CAL TODAY

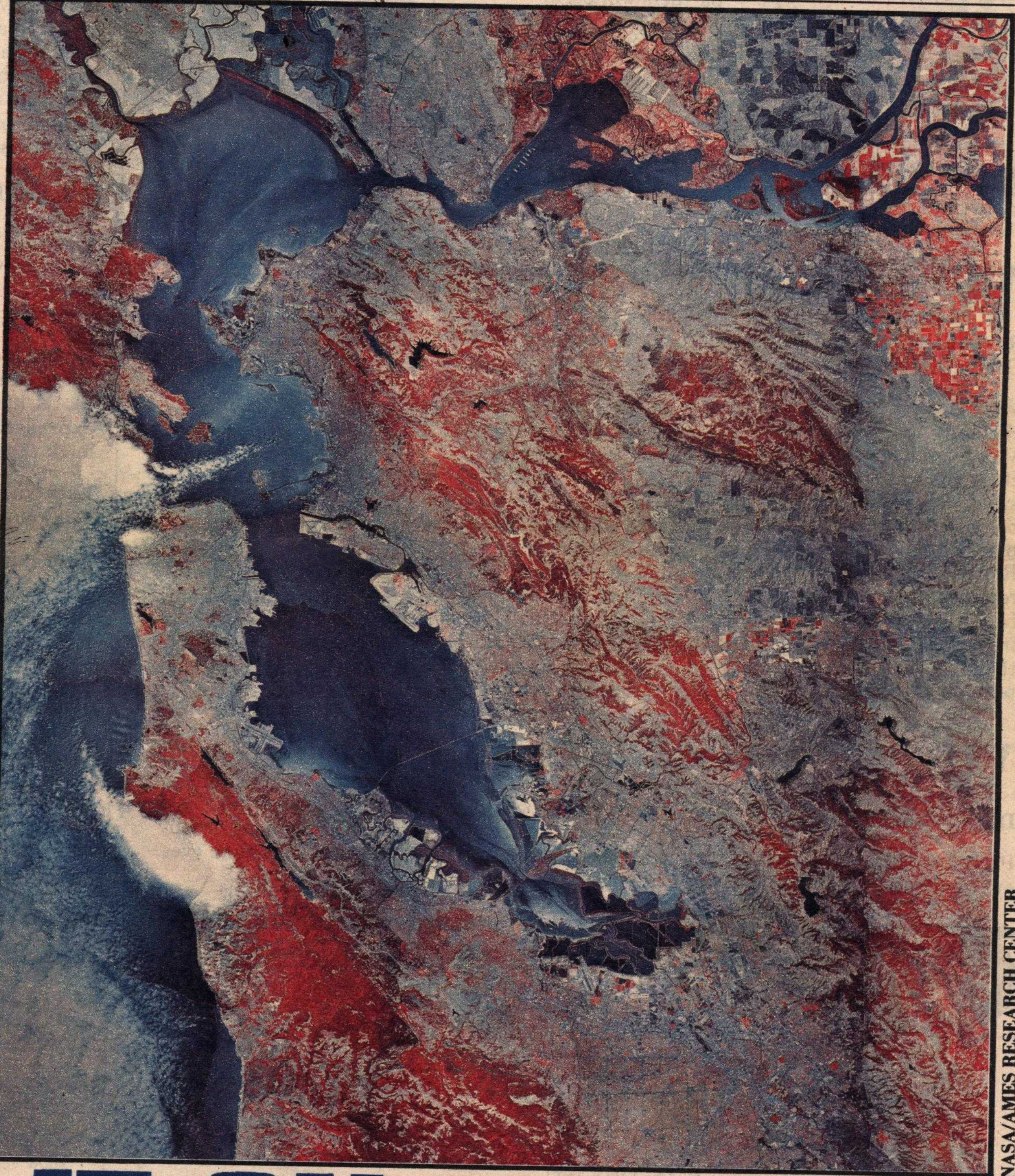
Weather

An infrared portrait of the Bay Area from 65,000 feet: The cities are gray, the water is blue and the vegetation is vivid red. That gap letting the fog in is the Golden Gate.

Want to know why it's 90 in San Jose when it's 55 in San Francisco?

Why it's foggy in Berkeley when it's clear in Belmont?

