GEOLOGY OF BLACK BUTTE, LOS ANGELES COUNTY, CALIFORNIA

William R. Cleveland Jr.

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Introduction

The area studied lies directly on the First Standard Parallel North of the San Bernardino Base and Meridian in the Black Butte Quadrangle, Los Angeles County, California. Black Butte is about 125 miles by auto northeast of Los Angeles. The size of the area is about 1 square mile, with a relief of approximately 600 feet. No part of the area has been put under culture. The field work was conducted by topographic location and with Brunton compasses insofar as was practicable. Five days were spent in the field. The work was undertaken to give the author experience in igneous geology.

Petrography

"Country" Rock (Paleozoic?)

The so-called "country" rock is a crystalline schist made up of minerals macroscopically identified and estimated as 45% quartz, 20% feldspar, 20% biotite, and 15% hornblende. The rock is very fine grained, the individual grains being barely visible under a hand lens. The quartz grains look almost rounded and are at least sub-angular. Biotite flakes are very small. The grains appear to be relatively fresh and unweathered.

The rock has a schistose texture that in some specimens is very good and in others is not so evident. The degree of metamorphism also varies within wide limits, some being relatively unchanged (and showing the sedimentary character of the rock), and other samples being well metamorphosed. The rock as a whole is relatively unweathered.

With the exception of one place (point A), the schist was found only as float. At point A, in a prospect pit, a band of schist not over a foot wide was found in place. The schist is, in all probability, a portion of a xenolith, since the outcrop is very small and no other outcrops are known.

Hornblende Diorite (Jurassic?)

The dioritic rock (the color of which gives the butte its name), consists macroscopically of about 60% feldspar, and 40% hornblende, with considerable local variation in the percentages present. The rock is medium grained; the average grain diameter being perhaps 2 millimeters. However, in some places, hornblende crystals up to three inches in length were found.

The diorite has locally been extensively epidotized into cylindrical "cores" the size of a silver dollar in diameter, the "cores" occurring in the center of a block of diorite. Large crystals of epidote are uncommon. The rock, on a fresh surface, is a dark blue-gray in color. However, where it is exposed to the air, it developes a shiny-black desert varnish of iron and manganese oxides. The rock as a whole is very fresh. Apparently there is a great deal of iron present in this rock as the compasses frequently showed a variation of as much as 25° within the space of five or six feet. Some samples even show lodestone qualities. Magnetite is visible in some samples.

The diorite crops out in a major portion of the area, and disappears underneath the alluvium at the southeast extremity of the butte, but otherwise extends only about half way down the slopes of the butte. The outcrops are largely obscured on the sides of the butte by diorite float, but the tops of some outcrops are visible on ridges and on the top of the butte. The diorite "cap" forms a great protection to the soft adamellite beneath. This diorite is found only on Black Butte and on another butte 5 miles to the east. Buttes a mile north and south of Black Butte have no diorite.

Adamellite (Jurassic?)

The rock forming the base of the butte on all but the southeast side is an adamellite with a composition of approximately 40% quartz, 25% orthoclase, 25% plagioclase, and 10% biotite. The rock is medium grained with an average diameter of about 3 millimeters. The feldspars are fairly well weathered to kaolin.

The rock is light gray to pinkish in color. Limonite staining is absent. On the whole, the rock is greatly weathered and in many places is present in the form of a soft gravel. Hand specimens are rather hard to obtain due to the softness of the rock. The rock, as mentioned before, is exposed on the lower half of the slopes of all sides of the butte save the southeast. Much of the adamellite is covered with diorite float--commonly 6 or 8 feet in depth. Outcrops are fair, but are often of gravel.

On the north side in particular, some exposures of rock are practically identical with the adamellite, with the sole exception that they are harder. This was first mapped as a separate rock in the form of dikes in the adamellite, but further work showed a gradational contact between the "two" rocks and it was deemed best to map it all as adamellite, and consider the friable material as merely a weathered phase of the adamellite. However, it is recognized that the harder portions may represent early jointing and filling in a still soft magma with the consequence that there may be, under the microscope, some difference between the rocks which tends to make the one harder than the other. Hence, while "both" rocks are mapped as adamellite, the boundaries of the "dikes" are indicated on the map. The adamellite is probably one of the Jurassic acid intrusives common in the Antelope Valley, and the Mojave Desert region.

