

REIGN OF THE SIERRA STORM KING: A WEATHER HISTORY OF DONNER PASS

BY MARK McLAUGHLIN

“Climb the mountains and get their good tidings. Nature’s peace will flow into you as sunshine flows into a tree. The winds will blow their own freshness into you, and the storms their energy, while cares will drop off like Autumn leaves.” – John Muir

Americans enjoy and endure some of the most dynamic and violent weather in the world, but we have also developed a sense of affinity with our changeable skies. When the wind kicks up its heels and atmospheric pressure falls, weatherwise folk acknowledge the blasts of Old Man Winter or capriciousness of Mother Nature with a sense of familiarity. For more than 150 years, unpredictable and overwhelming weather events in the rugged Sierra Nevada have etched their impact into the annals of the West. Early pioneers, burly railroad men, and modern motorists challenging stormy weather in the Sierra have their own regional nemesis to deal with. His lair is in the Gulf of Alaska and we call him the Storm King. When the Sierra Storm King asserts his meteorological power over this rocky domain, travelers beware.

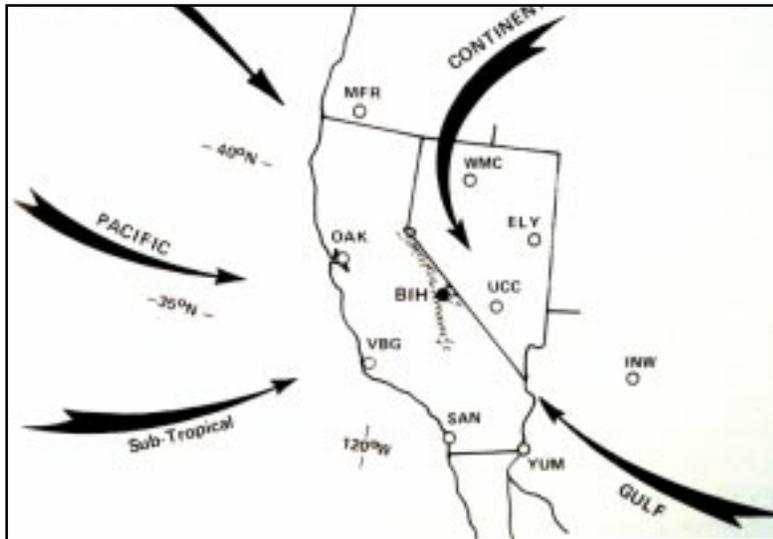


Born under Mesozoic seas 220 million years ago, its highest peaks now scrape the sky at 14,496 feet. Easily the largest single mountain range in the lower forty-eight, the majestic Sierra Nevada encompass an area nearly as large as the French, Swiss and Italian Alps combined. During the summer months, crystal clear alpine lakes dot the forested landscape while stubborn snowfields cling to northeast slopes below ridgeline. Glacial epochs have scoured and polished the Sierran granite so that it reflects sunlight with stark clarity. John Muir, a 19th century naturalist and first president of the Sierra Club, loved these mountains, as did famed photographer Ansel Adams, who called them the Range of Light. The sublime vistas have inspired adventurers, poets, and tourists for generations.

Padre Pedro Font gave the name Sierra Nevada to the mountain range on the eastern fringe of Spanish California in 1776. In Spanish, Sierra means mountains (plural) and Nevada means snow-covered. There are several interacting mechanisms that generate the uniquely mild but snowy climate of the Sierra range. The circulation around, and subsidence and stability within the eastern Pacific Ocean anticyclone that generates California’s long dry summers, weakens in winter allowing strong Gulf of Alaska storms to invade the region. In addition, the

northwest-southeast trend of the range puts it at a right angle to the winter storm track, which forces orographic uplift. The combination of both frontal band convection and orographic lifting generates heavy precipitation on the Sierra west slope. Third, its close proximity to the moderating influence of the Pacific Ocean and a location between 36 degrees and 40 degrees north latitude warms average midwinter daytime temperatures to well above freezing.

