TRAILSIDE GEOLOGY

OF THE

OAT HILL ROAD

CALISTOGA, NAPA COUNTY, CALIFORNIA

By Dean A. Enderlin, March 1995

INTRODUCTION

The Oat Hill Road, which begins near the intersection of the Silverado Trail and Highway 29 near Calistoga, offers the hiker an opportunity to view some excellent examples of geologic rock units common in the upper Napa Valley. By far, the most abundant are of volcanic origin. The local exposures of these rocks are part of an ancient volcanic "field," ninety kilometers long and thirty kilometers wide (Fox, et al, 1983). Named the "Sonoma Volcanics" in 1949 by C. E. Weaver, this complex series of lava flows and pyroclastic units is one of numerous volcanic fields that extend along the Coast Ranges of California. Although the Sonoma Volcanic field has long been extinct, it is quite young in terms of geologic time. Radiometric age determinations suggest the field was active between 10 million and 3 million years ago. This increment of time spans the late Miocene and early Pliocene epochs of the Tertiary period (as geologic time is reckoned). This was a time when the ocean was higher, and marine climatic influence extended farther inland. Much of Sonoma County was inundated, as was the southern end of the Napa Valley. Before the onset of volcanism, the upper Napa Valley was dominated by conifer forests, not unlike those of the northern California coast today. Trees of these ancient forests included redwood (*Sequoia langsdorfii*, a now extinct species), fir, spruce, Douglas fir and hemlock. Other contemporary plant species included wax myrtle, red alder, chinquapin, tan oak, pepperwood, rhododendron and huckleberry. Scattered populations of chestnut, oak, elm, red bay, holly, avocado and even water chestnut were also present at the time (Chaney, 1951)(Axelrod, 1944)! The animals that inhabited the region were far less familiar. Elephant-like mastodonts, early horses (with two toes!), camels, beavers, sabre-tooth cats, peccaries, ground sloths, rhinoceroses, and animals resembling hyenas, coatis and wolverines all lived in the region (Stirton, 1951)!

The onset of volcanic activity near Calistoga occurred about 3.4 million years ago (Everndon and James, 1964). The total devastation resulting from these violent events is (in part) preserved today in the fossil remains at the Petrified Forest, four miles southwest of Calistoga. There, the fallen and petrified remains of gigantic trees give silent testimony to the powerful forces that uprooted them eons ago. The initial eruptions were explosive in nature, and may have been similar to the Mount St. Helens blast of 1980 in the state of Washington. The Napa Valley, which today is green and peaceful, would then have been a hellish place. Thick clouds of volcanic ash filled the air, blocking out the sun in a gray dismal gloom. Harmonic earthquake tremors constantly shook the land...indicators of upward-moving magma bodies and harbingers of imminent volcanic eruptions. Heavy toxic gases, like hydrogen sulfide (with its characteristic rotten egg smell), permeated the air, and concentrated in low-lying areas. Glowing red avalanches of incandescent gas and superheated ash would occasionally belch from a volcanic vent, searing all life in their paths. Water vapor, contributed by the eruptions, condensed in the thick ash clouds. Torrential rains resulted. These, in turn, saturated the unstable slopes of newly deposited volcanic debris, causing tremendous mudslides...still steaming from the remaining heat in the ash.

The volcanic vents were widely distributed along the length of the volcanic field, and did not form distinct volcanoes as one might think. Instead, the eruptions most likely occurred along ancient northwest-trending deep-seated fault zones. Irregularities or kinks along the faults created numerous pipe-like openings along their courses, which allowed magma bodies to rise from deep within the earth. The initial eruptions in the Calistoga area were rich in pumice...a frothy form of volcanic glass. These explosive eruptions eventually subsided, and gave way to more passive andesite lava flows. These, in turn, were followed by renewed explosive activity, which emplaced huge volumes of rhyolite lava and volcanic ash. This was the culminating episode in the Sonoma Volcanic field. A "rhyolite-like" welded tuff unit capping

Mt. St. Helena is believed to represent one of the final eruptions in this field (Fox, et al, 1983). It has been age-dated at 2.9 million years (Mankinen, 1972).

