan. 7, 1953 | 21.3 |
| Jan. 3, 1952 | 21.5 | 28 | 21.1 | Feb. 9 | 21.2 |
| Feb. 4 | 21.55 | Aug. 28 | 21.2 | Mar. 5 | 21.2 |
| Mar. 3 | 19.3 | Sept. 25 | 21.2 | Apr. 6 | 21.2 |
| Apr. 14 | 21.3 | Nov. 10 | 21.2 | Nov. 4 | [1]21.69 |
| May 1 | 21.2 | Dec. 18 | 21.3 | May 5, 1954 | [1]21.4 |
| June 4 | 21.1 | | | | |

[1]By U. S. Geological Survey.

47/1E-29H2

[K. Holbrook. About 5.6 miles southeast of Dorris, 0.23 mile west of section-line road, 0.28 mile south of section line, about 300 ft southwest of a large wooden barn, beneath a wooden windmill tower. Stock well, diam. 8 in., reported depth 60 ft. Measuring point, top of casing which is about 4,238 ft above mean sea level and about 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Feb. 18, 1952 | 23.0 | July 28, 1952 | 24.9 | Feb. 9, 1953 | 25.1 |
| Mar. 3 | 25.5 | Aug. 28 | 25.0 | Mar. 5 | 25.1 |
| Apr. 3 | 25.3 | Sept. 25 | 24.9 | Apr. 3 | 25.1 |
| May 1 | 25.1 | Nov. 10 | 25.0 | Nov. 2 | [1]21.67 |
| June 4 | 25.0 | Dec. 18 | 25.1 | May 5, 1954 | [1]20.93 |
| July 9 | 24.9 | Jan. 7, 1953 | 25.2 | Sept. 28 | 27.4 |

[1]By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

47/1E-31E1

[Cross. About 6.3 miles south of Dorris, 0.32 mile south and 0.20 mile east of section line. Unused stock well, diam. 6 in. Measuring point, top of casing which is 4,233.1 ft above mean sea level and 2 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 26, 1951 | 15.6 | June 4, 1952 | 13.0 | Dec. 18, 1952 | 14.3 |
| Jan. 10, 1952 | 14.2 | July 9 | 13.4 | Feb. 9, 1953 | 12.9 |
| Feb. 4 | 13.8 | 28 | 13.5 | Mar. 5 | 12.7 |
| Mar. 3 | 12.3 | Aug. 28 | 14.1 | Apr. 6 | 12.5 |
| Apr. 3 | 11.9 | Sept. 25 | 14.1 | Nov. 4 | [1]14.70 |
| May 1 | 12.4 | Nov. 10 | 14.7 | May 5, 1954 | [1]13.95 |

[1]By U. S. Geological Survey.

47/1W-1D1

[U. S. Bureau of Reclamation. About 1.5 miles southwest of Dorris, 25 ft south of a section-line road, 3 ft east of a north-south fence, 40 ft east of a northeastward-trending telephone line. Observation well, diam. 2 in., reported depth 60 ft. Measuring point, top of casing which is 4,239.9 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 21, 1951 | 28.0 | July 9, 1952 | 25.8 | Feb. 11, 1953 | 25.6 |
| Jan. 9, 1952 | 26.6 | 28 | 25.9 | Mar. 2 | 25.8 |
| Feb. 7 | 25.9 | Aug. 27 | 26.0 | Apr. 2 | 25.7 |
| Mar. 6 | 25.7 | Sept. 23 | 26.0 | Oct. 27 | [1]26.00 |
| Apr. 3 | 25.7 | Nov. 6 | 25.9 | May 5, 1954 | [1]25.92 |
| May 2 | 25.7 | Dec. 16 | 25.9 | Sept. 28 | 26.3 |
| June 2 | 25.8 | Jan. 7, 1953 | 25.85 | | |

[1]By U. S. Geological Survey.

47/1W-2N1

[E. Marshall. About 2.7 miles southwest of Dorris, 0.13 mile north and 0.04 mile east of section line, beneath a wooden windmill tower. Unused stock well, diam. 8 in. Measuring point, top of casing which is 4,235.2 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 30, 1951 | 14.85 | July 9, 1952 | 13.1 | Feb. 11, 1953 | 12.6 |
| Jan. 5, 1952 | 14.8 | 28 | 13.1 | Mar. 3 | 12.5 |
| Feb. 11 | 13.9 | Aug. 27 | 13.1 | Apr. 3 | 12.6 |
| Mar. 6 | 13.8 | Sept. 23 | 13.2 | Oct. 27 | [1]12.80 |
| Apr. 1 | 13.9 | Nov. 6 | 13.3 | May 5, 1954 | [1]11.4 |
| May 2 | 13.2 | Dec. 16 | 13.4 | Sept. 28 | 12.4 |
| June 3 | 13.2 | Jan. 7, 1953 | 13.4 | | |

[1]By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

47/1W-3D1

[U. S. Bureau of Reclamation. About 3.2 miles west of Dorris, 30 ft east and 30 ft south of section line, about 100 ft southeast of the northwest corner of section 3. Observation well, diam. 2 in., reported depth 50 ft. Measuring point, top of casing which is 4,241.9 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 28, 1951 | 16.0 | July 10, 1952 | 15.7 | Feb. 11, 1953 | 15.1 |
| Jan. 9, 1952 | 17.4 | 31 | 15.6 | Mar. 2 | 14.9 |
| Feb. 7 | 17.25 | Aug. 27 | 15.5 | Apr. 2 | 14.6 |
| Mar. 6 | 17.1 | Sept. 23 | 15.5 | Nov. 11 | [1] 14.28 |
| Apr. 14 | 16.5 | Nov. 6 | 15.4 | May 5, 1954 | [1] 13.77 |
| May 12 | 16.1 | Dec. 16 | 15.4 | Sept. 28 | 13.6 |
| June 2 | 16.0 | Jan. 7, 1953 | 15.3 | | |

[1] By U. S. Geological Survey.

