Interpretive Guide

of the American, Stanislaus and Tuolumne Rivers

Rebecca Lawton

INTERPRETIVE GUIDE

to the

AMERICAN, STANISLAUS AND TUOLUMNE RIVERS

Edited by

Robert M. Center

Special Edition

For

Pacific Rivers Outfitters Association

Rebecca Lawton

INTERPRETIVE GUIDE

to the

AMERICAN, STANISLAUS AND TUOLUMNE RIVERS

Edited by

Robert M. Center

Special Edition

For

Pacific Rivers Outfitters Association

by

Robert M. Center

and

Robert C. Preston

Preface

Over the years, a large group of people have accumulated a substantial body of knowledge about the boating rivers of the Sierra Nevada foothills. Most of these people have taken the time to pass this knowledge on verbally; some have taken the time to do some writing. However, as far as I know there has never been a single source containing an integrated body of material that applies specifically to the rivers that we run both commercially and privately.

The immediate goal of this guide is to provide such a source. All of the material herein was written and compiled by people who have an intimate knowledge of rivers. It is a boater's guide written by and for boaters. Hopefully, this guide book will contribute to our sense of appreciation for rivers, with the ultimate goal of preserving rivers in their natural state.

This guide was made possible through great contributions of time and energy by many fine people. First of all, I would like to thank all of the people who submitted material for this guide. Sarge Preston deserves special thanks for his extensive research on the Stanislaus River, and for the many enjoyable days we spent running the Stanislaus and discussing this book.

Marty MacDonnell, acting for the Pacific Rivers Outfitters Association (PROA), supplied the money for printing this edition. Marty and PROA have been instrumental in improving the quality of the river experience and enhancing professionalism among river guides.

I would like to personally thank Lou Elliott, founder of the American River Touring Association (ARTA), and the ARTA office staff for supplying me with materials, equipment and a place to work while assembling and typing this guide.

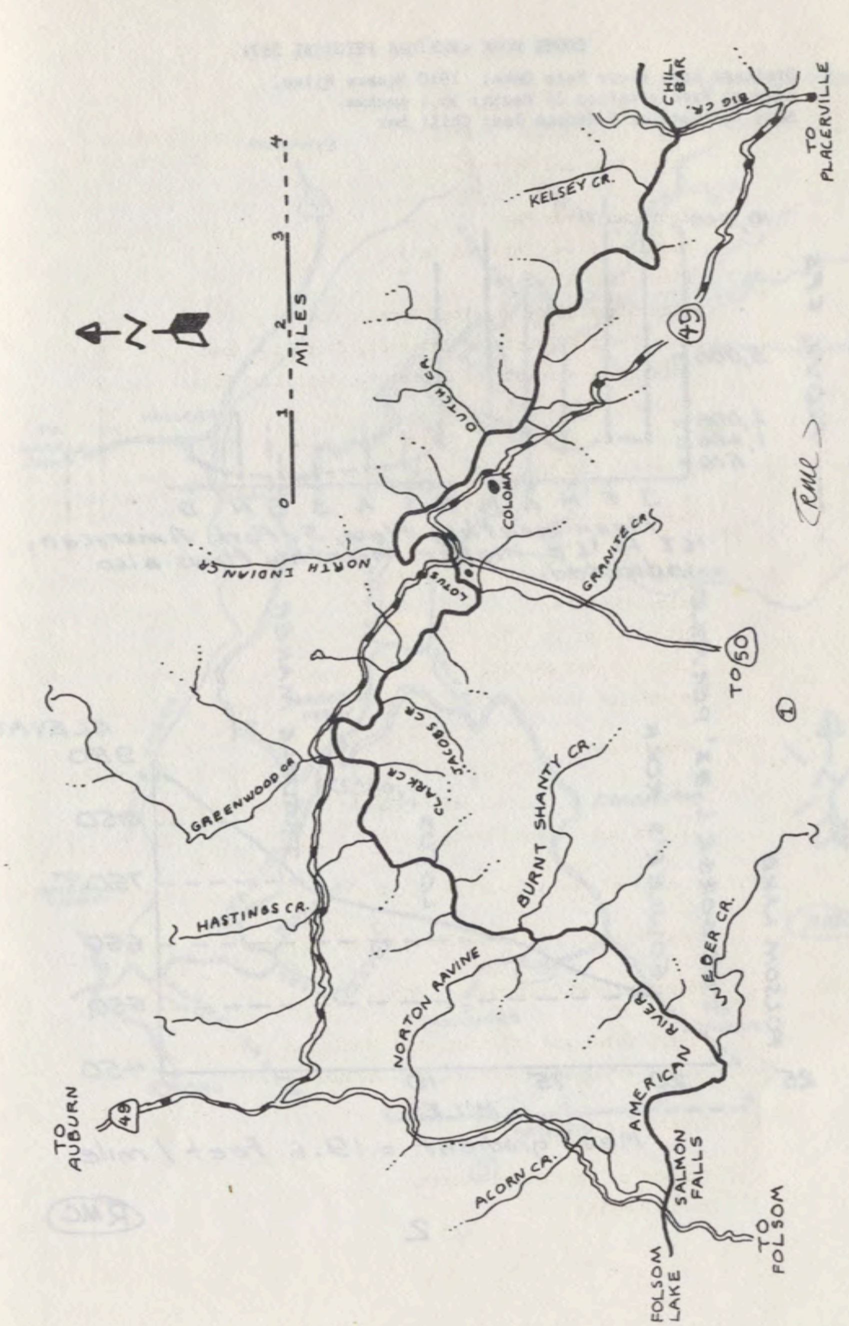
This guide is far from being complete. We would like to publish a revised edition this fall, and in the future we would like to see it become an organic, growing thing. Please send suggestions, criticisms and new material to:

GUIDE
c/o Bob Center
933 Edwards Avenue, #6
Santa Rosa, California 95401

I am looking forward to discussing improvements with all who are interested. See you on the river,

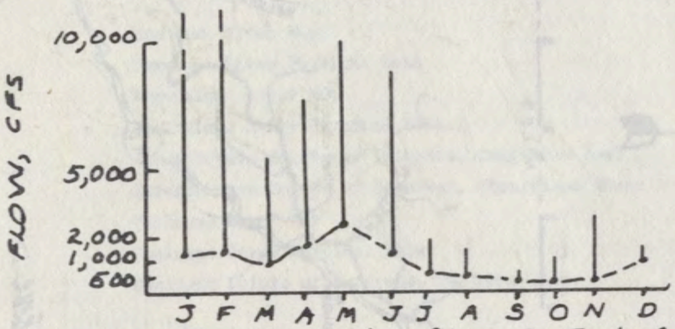
Bob Center
Vallecito, California
April 1975

TABLE OF CONTENTS

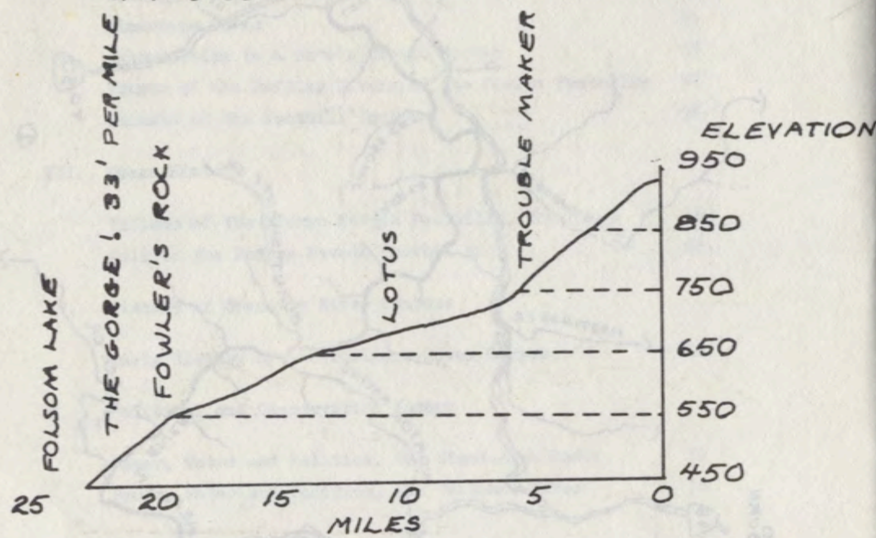


SOUTH FORK AMERICAN PHYSICAL DATA

Drainage Area Above Fair Oaks: 1910 Square Miles.
Average Precipitation In Basin: 55.1 inches.
Most Influential Upstream Dam: Chili Bar



Mean monthly flow, S. Fork American, '61 to '69. Higher monthly flows also indicated.

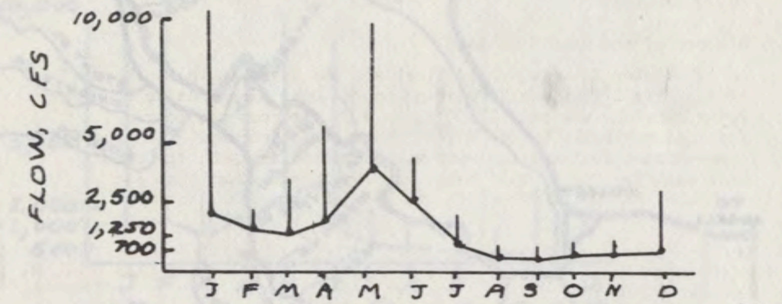


Mean gradient = 19.6 feet / mile

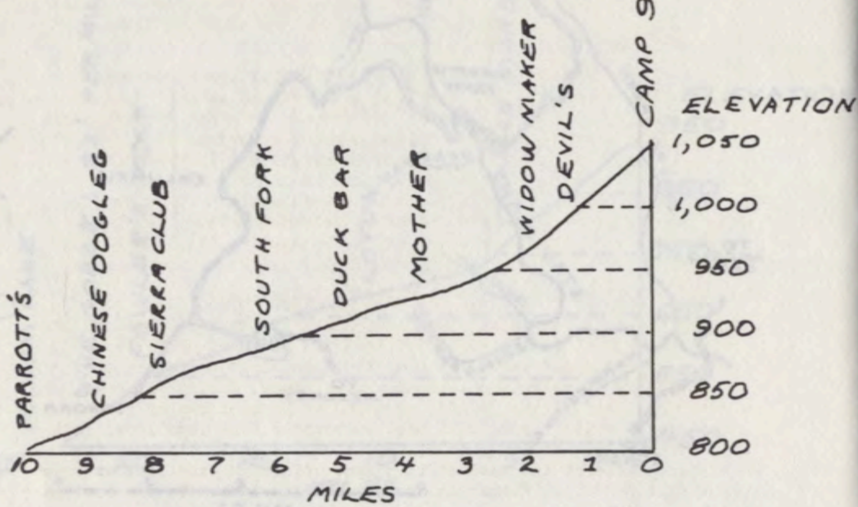
(RMC)

PHYSICAL DATA STANISLAUS RIVER

Drainage Area Above Knight's Ferry: 935 Square Miles.
Average Precipitation In Basin: 50 inches.
Most Influential Upstream Powerhouse: Camp Nine, Max 820 CFS



Mean monthly flow, Stanislaus, Aug. '67 to Sept. '70. Higher monthly means also indicated.



Mean Gradient = 25' per mile

RMC

ITERPRETIVE POINTS OF INTEREST ALONG THE CAMP NINE ROAD

Note: The geology in this section was taken from Terry Wright's paper, "The Stanislaus River, a study in Sierra Nevada geology", California Division of Mines and Geology, January, 1975. The information on human history was researched and written by Sarge Preston.

History of the Camp Nine Road

Victor Soleri, an old timer who has lived in Vallecito most of his life, recalls working on the Camp Nine Road as a young man. He was paid $2.00 minus $.75 for room and board. The road was built by the Union Construction Company. Construction began around 1905 and the road was completed in 1908, the same year that the first power house was completed. Camp Nine got its name because it was the ninth camp set up by the Union Construction Company.

Victor recalls the time that he helped haul the 16 ton transformer for the power house down the road in a wagon with huge wheels.

<u>Mile 0.0</u> Junction of Camp 9 Road and Parrotts Ferry Road, approximately 1 mile east of Vallecito.

<u>Mile 0.1</u> Gold-bearing quartz-rich (auriferous) gravels of Eocene age (53 to 37 million years ago) exposed in low cuts on south(right) side of road. These ancient river deposits were mined in this vicinity during the gold rush.

<u>Mile 0.7</u> White volcanic tuff from the Valley Springs Formation (Miocene age, 26 to 12 million years ago) exposed on east (right) side of road. The tuff was deposited probably as a hot glowing cloud of ash, (nuée ardente) similar to the gaseous eruptions of Mt. Pelée on Martinique. Gravel and clay interbedded with the tuff indicate the presence of rivers and lakes during the time these rocks were deposited. Small pieces of volcanic glass, that were molten when deposited and are therefore welded together, can be seen in the tuff. Across the valley to the west (left) is Bald Mountain.

<u>Mile 1.7</u> Small vein of volcanic material intruding tuff.

<u>Mile 2.0</u> Highest pass along the road. The flat-topped ridges to the north and south (left and right) of the road are part of Table Mountain, a resistant lava flow from the Stanislaus Formation that was originally deposited in a broad river channel during Pliocene (about 9 m.y. ago) time. Uplift, accompanied by millions of years of erosion of softer rocks that once surrounded that lava flow, left the resistant lava at its present elevation. A small ditch on the west (left) side of the road at this spot offers an excellent exposure of the Valley Springs Formation overlain by the lava. To the southeast

(right) the Stanislaus River has cut a canyon nearly 1000 feet into the rolling upland surface of the Sierra Nevada.

Mile 2.2 Gold-bearing gravels exposed in a series of steep slopes.

Mile 3.0 Gray, banded outcrops of the Calaveras Formation (Paleozoic). These rocks are part of the largest limestone body in the Sierra Nevada. In many places along the road and along the river the limestone has been metamorphosed into crystalline marble ranging in color from white to light bluish gray. The rock is often banded or veined because of segragation of graphitic rock and variations in grain size (Clark, Fuller and Weeks, 1973).

Mile 3.6 Three blue water tanks and large buildings mark the site of the Cataract Quarry, operated by the Calaveras Cement Division of the Flintkote Company. It occupies approximately 1,200 acres of land, and was built in 1970 and '71, and began operation in June, 1971. The cost of construction of the plant and pipeline was about 18 million dollars. The limestone and marble of the Calaveras Formation is quarried, crushed (at a maximum capacity of 600 tons per hour), milled in two gigantic ball mills (maximum capacity, 250 tons per hour), slurried with water and orazan (a by-product of wood pulp processing) to 70% solids, and pumped through a 17.4 mile pipeline to the Calaveras Cement Plant in San Andreas where it is made into cement products. The pipeline is at least 3 feet underground, completely insulated, and has a 7 inch inside diameter and 3/8 inch walls. Its capacity is 810 gallons per minute at a rate of 5 feet per second. You can see where the pipeline goes from the bare strip that runs over the hill to the north.

The three blue water tanks hold 5 million gallons of water each. The water comes from the forebay reservoir at the Utica Power House near Murphys through a pipeline. The plant could operate with only one tank but before granting water rights, P. G. & E. required that there be enough water stored at the plant for 30 days operation.

The large building near the road is a storage bin for the crushed rock. It is 450 by 200 feet with storage capacity of 50,000 tons. The two large white tanks are slurry tanks which hold 500,000 gallons each.

The entire plant is run by a large Honeywell computer which requires a single operator. In the day time, along with the operator, there is a crew of 21 who run the quarry machinery, do maintenance, etc. At night only two men are on duty.

The expected life of the quarry is 80 to 90 years. The plant is expected to wear out much sooner. If you are interested in seeing the operation, the people are very friendly and willing to show you around.

Mile 4.0 Plant gate. Limestone bedrock is exposed on both sides of the road which descends a steep grade.

Mile 5.0 Cataract Gulch. Black, red and green phyllites, schists and cherts of the Calaveras Formation exhibit jointing, banding and folding respectively.

Mile 5.6 Road takes a sharp turn to the east (left) directly above the Stanislaus River canyon, 1000 feet below. To the south, across the river, is Rose Creek canyon.

Highly foliated schist on the north (left) side of the road contains small garnets. The parallel alignment of platy mica minerals and the prescence of garnets in the schist indicate that these were once subjected to high pressures and high temperatures.

Mile 5.8 Diorite and quartz-diorite porphry dikes intruded into schists and cherts of the Calaveras Formation. Cherts are inter-bedded with phullites and schists along the remaining portion of the road to the raft put-in area. The reddish color of some of these rocks is due to a high concentration of iron.

Mile 8.3 Raft put-in area. The gray, recrystallized limestone cliffs on the west side of the put-in parking lot contain a white sausage-like quartz vein. The vein formed its sausage-like pattern as it responded to former high temperatures and pressures. Just north of the parking lot is an outcrop of folded chert. Baird (1962) recognizes at least two phases of folding in these rocks.

History of the Camp Nine Power House

Camp Nine, now called Stanislaus, was located just up from the existing power house. Some concrete walls still remain where the power house, a bunk house, a boarding house and a club house were once located. There were as many as nine cottages on the hillside at one time. There were probably more than 40 people living at Camp Nine at that time. One of the reasons the foot bridge was built was so that the residents could use the flat area across the river for recreation.

The power house was built by Sanderson and Porter. It had four generators which produced 10,000 kilowatts each and required 20 people to operate. Mrs. Soleri, then Ruth Lunberg, said that once when she was visiting there a friend who was an operator told her that if she pulled a certain switch it would turn off all the lights in San Francisco. So she pulled the switch and quickly pushed it on again. Who knows- maybe she did blink the lightbulbs in the City!

The water for the old power house came from a wooden flume which ran from a reservoir at Sand Bar Flat on the Middle Fork. The flume was at one time maintained by a crew of 40 who lived at Camp Four. Because of frequent landslides and other natural disasters, the old flume was replaced by an 11 mile tunnel in 1939. The tunnel is still in use. Several companies owned the old power house before it was finally purchased by P. G. & E. in 1920.

The existing plant was put into operation March 11, 1963. It has a single turbine and one generator which produces 91,000 kilowatts of power, which goes into the P. G. and E. power network. The water from the tunnel is collected in the 320 acre-foot forbay at the top of the hill and then funneled' through the 4,700 foot penstock which has a 10 foot diameter at the top and a 6 foot diameter at the bottom, where the pipe is 1-1/2 inches thick. The water drops a total of 1,500 feet creating a head of 600 pounds per square inch at the base of the pipe at the maximum flow of 800 cfs (cubic feet per second).

Because the flow of water back into the river ranges from zero to 800 cfs and often changes very rapidly, the check dam was built to prevent sudden surges of water from endangering lives down stream.

The existence of the Camp Nine or Stanislaus power house provides flows high enough for rafting throughout the summer. Spring runoff water is stored in Donnells and Beardsley reservoirs on the Middle Fork of the Stanislaus and released according to power needs during the summer months.

INTERPRETIVE POINTS OF INTEREST
ALONG THE STANISLAUS RIVER

by

Sarge Preston

This section is a mile by mile "run" down the river pointing out specific places of interest related to natural and human history. Mileages given are only approximate, but should guve you a good start in finding the points mentioned.

Mile 0.0 The Camp Nine Bridge was fabricated by the Baltimore Bridge Company in 1906 and erected in 1908. The Camp Nine Power House and a portion of the penstock are visible from the bridge. The dam just upstream from the bridge was built in 1963 to level off dangerous surges of water from the power house.

Mile 0.1 to 0.2 Commercial and private boat put-in points on U. S. Government property.

On the wall above the parking lot a sausage-like quartz vein is visible.[1] To the right of and slightly below the quartz vein is a small exploratory tunnel. It is probably part of the old Deer Lodge Quartz Mine patented on May 5, 1880 by Charles Pierce.[2] I have not been able to locate the two main tunnels of the mine.

Most of the rapids between here and Rose Creek are caused by ledges of resistant chert with large boulders stranded upon them.[1]

Mile 0.3 The buildings on the left were once part of a quartz claim called the True Business No. 3. The land is now owned by the U. S. Government. There is a drift adit (tunnel) about 100 yards downstream from the buildings and about 150 feet above the river.

Mile 0.4 The land on the right side of the river is owned by Thomas and Sylvia Winkel who bought the land from Clevland Schermerhorn on June 6, 1955. Please respect the Winkel's privacy and avoid trespass on their land.

In September, 1972 the Winkels acquired the old Louise Quartz Mine[4] which lies in the draw behind their place. This draw provides a view of the latite cliffs of Table Mountain. Latite is a form of andesitic rock (lava) which flowed along the course of an ancient river channel about 9 million years ago.

Mile 0.5 A large granitic dike can be seen on the right. The technical name for this rock is quartz diorite porphry[1]. This rock has a mineral composition that is slightly different from that of granite. It contains more of the heavy minerals such as amphibole, pyroxene and mica, and less of the lighter minerals such as quartz and potassium feldspar. Its structure consists of small crystals, the ground mass, surrounding larger crystals, phenocrysts.

Mile 0.8 The adit on the left near river level goes in about 20 feet, and was probably a prospecting shaft that did not pan out.

Indian Rhubarb grows abundantly along the shore in summer. The vegetation on the canyon walls is a good example of an oak-pine woodland.

Mile 0.9 The buildings on both sides of the river sit on property owned by Leo and Mytrice Tellefsen of El Cerrito. Yea Hoo Gulch comes in on the right.

A ledge of highly sheared chert and fine-grained schist crops out on the right.[1] About 25 feet downstream and behind the willows is a large block of soft, gray "soapstone" (talc schist), a metamorphosed olivine-rich igneous rock commonly found along fault zones. "The sheared chert and talc indicate a fault zone here."[1]

Mile 1.0 Except where indicated, the land on both sides of the river from here to Melones is federally owned. The controlling agencies are the Bureau of Land Management and the Army Corps of Engineers. The latter is gradually taking over all control in anticipation of innundation by the New Melones Project.

Mile 1.2 The stand of Yellow Pine occupies one of the many river-canyon niches that simulate climates found at higher elevations, allowing Yellow Pines and related plants to exist here.

Mile 1.8 Stony Creek comes in from the east. On its south side another example of a Yellow Pine Woodland is found. The wall to the right of Bailey Falls is another intrusive dike.

Mile 1.9 The angle of foliation in the metamorphic rocks (Phyllites, schists, and cherts) is evident.

Mile 2.1 The gully on the right has large Chain Fern growing in it. The beautifully sculptured granitic dike is one of the largest found on the river.

Mile 2.4 Rose Creek comes in from the left. "Folded and faulted chert containing gray quartz diorite porphyry dikes are present at the mouth and several hundred yards up Rose Creek."[1] About a quarter mile up Rose Creek Knight's Creek comes in. Some Miwok mortar holes can be found at the confluence. Up another three tenths of a mile or so is the beginning of an old flume that ran down the left side of Rose Creek and down the river to Marty's camp.[5]

Mile 2.7 Cataract Gulch comes in from the northwest.

Mile 2.9 On the right the marble talus extending into the river was caused in the summer of 1973 by a blast from the Cataract Quarry. The contact between the chert-schist-phyllite member of the Caleveras Formation and the marble member may be seen on the right wall. The marble cliffs rise about 1000 feet above the river at this point.

Mile 3.0 A stand of Bracken Fern grows on the flat about 50 feet above the left bank. Indians used the young fronds for food, and wove baskets and cloth from the rootstock. Early white settlers thatched summer shelters with the fronds.[6] This flat was the site of a great deal of mining activity. The flume which ran from Rose Creek supplied water for placer and possibly hydraulic mining, evidence of which is found at the downstream end of the bar.

Mile 3.1 Dead ahead and about 200 feet above the cliff is a white stake that marks the proposed New Melones high water level.