Why there's 60 inches of rain in Felton when there's only 14 in Fremont?



NASA/AMES RESEARCH CENTER

BLAME IT ON THE BAY

MEDITERRANEAN

People like to live where grapes grow. Both thrive in a climate marked by dry, fruitful summers that yield to mild and rainy winters. Scientists call this climate "Mediterranean," and it blesses only 1 percent of the Earth's surface, the Bay Area included.

Grapes do well in the Bay Area, but that is not all. Apricots, oranges and cherries grow here, as do flowers of every hue and fragrance. By such diverse abundance, these earthly riches reflect the varied place in which they grow. From the fogbound coast to arid interior hills, the Bay Area climate assumes countless forms and guises. For such a small area, this region's weather is among the most diverse and complex in the world.

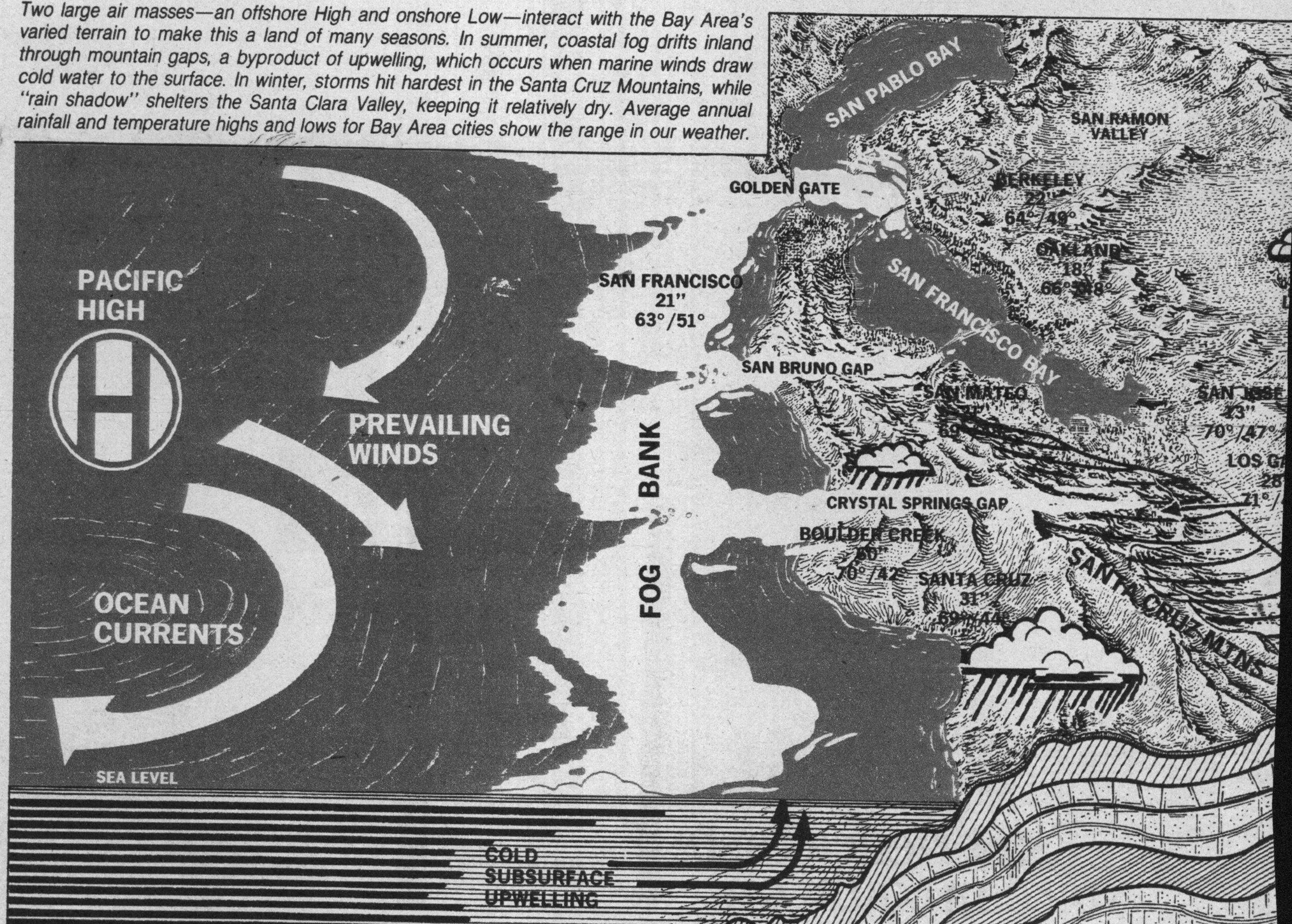
Two basic factors underlie this diversity: Air and terrain. Over the Pacific Ocean there sits a mass of air called the Pacific High. In summer it hovers some 1,000 miles west of the California coast. Air, like all elements, seeks equilibrium. The Pacific High flows toward its low-pressure opposite, the California Heat Trough. The Trough is cooked up in the summertime oven of the Central Valley when the sun beats down on the land. The westerly winds of summer are created by this constant flow of air from high pressure area to low; the winds that are spawned out at sea rush inexorably toward the low in the Central Valley.