47/1W-6A1

[U. S. Bureau of Reclamation. About 5.2 miles west of Dorris, located in the northeast corner of section 6, 3 ft south of an east-west fence line along the south side of section-line road. Observation well, diam. 2 in., reported depth 52 ft. Measuring point, top of casing which is 4,244.8 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 28, 1951 | 11.5 | July 10, 1952 | 7.4 | Feb. 11, 1953 | 2.6 |
| Jan. 9, 1952 | 12.4 | 31 | 8.0 | Mar. 2 | 2.9 |
| Feb. 7 | 11.6 | Aug. 26 | 8.4 | Apr. 2 | 3.1 |
| Mar. 6 | 9.4 | Sept. 24 | 8.9 | Nov. 11 | [1] 8.14 |
| Apr. 14 | 5.0 | Nov. 6 | 9.2 | May 5, 1954 | [1] 4.44 |
| May 12 | 5.8 | Dec. 16 | 9.4 | Sept. 28 | 7.15 |
| June 2 | 6.5 | Jan. 7, 1953 | 9.5 | | |

[1] By U. S. Geological Survey.

47/1W-7M1

[U. S. Bureau of Reclamation. About 6.5 miles southwest of Dorris, 10 ft east of section-line fence, 0.20 mile south of half-section-line road. Observation well, diam. 2 in., reported depth 50 ft. Measuring point, top of casing which is 4,242.3 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 28, 1951 | 13.6 | July 10, 1952 | 8.4 | Feb. 11, 1953 | 5.8 |
| Jan. 9, 1952 | 13.9 | 29 | 8.8 | Mar. 2 | 6.0 |
| Feb. 7 | 12.1 | Aug. 26 | 9.1 | Apr. 2 | 6.6 |
| Mar. 7 | 6.7 | Sept. 24 | 9.5 | Nov. 11 | [1] 8.35 |
| Apr. 14 | 5.8 | Nov. 6 | 10.0 | May 5, 1954 | [1] 7.4 |
| May 12 | 7.2 | Dec. 16 | 10.45 | Sept. 28 | 9.2 |
| June 3 | 7.8 | Jan. 6, 1953 | 10.5 | | |

[1] By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

47/1W-9J1

[U. S. Bureau of Reclamation. About 4.2 miles southwest of Dorris, 0.30 mile north and 0.23 mile west of section line, 40 ft east of northeastward-trending road. Observation well, diam. 2 in., reported depth 40 ft. Measuring point, top of casing which is 4,239.9 ft above mean sea level and 1.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 21, 1951 | 18.3 | July 9, 1952 | 16.5 | Feb. 11, 1953 | 16.0 |
| Jan. 9, 1952 | 18.6 | 28 | 16.6 | Mar. 3 | 15.9 |
| Feb. 11 | 17.1 | Aug. 27 | 16.8 | Apr. 3 | 15.8 |
| Mar. 6 | 16.9 | Sept. 23 | 16.9 | Oct. 27 | [1]16.40 |
| Apr. 1 | 15.9 | Nov. 12 | 17.0 | May 5, 1954 | [1]15.55 |
| May 2 | 16.2 | Dec. 16 | 17.0 | Sept. 28 | 15.8 |
| June 3 | 16.4 | Jan. 7, 1953 | 17.0 | | |

[1]By U. S. Geological Survey.

47/1W-14B1

[U. S. Bureau of Reclamation. About 3.4 miles southwest of Dorris, 120 ft west of U. S. Highway 97, 40 ft south of section-line fince, 0.33 mile west of section line. Observation well, diam. 2 in., reported depth 50 ft. Measuring point, top of casing which is 4,234.3 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 26, 1951 | 19.0 | July 10, 1952 | 14.6 | Feb. 9, 1953 | 13.9 |
| Jan. 9, 1952 | 15.5 | 29 | 14.7 | Mar. 3 | 13.9 |
| Feb. 5 | 14.8 | Aug. 26 | 14.8 | Apr. 6 | 14.2 |
| Mar. 7 | 14.35 | Sept. 25 | 14.9 | Oct. 27 | [1]14.80 |
| Apr. 1 | 14.5 | Nov. 12 | 14.8 | May 5, 1954 | [1]14.42 |
| May 7 | 14.5 | Dec. 15 | 15.1 | Sept. 28 | 14.8 |
| June 2 | 14.6 | Jan. 5, 1953 | 15.1 | | |

[1]By U. S. Geological Survey.

47/1W-17R1

[U. S. Bureau of Reclamation. About 5.7 miles southwest of Dorris, located in the southeast corner of section 17, 0.65 mile south of a northeastward-trending road. Observation well, diam. 2 in., reported depth 45 ft. Measuring point, top of casing which is 4,240.3 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 21, 1951 | 18.5 | July 9, 1952 | 17.2 | Feb. 11, 1953 | 16.6 |
| Jan. 9, 1952 | 17.2 | Aug. 27 | 17.2 | Mar. 3 | 16.6 |
| Feb. 6 | 18.5 | Sept. 23 | 17.2 | Apr. 3 | 16.5 |
| Mar. 6 | 18.3 | Nov. 12 | 17.9 | Oct. 27 | [1]16.34 |
| Apr. 14 | 17.5 | Dec. 16 | 17.1 | May 5, 1954 | [1]16.10 |
| May 2 | 17.3 | Jan. 7, 1953 | 17.1 | Sept. 28 | 16.0 |
| June 3 | 17.3 | | | | |

[1]By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|

47/1W-19L1

[U. S. Dept. Agriculture. About 7.2 miles southwest of Dorris, 300 ft west and 75 ft south of half-section-line road, beneath a metal windmill tower. Stock well. Measuring point, top of casing which is 4,238.2 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 30, 1951 | 12.6 | July 10, 1952 | [2]15.3 | Feb. 11, 1953 | 11.7 |
| Jan. 5, 1952 | 13.9 | 31 | 13.4 | Mar. 2 | 11.5 |
| Feb. 6 | 13.8 | Aug. 26 | 11.9 | Apr. 2 | 11.4 |
| Mar. 5 | 13.3 | Sept. 24 | 11.9 | Oct. 27 | [1]11.42 |
| Apr. 1 | 12.5 | Nov. 18 | 12.0 | May 5, 1954 | [2]10.9 |
| May 12 | 12.1 | Dec. 16 | 11.9 | Sept. 28 | 10.8 |
| June 3 | 13.8 | Jan. 6, 1953 | 11.95 | | |

[1]By U. S. Geological Survey.
[2]Pumping.

