Geology and Ground-Water Features of Scott Valley Siskiyou County, California

By SEYMOUR MACK

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By Seymour Mack

ABSTRACT

The Scott Valley area is in the Klamath Mountains in the northwestern part of California, about 28 miles south of the Oregon border. The area has a north-south length of about 25 miles and extends in an east-west direction for about 10 miles at its widest part. The average seasonal precipitation from July 1 to June 30 is 21.7 inches and the average annual temperature is 50.3° F. The area has a population of about 3,000. The industries are agriculture, cattle raising, and lumbering. About 60 percent of the farm income is derived from livestock. Hay, largely alfalfa, is the chief agricultural crop and is dependent upon surface-water irrigation for successful production.

The drainage basin of the Scott River comprises about 819 square miles. The East Fork and the South Fork of the Scott River merge at Callahan to form the Scott River. From Callahan the Scott River flows to the northwest about 60 miles where it joins the Klamath River 2 miles above Hamburg.

The bedrock in the area, dating from pre-Silurian to Late Jurassic and possible Early Cretaceous time, consists of consolidated rocks whose fractures yield water to springs at the valley margins and in the surrounding upland areas. The oldest rocks are the Salmon hornblende schist and Abrams mica schist, a sequence of completely recrystallized sedimentary and volcanic rocks of pre-Silurian age. Overlying these rocks with profound unconformity along the eastern part of Scott Valley are beds of the Chanchelulla(?) formation of Hinds (1931) consisting of more than 5,000 feet of sandstone, chert, slate, and limestone of probable Silurian age. Along the northern part of the area, the Salmon and Abrams schists are unconformably overlain by andesitic and basaltic volcanic rocks altered to greenstone and greenstone schist, which may be correlative with either the Copley greenstone of Devonian(?) age or the Applegate group of Triassic (?) age. Beginning in Late Jurassic and perhaps continuing into Early Cretaceous time, the Klamath Mountains were the scene of profound orogeny. The rocks were strongly folded and faulted and were invaded by a series of magmas which solidified into rocks ranging in composition from peridotite, now largely altered to serpentine, to granodiorite. The granodiorite is the youngest of all the consolidated rocks in the area.

The valley alluvial fill consists of a few isolated patches of older alluvium (Pleistocene) found along the valley margins and of younger alluvium which includes stream-channel, flood-plain, and alluvial-fan deposits of Recent age. The Recent deposits underlie and form the alluvial plains of Scott and Quartz Valleys, the valley of Oro Fino Creek and the fans at the valley margins, and extend in tongues up the valleys of tributary streams. Thickness of the Recent alluvial deposits reaches a maximum of more than 400 feet in the wide central part of the valley between Etna and Greenview.

The most permeable alluvium underlies the flood plain of the Scott River. The major irrigation wells in the area, which yield from 1,200 to 2,500 gallons

per minute (gpm), are on the Scott River flood plain between Etna and Fort Jones. The average specific yield of the flood-plain sediments is estimated at 15 percent. The alluvial deposits along the west side of the valley comprise the fans deposited by the major western tributary streams and the deposits forming the gently sloping zones of ground-water discharge near the base of the fans. Hydrologic data indicate that these deposits are of much lower permeability than the flood-plain deposits with which they merge to the east. Specific yield of the alluvium underlying the fans and discharge zones is estimated to range from 5 to 7 percent.

Most of the wells in the area are shallow dug wells, averaging about 25 feet in depth and about 4 feet in diameter. The depth to water below land surface ranges from zero in the discharge areas to as much as 35 feet in the upland areas of the western mountain alluvial fans. The seasonal fluctuation of water levels in the wells probably averages about 4 feet.

Recharge to the ground-water body is effected by infiltration of rainfall, by influent seepage from tributary streams, particularly those issuing from the western mountains, and by seepage of surface water used for irrigation. Recharge from precipitation in 1953 was estimated at about 20,000 acre-feet, and recharge from surface-irrigation water at about 17,000 acre-feet.

Ground water is discharged mainly by seepage into the Scott River, and by evapotranspiration. It is estimated that about 30,000 acre-feet of water is lost to the atmosphere by evapotranspiration in the discharge zones near the base of the alluvial fans built out from the western mountains. The total pumpage in 1953 was nearly 2,100 acre-feet, but net artificial discharge from the ground-water reservoir was probably no more than 1,500 acre-feet. About 1,000 acre-feet of the total pumpage was used for irrigation.

The ground-water storage capacity of sediments lying between 10 and 100 feet below the land surface beneath the entire area is estimated to be 400,000 acre-feet. Storage capacity in the flood-plain sediments is about 220,000 acre-feet.

Surface water and ground water are of low mineral content and are generally of excellent quality for most uses. A close correlation exists between the composition of the bedrock and the quality of samples of water taken from different parts of Scott Valley.

INTRODUCTION

PURPOSE AND SCOPE OF INVESTIGATION

In the spring of 1953, in connection with the special investigation of the water resources of the Klamath River basin in California, the U. S. Geological Survey was requested by the office of the State Engineer, as part of the cooperative program with the State of California, to initiate a series of ground-water investigations in the upper Klamath River basin in California. As a part of this program, a study of the geology and ground-water resources in Scott Valley was begun June 1, 1953.

The purposes of this investigation were: to map the extent and thickness of water-bearing deposits and to differentiate the geologic units in the bedrock surrounding Scott Valley; to learn the geologic factors that are related to and that control the occurrence of ground water; to determine the chemical character of the ground water and its relation to occurrence, movement, and use; and to estimate, insofar as practicable, the ground-water storage capacity of the Scott Valley area.

This investigation was made under the immediate supervision of A. R. Leonard, U. S. Geological Survey, Sacramento, Calif.

LOCATION OF AREA

The area covered by this report consists of Scott Valley and its tributary valleys: Quartz Valley and the valley of Oro Fino Creek. To residents of the area, the terms "Scott Valley" and "Scott Valley area," imply all three valleys, and will be so used in the following pages. The valleys are in the south-central part of Siskiyou County, Calif., about 28 miles south of the Oregon border, in one of the most primitive and scenic parts of the Klamath Mountains (fig. 1). Throughout the area, the bedrock consists of metasedimentary and metavolcanic rocks of Paleozoic age, into which has been intruded an assemblage of igneous rocks of Late Jurassic and possibly Early Cretaceous age. The line separating the predominantly volcanic rocks of the southern Cascades from the Klamath Mountains lies over the mountains 15 miles to the east, where locally it is marked by the western boundary of Shasta Valley.

The area has a north-south length of about 25 miles and extends in an east-west direction for about 10 miles at its widest part. It lies between 122°45′ and 123° W. longitude and 41°15′ and 41°40′ N. latitude, and is included within the Etna and Yreka 30-minute quadrangles of the U. S. Geological Survey.

PREVIOUS AND CURRENT INVESTIGATIONS

With but few exceptions, geologic investigations in the Klamath Mountains have been of a reconnaissance nature; only the broader aspects of the lithology, structure, and stratigraphy are known. Diller (1902) traced the topographic development of the Klamath Mountains, and in 1906 in the Redding quadrangle made the first detailed geologic study of a part of the southern Klamath Mountains. O. H. Hershey (1901) made an important contribution to the geology of the region, describing many stratigraphic units in Trinity and Siskiyou Counties.

In later years Averill (1931) and Maxson (1933) discussed the economic geology of the area. Averill's report was accompanied by a geologic map of the Shasta quadrangle, drawn by the geological department of the Southern Pacific railroad. Hinds (1932, 1933) discussed the stratigraphy in the southern Klamath Mountains, much of which is especially pertinent to the Scott Valley area.

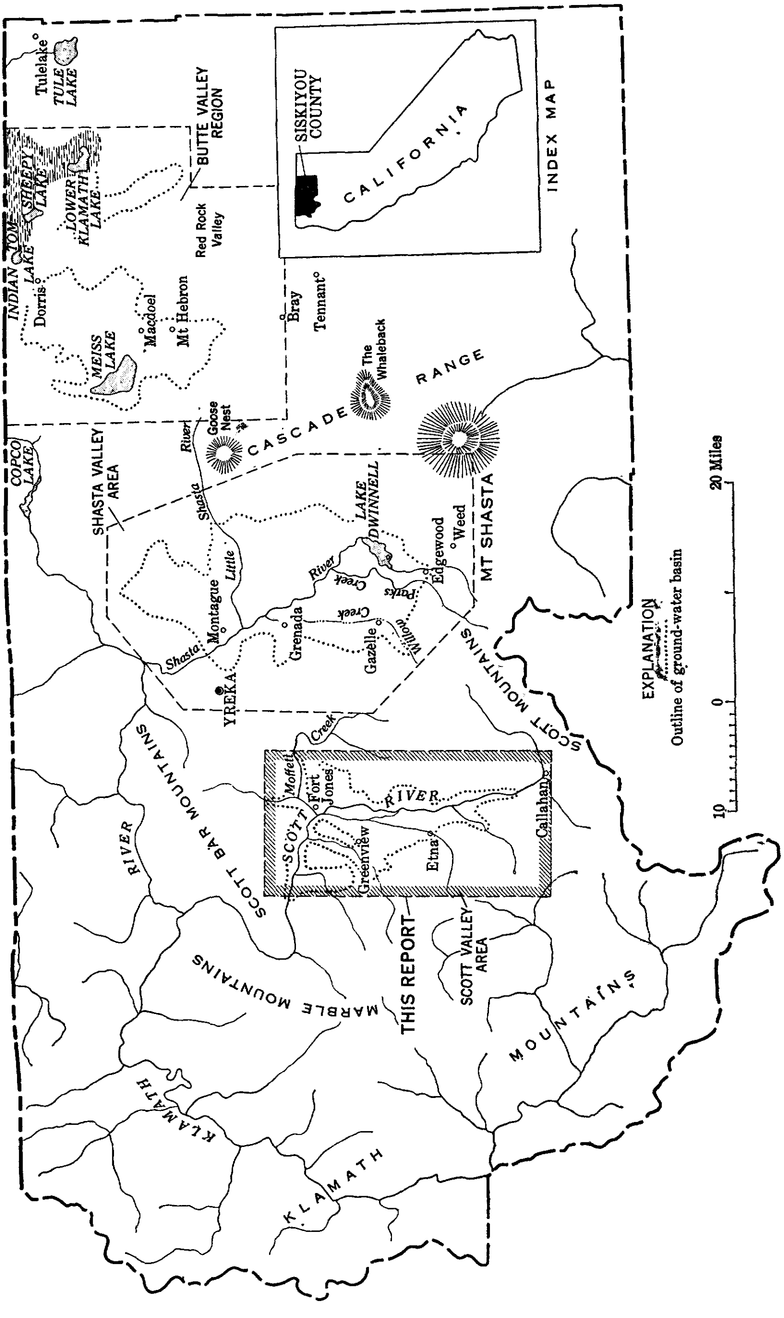


FIGURE 1.—Map of Siskiyou County, Calif., showing location of Scott Valley.

O'Brien (1947) described the mines and mineral resources of Siskiyou County, and Westman (1947) discussed the occurrence of a Silurian fauna near Scott Valley. Wells (1939) and Wells, Hotz, and Cater (1949) described the geology of the Klamath Mountains in southern Oregon, and Wells and Cater (1950) described the chromite deposits of Siskiyou County.

Geologic investigations are currently (1956) in progress in the area between Scott Valley and Shasta Valley and a report on the early Paleozoic stratigraphy of the area by F. G. Wells and C. W. Merriam is now in preparation. It is understood that conclusions expressed in the above report, concerning correlation of the slightly metamorphosed sedimentary rocks along the east side of Scott Valley, may deviate substantially from conclusions of earlier geologic reports on the Scott Valley area and from those of the present report.

METHODS OF INVESTIGATION

During the summer and autumn of 1953, the writer spent 5 months in the field canvassing wells, mapping the geology, and studying ground-water conditions in the Scott Valley area. From July 13 to October 26 a series of weekly water-level measurements were made in 22 selected wells. Measurements were made in 83 wells during the middle of October. All measurements were made from a fixed measuring point at the top of each well with a steel tape graduated to hundredths of a foot. The elevation of land surface at most wells was determined by an altimeter survey. Elevations at 19 wells were obtained by a spirit-level survey made by the California Department of Water Resources (formerly California Division of Water Resources). The character and thickness of the water-bearing materials and yields of wells were obtained from drillers' logs and from well owners in the area.

Geologic units were mapped in the field on aerial photographs, scale about 1:47,000, and later transferred at scale 1:62,500 to the base map which had been enlarged from parts of the U. S. Geological Survey Etna and Yreka quadrangles at scale 1:125,000. Wells were located on the base map with an odometer by measuring distances from section corners, section lines, and roads.

WELL-NUMBERING SYSTEM

The well-numbering system used by the Geological Survey in California shows the location of wells and springs according to the rectangular system for the subdivision of public land. In well 43/9–24F1, the part of the number preceding the hyphen indicates the township and range (T. 43 N., R. 9 W); the digits between the hyphen and

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

the letter indicate the section (sec. 24), and the letter indicates the 40-acre subdivision of the section as shown in the accompanying diagram.

Within each 40-acre tract the wells and springs are numbered serially, as indicated by the final digit of the number. Thus, well 43/9–24F2 is the second well to be listed in the SE¼NW¼ sec. 24. Inasmuch as all of the area in Scott Valley is north and west of the Mount Diablo base line and meridian, letters designating cardinal directions can be omitted and the foregoing abbreviations of the township and range is sufficient.

Incomplete numbers which lack the final digit, such as 40/8–7Q or 44/10–28D, indicate locations of wells, springs, sampling points, or rock outcrops described in the text which are adjacent to the 40-acre tract indicated by the letter.

ACKNOWLEDGMENTS

Appreciation is expressed to the many persons and agencies who cooperated and assisted in the collection of field data. The California Department of Water Resources inventoried and measured water levels in wells in the Scott Valley area in the springs of 1953 and 1954, and also collected surface-water and ground-water samples in the spring and autumn of 1953 for analysis by the U. S. Geological Survey at Sacramento. Special thanks are due R. B. Bond of the California Department of Water Resources, who cooperated in supplying hydrologic data required by the writer during this study. Kenneth Croeni, of the Siskiyou County Soil Conservation District at Etna, kindly furnished information on the soils and agricultural practices in the area, and Ernest Smith, secretary of the Scott Valley Irrigation District, made available information on surface-water irrigation facilities.

The writer is grateful to Carl McConnell, William Matthews, Carl Black, and other residents of Scott Valley who cooperated in furnishing valuable information concerning their wells. The writer acknowledges the advice and criticism of his colleagues in the Geological Survey, especially the critical review of the text by A. R. Leonard.

GEOGRAPHY

TOPOGRAPHY AND DRAINAGE

The Scott River basin is nearly rectangular in shape, containing about 819 square miles in an area 40 miles long in a north-south direction, and 21 miles wide in an east-west direction; it is comprised of two physiographic types: mountains and flat valley lands.

In a setting of rugged wilderness and towering mountains, Scott Valley, which is 22 miles long, is narrow at its southern upstream section and widens downstream where it is joined by many armlike tributaries. The valley is ringed by an impressive series of mountain chains. Five miles southeast of the valley, the crest of the Scott Mountains marks the boundary between Siskiyou and Trinity Counties. To the west and south are the Salmon Mountains, and to the north and northwest are the Scott Bar and Marble Mountains.

Scott Valley ranges in altitude from 2,700 to 3,000 feet. From the edge of the valley, the mountains rise abruptly 8,000 to 8,500 feet. The headwaters of the East Fork of the Scott River rise on China Mountain, about 6.5 miles northeast of Callahan; the source of the South Fork of the Scott River lies in the mountain lakes about 4.5 miles southwest of Callahan. These two forks merge at Callahan to form the Scott River. From Callahan, the Scott River flows northwestward about 60 miles where it joins the Klamath River 2 miles above Hamburg.

The Scott River flows north-northwestward from Callahan to Etna through its valley which is only 200 feet wide at Callahan but which gradually expands until it is more than a mile wide in the vicinity of Etna. Throughout the lower part of this reach of the river, immense piles of gravel 20 to 25 feet high are testimony to recent gold-dredging operations in the area. From Etna to Fort Jones, the Scott River flows along the east side of the valley and in a more northerly direction. From Etna north, Scott Valley opens out toward the northwest, and immediately south of Greenview reaches greatest width, about 5 miles.

North of Greenview, the northeastward-trending Chapparal Hill marks the western boundary of the valley which narrows steadily until it is less than a mile wide at Fort Jones. There the Scott River turns sharply to the west around the northern margin of Chapparal Hill and flows for about 9 miles before it finally leaves the valley.

Chapparal and Quartz Hills rise out of the alluvium to altitudes of 1,400 feet above the valley floor. These massive bedrock hills delineate the boundaries of Oro Fino Creek valley and Quartz Valley. Oro Fino Creek flows northeastward in a valley half a mile in average width between Chapparal Hill on the east and Quartz Hill on the west and joins the Scott River 3 miles west of Fort Jones. Quartz Valley averages 2 miles in width and lies between the western mountain front and Quartz Hill to the east. Several streams flowing from the western mountains drain Quartz Valley. The source of Shackleford Creek, the major stream in this system, is the Campbell Lakes, high in the western mountains about 8 miles southwest of Quartz Valley.

Except for the East Fork of the Scott River, and Moffett Creek, which drains the mountains northeast of Scott Valley and often has yearlong flow to the valley, the streams along the east side of the valley are ephemeral, flowing only during the winter and spring months after prolonged periods of precipitation. Many tributary streams flow into the area from the north and west. Most of these streams have yearlong flow in their upper reaches, but in the dry summer months, much of the water sinks into the coarse, permeable gravel of the upland areas, and the streams do not normally maintain flow to the valley floor after the beginning of July.

The western mountains rise more abruptly from the valley than the mountains to the east. The debris dropped by streams disgorging from the mountains to the west has been built up into a series of distinct, steeply sloping coalescing alluvial fans. The western piedmont slope thus developed is in marked contrast to the more subdued topography characteristic of the valley floor at the foot of the eastern mountains. The major streams flowing into Scott Valley from the west are Shackelford, French, Etna, Kidder, and Patterson Creeks. Another stream named Patterson Creek flows into the valley from the north. In this report, the two Patterson Creeks henceforth will be distinguished as West Patterson and North Patterson Creeks.

In the wide central part of the valley between Etna and Fort Jones, a meandering stream, which receives drainage from the western mountain streams, occupies a north-south trending lowland area between the western mountain alluvial fans and the Scott River. The stream flows parallel to the Scott River for about 6 miles, joining it near the northeast corner of Chapparal Hill. During flood stages, the Scott River has apparently built up broad, low natural levees sloping gently away from the channel banks toward the valley margins. The natural levee along its west side prevents the western tributary streams from entering the Scott River via the shortest distance, directly to the east. The phenomenon of a deferred tributary junction has thus resulted, because the combined drainage of the western streams has been forced to flow northward parallel to the Scott River for several miles within the confines of the slough between the area of higher fans to the west and the natural levee to the east.

The mountains west of Scott Valley are covered with mixed-conifer forest. Ponderosa pine is the main species at altitudes between 3,000 and 5,000 feet. Associated species include Douglas fir, incense cedar, sugar pine, and white fir. Above 5,000 feet red fir and western white pine are also found. Scattered throughout this heavily timbered area are grassy meadows and small patches of brush. In contrast, the eastern mountains are covered by extensive areas of brush and western juniper. Subordinate patches of conifers, chiefly ponderosa pine, are found in the cooler and more moist sites. Extensive areas of woodland grass also occur in this zone.

The contrast in vegetative cover on the mountains to the east and west of Scott Valley is due mainly to the greater amount of precipitation which falls on the western mountains. Differences in the underlying bedrock are another factor, for invariably the brush-covered areas in the eastern mountains are underlain by serpentine.

DISCHARGE OF SCOTT RIVER

Since December 1941 the Geological Survey has maintained a recording gage on the Scott River at the valley outlet about 10 miles downstream from Fort Jones and 150 feet south of the road from Fort Jones to Scott Bar. The average annual runoff for 1942–43 to 1953–54 was about 450,000 acre-feet. Figure 2 shows the yearly runoff reported by the Geological Survey plotted with the precipitation recorded by the Fort Jones ranger station. The plotted discharge figures are for the water year October 1 to September 30; the precipitation figures are for the climatological year July 1 to June 30. In general, the two graphs show a close correlation. However, in 1945–46, a year with only 0.24 inch more precipitation than the preceding year, the discharge was about 165,000 acre-feet higher; in 1947–48 the precipitation was 0.24 inch above that for 1945–46, yet surface runoff decreased by about 108,000 acre-feet. These apparent anomalies result from the erratic nature of the precipitation. During the winter months the area is susceptible to heavy storms with much precipitation falling within a short time.

If the rate of rainfall exceeds the infiltration rate of the soil, large amounts of water which might otherwise be absorbed into the ground run off rapidly. Therefore even with an annual decrease in total precipitation the storm-frequency pattern of rainfall could give rise to an abnormally high stream runoff.

CLIMATE

Although seasons are sharply defined, the climate of Scott Valley is not severe. Winter temperatures below 0°F are rare and summer temperatures seldom exceed 100°F. U. S. Weather Bureau records of precipitation and temperature data from the Fort Jones ranger station are summarized in tables 1, 2, and 3. July, the hottest month, has a mean temperature of 69.4°F, and January, the coldest month, has a mean temperature of 32.4°F. The average annual temperature is about 50.3°F. The growing season (last killing frost in the spring to first killing frost in the fall) averages about 130 days.

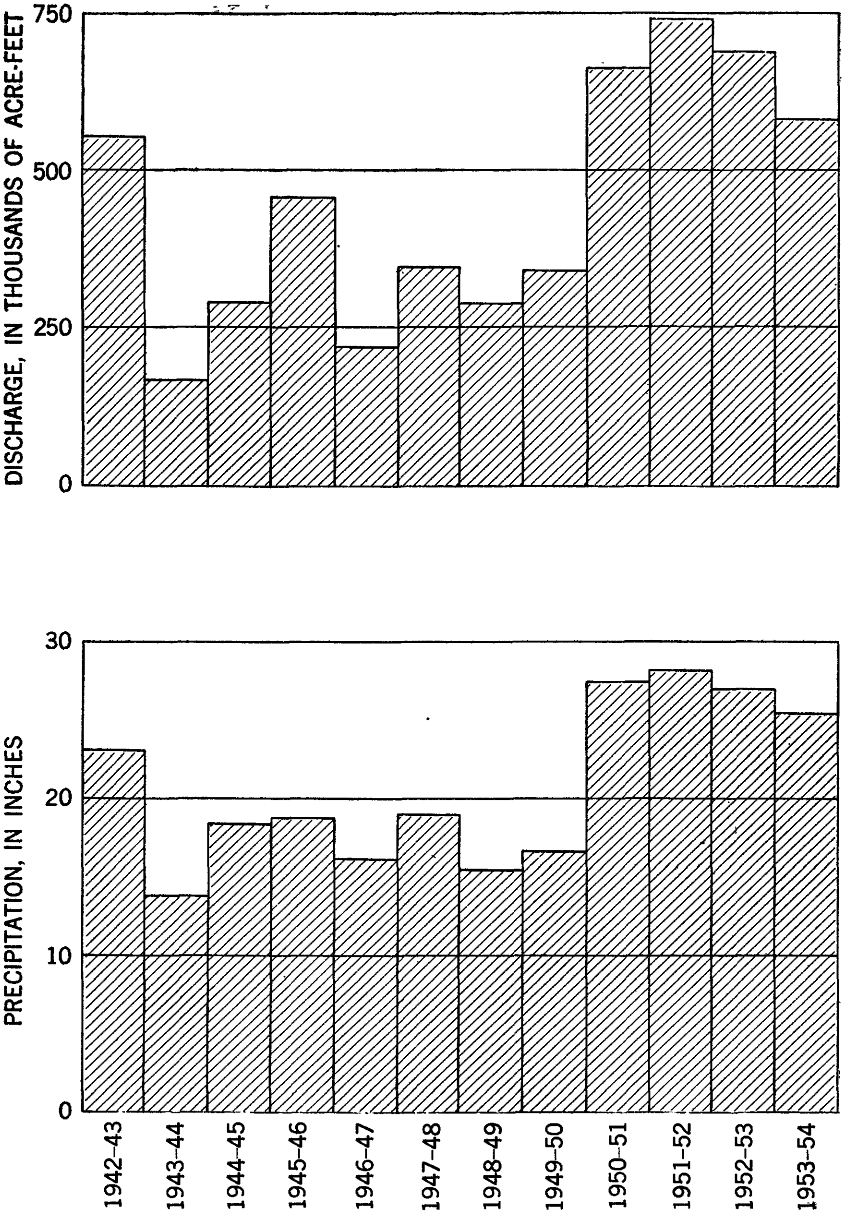


FIGURE 2.—Annual discharge of Scott River and seasonal precipitation at Fort Jones.

The average seasonal precipitation (July 1 to June 30) at Fort Jones for 1937–38 to 1953–54 was 21.70 inches; 40 percent of the total fell during the autumn months, 40 percent during the winter months, 15 percent during the spring months, and 5 percent during the summer months. These results agree closely with old precipitation records obtained from a gage that was located on Rattlesnake Creek at the north end of Scott Valley (Wells, 1881, p. 43). The average annual precipitation for 1859 to 1880 at this location was 21.91 inches.

TABLE 1.—*Seasonal precipitation (July 1 to June 30) at Fort Jones, Calif.*

[From publications of the U. S. Weather Bureau]

Season	Precipitation (inches)	Season	Precipitation (inches)
1937–38	29.65	1947–48	19.02
1938–39	13.48	1948–49	15.55
1939–40	26.37	1949–50	16.79
1940–41	25.98	1950–51	27.43
1941–42	23.96	1951–52	28.13
1942–43	23.04	1952–53	27.03
1943–44	13.73	1953–54	25.35
1944–45	18.54		
1945–46	18.78	Average	21.70
1946–47	16.17		

TABLE 2.—*Average monthly precipitation at Fort Jones, Calif., from 1937–38 to 1953–54*

[From publications of the U. S. Weather Bureau]

Month	Average precipitation (inches)	Month	Average precipitation (inches)
January	4.09	August	.30
February	2.63	September	.38
March	2.18	October	1.69
April	1.08	November	2.94
May	1.24	December	4.10
June	.70		
July	.37	Average yearly total	21.70

TABLE 3.—*Average temperatures at Fort Jones, Calif. (length of record: 12 years)*

[From publications of the U. S. Weather Bureau]

Month	Average daily temperature (° F.)	Month	Average daily temperature (° F.)
January	32.4	August	67.4
February	38.2	September	62.1
March	42.2	October	51.3
April	48.9	November	41.4
May	54.7	December	35.3
June	60.8		
July	69.4	Annual	50.3

In the mountains south and west of Scott Valley, the annual precipitation is as much as 35 to 40 inches and occurs largely during the winter months, mostly in the form of snow. At these altitudes, the snow accumulates to a depth of 6 feet. During most years in the spring and summer months melt water from the snow pack constitutes an abundant source of water for the western and southern tributary streams flowing into Scott Valley.

Summer rainfall usually comes during convectional storms which occur at intervals of 2 to 3 weeks between the months of June and October. Sometimes a summer storm may produce a cloudburst which covers a relatively small area in the valley and results in localized flood conditions. Spring chinook winds, which rapidly melt the accumulated snow in the mountains, cause more widespread flooding, such as that of the spring of 1948. In the past excessive rainfall has been the cause of the most disastrous floods in the valley. The following is quoted from H. L. Wells' account of the flood of 1861 (1881, p. 41):

> * * * The month of November 1861 was a very rainy one, and the last two weeks witnessed a steady and constant rain that filled the creeks and rivers to their fullest capacity * * * Shasta and Scott Rivers overflowed their banks and flooded large tracts of land * * * Scott Valley was one vast sea upon whose bosom floated the debris from a hundred farms * * * At Fort Jones the river carried away everything in its path, including buildings, while at Etna the sawmill went down the stream and the water-wheel of the flour mill was also borne away.

ROAD NETWORK

There are four active communities within Scott Valley: Fort Jones, Etna, Greenview, and Callahan. Good State and county roads connect these communities with each other and with other points outside the valley (pl. 1). Within the valley, the main transportation network consists of three northward-trending roads along the east, west, and central parts of the valley. State Highway 82, a hard-surface medium-duty road, intersects Highway 99 in Shasta Valley 2 miles south of Yreka, and extends southwestward over the mountains into Fort Jones at the northeast corner of Scott Valley. State Highway 82 then extends southward along the west side of the valley, connecting the communities of Fort Jones, Greenview, and Etna. At Etna an improved county round crosses the Scott River and turns south along the east side of the valley into Callahan. A loose-surface graded road 28 miles long connects the south end of the valley at Callahan with Gazelle on Highway 99, 18 miles south of Yreka. The Scott Bar road extends westward from Fort Jones along the north side of the valley.

POPULATION

According to the 1950 census, Etna and Fort Jones had a combined population of 1,172. The combined population of Greenview and Callahan is probably not greater than 250. The population outside of these communities is estimated at 1,500 persons, making a total population of about 3,000 in Scott Valley. Etna and Fort Jones are the trading centers of the valley, although much buying is done at nearby Yreka, the county seat of Siskiyou County.

AGRICULTURE AND INDUSTRY

The industries of the Scott Valley area are agriculture, cattle raising, and lumbering. About 60 percent of the farm income is derived from the production of livestock, principally beef cattle, hogs, and sheep. Hay, largely alfalfa, is the chief agricultural crop and is dependent upon irrigation for successful production. A large part of the hay is shipped from the valley; some of it as far south as Los Angeles. Much stock feed is produced on wet pasturelands within the valley. Wheat, barley, and grain-hay are produced on subirrigated and dry-farmed areas. In the past, hay and grain have been the principal cash crops but seed production is increasing in importance.