Dikes (age uncertain)

Aplite--granitic in composition. Very fine grained and chiefly pinkish in color. Some of the aplite dikes bear small quartz veins.

Pegmatite--very coarse grained, containing orthoclase, albite, and quartz. The orthoclase gives the pegmatite a definite pink color.

The dikes are broken up and discontinuous and, hence, are difficult to map. Dikes on the lower slopes of the butte are frequently obscured by diorite float. The dikes are very fresh if the adamellite "dikes" are excluded. Considerable amounts of chrysocolla and caliche are associated with the contacts between the diorite and adamellite. The area has been extensively prospected, but apparently no economically profitable veins have been discovered.

Quaternary Deposits

Desert sands--eolian and fluviatile deposits around the base of the butte.

Geologic Structure

On the north side of the butte a fault plane bearing slickensides was found. The faulting was apparently normal judging from chatter marks on the surface. The strike is due east-west and the dip is 47°N. The slickensides trend N45°E on the fault surface.

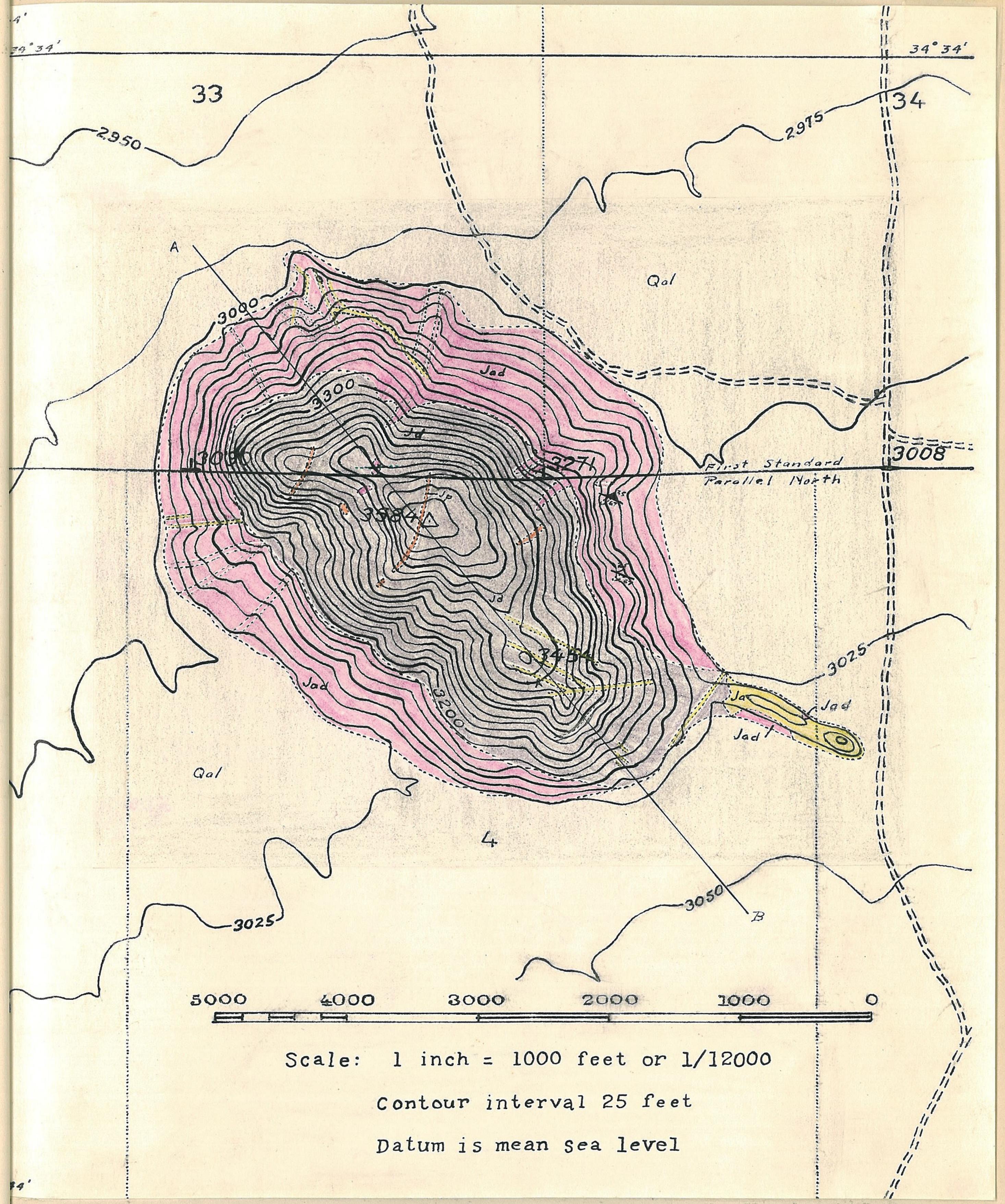
At approximately the same point two small outcrops of adamellite occur. These are apparently apophyses from the adamellite massif below, and appear to have no relation to the fault. One of these outcrops of adamellite could possibly be the upward extension of the main mass of adamellite, but the intervening space between the outcrop and the main mass is buried deeply under diorite float and it was not deemed advisable to connect the outcrop with the main exposure. Known diorite outcrops occurring below the adamellite outcrop and the fact that the other small outcrop of adamellite could not be connected with the massif, lend credence to the view that the outcrops are apophyses.