47/1W-27B1

[U. S. Bureau of Reclamation. About 5.6 miles south of Dorris, 60 ft south of section-line road, 60 ft west of U. S. Highway 97, 30 ft southwest of USC and GS triangulation station (Meiss, 1948). Observation well, diam. 2 in., reported depth 40 ft. Measuring point, top of casing which is 4,233.8 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 26, 1951 | 15.6 | July 10, 1952 | 12.9 | Feb. 9, 1953 | 11.5 |
| Jan. 9, 1952 | 13.5 | 29 | 13.1 | Mar. 3, | 12.0 |
| Feb. 5 | 12.7 | Aug. 26 | 13.3 | Apr. 3 | 12.3 |
| Mar. 7 | 11.4 | Sept. 25 | 13.5 | Oct. 26 | [1]13.62 |
| Apr. 1 | 12.25 | Nov. 12 | 13.6 | May 5, 1954 | [1]12.67 |
| May 7 | 12.55 | Dec. 15 | 13.6 | Sept. 28 | 13.4 |
| 28 | 12.7 | Jan. 6, 1953 | 13.55 | | |

[1]By U. S. Geological Survey.

47/1W-28M1

[U. S. Bureau of Reclamation. About 4 miles north of Macdoel, 0.70 mile south and 50 ft east of section-line road. Observation well, diam. 2 in., reported depth 50 ft. Measuring point, top of casing which is 4,238.2 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 21, 1951 | 16.8 | July 9, 1952 | 16.3 | Feb. 10, 1953 | 16.1 |
| Jan. 9, 1952 | 17.2 | 28 | 16.3 | Mar. 2 | 16.0 |
| Feb. 6 | 17.4 | Aug. 27 | 16.3 | Apr. 2 | 15.9 |
| Mar. 6 | 17.1 | Sept. 23 | 16.4 | Oct. 27 | [1]15.15 |
| Apr. 1 | 16.7 | Nov. 12 | 16.4 | May 5, 1954 | [1]15.60 |
| May 2 | 16.5 | Dec. 15 | 16.4 | Sept. 29 | 16.0 |
| June 3 | 16.5 | Jan. 6, 1953 | 16.4 | | |

[1]By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

47/1W-33Q1

[U. S. Bureau of Reclamation. About 2.9 miles north of Macdoel, 0.40 mile west of section-line road, 100 ft west of U. S. Highway 97. Observation well, diam. 2 in., reported depth 70 ft. Measuring point, top of casing which is 4,239.9 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 21, 1951 | 17.0 | July 10, 1952 | 16.6 | Feb. 9, 1953 | 16.5 |
| Jan. 9, 1952 | 17.6 | 29 | 16.8 | Mar. 3 | 16.5 |
| Feb. 5 | 17.6 | Aug. 26 | 17.0 | Apr. 3 | 16.3 |
| Mar. 7 | 17.4 | Sept. 25 | 17.2 | Oct. 20 | [1]16.85 |
| Apr. 1 | 17.2 | Nov. 12 | 16.7 | May 5, 1954 | [1]16.46 |
| May 7 | 17.0 | Dec. 15 | 16.4 | Sept. 28 | 17.4 |
| 28 | 16.7 | Jan. 7, 1953 | 16.45 | | |

[1]By U. S. Geological Survey.

47/1W-36D1

[U. S. Bureau of Reclamation. About 5 miles northeast of Macdoel, 235 ft south of section-line fence, 20 ft east of section-line fence. Observation well, diam. 2 in., reported depth 40 ft. Measuring point, top of casing which is 4,229.7 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 6, 1951 | 7.6 | June 4, 1952 | 8.1 | Dec. 18, 1952 | 9.5 |
| Jan. 3, 1952 | 8.6 | July 9 | 8.3 | Jan. 7, 1953 | 9.55 |
| Feb. 2 | 7.8 | 31 | 8.4 | Apr. 6 | 8.2 |
| Mar. 3 | 7.8 | Aug. 28 | 8.8 | Nov. 4 | [1]9.32 |
| Apr. 14 | 8.2 | Sept. 25 | 9.2 | May 5, 1954 | [1]7.96 |
| May 1 | 8.15 | Nov. 10 | 9.3 | | |

[1]By U. S. Geological Survey.

47/2W-4G1

[U. S. Bureau of Reclamation. About 9.4 miles west of Dorris, 0.15 mile east and 20 ft north of half-section-line road. Observation well, diam. 2 in., reported depth 50 ft. Measuring point, top of casing which is 4,251.0 ft above mean sea level and 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 8, 1951 | 13.0 | July 10, 1952 | 10.7 | Feb. 12, 1953 | 11.9 |
| Jan. 4, 1952 | 13.5 | 29 | 10.9 | Mar. 2 | 11.1 |
| Feb. 7 | 13.1 | Aug. 26 | 11.1 | Apr. 2 | 10.5 |
| Mar. 6 | 13.7 | Sept. 24 | 11.5 | May 27 | 10.4 |
| Apr. 1 | 11.6 | Nov. 7 | 12.0 | Nov. 11 | [1]11.55 |
| May 12 | 10.8 | Dec. 16 | 12.4 | May 6, 1954 | [1]8.90 |
| June 3 | 10.7 | Jan. 6, 1953 | 12.5 | | |

[1]By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

47/2W-9H1

[J. Fleming. About 9.5 miles west of Dorris, 0.25 mile east and 50 ft north of half-section-line road, beneath a wooden windmill tower. Stock well, diam. 4–5 ft. Measuring point, top of well platform which is 4,248.6 ft above mean sea level and about 0.5 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 3, 1951 | 19.25 | July 29, 1952 | 8.1 | Feb. 12, 1953 | 2.6 |
| Jan. 4, 1952 | 14.9 | Aug. 26 | 8.4 | Mar. 2 | 1.8 |
| Feb. 7 | 12.1 | Sept. 24 | 8.9 | Apr. 2 | 2.1 |
| Mar. 5 | 7.4 | Nov. 7 | 13.2 | Nov. 11 | [1]10.8 |
| May 12 | 0.0 | Dec. 16 | 14.5 | May 6, 1954 | [1]3.8 |
| June 3 | 4.5 | Jan. 6, 1953 | 14.6 | Sept. 28 | 11.7 |
| July 10 | 5.7 | | | | |

[1] By U. S. Geological Survey.