TRAILSIDE GEOLOGY

The trailside stops related to the following discussions are identified by number on the accompanying topographic map. This map is adapted from a portion of the U.S. Geological Survey's Calistoga 7.5 minute topographic quadrangle (photorevised 1980). The course of the Oat Hill Road appears as a dark black line. The town of Calistoga is in the lower left corner of the map.

The hike to the Palisades is approximately four miles. There are many sights to see and enjoy along the way, so allow the better part of a day to make the round trip!

1. Gate at Trailhead (Elevation: 400 feet)

This is the beginning of the trail. We are near the intersection of the Silverado Trail and State Highway 29. The segment of the Oat Hill Road you are about to explore was completed in the early 1890's to service the freight wagon traffic from the Oat Hill and neighboring mines. These mines produced the liquid metal, mercury (also called quicksilver), which was used in the gold and silver mines of the Mother Lode and Comstock Lode to recover the precious metals from pulverized ore. This process of recovering gold and silver, called amalgamation, was widely used until the early 1900's when more efficient gold and silver recovery techniques became available. Mercury occurs most commonly in the form of a red mineral, called cinnabar. Cinnabar is a combination of mercury and sulfur. To refine the mercury, the ore was roasted to drive off the sulfur. The mercury, which vaporized during the roasting process, was forced to pass through elaborate cooling systems, causing it to condense. Droplets of the condensed liquid metal would flow by gravity into receptacles beneath the condensers, to be later bottled for shipment. The shipping bottles were called *flasks*. They were made of iron or steel, each with the capacity to hold 76 pounds of mercury. Shipments were made to Calistoga by freight wagons using heavy teams. It was customary for the horses to have bells mounted on their harness to warn other traffic on the road of their approach. Calistoga was an important commercial hub in those days, because the railhead was located here. Most of the mercury produced from the mines of eastern Sonoma County, northern Napa County and Lake County was shipped via the railroad from this point. From its beginning, the Oat Hill Road was open to the public as a county road, and traffic was allowed to pass over the road without toll. For those traveling to and from Lake County, the completion of this road allowed them an option to taking the expensive (but better maintained) Lawley Toll Road over Mt. St. Helena. The gate has been here since 1978, when the road was abandoned as a liability by Napa County.

2. Quarry Site (Elevation: 490 feet)

Scars in the hillside above the road are the remnants of a "shale" pit. The rock is actually andesite lava, not shale, and is one of the common rock types found in the Sonoma Volcanic field. Andesite is an "intermediate" lava...its composition being halfway between silica-rich rhyolite and silica-deficient basalt. Silica (a combination of silicon and oxygen) can range from 45% to 75% by volume of an igneous rock, and the determination of its percentage is a fundamental means of naming the rock. This andesite is highly weathered, and blue-gray iron and manganese oxide stains are common on the weathered surfaces. Fresher surfaces show tiny needle-like feldspar crystals in a dark gray matrix. This rock was quarried for use as a road base. A quarry in similar material, one-half mile northwest of here, produced rock that was used as the road base of Highway 29 between the Silverado Trail intersection and downtown Calistoga (Roy Enderlin, pers. communication).

3. Rhyolite (Elevation: 810 feet)

Good exposures of bedrock are sparse here, but we are passing upward through the volcanic sequence into rhyolite lava flows and volcanic ash sequences. These rocks represent the final stage of volcanism in the Sonoma Volcanic field. Rhyolite is silica-rich volcanic rock. Silica tends to make magma (the molten rock within the earth) viscous, with a consistency not unlike peanut butter! As a result, such lavas often explode, rather than flow, in an effort to release the gases trapped within them. Explosive eruptions produce broad blankets of volcanic debris that later solidify to become rock known as tuff. Most of the rock exposed along this segment of road is rhyolite tuff, although a few rhyolite lava flows are present. Tuffs can vary greatly with respect to the sizes of particles they contain. Those you see here are mostly "lapilli" tuffs, with particles up to several inches in diameter.