The Sierra Nevada receives nearly all its moisture between Thanksgiving and Easter when the storm-blocking seasonal Pacific High shifts south and westward toward Hawaii. Low



pressure in the Gulf of Alaska strengthens and expands, forcing the sub-polar jet stream south. The region's reputation for heavy snowfall is well deserved and primarily topographically derived. The Sierra range is classic fault block uplift tilted west so that its crest and high peaks are on the eastern edge of the mass. The range is characterized by an abrupt, faulted eastern flank, which is the western border of the arid Great Basin. Situated only 150 miles from the largest ocean in the world and

prodigious breeding ground for storms, the gradually rising Sierran west slope squeezes copious moisture from vigorous eastbound Pacific cyclones, creating a towering island of enhanced precipitation. (Precipitation is rain and snowmelt combined.)

The Sierra's gain in precipitation is Nevada's loss; averaging only nine inches of precipitation per year, the Silver State is the driest in the country. At 210,000 square miles, the Great Basin is the largest, highest, coldest and furthest north of all North American deserts, a direct result of the synoptic climatology produced by the Sierra's rain shadow.

The persistence and duration of precipitation events on the windward slopes steadily increases in the climb from the Sacramento Valley at sea level toward the Sierra Nevada crest above 10,000 feet, but the greatest intensity generally occurs over the lower slopes between 2,500 to 4,500 feet. These characteristics combine to produce an average accumulation maximum between 4,500 and 6,500 feet. Northern California foothill loca-



tions receive about 30 inches annually, while 70 to 80 inches of precipitation are common in the optimum zone located in higher elevations. Above 7,000 feet, northern Sierra annual snowfall totals range from 400 to 450 inches.

At 7,239 feet, Donner Pass is located above the maximum precipitation zone, but its higher elevation guarantees that most of the moisture that falls there is frozen. The summit's 130-year-old weather record began in 1870 (longest in the Sierra) when Central Pacific Railroad started recording precipitation and snowfall amounts at Summit Station, located in Norden at elevation 7,017 feet. Station clerks were supposed to measure precipitation every eight hours, but reliable information about their adherence to any consistent methodology is limited. Even so, these early measurements are vitally important for reconstructing historic weather events and 19th century snowfall accumulations. Modern records indicate that the average annual precipitation in the Donner Pass region is about 54 inches, which includes 34.12 feet of snow.



For early American settlers struggling with ox-drawn farm wagons, crossing the range ranked as the most difficult obstacle in their 2,000-mile trek to the Pacific. Fantastic tales of an endless summer paradise in coastal California were tempered by the fear of mind-boggling snowfall in the mountains.



Although there are nearly a dozen trans-Sierra routes, Donner Pass is the most notorious of all the crossings. For more than a century and a half severe weather and rugged topography have combined to challenge those taking this route. In 1844 a Paiute Indian chief called Truckee came upon a wagon train of pioneers searching for an overland route to California. Truckee found them stalled at the Humboldt Sink in present-day Nevada so the friendly native pointed them towards an unnamed pass off to the west. The Stephens-

Murphy-Townsend Party, a group of 50 men, women and young children, had to dismantle the wagons and hoist sections by rope to ascend the sheer granite escarpment, but they succeeded in getting five of their eleven wagons over the pass.

Exhaustion and late November snowstorms forced them into a winter survival camp along

the south fork of the Yuba River while some of the men pushed on to Sutter's Fort for help. Bred for endurance and blessed with luck, all 50 men, women and children survived the ordeal. Two babies arrived during their journey, including Mary "Yuba" Murphy, who was born at the survival camp on the river. The Stephens Party was the first group of American emigrants to haul wagons over the mountains and are credited with opening the long-sought California Trail.



Nestled along the Truckee River a few miles east of Donner Pass sits the town of Truckee, named after the helpful Paiute chief. Truckee, California, where logging and ice harvesting industries have been replaced with snowsports and tourism, often ranks as one of the nation's coldest locations. Ohio Wesleyan University geographer, Professor David Hickcox, compiles an annual list of the cities that record the nation's lowest temperature on a daily basis. Out of the last 15 years, Truckee has made the top five rankings 11 times. And three of those years, 1991, 1993, and 1994, Truckee claimed the dubious honor of coldest spot in the nation, excluding Alaska. Truckee placed third in 1998. (In deference to the country's truly cold locations in the Rockies and upper Mid-west, Truckee primarily captures relatively mild national low temperatures in the summertime.)