Mile 3.3 Rock debris coming in from Wool Hollow (on the right) helps form Mother Rapids.

Mile 3.5 Running downstream from Mother Camp to Razorback is the remains of a trail built and maintained by prospectors and miners of two centuries. Down from Mother Camp and about 200 feet up the cliff is a section of talus that has been cemented together by calcite, the main mineral constituent of marble. The red color comes from iron in the Caleveras Formation. Nearby is another group of Miwok mortar holes.

Mile 3.9 Grapevine Gulch comes in on the right. Two small flumes ran from the gulch and emptied into holding ponds. Water was released from the ponds to flush gold-bearing gravel from a channel and through a sluice box. While the holding ponds refilled, miners prepared the channel for another flushing. The next gulch downstream contains the remains of a holding pond that was filled by a flume from Grapevine Gulch.

The hanging garden spring runs year-round and is covered with Maidenhair Fern which is rather rare in the Sierra Nevada foothills. The lower part of Razorback Rapids was formed by some large chunks of marble which fell from the cliff into the river. The sharp nodules jutting from the rocks are composed of dolomite, a mineral that is considerably harder than calcite.

Mile 4.0 On the right is a black, shiny and nicely sculptured dike which is probably composed of amphibolite, a rock with a high iron and magnesium content.[1]

Mile 4.1 to 4.3 This quiet stretch offers an excellent opportunity to identify trees of the streamside woodland. There are incense cedars, yellow pines, big leaf maples, willows, white alders and Oregon ash; live oak, digger pines and California buckeye, and at least one fig tree.

Mile 4.3 The run-down buildings and the remains of an old dredge were left by recent argonauts who came to rework a claim first recorded on January 31, 1891 by George Batten as the Duck Bar Placer Claim. The claim extended along the river on both sides and covered about ten acres. Jose Navis later worked the claim. Then from 1911 to 1913 a man named Matteson worked it before Mattew H. Manuel, who was responsible for the cabin, out buildings, the dredge, and the twenty-foot deep hole, took over in January of 1914. After Manuel died the property was trusted to the United Bank of California on November 12, 1965, who sold it to the Six Mile Bows, Inc. in December, 1966. This company sold it to the Two Rivers Mining Corporation in December 1967, who sold it to Columbia Aggregates, Inc. of Oakland in March, 1969.[8] The cabin is occasionally used by some people from Angels Camp.

Pipeline Rapids is formed by a rock dam that was built to divert the river through a channel which runs from one end of Duck Bar to the other. Records show that Manuel diverted the river in 1914 to mine the gravel bar below.[8] A portion of the rock dam near where the pipe is, remained until 1971.[9] It is possible that the river was diverted several times in the 19th century in order to mine the river bed. At the head of Duck Bar there is a maze of glory holes, ditches, and flumes. Most of these are lined with intricate rock walls which are evidence of Chinese labor.[5] They were either working as hired labor or they were reworking an abandoned claim. (The Chinese of that time were not allowed to work fresh claims.) The same sort of stone work is found across the river at Duncan's Camp and down at Chinese Camp. Since Mariana Gulch is dry most of the year, the water for the early mining operations came from the large flume on the other side of the Camp Nine Road, and a smaller flume which comes from near Grapevine Gulch. Another small flume ran from above the bar around the corner to provide the water for the placer operations at Chinese Camp.[5]

Mile 4.5 Down the bar from the fig tree are some large willows, Datura, Mule Ears and many species of wildflowers in the spring. Here around the turn of the century lived a black miner known as Bill of Duck Bar. He made a good strike and lent his gold out at interest. However, because he was black and a money lender he became very unpopular. For his protection he kept his gold in a dutch oven under his cabin. Before he died, he buried the dutch oven and placed a curse that no white man would ever find it. As far as is known, no white man ever has.

Mile 4.8 The rock wall on the left at the bend in the river was built by early prospectors as part of the old path which runs from the South Fork to across from Duck Bar. Here the river was forded at low water. Another path runs on the other side from Duck Bar to Mother. This was probably one of the main routes which miners used to enter the upper reaches of the canyon.

Mile 4.9 Here beavers have been reported by Stu Smith He often heard the slap of their tails upon the water during the night. Beavers were trapped out of existence by early trappers working the Stanislaus region. The State Department of Fish and Game has re-introduced them.

Mile 5.6 Several Chinese Trees of Paradise are on the left bank.

Here the South Fork of the Stanislaus comes in from its drainage in Emigrant Basin. In 1849 a tent city was established about two miles up the South Fork at a place called Pine Log Crossing, the name coming from two pine logs used as a bridge. There were about fifteen hundred inhabitants there in 1849, mostly Sonorans. In 1850 at Pine Log, the first white woman in Tuolumne County, gave birth to the first white child born in Tuolumne County. The miners there reported being harassed by Indians who reportedly stole their cattle. The whole community was washed away in the flood of 1862, but the miners returned. The site was apparently active into the 1880s.[10]

In addition to placer mining, some attempts at quartz mining were made in the South Fork area. Leroy Reed located the Hi-a-po Quartz Mine in 1872 on the north side of the river. The same ground was later claimed by Draper and Kimball in 1925 as the Mary Ann Quartz Mine and in 1950 by H. A. Moore as the "South Stanislaus Gold Mine."[11]

At the confluence during the summer of 1850, John Jolly of Gold Springs and a party of 10 men attempted to dam the main fork of the river so that they could work the river bed below, but high water washed out the project.[12] In January of 1887, B. R. Sockett worked a claim here

called Claim 13. On july 26, 1882 George Blake took over the claim, officially filing it as the Good Return Mining Company's Placer Claim. It is presently owned by Gurney Robinson of Larkspur, California who bought the property on November 10, 1969.

Here much of the cliff face is flowstone or travertine, which is re-deposited calcite. The large cave about 300 feet up the cliff was once used by the Joaquin Murrieta gang.

Mile 6.3 The rock slides on the left are from a recent blast at the old Columbia Marble Quarry.

Mile 6.4 The house on top of the hill is owned by Mr. Stearns who has subdivided some of his property into lots.[13]

Mile 6.5 View of tailings from the old Columbia Marble Quarry. It was located by William P. Grant in 1854. Gang saws cut the marble into 1¼" slabs which were then hauled to Sonora for shipping. The saws were first powered by a waterwheel, then by electricity after a small power house was built next to the river in 1904.[14] The quarry contains Portola marble, blue in color with red veining.[15] Marble from this quarry can be seen inside the Tuolumne County Courthouse in Sonora.

The quarry closed in the 1930's and was bought by U. S. Lime Products Corporation in 1938. U.S. Lime sold the property to Flintkote who later sold it to the Merc Company of New Jersey. Presently the quarry is mined for dolomite and high calcium lime. Blasting connected with mining operations has ruined the marble in the quarry.

Mile 6.7 The old power plant for the quarry sat near the fallen down building on the left. The penstock and generator foundation still remain. The water for this power plant came from the Gold Springs Ranch and dropped 2,500 feet.[14] The two buildings were used for storage and residence by the plant operators.

Downstream on the right more Miwok mortar holes may be found in a large, flat piece of granite. Blackberry vines cover a wide strip of the sidehill on the left.

Mile 6.9 Leading down to the river on both sides are the old roads marking the location of Abbey's Ferry, constructed by George W. Abbey in the early 1850's. It was the only direct route between Columbia and Vallecito before Parrott's Ferry went into operation in 1860. The road up the north slope led to a place known as the Columbia Reservoir where one branch went to Vallecito and the other to Douglas Flat and Murphys.[16] The road now connects with the Skunk Gulch road which runs into the Camp Nine Road. Going toward Columbia, the road connects with the Marble Quarry Road which meets Parrott's Ferry Road at Gold Springs. There was a dwelling, saloon and stable associated with the ferry.[16] Remains of the foundations of these buildings can be found, along with a large ring bolt to which the ferry cable was attached.

Abbey sold half interest in the ferry on March 26, 1852 to George Bowles, George McLean and William Jeffery, and the other half to Abner Reed and John M. Loring a year later for $7,000. Reed and Loring sold their interest in 1858 for $7,500 to Joseph French, who in 1860 sold it to M. W. Parsons for $6,000. The Jeffery and McLean interest passed to Daniel and Joshua French and later to I. H. Harding. The last record of the ferry's operation was an application for renewal of liscence by Parsons and Moorehouse in April, 1863. However, the ferry was probably bought by the owners of Parrott's Ferry when their ferry was destroyed by the flood in 1862.[16]

In the early summer of 1860 two elephants named Victoria and Albert, after Queen Victoria and her consort, were on tour of the Mother Lode. Victoria fell off of the ferry and was swept through Deep Throat and Sierra Club rapids. She was able to reach shore and was taken toward Vallecito but died somewhere on the road from injuries suffered on the rocks. Albert continued the tour.[18]

A ditch on the right was a diversion channel similar to the one at Duck Bar.

Mile 7.0 Wolf Gulch comes in on the left. "Here is the contact between the Calaveras Formation limestones and the granite pluton. The granite, composed of plagioclase feldspar and quartz, is probably Jurassic (135 to 180 million years ago) in age."[1]

Mile 7.2 Steiner's cabin was built around 1930 by Walter Steiner who bought the claim on which it sits. He finished it in 2 months using yellow pine logs which he cut and hewed himself, and hoisted into place with the help of two boys, a tripod, and a winch. "Steiner did not have to do this himself. He was quite wealthy for those times as owner of Harbor Petroleum Co. He was a passionate, if not very ecologically minded, miner.... He was a big sturdy man-- a prototype of the American Individualist..." Steiner bought up several old claims about 1930 forming a single claim covering about 270 acres, running on both sides of the river with parcels as far down as Chicken Falls.[13]

Henry Stagnaro from Stockton purchased the claim from Steiner's widow in 1972. Since then the claim has been worked by a variety of "summer hobbyists and exploiters", who have been given the right to dredge by Stagnaro for a percentage of their take. Some have come up with small fortunes; one reportedly made about $10,000 in one season.

Looking upstream and to the east, a cave is visible near the top of the hillside. In this cave was found a skeleton with a cross under its head. The rib cage was scattered about and a rectangular hole the size and shape of a gold strong-box was dug out below. This may have been Jaoquin Murrieta's work, as this was one of the caves used by him and his men to observe traffic along the Abbey's Ferry Road. There were two other caves, one above the "shark's head" upstream, and another above the Steiner cabin, allowing the gang a clear view of all approaches to Abbey's Ferry. The gang signalled one another with torches from these caves, surrounded the stages, killed the guards and drivers and made off with the gold and fair damsels.

Mile 7.4 On the left are the remains of a dredge which Steiner built. The diesel winch under the live oak was used by Steiner for dragging large rocks across the river.[13]

Skunk Gulch comes in from the north. During the rainy season a beautiful waterfall may be seen. About a mile up the gulch is the Angels Marble Quarry which was worked prior to 1915.[19]

Mile 7.7 The ball mill, which is about 200 yards from the river on the left side, probably is on the old Densmore claim. It was opened during the gold boom in the 30's and probably closed down in 1942.[14] Another mill, the principal Densmore operation, is located several hundred yards up the hill. The claim is now worked by a Dr. Henry and a Mr. Gaddy of Turlock.

Mile 8.3 On the left is the residence of Walter Breens who works the old Republic mining claim which was first worked in 1890. About $385,000 was invested in the mine but only $100,000 was taken out. One of the reasons for this poor showing was that the mine used cyanide to extract gold from the ore, and when the State Department of Fish and Game banned the use of cyanide, the mine went broke.[20] The cabin on the right is located on a claim worked by two local couples.

Mile 8.5 The trailers on the right mark the location of the headquarters of ETC (Etcetera), a group that specializes in free river trips for underpriveleged folks. The property belongs to Betty Schultz of Long Beach. She acquired it from the Dutchess Mining and Milling Company in January of 1968.[21] The Duchess mines, several hundred feet up the steep slope and visible from the river, were located in the late 1800's by a man named Lilly. In this century they were operated with three drift adits and a 10-stamp mill. The operation closed in 1937.[22]

Mile 8.7 Parrott's Ferry Bridge was built in 1938 by both counties at a cost of $26,662.[10]

Mile 9.9 The remains of the foundation of the first bridge at Parrott's Ferry are visible on the right and left bank. It was built in 1903. Tuolumne County built the south half and Calaveras County built the north half. However, the south end turned out to be 5 feet lower than the north end. John Soleri, the father of Victor Soleri of Vallecito, did the stone work for the Calaveras side and was very proud when, as a result of the flood in 1937, his side held while the Tuolumne side washed away.[23,24]

The commercial take-out is at the site of the original Parrott's Ferry. The location was called Walker's Bar before Thomas H. Parrott established the ferry in 1860. The ferry was was destroyed in the flood of 1862 but was soon rebuilt. The ferry changed hands many times, each time for a higher price, until Parrott bought it back in 1871. The Parrott family lived on the Calaveras County side until Parrott's death in 1895. The property went to his daughter, Cecelia (now a resident of Angel's Camp) and was operated on a percentage basis by J. J. Groeper until 1897.[23]

Mile 9.2 Residence of Glenn Fuller, the Army Corps of Engineers ranger.

Mile 9.4 Deadman's Bar on the left was named after Walker was found dead there.[17] Chile Gulch comes in on the left.

Mile 9.5 Volcanic breccia, a conglomeration of rocks metamorphosed during late Paleozoic time, crops out on the left.[1] Rich Gulch comes in on the right.

Mile 9.8 The remains of a stamp mill sets next to the river on the right. This is the upstream boundary of the Melones fault zone as indicated by the dark green olivine and pyroxene on the left.[1]

Mile 11.0 Greenstone and slate form bladed or "tombstone" outcrops on the southern (left) shore.

Mile 11.8 Quaif Gulch is on the left. The large canyon just downstream is called Devil's Canyon.

Mile 13.3 The remains of an old power plant can be seen on the right shore. It recieved its water from the three flumes visible on the hillside. Part of the old penstock still remains.

Mile 13.7 Norweigan Gulch comes in on the left.

The huge white "sanddune" visible up ahead is really a tailings pile from the cyanation plant at the old Melones Mill which processed gold ore concentrates from the Carson Hill Gold Mining Corporation mill, which had thirty stamps and was operated from 1920 to 1942. The ore for these mills came from the famous Carson Hill Mines which had the largest output of lode gold ($26 million) in Calaveras County.[26] Carson Hill was named after James H. Carson who discovered gold there in August of 1848 after being led to the area by friendly Indians. He panned 180 ounces in 10 days.[28]

Melones was once the largest mining camp in the state with three to five thousand people.[25] Melones had, for the most part, a Mexican population and recieved its name from the melon-shaped nuggets found there.[23]

The most famous mine of Carson Hill, the Morgan, was located on the north-west slope of the hill. The huge pit created by the mine is visible from Highway 49 when driving towards Melones from the little town of Carson Hill. The mine was located in 1850 by an Englishman named Morgan.[28] The mine had yielded at least $2,800,000 by the end of 1851.[27] In November of 1854 the largest mass of gold ever found in the U. S., the Perkins Nugget, was found here. It weighed in excess of 190 pounds troy, was 15x3x6 inches, and brought $43,534 at the price of gold at that time. (At todays prices, the same nugget would be worth close to half million dollars!)

Mile 13.9 Here are the remains of an old railroad bridg that crossed the river. This is probably the site of McLean's ferry, which was founded in 1848 by George McLean. It was probably the earliest ferry on the Stanislaus and was on one of the main routes connecting the southern and northern mines of the Mother Lode.[23] Bret Harte's "Roaring Camp" is thought to have been in this area.[23] The main quartz vein of the Mother Lode can be seen on the side of Carson Hill. Coyote Creek comes in from the north.

Mile 14.1 The wall on the right may have been built to prevent high water from flooding the town of Melones. The huge Tevenot bridge can be seen from here.

Mile 14.3 The final commercial take-out is on the right. The Melones bridge marks the site of Robinson's Ferry established by J. W. Robinson and Stephen Mead in 1848. They built the first real ferry boat to operate on the river, at first carrying only foot passengers. Later they built a larger ferryboat. The rush to the mines was so great in 1849 that in a six-week period the ferry brought in $10,000. Robinson and Mead also operated a trading post at the ferry. Mead sold his interest to the property in 1853 to George Graham for $10,000 who later sold it to a man named French. Harvey Wood, who had bought Robinson's interest in 1856, bought out French and was the sole owner of the ferry until Tuolumne and Calaveras counties built a toll bridge[23] in 1910.[10] It collapsed in 1952 and present bridge was built by the state and opened for traffic in July, 1953.[23]

FOOTNOTES

1. William H. Wright III, "The Stanislaus River- a study in Sierra Nevada geology", California Geology

2. California Division of Mines and Geology, Mines and Mineral Resources of Caleveras County,California page 147,1962.

3. Tuolumne County Recorder, Proof of Labor, 5-22-47, 20/426.

4. Calaveras County Recorder, Deeds, 9-22-72, 346/170.

5. Dubois, Mark, "Summary of Historic Sites on the Stanislaus".

6. Storer and Usinger, Sierra Nevada Natural History, University of California Press, page 57.

7. Ibid. , page 56.

8. Calaveras County Recorder, Proofs of Labor and Deeds.

9. Personal interview with Ken Lewis.

10. Debby Baker, "Selected History and Future of the Stanisalus River"

11. Tuolumne County Recorder, Quartz Claims, Book 2, pages 87 and 270.

12. Gold Springs Diary, The Journal of John Jolly, edited and annotated by Carlo DeFerrari, Tuolumne County Historian.

13. Personal correspondence with Michael John, caretaker of the Stagnaro claim.

14. Personal interview with Jack Grant of Colombia.

15. W. B. Tucker, Mines and Mineral Resources of Amador County, Calaveras County, and Tuolumne County, California, State Mining Bureau, 1917.

16. Louise Nau, "Tuolumne County's Pioneer Ferries, Chispa, Quarterly of the Tuolumne County Historical Society, page 350, vol. 10, no. 4., 1971.

17. Personal interview with Carlo DeFerrari.

18. New York Sunday Dispatch, August 25, 1860, 6/3.

19. California Division of Mines and Geology, Mines and Mineral Resources of Caleveras County, page 213, 1962.

20. Personal interview with Walter Breens.

21. Calaveras County Recorder, Deeds, 1-17-68, 309/318.

22. California Division of Mines and Geology, Mines and Mineral Resources of Calaveras County, page 52, 1962.

23. Louise Nau, "Tuólumne County Pioneer Ferrys", Chispa, Quarterly of the Tuolumne County Historical Society, page 349, Vol. 10 no. 4, 1971.

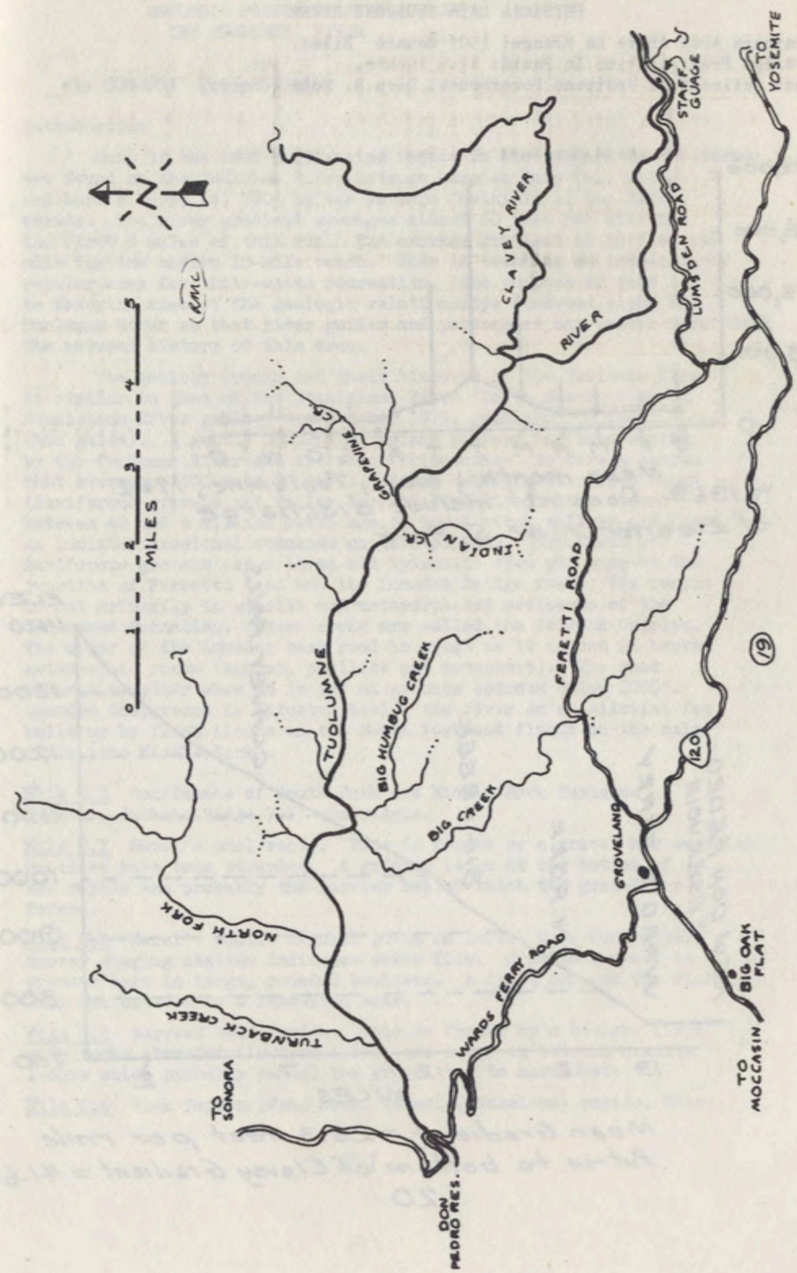
24. Personal interview with Victor Soleri of Vallecito.

25. California Division of Mines and Geology, Mines and Mineral Resources of Calaveras County, page 49, 1962.

26. Ibid, page 26.

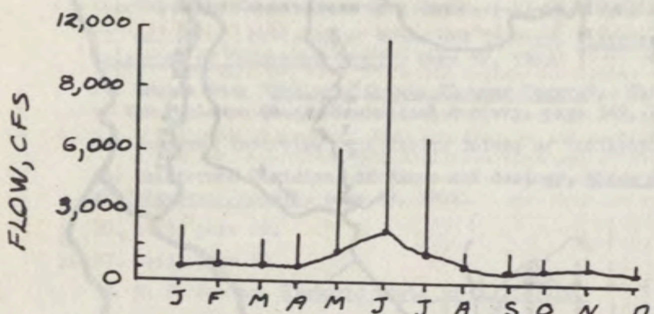
27. Ibid, page 50.