4. View of Calistoga (Elevation: 900 feet)

From this point, if you look southwest, you can see directly down Lincoln Avenue (Highway 29) in Calistoga. The settlement of Calistoga is closely related to the geology of the region...specifically, the hot springs. Prior to the settlement by whites, this land was occupied by the Mutistul...a triblet of the Wappo Native American culture (Calkins, 1994). There were three villages in the vicinity of the hot springs. These were known as *Miyakma*, *NiLektsonoma* and *Tselmanan* (Beard, 1979). The villages were located at some distance from the steaming marsh-like environment of the springs themselves. It seems likely, however, that members of the villages made use of the warm waters for therapeutic purposes, and perhaps even in the cultural tradition of the (all male) sweat house. The Wappo term for the hot springs was "*Coo-lay-no-maock*," the oven place (Archuleta, 1977). Samuel Brannan established his Hot Springs Hotel here in 1860, and opened his resort in 1862 (Archuleta, 1977). Because of the high concentrations of boron (an element toxic to many plants) in the soil near the springs, Brannan was forced to haul in clean soil to decorate his resort with exotic trees and shrubs. The high boron concentrations in the soil are the product of the thermal waters, and remain to this day, hindering the planting of vineyards in some areas. The naming of Calistoga is credited to Sam Brannan: Sam (while in an intoxicated state) reportedly proclaimed the new town the "Calistoga of Sarafornia," having meant to say the "Saratoga of California." His comparison was to Saratoga Springs in the state of New York...a lavish hot springs resort of the time.

Development of the geothermal resource at Calistoga has continued since the time of Brannan. The first hot water well was drilled sometime prior to 1871. Over eighty other thermal water wells have been drilled in the area since that time, some to depths of over 2000 feet. Approximately ten of these exhibit artesian (surface) flow (Youngs, et al, 1981), and some well water actually shot into the air (geysered) after being drilled. All artesian wells but one (the "Old Faithful Geyser of California" on Tubbs Lane) have been capped. The use of wells over time has apparently caused the local "hot water" table to drop. As a result, the standing pools of hot water around the springs grounds gradually dried up between about 1915 and 1924 (Youngs, et al, 1981), and the "hot water" table is now approximately 120 feet below the ground surface (Taylor, 1981). Water temperatures as high as 134^{o} Celsius have been recorded in a 1,890 foot deep well near the original springs.

The thermal waters of this area are an artifact of the Sonoma Volcanic volcanism. Even though the volcanic activity has subsided here, the heat remains. The heating of the water takes place at great depths. The waters in the Calistoga hot springs field have risen from these depths along convenient pathways through the rock...most likely fault zones and permeable rock formations beneath the valley floor.

5. Tuffaceous Lake Beds (Elevation: 1080 feet)

You are now passing into a very peculiar unit that is composed entirely of very fine-grained white to tan colored tuff. In spots, it shows thin bedding planes and resembles a sandstone. In fact, previous geologists have improperly mapped this as an outcrop of sandstone of the Franciscan Complex (the much older rock that lies beneath the volcanics in this region). Instead, this unit is part of what was once an ancient lake. Ash, as it fell into the lake water, formed this well-bedded water-lain tuff unit. Considering the high rainfall associated with the volcanic eruptions, local ponding of water is not at all surprising. This unit is a good example of this phenomenon. Thin seams of calcite are occasionally seen along the roadway here. Calcite is a common mineral in many types of rock. Here, it occurs as veins (fracture fillings) and as tiny spherical nodules called "concretions."

Ancient lake sediments such as these are often an ideal environment to find fossils. Plant debris and animal remains preserve well in lake mud. The Cache formation in Lake County is a good example of fossiliferous lake beds deposited during a period of volcanism in that region. The Cache formation was formed along an ancient shore of Clear Lake around 1.5 million years ago, and contains zones rich in plant and animal matter. The situation in the lake beds along *this* trail appears to have been different. Fossil remains are absent or extremely scarce. Why? Consider what was happening at the time. When *this* lake was forming, the entire area had been subjected to devastating volcanic eruptions. This activity had virtually annihilated all life in the area, so it is likely that no plants or animals were here to be preserved!

6. Old Sled Trail (Elevation: 1140 feet)

The Oat Hill Road crosses a prominent ravine at this point. To our left is the beginning of an old sled trail that passes into a canyon to the north. This trail was used by an old prospector, named Jack Nicchia (pronounced "Nick-ya"), who was engaged in prospecting for silver, gold and mercury in this area in the 1930's (Frank Barberis, pers. communication).