In blowing through the Bay Area, these cool marine winds caress a varied landscape. The coast rises sharply into the Santa Cruz Mountains. They crest at around 3,800 feet and then roll back down to a broad valley floor. To the east juts a new range of mountains, the Diablos. In the midst of this basin, open to the sea at the Golden Gate, lies San Francisco Bay.

Such terrain creates strong gradients—sharp changes in topography and atmospheric pressure over short distances. These, in turn, spawn large temperature contrasts, complex wind currents, a variable pattern of rainfall.

An August day can bring a breezy 50 degrees to San Francisco, while San Jose, 50 miles to the south, bakes in valley heat. Real estate values in parts of Berkeley hinge on whether fog has moved into the neighborhood. During last

Two large air masses—an offshore High and onshore Low—interact with the Bay Area's varied terrain to make this a land of many seasons. In summer, coastal fog drifts inland through mountain gaps, a byproduct of upwelling, which occurs when marine winds draw cold water to the surface. In winter, storms hit hardest in the Santa Cruz Mountains, while "rain shadow" shelters the Santa Clara Valley, keeping it relatively dry. Average annual rainfall and temperature highs and lows for Bay Area cities show the range in our weather.



Map by Al McCahon

WEST

A dozen microclimates make the Bay Area a weatherman's nightmare, but a great place to live—even in the winter.

By EDWARD O. WELLES

month's big storm, the sky burst over Felton, which got four inches of rain while San Jose got an inch and a half.

Felton, Ben Lomond, Boulder Creek. These towns lie in the San Lorenzo Valley, a place for big winter storms. It rained two feet in 30 hours here during the epic storm of last January. Creeks jumped their banks; hillsides fell apart and crashed. The valley is a funnel. Open—unprotected—to the south, it invites moisture-laden air to sweep off the Pacific from warmer, wetter latitudes. It bears the brunt of winter.

Sunlight slants through the forest as Marie Locatelli drives up the narrow road, twisting ever higher up the grade to the mountain's peak. "I'll never forget the first time I came up this road. I was a bride then." That was half a century ago, when the road was dirt and the Locatelli family grew grapes, walnuts and chestnuts. Now the road is eroded, eaten away at some places to a single lane.

Locatelli, 73, a widow now, lives in Boulder Creek, but she drives up the mountain daily to help out on the family ranch. Her husband, Vincent, died in November 1981. His work was agriculture, his passion the elements. For 20 years, Vincent Locatelli was a volunteer observer for the National Weather Service. Like a small memorial, a rain gauge stands on a slope in the field. A white conical structure, it holds a pan for collecting water and, beneath that, a gauge whose upper limit is 20 inches.

Last January, that gauge spun off the scale. When meteorologists drew rainfall charts of the big storm, this place was the bull's-eye. The Locatelli ranch got 25 inches; it was at the core of the deluge. On the average, that kind of downpour occurs once every 100 years. Vincent Locatelli died just two months before the storm of the century.

Such rains come only in winter, when the Pacific High drifts south toward the equator. In summer, the High is a "ridge" of high pressure that deflects ocean storms to the Pacific Northwest. But come winter, the Pacific High weakens and yields to the Aleutian Low, a strong low-pressure air mass that moves south from the Gulf of Alaska.