The sawmill industry is a substantial source of income to Scott Valley. Four mills cut 40,000 or more board feet per day, and there are perhaps 9 other mills cutting 5,000 or more board feet per day.

MINERAL RESOURCES

The principal mineral resources of the Scott Valley area are gold and chromite. During field investigation for this report neither of these minerals was being mined.

Gold.—Mining of gold in Scott Valley and vicinity virtually ceased with the advent of World War II. Prior to that time, gold was recovered from quartz veins (generally in greenstone) and by dredging operations along the Scott River and its tributary streams. Gold mining has been slow to recover since the end of the war, owing to the high cost of labor. Dredging operations have been the only source of gold production since that time. A bucketline dredge was operated on the Scott River a few miles north of Callahan, and a dragline dredge on Indian Creek. By 1949, both these operations had ceased.

Chromite.—Chromite mining was resumed on the Scott Valley area in 1939, after 18 years, but operations ceased during the latter years of World War II. Production came from small lenses of high-grade ore found in the peridotite, serpentine, and dunite which crop out over a large part of the area.

Other minerals.—Low-grade deposits of manganese and copper occur in the area but have never been mined profitably. A small amount of platinum has been recovered north of Callahan as a by-product of gold-dredging operations.

RECREATION

Fishing for steelhead trout attracts many people to Scott Valley in the late summer and fall. Some of the mountain lakes are stocked with fish and offer recreation to those willing to make the pack trip into the wilderness area of the high country. The Marble Mountains, covering 238,000 acres, one of the most scenic parts of California, have been preserved as a wilderness area in their natural state. Opportunity for hiking is afforded by trails out of Scott Valley, and many improved camping facilities are available beside streams or in the woods.

GEOLOGY

SUMMARY OF STRATIGRAPHY

The formations in the Scott Valley area may be divided into two units, the bedrock and the valley alluvial fill. The bedrock comprises the consolidated rocks, of pre-Silurian to Jurassic and possibly Early Cretaceous age, whose fractures yield water to springs located at the margins of the valley and in the surrounding upland areas. It includes in upward succession the Abrams and Salmon schists of pre-Silurian age; the Chanchelulla(?) formation of Hinds (1931) of Silurian age; the greenstones, correlative with either the Copley greenstone of Devonian(?) age or the Applegate group of Triassic(?) age; and ultrabasic intrusive rocks of Jurassic age and granitic intrusive rocks of Jurassic or Early Cretaceous age. Although some wells have bottomed in bedrock, no wells in the Scott Valley area are known to derive water from any of the above rocks. Consequently, for the purpose of this report, the units comprising the bedrock are considered to be non-water-bearing. The discussion in the following pages concerning their nature and extent is of importance to the study of ground-water conditions in the Scott Valley area, inasmuch as the lithologic structure of the bedrock has influenced the course of the Scott River, has been a controlling factor in the deposition of several types of alluvium, and has determined the chemical quality of surface water and ground water in parts of the area.

The alluvial fill in the valley consists of unconsolidated Pleistocene and Recent deposits. No wells are known to obtain water from the older alluvium (Pleistocene) and these deposits probably do not constitute an important aquifer because of their limited extent and position generally above the water table. Younger alluvium (Recent), which comprises the alluvial-fan deposits and the stream-channel and flood-plain deposits of the Scott River and its larger tributaries, yields appreciable quantities of water from permeable beds or zones and is the only unit tapped by wells in the area.

TABLE 4.—*Stratigraphic units in the Scott Valley area*

Age	Formation or unit	Thickness (feet)	Character
			Alluvial fill
Recent	Younger alluvium	0–400±	Stream-channel, flood-plain, and alluvial-fan deposits, which constitute the only important water-bearing materials in the Scott Valley area. The most highly permeable deposits, consisting of alternating lenses of clay and gravel, are located beneath the Scott River flood plain between Etna and Greenview. Yield abundant water to wells.
Pleistocene	Older alluvium	0–100±	Older alluvial-fan and terrace deposits along valley margins. Generally consist of poorly sorted boulders in a matrix of sand and silty clay. Not tapped by wells. Do not constitute an important aquifer because of limited extent and position generally above the water table.
			Consolidated rocks (non-water-bearing)
Early Cretaceous or Late Jurassic	Granodiorite		Mostly granodiorite, although every gradation exists between granite and quartz diorite. Intrusive into all other rocks of the bedrock. Strongly jointed. Yields water from fractures to springs which feed the western mountain tributary streams.
Late Jurassic	Serpentine		Generally concordant intrusive masses of peridotite almost completely altered to minerals of the serpentine group. Strongly sheared and fractured. Yield water to mountain springs. Surface and ground water draining over serpentine-rich rocks have high magnesium content and are generally hard.
Devonian(?)	Greenstone		Andesitic volcanic rocks altered to greenstone and greenstone schist. Sedimentary interbeds of chert, argillite, and limestone. Strongly jointed and yield water to springs. Surface water and ground water draining over greenstone are moderately hard.
Silurian	Chanchelulla(?) formation of Hinds (1931)	5,000±	Beds of chert, quartzite, slate, phyllite, chlorite-sericite schist, and limestone. Yield water to springs from joints. Water draining over limestone ridge south of McConnahue Gulch is hard.
Pre-Silurian	Salmon hornblende schist and Abrams mica schist		Salmon hornblende schist is composed of hornblende schist and gneiss and represents a period during which several thousand feet of basic lava and volcanic ejectamenta were erupted over the eroded surface of the underlying Abrams. Metasedimentary interbeds of white marble are present in the Salmon. Abrams mica schist is of sedimentary origin and composed mainly of quartz-mica schist. Beds of graphite schist, actinolite schist, and blue marble also present. Both formations yield water from fractures to springs.

DESCRIPTION OF FORMATIONS

PRE-SILURIAN ROCKS

ABRAMS MICA SCHIST AND SALMON HORNBLENDE SCHIST

The most ancient rocks found in the southern Klamath Mountains are the Abrams mica schist and the Salmon hornblende schist. The Abrams is a thick series of metasedimentary rocks, dominantly quartz-mica schist, which is overlain uncomformably by the metavolcanic Salmon hornblende schist. Hinds (1932, p. 385) introduced the term "Siskiyou terrane" to include the Abrams and Salmon schists. He reasoned that, though of different ages, they form a distinct stratigraphic group in the Klamath-Siskiyou region, because they are much more highly metamorphosed than any of the younger rocks so far known in the region, and moreover their degree of recrystallization is similar.

The Abrams and Salmon schists were first named by Hershey (1901, p. 227) as a result of his early investigations in Trinity and Siskiyou Counties. As described by Hershey, the Abrams mica schist in the upper Coffee Creek region of Trinity County is composed of thin folia of muscovite of dull colors, such as gray, light brown, yellow, and pink, separated by irregular layers of white quartz representing the original laminae. Interbedded with the schist are thin folia of hard blue crystalline limestone. Thin beds of graphite schist and actinolite schist were observed in what Hershey believed to be a gradational zone between the Abrams and Salmon schists.

In the area north of Etna bedrock of the mountains bounding Scott Valley on the east and west consists largely of rocks of the so-called Siskiyou terrane. The Abrams mica schist crops out in the mountains east of Scott Valley, in Chapparal Hill, and in the small hillocks jutting through the valley alluvium. Extensive areas of the mountains to the west are underlain by the Salmon hornblende schist although the Abrams generally forms the bedrock in the western mountain front directly in contact with the alluvial fill of Scott Valley. The Salmon crops out adjacent to the alluvium along the northwestern part of Quartz Valley and extends northward to Scott Valley, where it forms the steep walls of the narrow canyon through which the Scott River flows as it leaves Scott Valley.

Throughout most of Scott Valley, the Abrams consists of rocks similar in lithology to those described by Hershey from the Coffee Creek region of Trinity County. The most abundant types are micaceous quartzite and quartz-mica schist; muscovite is the dominant mica. Thin beds of highly fissile biotite schist occur locally along the west side of the valley north of Etna. Beds of graphite schist, grass-green actinolite schist, and blue finely crystalline marble also are present. The actinolite schist underlies large areas of the hills immediately south of Etna. Marble makes up much of the Abrams along the east side of the valley between Shell and Hurds Gulches, and is a dominant part of the bedrock in the small hills which rise out of the alluvium northeast of Etna in sec. 15 and 21, T. 42 N., R. 9 W.

The Abrams represents several thousand feet of beds of argillaceous and arenaceous sediments, carbonaceous shale, and limestone which have undergone considerable metamorphism. Despite the intense metamorphism which has resulted in complete recrystallization of the sediments, the schistosity follows closely the original bedding of the sediments.

North of Fort Jones, along the east side of McAdam Creek and to the north of Moffett Creek, highly resistant podlike masses of a tough nonschistose blue-gray rock form ledges within the Abrams. The most important minerals in the rock are pale blue amphibole (probably glaucophane), clinozoisite, and quartz. This rock may have originated through hydrothermal alteration of the Abrams. Several other lenses of this type rock occur in the Scott Valley area and are always associated with the Abrams.

At first Hershey (1901, p. 228) believed the Salmon hornblende schist was of sedimentary origin, although in a later report (1902, p. 277) he stated that the Salmon probably had been deposited as a fine water-laid volcanic ash. The Salmon exceeds 3,000 feet in thickness and extends for more than 200 miles from the southern Klamath Mountains northward into the Siskiyou ranges of Oregon. Hinds (1932, p. 389) stated that its remarkable uniformity of texture and mineralogical composition undeniably suggests igneous origin. Although hornblende schist may conceivably be derived from certain sedimentary deposists, the process should have resulted in more diverse metamorphic equivalents than those found in the Salmon. He believed that, during Salmon time, vast quantities of lava and volcanic ejectamenta which were erupted upon an Abrams landscape eroded to low relief, and formed a great lava plateau which once covered vast areas in Northern California and adjacent parts of Oregon.

The Salmon rocks, which form but a small part of the so-called Siskiyou terrane within the area of investigation, consist predominantly of hornblende schist and hornblende-plagioclase gneiss. The lithologic similarity and the degree of recrystallization of the Salmon and Abrams schists suggest that metamorphism of both formations was simultaneous. In the upper reaches of Etna Creek, near the contact with the granodiorite, the hornblende schist of the Salmon contains interbeds of coarse white to pink crystalline marble that parallel the foliation of the schist. These interbeds suggest halts in volcanism, temporary but sufficient to allow the accumulation of sedimentary deposits.

West and northwest of Scott Valley along the Scott Bar road, extensive beds of white marble are interbedded with the hornblende schist. Granodiorite and pegmatite stringers in this area intrude the hornblende schist lit-par-lit forming an extremely coarse textured hornblende gneiss. Along Shackleford Creek the typical hornblende schist is composed mostly of dark-green hornblende and quartz with smaller amounts of feldspar and scattered grains of magnetite. Along Moffett Creek immediately northeast of Fort Jones a few thin beds of hornblende schist are included with apparent conformity within the Abrams; they may represent falls of volcanic ash erupted during Abrams time or possibly basic sills and dikes injected into the Abrams during intensive Salmon volcanism.

The exact stratigraphic position of the rocks comprising the so-called Siskiyou terrane is not known. The Abrams and Salmon schists are the oldest formations in the Scott Valley area, and have been so reported by Hinds (1932, p. 385) in the Redding-Weaverville area of the southern Klamath Mountains, and by Hershey (1901, p. 244) from his explorations in Trinity and Siskiyou Counties. What appears to be an older sequence of rocks is found in the Medford quadrangle, Oregon, about 28 miles north of Scott Valley. In that area, Wells (1939) mapped schist which he divided into two groups: (1) a section of older highly foliated rocks which consist mainly of quartz-epidote-chlorite schist, and (2) a section of younger rocks which resemble lithologically, and may be equivalent in age to, the so-called Siskiyou terrane. If this theory is correct the schist described by Wells is the oldest rock known in the Klamath Mountains. Both of Wells' units could be Precambrian, but it seems likely that the younger, less foliated rocks may be lower Paleozoic.

In the northern and western parts of the Scott Valley area the Abrams and Salmon schists are overlain unconformably by several thousand feet of greenstone and greenstone schist possibly correlative with the Devonian(?) Copley greenstone of the southern Klamath Mountains. In the southern part of the mountains surrounding Scott Valley the Chanchelulla(?) formation of Hinds (1931), a series of moderately metamorphosed sedimentary rocks probably of Silurian age, lies unconformably on the Abrams and Salmon schists. Thus, present evidence indicates only that the Abrams and Salmon schists can be adjudged with certainty to be of pre-Silurian age. Any assignment of these rocks to the Precambrian or lower Paleozoic would be extremely tenuous.

A, SHEARED ARGILLACEOUS BEDS IN CHANCHELULLA(?) FORMATION OF HINDS

B, GRAYWACKE OF CHANCHELULLA(?) FORMATION INTRUDED BY A NEARLY VERTICAL DIORITE DIKE

A, STRONGLY JOINTED GREENSTONE ON SOUTH FLANK OF QUARTZ HILL

B, GRAVELLY CHANNEL DEPOSITS ON KIDDER CREEK FAN SOUTH OF GREENVIEW

A, SHEARED, RUBBLY SERPENTINE ALONG MOFFETT CREEK

B, STRONGLY JOINTED SERPENTINE ALONG EAST SIDE OF VALLEY SOUTH OF HARTSTRAND GULCH

SILURIAN SYSTEM

CHANCHELULLA(?) FORMATION OF HINDS (1931, 1935)

The Abrams and Salmon schists are uncomformably overlain by slightly metamorphosed, strongly folded sedimentary rocks which exceed 5,000 feet in thickness and which largely compose the bedrock in the mountains throughout the southern part of Scott Valley. The rocks are composed of generally eastward-dipping alternating beds of chert, sandstone, shale, slate, chlorite-sericite schist, and limestone which represent sediments of substantially the same type as those from which the Abrams mica schist was formed, although they do not show the same intensity of recrystallization shown by the more ancient Abrams except in localized zones of extreme shearing.

Hershey (1901, p. 230), named these rocks the "Lower Slate series" during his early reconnaissance work in Trinity and Siskiyou Counties. He described them as occurring in the Scott Valley region between Fort Jones and Callahan and extending eastward to Shasta Valley near Gazelle. In the Red Bluff, Weaverville, and Big Bar quadrangles of the southern Klamath Mountains, a thick section of moderately metamorphosed beds of chert, quartzite, schist, and marble overlies the Abrams and Salmon schists with distinct erosional unconformity, and in turn are overlain unconformably by the Devonian(?) Copley greenstone. Hinds (1931, p. 292) named these rocks the Chanchelulla formation from exposures on the slope of the mountain of that name in the northwest corner of the Red Bluff quadrangle. The stratigraphic position, lithology, and degree of recrystallization in Hinds' Chanchelulla(?) beds suggests that they may be the equivalent of the thick section of sedimentary rocks in the Scott Valley region.

As Hershey indicated, the above-mentioned sedimentary sequence in the Scott Valley area, tentatively correlated with the Chanchelulla(?) formation of Hinds (1931) forms much of the bedrock in the mountains between Callahan, at the south end of the valley, and Shasta Valley. Fossils examined from many isolated limestone outcrops 14 miles southwest of Shasta Valley, between Gazelle and Callahan in Plowman's Valley, were considered Silurian by Westman (1947, p. 1263). He noted also that brachiopod and trilobite fauna collected by C. W. Marriam from a locality 3½ miles southwest of Gazelle were doubtless Silurian; thus, the Chanchelulla(?) formation of Hinds (1931) in the Scott Valley area is probably Silurian in age.

East of Scott Valley, near Gazelle, the Chanchelulla(?) consists of gray and red shale, green and black chert, gray siltstone, graywacke, sandstone, conglomerate, and limestone (Heyl and Walker, 1949, p. 517). Lateral gradation from one type to another is not uncommon.

The limestone in that area is present as discontinuous lenses in the shale and sandstone and higher in the section as a fairly continuous unit averaging 200 feet in thickness which Heyl and Walker (1949, p. 517) designated "the main limestone." At some localities near the base of this main limestone there is a medium- to coarse-grained intraformational conglomerate containing angular fragments of bluish-gray limestone cemented with grayish-white calcium carbonate.

In Scott Valley, Hinds' Chanchelulla(?) formation has been slightly metamorphosed, as is evidenced by recrystallization of the more argillaceous layers (pl. 4). By contrast, the sandy beds have been only slightly affected. Quartz grains in the sandstone are jagged, and invariably have been rotated slightly so that the longer dimensions are parallel or nearly parallel to the bedding, but rarely do they show the mosaic texture characteristic of complete recrystallization. The original shaly beds have been converted in many cases to slate, phyllite, and sericite-mica schist. Thin quartzose beds separated by fine schistose layers, composed almost entirely of chlorite and sericite, are common along shear zones.

Along Shell Gulch near the contact with the Abrams mica schist, the base of the Chanchelulla(?) is composed of thin-bedded blue chert, micaceous sandstone, and a thick zone of banded blue and gray chert. Thin lenses of fine-grained even-textured blue limestone, which weathers to a light-gray color, are included within these beds. South of McConnahue Gulch and higher in the stratigraphic section, there is a resistant and fairly continuous layer of blue limestone several hundred feet thick which contains abundant narrow veinlets of white calcite cementing prominent joint sets and is probably correlative with the main limestone in the Gazelle area. The limestone forms prominent castlelike ledges which cap the mountains overlooking the east side of the valley. From Scott Valley eastward to Shasta Valley limestone-capped mountains and ridges are conspicuous physiographic features which indicate the presence of the Chanchelulla(?) formation of Hinds (1931).

DEVONIAN(?) ROCKS

GREENSTONE

A thick section of volcanic rocks crops out continuously along the north side of Scott Valley from McAdam Creek westward to the vicinity of Meander Creek. These rocks are altered to greenstone and greenstone schist and contain a few sedimentary interbeds of chert, argillite, and limestone. The volcanic rocks also underlie Quartz Hill and the small hills in Quartz Valley, and compose the bedrock along a 4-mile stretch of the western mountain front between Evans Creek and the area midway between West Patterson and Crystal Creeks.

The greenstone is pale grayish green to dark green, ranges in texture from coarse grained to fine grained, and represents a period of volcanic activity when several thousand feet of flows, flow breccia, and tuffaceous beds were deposited. The flows apparently consisted mainly of pyroxene andesite and less commonly of basalt. Recrystallization has not everywhere destroyed the textural and mineralogical characteristics of the original volcanics. Vesicular or amygdaloidal structure is common. Many of the rocks are porphyritic, containing phenocrysts of plagioclase feldspar and pyroxene set in an aphanitic groundmass. The pyroxene generally has been altered to uralite. The rocks have been heavily chloritized and contain abundant zoisite and epidote.

The greenstone can be traced for about 25 miles to the northeast from Scott Valley into the western part of Shasta Valley where it underlies much of the rugged hills known locally as the Paradise Crags. Highway 99, as it follows the deeply incised gorges of the Shasta and Klamath Rivers, cuts the greenstone. Williams (1949, p. 15) describes the greenstone in the Shasta Valley area as a massive strongly jointed pale-green rock, thoroughly chloritized and containing much calcite, epidote, and prehnite accompanied by albitized feldspar. An interesting aspect of the greenstone in that area is the absence of both vesicular structures and sedimentary interbeds in the towering and extensive exposures along Highway 99. Westward from the highway along the Klamath River, however, vesicles are a common feature of the greenstone.

In the Scott Valley area the metavolcanic rocks contain lens-shaped beds of chert, argillite, and limestone. It was impracticable to map these separately because of their limited extent. The beds of chert and argillite are generally dark blue to black, weathering to lighter shades of gray and brown, and are especially common along the north side of Scott Valley and in the hills rising out of the alluvium in Quartz Valley.

The sedimentary interbeds nowhere display the complete recrystallization shown by the Salmon and Abrams schists, and undoubtedly the greenstone is much younger than these rocks. Wherever observed near the contact with the Abrams and Salmon schists, the chert and argillite of the greenstone unit dip to the east under the older schist as part of a fold system sharply overturned to the west. The greenstone is everywhere strongly jointed and sheared (pl. 5) and cut by many dikes. One set of shear fractures, which trends eastward, has been notable for the prolific gold-bearing quartz veins which it contains.

Either of two possible formations in the Klamath Mountains may be correlative with the greenstone of the Scott Valley area. In the southern Klamath Mountains a thickness of about 1,500 feet of greenstone was named the Copley metaandesite by Diller (1906, p. 6–7) from the exceedingly good exposures along the canyon of the Sacramento River near Copley station on the Southern Pacific railroad. In the Redding-Weaverville area, the Copley lies unconformably between the overlying Kennett formation, which contains Middle Devonian fauna, and Hinds' underlying Chanchelulla(?) formation (Hinds, 1932, p. 398).

To the north and northwest of the Scott Valley area in the Medford, Grants Pass, and Kerby quadrangles, Oregon, a thick series of altered volcanic rocks containing lens-shaped interbeds of argillite, chert, quartzite, conglomerate, and marble may be correlative with the greenstone in Scott Valley. That assemblage of rocks was named the Applegate group after the drainage basin of the Applegate River in Oregon where the group is the prevailing country rock (Wells and others, 1949, p. 3). Wells reports that Reeside examined fossils from this formation and considered them to be Mesozoic, probably Late Triassic in age (1949, p. 4).

Because of the spotty coverage and reconnaissance nature of the geologic mapping in the Klamath Mountains, and because the greenstone was not found in contact with Hinds' Chanchelulla(?) rocks along the southern part of the valley, it is not possible at this time to determine which of the above formations, if either, is the equivalent of the greenstone in Scott Valley. If the greenstone is equivalent to either the Copley or the Applegate in age it undoubtedly represents the youngest preintrusive bedrock in the area.

UPPER JURASSIC AND LOWER CRETACEOUS(?) INTRUSIVE ROCKS

During the Late Jurassic and perhaps extending into the Early Cretaceous the Klamath Mountains were the scene of profound orogeny (Diller, 1906, p. 10). The bedrock was strongly folded and invaded by a series of magmas which solidified into rocks ranging in composition from granite to peridotite. The intrusive rocks occupy large areas underlying the mountains on the east and west sides of Scott Valley. Igneous intrusion progressed, as has been noted elsewhere, from a sequence of rock types representing an earlier mafic to those of a later more strongly felsic nature. Two rock types of this magmatic sequence are recognized in the area under investigation: earlier peridotite now largely serpentinized, and granodiorite. By analogy with rocks of the Sierra Nevada, the serpentine is presumed to have been emplaced during the latter part of the Jurassic period and the granodiorite during Late Jurassic or Early Cretaceous time.

The relative ages of the serpentine and the granodiorite at several localities in the Scott Valley area can be established. Along the upper reaches of Shackleford Creek, in the area west of Quartz Valley, stringers of pegmatite, probably related to the period of felsic intrusion, have cut through an extensive outcrop of serpentine, and along the east side of Scott Valley at locality 42/9–26K serpentine is intruded by a quartz latite porphyry dike probably also related to the intrusion of the granodiorite.

SERPENTINE

The rocks in the Scott Valley area mapped as serpentine are peridotite masses which have been almost completely altered to minerals of the serpentine group. The original peridotite from which the serpentine has been derived is designated by varietal names, such as dunite and pyroxenite. Dunite contains more than 95 percent olivine and little or no pyroxene, whereas pyroxenite contains more than 95 percent pyroxene. Varieties of pyroxenite are further distinguished as saxonite, wehrlite, or lherzolite, depending on whether the pyroxene is enstatite, diallage, or both. Chromite is an accessory mineral in the serpentine. It ranges in amount from a few disseminated grains to masses large enough to be mined commercially.

The serpentine (pl. 6) is dark greenish gray to nearly black and weathers to lighter shades of gray and green. As a rule the serpentine is strongly sheared and is cut by innumerable highly polished slip surfaces. It is an extremely incompetent rock and fractures easily into irregular blocks having waxy, slickensided surfaces. Areas underlain by serpentine are distinctive, invaribaly supporting characteristic sparse growths of brush on poorly developed brownish- or brick-red soils.

The serpentine generally occurs as elongate tabular sheets several miles long, crudely conformable to the enclosing rocks. Smaller bodies range in size from "blisters" several feet in diameter to large irregular masses a mile or more in extent which do not exhibit any apparent localization by structural control. The largest body of serpentine extends from Yreka 15 miles south-southwest into the northeastern part of Scott Valley as far south as Hamlin Gulch (Wells and Cater, 1950, p. 110) and dips steeply to the southeast in apparent conformity with the host rock, the Abrams mica schist. From Hamlin Gulch southward into the vicinity of Callahan, smaller, disconnected masses of serpentine are crudely parallel to, and are probably apophyses from, the main sill-like body. Intrusion evidently was not guided preferentially by lithologic structure, because in the area south of Etna the Chanchelulla (?) of Hinds (1931) is the host rock for the serpentine.

The funnellike shape of most of the tributary valleys along the east side of Scott Valley results from the presence of the highly sheared, readily eroded serpentine bedrock. Apophyses from the large serpentine sill previously described cross Hamlin, Hurds, Sharps, Shell, and Hartstrand Gulches. All these gulches widen in the area underlain by serpentine. By contrast, McConnahue Gulch, which is underlain by sandstone of the Chanchelulla(?) formation of Hinds (1931) shows no such widening effect.

The geologic map (pl. 1) suggests that the east side of the Scott Valley flood plain from Hamlin Gulch southward to the vicinity of Etna may be underlain largely by serpentine bedrock. As discussed more fully in a later section on the physiographic development of Scott Valley, this condition has undoubtedly been important in determining the course of the ancestral Scott River along this reach.

GRANODIORITE

A large body of granodioritic rock, intrusive into the Abrams and Salmon schists and the greenstone, is exposed for about 8 miles in a north-south direction along the western flank of Scott Valley. Between Patterson and Crystal Creeks the intrusive body is directly in contact with the valley alluvium. From Crystal Creek south to the vicinity of Etna, the granodioritic body intrudes the Abrams mica schist and the intrusive contact lies about half a mile west of the valley alluvium. South of Etna the granodioritic body intrudes the Salmon hornblende schist, and the contact trends first westward and then southeastward. At the crossing of Etna Creek the intrusive contact lies several miles west of the mountain front.

Though the intrusive body is largely granodioritic in composition, every gradation between granite and quartz diorite occurs. In appearance the granodiorite generally is a light-gray medium- to coarse-grained massive rock. Biotite is the dominant ferromagnesium mineral and constitutes 15 to 20 percent of the total mineral content. Hornblende occurs locally but only in minor amounts. Feldspar, dominantly sodic plagioclase, constitutes about 60 percent and quartz about 20 percent of the rock. Accessory minerals include apatite, sphene, and zircon.

Where observed, the granodiorite was strongly jointed with many of the joint faces covered by fine drusy encrustations of epidote. Sheared zones are common and in these the granodiorite is extremely friable and crumbles to the touch. Along Etna Creek, near the contact with the Salmon hornblende schist, the granodiorite is cut by a set of prominent vertical joints which trend N. 60° E. and N. 30° W. at right angles to each other. A nearly horizontal joint set is poorly developed. In this area many aplite dikes cut both the hornblende schist and the granodiorite. Frequently the aplite dikes show narrow, distinct, porcelain-like border zone and fine-grained sugary-textured inner parts.

PLEISTOCENE AND RECENT DEPOSITS

OLDER ALLUVIUM (PLEISTOCENE)

The older alluvium, of Pleistocene age, comprises strongly dissected older fan and terrace deposits along the valley margins. They represent interruptions in a period of uplift which initiated the downcutting by the Scott River and its tributary streams. These deposits are most continuous at the south end of Scott Valley near Callahan where they underlie narrow terraces along both sides of the valley. The maximum exposed thickness in that area is probably less than 50 feet. The deposits are poorly sorted and consist for the most part of well-rounded rotten granodiorite, serpentine, chert, and quartzite boulders which average about 1 foot in diameter and are set in a matrix of sand and silty clay.

To the north, deposits of older alluvium are also found in small isolated patches along the margins of Oro Fino Creek valley and Quartz Valley, and at the mouth of Etna Creek. The deposits along the west side of Oro Fino valley form an old and moderately well preserved terrace. Those deposits along Quartz Valley and at the mouth of Etna Creek represent old alluvial fans formed by Shackleford and Etna Creeks. The fans are highly dissected, and wherever exposed the fan material appears to consist of poorly sorted boulders of western-mountain origin set in a matrix of brown sandy clay. Both these fan deposits have been mined intensively for gold in past years. Remnants of the Etna Creek fan deposit are 100 feet or more in maximum thickness and were deposited by the ancestral Etna Creek when it flowed in a north-northeasterly direction, prior to the recent eastward tilting of the Scott Valley area (see section on "Physiographic Development of the Scott Valley area," p. 32). The old fan deposited by Shackleford Creek lies directly against the fault at the western mountain front, suggesting that faulting has occurred subsequent to deposition of the fanglomerate. The old Shackleford Creek fan is deeply trenched by eastward-trending gullies, and the fan material appears to have a maximum thickness of more than 100 feet. The Recent fanglomerate of Shackleford and Sniktaw Creeks has been deposited around the dissected margins of the old fan. To the south, the margins of the old Etna Creek fan are likewise in contact with the Recent fanglomerate deposited by Etna Creek.

No wells are known to obtain water from the older alluvium in the Scott Valley area. The deposits probably do not constitute an important aquifer because of their limited extent, usually poorly sorted nature, and position above the water table.

YOUNGER ALLUVIUM (RECENT)

Aside from the few scattered remnants of older alluvium found along the valley sides, the valley fill is made up entirely of younger alluvium of Recent age composed of (1) stream-channel and flood-plain deposits and (2) alluvial-fan deposits. These two units are shown separately on the geologic map (pl. 1) as Qp and Qf. These units may be readily distinguished in mapping because of their surface characteristics. However, they are partly intercolated, largely contemporaneous, and not easily differentiated in well logs. Hence, they are discussed in the text together. These deposits underlie and form the alluvial plains of the Oro Fino Creek valley, and Scott and Quartz Valleys, and the fans at the valley margins. They extend in tongues up the valleys of tributary streams.