After crossing the ravine, the road levels off. About 150 feet ahead is a grassy field, once occupied by Mamie Flynn's cabin. The structure burned in the 1940's leaving little evidence of its existence. We are still walking over lake beds. The lake sediments here are especially well bedded, and will break into sheets parallel to the bedding planes. Notice how fine-grained the rock is...almost like chalk. The lake beds were originally horizontal, but are now tilted about 27^{o} toward the northeast.

The next ravine past the Mamie Flynn cabin site (at elevation 1120 feet) hosts an exceptional example of a lava flow over the aforementioned tuffaceous lake bed unit. The lava flow is rhyolite. Notice that the base of the lava flow is tilted about 20^{o} toward you (to the southwest). This direction is opposite to the one noted previously in the lake beds. It suggests that we are passing across a broad fold in the rock. In tectonically active areas (affected by earth stresses) like the Coast Ranges, tilting and folding of rock by tectonic forces is quite common. Here, the rock layers have apparently been gently warped by these processes.

7. Flynn Tunnel (Elevation: 1150 feet)

As the trail steepens again, we pass across the 1120 elevation for a second time. About 500 feet up the road from the rhyolite lava flow exposure, the road curves sharply to the left. At this point, we pass out of the lake beds and back into rhyolite tuffs. Here is a mine tunnel (properly called an *adit*, because it has only one entrance) that was the site of a mining venture by P. H. Flynn (Mamie's father) around the turn of the century. Reports of Flynn's progress in this prospecting venture on his property go back at least to 1889, and he was still working this adit as late as 1907, according to contemporary accounts in the *Weekly Calistogian* newspaper. The adit is approximately 100 feet in length and follows a northerly course. It appears to have been a *crosscut*. That is, it was designed to encounter an orebody deep within the hillside. An outcrop of weakly silicified (hardened) rock on the hillside above this prospect appears to have been Flynn's focus of interest. Gold, silver and mercury were the metals he was looking for.

A word of caution: Abandoned mine workings can be dangerous, and should not be explored unless proper safety measures are taken. The Flynn tunnel is hazardous, and should be avoided!

From the Flynn tunnel to the 1200 foot elevation, the road is very rough, and the rock appears bleached and locally iron-stained. This appearance is the result of chemical attack imposed on the rock by hydrothermal (hot water) activity. Hot springs water often releases hydrogen sulfide gas, which reacts with oxygen in the air to form sulfuric acid. This acid is capable of chemically digesting many minerals, converting them to clays. The hot water can also transport dissolved substances such as silicon and oxygen, which combine in fractures near the surface to form quartz veins. Metals can be transported by the hot water as well, and are often trapped in the quartz as it forms. Pyrite (iron sulfide) and other sulfur-rich metallic minerals commonly form under these conditions, and the iron stains you see in the rock are undoubtedly from the weathering of these. Gold, silver, copper and other metals are also highly concentrated in the quartz veins of this area, and have been the focus of mining and prospecting activity for over a century (Enderlin, 1993).

8. Vegetation Change (Elevation: 1320 feet)

As the Oat Hill Road turns from a northwesterly course to a northeasterly course, we are passing across a change in the type of volcanic rock. Notice that, although the rock is not well exposed here, there is a profound change in the style of vegetation. We have been in heavily wooded and brush-covered hillsides, but are now passing into open, sparsely wooded grasslands and chaparral. The rock here includes a volcanic unit called agglomerate. We will see good exposures of this rock farther up the trail. It is similar to the lapilli tuff units we have previously seen, but it is much coarser. The clasts (rock fragments) vary considerably in composition, and range up to the size of boulders. Imagine hiking here when this material was hurtling through the air!

The underlying rock type (as well as direction of slope) can play an important role in the type of vegetation present. In certain cases, vegetation changes may be the only clues available to the geologist to indicate transitions between poorly exposed geologic units.

9. Bald Hill (Elevation: 1360 feet)

Ahead and on the left is Bald Hill. This hill is an exposed andesite intrusive. As is typical in volcanic fields of this type, younger volcanic intrusives often force their way upwards through older volcanic deposits. Although no age has been determined for this andesite, it is definitely younger than the surrounding agglomerate, as suggested by its cross-cutting relationship. Our first encounter with an andesite along the trail was at stop #2. That andesite is similar to this one in composition, but is older. We know this because of their different relative positions in this "layer cake" of stacked volcanic units.