If the adamellite "dikes" are included, two general dike trends can be determined. One trends about N60°W and the other trends slightly east of north.

Since the diorite is so much more impervious to weathering, it forms an effective "cap" over the adamellite. In my opinion, it is really this "cap" of diorite that has prevented the butte from eroding away entirely. It forms the typical protection that a hard overlying layer affords a softer lower layer of rock.

Geologic History

1. Deposition of Paleozoic (?) sediments.
2. Intrusion of Paleozoic sediments by diorite (Jurassic?).
3. Intrusion of diorite by adamellite (Jurassic?).
4. Intrusion of adamellite and diorite by pegmatite and aplite dikes (late Jurassic? or post-Jurassic?).
5. Probably uplift and, certainly, erosion of the overlying rock to the present form.



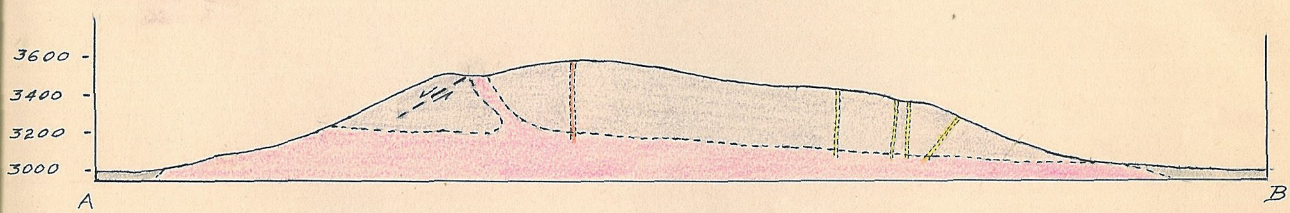
Topography by U. S. Geological Survey
Black Butte Quadrangle

Geology by W. R. Cleveland
1940

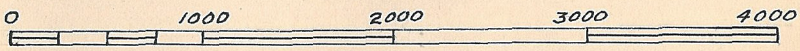
GEOLOGIC SECTION ACROSS BLACK BUTTE

by W. R. Cleveland

1940



Scale: 1 inch = 1000 feet or 1/12000



Datum is mean sea level

See map for legend

GEOLOGY OF THE PUENTE HILLS

William R. Cleveland Jr.

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Geology of the Puente Hills

Introduction

The area described in this report, is that part of the Puente Hills, California, lying to the north and west of the Turnbull Canyon road, and is the extreme western end of this range of hills. The area is most readily reached by the Turnbull Canyon road from the town of Whittier, which lies about two miles to the southwest. Whittier is some thirteen miles east of Los Angeles. The area in question lies on the common corner of the El Monte, Puente, Whittier, and La Habra quadrangles, and has an area of about four square miles. A small portion (perhaps five percent) is under cultivation with citrus and avocado orchards. Approximately ninety percent of the total area is grazing land for sheep, horses, and dairy cattle. The remaining five percent is covered with sage and other brush. The relief is about 1200 feet, the elevations ranging from 250 to 1400 feet. The drainage in this particular portion of the Puente Hills is east and west, since a long ridge trends almost due north across the area. The topography appears to be in early maturity. Outcrops are fairly abundant, but in many cases do not lend themselves readily to giving a dip and strike. The field work was done with a topographic map by the U. S. G. S., and a Brunton compass. Fifteen days were spent in the field.