The younger alluvium ranges in thickness from a feather edge at the valley borders to probably more than 400 feet in the center of Scott Valley where it is widest. Kenneth Croeni of the Siskiyou Soil Conservation District at Etna, and Harvey Palmer, a well driller of Greenview, report that the maximum known thickness of valley fill was noted during the drilling of a well at approximate location 42/9–9G between Etna and Greenview. This well, which has been destroyed, penetrated more than 400 feet of non-water-bearing alluvium without reaching bedrock. The thickness of the alluvium decreases to both the north and south of the well. To the north, in the Fort Jones area, the approximate thickness of the alluvial fill was determined from information obtained by George A. Milne of Fort Jones as a result of operations of the French Gulch Dredging Co. on McAdam Creek. Test drilling and dredging operations revealed that along the upper reaches of McAdam Creek, about 3.5 miles north of Fort Jones, the alluvium is about 100 feet thick and it increases in thickness in a downstream direction at a rate of about 30 feet per mile. If this rate were projected toward Fort Jones, the thickness of alluvium there would be about 200 feet.

The alluvial deposits vary greatly in composition. Along the west side of the valley area, from Etna northward to Quartz Valley, the principal streams have built large bouldery and cobbly alluvial fans which are generally most permeable in their mountainward reaches. The channel deposits of these streams differ with regard to the percentage of granitic bouldery debris which they contain; thus, Patterson and Kidder Creeks contain about 20 and 10 percent, respectively, of granitic material, and Etna Creek contains about 40 percent. The Crystal Creek fan, which is not as bouldery nor of such large extent as the fans deposited by the above streams, is composed almost wholly of granitic gravel, sand, and clay. This deposit is rendered impermeable throughout much of its extent because of the high clay content derived from the weathering of feldspar in the granodiorite which comprises the bedrock along the western mountain front in the Crystal Creek area. Normally, surface water from Kidder Creek (pl. 5) and west Patterson Creek does not reach Scott Valley during the early part of the summer because water is diverted from the creeks' upper reaches for irrigation, and the remainder sinks into the coarse gravels of the fanhead area. Crystal Creek, however, maintains flow throughout the year, owing to the relatively impervious nature of the underlying granitic rocks, which apparently prevent much influent seepage from reaching the ground-water body. Instead, water stored in the fine-grained deposits discharges into the creek by effluent seepage during the summer, thus maintaining streamflow.

Downslope from the apices of the western mountain fans toward the valley the alluvium becomes progressively less coarse, and in the zone near the toe of the fans, fine sand, silt, and clay predominate. At the surface the limit of the gravelly phase runs fairly close to the west side road (State Highway 82) in the area between Etna and Greenview. Extending to the east for about 2 miles with a gentle slope towards the valley is an area underlain by the finer fraction of the alluvium deposited by the western streams. Well logs (pl. 2) show that this body of alluvium consists of lenses of water-bearing gravel confined between fairly impermeable beds of clay. The alluvium in this zone is much less permeable than the flood-plain and stream-channel deposits of the Scott River with which it merges to the east.

The area underlain by the flood plain of the Scott River averages 1½ miles in width between Etna and Fort Jones. Wells 42/9–10K1 and 10Q1, each 120 feet deep, are located on the flood plain about half a mile east of the boundary with the western mountain alluvium. Logs of those wells indicate that the flood-plain alluvium there consists of highly permeable sand and gravel in beds averaging as much as 5 feet in thickness, alternating with beds of clay which are from several inches to several feet thick (pl. 2). Logs of several other wells that penetrate the alluvium of the flood plain between Etna and Fort Jones indicate a similar depositional sequence, probably because of the constant shifting of the Scott River during the alluviation of the valley. The lenses of sand and gravel were deposited in old channels which are included within and extend through clayey sediments of flood-plain origin. The sand and gravel lenses constitute the ground-water arteries which yield abundant water when tapped by wells. Wells 43/9–23F1, 26C2, and 26L1, located along the road which bisects Scott Valley, are shallow driven wells, 2 inches in diameter, which have penetrated similar deposits. The log of well 43/9–23F1, which is representative of the group, reads as follows: topsoil, 6 feet;

blue clay, 6 feet; quicksand, 2 feet; clay, 6 feet; and water-bearing gravel, 3 feet.

Relatively few wells tap the younger alluvium of Quartz Valley and Oro Fino Creek valley. Hence the probable water-bearing properties of sediments in these areas are based mainly on surface observations. The sediments deposited by Shackleford Creek and the smaller streams in Quartz Valley generally consists of a high proportion of rounded boulders and are probably fairly permeable. Surface deposits in Oro Fino valley are fine grained, but, because the valley was carved by the ancestral Kidder Creek, at depth its alluvium may be as coarse as the surficial deposits in Quartz Valley.

Little is known of the alluvium in the tributary valleys adjoining Scott Valley on the north and east. Because of the ephemeral nature of the surface streams in the eastern tributary valleys, the alluvium in these valleys between the East Fork of the Scott River and Moffett Creek is probably poorly sorted and consequently has a much lower permeability than the alluvium of the main-stem Scott River deposits. The valleys of McAdam and Moffett Creeks are the most important northern tributary valleys for this study because they contain the largest amount of arable land. Logs of several wells that tap the alluvium of Moffett Creek indicate that it is at least as permeable as the Scott River deposits. McAdam Creek has dredge tailings composed of coarse rounded boulders of greenstone and granitic rocks in its upper reaches; hence the alluvium is likely to be quite permeable.

At the south end of Scott Valley, from the area just north of Callahan to within 2 miles of McConnahue Gulch at location 41/9–25, the reworked alluvium is exposed along the Scott River in piles of dredge tailings 20 feet high. Rounded boulders of granodiorite, chert, slate, quartzite, greenstone, and schistose rocks several feet in diameter are common. No logs are available for this part of the valley, but it is probable that the alluvium is highly permeable. Information as to its thickness is obtained from the results of gold-dredging operations of the Yuba Consolidated Gold Fields, Siskiyou unit, bucketline dredge (O'Brien, 1947, p. 453), which revealed the gravels to be only 12 feet thick about 2 miles north of Callahan at location 40/9–1. Test drilling showed 36–52 feet of alluvium to the north although no information is given as to the location of the test holes. The alluvium probably is about 100 feet thick near McConnahue Gulch.

STRUCTURE

One of the most striking structural features in the area is suggested by the relation of the greenstone to the older rocks. The geologic map (pl. 1) indicates that the contact on the east between the greenstone and the Abrams mica schist trends across the northern part of the Scott Valley area generally in a northeasterly direction, and that probably all of Quartz Valley and most of Oro Fino Creek valley are underlain by greenstone. Sedimentary interbeds within the greenstone everywhere dip toward the east, and near the contact with the older schist the greenstone dips under the schist and appears to occupy a lower stratigraphic position. Such a structural relationship probably has been brought about by strong downfolding and overturning to the west of the greenstone and contiguous parts of the Abrams, possibly accompanied by thrusting of the Abrams over the greenstone. To the east of the downfolded area there is a corresponding broad overturned major anticlinal structure on which are superimposed many smaller northeastward-trending folds. The crest of the anticlinorium is underlain by the Abrams mica schist, and the east flank by the Chanchelulla(?) formation of Hinds (1931).

The contact between the Abrams mica schist and the greenstone may represent a low-angle thrust fault. No Chanchelulla(?) is found between the greenstone and the Abrams, yet about 8 miles east of the greenstone-Abrams contact, Hinds' Chanchelulla(?) formation consists of more than 5,000 feet of sedimentary rocks unconformably overlying the Abrams. This raises the question of why the Chanchelulla(?) beds are not present to the west: They may never have been deposited in that area, or if they were, they may have been eroded before deposition of the greenstone. Whether the Abrams has been thrust westward over the greenstone is not known. The exact nature of the contact is difficult to establish, because for the most part it underlies the alluvium. However, along McAdam Creek, faulting perhaps of a localized nature is indicated, for near the contact of the Abrams mica schist with the greenstone the schist is strongly sheared.

Along the west side of the Scott Valley area from south of Crystal Creek to the northern part of Quartz Valley, the western mountain front is marked by a northwestward-trending normal fault which dips to the east at a steep angle. The upthrown side along the fault is on the west and the relative displacement may amount to many thousands of feet. The intensity of movement along the fault is shown by the outcrop pattern of the greenstone along both sides of the fault. On the western upthrown side the greenstone outcrop has been offset several miles to the southeast in the direction of its regional dip. The fault also bevels the Salmon and Abrams schists and the granodiorite. From Crystal Creek to Evans Creek the fault is indicated by a series of alined reentrants between the Abrams schist and the mountain front. Along Crystal Creek the fault is marked by a slickensided tombstone-shaped granodioritic monolith which dips towards Scott Valley at an angle of 60° to 70°.

South of Crystal Creek the fault trace trends away from the mountain front and passes beneath the alluvium of Scott Valley. North of Shackleford Creek the fault is cut off by an eastward-trending cross fault, upthrown to the north. Prominent cross faults are found also immediately to the south of Quartz Hill and in the hill northwest of Fort Jones. Both faults are upthrown to the north, and in each case the greenstone-Abrams contact has been offset to the east along the upthrown side. The younger cross faults and the major fault along the west side of Scott Valley probably originated in Late Jurassic time during the intense deformation associated with the Nevadan orogeny. Movement along the faults, which was initiated before intrusion of the granodiorite, suggests localization of granitic dikes in the fault zone in the hill northwest of Fort Jones and in many east-west fracture zones probably associated with that epoch of faulting. The faulting of the granodiorite along the west side of Scott Valley indicates that movement continued along the western mountain fault after the intrusion of the granodiorite.

Near the south end of Scott Valley, about 1 mile north of Callahan, a zone of crushed rock several hundred feet wide marks a high-angle reverse fault striking northeastward through Hinds' Chanchelulla (?). The relative displacement is south side up, probably as much as several hundred feet. From its confluence with Scott Valley and extending westward about 1 mile Wildcat Creek follows this fault zone. Many unmapped faults of small extent are also present throughout the area, particularly in the vicinity of serpentine intrusions. During the instrusion of the ultra-mafic rocks, strong compressive forces were generated in the neighboring rocks, resulting in the formation of localized low-angle faults and shear zones (pl. 2). About a mile south of Etna along the east side of the valley a near horizontal thrust is present in an exposure of Chanchelulla (?) formation of Hinds (1931) surrounded by serpentine. The thrust has produced a crushed zone averaging 3 feet in thickness, and the hanging wall apparently has moved northward over the footwall about 30 feet.

Scott Valley owes its present shape in part to an excellent adjustment of the Scott River to noticeable joint directions in the bedrock along certain parts of the valley. At the south end of the valley from Callahan northward to Messner Gulch, the Scott River flows N. 30° W. for about 3 miles, nearly paralleling a conspicuous joint set which strikes on the average N. 35° W. and dips to the southeast 45° to 65°. At its north end, downstream from Fort Jones where the valley bends to the west, structural control appears to have been exerted by many eastward trending normal faults of small extent and by three conspicuous joint sets. Two of the joint sets form a conjugate system that strikes on the average N. 65° E. and dips 45° to 60° to the southeast and northwest; a third set strikes on the average N. 80° W. and dips steeply to the north.

GEOLOGIC HISTORY AND GEOMORPHOLOGY

BEDROCK HISTORY

The oldest rocks in the Scott Valley area are the Abrams and Salmon schists, probably of pre-Silurian age. The Abrams originally consisted of several thousand feet of sandstone and shale, including a few thin layers of limestone. Before deposition of the Salmon rocks the beds were uplifted and dissected. There followed, during Salmon time, a period of long-continued volcanic activity wherein several thousand feet of mafic lava and volcanic ejectamenta accumulated over the eroded surface of the Abrams. Subsequent metamorphism converted the Abrams strata to mica schist and quartzite, and the Salmon volcanic rocks to hornblende schist and gneiss.

Subsidence during Silurian time resulted in the deposition of Hinds' Chanchelulla (?) formation which consists of more than 5,000 feet of alternating beds of marine sandstone, chert, shale, and limestone, unconformably overlying the Abrams and Salmon schists. Uplift and metamorphism followed the deposition of the Chanchelulla (?), and once again the area was deeply eroded. The next event recorded by these rocks is a renewed period of intense volcanic activity. Products of this period of volcanism were several thousand feet of andesitic and basaltic lava, and pyroclastic rocks, subsequently converted by metamorphism to greenstone and greenstone schist. The age of the greenstone is problematical; possibly it is correlative with the Copley greenstone of Devonian (?) age in the Redding area, or with the Applegate group of Triassic (?) age in southern Oregon. Whatever the age of the greenstone, it seems probable that during the latter part of the Paleozoic and continuing into the Mesozoic era, as has occurred elsewhere in the southern Klamath Mountains (Diller, 1906, p. 10), a great thickness of sedimentary and volcanic rocks was deposited and subsequently eroded from the Scott Valley area.

The Nevadan orogeny, one of the great mountain-building epochs of the Pacific coast of the United States, began near the close of the Jurassic period. The rocks were strongly folded, faulted, and uplifted, and as a result the Klamath Mountains probably stood higher than ever before. During and after this orogenic action intense igneous activity occurred, with the intrusion of rock types ranging in composition from peridotite to granodiorite. No consilidated rocks younger than the granodiorite, which may be in part as young as Early Cretaceous, are known in the immediate vicinity of Scott Valley. However, the outcrop pattern of Upper Cretaceous rocks, which almost surround the Klamath Mountains, suggests that the Late Cretaceous sea may have covered a great part, if not all, of the area.

At the close of Cretaceous time, the Klamath Mountains again were uplifted high above the sea, and they have remained above sea level since. During the Tertiary period long continued erosion of the highly resistant bedrock gradually wore the mountains down to a subdued surface of low relief, known as the Klamath peneplain. Subsequent uplifts, probably accompanied by warping of the peneplain surface, brought about the cutting of broad valleys in an earlier cycle and of narrow valleys in a later cycle. Diller (1902, p. 11) assigned the peneplain and broad valleys to Miocene time and the uplift which started the cutting of the narrow valleys to the beginning of Pliocene. Others believe the Pliocene to be the great baseleveling period and would place the great uplift which preceded cutting of the narrow valleys at the beginning of the Quarternary (Frenneman, 1931, p. 471). Scott Valley appears to have been carved during the later cycle of narrow-valley cutting.

PHYSIOGRAPHIC DEVELOPMENT OF THE SCOTT VALLEY AREA

A line extending northward, from the east side of the low hills that rise from the alluvium about 1 mile northeast of Etna, to the northeastern corner of Chapparal Hill marks the approximate western limit of the alluvium deposited by Scott River in the area between Etna and Fort Jones. This line corresponds also with what was the western boundary of Scott Valley during much of its early physiographic history when the Scott River was an active, downcutting stream. During the Recent epoch the eastern margin of the valley floor appears to have remained in its present position, whereas the western valley margin has been shifted about 3 miles westward by erosion.

As discussed in the section on structure, the trend of Scott Valley westward from Fort Jones is probably controlled by the nearly east-west orientation of marked fault and fracture systems. Between Etna and Fort Jones, however, it appears that the initial course of the Scott River was determined chiefly by the relative softness of the underlying bedrock. Thus, along the east side of the valley between Hamlin Gulch and the vicinity of Etna serpentine is intrusive into the Abrams mica schist and generally has a sill-like relationship with the enclosing beds, the overall effect resembling lit-par-lit injection on a regional basis. If the outcrops of the serpentine are projected toward the valley, it is seen that serpentine can probably be inferred to underlie the alluvium in much of this reach of the valley. Inasmuch as the serpentine is generally highly sheared it is therefore readily susceptible to erosion. Moreover, the Abrams along this reach of the valley is highly micaceous and contains many limestone beds. Hence it is much less resistant and more susceptible to erosion than the more massive quartzitic members exposed along the margins of the northern part of the valley.

Once its course had been established after the regional uplift in Quaternary(?) time, many tributary streams integrated themselves with the youthful Scott River. The western tributaries are of particular interest, because they eroded away the bedrock from the wide northern bay of the valley area. Thus the isolated hills, 1 to 2 miles to the northeast of Etna, represent remnants of an old divide that lay between the former western margin of Scott Valley and the east wall of the canyon formed by the ancestral northeastward-trending Etna Creek. Etna Creek must formerly have flowed beyond its present mouth for several miles in a northerly direction before entering Scott Valley. The other major ancestral western tributaries likewise appear to have formerly had northerly to northeasterly courses. Kidder Creek probably at one time flowed through Oro Fino Creek valley. The east side of the northeastward-trending Chapparal Hill appears to represent the western flank of the canyon cut by the ancestral West Patterson Creek, and the northward-trending Quartz Valley was carved by Evans, Mills, Sniktaw, and Shackleford Creeks, all debouching from the western mountains.

Throughout much of its early history the Scott River was an actively degrading stream, cutting down in response to regional uplift. The uplift was apparently intermittent because at several localities along the valley margins there are remnants of highly dissected fans and terraces which probably were formed in Pleistocene time during pauses in the uplift. With the passage of time the dividing ridges between the western tributaries that had once abutted well out into the main valley area were reduced and slowly worn back by erosion toward the present western mountain front. The regimen of the Scott River and its tributaries gradually changed, and they eventually began to aggrade their courses.

The aggradation process was not uniform throughout the valley area, for in the wide part of Scott Valley between Etna and Greenview the depth to bedrock, and consequently the thickness of the alluvial fill, appears to be much greater than it is farther downstream. A well drilled at location 42/9–9G cut through about 400 feet of alluvial deposits, mostly clay, without reaching bedrock. Five miles downstream to the northeast, near the mouth of Hamlin Gulch, and about half a mile east of the Scott River, wells 43/9–24F1 and F2 reached bedrock at 203 feet and 183 feet. Even assuming that the bedrock slopes at an extremely steep angle from these wells westward toward the central axial part of the valley, about 1 mile to the east, it would appear that the greatest depth to bedrock in this part of the valley may be much less than that farther upstream.

The variation in thickness of the alluvial deposits is probably the result of a slow downward movement, during early Recent time, along the northwestward-trending western mountain fault, accompanied by a westward tilting of the whole valley area. The movement probably reached a maximum of several hundred feet along the western part of the valley. Aggradation of the Scott Valley area must have accompanied the downward movement, the thickest alluvial fill accumulating opposite the zone of maximum downwarping between Etna and Greenview.

In late Recent time there was a gentle tilting of the area to the east. As a result Etna, Patterson, and Kidder Creeks abandoned their northerly courses and shifted toward the east. West Patterson Creek shows evidence of stream capture during this period. Formerly, West Patterson Creek flowed in a continuous northeasterly direction from the western mountains along the east side of Chapparal Hill and joined the Scott River immediately south of Fort Jones. At present, however, West Patterson Creek makes a sharp right-angle bend to the southeast in the uplands near the western mountain fault. This bend apparently represents the point of capture of the upper reaches of West Patterson Creek by a stream working to the northwest by headward erosion, partly along the weak zone of crushed rock associated with the fault.

Among the latest geologic events of the Recent epoch in the area were the migration of the Scott River channel toward the east side of the valley and the erosion and burial by alluvium of most of the bedrock spurs that constituted the valley divides for the ancestral western mountain tributaries. Discontinuous alluvial terraces along Hartstrand Gulch and the southern part of Scott Valley, 5 to 10 feet above the present surface of alluviation, may have originated through a local change in base level or through accelerated downcutting induced by a period of heavy precipitation in late Recent time.

GAMMA-RAY LOGGING

On November 4, 1953, Robert E. Evenson of the U. S. Geological Survey made well surveys by the gamma-ray logging method of three unused wells on the west side of Scott Valley. Apparatus for the logging, which was mounted in a station wagon, consisted of a Geiger-Müller tube housed in a watertight brass probe, a winch, about 2,000 feet of coaxial cable, an electric generator, and an automatic recorder.

Gamma-ray logging is feasible because radioactive elements are found in varying quantities in all types of geologic deposits. Thus, in any particular area, differences in radioactive intensity may be used to differentiate one rock type from another. The logging procedure involves lowering the Geiger-Müller tube to the bottom of the well, and then raising the tube slowly at a rate of about 2 feet per minute. Radioactive elements, during their disintegration, emit gamma rays which penetrate a well casing and are not appreciably affected by water. When these rays strike the tube, a small electric impulse is sent up the cable to an amplifier and eventually to a unit which records the number of pulses per minute as a graph on a curvilinear chart. The average number of pulses (counts) per minute per 4-foot interval, taken from the graph, is plotted against depth to form a bar diagram.

Figures 3, 4, and 5 are diagrams of the gamma-ray logs which were run on the three wells in Scott Valley. Generally the top 28–36 feet of each log registered between 250 and 400 pulse counts per minute. This count is much higher than that found in deeper sections of the wells and is due to the increased effects of cosmic rays as the probe nears the surface. Therefore it can be seen that gamma radiation cannot be utilized satisfactorily to log shallow wells. Drillers' logs were available for all three wells and are plotted alongside the bar diagrams.

The gamma-ray logs agree well with the major breaks shown on the drillers' logs. On the driller's log for well 42/9–16Q1 (fig. 3), the first 135 feet are indicated as topsoil, fine gravel, clay, and sand. From 135 feet to the bottom of the well at 200 feet, the log lists coarse gravel, shale, rock, and clay. No breakdown into individual zones is indicated. The gamma-ray log shows a break at 136 feet. Above this depth and below the zone of influence of cosmic rays the counts range from 100 to 150 per minute. Below 136 feet the counts range from 80 to 150 per minute.

Similar correlation between driller's log and gamma-ray log is shown in well 42/9–17K1 (fig. 4), on the Crystal Creek fan. The driller reports the first 64 feet of this well to be composed of topsoil and granitic sand and gravel. The interval from 64 to 85 feet is reported as blue and yellow clay with broken rock, which is presumably a zone of residual bedrock plus some colluvial deposits. From 85 to 221 feet the well penetrates broken blue bedrock, possibly serpentine. The gamma-ray log records significant breaks at 60 and 80 feet which agree closely with the drilling information. Of interest is the radioactive count for the different rock types. The granitic sand and gravel average 160 counts per minute. The residual bedrock and (or) colluvial deposits average 90 counts per minute. The serpentine(?) bedrock registers an average of 50 counts per minute.

The presumed residual bedrock and (or) colluvial deposits in well 42/9–17K1 have a radioactive count similar to that obtained for the

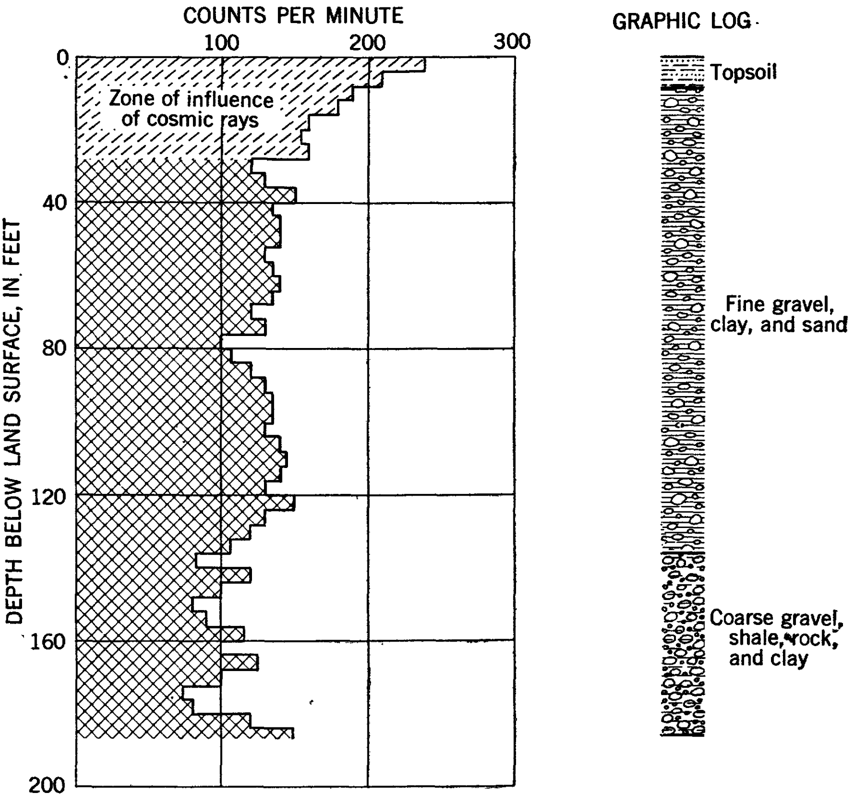


FIGURE 3.—Gamma-ray log of well 42/9-16Q1.

lower zone in well 42/9–16Q1 in which the driller logged coarse gravel, shale, rock, and clay in the interval from 135 feet to the bottom of the well. As the following discussion points out, this latter interval is probably also of colluvial and (or) residual origin, and therefore does not consist of material deposited by the ancestral Etna Creek.

The "shale" reported by the driller is probably one of the schistose rock types common to this part of the valley. Well 42/9–16Q1 is near the mouth of the former northeastward-trending channel of Etna Creek, and it is noteworthy that the low-lying hills to the southeast, which are remnants of the former east wall of the Etna Canyon, are composed mainly of schistose rocks. The bouldery deposits along the present course of Etna Creek are composed in large part of silicic intrusive rocks, generally granodiorite, which normally would be expected to yield a much higher radioactive count than the 80 to 150 per minute obtained for this zone. Moreover, deposits derived from granitic rocks are consistently recognized by drillers and undoubtedly would have been so reported had they been found in the well. Therefore the interval from 135 to 200 feet in this well probably is composed

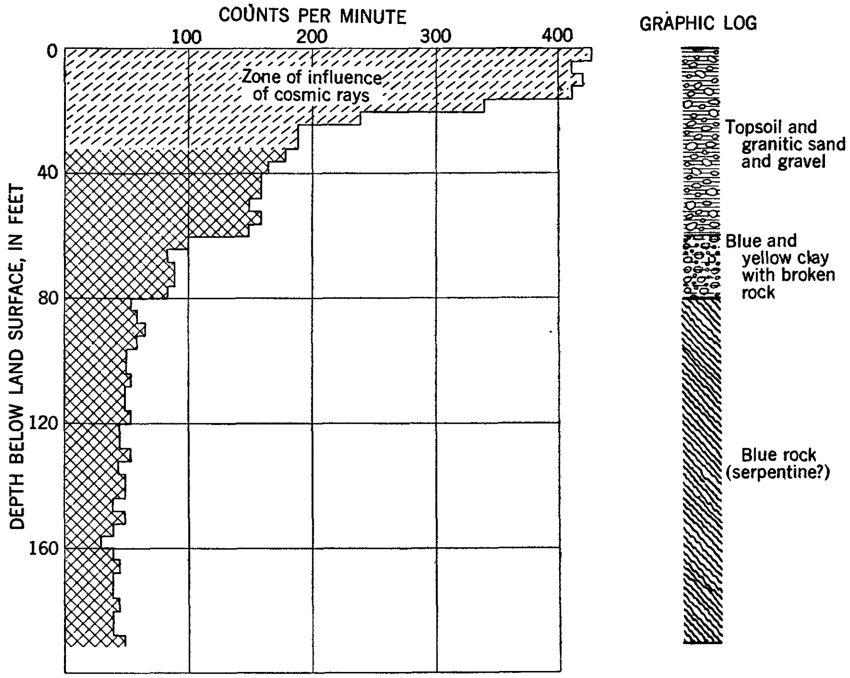


FIGURE 4.—Gamma-ray log of well 42/9-17K1.

mainly of highly clayey residual and (or) colluvial deposits associated with the hills lying to the southeast. A site about a quarter of a mile to the west of 42/9-16Q1 would be more favorable for intercepting at depth the gravel deposits associated with the channels of the ancestral Etna Creek.

The driller's log and gamma-ray log of well 42/9-20G1 (fig. 5) are also in close agreement. This well was selected for radioactive logging because of its position near the major northwestward-trending fault which runs along the western mountain front. From the surface to a depth of 92 feet the driller's log reports tight fan gravel with a few layers of blue clay. From 30 to 35 feet of bedrock (mica schist) is recorded underneath which is found a layer of sand in which the well is bottomed. The "sand" is probably in a gouge zone associated with western mountain fault, and it thus seems probable that the well is located close to, and on the downthrown side of, the fault. This gamma-ray log shows a break at 96 feet which marks the boundary between fan material and bedrock. Above 96 feet and below the zone of influence of cosmic rays the radioactive count ranges from 135 to 195 per minute. From 96 to 128 feet, in the bedrock, the count ranges from 220 to 235 per minute. Another break which corresponds to the "sand" or fault gouge occurs at 128 feet, where the radioactive count increases to 290 per minute.

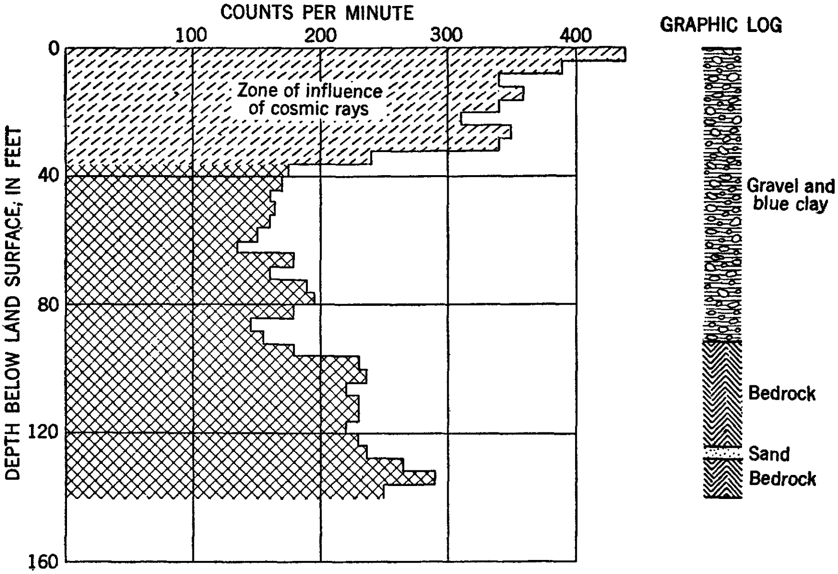


FIGURE 5.—Gamma-ray log of well 42/9-20G1.