From this point to the 1760 elevation, we will be skirting along the contact between the andesite and agglomerate.

10. View of Napa Valley (Elevation: 1640 feet)

The best view of the Napa Valley from the Oat Hill Road can be had at this point. Looking to the southeast, one can see down the valley over twenty miles. The Napa Valley is a structural basin. That is, it formed as the result of vertical movement along northwest-trending faults along its edges. This movement apparently commenced during the period of Sonoma volcanism, and has persisted to the present. In this process, the valley floor dropped with respect to the surrounding mountain ranges, and accumulated deep deposits of volcanic ash and sediments as downwarping progressed. In fact, there is strong geological evidence to suggest that the floor of the valley at Calistoga has dropped over 2500 feet, with respect to the mountains to the west!

11. Chilled Margin of Andesite (Elevation: 1760 feet)

This is the last exposure of the andesite of Bald Hill that we will see as we walk up the road. Notice that at this point the andesite is nearly black on fresh surfaces (weathered surfaces are covered with lichens). The dark color is due to chilling of the margin of the intrusive. As a magma body rises through the surrounding rock, its edges tend to cool very rapidly, while the interior remains molten. These "chilled margins" tend to be glassy and dark in color, just as this one is.

12. View of Mount St. Helena (Elevation: 1790 feet)

The trail crosses a saddle along the crest of the ridge at this point. A good view of Mount St. Helena appears to the northwest. For years, people have argued over the question of the mountain's origin. Is it a volcano? No...at least not in the sense that most of us envision volcanoes. Mt. St. Helena is composed almost entirely of volcanic rock of the Sonoma Volcanic field, but these deposits did not all originate from this mountain. As was mentioned earlier, the Sonoma Volcanics were the result of myriads of small- and large-scale volcanic eruptions in this area. The volcanic vents were widespread. Although some of the rock on the mountain *did* erupt from that point, most of its deposits may very well have been the products of eruptions miles away. The mountain seemingly appears in the conical form of a volcano only because of its stature. At 4343 feet above mean sea level, the north peak of the mountain is nearly 4000 feet higher than the town of Calistoga. This difference in elevation is attributed to regional uplift: Just as the Napa Valley dropped along faults, so the mountain rose!

13. Volcanic Mudflows (Elev. 1940 feet)

Here, we have an excellent exposure of volcanic mud flow deposits. These tend to mix with the agglomerate deposits along the trail. Notice the boulders of dark volcanic rock suspended in fine gray material. These deposits formed when torrential rains (caused by the volcanic activity) saturated the slopes of unconsolidated volcanic debris. The resulting streams of fluidized mud (called lahars) may have flowed for miles, depending on the layout of the landscape at the time. About 80% of the boulders suspended in the muddy matrix are a volcanic rock called vitrophyre. It is primarily black volcanic glass (obsidian) speckled with white feldspar crystals. Vitrophyre forms when a magma begins to cool slowly, and then is suddenly chilled. The feldspar crystals grew during a period of slow cooling. The glassy portion of the rock formed as the magma reached the surface and erupted as lava. Volcanic glass tends to form from rhyolite magmas, which are rich in silica. Because of its thick, pasty consistency when molten, rhyolite does not crystallize readily when it flows as lava. Instead, it often forms glass. We see these volcanic glass deposits scattered throughout the Sonoma Volcanic field. The most noteworthy of these are at Glass Mountain (near St. Helena) and at Annadel State Park (near Santa Rosa). Obsidian (pure glass) was quarried at both these sites by the local natives for use in the fabrication of projectile points and various cutting and scraping tools.

From this point to the end of the trail, we will be in volcanic mud flows, agglomerate and welded tuffs (ash deposits that accumulated in a semi-molten state). Even the bluffs that lie ahead (the Palisades) are made up of these materials. These rocks represent the most violent of the eruptions in the volcanic field. This would not have been a good place to hike 3 million years ago!