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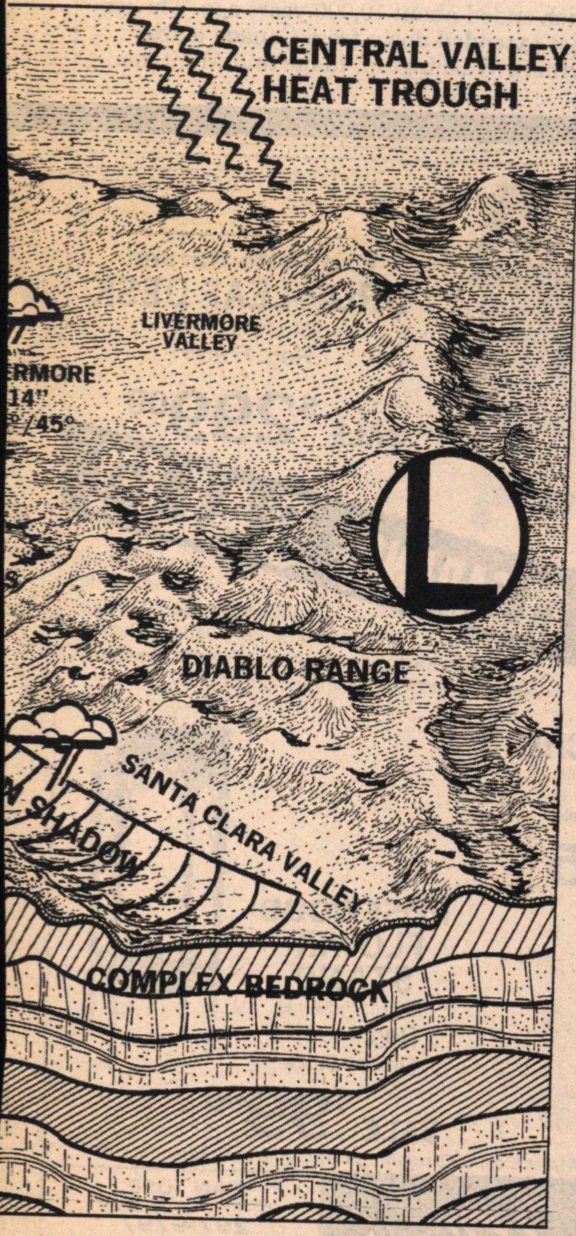

Photograph by Tom Van Dyke

Marie Locatelli recalls last January's storm on her ranch near Boulder Creek. The rain gauge, maintained by her late husband, Vincent, a longtime observer for the National Weather Service, registered the highest reading of anywhere in the Bay Area. It measured 25 inches in 30 hours, marking a storm that occurs, on the average, once a century.

Where these two air masses meet, they form a signal feature of winter weather, the polar front. The greater the gradient—the difference in temperature between the two air masses—the stronger the front. The stronger the front, the bigger the storms it will produce.

The biggest storms happen when the front swings around and comes onshore from the south, driven by the jetstream. It thus draws a higher percentage of air from lower, warmer latitudes. Warm air holds more moisture than cold. The more ocean an air mass moves over, the greater the "fetch"—the water-collecting potential. When these big storms come onshore they blast right up the south-facing San Lorenzo Valley.

It rains as much as 60 inches a year here, nearly five times what San Jose gets. San Jose sits in "rain shadow." Moist marine air is forced to rise and cool when it comes onshore and runs into the Santa Cruz Mountains. In cooling, it loses its ability to carry moisture. Moisture condenses out as fog, then as rain that falls on the mountains. San Jose, meanwhile, lies sheltered and dry on the landward slope of the mountain range.

Rain shadows fall all over the Bay Area. Northern slopes in the coastal mountains tend to get less rain than southern ones. Gaps in the coastal range open the door to rain; peaks snap it shut.

EDWARD O. WELLES is a *CalToday* staff writer.

Berkeley, opposite the "door" that is the Golden Gate, gets 25 percent more rain than its East Bay neighbor, Oakland. The hills of San Francisco shadow Oakland. They help to shelter it from ocean winds.