Despite being located on the protected lee side of Donner Summit, the town of Truckee gets its fair share of snowfall too. The Truckee Ranger Station at elevation 5,995 feet averages 32.46 inches of annual precipitation, which includes 208 inches of snow. (The modern snowfall record for Truckee is 444 inches recorded during the winter of 1951-52.)

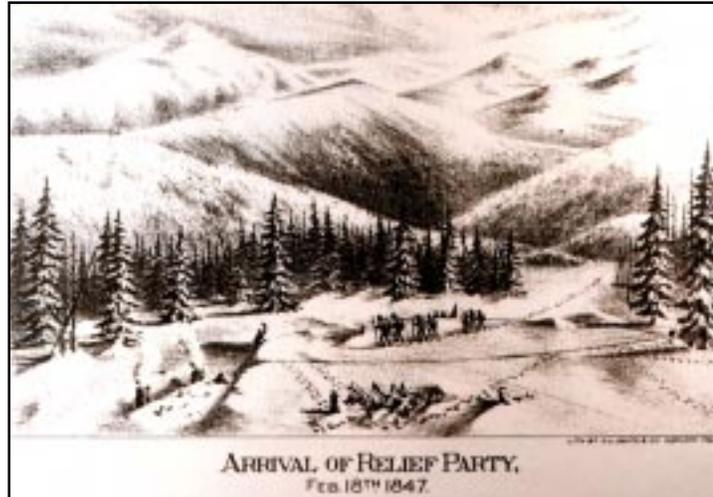
In 1846 Truckee's pass gained perpetual notoriety as well as its infamous moniker when the Donner Party was caught east of the summit by early winter storms. The snow was already three to five feet deep in the pass when the California-bound emigrants arrived on October 31. (October snows are not unusual in the Sierra, but the coincidence of two storms heavy enough to impede traffic this early in the season is rare.) More storms in November closed the pass for good and forced them to wait for rescuers from the Sacramento Valley. Trapped for months with diminishing food supplies, the starving pioneers were reduced to cannibalism. There were 10 major storm periods that winter, beginning October 16, 1846, and ending April 3, 1847, with intervening fair weather. Hard as the successive storms were to take, physically and mentally, the sunshine and thaws between them gave rise to false hopes that winter was breaking.

In mid-December a lull in storm activity encouraged 15 of the party to attempt a crossing on improvised snowshoes. Provisioned with only enough food for one week, it took them 33 days to reach the closest settlement on the Sierra west slope; only seven survived their ordeal of fatigue and starvation, including all five women who set out.

Settler Patrick Breen kept a diary recording the weather at Donner Lake from November 20, 1846, until he and his family were rescued around March 1, 1847. On November 29, 1846, Breen wrote: *"Still snowing now about 3 feet deep, wind West. Killed my last oxen today. Will skin them tomorrow. Gave another yoke to Fosters. Hard to get wood."* The following day his entry read, *"Snowing fast. Wind W. About 4 or 5 feet deep, no drifts. Looks as likely to continue as when it commenced. No living thing without wings can get about."*

For the hapless pioneers, the winter only got worse. Several major storm periods occurred during December, January and February. On January 23, 1847, Breen wrote, *"Blew hard and snowed all night; the most severe storm we have experienced this winter; wind west."* On February 4, Breen penciled in:

"Snowed hard until twelve o'clock last night; many uneasy for fear we shall all perish with hunger." The Storm King was literally burying them alive. On February 5, Patrick Breen observed, *"It snowed faster last night and to-day than it has done this winter before; still continues without intermission; wind south-west."* The luckless emigrants spent three months at Donner Lake, their crude cabins buried under the snow. The first of several rescue efforts did not reach them until February 18, 1847. After spring melt, stumps of trees cut by the stranded pioneers



ranged from 15 to 18 feet in height, indicative of the exceptional snow-pack. Nearly half of the 81 settlers stranded at the camps died before reaching sunny California.