To summarize briefly, gamma-ray logs in Scott Valley agree closely with logs obtained from the drillers. The logging apparatus is simple to operate; it thus affords a quick, efficient means of determining the general lithology in wells for which no drilling information is available through comparison with gamma-ray logs of wells for which reliable lithology logs are available.

GROUND-WATER FEATURES

PRINCIPLES OF OCCURRENCE

The ultimate source of ground water in the Scott Valley area is precipitation as rain or snow, part of which percolates downward through the soil and eventually becomes ground water. The remainder either becomes surface runoff or is retained by the soil and later lost to the atmosphere by evaporation and plant transpiration.

The proportion of precipitation that becomes ground water is always dependent in part on topography and the character of the underlying soil and bedrock. The steeply sloping mountainous areas surrounding Scott Valley are conducive to rapid surface runoff which, during periods of intense precipitation on the valley floor, may infiltrate readily and make an important contribution to the ground-water body.

Nearly all the rocks that immediately underlie the surface of the earth contain open spaces or interstices, which range in size from the minute pores in clay to large tunnels and caverns in lava and limestone. The porosity of a rock is the percentage of the total volume that is occupied by interstices and other openings, but porosity is not by itself a measure of permeability or the ease with which fluids may be transmitted through the rock. For example, the porosity of some clay is more than 50 percent, but the small size of the individual interstices makes the clay nearly impermeable. A rock containing larger openings also may have a low permeability if the pore spaces are poorly interconnected.

The size, shape, and arrangement of the openings is dependent upon the mode of emplacement of the rocks and the subsequent geologic processes that have operated upon them. The interstices in unconsolidated sedimentary deposits such as gravel, sand, and clay are the openings between the constituent grains. In consolidated rocks such as conglomerate and sandstone the size and number of these openings are reduced by compaction and by the deposition of cementing material.

In crystalline rocks the interstices are largely in the form of joints and other fractures, including openings along cleavage planes. The strongly jointed and foliated crystalline rocks of the mountains surrounding Scott Valley contain many crevices which function as reservoirs for the water supplied by melting snow and rainfall. Throughout the dry summer months this water feeds the many perennial springs in the upland areas which supply water to the major tributary streams of the Scott River. In addition, immediately after the summer convectional storms which are common in the area, many small wet-weather springs and seeps may be seen issuing along joints and fracture planes in the different bedrock types adjoining the valley floor.

The approximate permeability of an earth material can be determined by several laboratory or field methods. In the laboratory the coefficient of permeability is fixed by determining the number of gallons of water that will flow in 1 day through a sample 1 foot square under a gradient of 100 percent at a temperature of 60°F. In the field it is possible to determine the permeability by means of aquifer tests and to determine other properties that are in part influenced by the permeability of the material penetrated by a well.

When water is pumped from a well, the water table or other piezometric surface develops a depression which has the form of an inverted cone whose apex is at the water level in the well during pumping, whose depth is equal to the drawdown, and whose base is the original water surface. The area affected by a pumping well (area of influence) is the land area that has the same horizontal extent as the part of the water surface that is lowered and is controlled largely by length of time the well is pumped and the coefficients of transmissibility and storage. Drawdown is proportional to the pumping rate so that a higher pumping rate in a well produces a greater drawdown, thereby increasing the depth but not the diameter of the cone. A well in an impermeable aquifer will have a larger drawdown than a well in a permeable aquifer, both wells having equal yields. Specific capacity, a term generally used to indicate the productivity of a well, is defined as the amount of water in gallons per minute (gpm) which is yielded per foot of drawdown; it is generally determined after the well has been pumped long enough to stabilize the drawdown. However, specific capacities of different wells generally are not directly comparable because of differences in thickness of aquifer penetrated by the wells and in the methods of construction. To obtain an approximate measure of the permeability of the material yielding water to a well a comparative index termed "yield factor" is sometimes used. As originally introduced (Poland and others, 1959), yield factor was defined as the specific capacity of the well multiplied by 100 and divided by the thickness in feet of the aquifers yielding water to the well. As used in this report the yield factor is defined as the specific capacity multiplied by 100 and divided by the thickness of saturated material tapped by the well (total depth of well minus depth to water). For a well in which the casing is perforated throughout its length, the yield factor as here defined affords an approximate measure of the average permeability cf the saturated material penetrated by the well. For other wells which are perforated only at certain intervals, the approximate permeability of the saturated material will of necessity be greater than that indicated by the yield factor.

In practice it has been found that an estimate for coefficient of permeability may be obtained by multiplying the yield factor by 15 (water-table conditions) or 20 (confined conditions). In several areas in California it has been found that, for wells penetrating semiconfined aquifers, multiplying the yield factor by 17 has given permeability estimates which compare reasonably well with aquifer-test results.

GROUND WATER IN THE YOUNGER ALLUVIUM

STREAM-CHANNEL AND FLOOD-PLAIN DEPOSITS

The stream channel, flood-plain, and alluvial-fan deposits of the younger alluvium constitute the only important water-bearing deposits in the Scott Valley area. So far as is known from a study of available well logs and hydrologic data, the most permeable alluvium underlies the east side of Scott Valley between Etna and Fort Jones in an area averaging 1½ miles in width on the flood plain of the Scott River. The yields of larger irrigation wells in this area range from 1,200 to 2,500 gpm, considerably higher than for wells in other parts of the valley. Table 5 shows the hydrologic properties of 6 wells tapping the stream-channel and flood-plain deposits of the younger alluvium.

TABLE 5.—*Properties of wells that penetrate stream-channel and flood-plain deposits*

Well	Yield (gpm)	Drawdown (feet)	Specific capacity (gpm per ft)	Saturated thickness (feet)	Yield factor
42/9-2G1	1, 200	18	67	65	103
2N1	140	5	28	23	122
10K1	2, 500	25	100	115	87
10Q1	2, 500	25	100	114	88
43/9-24F1	1, 420	17	84	196	43
24F2	1, 230	14	88	173	51

Of the 5 irrigation wells on the Scott River flood plain, wells 43/9-24F1 and 24F2 penetrate the least permeable alluvial section. Based on yield factors of 43 and 51 for wells 43/9-24F1 and 24F2, the coefficient of permeability of the sediments tapped by these wells is estimated at 600 to 800 gpd per square foot, or about one-half that of the sediments tapped by other irrigation wells listed in table 5. The uppermost 70 feet of sediments found in both wells consists dominantly of poorly sorted gravel and clay which may constitute an interfingering of alluvium of the Scott River with less permeable, poorly sorted alluvium deposited by intermittent streams that drain Hamlin Gulch. The lower permeability of the materials tapped by these wells is also in part the result of both wells being bottomed in serpentinous(?) bedrock overlain by fairly impermeable colluvium and residual deposits described in the logs as "blue rock and clay."

A very high yield factor is recorded for well 44/8-33C1 which is in the flood plain of Moffet Creek about 4 miles northeast of Fort Jones. During a pumping test, this well produced 250 gpm with about 2.5 feet of drawdown equivalent to a specific capacity of 100. Based on a saturated thickness of 31 feet, the yield factor is about 300. However, the well bottoms in water-bearing pea-size gravel and evidently draws water from the gravel aquifer from a much greater effective depth than the depth at which the well is bottomed. If this effective depth were known and if it were applied to the computations, the yield factor probably would be considerably less than that recorded. It is also possible that the high yield factor results from induced recharge from nearby Moffet Creek.

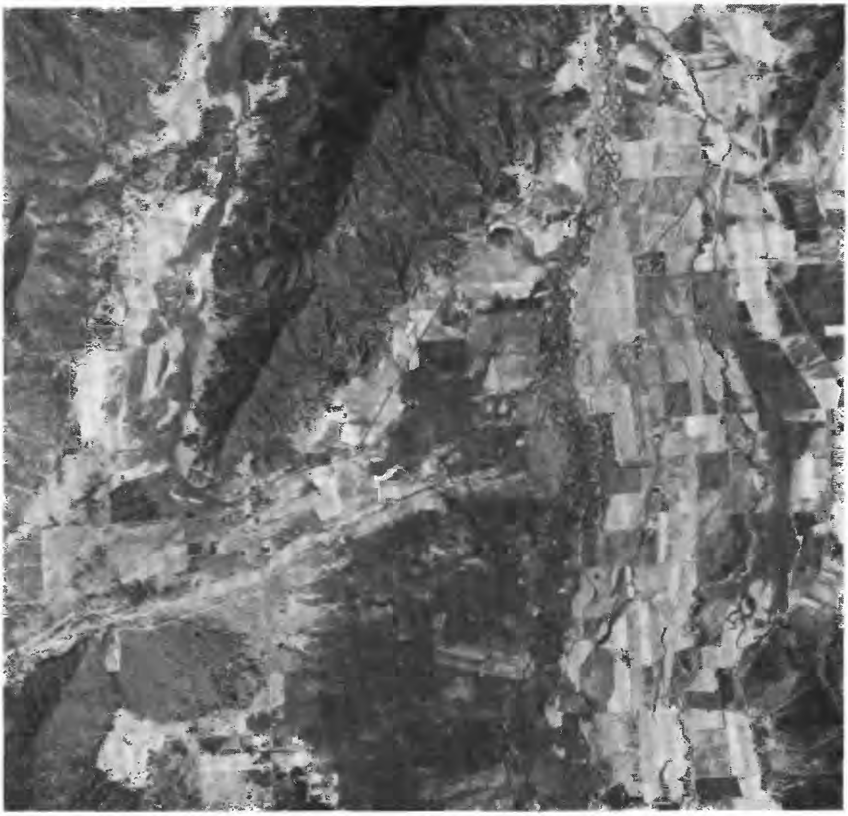
Inasmuch as the alluvium of the Scott River is highly permeable in the reach between Etna and Fort Jones, as evidenced by the values for specific capacity and yield factor shown in table 5, it is probable that the flood-plain sediments both upstream and downstream from this stretch of the valley possess a like permeability. However, the water-yielding properties of the alluvium in these areas, particularly with regard to irrigation possibilities, is virtually untested because most of the wells from Fort Jones westward to the valley outlet and from Etna southward to Callahan are found along the valley margins, are fairly shallow, and are used mainly for domestic purposes.

ALLUVIAL-FAN DEPOSITS

Hydrologic data indicate that the younger alluvium deposited as fans by the western mountain streams is, throughout most of its extent, much less permeable than the alluvium beneath the Scott River flood plain with which it merges on the east. The most permeable known sediments along the western mountain front are found in the large gravelly fans deposited by West Patterson, Kidder, Etna, and Shackleford Creeks, and in the stream channels, both present and former (buried), which radiate downslope from the fanhead areas.

The sedimentation processes which determine a typical fan structure are favorable to the production of confined-water systems. Normal streamflow occurs between the banks of a stream issuing from the mountain front and commonly carries well-sorted sand and gravel which are deposited between the banks. Subsequent flooding may cause water to overtop the banks and spread coarse material over the fanhead area, but in the lower part of the fan, the deposition of coarse material is restricted to a stream channel, and the subsiding flood waters may deposit fine sediments over the area between channels. New channels are cut by flood waters which overtop the banks, particularly near the apex of the fan. Flow downslope from the fan is radial, and the course taken by a new channel may diverge from the direction of an older channel. Near the foot of the fan a stream separates into diverging forks because of decreased gradient, which causes a stream channel to fill with silt and eventually to seek a new course.

These processes thus build up a series of diverging and poorly connected aquifers represented by coarse channel deposits. Downslope from the fanhead area, these channel deposits are separated by progressively finer sediments which constitute the aquicludes in the confined water system. The principal source of most of the confined and unconfined ground water in the alluvial fan is from infiltration in the belt of coarse permeable sediments around the apex of the fan, which extends down present and buried channels. Near the base of the fan is a discharge zone where the confined water that moves through the aquifers is discharged by leakage to the land surface. In this zone the aquifers either end abruptly or grade into materials



AERIAL PHOTOGRAPH OF NORTHERN SCOTT VALLEY

similar in grain size to those of the confining beds. Unconfined water moves in the direction of the slope of the water table and is discharged where the water table intersects the land surface in the upper part of the discharge zone.

Along the west side of Scott Valley between Etna and Greenview the combined discharge of confined and unconfined water down the fans has produced a series of wet areas whose western margin lies about half a mile east of State Highway 82. On the east the wet areas merge with the Scott River flood-plain deposits. According to the Soil Conservation Service, the wet areas can be classified as follows:[1]

W1—Water table is within 5 feet of the surface for part of the year.

W2—Water table is within 5 feet of the surface all year round but land can be cultivated in dry years.

W3—Very high water table; land cannot be cultivated.

The most extensive wet area in Scott Valley is a result of groundwater discharge from the fans of West Patterson and Kidder Creeks (pl. 7, fig. 6). The wet area extends from the vicinity of Greenview southward for 4 miles and eastward toward the Scott River flood plain for about 2 miles at its maximum width. The northern three-quarters of the area is classified as W3; the southern quarter as W2. Many wells within this area tap confined bodies of permeable sand and gravel, and flow for part of the year, generally between the early winter and early summer months. Well 43/9–33G1, 100 feet deep, has a small artesian flow for part of the year. On October 13, 1953, water stood in the casing 1.62 feet below the land surface. When tested, the well reportedly yielded 300 gpm with 53 feet of drawdown. The specific capacity thus obtained is 5.7; the yield factor, based on a perforated interval of 90 feet, is 6.3. Well 42/9–4P1, which is 156 feet deep, also has a small artesian flow for part of the year. Test data indicate a yield of 500 gpm with a drawdown of 100 feet, equal to a specific capacity of 5. The yield factor is 3.5, based on a perforated interval of 144 feet. The above specific capacities and yield factors are much less than for wells on the Scott River flood plain.

Well 42/9–4Q1 which is several hundred feet east of well 42/9–4P1 also flows during part of the year. This well was observed weekly from July 13 to October 26, 1953. At no time during the observation period did the water level decline below the land surface. Between July 13 and September 12, the water flowed slowly over the top of the casing which is set 1 foot above the land surface. Between September 12 and October 26 the water level fluctuated between 0.1

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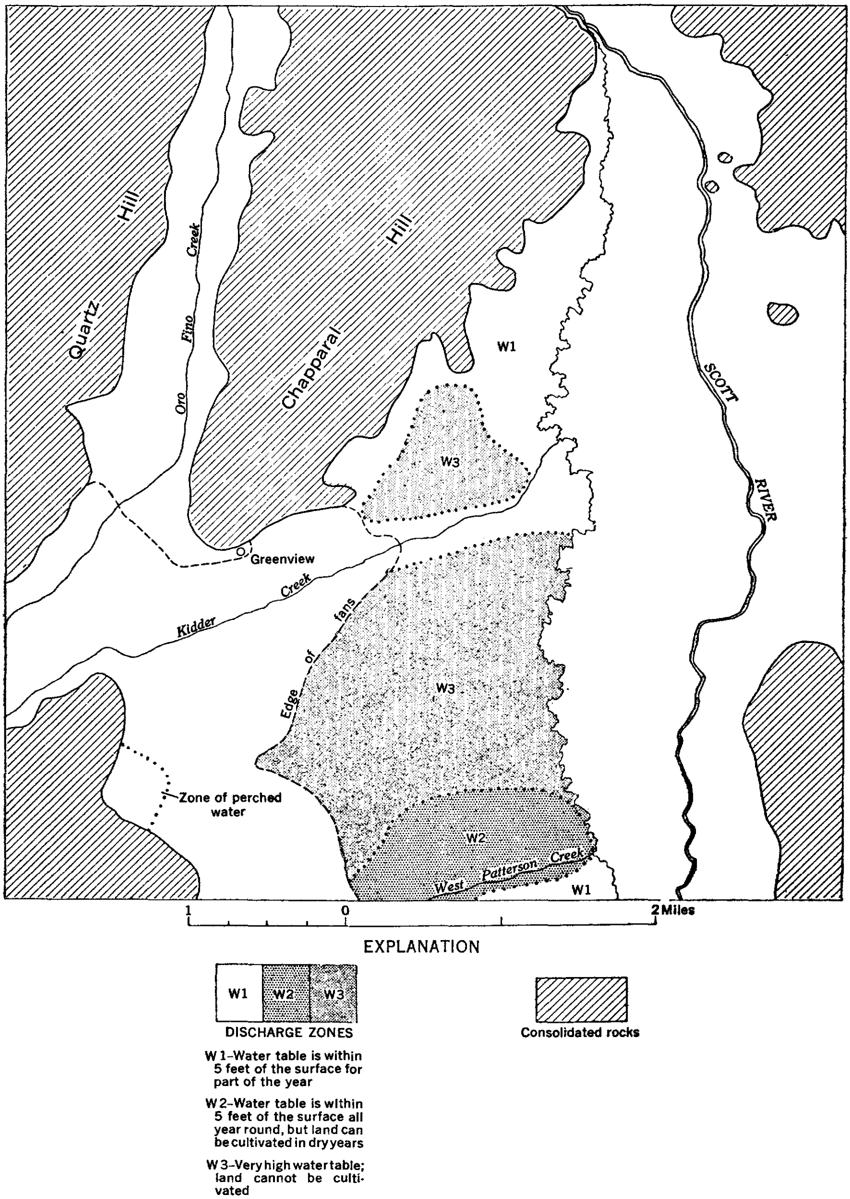
[1] Siskiyou Soil Conservation District Program, 1949, Unpublished manuscript, District office, Etna, Calif., 15 p.



W 1–Water table is within 5 feet of the surface for part of the year

W 2–Water table is within 5 feet of the surface all year round, but land can be cultivated in dry years

W 3–Very high water table; land cannot be cultivated

FIGURE 6.—Principal hydrologic features shown on aerial photograph of northern Scott Valley.

and 0.3 foot below the top of the casing. The log of this well records one layer of water-bearing gravel between 31 and 33 feet and another from 50 feet to the bottom of the well at 60 feet. Both gravel zones are confined by layers of impermeable clay, an upper confining layer between 15 and 31 feet and a lower layer between 33 and 50 feet. The log of well 42/9–8C1, about 1 mile to the west, shows a zone of silty clay between 22 and 30 feet which overlies water-bearing gravel and may correspond to the upper confining clay layer in well 42/9–4Q1.

Well 44/10–34Q1 at the north end of Quartz Valley has a small flow which generally commences about the beginning of January and ends during the first part of July. The well is on the flood plain of Sniktaw Creek, several hundred feet east of a small fan built up by Alder Creek where it discharges from the western mountains. The log of the well records gravelly soil from the surface down to 10 feet, blue clay from 10 to 50 feet, yellow clay with streaks of gravel from 50 to 90 feet, and at 90 feet coarse well-rounded water-bearing gravel. During drilling when the well penetrated the gravel at the 90-foot level water rose to within 2 feet of the land surface. When the well was visited on October 15, 1953, the water level stood 1.45 feet below the land surface.

PERCHED WATER

Along the west side of the valley a small area comprising about 100 acres apparently is underlain by a perched or semiperched water body (pl. 7, fig. 6). The area occupies parts of sec. 31, T. 43 N., R. 9 W., and sec. 6, T. 42 N., R. 9 W., and is east of a crescent-shaped bedrock hill which is concave toward the valley. Coarse fan material from Kidder and West Patterson Creeks has been built up around the northern and southern margins of the hill, and the topographically lower, inner concave part is underlain by silty clay deposited along the peripheral zones of the merging fans.

Well 42/9–6F2, on the north edge of the West Patterson Creek fan, is an unused dug well, 26 feet deep and 5 feet in diameter. The well penetrates poorly sorted cobbles, gravel, sand, and clay. On October 1, 1953, water stood in the well 21 feet below the land surface. In a field about 1,000 feet north of the well, in the area underlain by silty clay, water stood 2 feet below the land surface in a trench 10 feet long, 4 feet wide, and 43 inches deep. The water-level altitude in the ditch was about 15 feet higher than that in the well and also was about 15 feet higher than the 2,840-foot water-level contour shown on plate 1. Hence, the water level in the trench probably marks the water table of a perched or semiperched water body supported by silty clay and does not represent the regional water level. Replenishment to the perched or semiperched water body is effected by infiltration from precipitation and from the seepage of springs issuing from joints in the Abrams mica schist that forms the bedrock in the crescent-shaped hill. The poorly permeable supporting bed is somewhat saucer-shaped because of its location between the higher, cobbly parts of the merging fans; it greatly retards infiltrating water from escaping horizontally from the area.

WATER TABLE AND MOVEMENT OF GROUND WATER

The water table is defined as the upper surface of the zone of saturation in ordinary porous rock (Meinzer, 1923, p. 32) and is generally a subdued replica of the surface topography. It is not a stationary surface but is continually fluctuating in response to additions to or withdrawals from water in storage.

According to Darcy's law which may be expressed

$$Q=PIA$$

Q is the quantity of water transmitted in a unit of time, P is the coefficient of permeability, I is the hydraulic gradient, and A is the cross-sectional area through which the water percolates. Thus, from the above formula, if A and Q remain constant, an increase in P will result in a decrease in I; correspondingly if P decreases, I will increase. Thus, the slope of the water table varies inversely as the permeability of the material through which the ground water moves. If the transmitting material is coarse and pervious, the water-table slope will be gentle; decreased permeability will result in a steeper slope.

Plate 1 shows water-level contours drawn on the surface of the ground-water body in Scott Valley. The contours are based on water-level measurements in wells made during the spring of 1954. The ground water moves perpendicularly to the contours in a downslope direction from the areas of recharge to the areas of discharge. Ground water moves downstream from Callahan northward to Fort Jones, and thence westward toward the valley outlet. From the margins of Scott Valley, movement is toward the valley trough where ground-water discharge supplements the flow of Scott River.

The hydraulic gradient differs from place to place in the valley. Between Etna and Fort Jones, in the central part of the valley, the contours are widely spaced; they slope to the north at about 7.5 feet per mile and reflect for the most part the flatness of the terrane. Along the western mountains hydraulic gradients are steep near the fanhead areas, averaging about 70 feet per mile. Downslope toward the center of the valley the slopes decrease to 25 to 30 feet per mile near the edge of the fans. The steep hydraulic gradients in the western alluvial fan areas are probably due to the relatively low permeability of the fan deposits. Although control in Oro Fino Creek valley and Quartz

Valley is inadequate, the hydraulic gradients in these areas appear to average about 30 and 60 feet per mile, respectively. These gradients are considerably steeper than those found in contiguous parts of Scott Valley and possibly reflect the steep slope of the buried bedrock together with a lower permeability of the alluvium than prevails in the main valley.

Between Fort Jones and the Scott Valley outlet, about 10 miles to the west, the average slope of the water table is about 10 feet per mile (pl. 1). At the upper end of Scott Valley, between Callahan and McConnahue Gulch, the slope of the water table is about 30 to 40 feet per mile and from McConnahue Gulch to the vicinity of Etna it is about 20 feet per mile.

The depth to water below land surface ranges from zero to slightly more than 35 feet. The deepest water levels are in the fanhead areas, particularly along the western mountain front. The shallowest levels are in the discharge areas near the edge of the fans, where the water table intersects the land surface, and near the Scott River whose present channel is generally less than 10 feet below the present flood-plain surface.

FLUCTUATIONS OF WATER LEVEL

The rise and fall of the water table in Scott Valley is related to the amount of recharge to and discharge from the ground-water reservoir. In general, the major factors which control the changes of water levels in wells are infiltration of rainfall, effluent seepage into the Scott River and its tributaries, variations of barometric pressure, transpiration by vegetation, return seepage from irrigation, and influent seepage from streams.

The effect of deep penetration of rainfall on the fluctuation of the water table is shown on the hydrograph (fig. 7) for February 14, 1952, through May 8, 1953, for well 43/9–2K2, a 19-foot dug well at the Fort Jones ranger station. It is possible that a part of the water-level rise attributed to rainfall penetration is caused by recharge from nearby Moffett Creek (pl. 1). Five-day rainfall totals at the ranger station are plotted along the base of the hydrograph.

The hydrograph shows that from April 8, 1952, to November 30, 1952, the normal seasonal decline of the water table was about 4 feet. From November 12 to 14, 1952, 1.79 inches of rain fell, and the hydrograph for this period indicates a water-table rise of about 0.2 foot from the preceding downward seasonal trend. In the storms from December 1 to 10, 6.96 inches of rain fell, causing a rise of only 1 foot in the water table. Thus, most of the precipitation during the period Nov. 12–Dec. 10 apparently was dissipated in replenishing the soil-moisture deficiency, because a rainfall of 0.75 inch from Decem-

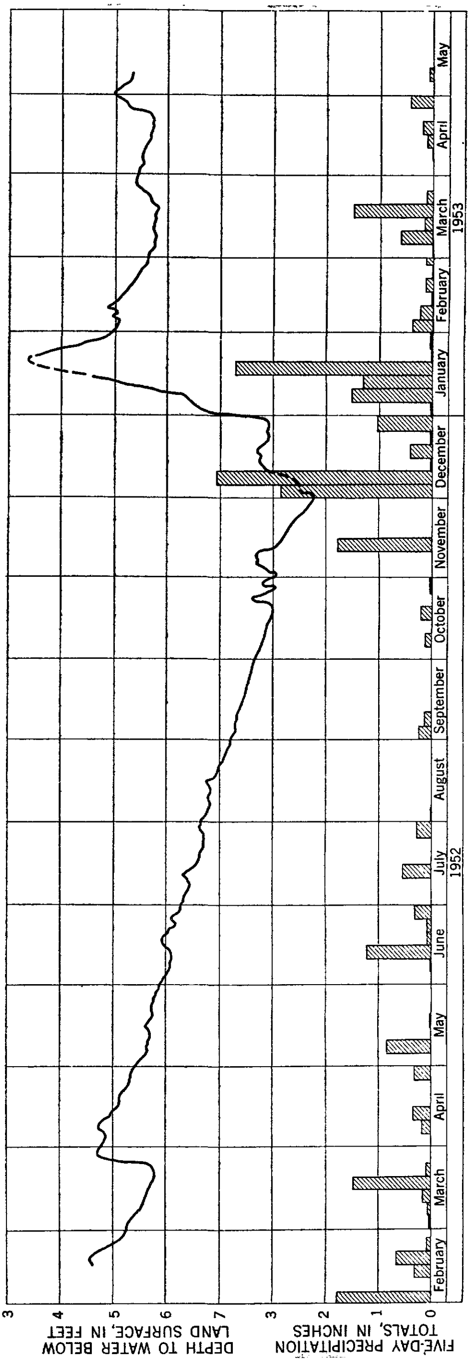


FIGURE 7.—Hydrograph of well 43/9-2K2.

ber 29 to 30 was followed almost immediately by a rise of 1.5 feet of the water table. Recharge from this rainfall was complete 6 days after the rain of December 30. From January 5 to 20, 1953, a total of 6.58 inches of precipitation caused the water level to rise almost 3 feet to a point about 3.5 feet below the land surface. The hydrograph record for the period between January 14 and 21 is unreliable and has been shown as a dashed line. However, because of the high position of the water table at that time and because soil-moisture requirements were satisfied previously, it seems logical to assume that recharge was complete almost immediately after the storm of January 20. From March 18 to 20, 1953, 1.36 inches of rainfall ended a previous slight downward trend of the water level, and resulted in a rise of 0.4 foot in the water table. Recharge was complete 6 days after the rain ended.

From October 15 to November 10, 1952 (fig. 7), 3 peaks in the hydrograph, with an average rise of 0.3 foot above the projected preceding seasonal downward trend, apparently are unrelated to precipitation. These oscillations are probably the result of a series of major atmospheric "highs" and "lows" associated with cyclonic storms common to the area in the fall and winter months. Frequently fluctuations due to this cause are masked by the effects of precipitation, particularly in the winter months when the soil-moisture requirements have been satisfied. The water-level "high" from November 5 to 9, 1952, probably accompanied an atmospheric "low" which preceded the storms of November 12–14. Because unconfined water normally does not fluctuate in response to changes in atmospheric pressure, these fluctuations suggest that the ground-water body tapped by well 43/9–2K2 is partly confined.

Figures 8 through 12 show hydrographs for observation wells measured weekly in Scott Valley from July 13 to October 26, 1953. Figure 8 contains hydrographs for two shallow wells on the flood plain of the Scott River and for the weekly stage of the Scott River as measured from a bridge over the river at a point about 6 miles south of Fort Jones. The water levels in wells 43/9–26L1 and 43/9–23F1 and the stage of the Scott River show the normal seasonal decline about the middle of August with a flattening of slope due to an approach to base streamflow and to the level of perennial ground-water storage.

Well 43/9–28E1 (fig. 9) is 46 feet deep and is at the northeast edge of the Kidder Creek fan. Although the overall trend of the water level in this well is downward in response to the normal seasonal depletion of ground-water storage, the hydrograph may be considered to be in three parts. From July 14 to August 10, the downward trend is gentle; between August 10 and October 12, a marked steepening of slope occurs, and from October 12 to 26 the slope begins to flatten once again. The steepening of the water-level decline occurs concurrently with a decrease in the amount of water available for infiltration to ground water from the Kidder Creek diversion ditch which flows northward along the east side of Chapparal Hill. The owners of the well, Al and Joe King, stated that a steep water-level decline has occurred for the past 3 years during the latter part of the summer. The flattening of the slope from October 12 to 26 is in response to the decreased consumptive use of ground water by plants during the fall months.