Stratigraphy

Puente formation (middle and upper Miocene)

<u>Upper shale</u>: Name applied by English (U. S. G. S. Bull. 768)

This shale is the lowest member in the section studied, and a small portion of it is exposed at the southern extremity of the area. The "shale" in my opinion should be classed as a very fine sandstone according to the Wentworth-Udden scale. The member is fairly well consolidated and the shale ranges in color from almost white (rare) to cream or yellow. Oil seeps are common.

<u>Upper sandstone</u>: Name given by English (op. cit.)

The sandstone is fairly fine grained, cream colored and fairly well consolidated. Individual grains are too small for identification with a hand lens. This member overlies the upper shale disconformably and ranges from a thickness of about 600 feet maximum in this area, to a thickness of about 200 feet farther to the west and out of the area described.

The Puente formation is similar lithologically and can be correlated with the Modelo formation farther to the west in the Los Angeles Basin.

Fernando formation (Pliocene?)

An attempt has been made (rather unsuccessfully) to differentiate the Fernando formation. This formation, supposedly of Pliocene age, is composed of a series of interbedded sandstones, silts and conglomerates. The silts weather to a clay soil. English has listed a series of some fifteen different members in the area north of Whittier, but unfortunately did not state exactly where he measured his section. Members corresponding to most of those mentioned by English have been found, but not on any one traverse across the section. It is worthy of note that English did not attempt to differentiate the Fernando. In general, the formation consists of a series of alternating reddish-brown conglomerates and yellow sandstones. The conglomerate beds all look much alike as do the sandstones. The pebbles in the conglomerate average about one inch in diameter and are subangular to rounded. Perhaps 99% of the pebbles are granitic; some of the pebbles are almost pure vein quartz and aplite pebbles are common. More basic pebbles make up the remaining 1%, granodiorites being the common; pebbles of extrusives are rare.

Contacts are difficult to follow due to the deep soil (up to ten feet deep) and the heavy growth of grass and weeds. The formation measures about 6000 feet in thickness. A mile farther west, the formation is about 5000 feet thick.

English aptly expresses the mapping conditions with the following statement: "The Whittier Hills, comprising the area west of La Habra Canyon, show some of the most complicated structure to be found within the district. Steep irregular dips, numerous faults, unconformities, and lithologic variations in the different formations and members make the structure, as well as the stratigraphy, difficult to work out. The writer has seen several maps of the area south of Workman Hill that were not in agreement with his own map or with one another!"

This portion of the Puente Hills is, in general, a northwest dipping monocline, with the dip averaging 30° or less. However, small local folds occur with axial trends that depart greatly from the regional structure. As previously mentioned, the section consists of sediments; no igneous rocks outcrop in this part of the Puente Hills. The beds, with local exceptions, rest unconformably on one another. The thickness of the Puente is unknown since the lower limit is outside of the region studied. However, a minimum thickness of some 2000 feet is indicated. The Fernando, as stated previously, measures some 6000 feet in this region.