28. M. B. Hoover, Historic Spots in California.

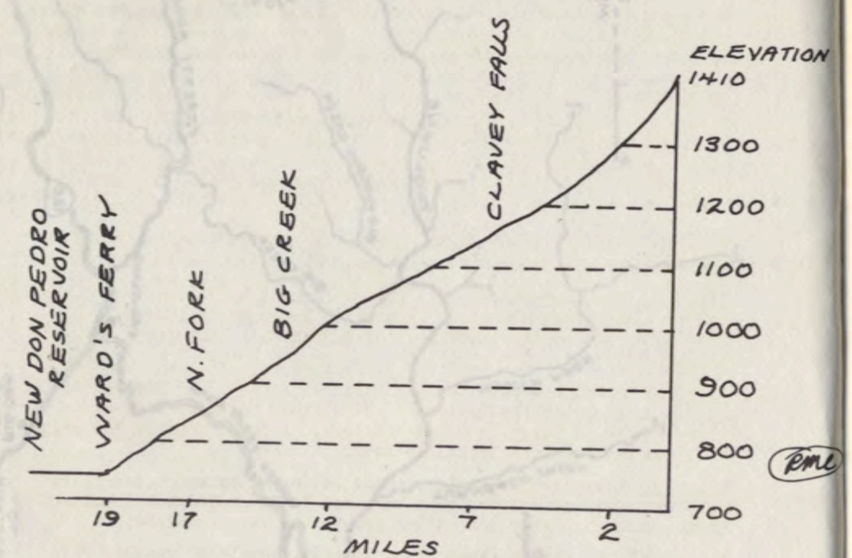


PHYSICAL DATA TUOLUMNE RIVER

Drainage Area Above La Grange: 1501 Square Miles.
Average Precipitation In Basin: 47.6 inches.
Most Influential Upstream Powerhouse: Dion R. Holm (Cherry) 600-800 cfs



Mean monthly flow, Tuolumne, 1961 to 1969. Does not include discharge of Eleanor Cr. or S. Fork.



Mean Gradient = 28.3 feet per mile
Put-in to bottom of Clavey Gradient = 41.6 '/mile

GEOLOGIC POINTS OF INTEREST ON
THE TUOLUMNE RIVER
by
Terry Wright

Introduction

Some of the most challenging rapids in the western United States are found on the Tuolumne River between Lumsden Camp (el. 1140) and Ward's Ferry (e. 760) in the western foothills of the Sierra Nevada. The river gradient averages almost 60 feet per mile for the first 6 miles of this run. The average gradient is 38 feet per mile for the entire 18-mile reach. This is becoming an increasingly popular area for white-water recreation. The purpose of this log is to describe some of the geologic relationships observed along the Tuolumne River so that river guides and passengers may better understand the natural history of this area.

The geology (rocks and their history) of the Tuolumne River is similar to that of the Stanislaus River (For a description of Stanislaus River geology see Wright, 1975, published on page of this guide). A gently undulating upland plateau has been carved by the Tuolumne River and its major tributaries to form a canyon that averages 1500 feet in depth. Young Superjacent series rocks (Auriferous gravels and Valley Springs Formation) which formed between 40 and 9 million years ago in broad river valleys are found as isolated erosional remnants on this plateau. Exposures of Auriferous gravels occur in an old hydraulic open pit mine at the junction of Ferretti Road and the Lumsden Bridge road. The canyon is cut primarily in granite and metamorphosed sediments of the Calaveras Formation. These rocks are called the Bedrock Complex. The upper of the Lumsden camp road is rough as it is cut in broken metamorphic rocks (schist, phyllite and metachert). The road becomes smoother when it is cut on granite bedrock below 1800'. Lumsden Campground is situated beside the river on an alluvial fan built up by flash floods on the South Fork and floods on the main river (the Middle Fork).

Mile 0.0 Confluence of South Fork and Middle Fork Tuolumne Rivers. Jawbone Ridge 7.5' quadrangle.

Mile 0.2 Meral's pool rapid. This is formed by a gravel bar on which boulders have been stranded. A granite ledge at the bottom of the rapids was probably the barrier behind which the gravel bar formed.

Mile 0.4 Meral's pool. Regular putin on left. U.S. Geological Survey guaging station indicates water flow. Granite bedrock is present here in large, rounded boulders. A fault zone on the right bank can be seen by a landslide scar.

Mile 0.5 Harvest Hole rapids. This is formed by a boulder field with rocks stranded first on a bar, and lower on bedrock granite ledges which probably caused the gravel bar to accumulate.

Mile 0.6 Rock Garden (Wrap Rock, Nemesis, Nameless) rapids. This is another large boulder field with several huge boulders of Calaveras Formation chert. The bedrock here is granite, so these boulders must have slid down from Calaveras Formation high above the river. On the right, several bands of light-colored granite dikes are visible.

Mile 1.3 Sunderland's chute. The river courses through a narrow, steep chute between a boulder field on the left and a bedrock cliff on the right. The steep gradient here is due primarily to boulders stranded on hidden bedrock ledges. Dark splotches on the gray granite are inclusions of older rock ripped off the margins by molten granite as it intruded this area. This intrusion took place about 6 miles below the surface of the earth about 140 million years ago.

Mile 1.6 Hackamack hole rapids.

Mile 2.1 Ramshead rapids.

Mile 2.5 India rapids. Coarse-grained granite dile forms ledge on right.

Mile 3.0 Contact between granite and chert-argillite melange of the Caleveras Formation. These rocks accumulated as sediment slides on the ocean floor and were later intruded by the granite. From this point to Ward's Ferry the river flows through chert, argillite (lithified mud), schists, metamorphosed volcanic rocks and marble which have been intruded by bands (dikes) of granite and basalt. These rocks (except granite and basalt) have been metamorphosed and deformed. Their main structure is a vertical platy aspect (foliation). Major rapids are formed where the river cuts across chert bedrock at an angle to foliation. When the river flows parallel to foliation and layers in schist or argillite these softer rocks allow a low gradient and few rapids. Rapids are formed mainly where hard chert ledges cause boulders to be stranded.

Mile 3.7 Tin Can Cabin on left. This cabin has been destroyed by natural elements. The river turns here to trend north and west, parallel to foliation so the gradient is low and rapids fewer.

Mile 3.9 Ledges on left show mixture (melange) of chert fragments in argillite. This indicates that the chert-argillite mixture deformed as soft-sediment slumps.

Mile 4.7 Stearn (Squeeze) Rapids. Large chert blocks form a narrow channel.

Mile 5.1 Evangelist rapids. Chert and marble blocks form a steem gradiient.

Mile 5.2 Granite dike forms white band parallel to river on right. This has been stretched into sausage-shaped boudinage structure.

Mile 5.8 Clavey river on right. This is the largest tributary to the Tuolumne River. During the winter it commonly contributes more than 1000 cfs to the Middle Fork. During the 1938 flood it contributed 38,000 cfs to the flow of the Tuolumne. The bedrock of the Clavey River is chert, argillite and marble mixed up in a melange structure. A beautiful falls .15 miles up the canyon is formed as the river is blocked by thick chert layers. Near the falls is a white granite dike which is offset by a fault. A fossil locality was discovered during our work in the

summer of 1974. This is the second fossil locality found in the Calaveras and thus is unique. This locality is still under study. Please do not collect any samples (here or elsewhere).

Clavey falls. This is the steepest drop on the river run. The main falls are formed by a chert bedrock ledge. In this ledge on the right are several cross-cutting bands (dikes) of light granite and dark basalt. The steep cliff on the left is also chert.

Mile 6.4 Enter Groveland 7.5' quadrangle.

Mile 7.4 Enter Tuolumne 7.5' quadrangle.

Mile 7.7 Powerhouse rapid. Several large blocks of chert form a narrow chute.

Mile 7.8 Large block of blue-gray marble on the left cliff. Folded quartz veins on right.

Mile 7.9 Old Tuolumne power house on right. For details on this ruin, see Rebecca Lawton's paper on page . The structure and workings were damaged beyond repair during the 1938 floods.

Mile 8.6 Indian Creek on left. A rough steep road descends 1600 feet from the rim of the canyon.

Mile 8.7 Large sandbar on right. This is one of the only flat areas next to the river. The steep gradient and frequent bedrock exposures indicate that this river is not graded and is actively deepening its canyon. Thus the canyon walls come straight down to the river. At flood stage, the river bends sharply to the right leaving relatively calm water on the right bank. Calm water in this eddy allows suspended sand material to be deposited as a point bar.

Mile 9.4 Grays Grindstone rapids. This steep, long rapids is caused by a boulder field on the left and bedrock wall on the right which constrict the channel A horizontal groove cut in the right bedrock wall was probably used to transport water downstream to placer mining operations.

Mile 10.8 Lunch rapids.

Mile 11.0 A train of marble blocks parallels the river to the right. This probably was originally a continuous layer which was pulled apart by tension, forming boudinage. The marble blocks are distinctively white in color here.

Mile 11.9 Chicken shot rapids. Several large boulders are stranded on a gravel bar.

Mile 12.1 White granite dike on right bank. Spectacular boudinage (pinch and swell structure) is present in these dikes. Dark colored basalt dikes are also present.

Mile 12.2 Numerous white streaks cross the cliff downstream and above the river. These are granite dikes.

Mile 12.2 Steamboat rapids. This is a long steep gravel bar on chert bedrock ledges. More chert in the bedrock and the fact that the river cuts across foliation and layers of chert create a steep gradient for the next mile.

Mile 12.9 Cabin rapids

Mile 13.0 Big creek on left. The rocks here contain mica. They are schists. Hells Kitchen rapids. A long, steep drop is caused by bedrock ledges and huge stranded boulders.

Mile 13.6 Beautiful folded cherts on the left bank. Layers of marble cause cliff lines on right slopes. Paper cabin ridge on right.

Mile 14.5 Suspension bridge, chert forms steep cliffs. See Rebecca Lawton's paper (page) for a history of mining operations in this area.

Mile 15.0 Enter Standard 7.5' quadrangle.

Mile 15.2 North Fork Tuolumne River on right. The bedrock is marble.

Mile 15.9 Chert bedrock, the gradient becomes steeper.

Mile 16.5 Foundation for stamp mill on left served the Russell Telegraph mine. The building for the mine may be seen up the gulley on the left.

Mile 16.6 Turnback Creek on right. A spectacular waterfall leaps from a chert ledge. Summer high water in lake Don Pedro reaches to here.

Mile 17.6 Pinball rapids (submerged in spring and summer) Several large boulders are caught on chert ledges.

Mile 18.0 Wards Ferry Bridge take-out. The bedrock is mica schist.

Note: This log is a preliminary draft, which I intend to revise for eventual publication in California Geology. Any corrections, additions or suggestions as to how this would serve you better are welcome. Please send to:

Terry Wright
Department of Geology
California State College, Sonoma
Rhonert Park, California, 94928

References:

Wright, W.H. III, 1975, The Stanislaus River; California Geology, v. 28, No. 1 (January), pp. 3-10.

GEOLOGY OF THE CENTRAL SIERRA NEVADA

William H. Wright III
Department of Geology
California State
College, Sonoma

ROCK TYPES AND DISTRIBUTION

Most of the central Sierra Nevada is composed of granite and related rock types. The granite, which is light grey in color, intruded a 20,000 foot thick accumulation of sedimentary and volcanic rocks that was later metamorphosed. These metamorphosed rocks, now visible in the complexly deformed western metamorphic belt of the foothills and isolated roof pendants in the Sierra, appear in many road and stream cuts as dark rocks with vertical foliation planes. The red soil of the foothills is a result of the high iron content of the rocks.

The metamorphosed sedimentary and volcanic rocks, together with the intruded granites, comprise the oldest material in the Sierra Nevada, and are commonly referred to as the bedrock complex (see table 1). Accumulations of younger sedimentary and volcanic rocks found on top of the bedrock are referred to as the super jacent series. The distribution pattern of the super jacent series suggests that it was laid down in broad river valleys which were carved into the bedrock complex. Near the Stanislaus River, the sinous table mountains of the foothills, capped by volcanic extrusives that flowed down the old river canyons, are composed of rocks of the superjacent series.

GEOLOGIC HISTORY

The geologic history of the central Sierra Nevada is summarized in table 1. The oldest events in the Sierra Nevada are recorded in a thick sequence of metamorphosed sedimentary and volcanic rocks called the Calaveras Formation. These rocks are located in the western metamorphic belt between the Melones fault zone and the Sierra Nevada Batholith. Individual members of the Caleveras Formation have been highly deformed and mixed together by both large and small scale faulting and flow folding. Metamorphism has also disguised the original features in the rocks. Although poor exposures between canyons make these rocks difficult to trace and analyze, it is now thought that the original sedimentary rocks were deposited in a marine environment where volcanic rocks were occasionally erupted onto the ocean floor. The original limestones, shales, sandstones, cherts, and volcanic rocks have been subsequently metamorphosed to marbles, quartzites, slates, phyllites, and schists. No distinctive fossils have been found in the Calaveras Formation, so that the age of the formation is subject to question. One poorly preserved fossil of Permian age was reported in the late 1800's but the fossil has since been lost. The rocks are dated questionably as Permian, or, more generally, Paleozoic in age on the basis of similar rocks which have been traced to fossil-rich sequences in the northern Sierra.

The first granitic bodies in the bedrock complex were intruded into the Lee Vining area about 200 m.y. (million years) ago (Triassic period). The granites melted and forced their way into the Calaveras rocks.

During early and middle Jurassic time(190-150 m.y. ago) a series of volcanic and sedimentary rocks accumulated in an island arc and ocean basin to the west of the present Sierra Nevada. These rocks, which include the Consumnes and Mariposa Formations and Copper Hill Volcanics, can be seen in the metamorphic belt located to the west of the Melones fault zone. Later metamorphism of shale and tuff produced slate and phyllite. Slate, which is quarried commercially, forms tombstone-like (tilted) outcrops in the foothills.

140 m.y. ago, granite was intruded into the Yosemite area. (Yosemite Intrusive Series). The sheer walls of Yosemite Valley display a complex history of at least four different intrusions. Gold and quartz veins formed during late-stage cooling of these granites.

At the end of the Jurassic period (136 m.y. ago), a major period of metamorphism and deformation, known as the Nevadan Orogeny, affected all of the rocks in the western Sierra Nevada and resulted in the first major mountain chain in the area. Flowage and metamorphism in the Calaveras Formation and younger bedrock complex took place at this time. In addition, originally horizontal layers were forced into a vertical position and the Bear Mountain and Melones fault zones formed with displacements measurable in miles. According to Bateman (1974), the Nevadan Orogeny mark a convergent plate boundary. Schwieckert and Cowan (1974) state that this boundary is where an island arc on the Pacific plate collided with the western margin of the North American plate.

The Nevadan Orogeny caused a great uplift of the Sierra Nevada nad initiated erosion and deposition of the superjacent series. During the Cretaceous and early Tertiary period (136-50 m.y. ago), the rocks from the ancient Sierra Nevada were eroded and deposited into the valley trough to the west. Estimates of the volume of sediments which accumulated in the valley (now known as the Great Valley) show that a thickness of 10 miles of material was eroded off the present Sierra (Bateman and Warhaftig, 1964, p. 127). As uplift and erosion were going on in the northern Sierra Nevada, a final granitic intrusion occurred in the Tuolumne Meadows area (Tuolumne Intrusive Series, 90 m.y. ago).

The rivers that caused early erosion probably cut deep canyons, similar to those we see today. However, with time these canyons and divides were worn down to broad valleys. In a classic study, Lindgren (1911) determined that five major rivers flowed west and north, with the largest streams approximately following the course of the present Yuba and Calaveras Rivers. These streams deposited beds of gravel and sand eroded from the Sierra. Gold veins were also eroded and particles of this valuable metal were concentrated in gravel beds as placer deposits. These auriferous (goldbearing) gravels of Eocene age are exposed in the hydraulic mining pits, of which the Malakoff diggings in North Bloomfield is the prime example. In the Great Valley a widespread blanket of clay

and sand was deposited simultaneously as the rivers flowed into a delta area. These rocks, called the Ione Formation (Eocene Age, 53-37 m.y. ago) are an economic source for potter's clay.

During the Miocene and Pliocene (26-3 m.y. ago), other major river channels were formed parallel to the present Stanislaus River and the Middle Fork of the American River. Gold-bearing gravels accumulated in these channels. Volcanic activity in the high Sierra in many areas caused glowing clouds of volcanic ash and glass and volcanic mudflows to move down these river canyons. The ash, which was deposited first, can be seen in the Valley Springs Formation (Miocene, 26-12 m.y. ago) as welded tuff. The Valley Springs Formation is generally rhyolitic. Some water-laid ash and gold-bearing gravels in this group of rocks indicate that

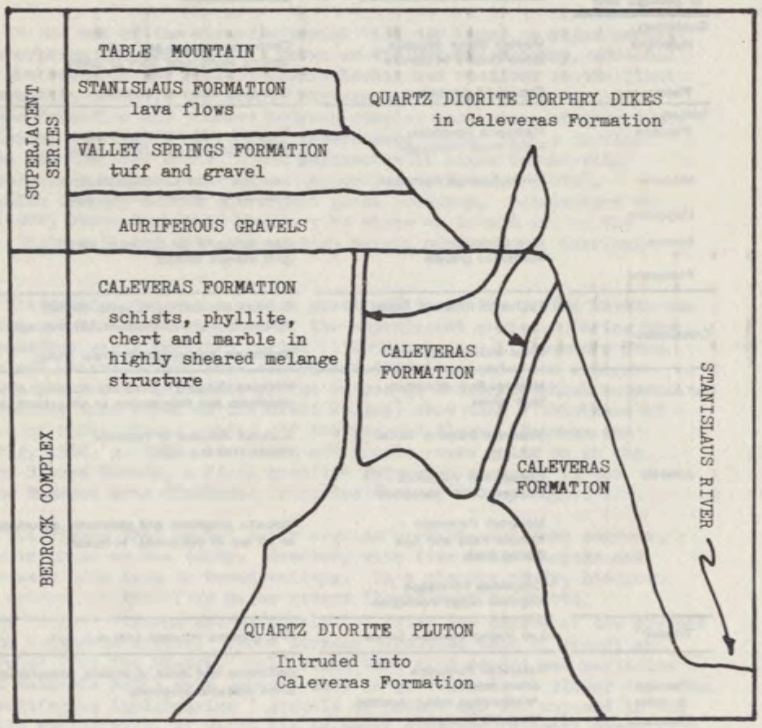
TABLE 1: SUMMARY OF THE GEOLOGIC HISTORY OF THE CENTRAL SIERRA NEVADA

Periods and epochs of geologic time	Rock units and structures	Geologic events	
Quaternary			
Holocene	Modern Sierra deposits Mono craters volcanoes	Continued erosion and uplift; faulting along east front of Sierra	
Pleistocene	Glacial till deposits	Glaciation and river erosion	
Tertiary			SUPERJACENT SERIES
Pliocene	Stanislaus Formation Relief Peak Formation	Renewed uplift and erosion; late gold placers formed (9 m.y. ago)	
Miocene	Valley Springs Formation	Lava and volcanic sediments flow down early canyons (23 m.y. ago)	
Oligocene			
Eocene	Ione Formation - Auriferous gravels	Early canyons cut by rivers; early gold placers formed	
Paleocene			
Cretaceous	Tuolumne Intrusive Series	Granites intruded; gold veins formed; erosion of higher mountains (90 m.y. ago)	BEDROCK COMPLEX
	Great Valley Sequence	Sediments accumulate in Great Valley	
Jurassic	Melones-Bear Mountain fault zones	Nevadan Orogeny - mountain building metamorphism and deformation of all older rocks	
	Yosemite Intrusive Series	Granites intruded in Yosemite region (140 m.y. ago)	
	Copper Hill Volcanics - Peaslee Creek Volcanics		
	Mariposa Formation - Merced Falls and Salt Spring Slate	Volcanic eruptions and sediments accumulated in an arc of volcanoes in ocean	
	Cosumnes Formation - Logtown Ridge Formation		
Triassic	Lee Vining Intrusive Series	First granites intruded (200 m.y. ago)	
Permian or older Paleozoic	Calaveras Formation Chert member Argillaceous (clay) member Volcanic member Clastic member	Sediments laid down in marine environment; some volcanic eruptions	

short periods of river erosion took place. These gold-bearing gravels were worked at Vallecito and Columbia during the middle 1800's.

Mudflows of volcanic debris (lahars) subsequently covered all but the highest peaks in the northern and central Sierra Nevada (Relief Peak Formation). These deposits are not present at lower elevations.

A later series of lava rivers extended down canyons along the present Stanislaus River drainage. These rocks, now called the Stanislaus Formation (Pliocene, about 9m.y. ago), have a latite composition, which is very similar to rhyolite. Erosion has exposed these hard rocks in the flat-topped Stanislaus Table Mountain. Remnants of the Stanislaus Formation extend from Sonora Pass high in the Sierra to Knight's Ferry in the low foothills. This hard cap preserved the Valley Springs Formation and the auriferous gravels from subsequent erosion.



Slow uplift and erosion formed the present Sierra Nevada range. Uplift began about 10 m.y. ago and continues today. The broad ancient river valleys, marked by auriferous gravels and volcanic rocks, were uplifted, tilted to the west, and cut by new river canyons. The modern streams established their present courses and gradients about 3 m.y. ago, so that tilting was largely completed by that time (Warhaftig, 1970). These modern rivers tapped the gold in the bedrock complex and super jacent series and re-concentrated the placer deposits. Marshall discovered gold in a deposit of this type on the South Fork of the American River. The rivers are actively eroding today, except in areas where their work has been temporarily halted by dams.

The Sierra Nevada rivers have roughly parallel courses flowing westward. This is typical of "consequent" rivers which develop their courses after a regional slope is created. The broad upwarping of the Sierra, which began about 9 m.y. ago (early Pliocene) and continued until the beginning of the Pleistocene (about 1 m.y. ago), created a low angle westward slope. Water started accumulating in low areas on this slope and eventually formed a series of west-trending river courses which cut deep canyons as uplift continued. The rivers probably did most of their cutting during the Pleistocene when abundant rainfall and glacial melt-water caused high water levels. Most channel cutting and load moving is done at flood stage today. What we now consider flood level was probably the common flow during the Pleistocene glacial epochs.

Glaciers covered most of the high Sierra Nevada several times in the past 3 m.y. Several river canyons acted as conduits for ice flow but the glaciers advanced only as low as 4,000 feet in elevation. Thus the effects of glacial erosion are not seen on any of the standard river tours, all of which are lower than 4000 feet elevation. Today's Sierra Nevada glaciers exist in cirques only along the highest crest of the Sierra.

THE STANISLAUS RIVER

There are many irregularities which form pools and rapids in the streambed of the Stanislaus River. Resistant bedrock ledges, which act like ribs in a gold sluicebox, trap sand, boulders, and cobbles that are bounced or rolled along by the river. These sediments account for the rocky nature of the rapids. Gravel and cobbles in the load tend to occur in bars which actually move slowly downstream, sometimes causing locally steeper gradients and rapids. The gradient of the Stanislaus River ranges from nearly 40 feet per mile below the Camp 9 Road bridge to about 10 feet per mile below Parrots Ferry.

Running the Stanislaus River by raft provides an excellent opportunity to study Sierra Nevada foothill geology. River canyon features, rocks of the superjacent series, and rocks of the bedrock complex are exposed both along Camp 9 Road, which leads to the raft put-in on the Stanislaus River, and along the river itself. Many caves, easily accessible from the river, offer a comprehensive view of the area's geology. Figure 2 shows a schematic section of rock units seen in the Stanislaus River Canyon.

REFERENCES

This paper appered in the January 1975 issue of California Geology pages 3 through 10. The complete text of the paper has been reproduced, with the exception of a step by step log of the Camp 9 road and log of the river from Camp Nine to Melones. Information contained in these logs has been incorporated in another section of this book. There are a number of fine photographs in the original paper; unfortunately we were not able to reproduce them.

Dr. William Wright gave us his kind permission to reproduce this paper. Following are the references that he cited in the original paper.

Bateman, P. C., 1974, Model for the origin of Sierra Granites: California Division of Mines and Geology, pp. 3-5.

Bateman, P. C. and Wahrhaftig, C., 1966, Geology of the Sierra Nevada: in Bailey, E. H., editor, Geology of northern California: California Division of Mines and Geology, Bulletin 190, p.107-172.

Baird, A. K., 1962, Superposed deformations in the Central Sierra Nevada: University of California Publications in Geological Sciences, v. 42, p. 1-70.

