

## The Aftermath of the Gold Rush: Mining and Mercury in the Bay

Watch the segment online <http://education.savingthebay.org/the-aftermath-of-the-gold-rush-mining-and-mercury-in-the-bay>

Watch the segment on DVD: Episode 2, 39:43–44:03

Video length: 4 minutes 33 seconds

### SUBJECT/S

**Science**

**History**

### GRADE LEVELS

**6–8**  
**9–12**

### CA CONTENT STANDARDS

#### Grade 4

*History – Social Science*

4.3.3. Analyze the effects of the Gold Rush on settlements, daily life, politics, and the physical environment (e.g., using biographies of John Sutter, Mariano Guadalupe Vallejo, Louise Clapp).

#### Grade 6

*Life Sciences—Ecology*

5.b. Students know matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.

#### Grades 9–12

*Biology/Life Sciences—Ecology*

6.b. Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.

*Earth Sciences—Ecology*

9.a. Students know the resources of major economic importance in California and their relation to California's geology.

*History – Social Science*

11.8.6. Discuss the diverse environmental regions of North America, their relationship to local economies, and the origins and prospects of environmental problems in those regions.

### VIDEO OVERVIEW

Mercury-laden sediments from mining operations in the Sierra Nevada and Coast Ranges still enter the vast network of streams and rivers that feed into San Francisco Bay. The mining activity dates as far back as California's Gold Rush era.



Hydraulic mining in the Sierra Nevada in the late 19th century. (Society of California Pioneers)

In this segment you'll learn that:

- hydraulic mining techniques caused massive amounts of sediment to enter the San Francisco Bay watershed.
- mercury, needed to separate gold from ore, was mined in the Coast Ranges, especially at the New Almaden Mine near San Jose.
- mercury persists in area rivers and its toxic effects are magnified as it works its way up the food chain.

### TOPIC BACKGROUND

In 1845, California was still Mexican territory. While on a routine scouting patrol, Andres Castillero—a captain in the Mexican army and an amateur geologist—recognized that the rolling hills above present-day San Jose might hold vast mineral deposits. A visit with the local Ohlone Indians confirmed his suspicions, and he quickly filed a claim and received mineral rights on the land. The rights were divided among Captain Castillero, his guide, and the Ohlones who led him to the mine.

Castillero soon learned that, due to the complexities of Mexican regulations, his claim on the mine could be disputed easily. Additionally, the captain was given orders by the Mexican army to prepare for war with the United States. These circumstances led Castillero to sell his rights to an English industrial firm, which organized mining operations at the renamed New Almaden Mine in 1847. This was the first large-scale mining venture in California and proved to be a wise investment indeed. There were huge cinnabar deposits to be mined—cinnabar is high-grade mercury ore. Mercury has a chemical affinity for gold and silver and is an essential component in gold mining to help draw out the smaller flakes of gold. And with the Gold Rush just starting, the need for mercury, or quicksilver, skyrocketed.

The Gold Rush progressed in the Sierra Nevada. After the most easily mined gold was gone, miners turned to new methods. Hydraulic mining was the most cost-effective way of getting to the gold in ancient streambeds now buried in the mountains. In hydraulic mining, water at high elevations was diverted into ditches and channeled, using gravity, through heavy iron pipes. The water exploded from a nozzle far below with a force of 5,000 pounds. Like a cannon, the water could blast the mountains apart.

Hydraulic monitors blasted 1.5 billion cubic yards of soil and rocks from the Sierra hillsides. The gravel slurry was washed through sluice boxes in search of gold, then dumped into the nearest stream. A massive amount of debris moved down the mountains, much of it ultimately reaching San Francisco Bay. Remnants of the mercury used to extract gold flecks from sediment washed down the mountainsides along with the debris.

## VOCABULARY

### **dredging**

deepening or cleaning out the bed of a waterway by scooping out mud, weeds, and rubbish from the bottom

### **hydraulic**

operated, moved, or brought about by moving water

### **levee**

an embankment or ridge built to prevent flooding or control where floodwaters go

### **mercury**

a silver-white, poisonous heavy metal

### **methylization**

a complex process that transforms inorganic mercury into methylmercury, a form of mercury that is biologically available and therefore can enter the food chain

### **mining**

the process of working a mine to extract ores or metals from the earth

### **neurotoxin**

a poison that acts on the nervous system

Mercury also leaked into waterways—particularly the Guadalupe River—from the New Almaden Mine and other abandoned mines. From there, it slowly made its way to the Bay. Even today, the New Almaden Mine has been identified as the single most significant source of mercury in the Bay. In the Guadalupe River, mercury levels are five times higher than those found in the Bay, which in turn has mercury levels 100 times greater than the levels found in Puget Sound and other estuaries not contaminated with mine waste.