In 1849 the region was invaded by history's greatest gold rush. Hordes of miners, merchants, prostitutes and desperadoes flocked to the rich diggings on the Sierran west slope. Just one year later, California joined the Union as the Golden State. During the 1850s Californians voiced support for a transcontinental railroad to stitch the nation together, but

Congress and investors doubted that iron rails could be linked over the Sierra Nevada. Theodore Dehone Judah, a brilliant, New York-trained engineer who believed that he could snake the tracks through the snowbound mountains, persuaded Congress to pass the Pacific Railway Act. Judah had seriously considered the problem of snow in his exhaustive study of the best route over the Sierra. In order to find some comparison, on his business trips back

East Judah made a point of examining the snow conditions on some of the higher rail crossings of the Appalachians. He observed the Eastern railroad crews successfully operating in



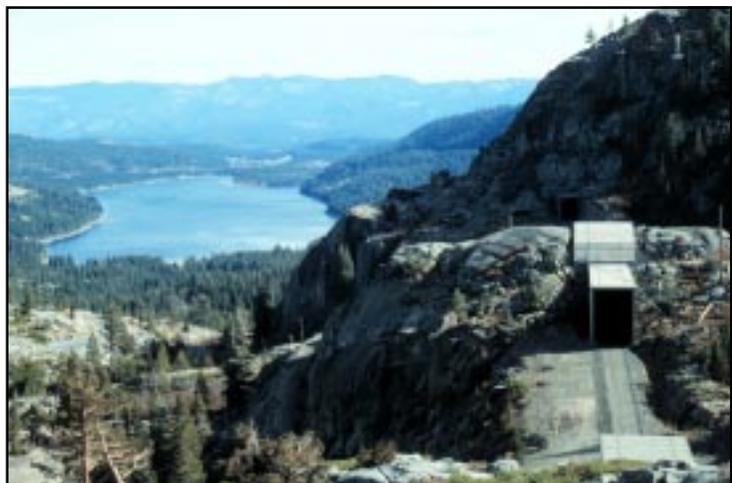
heavy snowfall zones and felt confident that Sierra snowstorms would not be a problem.

In reality Judah had little information regarding the prodigious Sierra snowpack and Central Pacific was later forced to construct 37 miles of expensive wooden snowsheds in order to protect track and trains from snowdrifts and avalanches. The visionary Judah never saw his railroad to completion. He died of Yellow Fever on Nov. 2, 1863, at the age of 37.

To conquer the Sierra by rail was an epic undertaking. Much of the initial construction material had to be shipped from New York around stormy Cape Horn to San Francisco, a voyage of 19,000 miles. William Tecumseh Sherman, who later became a Union General in the Civil War, was an experienced engineer and surveyor familiar with the Sierra range. When he heard of Judah's plans he wrote his brother of the project: "If it is ever built, it will be the work of giants." Those giants were diminutive Chinese laborers who shoveled, picked and blasted their way through the Sierra's granite spine.

James Harvey Strobridge, superintendent of construction, initially did not want to use the foreign labor force, but California's white laborers were mostly undisciplined gold miners. Strobridge later said, "Labor sufficient for the rapid construction of the Central Pacific was then not on the coast and the labor as it existed could not be depended upon if the first mining excitement meant a complete stampede of every man and a consequent abandonment of all work."

The Chinese had assembled the Great Wall; they would build the western portion of America's Great Rail too. Thousands of Chinese laborers endured blinding blizzards and lethal avalanches to construct the railroad over storm-swept Donner Pass. Where a roadbed could not be built, a tunnel was chipped and blasted out. In the heavy snowbelt between 6,000 and 7,000 feet, nine tunnels were excavated through the obdurate granite, totaling 5,158 feet in length.



Forty-four storms during the winter of 1866-67 pounded the summit with 44 feet of snow. The biggest dropped 120 inches in 13 days. One avalanche wiped out an entire work camp; when the bodies were discovered the following spring, tools were still clutched in their frozen hands. The following week another slide near Tunnel No. 9 swept twenty Chinese to their death. The following winter was little better. Sub-tropical storms deluged the region with more than 40 inches of rain in December 1867, causing extensive flood damage. The South Yuba Canal Company near 3,000 feet in elevation recorded more than 115 inches of rain that season.



The weather was eerily calm for much of January and February, but in early March 1868 a fierce blizzard deposited 10 feet of snow in five days. The *Virginia City Territorial Enterprise* newspaper stated, "This winter has been pretty rough on the Chinese along the line of the railroad, and a great number of them have been killed and crippled by similar accidents at various points on the road." Despite every obstacle the Storm King could throw at them, the hard-working Chinese crews pushed the track through the mountains, reaching Donner Summit on November 30, 1867. Winter storms had taken a heavy toll on the laborers, but the transcontinental railroad was finally completed in May 1869.