Clark, L. D., 1964, Stratigraphy and structure of part of the western Sierra Nevada metamorphic belt, California: U. S. Geological Survey Professional Paper 410, 70 p.

Clark, W. B., Fuller, W. P. and Weeks, O. D., 1973, Quarry to mill by pipeline: California Geology, v. 26, no. 9, California Division of Mines and Geology, p. 207-213.

Lindgren, W., 1911, The Tertiary Gravels of the Sierra Nevada of California: U. S. Geological Survey Professional Paper 73, 226 pages.

Schweickert, R. A. and Cowan, D. S., 1974, Pre-Tithonian magmatic arcs and subduction zones, Sierra Nevada, California: Geological Society of America Abstracts with Programs, v. 6, no. 3, p. 251-2.

Wahrhaftig, C., 1970, Course Syllabus, "High Sierra", U. C. Berkeley, 57 p.

LIMESTONE CAVES

by

David Westphal

Origin of Caves

The caves found in the Stanislaus River Canyon were formed in the limestone of the Caleveras Formation. Most of these caves are at least one million years old.

Limestone and marble are composed of calcite ($CaCO_3$). The limestone that now contains caves was formed in the sea during Paleozoic time, probably about 280 million years ago. Limestone is formed by marine creatures and plants which extract calcium carbonate from sea water. The skeletons of these organisms are deposited on the sea floor to be later compacted under pressure and cemented into firm rock. When these rock layers are uplifted and exposed to the dissolving power of underground water, caves are formed.

Limestone caves are formed when acids attack calcite. The acid chiefly responsible for dissolving of limestone is carbonic acid (H_2CO_3) which is produced when carbon dioxide, a product of plant and animal respiration and decay, combines with water. The chemical equation for the reaction is as follows:

$$CO_2 + H_2O \rightleftharpoons H_2CO_3 + CaCO_3 \rightleftharpoons Ca^{+2} + 2HCO_3^{-1}$$

Carbon Dioxide	Water	Carbonic Acid	Calcium Carbonate (Calcite)	Calcium Ion	Bicarbonate Ion

This is an equilibrium reaction, and the reaction proceeds in both directions simultaneously as the arrows indicate. The dominant direction of the reaction is related to the relative concentration of the reacting molecules and ions. For instance, addition of CO_2 will drive the reaction to the right, causing calcite ($CaCO_3^{2}$) to go into solution as calcium bicarbonate($2HCO_3^{-1}$). A high concentration of calcium bicarbonate will drive the reaction to the left, causing calcium bicarbonate to drop out of solution and become solid calcite.

Caves are formed by slowly moving water in a zone below the water table, which is the level below which the rocks are saturated. Two factors that influence the distribution of cave passages are 1) The position of horizontal planes that mark the past water table and 2) Fractures in the limestone. There are three types of fractures: 1) Partings, which follow thin layers of silt or clay laid down with the limestone, 2) Faults, which are caused by mountain building forces that folded rocks until they fractured, and 3) Joints, which occur in both folded and non-folded rocks and are thought to be produced by earth tides, which produce great flexing of the rocks.

Formation and Enlargement of Passages

Surface water first moves rapidly downward through cracks to the water table, then collects in joints and partings, to then be discharged at springs or along streams. When fractures are very small, the volume of water is also small and water becomes saturated with calcium bicarbonate soon after descending below the water table. Therefore early stages of solution are slow. When a particular channel becomes larger than others, it takes in more water and therefore grows faster. When a channel reaches a certain critical diameter (approximately one-quarter inch), flow in the channel becomes turbulent and the rate of solution increases. This channel is the one that usually becomes the cave.

One popular theory of cave formation is that most limestone caves have been formed in a relatively thin horizontal zone directly below the water table. The two main reasons for this theory are 1) The carbon dioxide content in this zone is relatively high, and 2) Unlike the downward-moving water above, the water below the table is in contact with the limestone long enough to become fully saturated with calcium carbonate.

Water containing carbon dioxide from the soil zone moves downward so rapidly that it dissolves only a very small percentage of limestone that it could dissolve if given enough time. When this water discharges into the main body of ground water it still contains unused carbonic acid. Therefore, the small cavities directly above the water table acquire a high and uniform carbon dioxide content. and this is where cave formation occurs. This process continues until one of two things happens. The water table may lower or an entrance to the cave may be formed by surface erosion. The lowering of the water table drains the cave, which means that the dissolving will cease or continue at a lower level. When an entrance is formed, the high partial pressure of carbon dioxide can no longer be maintained. The dissipation of the carbon dioxide causes the dissolving process to stop. However, it is at this stage that the deposition of calcite in the form speleothems occurs. (Speleothems are cave formations.)

Stages of Limestone Cave Evolution

Geologically speaking, caves are short-lived with only a few million years elapsing between the time of cave formation and the collapse of its roof. The four stages of cave formation are as follows:

1. Enlargement of joints and partings
2. Development of master channels below the water table.
3. Transitional stage wherein nearby streams have cut down to the level where their seasonal fluctuations strongly affect the level of the water table in the cave system.
4. Further lowering of the water table and downcutting of the surface until an entrance is formed.

Charachteristics of the Underground Atmosphere

Since the air movement in a cave is slow, the air takes on the same temperature as the surrounding limestone. In limestone, a daily surface temperature fluctuation of 50 degrees is reduced to a fluctuation of less than one degree at a depth of 2-1/2 feet. Also,a yearly fluctuation of 50 degrees gives a one degree fluctuation at 48 feet. Therefore a cave usually has a one degree fluctuation yearly and its temperature is determined by the "average" temperature of its surroundings.

During the day, the air outside of a cave is warmed and becomes less dense, so its pressure falls. Therefore, at dawn the air begins to flow out of the cave. The inward flow occurs when outside air cools and becomes more dense. In caves with two entrances, one above the other, the air will flow out of the top entrance in winter and out of the bottom in summer. (i.e. the cold winter air enters the cave and is warmed, becomes less dense and rises, like smoke up a chimney).

Speleothems

Features formed in a cave by the deposition of secondary minerals are called speleothems. Speleothems consist mainly of calcite which was solutioned away from the limestone above. The slightly acidic water that percolates down through the limestone becomes saturated with calcite. Upon exposure to the air in a cave, the water is given off and this lowers the calcite carrying capacity of the water, and the calcite is deposited. In cases where the downward seeping water has not become saturated with calcite the speleothems formed have a hollow solution tube. This is because deposition may occur only on their outsides where the water has lost some carbon dioxide. The water in the center remains saturated with calcite. Speleothems usually form only in well-ventilated parts of a cave because if the carbon dioxide content of a cave becomes too high, then calcium carbonate (calcite) deposition will not occur.

Tubular stalactites (soda straws) are common, and have walls that are only 1/64" thick. Conical stalactites are not formed by dripping water but by flowing water. As the water from the ceiling flows down a tubular stalactite it deposits calcite and forms a conical stalactite. The growth of a stalactite is never much over 1/10" a year and may average 1/100" yearly. This growth is arrested if the stalactite becomes contaminated from the oil deposited when touched by human hands.

Draperies are formed when a drop of water flows down an inclining ceiling and leaves behind it a trail of mineral matter. Drop follows drop and the deposit is slowly built downward. The brown color in draperies which give them the

As drops fall from a stalactite, they retain some carbon dioxide and therefore also contain calcite. The shock of the drops striking the top of a stalagmite and breaking up into many droplets or films with more surface area, causes the gas to be driven off and thus the calcite deposited. When a stalactite and stalagmite meet, they form a column. Stalagmites grow at the same rate as stalactites. A stalagmite in Moaning Cave had a growth rate of 25 ten thousandths of an inch per year (determined by radiocarbon dating)

Flowstone is formed when water flows down a cave wall. In some caves flowstone forms over gravel or silt beds. Later, if the gravel or silt is washed out from under the flowstone, unsupported overhanging deposits called canopies are formed. These often have the impression of mud cracks on their undersides.

Rimstone dam -- located on cave floors. These dams are usually well-shaped forms that impound small pools of H_2O. One hypothesis is that as the H_2O flows over the lip, it is agitated enough to give off CO_2 and deposit calcite.

Cave pearls -- smooth, round-shaped deposits of calcite with a nucleus of a grain of sand or some fragment. Surrounding the nucleus are concentric layers of calcite. Most pearls are formed in nests below dripping water. The layers of calcite are formed equally on the complete surface of the pearl, yet for some unknown reason they usually remain unattached to the cave floor. Cave pearls are considered rare because they can and are easily removed from caves by unthinking and inconsiderate people.

Helectites -- small twisted structures of calcite. A hole in the cave ceiling can be too small to form a drop and with too little a flow of H_2O for gravity to affect it. Most of the deposition takes place right around the hole at the tip of the helectite. Each new layer is shaped like a tiny cone, and each cone consists of a single crystal. Their crystal form causes the cones to be slightly distorted.

Shields -- currently accepted theory of formation -- each shield consists of two parallel plates separated by a planar fracture. This fracture is always an extension of a joint or parting in the limestone wall. As in helectites, H_2O under pressure moves out to the rim of the shield. Here deposition occurs and the shield slowly increases in diameter. Shields are considered to be rare.

Cave coral -- occurs in places where it could not have received H_2O from dripping or splashing. Usually found in cracks on the wall or on porous deposits of cave silt. Coral is formed by seeping water, but since no central canals have been observed thus far, the water apparently seeps out between the crystals.

Spherical stalactites -- bulbous shaped stalactites. They are porous and their cavities appear to have been dissolved after stalactites were formed. The water seeps outward from the interior and deposits calcite on the surface.

INTRODUCTION TO A CAVE'S BIOTIC SYSTEM

Mark Dubois

Life conforming to the special limits within the cave environment lives in a delicate balance. A cave contains pretty much a closed eco-system in that little energy comes from outside. Outside a cave, nearly all forms of life depend on energy from the sun, either directly (green plants) or indirectly (fungi and animals). In a cave there is absoulutely no light, and microscopic plants that get their energy from breaking down minerals within the cave form the base of the food chain.

The amount of time critters spend in a cave is used to classify them: Troglobites (troglos=cave, bite=life), troglophiles (phile=love), and trogloxenos (xenos=foreign or guest). Troglobites have totally adapted to cave life and only on rare occasions leave it. Most often they have lost their pigment, their skin or shell has become softer, and all senses aside from sight are highly developed. A few troglobitic insects have been found in California caves. At least one species will be adversely affected by New Melones Dam.

Few animals do more than enter the twilight zone of caves- lack of light and too much moisture make cave environments unattractive to most species. Raccoons, porqupines, rats and snakes are a few of the animals that occasionally make their homes in the front part of caves. Some animals will penetrate more deeply into caves by following a wall and leaving a urine trail. Bats are more permanent dwellers in caves, sleeping in them diurnally and coming out at night to eat. Bats also hibernate in caves in winter months.

The web of life in caves is complex, and life in all caves is extremely delicate. Tests have shown that just a few visitors to a virgin cave will effect and change the micro-biology within the cave, which in turn will eventually affect the whole cave.

Sensitivity to caves

Many crazy cavers or spelunkers migrate every weekend from the city to crawl about in caves. (Much the same as rafters and kayakers migrate to the rivers) Cavers have developed a very tight clan-- most are very paranoid about having too many people crawling around in the fragile cave environment and visiting Mother Lode caves shows why. Of the caves that have been known for a while many are nearly void of formations. In 1962 a series of vandalisms occured in the popular caves. Part of McLean's cave is still littered with a pile of such formations- 100,000 years just lying there. More often, caves are devoid of formations because each visitor wanted one for a keepsake. These souveniers are invariably misplaced or lost, and in addition will never again be seen in their natural setting. Formations may also be destroyed by accident, and Coral Cave is now devoid of the cave coral for which it was named. Broken formations should be left where they are found, so that subsequent visitors will have a chance to see them.

For savety sake, cavers wear long pants, thick long sleeved shirts and hard hats. From personal experience, I have found it is much better to to go into caves wearing little. Few clothes cause us to go much slower because of wanting to protect our bodies, thus protecting the cave. Remember, your body will heal much faster than the slow-growing cave. When entering a cave, it is agood idea to have three independent light sources and also to leave word with someone indicating whereabouts and intended return time.

My purpose in writing these paragraphs is to remind would-be visitors to caves that we humans are often extremely insensitive to the worlds we do now know or that are unfamiliar to us. So. . . when entering a cave, remember that it has never seen natural light, the temperature has been constant, the silence has only been broken by the dripping of water and occasional flight of a bat... sit for a moment... try to imagine yourself being a stalagtite... a young one... you've been there a few thousand years... how does a visitor's intrusion affect you?

Take nothing but pictures, leave nothing but footprints, kill nothing but time.

The major source of material for the two papers on caves was:

Morre and Nicholas: 1967, Speleology, D. C. Heath and Company.

PLANTS OF THE RAFTING RIVERS OF THE SIERRA NEVADA FOOTHILLS

by
Gary Genest, Tim Lawton and Bob Center
with illustrations by Janet Peterson

Boating and associated activities in the Sierra Nevada foothill region offer a good opportunity to observe several distinct plant communities and a great variety of individual plant species. The plant communities and some of their member species will be discussed in detail, but first let's take a look at some of the factors that affect the growth of plants in this region. Broad categories of environmental influences are as follows:

1. Climate
2. Soils
3. The shape of the land or physiography
4. The influence of other plants, animals and man, or biotic influences
5. The ancestry and migration of plant communities and species

CLIMATE

The climate of the foothill region of the Sierra Nevada is influenced by two major factors: The Pacific Ocean and the Sierra Nevada Mountains. The Pacific stabilizes the temperature in California, resulting in a Mediterranean climate. The summers are warm and very dry; the winters are cool and wet. Temperature extremes found in more northerly climes and in the deserts east of California are uncommon in California itself. Rainfall, on the other hand, varies widely from season to season. Weather patterns over the Pacific result in one of the most significant charachteristics of the foothill climate, the familiar wet and dry cycle. Low pressure systems that originate in the Gulf of Alaska move southward off the coast of California during the winter, generating moisture laden storms. In the summer, these Pacific lows are generally centered more to the northward and as a result summer rainfall is rare, except for thunder storms in the high mountains. Precipitation in the foothills averages from fifteen to forty inches per year, and almost all of it falls between mid-October and mid-May.

During the winter, the Sierra Nevada Mountains and foothills cause moisture-laden winds from the Pacific to be deflected upward and cooled. Moisture is lost from this cooling air mass as rain in the foothills and snow at higher elevations. During the summer, great expanses of bare granite in the high mountains heat the surrounding air, causing it to rise. Air to supply these convective currents originates over the Pacific Ocean and the Great Valley, rushing eastward to form the familiar dry, warm upcanyon breezes.

SOILS

Soils are derived from the weathering of underlying bedrock and the decay of organic material from the vegetation cover. The rocks encountered in the foothill region are of four basic types:

Granites and associated rocks, schists and phyllites, limestones and marbles and rocks of volcanic origin. In this region, granite weathers fairly rapidly and contains the chemical elements required for most plants for growth. The schists and phyllites form a fairly complete soil upon weathering, but weathering may be slowed by large amounts of resistant chert (flint) contained in this group of rocks. Limestones and marble are chemically simple rocks, composed mostly of calcium carbonate. Weathering of these rocks proceeds slowly in the local climate, and weathering results in joints and fissures in the underlying rock through which water seeps, becoming unavailable for plant growth. Limestone-derived soils develop slowly; however, once developed, they may be quite fertile. Volcanic rocks, such as the andesite that caps Stanislaus Table Mountain, tend to be very resistant to weathering, and are slow to form soil cover.

Given moisture, plant cover, and enough time, a substantial cover of "good" soil will build up in most areas. As the soil becomes older, its charachteristics come to depend more upon the nature of the plant cover and less on the composition of the underlying rock. Another factor influencing the development of soils is the shape of the land, or physiography.

PHYSIOGRAPHY

The mountains rising from the Central Valley have a great influence on the climate as a whole, and smaller topographic features contrubute to great variation in local habitats. Due to our northern latitide, the sun spends most of its time in the southern sky. This means that slopes facing toward the south recieve more sunlight than those facing toward the north. Through most of the foothill region, water is relatively scarce, and the sun beating down on southern exposures exagerates this aridity. The north facing slopes tend to be cooler and damper. In the foothills, this tends to result in more lush vegetation on the northern exposure.

Dry summer winds blowing up the canyons increase evaporation and transpiration on west-facing slopes. Eastward-facing slopes and small pocket canyons are in "wind shadows" and escape much of this drying effect.

The steepness of the terrain has several influences on soil formation and plant growth. Steep slopes drain quickly, and so lose water that is important to soil formation. Soil that does form is succeptible to erosion, and so soils on steep slopes are usually thin and dry. The thickest, best developed soils tend to occur in small pocket canyons and swales.

BIOTIC INFLUENCES

Plants, as all organisms, modify their own environment in many ways. For example, trees with dense foliage sharply reduce the light available to the light available to plants growing beneath their boughs, and their dropping leaves form a thick mulch on the forest floor. The mulch and shade reduce water lost through evaporation and transpiration, leaving more water available to the tree. Some plants practice active chemical warfare by means of germination inhibiting chemicals, similar to turpentine, that are washed from their leaves into the surrounding soil.

Animals, from the smallest bacteria to man himself, have a great influence upon plant growth. Microorganisms and insects are important in the decay of organic material, returning nutrients to the cycle of life. Insects play an important part in the pollination of flowering plants, and in turn recieve their nourishment from the nectar, pollen and foliage of the plants. This co-operation, or symbiosis, between plants and insects may become highly developed. The nectar of some flowers contains many of the amino acids necessary to protein systhesis. Apparently, these amino acids are not directly necessary to the well-being of the flowers, but have been evolved over millions of years to attract and nourish a healthy group of pollinating insects. Birds and animals depend upon plants for food, and in turn transport seeds far and wide.

Man has had, and continues to have, a great influence on local flora and vegetation. The Indians made extensive use of fire to increase the productivity of the land. The Spanish inadvertently imported many species of annual grasses that have virtually replaced the native perennial species. Hydraulic and placer mining caused many millions of tons of fertile soil to be washed down local streams, leaving sterile rockpiles behind. Logging has denuded slopes of cover and has greatly reduced the extent of the yellow pine forest. Dams for water and power have turned many miles of free-flowing streams into flat water lakes, burying entire biotic communities.

Much of the impact of past modifications to the land and the flora is not readily apparent, as local climate and soil conditions allow fairly rapid re-vegetation of denuded areas. The extent of the long-term changes wrought by man is difficult to determine, as there are very few areas in California that are in the pristine state, and there is no way to compare the way things are now with the way things were prior to man's influence.

Man's interaction with the natural environment generally results in reducing the complexity of the environment through the elimination of species and communities. One of the axioms of the science of ecology is that the stability of a community, and its ability to respond to new conditions, is decreased as the complexity of the community is reduced. Many species of plants and animals will no doubt survive in spite of Man's continuing simplification and de-stabilization of the world eco-system. A very real question is whether or not man will be among the surviving species.

PLANT ORIGINS

The above factors may be likened to pieces of a gigantic picture-puzzle that we call life. Since the origin of life on earth, the pieces of this puzzle have changed in size and shape, and the resulting "picture" of life has changed accordingly.

In early Tertiary time (70 million years ago) the North American Continent had a topography and climate that was much less varied than it is at present. Fossil evidence indicates that plant life of that era consisted of three broad groups of plants. The northern half of the continent was covered by a forest of mixed decidious hardwoods and conifers. This forest extended from about the latitude of San Francisco well into what are now arctic regions, and has been termed the Arcto-Tertiary geoflora. "Arcto" refers to its northern distribution; "Tertiary" refers to the time period during which it flourished and "geoflora" is a major vegetation unit that has continuity in space and time. Trees of the streamside woodland such as the willows, alders, cottonwoods and the bigleaf maple trace their ancestry to this forest. They thrive in cool, damp streamside woodlands that are similar to their ancestral habitats. The yellow pine and incense cedar also came from the Arcto-Tertiary geoflora, and though they do not require as much water as the broad-leaved species, they tend to grow on northern exposures and in relatively cool areas. The California Buckeye originated in these northern forests, and has made an interesting adaptation to its present habitat. The Buckeye requires a cool environment and large amounts of water to live; why, then, is it so wide-spread? The answer is that the Buckeye does most of its "living" from early March to late June and is dormant the rest of the year. Instead of restricting itself to cool, damp geographical regions, the Buckeye has made a temporal adaptation, and "lives" during the period when the whole region is cool and damp.

At the southern edge of its range, the Arcto-Tertiary geoflora merged with the Neotropical Tertiary geoflora. This geoflora was composed of tropical and subtropical trees, and its descendents have largely disappeared from the foothill region. Fig trees originated in this forest, and have been re-introduced by Man at many locations in the foothills.

Most of the chaparral species originated in the Madro Tertiary geoflora, which existed in pockets between the Arcto-Tertiary and the Neotropical tertiary. Madro comes from the name of the Mexican mountains, the Sierra Madre Occidental. Most of these plants are small-leaved trees and shrubs such as Buckbrush, Chamise and Scrub Oak, and originally evolved in almost-desert arid environments. The chaparral plants have since adapted to the California wet and dry cycle. These plants live in areas that are exposed to the drying effects of sun and wind; habitats that are similar to those of their ancestors.

Since early Tertiary time (70 million years ago) fluctuation in climate caused the relative coverage of the three geofloras to vary widely. As each geoflora spread across the land and then receded, it left behind plants that found niches in and/or adapted to the changing environment.

Starting in the Pliocene (11 m.y. ago) the uplift of the Sierra Nevada and the creation of the Cascades formed barriers to the movement of plant species into and out of the California natural province. The mountains intercept most of the moisture conveyed by the prevailing westerly winds, creating rain-shadowed desert areas that line the east edge of the California natural province. The mountain ridge-crests represent a boreal or near-arctic environment. Thus, in order to migrate to or from California, a plant would have to be able to survive in (or adapt to) two rather different and extreme sets of climactic conditions. Due to this isolation, about 30 per cent of the plant species present in California are endemic to the state. (That is, they are found no where else.) Among the endemic plants found in the foothills are the monkey flowers, locoweeds, lupines, Ceanothus, manzanitas and the Digger Pine.

PLANT COMMUNITIES OF THE RIVER CANYONS

The vegetation found in the foothill region and the river canyons may be conviently divided into four plant communities, the Chaparral, Oak Woodland, Streamside Woodland and Yellow Pine communities. These communities may be considered separately, because they represent different groups of plants best adapted to live in relatively distinct environments. Although the different communities may be considered separately, in reality the variou communities may intermix to a considerable extent. The sharpness of the edge between two communities will often depend upon the change of a particular environmental factor, such as the availability of water. The division between the Streamside Woodland and the Oak Woodland is quite abrupt. A sudden drop in the water content of the soil a short distance from the river bank causes an almost immediate shift to plants favoring drier soils. The change between chaparral and other communities is sometimes abrupt, but at other times it takes place slowly, with the shrubs of the Chaparral and the oaks of the Oak Woodland intermingled. There are several plants that further complicate the picture by thriving in more than one plant community.

In some cases an area may be in the process of changing, or succeding, to another type of plant community. Succession is a natural process by which the organisms of an existing biotic community alter their own environment to such an extent that they are no longer able to tolerate it. In doing so, they create an environment suitable to a different set of organisms. This process continues until an equilibrium with the environment is achieved. This equilibrium stage is called the climax community. It is self-maintaining, and is generally long-lived as long as it remains relatively undisturbed.

STREAMSIDE WOODLAND

On the banks of the foothill rivers a verdant community of water loving plants makes its home. Many of the members of this community are found only along stream courses where they find the abundant water supply and the shaded, cool environment they require.