We crest the mountain and pull into the Locatelli ranch. Ahead of us unfolds the convoluted Santa Cruz Mountain geology. Serrated ridges crowned with redwoods cut across the deep blue sky toward the hazy beyond of the ocean. The

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redwood, a tree with a healthy thirst, thrives in this humid place. It wrings moisture from the fog and thus survives the rainless California summer. This tree, for all its stature, is really no more than a biological remnant. Once, vast stands of it grew across the Pacific Northwest, sustained by a climate noticeably wetter than the present. That was during the latest Ice Age, which ended about 10,000 years ago. The ice sheet extended down from Canada across northern Washington, Idaho and Montana.

South of the ice sheet warmer, wetter weather occurred. Here the redwood flourished. Now in a drier time, this massive tree clings to survival by clinging to the foggy maritime coast.

In this place, 60 inches of rain is packed into less than five months of the year, yet Locatelli says, "You get used to it. Look, it's beautiful. It could rain 20 inches a minute here, and I'd still love it." She is an open, energetic woman, not easily daunted. She recalls recent days of working with her husband on the ranch. She was born in Italy and came to America at the age of 4. "I'm an import."

Locatelli walks back from the rain gauge over toward the winery the family ran. She knows every fold in the land and what it bears best. The walnut and chestnut trees went in in 1928, she recalls. What was planted in that grassy knoll in the distance? "White grapes." Near the house rises a gnarled old oak, and under it the family used to picnic.

With her husband gone, the place is more memory than moment. But the moment this day is fine. The wind blows hard; clouds sail across a high, open sky. "There must be a big storm at sea out there," says Locatelli. There is, but the Pacific High resists. It has built a sturdy ridge of high pressure that will block, for now, any storm from coming on shore. It shows its summer self.

In summer the Pacific High comes into its own. Its high-pressure "ridge" deflects ocean storms to Oregon, ensuring a rainless season in California. Its winds are at their strongest this time of the year.

Those winds, in their westerly flow, push the surface waters of the ocean toward the coast. Shaped by the Coriolis Effect, which, due to the Earth's rotation, causes winds in the Northern Hemisphere to curve in a clockwise direction, the ocean waters glance off the California coast and veer back offshore. To replace these surface currents moving back out to sea and maintain sea level, subsurface water gushes up along the coast in a process called upwelling.

This churning of the ocean exchanges surface water for colder, bone-chilling water hundreds of feet down. Upwelling lifts a feast of nutrients to the surface and up through the food chain. It is ultimately converted into food for fish. Anchovies, hake, rockfish and tuna rely on upwelling.

So do sardines. Once sardines flowed in a silvery stream through the sheds of Cannery Row. In the late '40s the catch declined, then crashed. Fished out, many biologists thought. Those who scanned the skies and watched the seas knew better. Weather, some believe, was a co-conspirator. The Pacific High lost its power in the late '40s, when the sea's surface temperature rose, reducing the thermal gradient between water and air. Winds languished; currents atrophied; upwelling slowed. Sardines died or migrated in search of survival. Anchovies, meanwhile, have taken their place.

Where did the anchovies come from? Peru perhaps. The Southern Hemisphere is a mirror image of the Northern, and upwelling occurs off Peru, as it does off California. A decade ago, the anchovies in Peruvian waters all but vanished. Their

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departure killed more than just canning jobs. Seabirds who fed on anchovies deposited guano on offshore islands, giving rise to a healthy commerce in phosphates. No fish meant no gulls; no gulls meant no guano. The phosphate industry collapsed.

The Pacific currents that bring nutrients to fish and cash to canners also bring tourists to San Francisco. The currents help conjure up the fog that festoons the Golden Gate Bridge. The cold, upwelled waters along the coast cool the sea air, diminishing its capacity to carry moisture. (Warm air can hold more moisture than cold.) The moisture condenses out as liquid droplets which cling to salt particles of ocean spray—making fog.

In concert with the gathering strength of the Pacific High winds, springtime wisps of coastal fog build in summer to form an offshore apparition—the Great Fog Bank. As wide as 100 miles, as high as half a mile, the Great Fog Bank hugs the coast and drifts south like a zeppelin in search of an onshore opening. The Golden Gate, a gaping break in the coastal range obliges—as do less prominent gaps down the coast: The San Mateo Gap, the Crystal Springs Gap, the San Bruno Gap. Cooling fog pours through the Gate, reaching its heaviest in summer, when the fog-generating westerly winds of the Pacific High are at their peak.