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The railroad made the Sierra crossing much more comfortable, but danger still lurked. In January 1890 a relentless barrage of blizzards and string of marooned passenger trains shut down Donner Pass for 15 days. Nevadans remember the brutal winter of 1889-90 as the Great White Ruin when deep snow on the range decimated their cattle and sheep herds. But in the mountains, avalanches and drifting snow caused the Great Sierra Snow Blockade. As the snow piled up on the desert floor cutting livestock off from forage, desperate Nevada ranchers began shipping their starving cattle by boxcar into California. On January 15, 1890, one of the westbound trains derailed, shutting down northern Nevada's only lifeline through the snowbound Sierra.

The wild and woolly railroad crews organized an incredible show of strength against this massive assault

by the Storm King. In addition to an armada of bucker snowplows and railroad crews, Central Pacific had recently acquired two new rotary snowplows, which could churn through deep snow and throw it off the track. The heavy machinery was backed up by nearly 5,000



snow shovelers who were hired to help keep the tracks clear. Despite this extensive, coordinated counter-attack, the 66 feet of snow that fell in 1889-90 generated so many avalanches it overwhelmed their efforts. For journalist Nellie Bly, the Sierra snow blockade nearly stymied her attempt to circumnavigate the globe in less time than novelist Jules Verne's fictional voyage "*Around the World in 80 Days.*"

Nellie Bly, a 23-year-old reporter for the New York *World* newspaper, was circling the globe in an effort to beat the French novelist's fantasy journey. Bly shipped out eastbound from New York to London on November 14, 1889. At the train station in Amiens, France, Jules Verne met the young lady who was bringing his story to life. She traveled by mail train to Brindisi, Italy, and then sailed through the Mediterranean, continuing on to India. By the time Nellie Bly reached San Francisco, she had burned 68 days. Unfortunately for Nellie, the news she received in California was not good. Donner Pass, blocked by blizzards, avalanches and several train derailments, would not be open for days. Her second problem was the "Nellie Bly Escort Corps," which consisted of her two New York editors, as well as other professional associates from the East. The members of this elaborate delegation were trapped with 700 other stranded passengers on the eastern side of the Sierra in Reno, Nevada. It seemed that after circling most of the globe, a California snowstorm was going to foil her success as a real-life Phileas Fogg.



All was not lost, however. Nellie's editor, John J. Jennings, had somehow managed to reach Donner Summit before railroad officials held down all westbound traffic in Reno. Jennings caught a ride on a snowplow until it was hit by avalanche. He survived but the machine was disabled. Despite sober advice for Jennings to remain with the plow, the resourceful editor found himself a pair of eight-foot-long wooden skis, the first he had ever seen. He skied all night until he broke past the blockade site where he could get a

train to Sacramento. Jennings remarked, "I have seen snow and blizzards in New York, but the people back there don't know what snow is."

For the millions of Americans reading about the drama in their hometown newspapers, the tension was electrifying. Embarrassed Central Pacific officials rerouted Bly and Jennings on a special express train south into the California desert and then east to Chicago. Nellie Bly arrived back in New York City on January 25, 1890, having traveled 72 days, 6 hours, and 11 minutes in her epic world circling journey.



Although the Storm King causes havoc with transportation at some

point nearly every winter, the army of men, women, and machinery stationed in the Sierra are always ready to battle for control of the highways and railroad. But no matter how prepared, sometimes nothing can withstand the Storm King's meteorological assault. Another prolonged trans-Sierra blockade occurred in January 1952, after an onslaught of powerful Pacific-bred storms inundated the mountains. When blizzard conditions stranded the luxury

streamliner train "*City of San Francisco*" high in the mountains, the event made national news. On Sunday morning, January 13, 1952, Truckee-Lake Tahoe residents were three days into a week-long blizzard. An intense vortex of low pressure had stalled off the California coast in a position favorable for heavy amounts of snow. Despite the best efforts of California road crews on this fateful Sunday, all northern Sierra highway passes were closed due to deep snow and avalanches. Only Southern Pacific trains were still crossing the Sierra, rumbling through the snowsheds and tunnels that made their passage possible. All that changed at 11 a.m. when one of SP's luxury streamliners, the *City of San Francisco*, rammed into a snowslide near Yuba Pass, west of the Sierra crest. Despite three 2,250 horsepower diesel-electric engines, the crew could not back up the train and quickly realized they were stuck. There were 226 passengers and crewmembers on board the 15-car westbound train, but everyone assumed that the powerful \$3 million express train would not be there long.