14. "Bubble" Rock (Elevation: 1960 feet)

Notice the large bubble-like pits in the rock here. Similar exposures are present on Mt. St. Helena. Many people mistake these for gas cavities preserved during the eruptions. They are actually the product of weathering. Some of the rock fragments suspended in the volcanic mud flow deposits tend to be more susceptible to weathering than others. The process of weathering usually involves the conversion of minerals in the rock to clay. The clay, which is soft, will decompose and wash away, leaving a cavity where the original rock fragment had been.

15. Wagon Ruts (Elevation: 1980 feet)

Wagon wheels were capped with steel treads to protect the wooden rims from abrasion. The wheels of countless numbers of wagons that passed over this road gradually cut these ruts into the rock. From here to the drainage divide the road is very uneven. And it was here that travelers paid the price (in the form of discomfort) to use the Oat Hill Road!

16. View of the Palisades (Elevation: 2040 feet)

This is the roughest stretch of the trail, and it is here that off-road vehicle enthusiasts met their greatest challenge. The rusting bodies of several vehicles still remain in the brush below the road, testifying to the risks involved when driving here. In order to construct this segment, the rock had to be blasted using dynamite. The December 7, 1892, issue of the *Independent Calistogian* newspaper noted this activity:

> "The road-makers on the hill north-east of town are doing a great deal of rock-blasting, and the noise is akin to a bombardment on a small scale."

J. L. Priest, of Chiles Valley, was awarded the contract for the entire job in early October of that year. According to the *Independent Calistogian*, his crew officially began work on Friday, October 26, 1892. They probably completed the project in the spring of 1893 in accordance with the stipulations of the contract.

The view of the Palisades from this point is excellent. As was previously mentioned, they are made up of alternating layers of volcanic deposits, including mudflows, agglomerates and welded tuffs. In addition, on the south end of the bluffs, there is a beautiful example of *columnar* andesite. This feature is easy to pick out, because it looks like a bundle of gigantic pencils pointing to the sky! The columns are actually fractures (called joints) in the rock, that formed when the molten rock contracted as it cooled. The columns are always six-sided, and point in the direction of cooling. You might notice that the columns point outward at the base of the exposure. This change in the orientation of the joints suggests that this may have been a shallow intrusive, instead of a lava flow. Columnar patterns occur in many andesites and basalts. They are identical to the famous columnar joints in basaltic rocks at Devil's Tower, Wyoming; Devil's Postpile, California; and Giant's Causeway, Northern Ireland. The north peak of Mt. St. Helena hosts a type of volcanic ash called “lithoidal tuff,” with similar joint patterns.

17. Drainage Divide (Elevation: 2320 feet)

Our final trailside geology stop is in the gap where the Oat Hill Road skirts the south flank of the Palisades. The road continues to the northeast, but our geological excursion ends here. Three miles ahead is the Oat Hill Mining District for which this road is named. We are standing on a drainage divide. The streams to the west of us are tributary to the Napa River. The streams to the east are tributary to Pope Creek, which flows into Lake Berryessa.

At one time this property was owned by Carl Holm (Joe Callizo, pers. communication). The stone foundations are all that remain of the structures that once stood here. Carved stone was an important industry in the Napa Valley at one time, as the many stone buildings in the valley will attest. The rock composition of these blocks is distinctive, and tells us something of their origin. It is a coarse volcanic ash unit (lapilli tuff), composed entirely of pumice. Pumice is volcanic glass that has a sponge-like texture due to the presence of countless tiny gas bubbles (vesicles) trapped within it. The blocks were carved by hand, but were not quarried here. There are no pumice lapilli tuffs like this one exposed anywhere nearby. They probably came from one of several quarries in the Calistoga or Pope Valley areas.

This concludes the trailside geology log for the Oat Hill Road. It is the author's hope that this geological excursion has been both interesting and informative to you. What you have seen during the course of this hike is only a sample of the geologic diversity of this region. The California Coast Ranges are filled with geologic complexities and many unanswered questions. Here, in the Napa Valley, we are fortunate to have places like the Oat Hill Road, where the student of nature can explore one of the pieces of this great puzzle.