The trees and other plants that grow along the river bank play an important role in the ecology of the river. Studies of various rivers have shown that as much as 66% of the energy, or food, available to the river ecosystem comes from terrestrial vegetation. Leaves and other plant parts fall into the water and are decomposed by primary consumers which are themselves consumed by a chain of organisms leading to game fishes, birds of prey and man.

Trees, shrubs and other plants stabilize the soil and greatly reduce erosion by the currents of the river. They provide habitats for many animals that nest, feed or find shelter in their growth. In the hot, dry days of summer they are attracted to this area because of the shade and the cool, moist air.

COMMON PLANTS OF THE STREAMSIDE WOODLAND

1. White Alder (Alnus Rhombifolia), Birch family.
This tree is 10 to 35 meters high with light green leaves and grey to whitish bark. The flowers form in green, hanging male catkins, and brown female cones about 3-8 cm. long.

I once gave relief to a hiker with swollen, hot feet by placing several moist White Alder leaves in his boots. He was able to continue his walk with the leaves in his shoes to cool his feet and relieve the swelling. Some Indians, though apparently not the Miwok, used dried White Alder bark in a decoction to induce circulation, to allay diarrhea and stomach ache, to aid childbirth, and to stop hemmoraging. Early Californians used the astringent cones and bark for tanning leather. They also peeled the bark in the spring and used it to make a dye.

2. Oregon Ash (Fraxinus latifolia), Olive family

A tree 10 to 25 meters high with each leaf divided into 5 to 7 leaflets. This tree is dioceous, which means that the male and female flowers are on different plants. The flowers are without petals. Branches of this tree were used to make bows and arrows and tree climbing ladders.

3. Big Leaf Maple (Acer macrophyllum), Maple family

This tree is 9 to 20 meters or higher, with the trunk to one meter in diameter. The tree is decidious and has brownish gray bark having narrow interwoven ridges or checked, small rectangular plates. The leaves are 10 to 24 cm. broad and roundish in outline with 3 to 5 lobes. The flowers bloom in April and May and produce a winged fruit.

This is the only large tree-maple in California. Euell Gibbons feels thatthis tree could be a sugar producer like the sugar maple of the east. The Miwoks used the bark as a binding in basketry. Young shoots were obtained in spring when the bark skins off easily, and were used for warp in basket making.

4. Umbrella Plant, Indian Rhubarb (Peltiphyllum peltatum) Saxifrage family

A coarse perennial herb with large roundish leaves. The thick, fleshy stalks attach to the middle of the underside of the leaves. The stalks and leaves grow from a gnarled rhizome in late spring and rapidly expand to their maximum size. The flowers are white to pink and bloom in clusters from May thru July1

The fleshy leafstalks may be peeled and eaten, and are good in salads, stews or cooked alone. The Miwok used the pulverized root to whiten acorn meal.

5, Button Bush (Cephalanthus occidentalis)

A shrub 1-4 meters high with young branches usually in 3s, smooth bark green, yellow or reddish. Older bark is gray or brown and furrowed. The shrub is deciduous with simple leaves that are opposite

or in whorls of 3 to 5. The leaves are 7-15 cm. long by 2-5 cm. wide, and are a glossy pale green and are often wavy edged. The pale green, spherical flowers are 1-3 cm in diameter and have a delicate, pleasing fragrance. Flowering Button Bush is conspicuous from July thru September close to the edge of streams and creeks.

6. Willows (Genus Salix)

Trees or shrubs of rapid growth and light wood; bark bitter-flavored; young shoots smooth, yellow or red, with the trunk bark of older trees fissured and dark. The leaves are simple, narrow and vary in size from species to species. Flowers are in catkins, with the male and female flowers found on different trees. The catkins are usually erect and appear before or with the leaves.

The slender pointed leaves, flowering catkins or "pussy willows" and close adherence to water make willows as a group easy to recognize. More than 14 species occur in the Sierra, with precise identification being difficult without detailed study.

The most common species of willow in the foothill area are the Red Willow and the Black Willow, which form a major element of the streamside woodland. Nesting birds favor willow thickets, as do many species of animals.

CHAPARRAL

Typically Chaparral is found where there are mild, wet winters and long dry summers. An average rainfall of 15-35 inches per year, falling mostly in the winter, is usual. This type of climate, called Mediterranean, supports chaparral type growth in parts of Chile, Africa, Austrailia, Mexico, in the land around the Mediterranean sea, and in California and Arizona.

A major environmental influence upon Chaparral is the sudden shutting off of the water supply in June. In California, very little rain falls after June. Chaparral knows when to close up shop. Growth begins for Chamise, a common Chaparral shrub, in January, accelerates in April and May, and stops in June. In August and September the Chaparral community is dormant. The need for water is reduced until the return of rains in the winter months.

When rainfall breaks the long period of dormacy, Chamise, Manzanita and other Chaparral members are ready to come to life. Most Chaparral species lose the old leaves in early summer, during or at the close of the growing season. By this time, the new leaves are functional so that the shrubs are never without leaves. In this way, plants are able to take immediate advantage of the first rains of winter for the production of new foliage and reproductive structures.

The hard, tough leaves of Chaparral plants provide mechanical protection from cracking associated with drying and wilting. A wax cuticle, or covering, reduces transpiration from the leaves. In many of the plants, the stomata or breathing pores are recessed. Manzanitas tend to turn their leaf surfaces away from the sun, thus reducing the drying effect of intense, direct sunlight.

All of these leaf adaptations prevent precious moisture from being cooked out of the plants by the intense sunlight and whisked away by the hot, dry summer winds blowing from the Central Valley.

The roots of some Chaparral species may extend further beneath the ground than the shrub extends above the ground, while other species have an extensive but shallow root system that rapidly blots up any moisture percolating through their territory.

Before the intervention of man, wildfires caused by lightning burned uncontrolled through Chaparral communities every 25 years or so. Fire is as much a part of the environment of the Chaparral community as is the California wet and dry cycle. Various plants have evolved some interesting charachteristics in response to fire, and fire is actually necessary to the health of Chaparral communities.

Some species, such as Ceanothus and Manzanita, have seeds that must be heated by a fire before they will germinate. Other species, such as Chamise, Scrub Oak and Mountain Mahogany are crown sprouters and new plants spring quickly from burned-over stumps and root stocks. Some annual species in California also require fire-shock for germination, and are found only after a fire. Seeds of these fire annuals may lie dormant for as much as a hundred years and still be viable. Fires reduce biological competition from other species such as the oaks and pines, as they do not recover nearly as rapidly as do the Chaparral species.

Periodic fires are good hygene for Chaparral communities. Fires clear away excess fuels, make animal travel easier, stimulate the growth of plants valuable as forage and keep the Chaparral young. In the absence of fire, Chaparral tends towards pure stands of dense, tangled Chamise. Fire favors mixed Chaparral stands that support more wildlife than pure stands of Chamise. Chamise by itself provides little shade or food, and through the use of chemical agents tends to inhibit the growth of other plants (botanists call this behaviour alleopathy). In mixed Chaparral the berries of Manzanita and Toyon, the acorns of Scrub Oak, and the highly nutritious leaves of the Ceanothus species supply an abundant quantity of food. California Indians purposely set fire to the Chaparral. They knew taht it improved the land from the standpoint of providing more forage for game animals and also made it easier to hunt and spot game.

Fires in Chaparral stands are inevitable, and do not necessarily need to be prevented or controlled. However, it makes about as much sense to build in Chaparral stands as it does to erect cities on flood plains. Chaparral is a fire "hazard" only if we fail to understand how to live with it.

The above adaptations are among those that allow Chaparral plants to thrive in areas where steeply sloping, porous soils and exposure to sun and wind make for rather arid summer conditions, and in areas where fire is a frequent visitor.

COMMON PLANTS OF THE CHAPARRAL COMMUNITY

1. Chamise (Adenostoma fasciculatum), Rose family.

A diffusly branched shrub, 0.5 to 3.5 meters high, rising from a basal burl. The bark is reddish and shreds in older individuals. The leaves are needle-like and resinous and occur in bunches like some pine needles. Brown seedcases produced by the white flowers that bloom in June persist on the plant throughout most of the year and give the plant a green-brown tone.

Chamise often grows in pure stands. These stands are especially meager in wildlife, since the plant offers little shade and actually prevents other plants that might provide forage from getting established.

The roots, leaves and flowers contain water-soluble and heat-labile saponins and unsaturated lactones. With these chemicals as weapons, Chamise engages in chemical warfare, or allopathy, with other plants. In some soils (mostly poor non-calcic stony and sandy types and shallow lithosoils) these agents accumulate into an inhibiting barrier to the germination of grasses. Around the borders of Chamise stands, a bare strip, as much as 9 feet wide, separates grassland from the shrubs.

The allopathic effects are eliminated when Chamise grows on calcareous soils, on serpentine, or on deeper more fertile ground. The heat-labile substances are also destroyed by the heat of a wildfire. After a fire, an area may be temporarily taken over by grasses and other plants during the period of regrowth of the crown-sprouting Chamise.

Also called Greasewood, because of the resinous leaves, Chamise will practically explode if ignited in the summer. It burns with a bright flame and supplies quick heat for cooking.

Bees visit the flowers for pollen and Gold Finches and woodrats eat the seeds. Chamise does provide some shade for certain animals, although it is a rather transparent shrub.

Indians made an infusion of the bark and leaves as a cure for Syphilis. An oil produced by the plant was used for skin infections. Ailing cows are said to find comfort in chewing the leaves.

2. Whiteleaf manzanita (Arctostaphylos viscida), Heath family.

This shrub is 1 to 4 meters high with smooth red-brown bark. The branchlets are pale green and evergreen leaves are light blue green, 2.5 to 4 cm. long and oval shaped. The flowers are pink to whitish and bell shaped. They form dense terminal clusters from February to April. The fruit is a sticky berry, 6 to 8 mm. broad with 2-3 nutlets inside.

The Miwoks considered Manzanita berries as the least desirable, although readily obtainable, of their vegetable foods. Whiteleaf manzanita was one of the best and sweetest of the Manzanitas that they knew.

Cider was made from the berries by briefly boiling them and then grinding them into a coarse meal. The meal was placed in a winnowing basket and water poured through and collected in a water-tight cooking basket. After decanting to separate the particles from the cider, it was used as a refreshing drink at social gatherings. As an appetizer, several small hawk feathers were dipped in the cider and then the liquid was sucked from the feathers. This was said to improve the appetite and to be good for stomach troubles.

The berries were chewed raw for taste, but were not swallowed. The leaves were chewed to relieve stomach-ache and cramps. The nutlets may be ground into a nutritious flour.

3. Toyon (Heteromeles arbutifolia), Rose family.

An evergreen arboreous (tree-like) shrub, 2 to 10 meters high. The leaves, 5 to 10 cm. long, are dark green above, lighter green below, leathery, and have sharply toothed margins. The flowers are small, white and numerous. The plant blooms from June through July and the red fruits are formed in clusters that are persistant on the shrub into the next year. The bright red berries contrast with the dark green foliage and account for the name Christmas Berry sometimes applied to this shrub.

An involved process went into the preparation of Toyon berries as a food by the Miwoks. First they were boiled and then they were baked in deep narrow earth ovens. A fire was kept going around the pit, but not over it, for 2 to 3 days. Another method was to store them for two months until they had softened. At this point they were parched with coals in a basket and eaten, sometimes first being mixed seed meal.

The berries are edible raw, or may be toasted, steamed, or boiled. They have a taste reminiscent of Marachino cherries, but are rather puckery. A little honey is a good addition. Cider may be made from them in the same way it is made from Manzanita berries. The fruits are eaten by Robins and other birds.

4. Buck Brush (Ceanothus cuneatus), Buckthorn family.

A rigid shrub 1 to 3.5 meters tall. The divergent gray branches bear short branchlets which hold wedge-shaped leaves, wider at the tip. The leaves are grey-green and 0.5 to 1.5 cm. long. The shrub blooms in May through July with flowers that are white, sweet-odored, and are arranged in small clusters.

Buck Brush and other species of Ceanothus, such as Deer Brush, are among the valuable deer forage plants. They are quite high in protein content, and when deer can't find enough of these shrubs in the critical winter months, they are forced to turn to less nutritious plants and may die. In over browsed areas, where deer populations are in excess of the carrying capacity of the land,, Deer and Buck Brush are stripped naked of leaves for as high as a deer can reach standing on its hind legs.

The leaves and flowers make an excellent, golden colored tea when boiled for about 5 minutes. I recommend it as one of the best herb tea plants in the area. An infusion of the bark can be used as a tonic.

5. Mountain Mahogany (Cercocarpus betuloides), Rose family.

An erect open shrub to a small tree, 2 to 7 meters high, with branches spreading, bark smooth, gray or brown, branchlets short, spur-like, and the leaves, 1 to 2.5 cm. long, are clustered on the ends. The whitish flowers that bloom from March to April produce small hard fruits with long feathery twisted plumes that look silvery in the sunlight.

This is a very good browse plant for deer and livestock. Its leaves contain 14% protein which is very high for a leaf. Deer seek it out in the winter months when they need plenty of nourishment to fight the cold.

Mountain Mahogany has a beautiful hard wood and the name Mountain Ironwood refers to this. The Miwoks used the tough branches of this shrub for digging sticks and as spears. A beautiful red dye can be obtained from the bark and roots.

6. Scrub Oak (Quercus dumosa), Beech family.

A small oak 1 to 3 meters high, sometimes tree-like. The leaves are 1.5 to 2.5 cm. long of various shapes with spiny-tipped teeth. This is an evergreen oak. The acorns are 1 to 3 cm. long. This is a variable species and apparently it hybridizes with other oak varieties.

7. Poison Oak (Rhus diversiloba), Sumac family.

An erect deciduous shrub 1 to 3 meters tall with stiff branches. Each leaf is subdivided into 3 leaflets. The leaflets are bright shiny green in the spring, but turn red, yellow, and orange in the summer. In open areas it grows as a shrub while in shady places it may grow as a vine, climbing up other shrubs or trees to reach for more sunlight. In April and May the tiny green flowers bloom and produce waxy white fruit in loose clusters.

Poison Oak is not related to true oaks but to eastern Poison Ivy and Sumac. The resin produced by the plant causes an irritating rash. In some people the reaction to it is severe and deaths from Poison Oak are on record.

The plant should be avoided year round, since it is always toxic. Most people are able to recognize it when it is leaved out, but in the winter and early spring it may look like an innocent, innocous deciduous shrub. Any part of the plant can cause the irritation, although the leaves are the most potent.

8. Coffeeberry (Rhamus californica), Buckthorn family.

Grows as an upright shrub or as a low spreading one, 1 to 4 meters tall. The evergreen leaves are leathery, 3 to 8 cm. long, usually shiny on the upper surface and sometimes with serrated edges. In May through July small green flowers are produced which are green, black or red when ripe.

The berries are edible raw and are good cooked with meat. The bark, if collected in the fall or spring and allowed to dry for a year or more, makes one of the most gentle and effective laxatives known. The correct amount is one level teaspoon in a glass of hot water. If you can't wait a year, the fresh bark is effective when boiled.

Some people recommend soaking the dried bark over night and drinking it upon rising to stimulate the appetite.

9. Cascara Sagrada (Rhamnus purschiana), Buckthorn family.

Closely related to Coffeeberry, this is a shrub to small tree 5 to 12 meters tall. The leaves are deciduous, tufted at the ends of the branches and 5 to 15 cm. long. Cascara may be used in the same manner as Coffeeberry for constipation and the berries are also edible.

10. California Buckeye (Aesculus californica)

A tree-like shrub, 3 to 5 meters high with a trunk diameter of 20 to 50 cm. The bark is smooth and gray to whitish. Leaves are palmate, with 5 to 7 lobes, 8 to 13 cm. long, pointed with toothed edges. Blossoms are numerous, with white petals about 1 cm. long. The fruit is a pear-shaped pod, containing a single seed 2 to 5 cm. in diameter.

The Buckeye or "horse chesnut" puts forth a showy display of white flower clusters in May or June, then sheds its leaves in late summer to leave the pear-like seed pods hanging from the tips of bare branches. No other local deciduous tree has the same habit of "closing shop" during the heat of summer.

Buckeye nuts are edible, but require extensive leaching to remove large quantities of bitter and poisonous hydrocyanic acid (cyanide). The Miwoks used the nuts for food only when the acorn crop failed. The seeds were crushed and thrown into small pools to stun fish, which then could be easily collected by hand.

OAK WOODLAND-GRASSLAND (OR OAK-PINE WOODLAND)

This community is charachterized by scattered trees with an undergrowth that usually consists exclusively of herbaceous plants, especially grasses, and scattered low shrubs. The understory species that are also found in the grasslands of lower valley areas and in the Chaparral. The grassland interspersed with stands of Blue and Valley Oak forms excellent pasturage for range cattle.

1. Blue Oak (Quercus douglasii)

A deciduous tree 7 to 20 meters high with a trunk to less than 1 meter in diameter. The bark is whitish and has small scales on the trunk. Leaves are variable in size and shape. They are 3 to 8 cm long by 1 to 5 cm. wide, shallowly lobed or with some teeth, and bluish green above and lighter green below. The acorns are about 2.5 cm. by 1 cm. and are held in a small cup.

Blue oak acorns were considered inferior by the Miwoks because they made watery soup and the bread made from them fell apart.

2. Valley Oak (Quercus lobata)

A tree 10 to 40 meters or higher with a trunk 1 to 4 meters in diameter. The Valley Oak has a spreading crown and is often broader than it is high. Drooping branches carry leaves 8-24 cm. by 6-8 cm. with 3 to 5 pairs of rounded lobes. The acorn is long and conical, 3.5-6 cm by 1-3 cm.

This is the most majestic of all California Oaks. It grows on flat, fertile ground. The crown is very broad and the branches sometimes reach the ground.

The Miwoks considered the Valley Oak acorn to be only fair. The outer bark was pulverized and used on running sores. It was considered to be especially effective for sore umbilicus in babies. The bark was boiled and the liquid drunk as cough medicine.

3. Interior Live Oak (Quercus wislizenii)

A tree 10 to 25 meters high with a trunk .3 to 1 meter in diameter. The leaves are 2.5 to 7 cm. long, evergreen, with edges that are sometimes smooth and sometimes toothed. The upper surface is smooth green, and the lower surface is yellowish green. The acorns are 3 to 5 cm. long, slender and tapered, and the cup covers half of their length.

The acorns of the Interior Live Oak were considered by the Miwoks to be a fairly good food source. The bark was used in much the same manner as that of the Valley Oak.

4. Redbud (Cercis occidentalis), Pea family.

A shrub or small tree 3 to 6 meters high with many small stems clustered at the base. The leaves are round to kidney shaped. The flowers are magenta-pink to reddish purple and appear in clusters from February through April, prior to the appearance of the leaves. The many fruit pods are reddish-brown, and resemble pea pods.

The flowers are rather sharp tasting and add an accent to salads. The buds, flowers and young pods may be fried in butter or made into fritters. The bark is astringent and is effective against diarrhea. It can be eaten raw for this purpose.

The Miwoks used redbud in coiled twinned baskets.

5. Digger Pine (Pinus sabiniana)

This tree is 12 to 30 meters high with a trunk diameter of .3 to 1.3 meters. The trunk is often slanting and is frequently divided at 3 to 5 meters above the ground into several upright branches, forming an open broom-like top. Bark on older trees is to 5 cm. thick, gray-brown and vertically furrowed. The needles are in 3's, 18 to 30 cm. long, sparse, and gray-green to blue. The cones are 15-25 cm by 13-15 cm, with a triangular hook at the tip of each scale.

The foothill Digger Pine bears little resemblance to its stately relatives in the deep green forests of higher elevations. It is grayish green, with several upper "trunks" and a spreading crown. The foliage is so open that it affords scant shelter in the heat of summer. The wood is coarse grained and pitchy and warps badly. Small wonder that early settlers, who gave the name "Digger" to local Indians as a term of contempt, applied it also to the tree. The abundant seed crops (pine nuts) were relished by the Indians, who also ate the soft central core of green cones in early summer. The nuts are staple food for squirrels, woodpeckers, jays, and other foothill birds.

THE YELLOW PINE COMMUNITY

The Yellow Pine community of the river canyons contains Yellow Pine, Black Oak, Incense Cedar and California Bay as the dominant species. This community provides more shade and is cooler than the Chaparral or the Oak Woodalnd.

Yellow Pine is usually found at higher elevations than they are in the canyons of the Stanislaus, American and Tuolumne Rivers. It is able to live, as are its associated plants, here because it finds conditions similar to those at higher elevations in the cool, shaded canyons. The Yellow Pine association of plants is more common on northern exposures than it is on the more southerly exposures.

Since less light reaches the ground in this well canopied community, few plants are able to find enough sunlight to survive. A full blown Yellow Pine forest is charachteristically clear of brushy and herbaceous plants and the trees are well spaced. An open needle-covered floor makes for easy hiking and animal travel. There are few plants to provide forage and food for deer and other animals, so wildlife is relative scarce. However, animals do retire to the Yellow Pine forest for shelter and respite from the heat.

1. Yellow Pine (Pinus ponderosa)

A tree 20 to 70 meters high with a trunk diameter up to 2.6 meters. In older trees the bark is 5 to 10 cm. thick, yellowish tan, and sectioned into large plates having a jigsaw puzzle surface of scales. Younger trees have red-brown to blackish bark that is narrowly furrowed. The branches are short, upturned at the ends and the tree has a flat-topped crown. The needles are in 3's, 12 to 25 cm. long and dark yellowish-green in tufts at the end of the branches. The cones are 5-13 by 6-9 cm. and each scale tip has a sharp point that is directed outward.

Yellow Pine is the most common and most widespread of all Western conifers. The name refers to the yellow bark of mature trees. It requires 25" of rain per year of less if it is near a body of water. It grows on a variety of slopes, plateaus and in different soils. It has several racial forms and can tolerate a wider range of temperature and precipitation than nearly any other North American tree.

Yellow Pine usually grows in evenly spaced stands. The dead needles blanket the ground and make for slippery footing on slopes. The pine cones have sharp points that are painful when stepped on. The wood is straight-grained, resinous and light. The wood is excelent for construction, and accounts for much of California's timber production.

The pitch was used by the Miwoks as an adhesive for gluing feathers to arrows and for other purposes.

2. Incense Cedar (Libocedrus decurrens), Cypress family.

An aromatic tree with flat branchlets on the ends of long branches. The tree is 16 to 35 meters high and .6 to 2.3 meters in diameter. The bark is cinnamon brown and fibrous. The needles are small, .7 to 1 cm. long and flat. The cones are 1.6 to 2.5 cm. long and composed of flat scales. Incense Cedars seldom are found growing in pure stands; rather, they will be mixed in with other trees of the Yellow Pine Community. The wood is long lasting and us used for fence posts, shingles, and lead pencils. A dry-rot fungus produces markings in the wood which give it a decorative finish prized for interior decorating.

3. Black Oak (Quercus Kelloggii)

A 10 to 25 meter high tree with a trunk diameter of .3 to 1.6 meters. The bark is dark, smooth and in small plates on the trunk. The leaves are 10 to 25 x 6 to 15 cm. and deeply lobed with about 3 lobes per side. The acorn is 2.5 to 3.7 x 1.9 cm and set in deep cups.

This Oak occurs with Yellow Pine trees on slopes or in Oak woodlands in flat valleys. In the spring the new pale green leaves stand out against the darker conifer leaves. The leaves later turn dark green and in the fall blanket the ground with golden-brown leaves. The Black Oak acorn was the favorite among the Miwok Indians.

BIBLIOGRAPHY

1. Barrett, S. A. and E. W. Gifford: "Miwok Material Culture", Yosemite Natural History Association, Inc., Yosemite National Park, 1933.