47/2W-13B1

[About 7 miles southwest of Dorris, 0.15 mile south and 0.40 mile west of section line, 100 ft east of road along west side of valley. Unused stock well, diam. 8 in., reported depth 34 ft. Measuring point, top of casing which is 4,253.5 ft above mean sea level and 0.6 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 10, 1951 | 18.1 | July 10, 1952 | 11.1 | Feb. 11, 1953 | 19.0 |
| Jan. 9, 1952 | 17.8 | 29 | 12.1 | Mar. 2 | 9.0 |
| Feb. 7 | 17.5 | Aug. 26 | 12.6 | Apr. 2 | 9.3 |
| Mar. 7 | 14.7 | Sept. 24 | 13.1 | Nov. 11 | [1]14.27 |
| Apr. 1 | 8.9 | Nov. 7 | 13.8 | May 6, 1954 | [1]11.48 |
| May 12 | 9.4 | Dec. 16 | 14.3 | Sept. 28 | 12.8 |
| June 3 | 9.9 | Jan. 6, 1953 | 14.3 | | |

[1] By U. S. Geological Survey.

47/2W-16P1

[Rocco. About 10.4 miles southwest of Dorris, 120 ft north of section-line road, 0.30 mile east of section. Unused well, diam. 3–4 ft, reported depth 10 ft. Measuring point, top of well platform which is 4,238.4 ft above mean sea level and 0.3 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 10, 1951 | 5.7 | July 10, 1952 | 4.0 | Feb. 11, 1953 | 1.0 |
| Jan. 4, 1952 | 2.5 | 29 | 4.6 | Mar. 2 | 1.2 |
| Feb. 7 | 1.0 | Aug. 26 | 5.2 | Apr. 2 | 1.5 |
| Mar. 5 | 1.4 | Sept. 24 | 5.5 | Nov. 11 | [1]5.6 |
| Apr. 1 | 1.0 | Nov. 7 | 5.9 | May 6, 1954 | [1]2.7 |
| May 12 | 2.5 | Dec. 16 | 5.8 | Sept. 28 | 5.2 |
| June 3 | 3.1 | Jan. 6, 1953 | 6.2 | | |

[1] By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| 47/2W-21D1 | | | | | |
| [U. S. Bureau of Reclamation. About 10.6 miles southwest of Dorris, 0.12 mile east of section line, 20 ft south of section-line road, about 1,000 ft east of farm buildings. Observation well, diam. 2 in., reported depth 81 ft. Measuring point, top of casing which is 4,237.3 ft above mean sea level and 0.5 ft above land surface] | | | | | |
| Dec. 3, 1951 | 5.2 | July 10, 1952 | 2.8 | Feb. 11, 1953 | 1.4 |
| Jan. 4, 1952 | 3.9 | 29 | 3.3 | Mar. 2 | 1.6 |
| Feb. 7 | 1.0 | Aug. 26 | 4.0 | Apr. 2 | 1.4 |
| Mar. 6 | 1.8 | Sept. 24 | 4.4 | Nov. 11 | [1]4.90 |
| Apr. 1 | 1.0 | Nov. 6 | 4.8 | May 6, 1954 | [1]1.85 |
| May 12 | 1.15 | Dec. 16 | 4.8 | Sept. 28 | 4.6 |
| June 3 | 1.7 | Jan. 6, 1953 | 4.9 | | |

[1] By U. S. Geological Survey.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| 47/2W-23M1 | | | | | |
| [About 9.2 miles southwest of Dorris, 200 ft east of section-line road, 50 ft south of half-section-line road, beneath an old wooden windmill tower. Unused stock well. Measuring point, top of well curbing which is 4,239.4 ft above mean sea level and at ground level. (Well caved in prior to November 1953)] | | | | | |
| Nov. 28, 1951 | 8.6 | June 3, 1952 | 6.3 | Dec. 16, 1952 | 8.7 |
| Jan. 5, 1952 | 9.5 | July 10 | 6.9 | Jan. 6, 1953 | 8.8 |
| Feb. 6 | 8.3 | 29 | 7.2 | Feb. 11 | 5.4 |
| Mar. 5 | 7.3 | Aug. 26 | 7.7 | Mar. 2 | 5.4 |
| Apr. 1 | 4.8 | Sept. 24 | 8.0 | Apr. 2 | 5.6 |
| May 12 | 5.85 | Nov. 6 | 8.4 | | |
| 47/2W-28N1 | | | | | |
| [U. S. Bureau of Reclamation. About 6.7 miles northwest of Macdoel, 0.24 mile north of section line, 6 ft east of section-line fence. Observation well, diam. 2 in., reported depth 41 ft. Measuring point, top of casing which is 4,238.7 ft above mean sea level and 0.6 ft above land surface] | | | | | |
| Dec. 14, 1951 | 4.8 | June 3, 1952 | 0.5 | Nov. 6, 1952 | 4.0 |
| Jan. 5, 1952 | 3.1 | July 10 | 1.5 | Dec. 17 | 3.7 |
| Feb. 11 | 1.1 | Aug. 26 | 4.4 | Jan. 6, 1953 | 3.4 |
| Mar. 5 | .7 | Sept. 25 | 4.9 | Apr. 3 | .7 |
| Apr. 22 | .3 | | | | |