Along with PCBs (polychlorinated biphenyls) from power transformers, mercury is considered one of the Bay's most dangerous pollutants. In its organic forms, mercury is a neurotoxin. It has been shown to kill bird embryos in the eggs, and it most likely kills fish hatchlings. Mercury magnifies as it moves up the food chain, and large fish can carry harmful doses of the toxin.

Wildlife further up the food chain is at risk of mercury poisoning, as are people eating large fish from the Bay. Fetuses and infants are subject to poisoning from their pregnant and nursing mothers. Effects range from delayed physical development and mental impairment in fetuses and infants to abnormal sensations in the hands and feet and blurred vision in adults. Long-term exposure can damage the kidneys. State warnings say that adults should eat no more than two 8-ounce meals a month of sport fish from the Bay and that women who are pregnant or may become pregnant should not eat more than one meal a month.

## PRE-VIEWING ACTIVITY

- Student pairs discuss the meanings of the words “exotic” and “invasive.” Are they synonymous? Do they imply different things? Have the pairs write their own definitions of each of the words.

## VIEWING ACTIVITY

- Ask students to draw a T-chart on a piece of paper. Label one side of the chart “Hydraulic Mining” and the other side “Mining for Mercury.” As students watch the segment, ask them to list changes to the environment that arose from each form of mining.

<b>Hydraulic Mining</b>	<b>Mining for Mercury</b>
<i>Created dams and reservoirs on rivers high in the Sierra</i>	<i>Washed mercury-laden sediments into the Guadalupe River and eventually into the Bay</i>
<i>Demolished landscapes with the force of the water</i>	<i>Seriously contaminated the Guadalupe River and other rivers in the watershed</i>
<i>Washed huge amounts of sediments into rivers, the Delta, and San Francisco Bay</i>	<i>Affected food chains because mercury is a toxin</i>
<i>Used lots of mercury</i>	

## POST-VIEWING ACTIVITIES

- Investigate the current status of the New Almaden Mine. Consider a visit to the Almaden Quicksilver County Park.
- Research state warnings about eating fish from San Francisco Bay. Discuss which populations might be most likely to eat tainted fish from the Bay and are therefore most subject to the effects of mercury poisoning.
- Discuss current human activities or environmental problems that might still have repercussions 100 years into the future.

## ABOUT THE AUTHOR

**Lori Mann** is an environmental education consultant with 30 years' experience at the local, state, and national levels. She has worked extensively with curriculum development and review, has taught numerous environmental education courses and workshops, and served for 15 years as education director at Coyote Point Museum for Environmental Education in San Mateo, California.

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## ADDITIONAL RESOURCES

### **Finding aid of the Jimmy Schneider and Robert Bulmore Collection of New Almaden Mine Materials (Historical Note)**, Online Archive of California

<http://www.oac.cdlib.org/view?docId=kt6f59r2fw;developer=local;query=;style=oac4>  
Read about the history of the New Almaden Mine, the first and largest mercury mining operation in California. This historical note is part of the archival record of a collection of related materials dating from 1845 to 1978. Follow the link and click on Collection Details in the navigation bar on the right.

### **Giant Gold Machines—Hydraulic Mining**, California's Untold Stories: Gold Rush!, Oakland Museum of California

<http://www.museumca.org/goldrush/fever19-hy.html>  
Read or listen to the text of a panel from an Oakland Museum of California exhibit on California's Gold Rush. The text explains the process and effects of hydraulic mining and includes photographs of equipment and landscapes.

### **Gold Rush Still Haunts San Francisco Bay**, Science@Berkeley Lab

<http://www.lbl.gov/Science-Articles/Archive/sabl/2005/November/01-gold-rush.html>  
Learn about a study that models how chemicals move and accumulate in San Francisco Bay and explores the toxic legacy of mercury used during the Gold Rush.