AS WIDE AS 100 MILES, THE GREAT FOG BANK DRIFTS SOUTH LIKE A ZEPPELIN IN SEARCH OF AN ONSHORE OPENING.

As summer turns to fall, the Pacific High weakens. The difference between its cool marine air and the now cooling Central Valley lessens. The result is greater thermal and pressure equilibrium. The offshore winds die down. Upwelling slows. This fog-making system breaks down. The sun breaks through in San Francisco, making autumn warmer than summer.

The subtleties of fog and fish are repeated when it comes to the growing of fruit in the Santa Clara Valley. "Here's a good orchard of bings," says Ray Lester, steering his pickup through a grove of trees. "Ah, those cherries are so touchy," he continues, excitement rising in his voice. "They have a big problem getting pollinated. Prunes are almost self-pollinating. You can count on the wind. With cherries, you need bees. They go together. If you don't have bees, then you don't have cherries."

A cherry orchard is taken for granted in the Santa Clara Valley, but put it in the context of climate and it offers food for thought. Surrounding, abutting, this orchard are magnificent groves of prunes. Beauty and the beast. The prune is proletarian, tough. Happy to root in wet, poorly drained soil, prune trees grow most anywhere. The cherry is delicate. Heat can scorch it; fungi prey on it; poor drainage can drown it. "It doesn't like to get its feet wet," says Lester. Yet here they stand side by side. They reflect the diverse soils that underlie this valley.

Soil is a geological image of the Bay Area climate. The geology of coastal California—the bedrock that shapes the region's many microclimates—is among the most active in the world. As a rough geologic rule of thumb, activity translates into complexity. Santa Clara County has plenty of complexity—at least 25 types of bedrock underlie it. By contrast, the state of Iowa has two. That complexity surfaces in the mix of soil types above, a fact that allows the prune, in places, to grow side by side with the cherry.

Ray Lester and his brother, Lee, reflect a place whose patterns of commerce are as active as its geology. They lease 100 acres from IBM in the midst of the corporation's South San Jose complex. Their world is circumscribed by chain-link fences, construction trailers, freshly poured acres of concrete. They grow prunes, cherries, apricots and walnuts, resisting for the moment the forces that ultimately will obscure the fruitful diversity of this land.

The day is classically winter for this part of the world—mild, brooding. Under an oyster sky clouds boil over the Santa Cruz Mountains. To the east, patches of sunlight break the sky and splash across the Diablo Range. Here in the middle, a warm wind blows, and blooming mustard carpets the valley floor. Once this place was called the Valley of Heart's Delight. That was before IBM, and refrigeration.

Before cold storage, fruit was eaten within a fortnight of picking or dried. Dried fruit grown here was shipped to the Gold Country to sustain miners; to the port of San Francisco so that ocean-going sailors might ward off scurvy. Santa Clara Valley fruit was harvested from mid-spring to late autumn. It spanned the seasons.

Such cornucopia was made possible not only by the array of valley soils, but also by the region's predominant physical feature, the San Francisco Bay. The Bay, year round, is a tempering force. In summer, its cool surface acts as a "heat sink." It draws heat from the air and radiates cool from its shores. In winter, the Bay, now warmer than the land, does the reverse.

Fruit trees, like bears, hibernate. Winter dormancy stills the sap and reinvigorates them for spring. The amount of time they need to be dormant is the "chilling requirement." Apple trees have a high chilling requirement. They need between 1,200 and 1,300 hours—about 50 days—below 40 degrees in winter. Cherry trees need 800 hours, walnuts 700.

The closer a fruit tree is planted to the Bay, the warmer it will stay in winter. Thus, cherry orchards, with a lower chilling requirement, do well near the Bay. Apples need some distance from the water. They do better down the valley or up in the foothills, under the colder spell of the land in winter.

The Bay Area's towns, in a sense, mimic its orchards. Those that lie close to the Bay have narrower temperature ranges than those further out. Like the fruit of those trees they offer plenty of choice to those who live here. They offer a climate as constant as the Bay; or weather as wild in its swings as a storm in the Santa Cruz Mountains. □