2. Johnston, Verna R.: "Sierra Nevada",Houghton Mifflin Company, Boston, 1970.

3. Kirk, Donald: "Wild Edible Plants of the Western United States", Naturegraph Publishers, Healdsburg, California, 1970.

4. Kloss, Jethro: 1939, "Back to Eden", Longview Publishing House, Coolmount, Tennessee,

5. Munz, Plilip A. and David D. Keck: 1959, "A California Flora", University of California Press, Berkeley, Los Angeles, London.

6. Smith, Robert Leo: 1966 "Ecology and Field Biology", Harper and Row, Inc. New York.

7. Storer, Tracy Irwin, and R. L. Usinger, "Sierra Nevada Natural History", University of California Press, Berkeley.

8. Sweet, Muriel: 1962, "Common Edible and Useful Plants of the West", Naturegraph Company, Healdsburg, Ca.

9. Ornduff, Robert: 1974, "Introduction to California Plant Life", University of California Press, Berkeley.

WHITE ALDER

BIG-LEAF MAPLE

WILLOW

CHAMISE

WHITE-LEAF MANZANITA

TOYON

BUCKBRUSH

MOUNTAIN MAHOGANY

SIERRA COFFEEBERRY

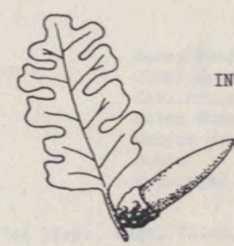
YERBA SANTA

CALIFORNIA BUCKEYE

BLUE ELDERBERRY

BLUE OAK

INTERIOR LIVE OAK



VALLEY OAK

REDBUD

BLACK OAK

ANIMALS OF THE FOOTHILL CANYONS

Bob Center

Hundreds of species of critters live in the canyons of the Stanislaus, Tuolumne and American Rivers. Unfortunately, we didn't get much of a paper together on the animals and their habits. I suggest that you use Storer and Usinger, Sierra Nevada Natural History as the best general source for inforamtion on the animals.

On the following pages are some figures that Mike Bronson (an old-time ARTA boatman) drew for a paper that he wrote on the animals of the area. Unfortunately, his paper seems to be among the things that used to be.

Below is a list of animals that have been observed by Stu Smith. If you look, you will probably see many of them along the rivers and in the surrounding hills.

MAMMALS:

Bats
Black Tailed Jackrabbit
Porcupine
Beaver*
Muskrat
Mule Deer
Calif. Gray Squirrel
Calif. Ground Squirrel
Coyote*
Striped Skunk
Wildcat

FISH, REPTILES AND AMPHIBIANS:

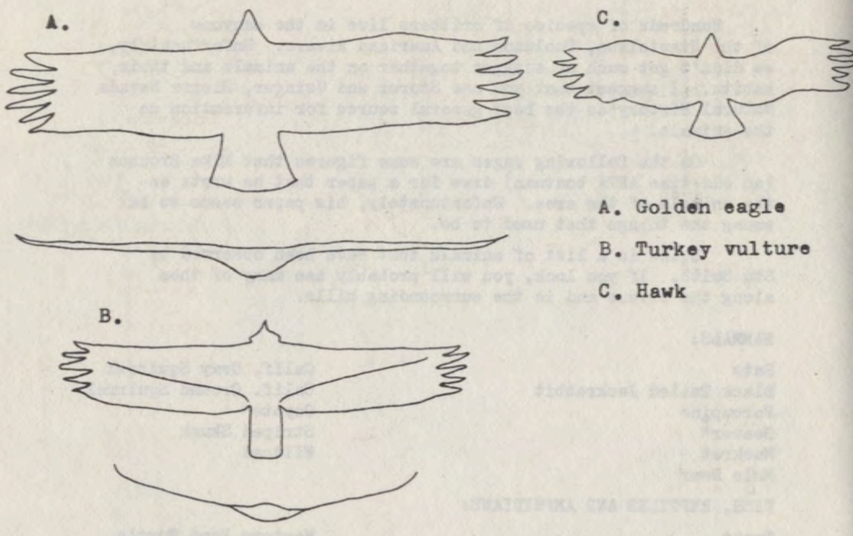
Trout
California Newt
Bullfrog
Western Pond Turtle
Various lizzards
Garter Snake

BIRDS:

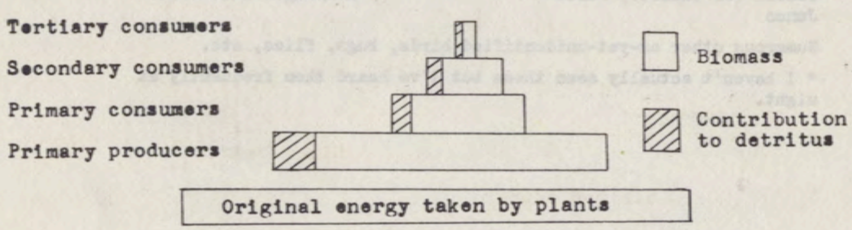
Common Merganser
Turkey Vulture
Redtailed Hawk
Bald Eagle
Golden Eagle
Mourning Dove
Cassin (or Calif.?) Finch
Junco
Downy Woodpecker
Cliff Swallow
California Jay
Water Ouzel
Canyon Wren
Robin
Redwinged Blackbird

Numerous other as-yet-unidentified birds, bugs, flies, etc.

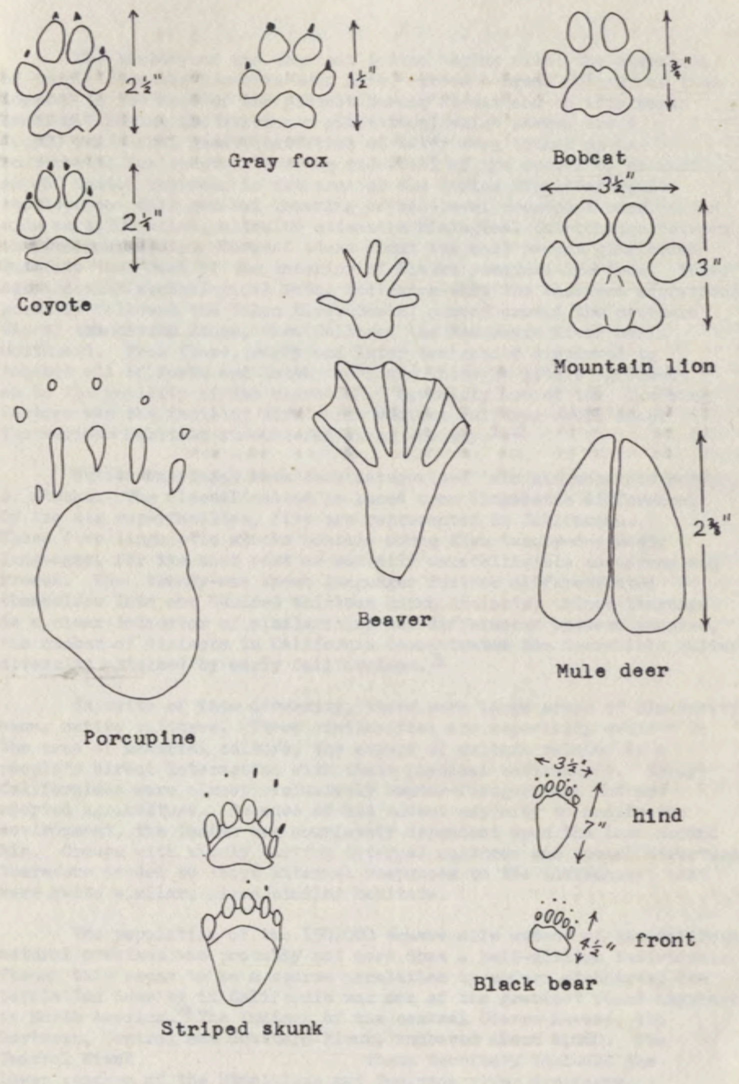
* I haven't actually seen these but I've heard them frequently at night.



Some silouettes of soaring Falconiformes.



Trophic pyramid of a hypothetical community showing relative amounts of biomass at each level of energy exchange.



Some mammal tracks of the Sierra Nevada foothills. (Taken from Murie, 1954.)

INDIANS OF THE SIERRA NEVADA FOOTHILLS
THE MIWOK

Bob Center

The history of the American Indian begins with the migration of people from the Eurasian land mass, across a broad isthmus of land located in the area of the present Bering Strait and on into North America. During the Wisconsin glaciation, which peaked about 40,000 years ago, great quatiities of water were locked up in continental ice sheets, lowering the level of the oceans by as much as 460 feet. The seas in the area of the Bering Strait are quite shallow, so this general lowering of sea-level created a corridor as wide as 1,300 miles, allowing extensive biological interchange between the two continents. Current ideas about the most recent glaciation indicate that much of the interior of Alaska remained ice-free. This, coupled with archeological data, indicates that the earliest migrations probably followed the Yukon River basin, curved around the southern tip of the Brooks Range, then followed the Mackenzie River basin southward. From there, early and later immigrants dispersed to inhabit all of North and South America. There is little agreement as to the rapidity of the migration. Certainly one of the limiting factors was the facility with which various cultures could adapt to the various habitats encountered along the way.[1,2]

Native Americans have been categorized into six separate groups, or stocks. The classification is based upon linguistic difference. Of the six superfamilies, five are represented in Californua. These five linguistic stocks contain among them twenty-one basic languages, for the most part as mutually unintelligible as German and French. The twenty-one known languages further differentiated themselves into one hundred thirteen known dialects. Since language is a clear indicator of similarities and differences between peoples, the number of dialects in California demonstrates the incredible cultural diversity attained by early Californians.[3]

In spite of this diversity, there were large areas of similarity among native cultures. These similarities are especially evident in the area of material culture, the aspect of culture related to a people's direct interaction with their physical environment. Early Californians were almost exclusively hunter-foragers and had not adopted agriculture. Because of his modest capicity to modify the environment, the Indian was completely dependent upon the land around him. Groups with widely varying internal cultures and social structures therefore tended to adopt external responses to the environment that were quite similar, given similar habitats.

The population of the 150,000 square mile extent of the California natural province was probably not more than a half-million individuals. Though this seems to be a sparse population by modern standards, the population density in California was one of the greatest found anywhere in North America.[4] The Indians of the central Sierra Nevada, the Northern, Central and Southern Miwok, numbered about 8,000. The Central Miwok whose territory included the lower reaches of the Stanislaus and Tuolumne river drainages, numbered about 2,000 individuals. (The American River drainage was occupied by Indians of the Maidu stock)

The Miwoks had a definite social structure and organization, but it conforms poorly to the common conception of Indians having Chiefs, Braves, distinct Tribes and Nations organized in a tightly controlled and militaristic manner. Since there was little occasion for warfare, this type of structure was unnecessary, and instead the social structure was a loose one made up of kinship ties. Individuals were grouped into families of 5-10 individuals composed of the direct biological unit plus perhaps a widowed aunt or two. Families were grouped into clans, or using the Miwok term, nena. The nena was a small community group of 50-100 individuals that owned and utilized a tract of land, usually about five by ten miles in extent and often bordering a stream. The area between Camp Nine and Melones along the Stanislaus probably supported two or three such groups, the total population probably being under 300. The nena were affiliated into tribelets, consisting of 250-300 individuals. The tribelet was the largest autonomous, self-governing and independent group, and was the largest unit to own territory. Tribelets further aggregated into tribes, which for most of California were groups of people sharing a dialect and a general geographic area, such as the Central Miwok. In general, what we would recognize as "Government" was nearly absent, and "power" was largely diffuse and decentralized.[5]

Despite the loosely structured society, the nena, tribe and tribelet did own land with boundaries that were definite and generally respected. These boundaries were delineated by prominent rocks, rivers, ridges or other geographical feature whose location and significance were part of the unwritten custom and tradition of the people.

Miwok permanent village sites were located near the major river canyons, seldom in the canyons themselves. A typical dwelling was a conical structure of bark slabs, 10-15 feet in diameter. Communal structures such as sweat houses and ceremonial halls were also circular and were usually constructed by excavating a circular pit up to 50 feet in diameter and roofing it over with bark, brush and various kinds of thatching. During much of the year most activities were conducted in the open, and due to the benevolent climate clothing was minimal.

As with most cultures, the Miwok had an extensive and elaborate set of ceremonies associated with various aspects of their life cycle. These ceremonies were not religious in the sense that going to church is an expression of our religion; they were an integral part of and an intensification of the attitudes and patterns which tightly controlled all aspects of Miwok life. The Miwok language has no word that translates as religion. We tend to divide our experience into various categories, such as the practical, religious spiritual and mystical. To the Miwok all of these were one. There was a "right" way to do all things, and this "way" generally contained elements of what we would term religious or spiritual behaviour. The Miwok approach to life was charachterized by a feeling of the unity of all things, to the extent that the Western distinction between the individual and the environment had little meaning.[6]

Materially, the Miwok were fairly well off. The available food resources of the Sierra Nevadan foothill region is charachterized by a large variety of species rather than a great abundance of any single item. This fact greatly influenced the material culture of the Miwok, and also lent a measure of stability to their existence. The plains Indians had a highly concentrated source of food and raw material in the buffalo, and consequently built a relatively sophisticated and specialized technology around this single resource. Good times were very good, but failure of the buffalo hunt for one reason or another could be disastrous. The Miwok, on the other hand, depended upon a wide variety of seeds and nuts, with the acorn being the staple plant food. In addition, game was plentiful, Tremendous numbers of salmon spawned in the rivers each spring, providing the Miwok with a major source of meat. Mule deer were plentiful and small game abounded. If the crop of the favourite acorn (the acorn from the California Black Oak) failed, the next most desirable acorn could be utilized. If the acorn crop failed altogether, the Miwok turned to the Buckeye, which, though inferior, would keep body and soul together. In addition, the grinding of acorns, buckeye nuts and many types of seeds all may be accomplished with the same mortar and pestle and all may be cooked using similar utensils and techniques, making the transition from one food source to another quite simple. The Miwok used basketry for all types of containers, and a basket used for cooking nup-pah' (acorn meal) is constructed in a similar manner to that used in constructing a trap for catching fish. The Miwok, then, secured and prepared his variety of foods by techniques that were closely interrelated.[7]

The Miwok were not agriculturalists, possibly because the natural bounty of the land made agriculture unnecessary. They did, however, exercise extensive and direct control of their environment through the use of fire. Two of the major habitats found in Central Miwok territory, the oak-pine woodland and the chaparral, are most productive when burned over at frequent intervals (every 5-7 years). In the absence of fire, shrubs of the chaparral association (Ceanothus, Chamise, Yerba Santa, Manzanita, etc) grow into a thickly tangled mass, nearly impenetrable by man or beast. A mature stand of chaparral is a very simple ecosystem dominated by a few species of shrubs and nearly devoid of grasses, greens and animal life. Frequent burning suppresses the brushy species, reducing the biological competition encountered by a wide variety of food plants, such as the bulbs, corms, grasses and oaks. After a fire, young tender shoots of brush provided browse for deer and other game animals. In addition to increasing the variety and quantity of available food species, the clearing of brush through the use of fire made it much easier for the hunter to spot game. Indian understanding of the use of controlled burning is illustrated by a quote from a Yurok woman: "Some kinds of trees are better when it is burned off; they come up better once again. But some kinds of trees when it is burned off disappears, never to come up again. The manzanita, another one does not come up, when it is burned off. An old tree bears better, too. And the tan oak is not good when it is burned off, the tree dies. When they are burning, they are careful lest the trees burn."[8,9]

The varied environment of the Miwok allowed them relative self-sufficiency; however trade, at least on a limited scale, was carried on with the Eastern Mono, Yokuts, Whaso, Plains M iwok and Paiute.

The absence of extensive trade is closely related to the diversity of language and internal custom of the peoples of California. Trade was limited as were other forms of cultural intercourse, leading to insularity and an introspective social and cultural development. Apparently, the greatest flux of goods moved east and west. Naturally available goods to the north and south were similar to those available to the Central Miwok, so trade was unnecessary. To the east and west, the geology and biotic communities changed more rapidly, a condition which naturally fostered trade for "exotic" material.

ENCOUNTER WITH EUOROPEAN CIVILIZATION

The first record of contact between Euoropean and California Indian cultures was made when Cabrillo's 1542 expedition encountered the Chumash Indians of the Santa Barbara area. For the next three hundred years, contact between the Spanish and Indians was considerable, but nothing like what was to come with the Gold Rush.

The Spanish interest in California Indians was both religious and secular. In 1512 the Pope decreed that the Indians were human. (Viewed in the context of what was to happen to the Native Californian at the hands of the Anglo, this was truly an enlightened position.) Since the Indians were human, they had souls to be saved. Also, labor was needed to maintain the missions and to work the land in numerous Spanish land grants. The Spanish earnestly set about converting the Indian to the useful service of God and the King of Spain. Many Indians of south and central California were converted, some willingly and some under considerable duress.[10]

Since Spanish material interest in California was mainly agricultural, Spanish influence was for the most part confined to fertile areas in the Coast Ranges and the Central Valley. The first recorded encounter between the Spanish and the Miwok is contained in the diary of Padre Pedro Munoz, who accompanied Lt. Gabriel Moraga on an expedition through the lower reaches of several Sierra Nevada rivers. In September the expedition came upon the Tuolumne River to which they gave the name Dolores. On October 2, 1806 they came to the Stanislaus River, which they named Rio de Nuestra Senora de Guadalupe. Among the successes of the expedition was the baptism of some 150 Indians, carefully noted in Padre Munoz diary.[11]

In 1827 a young neophyte Christian ran away from Mission San Jose where he had been named after the Polish saint Estanislao. He was thought to have led a general uprising of mission Indians in the San Joaquin Valley. In 1829, troops led by Ensign Mariano Vallejo fought Estanislao's band to a standstill along the banks of the river, then known as Rio de Los Laquisimes. In a later conflict with Vallejo, Estanislao was killed. The river was re-named in honor of Estanislao, and in 1844 John C. Fremont first used the Americanized form Stanislaus when mapping the area.

In 1848, Charles Weber, a German American pioneer of the San Joaquin valley and founder of Stockton heard of the gold strike at Coloma

on the American River. His prospecting on the Stanislaus and Mokelumne rivers led to several gold strikes, and the gold rush in the southern Mother Lode got into full swing. The gold rush had devastating consequences for the Central Miwok. By 1850 the emmigrant population in the Stanislaus and Tuolumne drainages exceeded 100,000- ten times as great as the already dwindling native population. This mob had one thing in common- an obsessive lust for gold. Unlike the Spanish, they had absolutely no use for the Indian, and certainly no time to attempt to understand the Indian point of view and way of life. The Indian was not considered to be human, and in the 1850s, even though California was a Free State in the slavery question, the State Legislature passed several laws by which Indians could be endentured (enslaved).[12]

Mining activities silted in the streams, destroying entire runs of salmon. Cattle and horses invaded the range of the Mule Deer, and game in general became scarce. The Miwok were forced to retreat higher and higher into the mountains, and even there were hunted down and slaughtered for taking an occasional horse or cow to replace the mule deer which had been greatly reduced in number and the salmon which no longer arrived with the coming of Spring. "Town" Indians fared no better, forced to live in utter degradation at the fringes of the forty-niner's tent cities. Here they encountered rape, pillage, plunder and diseases from which they had no immunity, most notably syphllis and tuberculosis.[13]

The more high-minded among the emmigrants deplored the decimation of the Indian populace, but even they regarded it as inevitable. Manifest Destiny had a momentum of its own, and was not to be diverted.

NOTES:

I would like to thank Louise Ravol of the Oakland Museum for her assistance in researching this paper. This paper does not reflect the quality of her assistance and interest- next time around I hope to do a little better job.

1. Early Man in America, 1972, Readings from Scientific American with an introduction by Richard S. Macneish.

A collection of 10 papers dealing with many aspects of American archeology. A good place to start in any study of American Indians.

2. Clairborne, Robert: 1973, The First Americans, Time Life Books, 159 pages.

"The remarkable, little known story of the prehistoric Indians. . . where they came from and how they learned to survive and flourish in North America."

3,4,5. Kroeber, A. L. The Food Problem in California

6. Conversations with Louise Ravol.

7. Kroeber, A. L. The Nature of Land Holding Groups in California

8. Lewis, Henry T: 1972, Patterns of Indian Burning in California: Ecology and Ethnohistory, Ballena Press Anthropological Papers, Number 1 ed. by Lowell John Bean.
A fascinating account of the ecology of the fire forests in California, and a rather unique approach of applying the principles of ecology to the study of ethnohistory.

9. Barrett, S.A. and Gifford, E.W. :1933, Miwok Material Culture, bulletin of the Milwaukee Public Museum, Vol. 2 No. 4, March, 1933.
A comprehensive treatment of how the Miwok utilized the material resources available to him.

10,12,13. Heizer, Robert F., 1974, The Destruction of California Indians, Peregrine Smith Inc.
A collection of original documents that give a rather devastating picture of the treatment of Indians at the hands of whites.

11. Cook, S.F.: 1960, Colonial Expeditions to the Interior of California's Central Valley, 1800-1820, U.C. Berkeley Press. Page 247; Lieutenant Gabriel Moraga's Expedition, 1806. Diary of father Pedro Munoz. The following may be the first written account of the Stanislaus River:

> October 2nd, 1806. 12th day of expedition:
> ". . . after going into the woods about a league and a half we came upon a river similar to the preceding ones in size and clearness of water, although its bed is narrower than the others. The banks are covered with an infinity of wild grapevines, a little torote, and an abundance of ash trees. We pitched camp on this river, so as to use it as a base for further exploration. The river we named Our Lady of Guadalupe."

GOLD IN THE SIERRA NEVADA FOOTHILLS

by

Bob Melville

The Sierra's most noted role in the development of the West is ironically due to its rich resources of a geologically insignificant mineral: gold. Of the various properties that give gold an outstanding place in the world of metals, the most important are resistance to corrosion, reflectivity, malleability and high specific gravity. While gold is chemically nearly inert, socio-economically it is a catalyst of tremendous influence.

In California, the principal deposits are mesothermal gold-quartz veins that are associated with the intrusion of granite bodies. The gold occurs either in slates, schists and greenstones that have been intruded by granite bodies, or in the granite rocks themselves. The veins range from a fraction of an inch to tens of feet in thickness; many deposits consist of a series of parallel or branching quartz stringers separated by slabs of country rock.

In a typical deposit, the gold occurs as microscopic grains, plates or threads in the quartz and is commonly associated with varying amounts of pyrite and small amounts of other sulfides. The extent of the ore shoots varies greatly. Many extend to depths of only a few hundred feet; in others such as the veins at Grass Valley or in the Mother Lode, the deposits extend to depths of 5,000 to 10,000 feet.

Because of its high specific gravity and resistance to weathering, gold is easily concentrated in river placer deposits. The gold particles are flat or rounded and range from microscopic size "flour gold" to nuggets 100 or more ounces in weight. The gold particles are everywhere associated with black sands composed of magnetite, the heavier minerals, and smaller amounts of chromite, zircon, garnet, pyrite, and in some placers, platinum.

Gold was first found in California some time between 1775 and 1780 on the lower Colorado River. These early operations were on a small scale and lasted only a few years. They extended west and north into the Cargo Muchacho and Picacho districts. Later in the 1820s, 1830s and 1840s placer gold was recovered near San Diego and in the San Gabriel Mountains. Thirty-five miles northeast of the Pueblo de Los Angeles, in San Feliciano Canyon, Francisco Lopez and a companion searching for stray cattle discovered some placer deposits of gold in 1842. This discovery stirred a local gold rush with some men of mining experience being imported from Sonora, Mexico. None of these early discoveries were of any great scale; in addition, the Mexicans presiding in the areas were careful to control the elploitation of the gold and restrict its publicity. Hence, none of these early operations had much significance in the development of the state.