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

47/2W-29J1

[Voelker. About 7.1 miles northwest of Macdoel, 0.46 mile north and 0.27 mile west of section line, 0.10 mile southeast of ranch buildings. Irrigation well, diam. 12 in., reported depth 150 ft. Measuring point, top of casing which is 4,240.6 ft above mean sea level and at land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 3, 1951 | 3.0 | July 10, 1952 | 1.5 | Jan. 6, 1953 | 2.5 |
| Jan. 5, 1952 | 3.0 | 31 | 2.0 | Feb. 11 | .6 |
| Feb. 7 | 1.5 | Aug. 26 | 2.3 | Mar. 2 | .8 |
| Mar. 5 | 1.2 | Sept. 24 | 2.5 | Apr. 2 | .7 |
| Apr. 1 | .2 | Nov. 6 | 2.2 | Oct. 29 | [1]2.54 |
| May 12 | .4 | Dec. 16 | 2.4 | May 6, 1954 | [1].8 |
| June 3 | .8 | | | | |

[1]By U. S. Geological Survey.

47/2W-32N1

[L. Luzzi. About 7.1 miles northwest of Macdoel, 0.90 mile west of section line, 0.20 mile north of section line, 0.20 mile southwest of ranch buildings. Unused stock well, casing 4 ft square. Measuring point, top of well platform which is 4,297.8 ft above mean sea level and about 3 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 3, 1951 | 12.5 | July 10, 1952 | 7.1 | Jan. 6, 1953 | 13.1 |
| Jan. 5, 1952 | 10.4 | 31 | 8.6 | Feb. 11 | 4.9 |
| Feb. 7 | 9.7 | Aug. 26 | 10.0 | Mar. 2 | 2.8 |
| Mar. 5 | 4.8 | Sept. 24 | 11.2 | Apr. 2 | 2.5 |
| Apr. 1 | 2.7 | Nov. 20 | 12.8 | Oct. 29 | [1]15.53 |
| May 12 | 3.0 | Dec 16 | 13.0 | May 6, 1954 | [1]5.61 |
| June 3 | 5.1 | | | | |

[1]By U. S. Geological Survey.

48/1E-30M1, M2

[J. Liskey. In Dorris, 100 ft east of section line (Butte St.), 0.40 mile north of section line (First St.), on the south side of a small concrete pumphouse. Well 30M1 is an old dug well, about 4 ft in diam., depth unknown and is connected to well 30M2, diam. 6 in., depth 415 ft, by a short conduit. Measuring point, top of concrete platform which is 4,246.1 ft above mean sea level and at land surface. (Water flows from the deep well into the shallow well and water levels measured in 30M1 reflect a composite head between two water bodies)]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 6, 1951 | 46.5 | July 10, 1952 | 50.3 | Jan. 7, 1953 | 47.8 |
| Jan. 10, 1952 | 46.2 | 31 | 50.5 | Feb. 11 | 46.6 |
| Feb. 5 | 46.4 | Aug. 27 | 50.6 | Mar. 4 | 46.3 |
| Mar. 7 | 46.9 | Sept. 24 | 49.0 | Apr. 3 | 46.3 |
| Apr. 3 | 45.7 | Nov. 18 | 47.1 | Nov. 10 | [1]49.22 |
| May 7 | 46.8 | Dec. 18 | 47.0 | May 5, 1954 | [1]48.4 |
| June 2 | 49.3 | | | | |

[1]By U. S. Geological Survey.

Table 11.—*Periodic water-level measurements in wells in Butte Valley, Calif.*—Cont.

48/1E-32N1

[Moore. About 1.2 miles southeast of Dorris, 50 ft east of section-line road, 0.26 mile south of half-section-line road, beneath an old wooden windmill tower. Unused stock and domestic well, diam. 3 ft, depth reported 44 ft. Measuring point, metal ring at top of well curbing which is 4,243.7 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Feb. 4, 1952 | 42.5 | July 9, 1952 | 42.1 | Mar. 5, 1953 | 42.0 |
| Mar. 7 | 41.7 | Nov. 10 | 43.1 | Apr. 6 | 41.9 |
| Apr. 3 | 41.85 | Dec. 18 | 42.9 | Nov. 10 | [1]41.5 |
| May 1 | 41.65 | Jan. 7, 1953 | 42.3 | Sept. 28, 1954 | 41.6 |
| June 4 | 42.1 | Feb. 9 | 42.0 | | |

[1] By U. S. Geological Survey.

48/1W-26Q1

[U. S. Bureau of Reclamation. About 1.6 miles west of Dorris, 0.50 mile east of section-line road, 50 ft north of section-line road, 0.45 mile west of section line. Observation well, diam. 2 in., reported depth 50 ft. Measuring point, top of casing which is 4,243.7 ft above mean sea level and 1 ft above land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Dec. 28, 1951 | 16.0 | July 10, 1952 | 11.4 | Jan. 7, 1953 | 13.3 |
| Jan. 9, 1952 | 16.1 | 31 | 11.5 | Feb. 11 | 9.1 |
| Feb. 11 | 13.0 | Aug. 26 | 12.0 | Mar. 4 | 9.7 |
| Mar. 6 | 13.0 | Sept. 24 | 12.3 | Apr. 3 | 9.7 |
| Apr. 3 | 8.7 | Nov. 18 | 12.9 | Nov. 12 | [1]11.48 |
| May 7 | 9.0 | Dec. 18 | 13.2 | May 5, 1954 | [1]10.05 |
| June 2 | 10.7 | | | | |

[1] By U. S. Geological Survey.

