
SAN FRANCISCO
TIDES OF HISTORY

Presidio gauge has measured the bay's rise and fall for 150 years

- [Carl Nolte, Chronicle Staff Writer](#)

Monday, June 28, 2004



A tiny, wooden white building with a red roof at the end of a pier near Crissy Field in the Presidio of San Francisco is so obscure it doesn't even have a sign -- but this is one of the country's major scientific landmarks, the oldest continually operating tidal gauge in the Western Hemisphere.

The 150th anniversary of tidal observations will be celebrated this week on the date the first bit of data was recorded, June 30, 1854. Only one other tide house -- in Brest, France -- has continuous records that are as old. All the others -- and there are 174 in the United States alone -- have had the reports interrupted by storms, disaster and human carelessness.

"It is a very unique hydrographic record," said Steve Gill, a scientist with the National Oceanic and Atmospheric Administration.

Though measuring the rise and fall of the tides appears to be among the simplest of natural observations, data gathered from the tides at the Golden Gate has helped scientists unlock such mysteries as the depth of the Pacific Ocean, climate change and understanding earthquakes. And establishment of mean sea level is the way all elevations are measured.

"This particular gauge has a record of adding to our knowledge of the oceans and its relationship with the Earth that is without peer," said Albert Theberge, the director of NOAA's central library.

"In its way, it was a pioneer of the global system," said Ben Sherman, an NOAA spokesman.

Tides and currents have always fascinated humans who lived along the seashore. From the ancients who puzzled over the rise and fall of the waters, to Shakespeare ("There is a tide in the affairs of men ...") to Longfellow ("The tide rises, the tide falls...") to Churchill, who

called the swing of fortunes in World War II "the turn of the tide," the tides have been both a physical presence and a metaphor.

Tides, of course, are important in the affairs of ships, helping to move everything from foreign cars to container ships full of running shoes arriving by sea. Some vessels that draw a lot of water can only come in and out of San Francisco Bay at times of high tides. Many tanker ships can only move up the bay to ports in Solano County, Contra Costa and upriver on the flood tide.

The tides are caused by the Earth and moon revolving around a common center of gravity, and the Earth in turn revolving around the sun. NOAA's Theberge calls the tides "a grand symphony that has been played out for billions of years -- an orchestration of moon, sun, Earth and ocean."

"The motions are manifested by predictable but changing gravitational forces acting on the atmosphere, the oceans and the solid Earth itself," Theberge writes.

The causes of tidal action were not understood until 1687, after famous discoveries by Sir Isaac Newton. The next step was learning how to predict the tides, and in particular how to factor in various different conditions, including the shape of various shore and sea basins. This depended on the advance of technology.

In the United States, President Thomas Jefferson established the Coast Survey in 1807 -- the country's oldest physical science agency.

Only a few years before, the western coast of North America was nearly unknown territory. The first European ship to enter San Francisco Bay made its voyage in August 1775, when Lt. Juan Manuel de Ayala brought the Spanish navy ship San Carlos through the Golden Gate. Ayala, who tried to come in on the ebb tide, had a terrible time -- at one point the current was so strong his ship seemed to be going backward.

When the U.S. coast surveyors came to California in 1849, they found that some of the charts of major headlands -- Point Conception and Cape Mendocino, for example -- were off by as much as 15 miles, and the tidal actions at the entrance to San Francisco Bay, the biggest and most important harbor, were poorly understood. There were 26 major shipwrecks on the approaches to the Golden Gate in a four-year period ending in 1854. Many of them were due to errors of navigation or misunderstanding of the currents.

The first tidal observations were made at Rincon Point -- near the site of today's SBC Park -- and Sausalito. For various reasons, these were unsatisfactory, and on June 30, 1854, the station was opened at the Golden Gate.

Only six months later, on Christmas Eve, the station observed a series of "sinusoidal squiggles" on the tidal register. These were different from the regular tidal movements and intrigued Army Lt. William Trowbridge, an Army officer detached for duty with the Coast Survey. In early 1855, Trowbridge wrote headquarters in Washington to say he thought the squiggles were from a tsunami caused by an earthquake that had occurred somewhere, possibly under the ocean floor.