Well 42/9–27N1 (fig. 9) is a 19-foot dug well on the lower edge of the Etna Creek fan immediately south of Etna Creek. The sharp rise of about 2.75 feet in water level from October 13 to 26 followed about 1 inch of rainfall on October 17. The rainfall induced an increase in discharge of Etna Creek, making available additional water for percolation through the coarse creek gravels. It is probable that increased percolation plus a decrease in consumptive use of ground water during this period caused the marked rise of the water level in the well.

Figure 11 shows hydrographs for three wells in the northern part of the valley. All three wells have a similar location downslope from an irrigation ditch that runs along the north side of the valley. This fact may explain a common rise of water level shown by each hydrograph for the weekly measurement of August 10. Inasmuch as the amount of precipitation during August was too small to satisfy the soil-moisture requirements, it is probable that an increased head of water flowing through the ditch at that time, with an attendant increase of seepage into the alluvium bordering the wells, caused the observed rise in the water levels. Except for this rise, the hydrographs for wells 44/9–34G1 and 44/9–28Q1 show a continuous seasonal downward trend of water level throughout the period of observation and indicate a uniform balance between rates of inflow and outflow of ground water in that area. By contrast the hydrograph for well 44/9-34R2, an unused dug well 19 feet deep, indicates a decrease in the rate of decline during the latter part of August, possibly in response to localized recharge from irrigation of a nearby garden.

Figure 12 contains hydrographs for two wells located 900 feet apart in a north-south direction on the east side of the valley at the mouth of Hamlin Gulch. Well 43/9–24F1 is 205 feet deep and bottoms in serpentine. Well 43/9–24F2 was drilled to a depth of 183 feet and probably also bottoms in serpentine. Hydrographs for both wells show a markedly similar decline of water level during the nonpump-

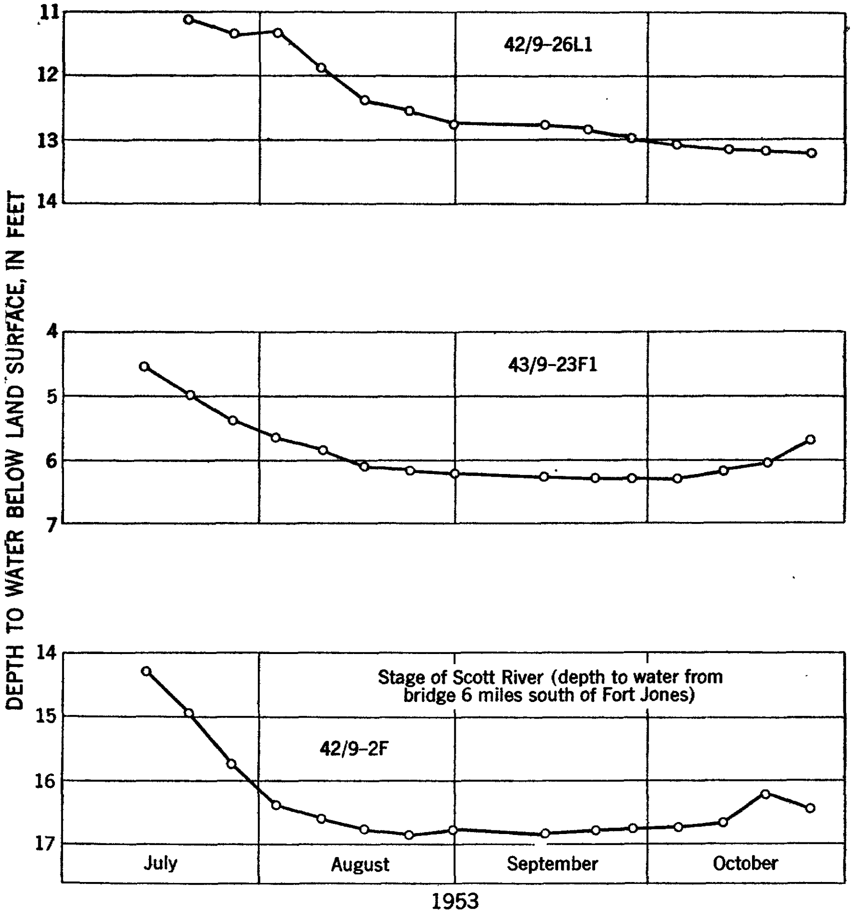


FIGURE 8.—Hydrographs of wells 42/9-26L1, 43/9-23F1, and stage of the Scott River at location 42/9-2F.

ing season in September and October. During the pumping season in July and August it is possible only to estimate the static level in both wells. The hydrograph constructed from the water-level measurements in well 43/9–24F2 on August 3 and 10 is similar in slope to that obtained from the measurements in September and October and has been projected to express the approximate static level during July and August. Because of the similar response of water levels in both wells during the latter 2 months of measurement, the same slope also has been postulated for well 43/9–24F1. The measurements of August 3 in both wells indicate that the water level in F1 deviated about 1.5 feet below the assumed static level, probably because of incomplete recovery from recent pumping.

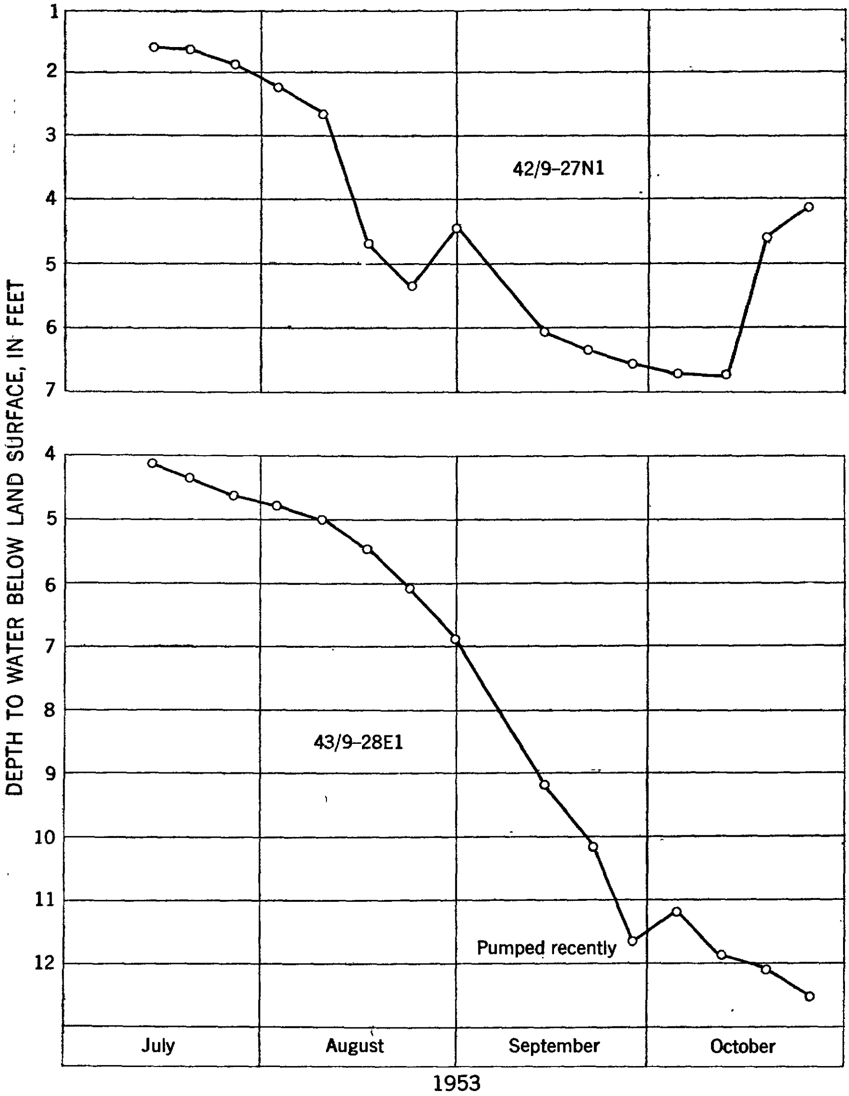


FIGURE 9.—Hydrographs of wells 42/9-27N1 and 43/9-28E1.

RECHARGE

The addition of water to the Scott Valley ground-water reservoir is effected by the infiltration of rainfall on the valley floor, by influent seepage from streams, particularly in the fanhead area of the western mountain front, and by return seepage of irrigation water. The amount of recharge in relation to rainfall is governed in part by the topography, the permeability of the surficial deposits, and the amount,

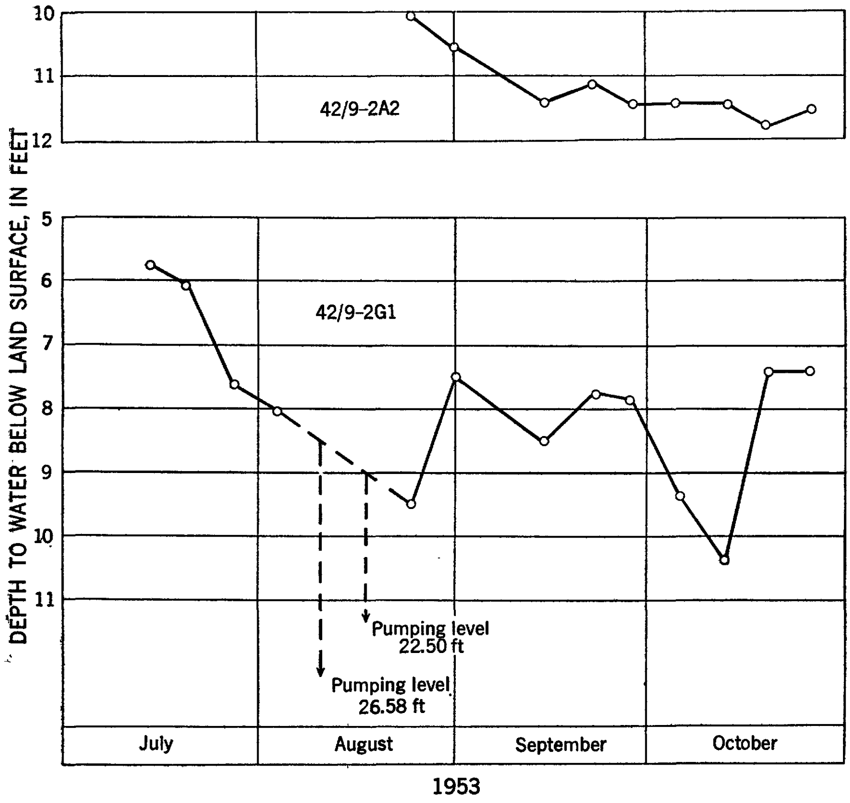


FIGURE 10.—Hydrographs of wells 42/9-2A2 and 42/9-2G1.

distribution, and intensity of rainfall. In the mountains surrounding Scott Valley the steep slopes allow much more surface runoff than occurs in the flat alluvial plains of Oro Fino Creek valley and Scott and Quartz Valleys. For this reason a larger percentage of the precipitation infiltrates the ground-water body in the valley areas than in the mountain areas.

Precipitation in the valley areas generally ranges from 21 to 22 inches annually. Inspection of the hydrograph of well 43/9–2K2 (fig. 7) indicates that the net annual rise in water level in 1952–53, largely from recharge from rainfall in the Fort Jones area, was about 4 feet. Using the estimated average specific yield of about 13 percent for the shallow sediments (see section on storage, p. 56), the amount of precipitation infiltrating the ground-water body was about 6 inches. Applying this figure to the total acreage of the valley floor (about 40,000 acres) and assuming a valley-wide water-level rise of 4 feet due to recharge from rainfall, the approximate recharge by precipitation in the winter of 1952–53 was about 20,000 acre-feet.

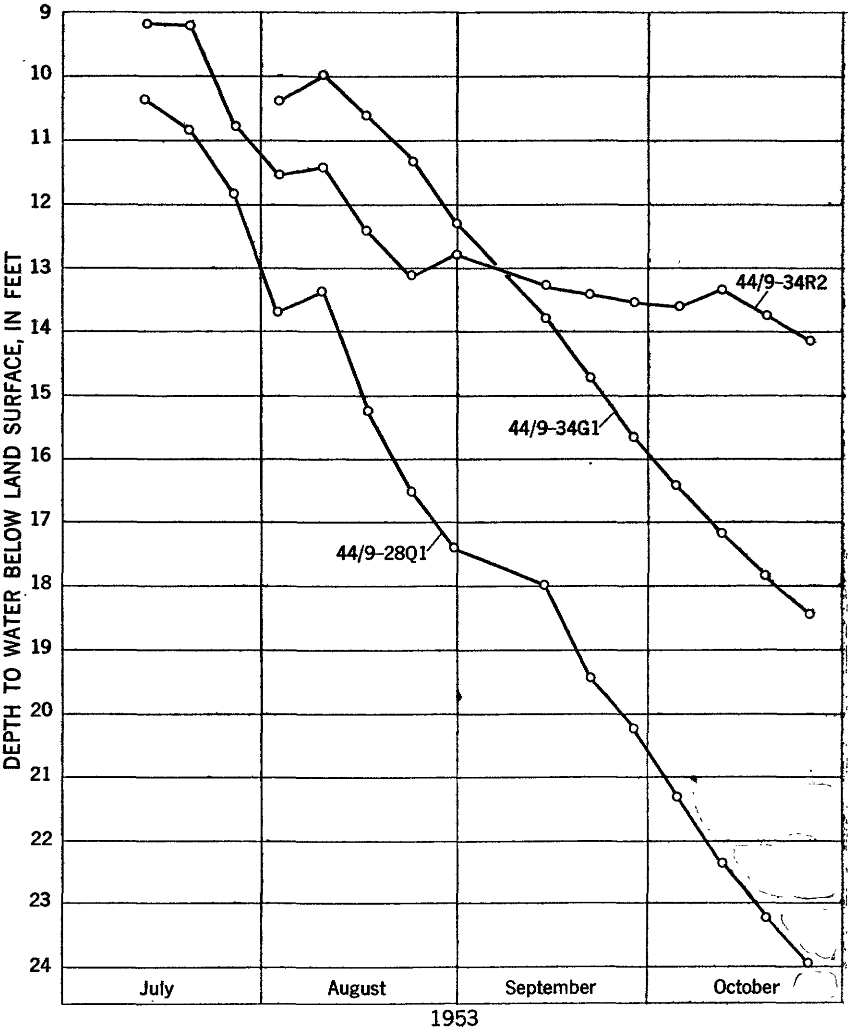


FIGURE 11.—Hydrographs of wells 44/9-34R2, 44/9-34G1, and 44/9-28Q1.

The Scott River is normally an effluent stream receiving water from the ground-water reservoir, but during floods the river overtops its banks and contributes some water to the ground-water reservoir by seepage through the flood-plain sediments. However, the streams tributary to the Scott River constitute highly effective sources of recharge in the valley. Most of the tributary streams flow perennially in their upper reaches, but during the summer months the water is either diverted for irrigation and other uses or sinks into the coarse stream gravels before reaching the valley floor. The western tributary streams are the major sources of influent seepage in the Scott

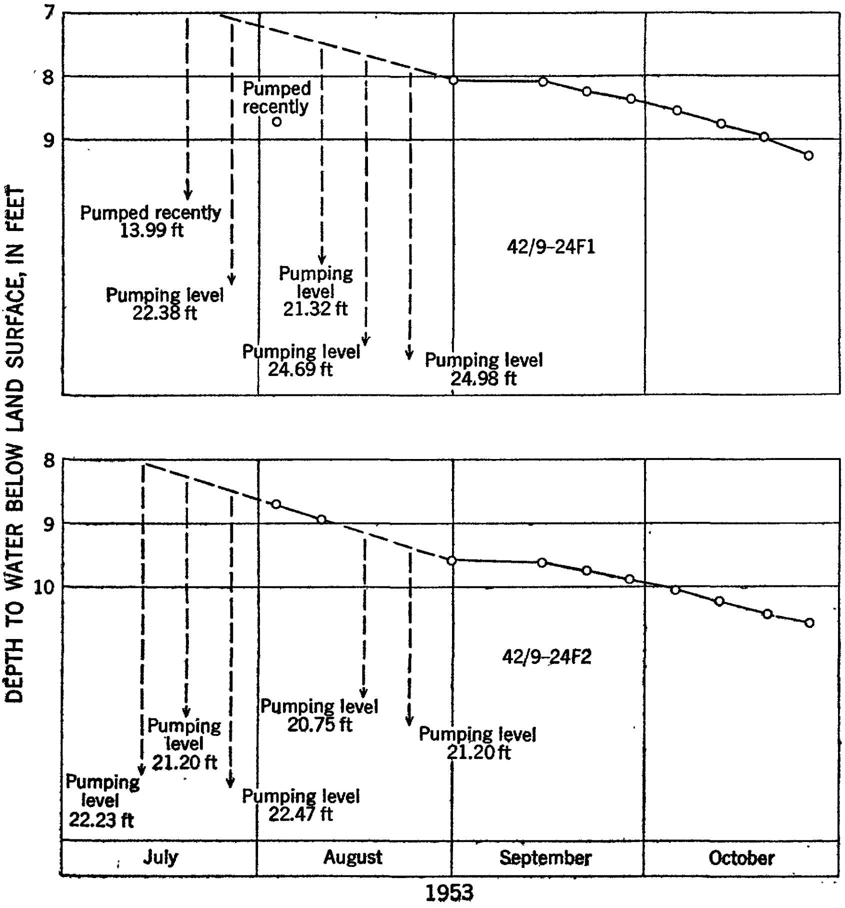


FIGURE 12.—Hydrographs of wells 42/9-24F1 and 42/9-24F2.

Valley area, supplying recharge to the confined and unconfined ground-water bodies which discharge in the lower reaches of the extensive deposits of the western mountain fans.

In 1953 about 15,000 acres in the Scott Valley area was irrigated by about 38,000 acre-feet of surface water. Based on figures compiled by the California Department of Water Resources (Horn, and others, 1954), the average irrigation efficiency throughout Scott Valley was about 55 percent. If the remaining 45 percent percolated to the ground-water reservoir, recharge from this source would be about 17,000 acre-feet. Normally surface flow is greatly diminished after midsummer, resulting in a deficiency of water for late crops. In past years, this has led to the practice along the western side of the valley, particularly along Shackleford Creek, of applying large quantities of water to the upland or fanhead area during high streamflow in the spring. This artificial recharge in the upland areas furnishes subirrigation to the contiguous lower lands during late summer periods of diminished streamflow.

DISCHARGE

Ground water is discharged from the Scott Valley ground-water reservoir both by natural and by artificial means. Natural discharge occurs by seepage into streams, by evaporation, and by transpiration by plants. Little or no ground water moves out of the valley as underflow. Artificial discharge results from the pumping of water from wells.

The following figures relating to pumpage and natural discharge are based on those given in the California Department of Water Resources interim report on the Klamath River basin (Horn and others, 1954).

About 2,100 acre-feet of water was pumped in 1953 in Scott Valley. This figure is broken down into 1,100 acre-feet for use in urban and miscellaneous water-service areas and 1,000 acre-feet for irrigation. These figures represent gross pumpage, however, and the net artificial discharge from the reservoir was probably no more than 1,500 acre-feet.

Natural discharge is by far the larger of the two types. Many seepage areas occur along the course of Scott River through the valley. Although no estimate is available, the water-level contour map (pl. 1) indicates that a large quantity of water discharges into Scott River as a result of movement of ground water toward the valley axis from the valley margins. In 1953 natural subirrigation was received by about 15,000 acres of pasture and grainland, most of which lies in the discharge zones near the base of the alluvial fans deposited from the western mountains. It is estimated that about 30,000 acre-feet of water was lost to the atmosphere by evapotranspiration from these subirrigated areas. Discharge by evapotranspiration also occurs along the courses of the Scott River and its tributaries where the water table is shallow and where phreatophytes, principally willows and poplars, grow in profusion.

GROUND-WATER STORAGE CAPACITY

In order to estimate the storage capacity of a ground-water reservoir, it is necessary to know its areal extent, the thickness of the deposits saturated with fresh water, and the specific yield of those deposits. The specific yield of a rock saturated with water is the ratio of its own volume to the volume of water it will yield by gravity, expressed as a percentage.

The following specific yield values assigned to the sediments in the Scott Valley area have been adapted with slight modification from those figures used in estimating the ground-water storage capacity of the Sacramento Valley (Poland and others, 1951).

TABLE 6.—*Specific-yield values for several lithologic materials used in estimating ground-water storage capacity in Scott Valley*

Material	Specific yield (percent)
Gravel, sand and gravel	25
Sand	20
Fine sand, sand and clay, tight sand	10
Clay and gravel, sandy clay	5
Clay	3

The Scott Valley area was divided into 6 storage units (fig. 13) of which the largest (unit 1) is the area underlain by flood-plain deposits of the Scott River; this area extends northward from McConnahue Gulch to the valley outlet near section 27, T. 44 N., R. 10 W. Well-log information for estimating specific yield of the sediments was adequate only for that part of the flood plain between Etna and Fort Jones in a belt averaging 1½ miles in width. Although well logs are scarce in the reach of the Scott River flood plain from McConnahue Gulch northward to the vicinity of Etna and in the reach from Fort Jones westward to the valley outlet, it is believed that the sediments in these areas have almost the same specific yields as deposits in the wide part of the valley between Etna and Fort Jones.

Storage was computed for the flood-plain sediments 10 feet to 100 feet below the land surface. The 10-foot level approximates the average depth to water, and the 100-foot level was selected because the most productive and deepest irrigation wells in the central part of Scott Valley, although only 5 in number, exceed slightly or are about that depth. By applying the assigned specific-yield values given in table 6 to the lithologic types reported in the logs of these wells, the specific yield of the sediments in the individual irrigation wells was found to range from about 7 to 21 percent and to average about 15 percent. The specific yield of the sediments between 10 and 30 feet for the 5 wells is about 13 percent. The average specific yield of the sediments between 10 and 30 feet in shallow wells tapping the flood-plain deposits is also about 13 percent. Thus, if the specific yield for the shallow sediments in all the flood-plain wells is similar, then the specific yield of 15 percent obtained for the interval 10 to 100 feet for the 5 deepest wells may be fairly representative of the entire section of flood-plain sediments. The Scott River flood-plain storage unit (unit 1) comprises an area of about 16,000 acres; this area multiplied by the saturated thickness of 90 feet and the resultant product multi-

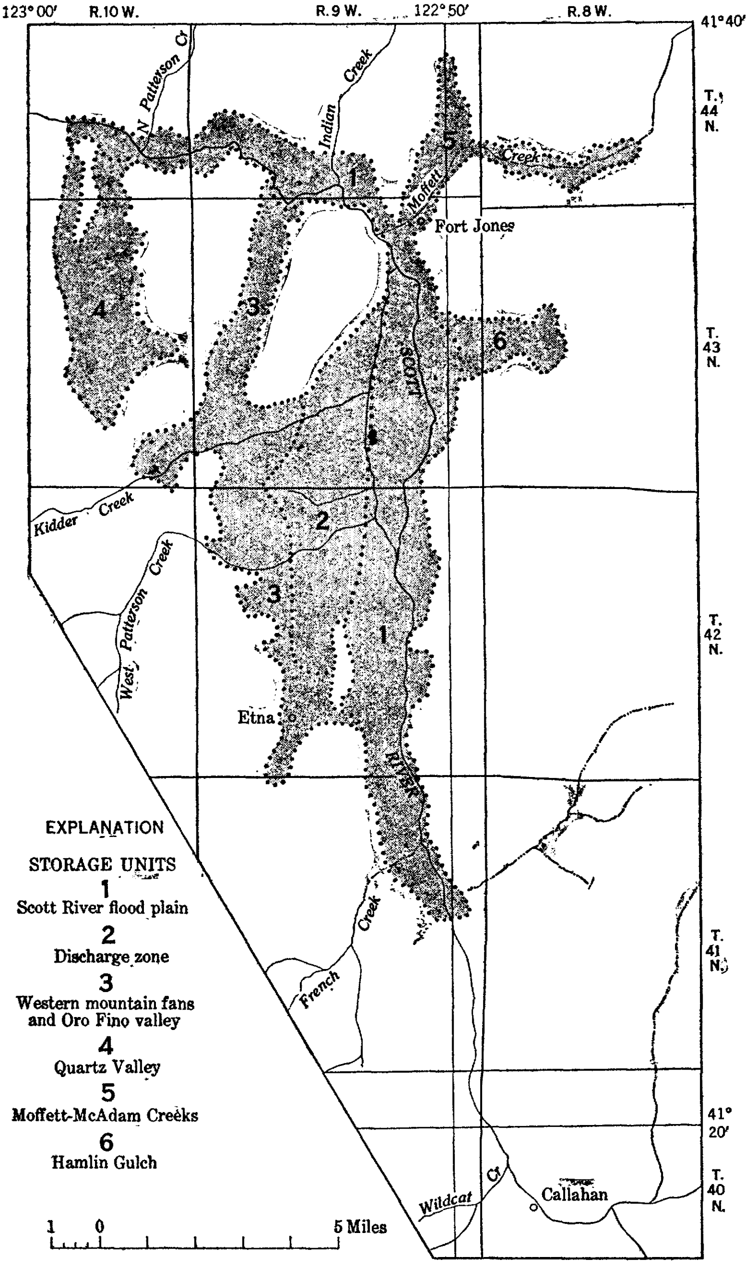


FIGURE 13.—Map of Scott Valley showing ground-water storage units.

plied by the average specific yield of 15 percent gives a product of about 220,000 acre-feet of ground-water storage for the flood-plain sediments.

Storage units 2, 3, and 4 are along the west side of the valley area. Because of the scarcity of well logs in this area, the specific yield of the sediments in these units has been estimated largely on the basis of surface geology and hydrology. Thus, unit 2 for the most part constitutes the discharge zone at the edge of the western mountain fans in an area underlain by the finer fraction of the alluvium carried by the western tributary streams. The average specific yield of these sediments is estimated conservatively at 5 percent and the average depth to water is 5 feet. Based on a saturated thickness of 95 feet and an area of 6,500 acres, there is about 31,000 acre-feet of storage within this unit.

Unit 3 comprises about 8,400 acres and includes Oro Fino valley and the western mountain fan area from Etna northward to Greenview. Highly permeable coarse gravelly sediments occur in a restricted zone near the apices of the fans and in the channel deposits, both present and buried, of the western streams. Downslope from the fanhead areas the permeability decreases because of the admixture of clay and silt with the coarse gravels. The average specific yield for this unit is estimated at 7 percent, and the average depth to water is about 15 feet. The storage capacity in unit 3 is about 50,000 acre-feet.

Unit 4 includes the Quartz Valley and covers an area of about 4,800 acres. The sediments deposited by Shackleford Creek and the other streams in the area generally consist of a high proportion of rounded boulders and are believed to be moderately permeable. The average specific yield of the unit is estimated at 15 percent, and the average depth to water is about 15 feet. The storage capacity is about 61,000 acre-feet for the Quartz Valley area.

Storage unit 5 includes the valley lands adjacent to Moffett and McAdam Creeks, an area of about 2,600 acres. A study of well logs in the Moffet Creek area and from surface exposures along the upper reaches of McAdam Creek indicates that the alluvium in these areas is moderately permeable. The specific yield of the sediments in this unit is estimated at about 15 percent, and the average depth to water is about 10 feet. The storage capacity of this unit is about 35,000 acre-feet.

Unit 6, the Hamlin Gulch area, includes about 1,560 acres. Because of the ephemeral nature of the surface streams in the area, it is believed that the sediments have considerably lower permeability than those of the Scott River flood-plain, Quartz Valley, and Moffett-McAdam Creek areas. The specific yield of the Hamlin Gulch sediments is estimated at about 7 percent, and the average depth to water is estimated to be about 10 feet. Based on the above estimates, the storage of unit 6 is about 10,000 acre-feet.

The total ground-water storage capacity of the stream-channel, flood-plain and alluvial-fan deposits to a depth of 100 feet in the Scott Valley area is estimated at 400,000 acre-feet. Table 7 gives the estimated storage capacity for the individual storage units.

TABLE 7.—*Average specific yield and estimated ground-water storage capacity for units shown on figure 13*

Storage unit	Location	Area (acres)	Average depth to water (feet)	Saturated thickness (feet)	Average specific yield (percent)	Ground-water storage (acre-feet) [1]
1	Scott River flood plain	16, 000	10	90	15	220, 000
2	Discharge zone at edge of western mountain fans	6, 500	5	95	5	31, 000
3	Western mountain fans and Oro Fino valley	8, 400	15	85	7	50, 000
4	Quartz Valley	4, 800	15	85	15	61, 000
5	Moffett-McAdam Creek	2, 600	10	90	15	35, 000
6	Hamlin Gulch	1, 600	10	90	7	10, 000
	Total	39, 900	-------	-------	-------	400, 000

[1] Ground-water storage of individual units (to the nearest one thousand acre-feet) and total storage of all units rounded to 2 significant figures.

The preceding estimate is for gross storage capacity and does not represent usable ground-water storage capacity. As defined by Poland and others (1951, p. 621) usable storage capacity represents that part of the gross storage capacity that can be economically dewatered during periods of deficient surface supply and resaturated, either naturally or artificially, during periods of excess surface supply. The water involved in the cyclic storage operation must have a satisfactory quality for irrigation and must occur in sufficient quantity in the underground reservoir to be available at usable rates of yield without uneconomic drawdown.