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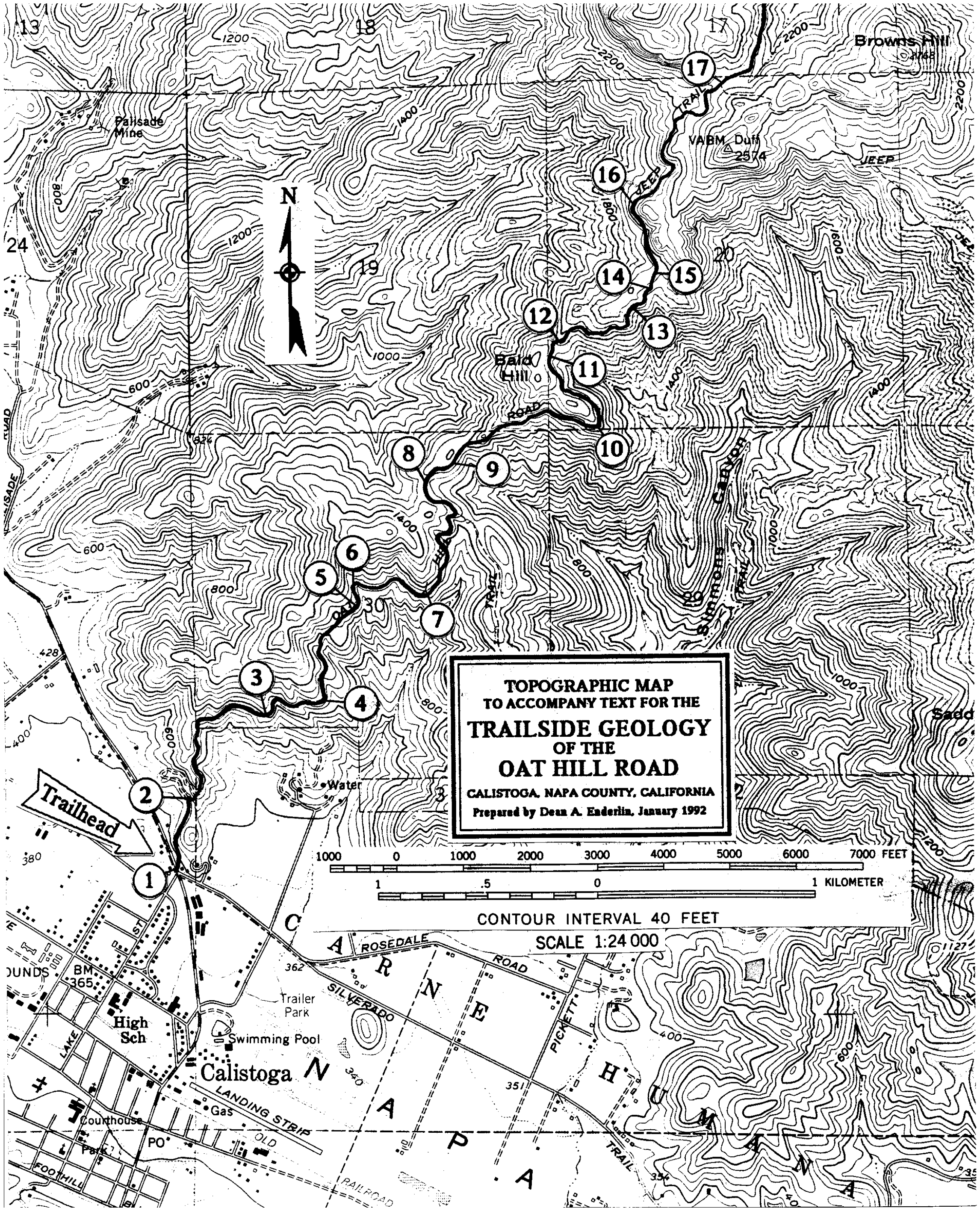
TOPOGRAPHIC MAP
TO ACCOMPANY TEXT FOR THE
TRAILSIDE GEOLOGY
OF THE
OAT HILL ROAD
CALISTOGA, NAPA COUNTY, CALIFORNIA
Prepared by Dean A. Enderlin, January 1992
Trailhead
N
Browns Hill
Palisade Mine
Bald Hill
Simmons Canyon
Calistoga
High Sch
Courthouse
Park
PO
Swimming Pool
Trailer Park
Water
Gas
LANDING STRIP
ROSEDALE
ROAD
SILVERADO
TRAIL
JEEP
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 40 FEET
SCALE 1:24 000