48/1W-28N1

[U. S. Bureau of Reclamation. About 4 miles west of Dorris, 0.17 mile north of section-line road, 175 ft south of an old wooden barn, 5 ft east of a north-south fence paralleling the section-line road. Observation well, diam. 2 in., reported depth 50 ft. Measuring point, top of casing which is 4,244.9 ft above mean sea level and at land surface]

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| Nov. 28, 1951 | 7.1 | July 10, 1952 | 5.2 | Feb. 11, 1953 | 2.5 |
| Jan. 9, 1952 | 7.9 | 29 | 5.8 | Mar. 4 | 2.0 |
| Feb. 11 | 6.3 | Aug. 26 | 6.4 | Apr. 3 | 2.7 |
| Mar. 6 | 5.9 | Sept. 24 | 7.0 | Nov. 12 | [1]5.75 |
| Apr. 14 | 3.1 | Nov. 18 | 7.4 | May 5, 1954 | [1]3.27 |
| May 12 | 3.9 | Dec. 18 | 7.35 | Sept. 28 | 3.7 |
| June 2 | 4.5 | Jan. 7, 1953 | 7.65 | | |

[1] By U. S. Geological Survey.

Table 12.—*Chemical analyses of ground water in*

| Well | Date sampled | Constituents in parts per million | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Silica ($SiO_2$) | Iron (Fe) | Calcium (Ca) | Magnesium (Mg) | Sodium (Na) | Potassium (K) | Bicarbonate ($HCO_3$) | Carbonate ($CO_3$) | Sulfate ($SO_4$) |
| BUTTE VALLEY | | | | | | | | | | |
| 45/2W- 3H1[1] | 10- -52 | ...... | ...... | 20 | 13 | 22 | ...... | 174 | 0 | 1 |
| | 10- 1-53 | 49 | ...... | 17 | 13 | 24 | 5.2 | 166 | 0 | 3.7 |
| 3Q1 | 5-13-53 | 49 | 0.0 | 14 | 11 | 18 | 3.9 | 138 | 0 | 1.6 |
| 46/1E- 8E1 | 5-13-53 | 51 | ...... | 26 | 18 | 17 | 5.5 | 152 | 0 | 11 |
| | 10- 1-53 | 48 | ...... | 27 | 19 | 16 | 5.3 | 142 | 0 | 12 |
| 1W- 1G1[1] | 10- -52 | ...... | ...... | 19 | 13 | 20 | ...... | 165 | 0 | 3 |
| 6P1[1] | 10- -52 | ...... | ...... | 27 | 25 | 16 | ...... | 227 | 0 | 6 |
| 17B1 | 5-13-53 | 34 | .1 | 18 | 14 | 22 | 3.5 | 181 | 0 | 2.6 |
| 18Q2[1] | 10- -52 | ...... | ...... | 27 | 25 | 14 | ...... | 220 | 0 | 15 |
| 19J1 | 5-13-53 | 46 | .0 | 18 | 17 | 11 | 3.8 | 160 | 0 | 10 |
| 20N1 | 5-13-53 | 47 | .2 | 14 | 12 | 10 | 3.7 | 125 | 0 | 5.7 |
| 22K2 | 5-13-53 | 32 | .0 | 18 | 9.2 | 17 | 3.4 | 144 | 0 | 4.6 |
| | 10- 1-53 | 33 | ...... | 18 | 8.7 | 17 | 3.6 | 142 | 0 | 4.7 |
| 32L1[1] | 10- -52 | ...... | ...... | 14 | 8 | 6 | ...... | 84 | 0 | 10 |
| 2W- 9R1 | 10- 1-53 | 31 | ...... | 15 | 8.9 | 8 | 1.9 | 110 | 0 | 3.9 |
| 9R2[1] | ...... | ...... | ...... | 16 | 9 | 8 | ...... | 114 | 0 | 1 |
| 12Q1 | 5-13-53 | 49 | .1 | 32 | 34 | 37 | 8.7 | 344 | 0 | 5.1 |
| 15Q1 | 5-13-53 | 40 | .0 | 14 | 9.6 | 10 | 2.0 | 117 | 0 | 1.6 |
| 25R2 | 5-13-53 | 46 | .2 | 24 | 12 | 10 | 3.8 | 150 | 0 | 12 |
| 47/1E- 29H2[1] | 10- -52 | ...... | ...... | 27 | 9 | 37 | ...... | 179 | 0 | 5 |
| 1W- 23A1 | 7-16-54 | 43 | ...... | 13 | 27 | 365 | 42 | 674 | 0 | 199 |
| 23G1 | 7-16-54 | 52 | ...... | 33 | 39 | 602 | 39 | 1,310 | 10 | 379 |
| 35Q1 | 7-16-54 | 40 | ...... | 21 | 17 | 34 | 7.7 | 228 | 0 | 4.3 |
| 2W- 16P1[1] | ...... | 22 | .0 | 25 | 14 | 34 | 7.6 | 182 | 0 | 41 |
| | 10- 1-53 | 33 | ...... | 30 | 19 | 37 | 8.6 | 238 | 0 | 37 |
| 20G1[1] | 10-17-52 | ...... | ...... | 20 | 16 | 20 | ...... | 156 | 4 | 2 |
| 48/1E- 30N1 | 10- 1-53 | 38 | ...... | 12 | 14 | 23 | 7.3 | 158 | 0 | 10 |
| | 5-13-53 | 41 | .0 | 16 | 20 | 24 | 7.7 | 188 | 0 | 15 |
| 31R1[1] | 10- -52 | ...... | ...... | 16 | 27 | 84 | ...... | 312 | Trace | 18 |
| 1W- 28J1[1] | 10- -52 | ...... | ...... | 36 | 21 | 26 | ...... | 224 | 0 | 6 |
| RED ROCK VALLEY | | | | | | | | | | |
| 45/1E- 11C1[1] | 10- -52 | ...... | ...... | 10 | 8 | 12 | ...... | 87 | 0 | 2 |
| 46/1E- 31P1[1] | 10- -52 | ...... | ...... | 10 | 8 | 20 | ...... | 91 | 0 | 1 |
| | 5-13-53 | 39 | 0.0 | 9.2 | 7.5 | 12 | 2.1 | 96 | 0 | 1.5 |
| OKLAHOMA DISTRICT | | | | | | | | | | |
| 46/2E- 7E1 | 7-16-54 | 41 | ...... | 7.4 | 6.0 | 11 | 2.5 | 74 | 0 | 2.1 |
| 22Q1 | 7-16-54 | 37 | ...... | 9.4 | 4.5 | 11 | 2.3 | 70 | 0 | 2.1 |
| 47/1E- 1M1[1] | 12- -52 | ...... | ...... | 10 | 7 | 27 | ...... | 111 | 0 | 14 |
| | 7-16-54 | 33 | ...... | 7.8 | 5.7 | 14 | 2.4 | 78 | 0 | 3.8 |
| 10B1[1] | 12- -52 | ...... | ...... | 9 | 8 | 52 | ...... | 177 | 0 | 13 |
| | 7-16-54 | 45 | ...... | 8.9 | 6.0 | 37 | 9.5 | 146 | 2 | 4.1 |
| 23H1[1] | 12- -52 | ...... | ...... | 11 | 8 | 16 | ...... | 103 | 0 | 4 |
| | 7-16-54 | 40 | ...... | 7.8 | 6.2 | 13 | 2.3 | 85 | 1 | 1.0 |