John Sutter, the pioneer settler of the Sacramento Valley, probably wished the same fate for James Marshall's discovery of placer gold on January 24, 1848, in the millrace of the lumber mill Marshall was constructing for Sutter at Coloma on the South Fork of the American River. Sutter attempted to keep the discovery a secret, at least until the mill was completed. Ironically he was one of the people who leaked the news and by March word of the discovery had reached San Francisco; by late April the gold rush excitement was sweeping San Francisco and fortune seekers were abandoning their homes and businesses to make their fortunes in the gold fields. The first gold rush immigrants to arrive were some Chileans and Mexicans, some of whom had already taken part in the gold rush of 1842.

After the news leaked of the Coloma discovery, residents of other areas of California began arriving to Coloma only to discover the similarity of that area to the regions they had left, so they returned home and began prospecting. Thus the northern fields of Weaverville, Feather River, Shasta and Trinity were discovered.

Gold was discovered on the Stanislaus River by a party of prospecting Indians in the employ of Charles M. Weber, the founder of Stockton, who was simultaneously successfully prospecting the Mokelumne River. By early 1849 gold mining was in progress from the Feather River in the north to John C. Fremont's Mariposa Estate, in the south, and in the coast range fields of the Trinity, Scott and Klamath Rivers.

The first arrivals at the rich placers of the Mother Lode streams reaped the greatest profits, often averaging $300 to $500 a day for several weeks. The first arrivals of 1849 averaged on the whole about $20 a day and at Coloma between $25 and $30 per day. As more and more fortune seekers invaded the area and the easily exploited placers diminished, the average fell to $10 a day by 1850 and to below $3 a day by 1860.

Due to the ignorance of the vast majority of the fortune seekers the first techniques were crude. The refinement of techniques and equipment was slow to evolve, considering the presence of an established gold mining industry in several parts of the world for hundreds of years. There is controversy over the question of some techniques being imported from other parts of the world or being reinvented in California. The first and simplest method was panning, with the wooden bowls of the Sonorans or the metal pans of the miners from the gold fields of the southeastern United States. This method of several hundred years ancestry was not nearly as productive as the rocker or cradle introduced by Isaac Humphrey, an examiner from Georgia, in the spring or summer of 1848. The cradle proved to be inefficient because of the loss of many of the small particles and was soon improved. The new development was the Long Tom, an elongated cradle in which the transverse cleats arrested these small particles. Soon, however, the long tom was replaced by sluices of various types.

Booming or gouging was the next innovation in mining technique. This consisted of merely letting the water do the work of clearing away the sediment. A dam was built and the water diverted through the area which was being mined; the water carried the lighter elements downstream, leaving the gold-bearing ore easily accessible to be worked by one of the other methods of placer mining. The success of this procedure soon brought about the introduction of hydraulic mining, which involves the use of water under pressure. Hydraulic mining seems to have been a California innovation and was devised to wash down the debris of the dry Tertiary gravels rich in gold.

These gravel deposits of ancient streams are rich in gold as was first noted near Nevada City. This discovery came as a result of the diminishing placers of the rivers and anxious miners looking for new resources of gold.

As the white miners abandoned the roughly exploited river placers, the Chinese began setting up operations on the so-called depleted placers and through their patience and perseverance they were able to obtain substantial rewards of gold.

Men of mining experience sought the source vein or veins from which the alluvial gold deposits originated. The first such vein, which was gold-quartz, was discovered on Colonel John C. Fremont's Mariposa estate in August of 1849. The subsequent discovery of more gold veins brought excitement and wild speculations to the mining industry. Many ventures into hard rock quartz mining, based on Yankee ingenuity and mining ignorance, resulted in a series of mining failures which gave hard rock quartz mining a bad reputation until it was reintroduced by experienced miners of the German gold mines in the late 1850's.

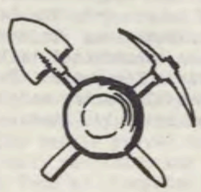
The prosperity of the gold industry in California has never even come close to the rewards of those first few flush years. In 1851 the State's output attained its all time high of four million ounces valued at 81.2 million dollars. As the rich surface placers declined in mid and late 1850s, river mining and hydraulic mining became the chief sources of gold.

As a result of hydraulic mining large quantities of evacuated material was allowed to flow into the rivers and was alleged to have caused flooding and silting of the farmlands downstream. Eventually the farmers brought the issue to the courts. In the famous case of Woodruff vs Bloomfield Gravel Mining Co (16 Fed. Rep. 25) in 1884, Judge Lorenzo Sawyer issued an injunction prohibiting the dumping of debris into the Sacramento and San Joaquin Rivers and their tributaries. Injunctions against other mines followed. A few mines constructed tailings dams or reservoirs and continued to operate for a few years. For a short time drift mining or buried gravel channels partly made up for the loss of placer gold production from hydraulic mines.

After the high of $81.2 million in 1851, the annual output declined steadily to below $20 million by 1865 and generally fluctuated between $10 million and $20 million per year. The annual production dropped to about $10 million in the 1880s as a result of the Sawyer decision banning unrestricted hydraulic mining, but began a steady gain in the 1890s as a result of improved lode mining methods. It fluctuated to above $20 million after 1900 as a result of the development of the bucket line dredge for the highly profitable dredging operations of the Quaternary placer deposits along the east margin of the Central Valley. Production peaked at $22 million plus just prior to World War I and declined steadily to below $10 million during the prosperity of the 1920's with the accompanying high costs. In 1930 output started to rise because of the depression and low operating costs. The rise was accelerated in 1934 when the price of gold was increased from $20.67 to $35 per fine ounce. Many mines were re-opened and there was much exploration which resulted in significant discoveries. In 1940 gold production amounted to 1,455,000 fine ounces valued at nearly $51 million, the highest figure since the gold rush. World War LL caused a precipitous drop in gold production. War Production Board Limitation Order L 208 was issued in 1942 and caused the gold mines to shut down. Order L 208 was lifted in 1945 and gold mining resumed, but by 1950 production resumed its decline because of rising costs and depletion of dredging ground. The trend was accelerated during the Korean War. The last large mine on the Mother Lode shut down in 1956, thus ending a major industry that had endured for 106 years. Some bucket line dredging and several quartz mines in the Alleghany were still in operation by the end of 1965 but have ceased operations. The only gold mining in California at present is the many small scale skindiving-dredging operations individuals utilize to obtain the small gold deposits remaining in the deep and difficult to reach potholes of of the gold district rivers.

Since 1848 California has yielded more than 106 million fine ounces of gold valued at $2.42 billion, the greatest production of gold of any state in the United States and representing 35% of the total U. S. production. The placer deposits of the western Sierra Nevada are estimated to have produced more than 40% of the State's total output.

There are still undeveloped gold bearing deposits in California: in the deeply buried Tertiary channel gravels, in the unmined terrace deposits on parts of the Klamath-Trinity River system, low grade gravel deposits adjacent to the dredging fields, gravels too deep to be mined by existing equipment in the Great Valley, deep veins in the major lode districts, and large bodies of mineralized schist and greenstone in certain districts.



EARLY HISTORY OF THE TUOLUMNE RIVER CANYON

Rebecca Lawton

The Tuolumne City Power House

Perhaps the most successful businessmen of early california were not the men directly involved in the excavation of gold from the diggings, but rather those who made their livings supplying the items essential to mining. R. W. Hersey and C. W. Quilty of San Jose were just such men. In 1904, as mines were springing up fresh in the Tuolumne River area, it appeared a sound though ambitious venture to supply both the mines and the surrounding towns with a reliable source of electrical power. Hersey and Quilty, along with several other San Jose merchants, filed Incorporation Articles for a "Tuolumne Electric Company" with the Tuolumne County Clerk in October of 1904 with the intention of establishing a "Powerhouse of the main Tuolumne" to operate the Garner mines and to supply "power to Groveland and Big Oak Flat districts."[1] R. W. Hersey was declared as the company's president, Quilty its secretary and manager. The Tuolumne Electric Company got off to an official start, with a board of five directors, a capital stock of $200,000 at $5 per share with 1250 subscribers.[2] Land was acquired through the pooling of personal deeds and water rights were secured by December of 1904. By 1905, the foundation for an earnest business seemed to be laid; the Tuolumne Electric Company was ready to haul wagonloads of cement and machinery down the steep canyon slopes to the Powerhouse site.

The aspiration to thrash through the dense growth of pine forest and scratch a line of road on the river's south side was instigated by the optimal powerhouse site already in Quilty's possession in 1904.[3] The parcel included a high, sandy bar in a river canyon shy of such sites, and a turn in the course of the flow where the water slows from its previous wild cascading and fans out to run relatively flat and wide in the vicinity of Indian Creek. A few miles upriver, the important Clavey tributary offered a fine combination of size and flow and a damsite from which water for power could be conveyed by flume.

Still, the decision to use the bar near the Indian Creek presented logistical problems not easily circumvented by a horse-and-wagon technology. The road for hauling materials still provides remote access to the Powerhouse via Corcoran Flat to drop suddenly and wind its way through a 2000-foot elevation drop to river level. The road was built in the enthusiastic early months of 1905, and was only one of several simultaneous projects which kept human activity bustling in the canyon: "Work on the Tuolumne Electric Company's plant is progressing. The pole line has been surveyed to Big Oak and Groveland. About 200 tons of pipe and machinery for the plant will soon be at Chinese Station. A road is being built down the river hill to haul in the machinery".[4] The road reaches the Tuolumne at the Indian Creek confluence and swings along the very edge of the river to run back upstream opposite the Powerhouse. The foundation for the road here is intricate masonry. Once the wagons were drawn along this, the equipment was conveyed across the river by footbridge, a plank-and-cable affair with stone abutments at either side of the river.

What did the Groveland District Mines do during the Electric Company's long months of construction? Many just sat, waiting, for the new, cheap source of power to make mining profitable again. The Tuolumne Independent carried a mining note which wxpressed how the pause in Groveland's mining activity must have appeared to the casual observer as a kind of irresponsible inertia:

> There is very little doing in Groveland at present. A lady tourist passing through town towards the Yosemite Valley a few days ago stopped and asked one of our townsmen what sort of a place Groveland was, he replied that it was a small mining town. In looking around she saw the Mt. Jefferson mine up on the hill and asked why it was not running. He replied that they were waiting for electric power. Next she saw a lot of chickens on the street close by her rig and remarked what a nice lot of chickens they were; then asked if she could get any eggs to buy. He replied that he did not think so, as they did not get enough for their own use. 'Why', she said, 'What is the matter with the chickens?' 'Oh,' he said, 'I guess they are waiting for electric power.'[5]

In September of 1906, Tuolumne Electric Company was concentrating much of its energy in the direction of the construction of the flume that was to convey water from the Clavey River to the Powerhouse. The lumber used to build the flume came from Quilty's own sawmill near the Clavey River on a ridge on the north side of the Tuolumne River which local inhabitants convieniently referred to as "Quilty's Ridge."[6] Work on the flume was supervised by a Walter Noland[7]; under Noland a company contracted for 500,000 board feet of lumber for the flume and spent 4 months cutting 800,000 board feet instead. The lumber was conveyed to the Clavey River by a chute three-quarters of a mile long, then used locally for the standard flume. When a crew of sisteen had already successfully laid a half-mile of flume, the company was expectant with hopes of finishing all construction and having the power flowing by spring of 1907.[8]

In February of 1907 the flume was the only limiting factor to the opening of the Powerhouse, as the plant was finished and the power lines ready. The company was chomping impatiently at the bit, the remaining mile and a half of unfinished flume was all that held it from instant prosperity. In Groveland, preparations were gradually being made for the electric life-blood which promised a new opportunity to reap harvests of California's riches. The Kanaka mines, "one of the best producers on this side of the river"[9], readied to re-open. Quilty also visited and contracted with the Non Pareil and Mt. Jefferson mines for the installation of electric power.[10] The Cosmopolite, the Del Monte, Longfellow and Mack all desired electrical power.[11] The opening in the spring of 1907, on schedule, set off a spark in the ignition of the fallow operations south of the river.

In later years, lines were also strung to Confidence, Tuolumne and Soulsbyville. With its expanded operation, the company became known as the Tuolumne Electric Company. In accordance with the company's policy to guard against possible deterring contingencies, an auxillary flume one mile long was built from Grape Vine Canyon to the power house, thus assuring uninterrupted service even though the Clavey River flume failed. The power house had a capacity of 1000 horse power and

and proved to be a most reliable hydro-electric system. During the summer of 1908, the driest known in the county in fifty years, the Tuolumne Electric and Transmission Company's system was in continuous operation, one of the few in the state. Although an excercise in Herculean efforts and construction, it was a small-scale operation, as dependent upon local mining operations as those operations were upon it. When the mines gave out, the Powerhouse lost vital business. The final blow was dealt with the installation of a more complete and modern power system in the Tuolumne River area.[12] The abandoned Powerhouse was largely destroyed by a flood in 1936.

FOOTNOTES

1. The Tuolumne Independent, Sonora, September, 1904.
2. Ibid, October 8, 1904.
3. Ibid, December 31, 1904.
4. Ibid, May 20, 1905.
5. Ibid, August 25, 1906.
6. Personal interview with George Laveroni, Groveland, California, April 11, 1974.
7. Quilty, though the company's manager, seemed to have several irons in the inferno of the San Jose business world. Occasionally he would appear to observe the progress that was being made on the powerhouse, in which case the local newspapers would herald his arrival. June 1, 1907: "Mr. Quilty of the Electric Company arrived in Groveland Monday evening and went down to the works on the river Tuesday morning." Quilty's next visit was mentioned in the February 29, 1908 edition of the paper.
8. The Tuolumne Independent, September 22, 1906.
9. Ibid, June 1, 1907.
10. Ibid, April 14, 1908.
11. The Mining and Scientific Press, San Francisco, August 4, 1906.
12. Interview, George Laveroni.

THE MOHICAN GOLD MINE

The Tuolumne River flows from its Sierran Headwaters and Hetch Hetchy to cut a westward path through Tuolumne County. Like all the Sierran rivers, the Tuolumne's natural gradient crosses the California foothills, thus transecting the "gold belts" which run parallel to the axis of the Sierra Nevada. These belts, or vein systems, are auriferous quartz deposits contained in the Caleveras Formation (the metamorphic bedrock) and the granitic rocks associated with the granodioritic intrusions which created the modern Sierras. In the process of carving its river canyon, the Tuolumne cut through gold-bearing veins, depositing gold along its banks and in its pools.

The discovery in 1848 that California rivers were lined with gold naturally effected a migration to the Tuolumne River. Its first mining was done in 1849 at Hawkin's Bar, south of Jacksonville, in the form of elementary placer mining. The gold deposits were so concentrated that at first they could be easily scooped from the river bed. Hawkin's bar was a river camp on the vein belt known as the Mother Lode, a thin, 120 mile long system. In the ensuing months, camps clustered at the junction of the Tuolumne River and the Mother Lode; Don Pedro Bar, Wood's Crossing, Indian Bar and Jacksonville.

Exploration along the river further inland, east of Ward's Ferry, reveals the remains of mining activitities which were nestled deeper into the folds of the river canyon. One of the most prominent sets of deserted structures, the Mohican Mine, is perched above the main fork of the Tuolumne, approximately a mile west of the Big Creek confluence. it is immediately recognizable by its suspension bridge, which, despite loose planks and dangling cables, still spans the river. An old brick house is located on the property upstream from the bridge.

Though the rich deposits of surface and placer gold disappeared with the sixties, technological improvements resulted in greatly profitable changes in mining and milling techniques in the 1890s. Air drills, pumps, explosives, rock crushers, and the introduction of electrical power made mineral development economically feasible again. Around this time, Albert C. Maier must have been looking for a way to utilize these innovations, because he stumbled on the Tuolumne River Canyon and began obtaining water rights for mining purposes, quartz claims and placer claims. He started his small empire in 1882, with a quisition of 5,000 inches of water ("for mining and other purposes"[1]) in the river and a four and one-half mile flume right-of-way running parallel with the bank. Maier actually located a quartz vein running at an angle across the river on New Years'Day of 1896 (See Figure 1, "A. C. Maier".)[2] Maier had a flair for acquiring claims[3] but was not renowned for working them steadily.[4]

1900 brought a dawning of activity at the Mohican. The first improvements to be made on the property were houses, cabins, roads and trails. [5] The cables were strung for the suspension bridge which still retains a failing grasp on the river banks. Once the land was made habitable in the eyes of the workers, underground work commenced. <u>The Engininეering and Mining Journal</u> tells of the first tunnelling that was done by the next owners: "Tunnel No. 1 on Lillian claim

extended on vein. Work on 100 feet in Tunnel No. 2, now in 300 feet, to be resumed. The vein in 7 feet wide in places."[6] Water rights were secured with the County Recorder, with the most ambitious intentions:

> <u>Mohican Mining and Milling Company</u>.
> Water Notice. We, the Mohican Mining and Milling Company, claim First: Twenty Thousand (20,000) inches of water flowing in the Tuolumne River, measured under a four (4") pressure. Second: The purposes for which we claim the water, is for mining purposes, viz. to furnish power, for the generation of Electricity to run Mills, Air Compressors, Drills and Lights, and to furnish Electric power to the surrounding towns and mines. Third: We intend to build a dam of suitable construction across the Tuolumne River, at a place where this notice is posted, about 200 feet East of our Suspension Bridge; then by means of a flume 10 feet wide on the bottom and 6 feet high, with a grade 1/2" to the rod, we intend to conduct the waters to the place of intended use. Fourth: The place of intended use will be situated below the dam, about 1600 feet."[7]

Improvements continued in 1902 under the supervision of a Felic Chapellet in the form of an operable 5-stamp gasoline driven mill, a new wagon road started up the south slope,and drilling in the bed rock for the placement of mortar blocks.[8] Eighteen men were at work on these several projects, reputedly succeding with "returns amounting to nearly $6,000. Rock averaging over $20 per ton."[10] The Mohican Mining and Milling Company felt that enough was being done to have the parcel surveyed in 1902. J. H. Finley, U. S. Surveyor General's Office in San Francisco, attested to the fact that "over Fifteen Hundred Dollars worth of labor has been expended or improvements made"[11] upon the Lillian Quartz Mine, the Lillian No. 2 Claim and the Oakland Quartz Mine all of which were contained in the Mohican claim on the south side of the river. The survey plat included the footbridge, a boarding house, storeroom, oil house, assay office, bunkhouse, cabin, superintendent's office, tramway, foot trail, pack trail and several tunnels. Its perimiter is fixed with some detail: a dead pine marks the western boundary of the Lillian No. 2, and a white oak is used to help locate its southern end. The entire claim covers nearly 58 acres on a bedrock of mica schists.[12,13] The Mohican operation expanded considerably. 1903 saw the inclusion of an underground hoist, as some of the tunnelling went deep enough to require such innovations. "Lumber is being delivered at the Mohican mine to be used in making an addition to the mill and building a new hoist."[14] Teams were employed in the hauling of the lumber. A compressor plant was constructed to run the hoist and other underground machines. The gasoline-driven mill was reported to be running steadily.[15] Sixty-five men were now under the supervision of F. Chapellet; 35 working on the new road to the top of the hill. In 1904, prosperity continued, and the Mohican proved to be valuable enough to be patented with the County Recorder.[16] The wagon road was complete, and some thirty men were working steadily sinking the vein shaft to a 300 foot level below the tunnel. More machine drills were installed. Three eight hour shifts worked on sinking the shaft, finding ore that was "yielding good results"[17]. These times would never be equalled in later years at the Mohican. There was never again to be so many men in the company's employ; the days of nights in a full bunkhouse and hot days cutting the wagon road gave way to a declining mine with failing energies and interests.

In 1905, the Mohican closed down, ostensibly due to "lack of wood and repairs to machinery."[18] The company made extensive repairs in hopes of re-opening in first class condition but the resumption of operations in 1906 provided employment for only five men. The five worked quietly and steadily into 1907, increasing the network of adits and inclines, making reported strikes and promising to increase the size of the crew.[19]

1910 brought another exciting report of fresh enthusiasm in development and an "important discovery."[20] Perhaps the important discovery was the free-milling pocket ore on the north side of the Tuolumne, because in 1910 the Mohican Mining and Milling Company saw fit to have the two parcels constituting the north end of the mine surveyed. The quadrangles were known as theNorth Star and Golden Eagle Lodes, and were included in the 1904 Mohican patent. Their improvements consisted entirely of "9 cuts and 10 tunnels; value 8320.00 dollars".[21]

Work continued on a small scale on both ends of the property through 1915, when the mine offered only enough work for "2 men prospecting".[22] The Company's headquarters let the once-prosperous land slip away uncontested; Tuolumne County's Tax Collector, James White, acquired ownership with a $155.44 tax bid.[23] Although the mine has not operated since 1915, the property has changed hands many times and is presently owned by the Coffills in Sonora.

FOOTNOTES

1. A.C. Maier, "Ditch and Water Right", October 26, 1892, Claims, Book 1, Volume 9, page 144; Tuolumne County Recorder's Office

2. A. C. Maier, Index to Quartz Locations, 1872-1911, Recorded January 2, 1869, Volume 7, page 89. Tuolumne County Recorder's Office

3. Index to Quartz Claims, Tuolumne County, 11,1899-1923 lists the following claims as A. C. Maier's responsibilities: Gold Standard, Stella, Anna, Deplex, Connecting Link, Triumph Quarted, Cedar, Castle Rock, Tuolumne Standard, Boston, Dead Horse South Extension, Piute no. 1 and Piute no. 2. Maier also filed several placer claims and pre-emption claims.

4. No Proof-Of Labor Claims are filed for either Maier or Mohican Mining and Milling Company. Proof of labor claims for a "Mohegan" mine begin in 1897 under the names A. C. Johnson and H. M. Hall, but they end abruptly in 1900 (A. C. Johnson et al, "Mohegan", January 2, 1900, Volume 1, Index to Proof of Labor Claims, Tuolumne County 1891-1907.) It is easy to imagine Hall and Johnson much more devoted to the improvements and the riches of the claim than spelling Mohican correctly; perhaps from this slurred confusion we get the popular pronunciation "Mohegan". The possibility also exists that Hall and Johnson and the "Mohegan are unrelated to the Mohican with which we are concerned. However, the California Division of Mines and Geology has no record on file of a Mohegan Mine in Tuolumne County. Therefore, this stage of the mine's story is obscure, though it is apparent that it came under the care of new owners, and work was well underway on a large scale after January of 1900.

5. The Engineering and Mining Journal, New York, 1900, Vol. 70, No. 3, p. 77.

6. Ibid, Vol. 71, no 8, p. 253.

7. Index to Pre-Emption Claims, Book 1, Vol. 10, p.95 April 28, 1901.

8. The Mining and Scientific Press, San Francisco, 1902, Vol. 84, no. 4, p. 53.

9. The Engineering and Mining Journal, 1902, Vol. 74, no. 25, p. 827

10. The Mining and Scientific Press, 1902, Vol 84, no. 4, p. 53.

11. Mineral Survey Number 4029, "Plat of the Claim of Frank Leach et. al. known as the Lillian Consolidation Quartz mine", Tuolumne Mining District, Tuolumne, California. Surveyed by J. H. Finley in 1920.