Usable ground-water-storage capacity in Scott Valley is undoubtedly less than 400,000 acre-feet. Because most of the wells on the Scott River flood plain are relatively shallow with an average depth of about 25 feet, lowering the water table in storage units 1 through 6 (fig. 13) to a depth of about 30 feet by increased pumping would necessitate the deepening of most of the existing domestic and stock wells in the area. Assuming there was no recharge, a withdrawal of about 85,000 acre-feet of water probably would dewater the valley sediments to that depth. Lowering the water table might necessitate supplying water to presently subirrigated areas by pumping, but it also would reduce substantially the present high losses of ground water by evaporation and transpiration from marshy areas on the Scott River flood plain (storage unit 1) and in the discharge zone (storage unit 2).

WATER UTILIZATION

Most of the wells in the Scott Valley area are used for domestic and stock supplies. These wells are shallow, averaging about 25 feet in depth, and generally are equipped with jet pumps and electric motors of ½ to 1 horsepower. The majority of domestic and stock wells are dug wells with an average diameter of 4 feet, walled with stone, brick, or wooden board. There are six irrigation wells in the area and most of these are on the Scott River flood plain between Fort Jones and Etna. Fort Jones obtains its municipal supply from well 43/9–2G1 which is 45 feet deep and 6 feet in diameter, and Etna draws its municipal supply directly from Etna Creek.

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

1. An irrigated-land group which includes all agricultural lands dependent upon surface application of water as well as those agricultural lands subirrigated by water from a high-water table or from winter flooding.
2. Urban lands which include the developed areas of cities and towns within the valley.
3. Miscellaneous water-service areas which include farmsteads, parks, golf courses, cemeteries, airports, and industrial sites, where such items are not within urban boundaries.

Total water used in 1953 for all purposes in Scott Valley was about 40,000 acre-feet. Urban use is about 400 acre-feet, based on an estimated daily per-capita consumption of 200 gallons (Horn, and others, 1954). Of this total, about 100 acre-feet was derived from streamflow and 300 acre-feet from pumping. Miscellaneous water-service areas used about 800 acre-feet, most of the supply coming from wells. The greater part of the water used in Scott Valley was used for irrigation. In 1953 about 15,000 acres was irrigated by surface water and 370 acres from wells. The average amount of water, expressed in feet per acre, which was applied to a crop in the Scott Valley area during the growing or irrigation season was estimated at 2.5 acre-feet per acre per year.[2] To supply this amount of water to the irrigated acreage, about 38,000 acre-feet of surface water and 1,000 acre-feet of ground water was required.

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[2] Swenson, M., 1947, Report on Scott River watershed basic data pertinent to development of a watershed management plan for the Klamath National Forest: U. S. Forest Service, region 5, Watershed Management Section, unpublished manuscript, 50 p.

The largest irrigation development in the area is operated by the Scott Valley Irrigation District which maintains diversion works from the Scott River to supply about 5,000 acres along the east side of the valley from Etna northward to within 5 miles of Fort Jones. The district's water rights call for 62.5 cfs from the Scott River. A ditch operated by a farmer's cooperative enterprise supplies water along the east side of the valley between Etna and Callahan. In 1953 about 1,500 acres was irrigated from this ditch. There are more than 100 other small diversions from the Scott River and its tributary streams in the area, the majority of which are used for irrigation purposes.

QUALITY OF WATER

Minerals are dissolved wholly or in part by water at the land surface and by water seeping downward through the rocks to the zone of saturation. The solvent action of water is assisted by the presence in solution of carbon dioxide, derived from the atmosphere or from the organic substances in the soil through which the water passes, and of organic acids leached from the soil. The character of the dissolved mineral matter is thus intimately related to the composition of the soils and bedrock in a particular area. The concentration of mineral constituents is controlled partly by rainfall. Where rainfall is abundant concentrations tend to be low because of the effects of dilution. The converse is true in arid regions where concentrations of dissolved minerals in natural waters are generally high.

In natural waters most of the mineral constituents occur in ionic form; some occur as colloidal suspensions. The common ionized constituents generally are reported in water analyses as the cations, calcium, magnesium, sodium, and potassium; and as the anions, bicarbonate, carbonate, sulfate, chloride and nitrate. The constituents that generally occur in nonionic form, chiefly silica, iron, and aluminum usually are reported as total quantities present of silica, iron, and aluminum. In addition many analyses report certain of the lesser constituents such as boron and fluoride, which may affect the usability of water for agricultural or domestic purposes.

Chemical analyses of natural water commonly are expressed in parts per million (ppm), equivalents per million (epm), and percentage reacting values. Parts per million is an expression of the concentration by weight of each constituent in a million unit weights of water. Equivalents per million is an expression of the concentration in terms of chemical equivalents rather than by weight. Parts per million may be converted to equivalents per million by dividing the concentration expressed in parts per million of a particular ion by the equivalent weight (combining weight) of that ion. The equivalent weight of an ion is obtained by dividing the atomic weight, in the case of ions composed of a single element, or the molecular weight, in the case of a complex ion, by the valence. For convenience in converting from parts per million to equivalents per million, constituent ions in parts per million are multiplied by the reciprocal of their equivalent weights. Following are the equivalent weights and their reciprocals:

	Equivalent weight	*Reciprocal*
Cation:		
Calcium (Ca)	20.04	0.0494
Magnesium (Mg)	12.16	.0822
Sodium (Na)	22.997	.0435
Potassium (K)	39.096	.0256
Anion:		
Carbonate (CO_3)	30.005	.0333
Bicarbonate (HCO_3)	61.018	.0164
Sulfate (SO_4)	48.03	.0208
Chloride (Cl)	35.457	.0282
Nitrate (NO_3)	62.008	.0161

Percentage is calculated from equivalents per million. It is the ratio of the individual cation or anion to the sum of all the cations or anions expressed as a percentage. In the following pages all percentages of the different constituents of the Scott Valley waters, with the exception of silica, have been calculated as percentage reacting values.

The specific conductance may be used to make a close approximation of the sum of ionized constituents present in the Scott Valley waters. The relation between specific conductance and sum of ionized constituents is shown on figure 14. The mean curve is drawn from the analyses of 36 ground-water samples with specific conductance (ordinate) plotted against the sum of ionized constituents (abscissa). The sum of the ionized constituents is necessarily less than the sum of total determined constituents because it it does not include silica, iron, and other minor dissolved constituents. The mean curve of figure 14 can be expressed fairly accurately by the formula:

$$S=0.53(K\times10^6)$$

where S=sum of ionized constituents in parts per million and K= specific conductance in micromhos at 25°C.

WATER QUALITY IN RELATION TO USE

In the spring and fall of 1953, personnel of the California Department of Water Resources collected 92 samples of surface and ground waters in Scott Valley for analysis by the U. S. Geological Survey. The results of these analyses are assembled in tables 11 and 12. These analyses show that the Scott Valley waters are calcium-magnesium bicarbonate waters, in which hardness ranges from 16 to 303 ppm. The percent sodium ranges from 3 to 24. Potassium, sulfate, chlo-

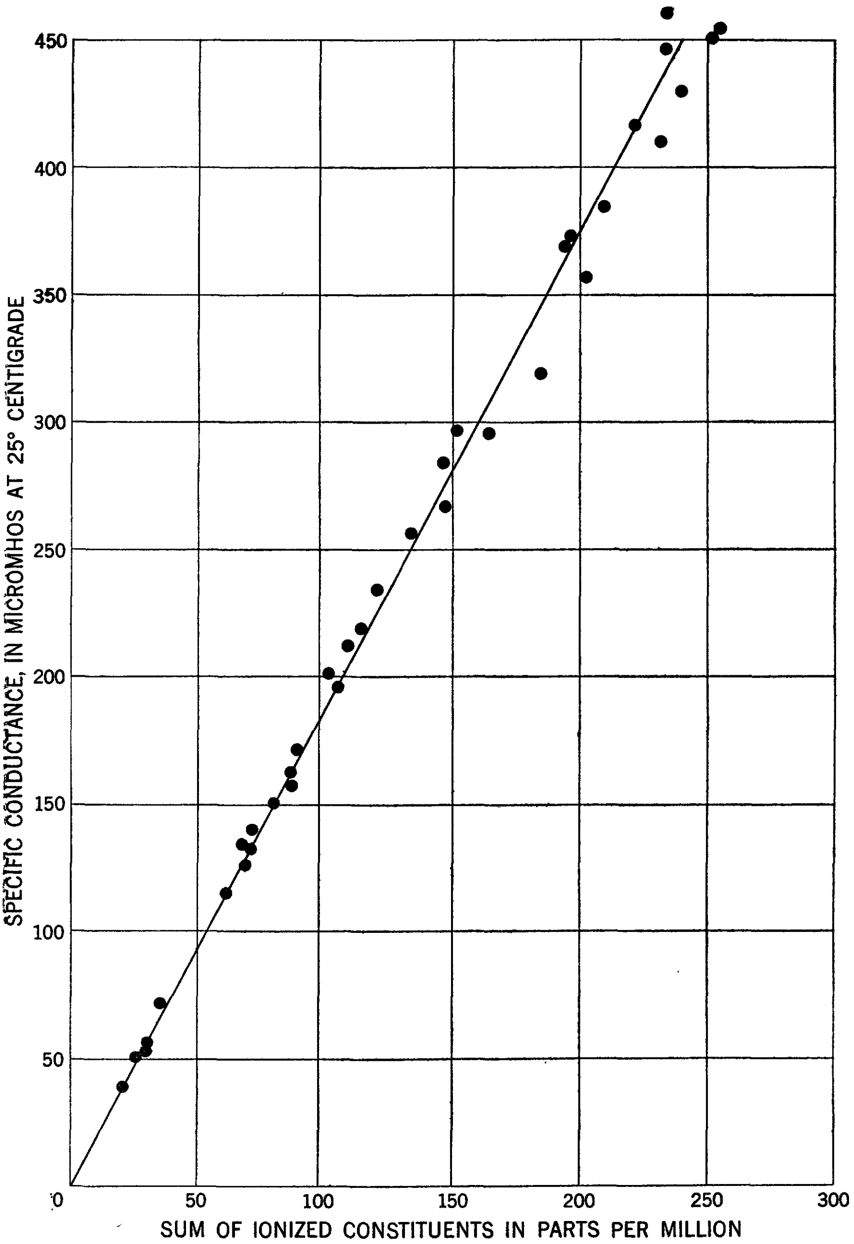

FIGURE 14.—Relation of specific conductance to sum of ionized constituents.

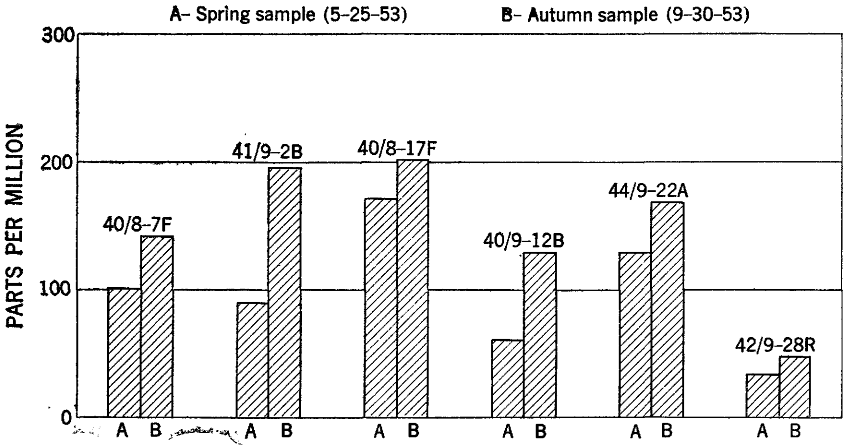

FIGURE 15.—Changes in salinity of surface waters in Scott Valley for samples taken in spring and autumn, 1953.

ride, nitrate, fluoride, and boron generally are present in negligible amounts, although several samples of ground waters show higher than average concentrations of chloride and nitrate, probably because of local contamination by livestock and human agencies. The waters are excellent for domestic purposes and for irrigation. A graphic representation of the composition of selected ground- and surface-water samples in Scott Valley is shown on plate 3 by means of circular diagrams. The area of each circle is proportional to the concentration of the sum of determined constituents, expressed in parts per million (ppm). Each individual wedge represents the percent of a particular anion or cation based on equivalents per million.

The sum of determined constituents in ground-water samples from the Scott Valley area ranges from 29 to 417 ppm and averages about 190 ppm. For surface-water samples, the sum of determined constituents averages 132 ppm in the autumn and 100 ppm in the spring. This change in concentration occurs because the autumn low or base flow of a stream is maintained by ground-water inflow which has leached the more soluble constituents from the rock and soil particles traversed in reaching the stream. At high-water stages during the spring, the base-flow salinity is diluted by snow melt or surface runoff. Figure 15 shows graphically the changes in salinity of samples taken from the Scott River and several tributaries during relatively high water discharge on May 25, 1953, and relatively low water discharge on September 30, 1953.

The hardness of water, a characteristic made familiar by the difficulty of getting a lather with soap, is caused mainly by calcium and magnesium. Hardness is troublesome in the home, in commercial laundries, and particularly in steam boilers because of the deposists of scale that choke the tubes. Hardness can be reduced by a chemical process involving the use of lime and soda ash or by cation exchangers. Generally, waters with hardness less than 60 ppm are classed as soft; with 61 to 120 ppm, as moderately hard; and with 121 to 200 ppm as hard. Very hard waters have a hardness of more than 200 ppm.

The hardness of the ground water in Scott Valley varies greatly from place to place, being dependent in large part upon the type of bedrock present in any particular area. Limestone and serpentine are the major rock types associated with hard waters in Scott Valley, the former by virtue of its relatively high solubility in waters charged with carbon dioxide and the latter because it commonly is highly sheared and presents large surfaces of easy access to the agents of chemical decomposition. The hardness of the surface waters is dependent on the composition and structure of the bedrock over which drainage is effected; it also varies greatly with streamflow, as does the salinity, being highest during periods of low-water discharge and lowest during periods of high runoff.

The very hard waters in Scott Valley generally are restricted to the east side of the valley. Northward from Callahan, these areas include McConnahue and Hamlin Gulches and Moffett Creek. The waters from the western part of the valley by comparison are soft, having an average hardness of about 38 ppm. Waters draining from the mountains to the north of Scott Valley have an intermediate hardness, ranging from 75 to 192 ppm.

The hardness of water from the Scott River varies with the sampling site. At locality 40/8–7P, about 1¼ miles north of Callahan, the hardness averaged 100 ppm for spring and fall samples. About 8 miles downstream, at sampling locality 41/9–2B at the diversion dam maintained by the Scott Valley Irrigation District, the hardness of spring and fall samples averaged 120 ppm, an increase probably due to the increment of waters of relatively high salinity derived from McConnahue Gulch and vicinity. No analyses are available for the Scott River between Etna and the northwestern part of the valley, but probably the hardness decreases somewhat because most of the inflow to the Scott River along this reach is supplied by the comparatively soft waters from the western mountain areas. This decrease in hardness is reflected in the average of spring and fall analyses at sampling locality 44/10–28D where the Scott River leaves the valley. The river water at this point has an average hardness of 95 ppm, 25 ppm lower than at the upstream sampling site near Etna.

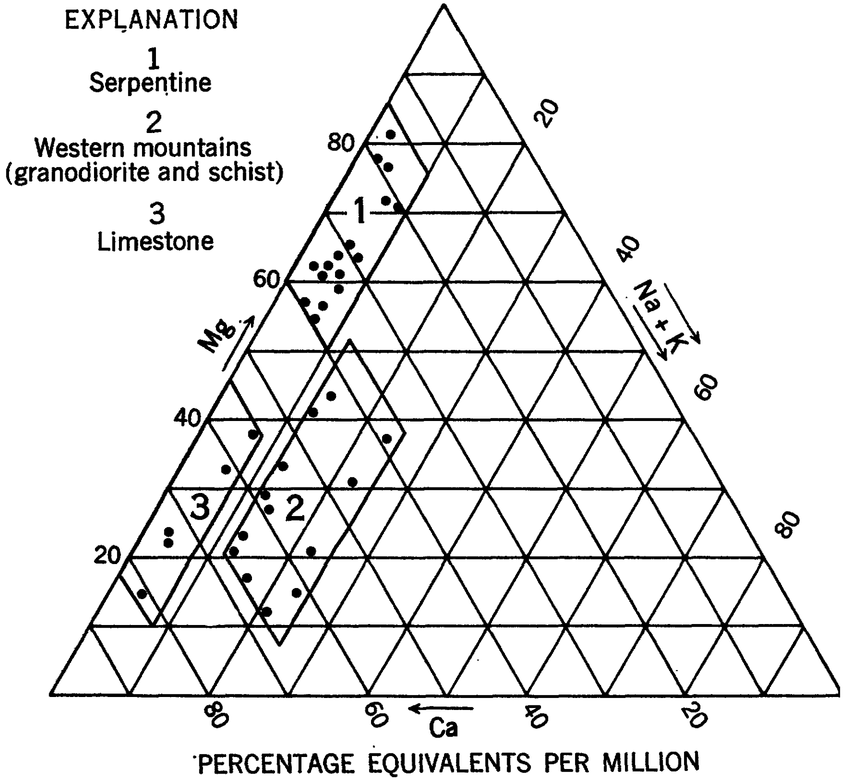

Figure 16.—Position on cation trilinear diagram of selected analyses illustrating relationship of water quality to bedrock.

RELATION OF GEOLOGY TO CHEMICAL QUALITY

There is a correlation between the composition of the bedrock and the quality of water from wells and streams in Scott Valley. Analyses for the spring and fall of 1953 were plotted on trilinear diagrams on which the cation field proved useful for illustrating a relationship (fig. 16). The anion field could not be subdivided, because most of the samples were high in bicarbonate ion and plotted within a narrow range; the central diamond field proved to be useful only in differentiating waters of the western mountains from the water on the east side of the valley which is higher in calcium and magnesium.

Four major bedrock types, which have influenced the chemical quality of the waters in the area, are discussed on the following pages. These bedrock types are: The crystalline rocks of the western mountains, serpentine-rich terrane, limestone terrane, and greenstone terrane.

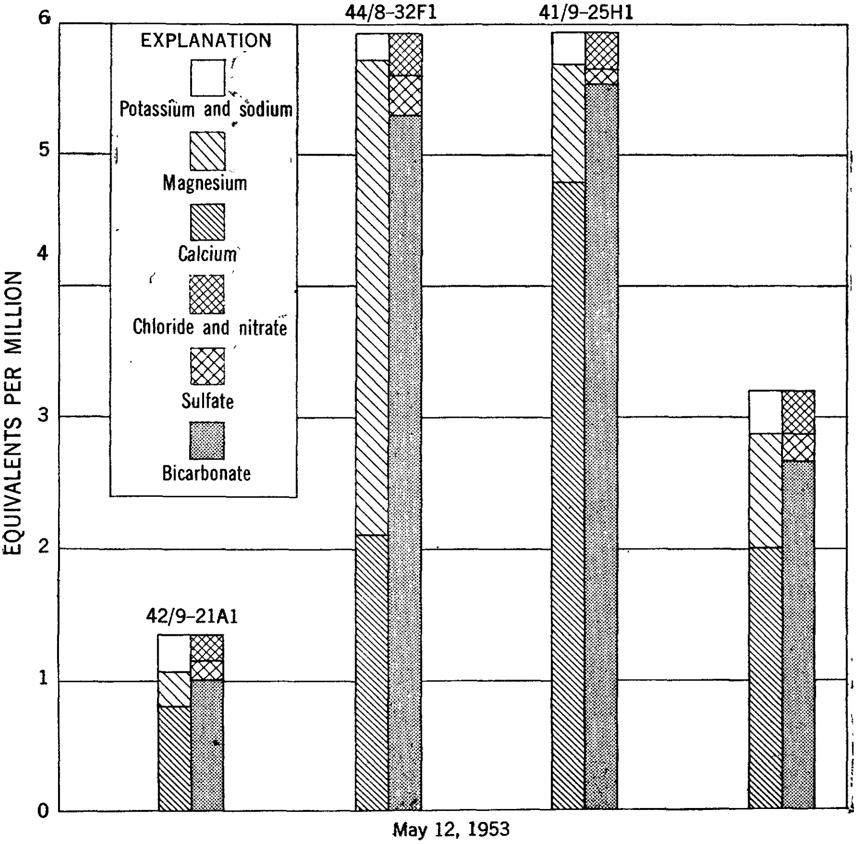

FIGURE 17.—Graphical representation of analyses of ground water in Scott Valley draining over different types of bedrock.

Figure 17 represents graphically analyses in equivalents per million of ground waters typical of these bedrock types. The cation field of the trilinear diagram (fig. 16) is utilized to plot the percentage equivalents per million of the three cation groups (Ca, Mg, Na+K) as a single point. Figure 16 shows the distinct grouping of water samples from the crystalline rocks of the western mountains, the serpentine, and the limestone. Plotted points of analyses of waters from the greenstone, which for the most part lie within the same zone as those from the limestone, on the cation diagram are not shown because they overlap several of the above groupings.

DRAINAGE OVER CRYSTALLINE ROCKS OF THE WESTERN MOUNTAINS

The water of the western mountains is distinguished by the relatively low mineralization and the high ratio of sodium plus potassium to total cations. This ratio averages about 15 percent for surface-water samples and 20 percent for ground-water samples and is significantly higher than that in waters derived from other sources in Scott Valley. Calcium generally is present in larger amounts than magnesium. The bedrock is composed mainly of granodiorite, mica schist, and hornblende schist, with lesser amounts of greenstone and serpentine. The sodium in these waters is presumed to have been released during the chemical weathering of feldspar in the igneous and metamorphic rocks. The sum of determined constituents in western mountain waters is much lower than that shown by analyses of waters in other parts of the valley, averaging 50 ppm for surface-water samples and 75 ppm for ground-water samples. The low salinity is characteristic of this source area and is a reflection of the greater amount of precipitation which falls on the western mountains in comparison with other parts of the watershed area.

Bicarbonate is the predominant anion in these waters as in all other waters in the valley. However, the analysis of water from well 43/10–25P2 in the upper Kidder Creek area is anomalous (pl. 3), showing a sulfate content of 56 percent and a bicarbonate content of 41 percent. The high sulfate content probably is derived from the oxidation of pyrite veins in the greenstone which in that area forms the bedrock along the mountain front.

DRAINAGE OVER SERPENTINE

Waters from areas underlain by serpentine are distinguished by the high proportion of the magnesium ion to the total cation content. Several areas of high-magnesium waters are recognized in Scott Valley. The south end of the valley near Callahan is a high rugged region with peaks exceeding 8,000 feet in altitude. An extensive area of serpentine underlies the northern slope of the Scott Mountains and that part of the Salmon Mountains south and west of Callahan. Analyses of ground- and surface-water samples show that magnesium averages 62 percent of total cations. The amount of dissolved solids in surface water generally is fairly low, averaging about 115 ppm.

A second area in which high-magnesium waters are found is in the northeastern part of Scott Valley along Moffett Creek. Drainage occurs over the southernmost part of the large tabular body of peridotite, largely altered to serpentine, which extends 15 miles south-southwest from Yreka into Scott Valley. Magnesium in surface and ground waters in that area averages 63 percent (of total cations). The sum of determined constituents in surface-water samples is much higher than that shown in analyses of the magnesium-rich waters of the Callahan area, averaging 210 ppm. The sum of determined constituents in ground-water samples averages 285 ppm. The quality of water in Hamlin Gulch also is affected by this serpentine mass and its south-southwestward-trending apophyses. Analyses of spring and autumn samples from well 43/9–13N2, at the mouth of Hamlin Gulch 2.5 miles south of Fort Jones, show an average of 57 percent of magnesium and an average sum of determined constituents of 246 ppm.

Several other analyses demonstrate the relationship of high-magnesium waters to serpentine. A sample from well 43/9–15L1, on the east side of Chapparal Hill, showed 70 percent magnesium. This well is only a few hundred feet east and downslope from the outcrop of a pod-shaped chromite-bearing mass of serpentine on the hillside. Similarly, analysis of sample 43/10–9L, from Shackleford Creek, shows 66 percent magnesium, which is related to the presence of a large northward-trending body of part serpentinized peridotite that crops out along the upper reaches of Shackleford Creek.

DRAINAGE OVER LIMESTONE

Water draining over limestone in Scott Valley is characterized by relatively high salinity and hardness, and calcium averages 63 percent of total cations. The average hardness and average sum of determined constituents from 9 analyses of surface- and ground-water samples are 227 ppm and 263 ppm, respectively. Points plotted for 5 of these analyses are grouped in the lower left part of the cation trilinear diagram (fig. 16).

Most of the analyses are for samples obtained near the large limestone body at the south end of the valley between McConnahue Gulch and Callahan. Analysis of a ground-water sample from well 43/9–18R1 in Oro Fino Creek valley, an area of typical western mountain waters, shows 58 percent calcium. The sum of determined constituents and hardness of 251 and 184 ppm, respectively, are much higher than those for other water samples in the area and probably reflect the influence of a small lens-shaped body of solution-pitted limestone that crops out on the east side of Quartz Hill several hundred feet west of this well.

DRAINAGE OVER GREENSTONE

Analyses of water draining over the extensive area of greenstone in the mountains north of Scott Valley do not plot in any one restricted area of the cation trilinear diagram. They plot most frequently within the zone bounding the analyses of limestone waters. Other analyses plot within the lower part of the serpentine boundary, and several fall within the narrow interzone areas between the boundaries drawn for waters draining limestone, serpentine, and the crystalline rocks of the western mountains.

Calcium and magnesium in surface- and ground-water samples from the greenstone area average 55 and 36 percent, respectively.

The average sum of determined constituents is 158 ppm. The relatively high calcium content is probably derived from the calcium-bearing alteration minerals, such as apidote and zoisite, in the greenstone.

SUMMARY

Drainage over the several rock types in the mountains surrounding Scott Valley has produced distinctive waters in different parts of the valley. Waters of highest salinity and with hardness of more than 200 ppm generally are restricted to the east side of the valley. These are differentiated by the high magnesium or calcium content, depending upon whether the source area is serpentine or limestone. Water draining the crystalline rocks of the western mountains is a soft calcium bicarbonate water; it generally contains less than 75 ppm of dissolved constituents and has a distinctly higher percent sodium than is found in water from other parts of the valley. Water draining the greenstone has a moderate concentration of dissolved constituents, averaging 158 ppm. Calcium for this water averages 55 percent, somewhat lower than for water draining over limestone.

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TABLE 8.—*Description of water wells in Scott Valley, Siskiyou County, Calif.*

Well number: See text for description of well-numbering system.
Type of well: Dug, dug well; P, drilled with percussion or cable-tool equipment; DV, driven well.
Depth of well: Depths are given in feet below land surface as a datum plane.

Type of pump: J, jet; L, lift; T, turbine; P, pitcher.
Use: Dom, domestic; Irr, irrigation; S, stock; PS, public supply; U, unused well.
Other data available: C, chemical analyses; L, drillers log; WM, weekly measurement; GR, gamma-ray log.