[1] U. S. Bureau of Reclamation, Sacramento.
[2] Dissolved solids by evaporation.

*the Butte Valley region, Siskiyou County, Calif.*

| Constituents in parts per million—Continued | | | | | | | Per cent sodium | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|
| Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Boron (B) | Dissolved solids: Residue on evaporation | Dissolved solids: Sum of determined constituents | Hardness as calcium carbonate ($CaCO_3$) | | | |
| BUTTE VALLEY—Continued | | | | | | | | | |
| ......... | ...... | ...... | <0.1 | (2) | 230 | 103 | 31 | 278 | 7.4 |
| 1.8 | 0.1 | 8.3 | .05 | ............... | 204 | 96 | 34 | 277 | 7.2 |
| 1.2 | .1 | 4.9 | .02 | ............... | 172 | 80 | 31 | 227 | 7.2 |
| 15 | .0 | 24 | .03 | ............... | 242 | 139 | 20 | ............. | ..... |
| 17 | .0 | 44 | .00 | ............... | 258 | 145 | 19 | 377 | 7.5 |
| 5 | ...... | ...... | .1 | (2) | 225 | 101 | 30 | 272 | 8.1 |
| 7 | ...... | ...... | <.1 | (2) | 308 | 170 | 17 | 362 | 8.0 |
| 2.0 | .1 | .5 | .05 | ............... | 186 | 102 | 31 | 281 | 7.6 |
| 5 | ...... | ...... | 0 | (2) | 306 | 170 | 15 | 370 | 8.1 |
| 2.5 | .2 | .7 | .01 | ............... | 188 | 115 | 17 | 268 | 7.5 |
| .8 | .2 | 1.2 | .05 | ............... | 156 | 84 | 20 | 209 | 7.3 |
| 3.5 | .1 | .2 | .04 | ............... | 159 | 83 | 30 | 233 | 7.7 |
| 2.0 | .2 | .5 | .00 | ............... | 158 | 81 | 30 | 233 | 7.8 |
| 1 | ...... | ...... | .1 | (2) | 123 | 68 | 16 | 159 | 7.8 |
| .5 | .0 | .1 | .04 | ............... | 124 | 74 | 19 | 176 | 7.7 |
| Trace | ...... | ...... | 0 | (2) | 148 | 77 | 18 | 176 | 8.3 |
| 7.0 | .2 | 13 | .06 | ............... | 356 | 220 | 26 | 549 | 7.5 |
| .2 | .0 | .1 | .03 | ............... | 135 | 74 | 22 | 178 | 7.6 |
| .8 | .2 | .5 | .02 | ............... | 183 | 109 | 16 | 256 | 7.4 |
| 14 | ...... | ...... | .2 | (2) | 271 | 104 | 43 | 337 | 8.1 |
| 174 | .6 | .5 | .91 | ............... | 1,200 | 144 | 80 | 1,940 | 8.0 |
| 83 | .4 | 3.1 | 1.1 | ............... | 1,890 | 243 | 82 | 2,640 | 8.3 |
| 7.0 | .2 | 5.0 | .11 | ............... | 248 | 122 | 36 | 351 | 8.1 |
| .8 | .1 | 3.2 | .20 | (2) | 237 | 120 | 36 | 374 | 8.0 |
| 1.5 | .2 | 1.9 | .12 | ............... | 285 | 153 | 33 | 446 | 7.7 |
| 12 | ...... | ...... | ........ | (2) | 230 | 116 | 26 | 301 | 8.3 |
| 2.5 | .3 | 1.4 | .05 | ............... | 186 | 88 | 34 | 277 | 8.0 |
| 8.5 | .3 | 7.3 | .06 | ............... | 232 | 122 | 28 | 345 | 7.5 |
| 53 | ...... | ...... | ........ | (2) | 510 | 151 | 55 | 615 | 8.2 |
| 27 | ...... | ...... | ........ | (2) | 340 | 176 | 24 | 403 | 7.9 |
| RED ROCK VALLEY—Continued | | | | | | | | | |
| 17 | ...... | ...... | ........ | (2) | 136 | 58 | 32 | 150 | 7.9 |
| 11 | ...... | ...... | ........ | (2) | 141 | 58 | 44 | 152 | 7.1 |
| 3.2 | 0.1 | 0.2 | 0.03 | ............... | 122 | 54 | 32 | 153 | 7.4 |
| OKLAHOMA DISTRICT—Continued | | | | | | | | | |
| 6.0 | 0.2 | 0.4 | 0.13 | ............... | 113 | 43 | 34 | 134 | 8.0 |
| 8.0 | .2 | .1 | .15 | ............... | 109 | 42 | 35 | 138 | 8.0 |
| 5 | ...... | ...... | 0 | (2) | 174 | 54 | 53 | 223 | 7.9 |
| 6.5 | .2 | .3 | .23 | ............... | 112 | 43 | 40 | 151 | 8.1 |
| 8 | ...... | ...... | Trace | (2) | 267 | 55 | 68 | 318 | 8.3 |
| 9.0 | .4 | .3 | .05 | ............... | 194 | 47 | 58 | 348 | 8.3 |
| 2 | ...... | ...... | Trace | (2) | 144 | 60 | 37 | 176 | 7.6 |
| 4.0 | .2 | .4 | .11 | ............... | 118 | 45 | 37 | 139 | 8.3 |