12. Finley, Mineral Survey no. 4029.

13. California Division of Mines and Geology, Report of the State Minerologist, 1915.

14. Daily Union Democrat, Sonora, July 25, 1903.

15. The Mining and Scientific Press, 1903, Vol. 86, no. 17, p. 268.

16. Tuolumne County Recorder, Quartz Patents, Book 54, p627

17. Daily Union Democrat, August 20, 1904.

18. The Mining and Scientific Press, 1905, Vol. 90, No. 16, p. 257.

19. Ibid, 1907, Vol. 94, No. 19, p. 581.

20. Ibid, 1910, Vol. 101, No. 10, p. 316.

21. J. H. Finley, "Plat of the Claim of Mohican Mining and Milling Company", Mineral Survey no. 4902, November 11-18, 1910.

22. California Division of Mines and Geology, Report of the State Mineralogist, 1915

23. Tuolumne County Recorder, Tax Deeds, Book 9, P. 25.

24. Tuolumne County Recorder, Deeds, 3-02-51: 49/246, 12-28-51: 43/319, 12-31-51: 56/009. References from Assessor's Office, Tuolumne County Building, Sonora.

POWER, WATER AND POLITICS:
THE STANISLAUS RIVER

Bob Center

Early water development along the Stanislaus River was directly connected with mining operations. Numerous small dams were built on the upper reaches of side creeks and water was conducted via open wooden flumes to mining sites where the water was used for placer and hydraulic mining and to run machinery for mills and quarries. Many of the old flume grades are still visible, especially below Parrott's Ferry.

By the turn of the century, power generation technology was good enough to make hydro-electric power generation feasible. The original Camp Nine power house was completed in 1908. Just above Sierra Club Rapids is the remains of a power plant that supplied power to the Columbia Marble Quarry, and below Horseshoe Bend is the remains of a powerhouse that was used to power the Carson Hill Mine and associated stamp mill and cyanation plant.[1]

Presently there is an extensive network of dams, flumes, tunnels and powerhouses upstream from Camp Nine. The plant that most directly influences the stretch between Camp Nine and Robinson's Ferry is the Camp Nine Power House, which has a maximum capacity of about 820 cfs and supplies most of our water (especially in the summer months). The set of factors governing how much water comes down the pennstock at Camp Nine is so complex that only PGE's central load-balancing computer knows for sure what is going on. In 1974, conditions were such that the Camp Nine Power House operated close to capacity during hours of peak power demand(approximately 7 AM to 6 PM). This was mainly due to a healthy snowfall, and cannot be counted on from year to year.

Altogether there are eleven dams and seven powerhouses in the Stanislaus River Basin. The average annual power generation from all of these installations is 995 million kilowatt hours. The Camp Nine Power House supplies 404 million kilowatt hours.[2] The Stanislaus River has been good to man in terms of the power and water it has supplied for agriculture, industry and domestic use. However, the Army Corps of Engineers, the Bureau of Reclamation (what a misnomer!) and large land-holding interests in the Valley would like to squeeze a little more from the river.

Enter New Melones.

New Melones was originally authorized in 1944 as a small flood control structure. In order to fit into the growing concept of multiple use, the project was expanded to its present size in 1962, and proponents now claim that New Melones is a multi-purpose progject.

That means that it claims to provide significant benefits in the areas of flood control, recreation, water quality control, power generation and irrigation. Let's take a look at each of these claims.[3]

Flood Control: The Corps of Engineers admits that a much smaller dam, one that would not flood the canyon from Camp Nine to Parrott's Ferry, would serve all flood control needs.

Recreation: In preparing the cost-benefit analysis of the project, the Corps projected four million user days annually for the completed reservoir. Don Pedro Reservoir is located 7 miles from New Melones, is about the same size and is in a similar environment, yet in 1974 Don Pedro recorded only 242,000 visitor days, In addition to Don Pedro, there are 10 major recreational reservoirs nearby, all of them under-used. Yosemite National Park recorded about 2.3 million visitor days in 1974.[4] Can you believe that a muddy lake would be nearly twice as attractive to visitors as is Yosemite?

Water Quality Control: The lower Stanislaus does become seriously polluted in the summer, and New Melones proponents claim that low-flow augumentation provided by the reservoir would alleviate this problem. However, flushing the pollution down the river does not ultimately solve the problem; it merely passes the problem on. According to Environmental Protection Agency standards, pollution must be taken care of at the source, not transported elsewhere. Moreover, if New Melones is built, the water will ultimately go into the East Side Canal, not down the lower river.

Power Generation: Lowland dams are charachteristically uneconomical in terms of power generation. Both Southern California Edison and P. G. & E. have rejected offers to participate in similar projects. (New Melones, a structure taller than the Trans America Tower, is slated to produce only 75% of the power currently generated by the little ol' Camp Nine Power House!) In addition, the Bureau of Reclamation has stated that all the power would be used in pumping irrigation water.

So far, all of the claims of benefit appear to be tenuous at best. What about water storage? New Melones will surely store a lot of water. (2.4 million acre feet gross capacity-- it will take 5-7 years to fill!) However, the California State Water Resources Control Board stated in Decision 1422 (April 1973) that there is no demonstrated need for the water to be impounded by New Melones-- now or in the forseeable future.

Quoting from Decision 1422:

> The Burea's own records indicate that without the yield of the New Melones Reservoir the Bureau can meet the estimated buildup of demands under present contracts for a long period of years.
>
> By failing to present evidence of a specific plan to use the water conserved by the New Melones Project for consumptive purposes, the Bureau has failed in spirit if not in substance to meet the statutory requirements for approval of a permit to appropriate water for such purposes.[5]

The people who know what is going on with California water and who should have control over California water don't see the need for additional agricultural water. In effect, Decision 1422 says that even if the dam is built, it cannot be filled until the Bureau can satisfactorily demonstrate need for the water. The Bureau did not like Decision 1422, and the issue is now being litigated in the Sacramento Federal District Court. Resolution of the issue will probably take years.

So, all of the claimed benefits of the project seem to go down the drain.

Proposition 17, an initiative measure that would have included portions of the Stanislaus under the State Wild and Scenic Rivers Act, was defeated by a vote of 53% to 47% after a bitterly fought campaign. The push against Proposition 17 was well packaged and very expensive. Remember the billboards and TV ads? People were told to save the Stanislaus and fight pollution by voting NO on 17. The intent of the No on 17 campaign was outright deception and perversion of the democratic process. The success of this approach was borne out by a post-election conducted by Corey, Canapary and Galanas. Their poll showed that 48% of the people voting No on 17 thought they were voting to stop the dam and save the river. Admittedly, this country is not run by public opinion poll; nonetheless, it is abundantly clear that the Stanislaus River and the people of California got the shaft in a big way.

The facts and issues stated above are still valid, the river is still flowing, and it can still be saved.

WHAT CAN BE DONE?

First of all, let's not write the Stanislaus off as a lost cause. I am sure that we will encounter many people in the next couple of years who have merely "come to see the river before it dies". Emphasize that the river is not lost, Maintain the enthusiasm for enjoying and saving the river that we all had during the campaign.

Governor Brown has the power to delay, modify or completely halt the project. Whether or not he does so depends largely upon the amount of support he feels he has for such an action. Write to him and strongly encourage others to do so. Send your letters to:

Governor Edmund Brown, Jr.
State Capitol
Sacramento, Ca. 95814

River guides, keep a kit (in an ammo box, for example) with you on all commercial trips that contains sample letters, a copy of this article, letter writing materials and stamps. Emphasize that letters are, in effect, payment for the enjoyment that the river has given them during the trip.

Friends Of The River is still alive and well under the direction of Mark Dubois and . FOR will be publishing periodic newsletters concerning nation-wide river preservation issues. Contributions will be welcome-- you will hear more about FOR and the newsletter soon.

Finally, stay in touch with issues concerning preservation of rivers and wilderness. The battle for wilderness has been going on for a long time and will continue for ever. With all of our efforts, we can save the wildness that is our nourishment and preservation.

NOTES

1. Personal observations by Mark Dubois, Sarge Preston and Bob Center

2. Hydroelectric Energy Potential in California, Resource Agency, California Department of Water Resources, Bulletin 194, March 1974.

This is an interesting document that summarizes existing and future hydroelectric power development in 32 California drainage areas. It is available from the State and at the U. C. Berkeley Water Resources Library located at the corner of Hearst and Euclid in Berkeley. (This library is an excellent source of materials on California water resources.)

3. This section was excerpted from "Proposition 17- A fact sheet" published by Friends of the River, September 1, 1974.

4. Personal conversation with the National Park Service, Sept, 1974.

5. Decision 1422, April 1973. California State Water Resources Control Board, p. 15.

POWER, WATER AND POLITICS:
THE TUOLUMNE RIVER
Bob Center

Hetch Hetchy Valley so nearly rivalled the beauty of its big sister to the south that it was often referred to as The Little Yosemite. Though similar in beauty and grandeur to Yosemite, Hetch Hetchy had some unique attributes that spelled its doom.

A flat-bottomed, steep walled canyon cut by Pleistocene glaciers, Hetch Hetchy has an extremely narrow exit at its downstream end. A large high-country drainage supplies the Tuolumne River with a huge annual flow of clear, cold and remarkably pure water. Overshadowed by its big sister, Hetch Hetchy and its natural beauties were relatively unknown. In short, it was a dam-builder's dream.

The possibilities of Hetch Hetchy as a water and power source were early recognized by engineers working for the bustling little city of San Francisco, and by 1882 extensive engineering studies of the site had been completed. The dam builders suffered a setback with the creation of Yosemite National Park in 1890, and Mayor James D. Phelan's application for the reservoir site was initially refused.

The setback was only temporary. The earthquake and fire on April 18, 1906 devastated San Francisco and added urgency to the City's search for an adequate water supply. The city immediately re-applied for Hetch Hetchy, and on May 11, 1908 Secretary James R. Garfield approved the new application. "Domestic use" he wrote, "is the highest use to which water and available storage basins can be put." [1,2]

The ensuing battle between preservationists and development interests was a long and bitter one. John Muir and the fledgling Sierra Club led the fight on the preservationist side; the developers included a large group of politicians, engineers and interest groups who were in basic agreement with Garfield when it came to conservation issues.

On December 19, 1913 Woodrow Wilson approved the Hetch Hetchy grant and signed the Raker Bill into law. The Raker Act gave San Francisco extensive rights in the Tuolumne River Drainage, and so far the act has resulted in the construction of an extensive water and power system with Hetch Hetchy Reservoir as the keystone.

There is considerable unexploited hydro-electric potential on the Tuolumne below the confluence of Cherry Creek. San Francisco has made extensive engineering studies of the following possible projects: [3]

1. A dam at Wards Ferry that would back water up to the Clavey confluence, innundating approximately 12 miles of free-flowing river.
2. A power house at the confluence of the Clavey River.
3. Replacement of Eleanor Dam with a large earth-filled structure. (Eleanor is within Yosemite National Park boundaries)

Although there are no definite plans to go ahead with any of these projects, the possibility of their construction increases as time goes on and the search for "clean" power sources increases. The effects of these projects upon the quality of the Tuolumne wilderness experience need no elaboration.

The Sierra Club fought its first major battle on the banks of the Tuolumne, and retains a vital interest in the well-being of the river basin. On June 7, 1969 the Tuolumne River Conference was formed with the following assignment:

> To draw together more information about the Tuolumne River and its potential for recreation, power development, flood control, irrigation, drinking water, fishery and wilderness values than can be found in any other single source.

The Tuolumne River Conference, chaired by Robert W. Hackamack, fulfilled its assignment admirably with the publication of a report entitled "The Tuolumne River- A report on conflicting goals with emphasis on the middle river." The report is well done and is must reading for anyone interested in the Tuolumne. A major reccommendation of the report was that the Tuolumne River above New Don Pedro be included in the National Wild and Scenic Rivers System.[4]

Shortly after publication of the Report, the Tuolumne was included under category 5D of the Wild and Scenic Rivers Act. The Tuolumne County Board of Supervisors led by Ralph Thiel encouraged representatives McFall, Mathias and Johnson to introduce a bill to the House of Representatives to upgrade the Tuolumne (and 28 other rivers) to classification 5A. At McFall's request, Senator Cranston, with the co-operation of Senator Tunney, introduced an identical bill to the U. S. Senate. The Senate bill was signed into law in January of 1975. The 5A classification means that the Tuolumne will be studied, and authorizes money to finance the study. Money will probably be appropriated in fiscal 1976-77. Study of the river will be supervised by Carl Rust of the U. S. Forest Service, and will be completed by October 2, 1979.[5]

After the study is completed, Congress will make the final decision on the Tuolumne's Wild River status. The matter will come before Congress early in 1980.

What you can do: Explain the issue to people. Let the river tell its story- it is its own most eloquent defender. Let people know that they will be asked to participate in an extensive letter-writing campaign to Congress in early 1980. The Forest Service will continue to direct intensive programs to preserve the quality of the Tuolumne wilderness experience. Lend your whole-hearted support to these programs. Let's keep the spirit of John Muir alive and flowing free.

NOTES:

1. Decisions of the Department of the Interior... June 1, 1907 to June 30, 1908, ed. George J. Hesselman (Washington D. C., 1908), p. 411.

2. Nash, Roderick, 1967, "Hetch Hetchy", in Wilderness and the American Mind, Yale University, pp. 161-181.
This is an excellent book tracing America's attitude toward wilderness. The section on Hetch Hetchy is an interesting political history of the demise of the Hetch Hetchy valley. The similarities between the Hetch Hetchy struggle and the Stanislaus struggle are striking.

3,4. "The Tuolumne River: A report on conflicting goals, with emphasis on the middle river", Tuolumne River Conference, chaired by Bob Hackamack, Sierra Club, February, 1970.
This report should be read by all who run the Tuolumne for profit and/or pleasure.

5. Personal conversation with Bob Hackamack, April 23 1975.

THE ART OF DUTCH OVEN COOKERY
by
Bill Center

Newly baked breads and pasteries are a real joy at any time, but by the tenth day of a river trip, when the fresh produce and meats are all gone, a steaming-hot blueberry pie transcends joy and becomes magic. Nothing completes a meal quite as well as a fresh-baked pastry from the dutch oven, and the successful production of a fully cooked but unburned batch of brownies is nearly as satisfying as a good run of Lava Falls. But how hard is cooking with the dutch oven? (Or, as it is more commonly known, the D. O.) Is it as magic as we sometimes lead observers to believe?

The answers will be as varied as the boatmen you ask. No subject, except perhaps the tying down of loads, is so endlessly debated by boatmen as is the art of dutch oven cookery. I have found a few areas of agreement, however, that seem to indicate that almost anyone with a little patience can become a gourmet pastry-maker. Or, at the very least, you can manage a successful Bisquick shortcake, drown it in strawberries and whipped cream, and have a fail-safe, rave-reviewed, ego boosting dessert.

A dutch oven is a heavy cast-iron or cast-aluminum pot. They come in a variety of sizes and types; you should make sure that yours has three little legs and a lid with a raised lip for holding coals. A 12" to 14" D. O. seems the best size for river trips up to 20 people, and a 10" is more efficient for smaller groups up to 10 or so. Recently aluminum D. O.s are available which have the advantage of being lighter, rust-proof, and needing less heat, and the disadvantages of being more sensitive to heat variations and harder to cook with, and warping or even melting when exposed to excessive heat. Any cast-iron pot, including a D. O., must be kept dry and well oiled to keep it from rusting, and it can break if dropped. A cracked D. O. is nearly worthless.

The first step in using a D. O. is the preparation of coals. If you are unable to use charcoal briquets, try to prepare coals from a hardwood like oak, manzanita, or madrone. With briquets, 2-3 pounds per D. O. are needed; with hardwood a couple of four foot long, 2"diameter limbs will usually do. Whatever you use, heating it on a grate <u>above</u> the fire makes transfer to the D.O. much easier. It also avoids getting sand and ash mixed in with the coals, which is necessary because they will keep the coals' heat away from the oven, and will keep air away from the coals, keeping them from burning hot. Heat the coals or wood only until they are just glowing or burning on their own; don't cook them. Also preheat the lid for five to ten minutes, and time your preparation so the batter will be ready when the coals are.

The first step in making any batter is gathering ingredients. Bisquick is a good base for almost anything and keeps you from having to carry so much, but everything starts to taste the same before long if you use Bisquick exclusively. Making breads and cakes from scratch is amazingly easy if you carry flour, sugar or honey, baking powder and soda, dried milk, eggs, shortening or oil, and spices; most of which are part of a staples box anyway. Canned or fresh fruits, nuts, cheeses, etc., add variety, and Eagle brand milk is a great frosting base or topping just as it comes from the can. Make a very simple bread cookbook part of your commissary, be creative and eat well. When you get good you'll be eating pies, brownies, and even yeast breads. They will rise, and get knocked down, quite well on a raft during the day.

I believe in mixing the ingredients exactly as if you were cooking in a normal oven; however, a drier, thicker batter is preferred by many as it cuts the cooking time, although it also results in a heavier bread. Mixing the eggs thoroughly with the dry ingredients before adding water or milk will make for a much lighter D. O. You should make enough batter to fill the D. O. 1/4 to 1/3 full; grease the D.O. well and pour in the batter. In layered pastries like pineapple upside-down cake put the fruit, or whatever needs the least amount of cooking, on the bottom, and the batter on the top.

Next, find or make a level and flat spot for the D. O. to sit on. It must be in rocks or sand, not in grass or anything else that can catch fire. It should also be out of the wind or sheltered from it. Make sure the D.O. is level, then get the coals.

Heat is the most important thing in cooking. Two general principles about D. O. heat are that it should be concentrated on the top and around the outside edge of the D. O., and it should be evenly distributed within those areas. I use only about 20 to 25 per cent of my coals behind the D. O., close to but not touching the bottom and about an inch in from the outside edge. The rest I use on the top, right next to the lip of the lid all around the lid nearly touching each other. The hotter the oven needs to be the more coals you use; using charcoal I've found that about 6-8 briquets on the bottom and about 20 briquets on top is roughly equivalent to a 375 degree oven. **The most important thing is to keep most of the heat on the top and almost all the heat right against the outside lip; the only places I've seen a D.O. really burned are in the middle and on the bottom. Taking a little time and care in placement of the coals is essential to a successful D.O.**

Periodically blowing the ashes off the coals will keep the oven hot, and rotating (without lifting!) the lid will even out the heat. You can check the heat by rapidly and gently lowering your hand (make sure it's dry and has'nt been near the fire, so it's sensitive) from a couple of feet above to within an inch of the lid. You should feel a sudden increase in heat about 3 to 6 inches above the lid; with practice you'll be able to tell just exactly the right heat level with your hand, which is particularly important when you are using hardwood coals rather than briquets.

Avoid lifting the lid and liiking at the D.O. Every time you look you lose 5 to 10 minutes of cooking time. The time needed to cook will be close to whatever the recipe says, from 15 minutes for biscuits up to an hour or more for pies and brownies. I usually wait until about five minutes after I first smell the D.O cooking, and sometimes even longer before checking it. Check it by lifting the lid and quickly inserting a dry fork or stick in several places. If it comes out clean it's done. Let it cool some before serving and it won't crumble as badly.

Make sure you return the coals to the fire and put something over the spot where the D.O. was, because the ground there will stay hot for quite a while. Avoid if at all possible using soap to clean the D. O. Usually just wiping it out with an oily paper towel will suffice, but if you have to use hot water dry it well and re-oil it before putting it away.

The D.O. can also be used to cook roasts, stews, and casseroles. Usually they are cooked for longer periods of time with lower heat. Anything you cook in an oven you can cook in a Dutch Oven. I've even known people to cook Baked Alaska in a D.O. The hardest part of that is to keep the ice cream hard-frozen up to the time when you put it in the D.O.

The dutch oven has become an essential part of most rafters' commissaries just as a century ago it was an essential part of most miner's mule packs. Even today ancient, rusting D.O.s are sometimes found at old abandoned camps and shacks along the Gold Rush rivers. So they have been around a long time, and around rivers a long time. I can't say that a D.O. is quite as magic as a river, but they surely do complement each other, and I would guess that rivers, rafters, and dutch ovens will be found together for many years to come.

RIVER RUNNING
by
Bill Center

After spending a good part of my life alone in the wilderness that I've grown to believe in, I became part of a company whose business it is to take people down white-water rivers.

The job is a chance to live intimately with people in an environment free of clocks and smog and traffic and constant commitment to all sorts of things besides ourselves; it is a chance to live an integrated life in a whole world, but most of all it is a chance to live near or on the river.

At first glance the river is power without pattern, jumping and falling at will, sweeping away anything that is in its path, running in clear channels that suddenly dead-end in bushes or rock piles or waterfalls, capricious and crazy; it runs its own path slowly devouring whatever it rubs against.

Then you are in it, at first fighting it, pulling against it and being dumped into banks and rocks and rushing out of control.

Until slowly, you learn not to fight it, you learn to flow with it, you learn to read it and be one with it.

Going down a river is like looking into the future; you see the place that you wish to be, and then trace a naturally flowing path back to the place you are or can easily reach.

You and the boat become part of the water, and flow wjere the water flows.

So when that water starts to run and tumble and thread the rocks and reeds, it is important to be in that little spot of water that will go through the rapids hitting the fewest obstacles. But if you're not in the right place at the top of the rapid, no matter how much work you spend trying to get there while you're in the rapid, you will probably, at best, come out somewhat ungraciously.

But rapids are only the remembered parts, the adrenalin-rushing, mind focusing, memory-fixing milestones by which a river is measured. The more a river is travelled the more the calm is learned to be loved.

For there the time can be spent to look at the shore and understand that theriver is a moving picture in a fantastic theatre, a track of captured time that can be left to walk around and explore and hunt for rocks that were touched by men a hundred years ago and flowers that have just bloomed and cliffs that expose a million years of geology, to feel and see just like the sky and clouds whose existence is measured by an endless pattern of color and change.

And to do this with people, people who perhaps have trouble not wanting a constant rapid, or people who are afraid of the next one. To talk and listen and share a summer with others who share their lives, to see the excitement of a day spill into the night with fire-licked hours of honesty and laughter that reflect both the spirit and calm of the water running a dozen feet away.

To do this with people who perhaps live in so much pain traffic, smoke and time-stained days that are alowys too long or short; with people who have slowly cut of the lower ends of their sensitivities not realizing that perhaps the upper ends went too;, with people who are just like me and totally different and all at the same time, in a place that quietly asks us to share ourselves without pride or apology, as it shares itself.

To do this with people is the greatest reward.

For here we learn that no one and nothing need be dominant to exist, that the may-fly is born, mates, and dies in one day never needing to know that it feeds the trout that have lived for years and the birds that visit and build nests on the rocks that have been there for everyone's forever.

Here we learn some of its inestimable wisdom, and we are touched by some of its energy, and we learn to flow also.
Sometimes.
Most of us.
Perhaps some day there will no longer be one of us, or part of me, that forgets that the river does not heedlessly take, it does not poison or batter us unless we have poisoned it or have not been listening. And the river is not invulnerable; many have been crippled or killed by us, and each time a river dies we have killed a very beautiful being, we have killed an intimate teacher of a very sacred source of wisdom.

A passage from Herman Hesse's great classic, Siddartha, says it very well;

He had often heard all this before all these numerous voices in the river, but today they sounded different. He could no longer distinguish the different voices- the merry voice from the weeping voice, the childish voice from the manly voice. They all belonged to each other; the lament of those who yearn, the laughter of the wise, the cry of indignation and the groan of the dying. They were all interwoven and interlocked, entwined in a thousand ways. And all the voices, all the goals, all the yearnings, all the sorrows, all the pleasures, all the good and evil, all of them together was the world. All of them together was the stream of events, the music of life, when Siddhartha listened attentively to this river, to this song of a thousand voices; when he did not listen to the sorrow or laughter, when he did not bind his soul to any one particular voice and absorb it in his Self, but heard them all, the whole, the unity, then the great song of a thousand voices consisted of one word: Om-perfection.
Om perfection.