### **Mercury Contamination from Historical Gold Mining in California**, Charles N. Alpers, Michael P. Hunerlach, Jason T. May, and Roger L. Hothem, U.S. Geological Survey

<http://pubs.usgs.gov/fs/2005/3014/>  
Review a fact sheet that addresses gold mining history, mercury mining, and health and environmental problems associated with mercury contamination downstream from abandoned mine sites.

### **"The Toxic Mercury Menace in San Francisco Bay,"** posted by Jane Kay, Village Green, *San Francisco Chronicle*

[http://www.sfgate.com/cgi-bin/blogs/chrongreen/detail?entry\\_id=31179](http://www.sfgate.com/cgi-bin/blogs/chrongreen/detail?entry_id=31179)  
Read a short article about the effects of methylmercury in San Francisco Bay and follow links to additional information.

### **"Tracking a Toxic Trail,"** Jane Kay, *San Francisco Chronicle*

<http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2002/12/22/BA66306.DTL&hw=mercury+fish&sn=002&sc=909>  
This article describes how scientists traced the path of mercury contamination and identified the New Almaden Mine as the single largest source of mercury in San Francisco Bay.

## CREDITS

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## VIDEO TRANSCRIPT

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**NARRATOR:** By the 1880s, an entire region of the United States built upon the cornerstone of mining was coming to terms with its consequences.

**GRAY BRECHIN:** Hydraulic mining means that you create a dam and reservoir at a relatively high level in the Sierra, which it's ideally suited for, and then bring the water down in iron pipes under high pressure to where gold-bearing ancient rivers were buried ... and then release that water under high pressure with enormous water cannons called monitors, or little giants. And you can just demolish the landscape at that time, going for the gold in these buried rivers.

**MALCOLM MARGOLIN:** Oh, the hydraulic mining, it was just so spectacularly ingenious and so astoundingly destructive.

**NARRATOR:** More than a century later, the scars of hydraulic mining remain etched in the landscape of the Sierra Nevada. But in 1884, as a federal court injunction effectively stopped the practice, hydraulic mining was also wreaking unprecedented havoc on San Francisco Bay.

**BRECHIN:** What happened was that a great sine curve estimated at one and a half billion cubic yards of material essentially was washed out of the Sierra, down the rivers, into the Delta, and then down into San Francisco Bay. And it's still coming down to this day. I think of it as the gift that keeps on taking because, in fact, what the mining companies were doing was shifting their overhead onto the public, which has had to pay to try to stabilize these rivers ever since then, with enormous levees and dredging.

**NARRATOR:** Hydraulic mining deposited as much as three feet of new sediment in the northern portions of San Francisco Bay. It also left the Bay with one other pernicious legacy: the widespread presence of mercury. Mercury was essential to the process of separating gold from ore and, as chance would have it, a source was close at hand. In the hills above San Francisco Bay, near San Jose, the New Almaden Mine would become the largest mercury mine in North America.

**MARK MARVIN-DIPASQUALE:** We have mines in the Coast Ranges, the cinnabar mines, mercury sulfide mines where mercury was mined, and there was mining done in the Sierra Nevada region where that purified elemental mercury was used to extract gold and silver. The Bay is still getting inputs from both of these types of mining regions.

**NARRATOR:** Today, the New Almaden Mine's legacy endures, in the name of the region's newspaper and the mercury-laden sediments of the Guadalupe River that flow into San Francisco Bay.

**SEJAL CHOKSI:** So, the New Almaden Mine actually sits right near the Guadalupe River. And right now, the Guadalupe River is in a state of emergency. Basically, mercury pollutes the entire bottom of that river, and they have a separate cleanup plan just for that river because it is so contaminated.

NARRATOR: By the end of the 19th century, as much as 8 million pounds of mercury from New Almaden and the hydraulic operations in the Sierra Nevada were unleashed into the rivers of the San Francisco Bay watershed.

MARVIN-DIPASQUALE: It's actually amazing how well distributed mercury is. You can measure mercury pretty much everywhere we look.

NARRATOR: Mercury remains relatively harmless until the process of methylation occurs. Methylmercury—a neurotoxin—works its way into the food chain, accumulating in ever larger, ever more harmful quantities in ever larger organisms.

CHOKSI: ... and then it just moves up the food chain, so anybody who is eating fish out of our bay is getting a dose of mercury every time they eat a large fish like white croaker, halibut, or striped bass ... any of those bigger fish that they eat and they catch in the Bay is going to have a large dose of mercury in it.