Table 13.—*Chemical analyses of surface water in*

| Location | Source | Date sampled | Silica ($SiO_2$) | Calcium (Ca) | Magnesium (Mg) | Sodium (Na) | Potassium (K) | Bicarbonate ($HCO_3$) | Carbonate ($CO_3$) | Sulfate ($SO_4$) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Constituents in parts per million | | | | | | | |
| 43/1W-12[1] | Antelope Creek near Tennant, Calif. | 10- -52 | ...... | 7 | 2 | 4 | ...... | 43 | 0 | 2 |
| 24N | Antelope Creek at U.S.G.S. gaging station about 0.4 mile southwest of Tennant. | 2-26-53 | 28 | 6.0 | 1.5 | 3.6 | 0.9 | 34 | 0 | 1.8 |
| | ................. | 9-25-53 | 30 | 6.1 | 2.1 | 3.0 | .8 | 38 | 0 | 1.6 |
| 45/1W-17[1] | Butte Creek..... | 10-17-52 | ...... | 7 | 3 | 4 | ...... | 57 | 0 | ...... |
| 29G | Butte Creek, about 7.2 miles south of Macdoel. | 2-26-53 | 29 | 6.4 | 2.3 | 4.1 | 1.3 | 42 | 0 | 1.6 |
| | ................. | 9-25-53 | 27 | 6.9 | 3.6 | 4.1 | 1.4 | 49 | 0 | 1.6 |
| 45/2W-8[1] | Prather Creek.. | 10-17-52 | ...... | 14 | 9 | 5 | ...... | 95 | 0 | 1 |
| 8C | Prather Creek, about 2.5 miles west of U. S. Highway 97, 100 feet south of section-line road (Prather Lane). | 10- 1-53 | 31 | 14 | 7.0 | 5.8 | 1.7 | 92 | 0 | .6 |
| | MEISS LAKE | | | | | | | | | |
| 46/2W-2E | ................. | 5- 5-54 | 36 | 18 | 12 | 232 | 14 | 696 | 0 | 8.1 |
| | ................. | 6- 9-54 | 29 | 17 | 12 | 148 | 11 | 476 | 0 | 6.8 |
| | ................. | 7-13-54 | 31 | 16 | 12 | 268 | 18 | 740 | 20 | 8.5 |
| | ................. | 8- 5-54 | 26 | 18 | 12 | 336 | 22 | 841 | 56 | 12 |
| | ................. | 9-21-54 | 24 | 16 | 18 | 432 | 30 | 1,050 | 110 | 14 |
| 11 | ................. | 9-21-54 | 19 | 16 | 19 | 430 | 28 | 1,080 | 63 | 18 |
| 11E[1] | ................. | 10- 7-52 | ...... | 16 | 11 | 360 | ...... | 895 | 41 | 9 |
| 47/3W-25[1] | Shovel Creek.... | ............ | ...... | 11 | 6 | 4 | ...... | 76 | 0 | 1 |
| 48/1E-17Q | Indian Tom Lake. | 8-13-54 | 9.6 | 8 | 7.8 | 891 | 163 | 1,090 | 362 | 173 |

[1] Analysis by U. S. Bureau of Reclamation, Sacramento.
[2] Dissolved solids by evaporation.

*the Butte Valley region, Siskiyou County, Calif.*

| Constituents in parts per million—Continued | | | | | | | Per cent sodium | Specific conductance (micromhos at 25°C) | pH |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Dissolved solids | | | | | |
| Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Boron (B) | Residue on evaporation | Sum of determined constituents | Hardness as calcium carbonate ($CaCO_3$) | | | |
| 4 | ...... | ...... | ........ | (2) | 62 | ............ | 22 | 64 | 7.6 |
| 0.8 | 0.1 | 0.2 | 0.02 | ............... | 60 | 21 | 26 | 55 | 7.1 |
| 1.0 | <.1 | .2 | .03 | ............... | 64 | 24 | 21 | 61 | 7.1 |
| 1 | ...... | ...... | .1 | (2) | 72 | ............ | 20 | 78 | 8.0 |
| .5 | .1 | .4 | .03 | ............... | 66 | 25 | 25 | 65 | 7.2 |
| 1.0 | .2 | .3 | .01 | ............... | 70 | 32 | 21 | 78 | 7.1 |
| 1 | ...... | ...... | 0 | (2) | 125 | ............ | 13 | 143 | 8.2 |
| .8 | .0 | .1 | .00 | ............... | 106 | 64 | 16 | 144 | 7.7 |
| MEISS LAKE—Continued | | | | | | | | | |
| 28 | 0.5 | 1.3 | 0.0 | ............... | 693 | 94 | 82 | 1,100 | 8.1 |
| 14 | .2 | .8 | .11 | ............... | 473 | 92 | 75 | 747 | 7.9 |
| 31 | .6 | 1.0 | .12 | ............... | 770 | 90 | 84 | 1,220 | 8.6 |
| 33 | .2 | .6 | .29 | ............... | 930 | 94 | 86 | 1,440 | 8.9 |
| 48 | 1.4 | 4.0 | .11 | ............... | 1,210 | 112 | 86 | 1,920 | 9.0 |
| 45 | 1.0 | 3.4 | .09 | ............... | 1,180 | 118 | 86 | 1,830 | 8.7 |
| 52 | ...... | ...... | Trace | (2) | 1,384 | ............ | 91 | 1,540 | 9.0 |
| ........ | ...... | ...... | 0 | (2) | 98 | ............ | 13 | 118 | 8.1 |
| 388 | 1.6 | 1.5 | 3.4 | ............... | 2,540 | 52 | 88 | 4,110 | 9.5 |

# INDEX

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(Continued on next card)

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