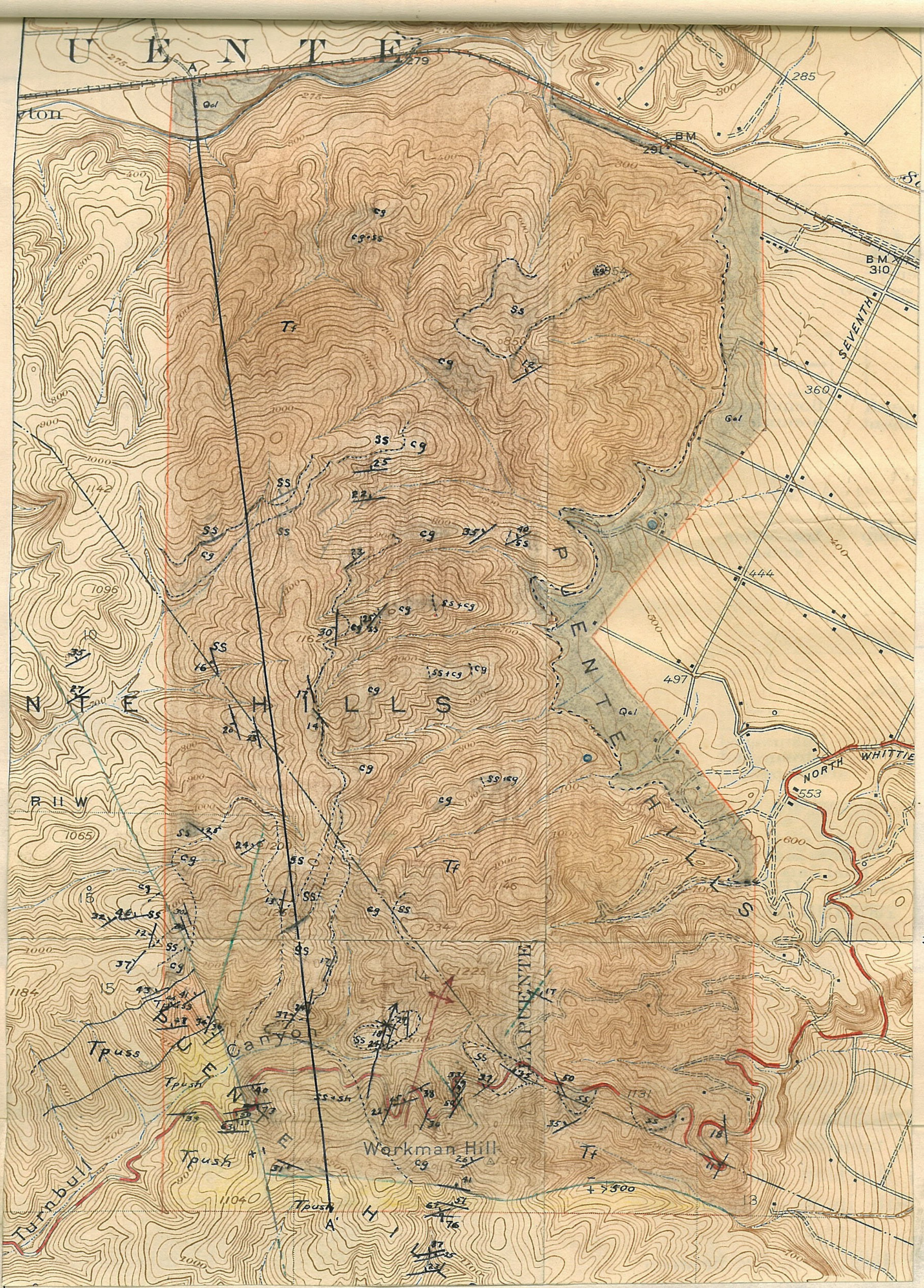
Geologic Structure

Folding, except for one fairly large fold involving Fernando conglomerates along the Turnbull Canyon road, is restricted to small, minor flexures. At one place, three small overturned folds occur within a space of sixty feet. The folds in general plunge north or northwest. The large fold previously mentioned is clearly visible from Turnbull Canyon road.

This portion of the Puente Hills is bounded on the south by the Whittier fault, a reverse fault that is responsible for the uplift of the Puente Hills block. Faulting in the area studied is characterized by off-setting of beds, and large zones of shattering (along the larger faults. The larger faults have had displacements of hundreds or even thousands of feet. A fault contact has caused the omission of the upper Puente sandstone south of Workman Hill.

Geologic History

1. Subsidence.
2. Deposition of Puente sediments in Miocene time.
3. Uplift and erosion without flexure.
4. Subsidence.
5. Deposition of Fernando formation in a basin that was fluctuating up and down, giving alternate conglomerates and sandstones. (Pliocene?)
6. Emergence and uplift with folding and faulting.
7. Erosion.



118° 00'

EXPLANATION

Qal	Quaternary
	(alluvium)
Tf	Pliocene?
	Fernando fm. (shales, sandstones, and conglomerates)
Tpuss	Miocene
	Puente fm. (sandstone)
Tpush	Miocene
	Puente fm. (shale)