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well	Casing diameter (inches)	Water level		Type of pump	Horse power	Discharge (gpm)	Drawdown (feet)	Use	Other data available
							Date measured	Distance above (+) or below land-surface datum (feet)						
40/8-14N1	Callahan Ranch	--------	3,256	16	Dug	48	10-15-53	8.29	--------	--------	--------	--------	Dom	C
40/9- 1G1	Helen Johnson	--------	3,019	20	Dug	48	5- 8-53	22.91	J	½	--------	--------	Dom	C
							10-15-53	23.13						
							4-30-54	21.70						
12A1	Robert Burns	--------	3,050	--------	P	6	5- 8-53	3.93	J	1	--------	--------	Dom	C
							10-15-53	2.14						
							4-30-54	3.20						
13R1	W. T. Cowdrey	1937	3,183	--------	Dug	48	5- 8-53	6.81	J	1	--------	--------	Dom	C
							10-15-53	6.34						
							4-30-54	4.82						
41/8- 7J1	Gilbert Cody	1900	2,951	22	Dug	60	5- 8-53	10.12	--------	--------	--------	--------	Dom	C
							10-15-53	7.48						
							4-30-54	6.00						
30L1	Jim Arbuckle	1923	3,089	18	Dug	48	5- 8-53	6.04	--------	--------	--------	--------	Dom	--------
							10-15-53	11.59						
							4-30-54	3.60						
41/9- 2J1	R. E. Richman	--------	2,828	--------	Dug	36	5- 8-53	7.30	J	½	--------	--------	Dom	C
							10-15-53	11.51						
							4-30-54	6.80						
3L1	Robert Tuttle	1949	2,827	25	Dug	36	5- 8-53	11.22	J	½	--------	--------	Dom	C
							10-14-53	14.58						
							4-30-54	12.11						
10J1	Calvin A. Ball	--------	2,872	50	P	12	5- 8-53	6.03	--------	--------	--------	--------	U	--------
							4-30-54	3.11						
10J2	do	1938	2,859	25	Dug	60	10-15-53	11.98	J	½	--------	--------	Dom	--------
							4-30-54	3.61						
13B1	Warren Parker	1930	2,889	18	Dug	36	5- 8-53	8.20	--------	--------	--------	--------	Dom	C
							10-15-53	7.26						
							4-30-54	3.50						

TABLE 8.—*Description of water wells in Scott Valley, Siskiyou County, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well	Casing diameter (inches)	Water level: Date measured	Water level: Distance above (+) or below land-surface datum (feet)	Type of pump	Horse power	Discharge (gpm)	Drawdown (feet)	Use	Other data available
41/9-13G1	G. F. Betschart	1900	2,889	32	Dug	60	5- 8-53 10-15-53 4-30-54	10.31 9.52 10.12					Dom	WM
22M1	Melvin Caloia	1952	2,958	15	P	6	5- 8-53 10-15-53 4-30-54	5.50 5.43 4.70					Dom	C
24H1	Howard A. Towne		2,896		P	8	5- 8-53 10-15-53 4-30-54	+1.20 flowing .60	J	1			Dom	C
25H1	W. N. Wolford	1949	2,928	65	P	8	5- 8-53 10-15-53 4-30-54	15.30 17.98 13.70	J	½	10		Dom	L, C
25R1	Antonio DeFeria		2,967	14	Dug	48	5- 8-53 10-15-53 4-30-54	4.95 8.24 4.95					Dom	C
36B1	Charles Facey		2,980	28	Dug	48	5- 8-53 10-15-53 4-30-54	12.40 16.90 10.20					U	C
36J1	Harold Duffy		2,973		Dug	60	5- 8-53 10-15-53 4-30-54	16.20 14.54 12.80	J	½			Dom	C,WM
42/9- 2A2	Carl Black		2,746	22	Dug	54	10-13-53 4-29-54	11.46 8.60	J	1			Dom	WM
2G1	do	1948	2,750	76	P	16	5- 8-53 10-13-53 4-29-54	5.20 10.39 5.70	T	20	1,200	30	Irr	L,WM
2N1	Lester H. Holmes	1952	2,743	28	Dv	2	5- 8-53 4-29-54	4.70 4.60	P		140	5	S	L
4P1	Vincent	1951	2,769	156	P	12	9-22-53	flowing	T		500	100	S	L
4Q1	F. Ray Eller	1936	2,767	60	P	6	5- 8-53 10-13-53 4-29-54	flowing +.69 flowing	J	1			Dom	L,WM
5H1	Frank Johnson		2,783		Dug	60	5- 8-53 10-13-53 4-29-54	2.10 5.78 2.60					U	
6F2	F. I. Kellems	1953	2,852	26	Dug	60	5- 8-53 10-13-53 4-29-54	9.60 21.72 11.10					U	L,WM

8C1	Wessley Carter	1950	2,831	52	Dug	48	10-13-53	36.32	P				Dom	L
							4-29-54	21.00						
9D1	Robert S. Young	1948	2,805	32	P	6	10-14-53	12.50	J	1			S	
							4-29-54	6.60						
10K1	A. H. Newton	1952	2,744	120	P	20	10-13-53	5.24	T	75	2,750	52	Irr	L
							4-29-54	1.70						
10Q1	do	1952	2,748	120	P	20	10-13-53	5.55	T	50	2,500	46	Irr	L
							4-29-54	2.70						
11D1	J. R. McNames	1951	2,746	22	Dv	2			J	½			Dom	L
13D1	Frank Bryan	1925	2,773	35	Dug	36	10-15-53	23.47	P				Dom	L
							4-29-54	19.90						
14E1	C. V. Hovenden	1942	2,756	20	P	6	5-8-53	6.60					U	
							10-13-53	9.50						
							4-30-54	6.20						
16Q1	Carl McConnell	1951	2,769	200	P	20	10-15-53	2.48					U	GR
17K1	do	1952	2,863	220	P	16	5-8-53	21.05			30		U	GR, L
							10-13-53	21.80						
							4-30-54	20.85						
17Q1	do	1952	2,843	201	P	20							U	L
20G1	Bill Matthews		2,946	141	P	12	10-15-53	36.36					U	GR, L
21A1	Lee and Ormand Smith	1924	2,780	10	Dug	60	5-8-53	flowing					U	C
							10-13-53	.98						
							4-30-54	flowing						
21M1	Carl Hammond		2,867		Dug	48	5-8-53	6.20					U	
							4-30-54	3.50						
24M1	R. Edwards		2,784	20	Dug	48	10-15-53	12.34	J	1			S	
							4-30-54	12.20						
26K1	Douglas Horn	1860	2,779		Dug	30	5-8-53	11.20					U	WM
							10-14-53	13.14						
							4-30-54	10.80						
27G1	do	1948	2,794		P	10	5-8-53	3.90					U	
							10-14-53	14.45						
							4-30-54	2.10						
27N1	Joe Starr	1933	2,840	19	Dug	60	5-8-53	1.60					U	WM
							10-14-53	6.70						
							4-30-54	1.90						
29A1	J. M. Miles	1950	2,917	55	P	6	5-8-53	1.40	J	½			Dom	C, WM
							10-13-53	13.94						
							4-30-54	1.00						
32H1	Bogue	1951	2,955	25	P	6			J	1	75		Dom	L
32H2	Ayres	1951	2,953	25	P	6			J	½	75		Dom	L
34L1	W. J. Halliday		2,803	20	Dug	36	5-8-53	9.60					Dom	C
							10-15-53	14.49						
							4-30-54	9.30						
34P1	J. S. Ranch	1910	2,804	18	Dug	36			J	1½			Dom	L
35Q1	Louisa Young	1860	2,806		Dug	48	5-8-53	11.60	P				Dom	C
							10-15-53	17.90						
							4-30-54	8.80						
43/8-17F1	Ft. Jones Mound School		2,853		Dug		5-7-53	11.80	P				U	
							10-12-53	18.44						
							4-29-54	11.20						
17Q1	L. F. Wood	1905	2,845	20	Dug	48			P				S	L

TABLE 8.—*Description of water wells in Scott Valley, Siskiyou County, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well	Casing diameter (inches)	Water level		Type of pump	Horse power	Discharge (gpm)	Drawdown (feet)	Use	Other data available
							Date measured	Distance above (+) or below land-surface datum (feet)						
43/9- 2G1	Fort Jones Municipal	--------	2,727	45	Dug	72	--------	--------	T	20	600	--------	PS	--------
2K1	George A. Milne	--------	2,725	25	Dug	48	10-15-53	8.76	--------	--------	--------	--------	U	--------
							4-29-54	6.60						
2K2	Fort Jones Ranger Sta	--------	2,725	19	Dug	60	10-15-53	8.50	--------	--------	--------	--------	Dom	--------
							4-30-54	6.50						
2L1	Perkins	1950	2,728	42	P	6	--------	--------	J	½	35	--------	Dom	L
2Q1	Paul Eichorst	1949	2,723	56	P	8	--------	--------	J	1	17	30	S	L
3F1	Dick Howell	--------	2,724	--------	Dug	30	10-13-53	16.04	--------	--------	--------	--------	U	--------
							4-26-54	14.10						
5F1	Clinton Custer	1947	2,737	65	P	6	5-7-53	5.63	J	½	--------	--------	Dom	--------
8F1	Frank Luckensmeyer	--------	2,753	19	Dug	48	5-7-53	6.50	J	¼	--------	--------	Dom	C
							10-14-53	7.89						
							4-30-54	6.50						
8Q1	Cassie Quigley	1948	2,773	25	Dug	48	5-7-53	13.70	J	½	--------	--------	Dom	C, WM
							10-14-53	14.40						
							4-26-54	13.90						
10J2	Mary R. Davidson	1949	2,743	72	P	8	5-7-53	22.20	J	¾	30	--------	Dom	C, L
							10-14-53	26.66						
							4-30-54	18.30						
11H2	Edwin Fisher	1946	2,736	51	P	8	5-7-53	25.50	J	½	--------	--------	Dom	C
							10-12-53	28.28						
							4-29-54	24.60						
12N1	R. H. Burton	1913	--------	42	Dug	36	--------	--------	--------	--------	--------	--------	Dom	C
13E1	Woolrey	--------	2,724	--------	Dug	60	10-15-53	11.67	J	¾	--------	--------	Dom	C
							4-29-54	7.70						
13N2	J. C. Stroud	--------	2,735	18	Dug	60	5-7-53	8.80	--------	--------	--------	--------	S	C
							10-12-53	11.68						
							4-29-54	9.50						
15L1	Joe Serpa	1934	2,785	23	Dug	48	10-14-53	6.70	J	½	--------	--------	S	C
18R1	Charles King	1951	2,801	--------	P	6	5-7-53	3.10	J	½	--------	--------	Dom	C
							10-14-53	4.01						
							4-26-54	3.40						
21K1	Bruce Martin	1940	2,762	100	P	12	10-13-53	1.27	T	3	100	--------	S	L
							4-26-54	.70						
21Q1	do	--------	2,761	32	Dug		5-7-53	.90	J	½	--------	--------	Dom	--------
22P1	Gorman Bros	--------	--------	7	Dug	48	5-7-53	2.40	--------	--------	--------	--------	U	--------
							4-26-54	1.90						

23F1	G. A. Reynolds	1952	2,728	23	P	8	5-7-53 10-12-53 4-29-54	3.60 6.13 3.20					U	L, WM
24F1	Lewis Lukes	1953	2,735	205	P	16	10-12-53 4-29-54	8.75 6.00	T	20	1,420	97	Irr	L, WM
24F2	do	1953	2,734	183	P	16	5-7-53 10-12-53 4-29-54	6.40 10.23 7.60	T	20	1,230	56	Irr	L, WM
24Q1	W. J. Pindell	1900	2,740	40	Dug	48			J	1½	30		Dom, S	L
26C2	H. J. Scharbarum	1952	2,732	27	Dv	2	5-7-53 10-14-53	3.50 5.55	L		60		Dom	L
26L1	Charles Seaver	1943	2,737	24	Dv	2	5-7-53 10-14-53 4-29-54	3.20 5.08 2.60					U	L
28E1	Al and Joe King	1950	2,784	46	P	8	5-7-53 10-12-53 4-25-54	4.10 11.89 4.70	J	½			S	L, C, WM
29M1	W. I. Montgomery	1936	2,829	27	Dug	36			L				Dom	L
30A1	E. Grant Lewis	1915	2,842	16	Dug	72	5-7-53 10-13-53 4-26-54	flowing 6.96 .50	T	1½			Dom, S	C
31B1	Tillson Palmer	1948	2,873	20	Dug	54	5-7-53 10-13-53 4-29-54	6.70 10.95 5.50	J	½			Dom	C
32G1	Bernard Walker	1924	2,806	30	Dug	60	5-7-53 10-13-53 4-29-54	8.90 18.49 8.40					U	C
33G1	Taylor	1941	2,766	100	P	14	5-7-53 10-13-53	flowing 1.62	T		300	53	S	L
43/10-14B1	Carl Craig		2,875		P	12	10-15-53 4-29-54	12.03 4.30	C	1			Dom	
15A1	Bob Curtis	1945	2,914		Dug	48	10-12-53 4-29-54	26.35 11.00					U	L
25P1	Ross Hughes	1951	2,974	30	Dug	48	10-14-53 4-29-54	9.42 5.30	L				Dom	L
25P2	do		2,980		Dug	72	5-7-53 10-14-53 4-29-54	6.90 11.80 6.00					U	C
44/8-27L1	Joe Deas		2,908	30	Dug	60	5-7-53 10-12-53 4-26-54	12.40 15.38 13.90	J	½			Dom	WM
30P1	J. C. Cardoza	1945	2,789	15	Dug	36	5-7-53 10-12-53 4-26-54	1.80 5.68 1.80					U	C
31G1	J. H. Stanton		2,893		Dug	48	5-7-53 10-12-53 4-26-54	15.50 19.76 14.40	J	½			Dom	C
32F1	A. W. Riedel	1935	2,825	27	Dug	30	5-7-53 10-12-53 4-26-54	2.85 7.28 2.85	W				Dom	WM, C
33C1	C. N. MacDonald	1953	2,848	35	P	12	9-24-53 4-26-54	4.00 2.10	C	5	250	2.5	Irr	L
33D1	do	1950	2,831	47	P	8	7-13-53	2.65	J	½	100		Dom, S	L

TABLE 8.—*Description of water wells in Scott Valley, Siskiyou County, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well	Casing diameter (inches)	Water level		Type of pump	Horse power	Discharge (gpm)	Drawdown (feet)	Use	Other data available
							Date measured	Distance above (+) or below land-surface datum (feet)						
44/9-27M1	John Crechriou	1900	2,743	45	Dug	42	5- 7-53	2.40	J	1	--------	--------	Dom	C
							10-12-53	25.74						
28P1	F. R. Simpson	1949	2,711	65	P	8	10-12-53	17.81	--------	--------	35	--------	U	L
							4-26-54	3.80						
28Q1	Grace Hullquist	1949	2,721	50	P	6	5- 7-53	5.30	C	1	--------	--------	Dom, S	WM
							10-12-53	22.39						
							4-26-54	4.00						
29F1	Jack Roesner	1920	2,704	19	Dug	72	5- 7-53	8.30	--------	--------	--------	--------	U	C, WM
							10-12-53	7.96						
							4-26-54	6.50						
29Q1	R. S. Simpson	1948	--------	36	P	6	--------	--------	--------	--------	--------	--------	S	C
30G1	Mary Johnson	1917	2,695	25	Dug	66	5- 7-53	14.70	J	½	--------	--------	Dom	--------
							10-12-53	15.74						
							4-26-54	15.80						
32A1	R. S. Simpson	1949	2,702	30	P	8	--------	--------	J	2½	15	--------	S	L
34G1	Star Ranch	1952	2,721	100	P	8	5- 7-53	8.80	--------	--------	100	--------	U	L, WM
							10-12-53	17.18						
							4-26-54	8.30						
34R2	do	1860	2,717	20	Dug	48	5- 7-53	10.30	--------	--------	--------	--------	U	C, WM
							10-12-53	13.38						
							4-26-54	9.70						
35Q1	E. H. Buscombe, Jr	1945	2,735	70	P	8	5- 7-53	5.30	J	3	--------	--------	Dom, S	--------
							10-12-53	6.38						
							4-30-54	4.30						
44/10-25H1	Staley Brothers	1952	2,703	52	P	6	--------	--------	J	½	6	15	Dom	L
25H2	Henry Kyte	1949	2,694	17	Dug	60	5- 7-53	9.60	J	½	--------	--------	Dom	WM
							10-12-53	13.55						
							4-26-54	9.40						
34H1	Ed Burton	--------	2,707	--------	Dug	48	10-15-53	8.50	--------	--------	--------	--------	Dom	--------
							4-26-54	7.30						
34Q1	R. DeNure	--------	2,824	91	P	6	10-15-53	1.45	J	½	--------	--------	Dom	L
35G1	Harry Tozier	--------	2,683	--------	Dug	36	10-12-53	12.62	J	½	--------	--------	Dom	WM
							4-26-54	9.40						

TABLE 9.—*Weekly water-level measurements in the Scott Valley area, California*

41/9-13G1

[G. F. Betschart. In frame pumphouse about 6.6 miles north-northwest of Callahan, 0.58 mile north of Fay Lane, 450 feet east of east side Scott Valley road, 20 feet east of dwelling. Domestic dug well, diameter 36 inches, depth 18 feet. Measuring point, loose board over pit, at land-surface datum which is 2,889 feet above sea level]

Date	Water level	Date	Water level
July 14, 1953	6.75	Sept. 14, 1953	7.85
July 20	7.78	Sept. 21	8.24
July 27	7.28	Sept. 28	8.58
Aug. 3	8.08	Oct. 5	8.48
Aug. 10	8.78	Oct. 14	9.52
Aug. 17	7.55	Oct. 19	9.93
Aug. 24	7.29	Oct. 26	10.94
Aug. 31	6.22		

41/9-36J1

[Harold Duffy. About 3.5 miles northwest of Callahan, 2.63 miles south of Fay Lane, 100 feet west of east side Scott Valley road, 10 feet north of dwelling. Domestic dug well, diameter 60 inches. Measuring point, east side of concrete curb over pit, 1 foot above land-surface datum which is 2,973 feet above sea level]

Date	Water level	Date	Water level
July 20, 1953	12.16	Sept. 14, 1953	14.59
July 27	12.35	Sept. 21	13.73
Aug. 3	13.68	Sept. 28	13.81
Aug. 10	12.88	Oct. 5	13.80
Aug. 17	12.56	Oct. 14	14.54
Aug. 24	12.87	Oct. 19	14.96
Aug. 31	13.58	Oct. 26	16.89

42/9-2A2

[Carl Black. About 5.6 miles south of Fort Jones, 0.36 mile north of Cory road extension, 20 feet west of east side road. In metal house. Domestic dug well, diameter 54 inches, depth 22 feet. Measuring point, top of casing 37 feet below land-surface datum which is 2,746 feet above sea level]

Date	Water level	Date	Water level
Aug. 24, 1953	10.03	Oct. 5, 1953	11.40
Aug. 31	10.55	Oct. 13	11.46
Sept. 14	11.39	Oct. 19	11.77
Sept. 22	11.10	Oct. 26	11.54
Sept. 28	11.42		

42/9-2G1

[Carl Black. In field about 5.8 miles south of Fort Jones, 0.28 mile north of Cory road extension, 0.37 mile west of east side Scott Valley road. Irrigation well, diameter 16 inches, depth 76 feet. Measuring point, hole on east side of pump base, 1.0 foot above land-surface datum which is 2,750 feet above sea level]

Date	Water level	Date	Water level
July 14, 1953	5.74	Sept. 14, 1953	8.51
July 20	6.07	Sept. 22	7.74
July 27	7.66	Sept. 28	7.84
Aug. 3	8.03	Oct. 5	9.39
Aug. 10	[a] 26.58	Oct. 12	10.39
Aug. 17	[a] 22.50	Oct. 19	7.41
Aug. 24	9.50	Oct. 26	7.40
Aug. 31	7.50		

See footnotes at end of table.

TABLE 9.—*Weekly water-level measurements in the Scott Valley area, California*—Continued

42/9-4Q1

[F. Ray Eller. In frame pumphouse about 2.7 miles southeast of Greenview, 1.30 miles east of Highway 82, 300 feet north of Cory-Griffin Lane, 60 feet north of dwelling. Domestic well, diameter 6 inches, depth 60 feet. Measuring point, top of casing, 1 foot above land-surface datum which is 2,767 feet above sea level]

Date	Water level	Date	Water level
July 14, 1953	[a] 5.65	Sept. 14, 1953	Flowing
July 20	Flowing	Sept. 22	Do.
July 27	Do.	Sept. 28	+0.77
Aug. 3	Do.	Oct. 5	+0.75
Aug. 10	Do.	Oct. 12	+0.69
Aug. 17	Do.	Oct. 19	+0.97
Aug. 24	Do.	Oct. 26	+0.86
Aug. 31	Do.		

42/9-6F2

[F. I. Kellems. About 2.2 miles southwest of Greenview, 1.1 miles west of Highway 82, 100 feet southeast of dwelling. Unused, dug well, diameter 60 inches, depth 26 feet. Measuring point, side of pit at land-surface datum which is 2,852 feet above sea level]

Date	Water level	Date	Water level
Aug. 17, 1953	19.95	Sept. 28, 1953	21.23
Aug. 24	20.36	Oct. 5	21.48
Aug. 31	20.60	Oct. 12	21.72
Sept. 14	21.18	Oct. 19	21.67
Sept. 21	21.14	Oct. 26	21.70

42/9-26K1

[Douglas Horn. About 2.4 miles east of Etna, 100 feet east of east side Scott Valley road, 50 feet southwest of dwelling. Unused dug well, diameter 30 inches. Measuring point, loose boards at land-surface datum which is 2,779 feet above sea level]

Date	Water level	Date	Water level
July 20, 1953	11.11	Sept. 14, 1953	12.76
July 27	11.34	Sept. 21	12.84
Aug. 3	11.30	Sept. 28	12.98
Aug. 10	11.86	Oct. 5	13.09
Aug. 17	12.38	Oct. 13	13.14
Aug. 24	12.54	Oct. 19	13.16
Aug. 31	12.74	Oct. 26	13.19

42/9-27N1

[Joe Starr. About 1.0 mile east of Etna, 50 feet north of Horn Lane, 50 feet west of dwelling. Unused dug well, diameter 60 inches, depth 19 feet. Measuring point, top of old pump base, 1.1 feet above land-surface datum which is 2,840 feet above sea level]

Date	Water level	Date	Water level
July 14, 1953	1.57	Sept. 14, 1953	6.03
July 20	1.59	Sept. 21	6.31
July 27	1.83	Sept. 28	6.55
Aug. 3	2.18	Oct. 5	6.70
Aug. 10	2.60	Oct. 13	6.74
Aug. 17	4.64	Oct. 19	4.56
Aug. 24	5.35	Oct. 26	4.06
Aug. 31	4.40		

See footnotes at end of table.

TABLE 9.—*Weekly water-level measurements in the Scott Valley area, California*—Continued

42/9-29A1

[J. M. Miles. In frame pumphouse about one-half mile north of Etna, 0.12 mile west of Highway 82, 50 feet southeast of dwelling. Domestic well, diameter 6 inches, depth 65 feet. Measuring point, top of casing, 0.3 foot above land-surface datum which is 2,917 feet above sea level]

Date	Water level	Date	Water level
July 14, 1953	2.48	Sept. 14, 1953	14.46
July 20	3.01	Sept. 21	14.53
July 27	10.37	Sept. 28	14.68
Aug. 3	15.25	Oct. 5	[b] 20.28
Aug. 10	11.37	Oct. 12	13.94
Aug. 17	10.93	Oct. 19	14.69
Aug. 24	12.09	Oct. 26	14.54
Aug. 31	12.16		

43/9-8Q1

[Cassie Quigley. About 2.5 miles north of Greenview, 0.57 mile northeast of ditch road, 100 feet west of Oro Fino road, in white frame pumphouse 30 feet north of dwelling. Domestic dug well, diameter 48 inches, depth 25 feet. Measuring point, board cover over well, 1.5 feet above land-surface datum which is 2,773 feet above sea level]

Date	Water level	Date	Water level
July 14, 1953	14.08	Aug. 31, 1953	14.19
July 20	13.90	Sept. 14	14.52
July 27	14.02	Sept. 21	14.43
Aug. 3	14.18	Sept. 28	14.39
Aug. 10	14.10	Oct. 5	14.37
Aug. 17	14.20	Oct. 12	14.40
Aug. 24	14.39	Oct. 19	14.42

43/9-23F1

[G. A. Reynolds. About 2.9 miles south of Fort Jones, 0.42 mile south of junction of middle Scott Valley road and Highway 82-Island Connection, 20 feet east of middle Scott Valley road, 50 feet west of red barn. Unused well, diameter 8 inches, depth 23 feet. Measuring point, top of casing at land-surface datum which is 2,728 feet above sea level]

Date	Water level	Date	Water level
July 13, 1953	4.55	Sept. 14, 1953	6.25
July 20	4.94	Sept. 22	6.26
July 27	5.33	Sept. 28	6.26
Aug. 3	5.67	Oct. 5	6.24
Aug. 10	5.82	Oct. 12	6.13
Aug. 17	6.04	Oct. 19	6.03
Aug. 24	6.13	Oct. 26	5.66
Aug. 31	6.19		

43/9-24F1

[Lewis Lukes. About 2.9 miles south-southeast of Fort Jones, 0.56 mile southeast of intersection of middle Scott Valley road and east side Scott Valley road, 50 feet west of east side Scott Valley road alongside of ditch. Irrigation well, diameter 16 inches, depth 205 feet. Measuring point, air-line notch, north side of casing, 2.0 feet above land-surface datum, which is 2,735 feet above sea level]

Date	Water level	Date	Water level
July 20, 1953	[c] 13.99	Sept. 14, 1953	8.07
July 27	[a] 22.38	Sept. 21	8.22
Aug. 3	8.71	Sept. 28	8.37
Aug. 10	[a] 21.32	Oct. 5	8.52
Aug. 17	[a] 24.69	Oct. 12	8.75
Aug. 24	[a] 24.98	Oct. 19	8.92
Aug. 31	8.05	Oct. 26	9.19

See footnotes at end of table.

TABLE 9.—*Weekly water-level measurements in the Scott Valley area, California*—Continued

43/9–24F2

[Lewis Lukes. About 2.7 miles south of Fort Jones, 0.38 mile southeast of intersection of middle Scott Valley road and east side Scott Valley road, 50 feet west of east side Scott Valley road alongside of ditch. Irrigation well, diameter 16 inches, depth 183 feet. Measuring point, notch in north side of casing, 1.0 foot above land-surface datum which is 2,734 feet above sea level]

Date	Water level	Date	Water level
July 13, 1953	[a]22.23	Sept. 14, 1953	9.59
July 20	[a]21.20	Sept. 21	9.72
July 27	[a]22.47	Sept. 28	9.88
Aug. 3	8.75	Oct. 5	10.07
Aug. 10	8.94	Oct. 12	10.23
Aug. 17	[a]20.75	Oct. 19	10.42
Aug. 24	[a]21.20	Oct. 26	10.57
Aug. 31	9.58		

43/9–28E1

[Al and Joe King. About one-half mile east-northeast of Greenview, 175 feet east of Highway 82, in white frame pumphouse, 30 feet east of corral gate. Stock well, diameter 8 inches, depth 46 feet. Measuring point, top of casing, 0.1 foot above land-surface datum which is 2,784 feet above sea level]

Date	Water level	Date	Water level
July 14, 1953	4.09	Sept. 14, 1953	9.18
July 20	4.34	Sept. 22	10.16
July 27	4.61	Sept. 28	11.69
Aug. 3	4.77	Oct. 5	11.16
Aug. 10	4.98	Oct. 12	11.89
Aug. 17	5.45	Oct. 19	12.09
Aug. 24	6.09	Oct. 26	12.53
Aug. 31	6.89		

44/8–27L1

[Joe Deas. About 5.0 miles northeast of Fort Jones, 0.25 mile west of Costa Gulch, 100 feet north of the old Fort Jones-Yreka road, 250 feet west of wood bridge over Moffett Creek. Domestic dug well, diameter 60 inches, depth 30 feet. Measuring point, top of concrete curb west side, 2.2 feet above land-surface datum which is 2,908 feet above sea level]

Date	Water level	Date	Water level
July 13, 1953	13.49	Sept. 14, 1953	14.35
July 20	11.92	Sept. 21	13.78
July 27	13.92	Sept. 28	12.75
Aug. 3	13.74	Oct. 5	15.05
Aug. 10	14.13	Oct. 12	15.38
Aug. 17	14.28	Oct. 19	15.34
Aug. 24	14.17	Oct. 26	14.91
Aug. 31	14.34		

44/8–32F1

[A. W. Riedel. Under windmill tower about 2.7 miles northeast of Fort Jones, 20 feet south of Highway 82, 1.28 miles east of intersection Highway 82 and old Fort Jones-Yreka road, 150 feet east of farm house. Domestic dug well, diameter 30 inches, depth 27 feet. Measuring point, north side of board, 1.85 feet above land-surface datum which is 2,825 feet above sea level]

Date	Water level	Date	Water level
Aug. 24, 1953	5.20	Oct. 5, 1953	6.89
Aug. 31	5.40	Oct. 12	7.28
Sept. 14	5.83	Oct. 19	7.65
Sept. 21	6.21	Oct. 26	7.92
Sept. 28	6.52		

See footnotes at end of table.

TABLE 9.—*Weekly water-level measurements in the Scott Valley area, California*—Continued

44/9-28Q1

[Grace Hullquist. About 2.6 miles northwest of Fort Jones, 0.6 mile west of Indian Creek road, 40 feet north of Scott Bar road, 300 feet east of house, on hillside below irrigation ditch. Domestic and stock well, diameter 6 inches, depth 50 feet. Measuring point, top of casing, 0.2 foot above land-surface datum which is 2,721 feet above sea level]

Date	Water level	Date	Water level
July 13, 1953	10. 36	Sept. 14, 1953	17. 97
July 20	10. 82	Sept. 21	19. 48
July 27	11. 85	Sept. 28	20. 23
Aug. 3	13. 70	Oct. 5	21. 34
Aug. 10	13. 35	Oct. 12	22. 39
Aug. 17	15. 25	Oct. 19	23. 23
Aug. 24	16. 50	Oct. 26	23. 97
Aug. 31	17. 40		

44/9-29F1

[Jack Roesner. About 4.2 miles northwest of Fort Jones, 1.3 miles west of Rattlesnake Creek road, 125 feet north of Scott Bar road, in garden 50 feet north of house. Unused, dug well, diameter 72 inches, depth 19 feet. Measuring point, top of loose boards, 0.8 foot above land-surface datum which is 2,704 feet above sea level]

July 20, 1953	9. 92	Sept. 14, 1953	5. 30
July 27	8. 44	Sept. 21	6. 61
Aug. 3	3. 00	Sept. 28	8. 52
Aug. 10	5. 25	Oct. 5	6. 09
Aug. 17	1. 36	Oct. 12	7. 96
Aug. 24	1. 69	Oct. 19	8. 19
Aug. 31	4. 32	Oct. 26	8. 93

44/9-34G1

[Star Ranch. In open field about 1.8 miles northwest of Fort Jones along Scott Bar road, 150 feet southwest of gate on Scott Bar road. Unused well, diameter 8 inches, depth 100 feet. Measuring point, top of open casing, 0.8 foot above land-surface datum which is 2,721 feet above sea level]

Aug. 3, 1953	10. 40	Sept. 21, 1953	14. 74
Aug. 10	9. 99	Sept. 28	15. 65
Aug. 17	10. 63	Oct. 5	16. 43
Aug. 24	11. 34	Oct. 12	17. 18
Aug. 31	12. 30	Oct. 19	17. 88
Sept. 14	13. 78	Oct. 26	18. 45

44/9-34R2

[Star Ranch. About 1.1 miles northwest of Fort Jones along Scott Bar road, 80 feet southwest of Scott Bar road, 450 feet west of section line, in old wooden pumphouse 550 feet north of section line. Unused, dug well, diameter 48 inches, depth 20 feet. Measuring point, loose board over well at land-surface datum which is 2,717 feet above sea level]

July 13, 1953	9. 19	Sept. 14, 1953	13. 29
July 20	9. 21	Sept. 21	13. 41
July 27	10. 78	Sept. 28	13. 54
Aug. 3	11. 44	Oct. 5	13. 63
Aug. 17	12. 44	Oct. 12	13. 38
Aug. 24	13. 12	Oct. 19	13. 78
Aug. 31	12. 80	Oct. 26	14. 13

TABLE 9.—*Weekly water-level measurements in the Scott Valley area, California*—Continued

44/10-25H2

[Henry Kyte. About 5.4 miles northwest of Fort Jones, 0.81 mile east of west Quartz Valley road, in wooden well house 200 feet north of Scott Bar road, 100 feet south of house. Domestic dug well, diameter 60 inches, depth 17 feet. Measuring point, top of metal tube, 0.1 foot above land-surface datum which is 2,694 feet above sea level]

Date	Water level	Date	Water level
July 13, 1953	11.47	Sept. 14, 1953	13.88
July 20	11.67	Sept. 21	13.45
July 27	11.87	Sept. 28	13.94
Aug. 3	11.94	Oct. 5	13.48
Aug. 10	13.00	Oct. 12	13.55
Aug. 17	13.20	Oct. 19	13.65
Aug. 24	12.93	Oct. 26	13.74
Aug. 31	13.75		

44/10-35G1

[Harry Tozier. About 6.4 miles west-northwest of Fort Jones, 20 feet west of intersection of west Quartz Valley road, and west Quartz Valley-Oro Fino road connection, in small shelter in front yard. Domestic dug well, diameter 36 inches. Measuring point, top of casing, 1.5 feet above land-surface datum which is 2,683 feet above sea level]

Date	Water level	Date	Water level
July 13, 1953	9.02	Aug. 31, 1953	9.70
July 20	7.60	Sept. 14	8.64
July 27	10.53	Sept. 21	8.34
Aug. 3	8.71	Sept. 28	11.28
Aug. 10	7.73	Oct. 5	11.84
Aug. 17	9.85	Oct. 12	12.62
Aug. 24	10.17	Oct. 19	12.17

[a] Pumping.
[b] Recently pumped.
[c] Nearby well pumping.