Their laissez-faire attitude, however, turned to anger when they were still snowbound 24 hours later. The wind was fierce, howling at speeds in excess of 90 mph and drifts towered 20

to 30 feet. Many feared it would be just a matter of time before another avalanche shoved the entire train into the dark ravine below. On Monday night, 36 hours into their ordeal and with no rescue in sight, the supply of diesel fuel ran out, cloaking the train in a cold eerie darkness lit only by dim emergency lights.

Unbeknownst to the frightened passengers and crew, SP rescue trains were inching their way closer from both east and west toward the stranded streamliner. One train carried dogsled



teams while the Sixth Army trucked in arctic-trained rescue squads over partially cleared Highway 40. (Interstate 80 was not built until the early 1960s). Military doctors and nurses aboard snowcats were rushed to the likely rescue points. Helicopters were grounded by the storm, but stood ready to fly at first chance.

A Southern Pacific rotary snowplow, manned by engineer Rolland Raymond of Sacramento, finally broke through to within a quarter

mile of the buried train. Raymond climbed down from the snow-streaked rotary in order to survey the hazardous conditions. Without warning, an avalanche roaring down the mountainside crashed into the rotary snowplow and swept the would-be rescuer to a violent death.

On the morning January 16 the skies suddenly cleared, giving relief operations a chance to reach the train. Pacific Gas and Electric Co. employee Jay Gold, 33, drove the first bulldozer opening the trail. His efforts enabled doctors to reach sick passengers with medicine and allowed others to bring food supplies. Tragically, the exertion proved overwhelming for the heroic young man and he died of a heart attack shortly after.

The critical mission had taken four days and cost two lives, but all 226 passengers and crew were eventually saved. From January 10 to 17, nearly 13 feet of snow fell. The winter of 1951-52 dumped 65 feet of snow on Donner Summit and the snowpack reached 26 feet deep, the greatest depth ever recorded there.



Trans-Sierra Highway 40 was blocked by snow for one month. (In modern times, only the winter of 1951-52 can compare to the unusual snow depths recorded in 1846-47 for lower

elevations east of the Sierra crest.)

No matter that we have entered a new millennium, the Sierra Storm King will continue to instill fear for those daring enough to cross Donner Pass during a winter storm. California's Department of Transportation (Caltrans) is responsible for the planning, design, construction, operation and maintenance of the state's highway system. Caltrans strives to control snow and ice on Sierra highways in order to provide safe travel for motorists while keeping traffic delays to a minimum. It is not an easy task. On Interstate 80, heavy seasonal recreational traffic as well as steady truck traffic make it difficult for Caltrans to keep this busy trans-Sierra freeway open during winter storms. The number of automobiles using Donner Pass increases yearly; westbound motorists must share the road with 2,000 commercial trucks that enter the Golden State everyday via I-80. Caltrans is increasingly being challenged in that higher public expectations and increasing traffic are complicating operations, but they continue to incorporate new and innovative products and techniques into their arsenal of snow-removal weapons.

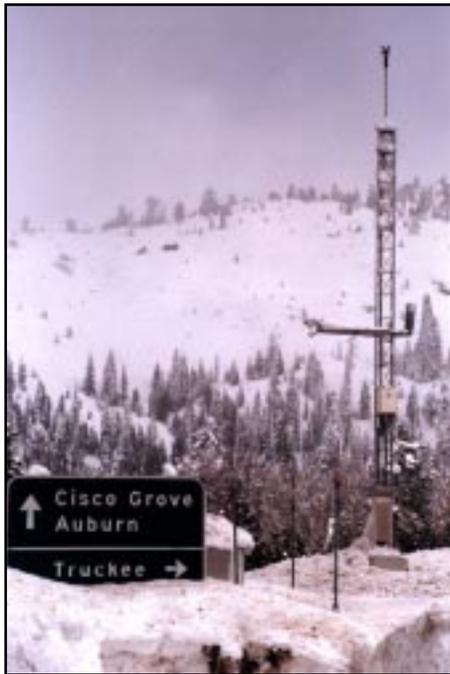


Caltrans backs up their snow-clearing force of truck-mounted wing plows, motor graders, and rotary snow blowers with speed limits, traffic metering, chain controls and deicing products. The blade on a wing plow can be hydraulically extended up to 22 feet to swipe two lanes at once, while the slow but efficient rotaries can throw up to 5,000 tons of snow per hour.