GEOLOGIC MAP OF A PORTION OF THE PUENTE HILLS,

CALIFORNIA

Scale 1/24000 or 1 inch = 2000 feet

0 2000 4000 6000

Contour interval 5 feet and 25 feet changing on the 300 foot contour

Datum is mean sea level

16° True North Mag. North

approximate mean declination 1940

May 1940

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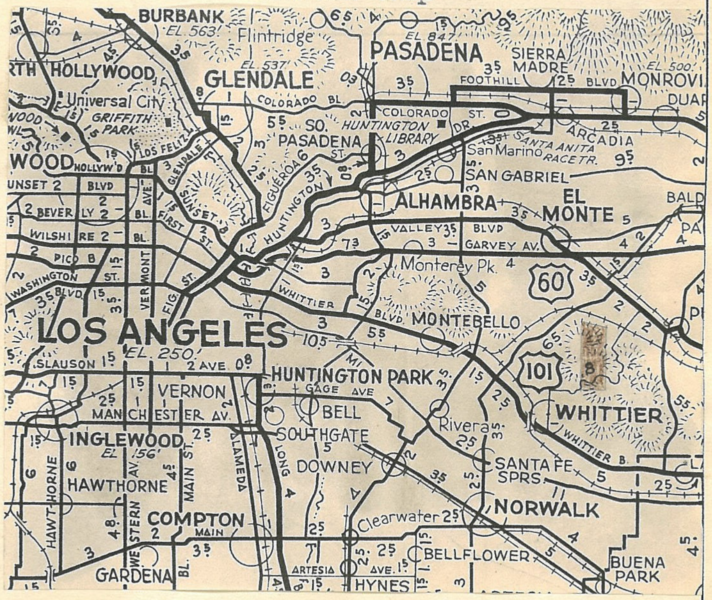


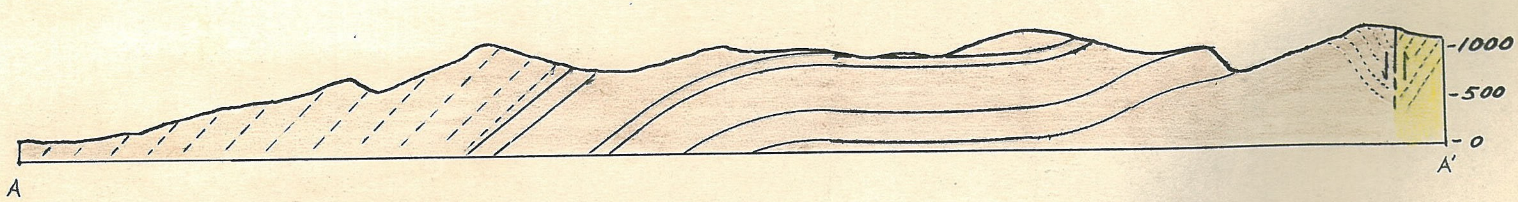
Base from U. S. G. S. topographic map

Geology by W. R. Cleveland

STRUCTURE SECTION ACROSS A PORTION OF THE PUENTE HILLS, CALIFORNIA

by W. R. Cleveland

1940



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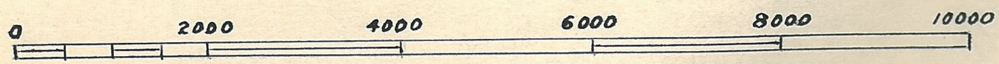


Datum is mean sea level

Explanation

Qal Quaternary

alluvium

Jp / Ja Jurassic(?)

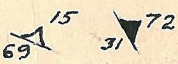
pegmatite and aplite dikes

Jad Jurassic(?)

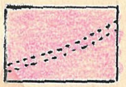
adamellite

Jd Jurassic(?)

diorite



dip and strike of flow planes



"dikes" in adamellite

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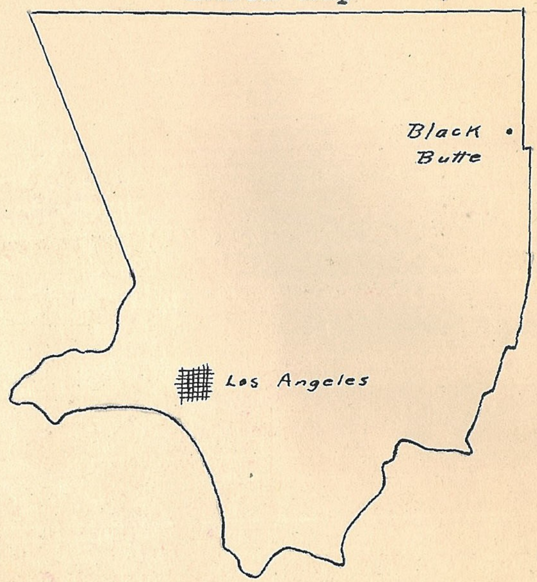
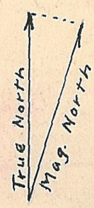


Los Angeles County, California



approximate mean declination 16^{o}, 1940