TABLE 10.—*Drillers' logs of selected water wells in the Scott Valley area, California*

42/9-2G1

[Carl Black. Drilled by Buckner. On Scott River flood plain. Altitude 2,750 feet. Casing perforated 39 to 76 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Top soil and sand	8	8	Water clay	1	39
Blue clay	10	18	Very coarse gravel	37	76
River gravel	20	38	Clay	3	79

42/9-2N1

[Lester H. Holmes. Drilled by owner. On Scott River flood plain. Altitude 2,743 feet. Casing perforated 22 to 28 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Top soil	9	9	Fine gravel (surface-water-bearing)	4	16
Mica in gravel and sand	1	10	Blue to yellow clay	5	21
Blue clay	2	12	Gravel	7	28

TABLE 10.—*Drillers' logs of selected water wells in the Scott Valley area, California*—Continued

42/9–4P1

[Vincent. Drilled by N. R. Jessee. On discharge zone near base of West Patterson Creek fan. Altitude 2,769 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Top soil	12	12	Clay and gravel	140	156
Hard clay	4	16			

42/9–4Q1

[F. Ray Eller. Driller unknown. On discharge zone near base of West Patterson Creek fan. Altitude 2,767 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Sandy loam	15	15	Gravel	2	33
Clay	5	20	Hardpan	17	50
Hardpan	11	31	Gravel	10	60

42/9–8C1

[Wessley Carter. Dug by owner. On West Patterson Creek fan. Altitude 2,831 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Clay, gravel, and rock	22	22	Gravel with clay lenses	22	52
Coarse sand and clay	8	30			

42/9–10K1

[Albert H. Newton. Drilled by N. R. Jessee. On Scott River flood plain. Altitude 2,744 feet. Casing perforated from 0 to 120 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Soil	4	4	Loose sand, thin clay streaks	5	69
Sand and fine gravel	9	13	Sand and gravel, streaked with clay	10	79
Sand and fine gravel	2	15	Yellow clay	4	83
Sand and gravel some clay	10	25	Sand and gravel, streaked with yellow clay	13	96
Sand and gravel as much as 3 inches	29	54	Red stained sand and gravel	9	105
Sand, gravel and clay	4	58	Gravel and clay	11	116
Yellow hardpan, some sand	3	61	Fine gravel	1	117
Gray hardpan, some gravel	3	64	Clay and gravel	3	120

42/9–10Q1

[Albert H. Newton. Drilled by N. R. Jessee. On Scott River flood plain. Altitude 2,748 feet. Casing perforated from 0 to 120 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Loam	3	3	Gravel, good water	8	35.5
Sand	1	4	Gravel and sand	7.5	43
Clay, loam	2	6	Tule mud	2	45
Quicksand	3	9	Quicksand	8	53
Gravel and sand	5	14	Gravel and sand	5	58
Tule mud	2	16	Good gravel with thin seams of clay, good water	32	90
Gravel and sand	4	20	Sand and gravel	30	120
Lake bed alder roots, mud	1.5	21.5			
Quicksand	6	27.5			

TABLE 10.—*Drillers' logs of selected water wells in the Scott Valley area, California*—Continued

42/9-17K1

[Carl McConnell. Drilled by N. R. Jessee. On Crystal Creek fan. Altitude 2,863 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Top soil	3	3	Greenish clay, broken rock and gravel	14	78
Granite sand	4	7	Green clay and gravel	2	80
Dirty, sandy	7	14	Yellow clay and gravel	5	85
Dirty sand	4	18	Broken blue rock, with clay and quartz veins	136	221
Dirty sand and medium gravel	19	37			
Clay and granite sand	27	64			

43/9-2L1

[Perkins. Drilled by Palmer. On Scott River flood plain. Altitude 2,728 feet. Casing perforated 20 to 42 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Top soil	4	4	Pea gravel	38	42

43/9-23F1

[G. A. Reynolds. Drilled by Palmer and Craig. On Scott River flood plain. Altitude 2,728 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Top soil	6	6	Clay	6	20
Blue clay	6	12	Water gravel	3	23
Quicksand	2	14			

43/9-24F1

[Lewis Lukes. Drilled by N. R. Jessee. On Scott River flood plain near mouth of Hamlin Gulch. Altitude 2,735 feet. Casing perforated from 18 to 200 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Soil and gravel	8	8	Gravel	3	115
Clay	20	28	Clay with gravel streaks	44	159
Gravel and clay	9	37	Hard clay with gravel	5	164
Yellow clay	11	48	Sandy clay with gravel	20	184
Sandy clay	12	60	Gravel and clay	17	201
Gravel	14	74	Clay and broken green rock	2	203
Clay	3	77	Hard green rock	2	205
Gravel	1	78			
Clay	17	95			
Clay with gravel streaks	17	112			

43/9-24F2

[Lewis Lukes. Drilled by N. R. Jessee. Scott River flood plain near mouth of Hamlin Gulch. Altitude 2,734 feet. Casing perforated 25 to 41 feet, 63 to 69 feet, 85 to 101 feet, 109 to 110 feet, 117 to 139 feet]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Soil and fine gravel	6	6	Coarse gravel	15	100
Soft reddish clay	7	13	Gravel, some clay	10	110
Gravel	4	17	Clay and gravel	27	137
Clay and fine gravel	20	37	Coarse gravel, some clay	5	142
Gravel	4	41	Broken rock with clay	14	156
Clay, some fine gravel	22	63	Blue rock and clay	8	164
Gravel	7	70	Hard blue rock	19	183
Clay and fine gravel	15	85			

TABLE 10.—*Drillers' logs of selected water wells in the Scott Valley area, California*—Continued

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Deph feet

43/9-26C2

[H. J. Scharbarum. Drilled by owner. Scott River flood plain. Altitude 2,732 feet]

Soil	8	8	Clay	9	23
Clay	4	12	Gravel	4	27
Quicksand	2	14			

43/9-26L1

[Charles Seaver. Drilled by owner. Scott River flood plain. Altitude 2,737 feet. Casing perforated 19 to 22 feet]

Soil	6	6	Clay	6	21
Sand and gravel	9	15	Sand and gravel, water	1	22

43/9-28E1

[Al and Joe King. Drilled by Palmer and Craig. Near base of Kidder Creek fan. Altitude 2,784 feet]

Gravelly soil	3	3	Clay	2	24
Medium size gravel (3- to 4-inch) with clay	10	13	Medium gravel	10	34
Clay	2	15	Clay	2	36
Large gravel (as much as 8 inches)	7	22	Fine sand	10	46

43/9-29M1

[W. I. Montgomery. Dug by owner. On Kidder Creek fan. Altitude 2,829 feet]

Soil	5	5	Gravel	12. 5	23
Gravel	4	9	Clay	1	24
Clay	1. 5	10. 5	Gravel	3	27

43/9-31B1

[Tillson Palmer. Dug by owner. On Kidder Creek fan. Altitude 2,873 feet]

Sand and gravel	20	20			

TABLE 11.—*Chemical analyses of ground water in the Scott Valley area, California*

Well	Date sampled	Temperature ° F.	pH	Specific conductance (micromhos at 25 ° C)	Sum of determined constituents (ppm)	Upper number, parts per million, ppm Lower number, equivalents per million, epm: Silica (SiO_2) (ppm)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B) (ppm)	Hardness as $CaCO_3$ (ppm)	Sodium (Na) (percent)
40/8-14N1	5-12-53	--------	7.1	136	87	18	5.8 0.289	14 1.151	1.0 0.043	0.4 0.010	88 1.442	1.7 0.035	1.0 0.028	0.1 0.005	1.3 0.021	--------	72	3
40/9- 1G1	9-30-53	--------	7.0	139	85	17	4.9 .235	15 1.234	1.0 .043	.6 .015	89 1.459	1.8 .037	.2 .006	-------- --------	.7 .011	0.04	73	3
	5-12-53	--------	8.1	372	222	26	26 1.297	33 2.714	5.0 .217	1.3 .033	250 4.097	6.4 .133	.2 .006	.1 .005	.3 .005	.03	201	5
12A1	5-12-53	--------	7.3	417	238	16	52 2.595	23 1.891	3.8 .165	.9 .023	265 4.343	11 .229	1.2 .034	-------- --------	.1 .002	.03	224	4
13R1	5-12-53	--------	7.5	461	249	15	30 1.50	39 3.21	5.8 .25	1.5 .04	312 5.11	3.2 .07	1.0 .03	-------- --------	.2 .00	.06	236	5
41/8- 7J1	5-12-53	--------	7.7	450	271	19	62 3.09	20 1.64	6.8 .30	.6 .02	260 4.26	13 .27	.5 .01	-------- --------	21 .34	--------	236	6
	10- 4-53	--------	7.4	576	348	19	82 4.09	24 1.97	8.9 .39	.5 .01	336 5.51	38 .79	3.5 .10	.1 .01	7.0 .11	.07	303	6
41/9- 2J1	5-12-53	--------	7.6	201	116	15	20 .998	12 .987	2.8 .122	.6 .015	115 1.885	6.9 .144	-------- --------	.1 .005	1.5 .024	.04	99	6
3L1	5-12-53	--------	7.4	625	414	40	92 4.59	17 1.40	15 .65	3.5 .09	274 4.49	21 .44	16 .45	-------- --------	74 1.19	--------	300	10
	1- 6-54	--------	7.2	652	417	36	96 4.79	19 1.56	13 .57	3.7 .09	314 5.15	17 .35	16 .45	-------- --------	62 1.00	--------	318	8
13B1	5-12-53	--------	7.4	428	259	19	69 3.443	13 1.069	4.1 .178	1.0 .026	248 4.064	9.1 .189	5.5 .155	.1 .005	16 .258	--------	248	4
22M1	5-12-53	--------	7.1	235	140	20	18 .898	10 .822	9.2 .400	6.2 .159	118 1.934	9.9 .206	8.8 .248	--------	.2 .003	.05	86	18

	10- 4-53	....	6.8	151	115	35	11 .549	4.9 .403	8.0 .348	6.7 .171	70 1.47	8.0 .167	5.5 .155	.2 .011	1.4 .023	.01	48	24
24H1	5-12-53	....	7.7	455	274	21	76 3.79	15 1.23	4.1 .18	.8 .02	298 4.88	3.5 .07	4.0 .11	....	2.8 .05	.03	251	3
25H1	5-12-53	....	7.6	531	327	28	96 4.79	11 .90	5.8 .25	.4 .01	338 5.54	4.4 .09	3.5 .10	....	11 .18	.01	284	4
25R1	5-12-53	....	7.7	369	210	16	34 1.697	27 2.220	5.0 .217	.5 .013	232 3.802	4.9 .102	2.8 .079	....	5.7 .092	.02	196	5
36B1	5-12-53	....	7.4	540	321	26	50 2.50	43 3.54	6.9 .30	.7 .02	368 6.03	9.4 .20	3.0 .08	....	.5 .01	.03	302	5
36J1	5-12-53	....	7.4	368	210	15	42 2.096	19 1.562	5.0 .217	.4 .010	204 3.343	5.7 .119	6.0 .169	.1 .005	16 .258	....	183	6
42/9-21A1	5-12-53	....	6.9	133	86	15	15 .749	3.5 .288	6.3 .274	.8 .020	61 1.000	6.3 .131	3.2 .090	.1 .005	5.3 .085	.03	52	21
	10- 4-53	52	6.9	126	84	16	15 .749	3.3 .271	6.5 .283	.7 .018	66 1.082	6.4 .133	3.0 .085	....	1.0 .016	.08	51	21
29A1	5-12-53	....	7.2	115	86	25	11 .549	6.6 .543	3.8 .165	.6 .015	74 1.213	2.6 .054	....	....	.2 .003	.03	55	13
34L1	5-15-53	....	6.9	267	178	31	31 1.547	13 1.069	5.0 .217	.2 .005	137 2.245	9.1 .189	5.0 .141	....	16 .258	....	131	8
42/9-35Q1	5-12-53	....	7.6	297	170	19	20 .998	25 2.056	2.8 .122	.6 .015	186 3.048	8.1 .169	1.0 .028	....	1.4 .023	.06	153	4
	10- 4-53	....	7.7	284	167	22	23 1.148	22 1.809	4.1 .178	.8 .020	178 2.917	4.9 .102	2.5 .071	....	.4 .006	....	148	6
43/9- 8F1	5-12-53	56	6.9	172	107	18	22 1.098	5.7 .469	1.8 .078	1.2 .031	93 1.524	3.2 .067	.2 .006	.1 .005	9.3 .150	.06	78	5
8Q1	5-12-53	50	6.6	721	49	13	4.2 .210	5.0 .411	2.4 .104	.3 .008	33 .541	4.7 .098	2.0 .056	....	1.0 .016	....	31	14
10J2	5-12-53	....	7.1	357	221	20	37 1.846	18 1.480	12 .522	.7 .018	176 2.884	17 .354	3.2 .090	.1 .005	26 .419	....	166	14
11H2	5-12-53	....	7.1	256	163	29	23 1.148	15 1.234	6.1 .265	.6 .015	128 2.100	8.1 .169	2.2 .062	.2 .011	16 .258	....	119	10
12N1	5-12-53	....	7.3	217	136	22	18 .898	16 1.316	3.8 .165	.8 .020	125 2.049	4.0 .083	1.5 .042	....	8.1 .131	.03	111	7

TABLE 11.—*Chemical analyses of ground water in the Scott Valley area, California*—Continued

Well	Date sampled	Temperature ° F.	pH	Specific conductance (micromhos at 25 ° C)	Sum of determined constituents (ppm)	Upper number, parts per million, ppm Lower number, equivalents per million, epm										Boron (B) (ppm)	Hardness as $CaCO_3$ (ppm)	Sodium (Na) (percent)
						Silica (SiO_2) (ppm)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)			
43/9-13N2	5-12-53	58	7.0	409	256	24	33 1.647	29 2.385	6.3 .274	2.3 .059	189 3.097	14 .291	4.8 .135	-------- --------	50 .806	--------	202	6
	10- 4-53	----------	7.5	384	236	27	29 1.447	30 2.467	4.3 .187	.8 .020	200 3.278	14 .291	3.5 .099	-------- --------	29 .468	--------	196	5
15L1	5-12-53	----------	6.9	218	141	27	11 .549	20 1.645	2.8 .122	.8 .020	104 1.704	23 .479	1.2 .034	-------- --------	4.0 .065	--------	110	5
18R1	5-12-53	58	7.3	441	251	18	54 2.695	12 .987	21 .913	.7 .018	196 3.212	3.5 .073	40 1.128	-------- --------	5.4 .087	.02	184	20
28E1	5-12-53	58	6.8	140	87	15	16 .798	6.2 .510	4.0 .174	1.6 .041	82 1.344	2.8 .058	1.0 .028	-------- --------	.2 .003	.08	65	11
30A1	5-12-53	55	6.6	53.2	44	15	4.8 .240	2.9 .238	1.8 .078	.3 .008	32 .524	2.5 .052	.2 .006	-------- --------	.4 .006	--------	24	14
	10- 4-53	----------	6.6	55.3	45	15	4.9 .245	2.7 .222	1.8 .078	.4 .010	32 .524	3.7 .077	.5 .014	.1 .005	.3 .005	.02	23	14
31B1	5-12-53	44	6.9	38.5	29	7.7	5.1 .254	.8 .066	1.2 .052	1.4 .036	22 .361	1.9 .040	-------- --------	-------- --------	.1 .002	.04	16	13
32G1	5-12-53	50	6.6	50.9	37	9.7	6.8 .339	.9 .074	1.4 .061	1.6 .041	27 .442	1.8 .037	.2 .006	-------- --------	1.7 .027	.03	21	12
43/10-25P2	5-12-53	50	6.9	157	97	11	10 .499	10 .822	3.1 .135	1.3 .033	38 .623	41 .854	.8 .023	-------- --------	1.2 .019	--------	66	9
44/8-30P1	5-12-53	52	7.9	490	290	25	44 2.20	40 3.29	5.0 .22	.4 .01	318 5.21	14 .29	1.0 .03	-------- --------	4.5 .07	.03	274	4
31G1	5-12-53	48	7.3	505	326	21	37 1.85	42 3.45	6.1 .27	1.9 .05	156 2.56	140 2.91	1.2 .03	.1 .01	.4 .01	.01	265	5

	10- 4-53	54	7.3	538	347	20	42 2.100	43 3.540	6.0 .260	2.2 .060	178 2.920	142 2.960	1.0 .030	.2 .010	2.5 .040	.06	282	4
32F1	5-12-53	54	7.9	515	312	30	42 2.10	44 3.62	4.5 .20	.7 .02	322 5.28	14 .29	1.8 .05	-------- --------	16 .26	--------	286	3
44/9-27M1	5-12-53	54	7.2	295	190	26	40 1.996	11 .905	8.2 .357	.4 .010	162 2.655	8.1 .169	2.8 .079	.1 .005	14 .226	--------	145	11
29F1	5-12-53	58	7.0	162	102	15	15 .747	9.2 .757	3.4 .148	2.0 .051	82 1.344	6.3 .131	.8 .023	-------- --------	10 .161	--------	75	9
	10- 4-53	65	7.0	212	126	18	22 1.098	11 .905	4.1 .178	1.9 .049	121 1.983	6.1 .127	.5 .014	-------- --------	3.2 .052	--------	100	8
44/9-29Q1	5-12-53	----------	7.0	197	124	19	23 1.148	9.1 .748	3.4 .148	.2 .005	100 1.639	14 .291	.2 .006	-------- --------	6.1 .098	--------	95	7
34R2	5-12-53	51	7.5	508	331	17	34 1.697	26 2.138	11 .478	25 .639	132 2.163	20 .416	13 .367	-------- --------	120 1.935	--------	192	10
	10- 4-53	----------	7.4	318	206	22	39 1.946	16 1.316	4.8 .209	.6 .015	164 2.688	12 .250	4.5 .127	-------- --------	26 .419	.03	163	6

TABLE 12.—*Chemical analyses of surface water in the Scott Valley area, California*

Name of stream	Well	Date sampled	Discharge (cfs)	Temperature (° F.)	pH	Specific conductance (micromhos at 25° C.)	Sum of determined constituents (ppm)	Upper number, parts per million, ppm Lower number, equivalents per million, epm												Percent sodium
								Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Hardness as $CaCO_3$	
Scott River	40/8- 7P	5-25-53	200	43.5	7.7	151	100	23	10 .499	13 .069	1.8 .078	0.5 .013	94 1.541	3.2 .067	1.5 .042	0.2 .011	0.5 .008	------	78	5
		9-30-53	50	60	7.8	240	142	21	15 .749	20 1.645	4.3 .187	.8 .020	144 2.360	4.9 .102	5.0 .141	------	.4 .006	------	120	7
East Fork, Scott	16N1	5-25-53	100	42.1	7.9	173	107	17	12 .599	15 1.234	1.9 .083	.4 .010	108 1.770	5.2 .108	1.5 .042	------	.4 .006	0.02	92	4
		9-30-53	25	56	7.8	274	161	21	20 .998	21 1.727	4.5 .196	1.2 .031	162 2.655	7.1 .148	4.5 .127	------	1.5 .024	.08	136	7
East Fork, Scott River.	16N2	4-20-53	------	51.8	7.7	187	111	20	13 .649	15 1.234	1.9 .083	.5 .013	114 1.868	3.2 .067	.8 .023	------	.1 .005	------	94	4
		9-30-53	25	58	7.8	257	154	22	19 .948	20 1.645	4.5 .196	.9 .023	157 2.573	6.1 .127	3.5 .099	------	.2 .003	.04	130	7
Wildcat Creek	17F	5-25-53	15	50.0	8.0	258	171	37	20 .998	22 1.809	2.8 .122	1.2 .031	168 2.753	3.0 .062	1.5 .042	.1 .005	.5 .008	.01	140	4
		9-30-53	5	64	7.8	331	202	31	29 1.447	24 1.974	4.5 .196	1.7 .043	218 3.573	3.7 .077	.5 .014	------	.2 .003	.02	171	5
South Fork, Scott	20Q	4-20-53	------	46.4	7.4	127	87	20	5.9 .294	12 .987	20 .087	1.0 .026	79 1.295	6.9 .144	.2 .006	------	.2 .003	------	64	6
		9-30-53	30	54	7.4	219	131	21	12 .599	17 1.398	6.5 .283	1.2 .031	116 1.901	6.3 .131	8.0 .226	------	1.7 .027	------	100	12

Sugar Creek----------	40/9-12B	5-25-53	40	41.0	7.4	80.9	61	17	8.4 .419	4.9 .403	1.9 .083	.6 .015	50 .819	2.1 .044	1.2 .034	.2 .011	.2 .003	.04	41	9
		9-30-53	2	58	7.6	210	128	19	19 .948	14 1.151	5.0 .217	1.3 .033	134 2.196	3.5 .073	.5 .014	------ ------	.1 .002	.02	105	6
Irrigation ditch, Scott	41/9- 2B	5-25-53	10	42.3	7.9	140	89	15	12 .599	11 .905	2.0 .087	.7 .018	88 1.442	3.6 .075	1.2 .034	.1 .005	.5 .008	------	75	5
		10- 3-53	10	56	7.9	329	195	21	35 1.747	19 1.562	5.8 .252	1.2 .031	196 3.212	10 .208	4.5 .127	.1 .005	1.8 .029	.16	165	7
Etna Creek----------	6K	5-26-53	100	39.0	7.1	35.9	32	11	5.0 .250	1.1 .090	1.4 .061	.2 .005	22 .361	1.1 .023	1.5 .042	.2 .011	.1 .002	------	17	15
		9-30-53	30	50	7.4	53.2	48	16	8.5 .424	.9 .074	3.0 .130	.3 .008	37 .606	1.3 .027	.2 .006	------	------	------	25	20
McConnahue Gulch--	13G	5-25-53	1	52.2	8.2	406	243	12	51 2.545	22 1.809	6.5 .283	.8 .020	244 3.999	19 .396	4.0 .113	.1 .005	7.7 .124	.01	218	6
		9-30-53	2	56	7.9	304	182	20	31 1.547	19 1.562	5.2 .226	.9 .023	184 3.016	7.9 .164	6.0 .169	------ ------	1.0 .016	.13	155	7
French Creek----------	15G	2-27-53	------	41.9	7.2	68.3	53	15	7.4 .369	2.1 .173	3.8 .165	.7 .018	40 .656	2.0 .042	1.8 .051	.1 .005	.3 .005	.03	27	23
		9-30-53	5	61	7.3	112	77	20	11 .549	43 .354	5.9 .257	.6 .015	58 .951	1.7 .035	5.0 .141	------	------	------	45	22
West Patterson Creek.	42/9- 8Q	5-26-53	40	41.0	7.5	62.3	51	17	8.8 .439	2.0 .164	1.8 .078	.1 .003	38 .623	1.5 .031	1.2 .034	.2 .011	.1 .002	------	30	11
		9-30-53	3	67	7.2	76.2	54	14	10 .499	2.0 .164	2.4 .104	.2 .005	46 .754	2.3 .048	------ ------	------ ------	.2 .003	.04	33	13
Etna Creek----------	28R	5-26-53	100	40.5	7.3	39.3	32	10	5.8 .289	.4 .033	1.5 .065	.3 .008	23 .377	2.7 .056	------ ------	.1 .005	.2 .003	.02	16	16
		9-30-53	1	62	6.9	65.9	46	9.5	8.4 .419	1.2 .099	3.4 .148	.7 .018	38 .623	2.7 .056	1.0 .028	------ ------	.2 .003	.08	26	22
Moffett Creek--------	43/9- 2L	5-22-53	------	58.5	8.1	362	204	16	19 .948	35 2.878	4.3 .187	.7 .018	224 3.671	16 .333	.5 .014	------ ------	2.5 .040	.04	191	5
Kidder Creek----------	29P	5-26-53	80	41.5	7.4	38.5	34	11	5.8 .289	1.1 .090	1.2 .052	.3 .008	24 .393	1.5 .031	1.0 .028	.2 .011	.2 .003	------	19	12
		9-30-53	2	61	7.1	53.2	40	11	7.5 .374	1.0 .082	2.0 .087	.4 .010	30 .492	2.0 .042	.8 .023	------ ------	.7 .011	.08	23	16

TABLE 12.—*Chemical analyses of surface water in the Scott Valley area, California*—Continued

Name of stream	Well	Date sampled	Discharge (cfs)	Temperature (° F.)	pH	Specific conductance (micromhos at 25° C.)	Sum of determined constituents (ppm)	Upper number, parts per million, ppm Lower number, equivalents per million, epm												Percent sodium
								Silica (SiO₂)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO₃)	Sulfate (SO₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO₃)	Boron (B)	Hardness as CaCO₃	
Oro Fino Creek	30A	5-26-53	8	4.10	7.3	42.1	35	12	6.8 .289	1.8 .148	1.2 .052	.3 .008	24 .393	2.1 .044	1.2 .034	.2 .011	.1 .002	.01	22	10
Shackleford Creek	43/10- 9L	4-30-53	140	37.4	7.2	75.8	46	9.0	4.6 .230	6.4 .526	.7 .030	.4 .010	47 .770	1.3 .027	.2 .006	------- -------	.2 .003	.09	38	4
Mill Creek	14B	5-26-53	40	43.3	7.3	74.8	56	16	8.4 .419	3.2 .263	1.8 .078	.6 .015	42 .688	4.0 0.83	1.0 .028	.2 .011	.2 .003	------	34	10
		9-30-53	8	58	7.4	93.0	62	14	11 .549	3.1 .255	2.8 .122	.7 .018	53 .869	4.1 .085	.5 .014	------- -------	.1 .002	.04	40	13
Moffett Creek	44/8-27H	4-21-53	------	52.0	7.9	408	236	13	52 2.595	22 1.809	4.8 .209	.9 .023	264 4.327	10 .208	1.5 .042	------- -------	1.9 .031	.03	220	5
		9-30-53	10	57	8.0	442	255	18	48 2.395	28 2.303	5.8 .252	.9 .023	287 4.704	9.6 .200	2.5 .071	.1 .005	1.0 .016	.13	235	5
Indian Creek	44/9-22A	5-22-53	------	50.3	7.9	210	128	15	30 1.497	8.1 .666	3.1 .135	.7 .018	133 2.180	5.3 .110	.2 .006	.1 .005	.4 .006	.04	108	6
		9-30-53	1	63	7.8	281	166	13	42 2.096	9.0 .740	4.3 .187	1.0 .026	174 2.852	7.2 .150	3.2 .090	------- -------	.2 .003	.19	142	9
Irrigation ditch	30A	5-22-53	5	55.4	7.6	242	138	14	21 1.048	17 1.398	4.0 .174	.6 .015	148 2.426	8.1 .169	.5 .014	.1 .005	.3 .005	.04	122	7
		9-30-53	2	63	8.2	306	174	14	32 1.597	19 1.562	4.7 .204	.9 .023	193 3.163	5.4 .112	2.5 .071	------- -------	.8 .013	.22	158	6
Moffet Creek	44/9-36B	5-22-53	------	58.6	8.1	383	217	16	16 .798	41 3.372	4.3 1.87	.8 .020	241 3.950	16 .333	1.2 .034	------- -------	2.9 .047	.03	208	4

North Patterson Creek	44/10-25N	5-22-53	5	53.6	8.5	342	203	17	39 1.946	20 1.645	5.6 .244	.7 .018	[a] 217 3.327	13 .271	.8 .023	....	.4 .006	......	180	6
Meamber Creek	27D	5-22-53	1	51.8	8.2	373	224	17	42 2.096	23 1.891	5.0 .217	1.1 .028	221 3.622	25 .520	1.0 .028	....	.6 .010	.01	199	5
Scott River	28D	5-22-53	......	46.0	7.4	112	71	13	11 .549	6.4 .526	2.0 .087	.5 .013	66 1.082	4.0 .083	.5 .014	.1 .005	1.0 .016	.03	54	7
		9-30-53	......	62	7.8	281	166	19	32 1.597	14 1.151	4.9 .213	.7 .018	167 2.737	6.6 .137	4.0 .113	....	2.2 .035	......	137	7
Shackleford Creek	35B	9-30-53	10	......	7.5	115	74	16	10 .499	7.2 .592	2.4 .104	.6 .015	68 1.114	3.5 .073	1.0 .028	......	......	.10	55	9

[a] Contains CO_3.

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