Caltrans relies on storm forecasts from the National Weather Service and various Internet sources, as well

as contracted private forecasters. District dispatchers advise mobile maintenance units of impending snowstorms via telephone or radio, and local superintendents complete the loop by relaying on-site conditions back to the NWS. A satellite link provides real-time radar, GOES images, storm updates, and offers reliable reception when weather conditions have caused power and telephone outages. The detailed real-time information provided by the satellite connection enables snow crew supervisors to more accurately predict the timing and intensity of localized storm cells.

Caltrans is also utilizing the latest technology on the road. They have installed a Road Weather Information System (RWIS) alongside Interstate 80, instrumentation that provides local pavement and atmospheric data. Accurate air and road surface temperatures are important in the application of deicing products. Wire-guidance systems embedded in the pavement are being used to enable snow plow operators to safely open a closed section of road by indicating the plow truck's location on the snowbound highway. A Global Positioning System (GPS) is also being installed on Interstate 80 over Donner Summit to see if in the future it can assist motorists and snow removal equipment operators who are driving and working in poor visibility.



A new high-tech snowplow is currently under development that will be distinctly different from the traditional machine. The University of California at Davis Advanced Highway Maintenance and Construction Technology Research Center is creating the snowplow of the future. Actual testing began in 1999 on several miles of Interstate 80 near Donner Summit, where drivers are utilizing several novel technologies to make plowing Sierra highways safer, quicker and more efficient.

Caltrans' advanced snowplow is loaded with gadgets like a radar system that will prevent the 10-wheeled diesel from colliding with snow-covered vehicles abandoned on the road. It also uses magnets embedded in the roadway to allow the operator to center the plow and properly clear a lane obscured by ice and snow. Sensors on the bottom of the snowplow detect the magnets and relay the information to a video screen inside the vehicle. Since the screen also provides the driver with a graphic representation of the road ahead in white-out conditions, Caltrans can employ an echelon formation with the hi-tech plow in the lead and two other "blind" snowplows following on either side and behind it. Nate Robinson, a Caltrans snowplow driver who has driven the new plow says, "You can't take out the human factor, but if the road was closed, the windows taped over and there were magnets in the road, I could drive from here to San Francisco."

Fighting the Storm King every winter is difficult and expensive, but Caltrans must also contend with California drivers coming from warmer and drier parts of the state who are unprepared for the challenges of driving in snow. According to Caltrans,



this problem is compounded because many motorists driving in the mountains expect to be able to drive the same way they do in summer, and are reluctant to pull over and install tire traction devices. Accidents frequently occur because many California motorists are unfamiliar with driving in snow and ice and are likely to drive too fast for the conditions.

In recent years, the popularity of 4-wheel drive Sport Utility Vehicles have given some inexperienced California drivers a false sense of security, adding to the frequency of winter road closures due to spin outs and accidents. Caltrans now implements R1 (chains required, except for autos or pickups with snow tires) requirements more quickly than in the past, in part to slow down the excessive speed of 4-wheel drive vehicles. The power and brawn of the SUV has inflated egos so that hubris often exceeds common sense. For 150 years winter travelers confronting the Storm King over Donner Pass have been warned, "Stay smart or stay home."

Caltrans chain control designations for various road conditions during snowstorms:

R1a – (Modified R1) Chains required for single axle drive vehicles with trailers.*

R1 – Chains required, except for autos or pickups with snow tires. (Caltrans has the authority to set reduced speed limits of 40, 35, 30, or 25 miles per hour.)**

R2 – Chains required, except for vehicles with four-wheel drive and snow tires on all four wheels. (Must carry chains.)

R3 – Chains required, no exceptions. (Note: R3 conditions are rare – the road is usually closed prior to this designation.)

*The enforcement of the chain requirements is the responsibility of the California Highway Patrol.

**Studded tires, while legal for use on highways during winter months, do not qualify as an approved "Tire Traction Device."