There were no seismographs at the time, but it turned out that the quake had occurred in Shimoda, Japan, on Dec. 23, 1854. Japan at that time was still in the age of the samurai, and word of the quake took months to reach the outside world.

But it had a major impact on understanding the natural world. By comparing the distances from Japan and the observations of the tsunami's arrival in San Francisco, the Coast Survey's chief, Alexander Bache, was able to estimate the average depth of the Pacific Ocean.

Modern technology showed his estimate was off only by 10 percent.

Over the years, the gauges also showed a gradual rise in the sea level --

eight inches in 150 years. However, there was also a period of 38 years, ending in 1913, when the sea level declined.

The San Francisco gauge also measured other phenomena -- such as the effect of the El Niño condition on water levels. The highest tide ever recorded was on Jan. 27, 1983, when the surface of the water at the Golden Gate reached 8.78 feet above mean sea level, or zero. The lowest tide was on Dec. 17, 1933, with minus 2.9 feet. The 1983 high tide accompanied a downpour associated with the El Niño condition; the lowest accompanied a period of the exact opposite condition.

The normal tidal range is about 5.8 feet, more when the moon is full. The tide also affects the currents in the bay, which are strongest in the Golden Gate, and in the San Pablo and Carquinez straits.

Sometimes, the currents in the Gate can reach well over six knots, particularly on an ebb tide. Millions of gallons of water flow in and every day: there are two high and two low tides a day. Various machines, from simple clockwork recorders to digital computers, have been used to record the rise and fall.

Most modern ships are powerful enough to sail on any tide, given sufficient water depth. But for the small boats, the currents and tides are as crucial as they were in the days of the old Spanish sailing ships.

The rise and fall of the tides four times a day in San Francisco Bay is "like a living thing" to Peter Evans, who is 74 and has been rowing on San Francisco Bay and its tributaries for 45 years. The salt water, he says "moves in a slow pace, like breathing."

Evans, who sometimes rows from Bolinas, on the Marin coast, to Alameda, must use the tides to help him make his way on the water.

"Just outside the Golden Gate on a big ebb tide there is a big upsurge," said Evans. "When you hit it, it is just like a car, sliding on ice."

Evans liked to calculate the tides himself. He still does it the old- fashioned way, using the tide tables, and his sense of what the water is doing.

"If you are successful, it is sort of a game," he said. "The water doesn't always do what you think it will do. It has a timetable all its own."

The anniversary

The National Oceanic and Atmospheric Administration will commemorate the 150th anniversary of tidal observations at the Golden Gate on Wednesday with an exhibit on the tides and presentation of the NOAA environmental hero award to Pietro Parravano, former president of the Pacific Coast Federation of Fishermen.

The ceremony begins at 5:30 p.m. at the San Francisco National Maritime Historical Park Visitors Center, at Hyde and Jefferson streets. The featured speaker will be vice admiral Conrad Lautenbacher, NOAA administrator.

E-mail Carl Nolte at cnolte@sfchronicle.com.

Page B - 1

URL: <http://sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2004/06/28/BAGLP7D9PT1.DTL>

[©2004 San Francisco Chronicle](#) | [Feedback](#) | [FAQ](#)

SFGate.com

[Search Photos](#)

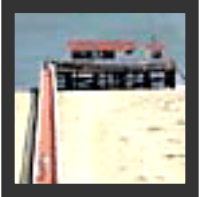
[Photo Gallery](#)

[Full Story](#)

[PREVIOUS](#) [NEXT](#)

[SAN FRANCISCO / TIDES OF HISTORY / Presidio gauge has measured the bay's rise and fall for 150 years](#)

The tide house at the Presidio, smaller of the two buildings, sits at the end of a pier near Crissy Field. Chronicle photo by Mark Costantini



Chronicle / Mark Costantini

[PREVIOUS](#) [NEXT](#)

SFGate.com

[Search Photos](#)

[Photo Gallery](#)

[Full Story](#)

[PREVIOUS](#) [NEXT](#)

[SAN FRANCISCO / TIDES OF HISTORY / Presidio gauge has measured the bay's rise and fall for 150 years](#)

The Golden Gate Bridge towers above the humble tide house, which has been in continuous operation since June of 1854. Chronicle photo by Mark Costantini



Chronicle / Mark Costantini

[PREVIOUS](#) [NEXT](#)