From the Auburn suture of the Smartville Block, where you glimpse for the first time (westbound) the Great Central Valley of California, the immense flatland runs so far off the curve of the earth that its western horizon makes a simple line to the extremes of peripheral vision. In California's exceptional topography—with its crowd-gathering glacial excavations, its High Sierran hanging wall, its itinerant Salinian coast—nothing seems more singular to me than the Great Central Valley. It is far more planar than the plainest of the plains. With respect to its surroundings, it arrived first. At its edges are mountains that were set up around it like portable screens.

While looking out on the Great Central Valley one time, Moores described a winter day when he took off from Newfoundland in a snowstorm and flew to Toronto, landed there in strafing sleet, and flew on to Chicago (horizontal sleet), and then on across the

high blizzarded plains and the Rockies (whited out) and the snowed-under Basin and Range to descend over the snowpacked Sierra, and bank toward a landing in a world that was apple green. The Great Central Valley was cool and moist and not cold and frozen, and for him, now, it was home.

It's not always cool, or—heaven knows—moist. Trunks of fruit and nut trees are painted white to keep them from being sunburned. Summer days commonly rise above a hundred, but the air will fall toward the fifties at night.

The ground surface is so nearly level that you have no sense of contour. A former lake bed can be much the same, where sediments laid in still water have become a valley floor. Such valleys tend to be intimate, however, while this one is fifty miles wide and four hundred miles long. It is not a former lake, although in large part it is a former swamp. Geology characteristically repeats itself around the world and down through time, but—with the possible exceptions of the Chilean Longitudinal Valley and the Dalbandin Trough in Pakistan—the Great Central Valley of California has no counterpart on this planet.

Engineers designing roads in the valley are frustrated by the lack of topographical relief. They have nothing to cut when they're in need of fill. If a new highway must cross over something, like a railroad track, the road builders go back half a mile or so and sink the highway into the earth in order to dig out enough dirt to build ramps to a bridge jumping the railroad. From the middle of this earthen sea, the flanking mountains are so low and distant that the slightest haze will give you the feeling that you are out of sight of land.

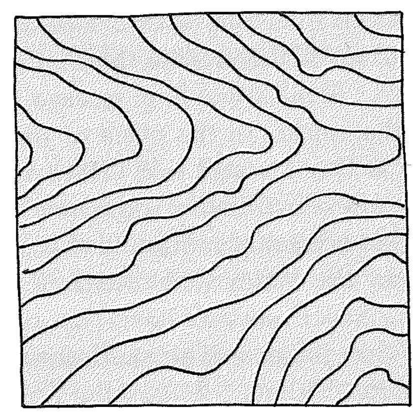
Over open ocean, the number of miles you can see before your line of sight goes off the curve of the earth is roughly equal to the square root of your eye level in feet. If your eyes are forty-nine feet up, you can see seven miles to sky. The formula is of very little use on land but is practical in this valley. When Darwin, off the Beagle, was travelling in Argentina, he sensed the subtle contours of the pampas:

> For many leagues north and south of San Nicolas and Rozario, the country is really level. Scarcely anything which travellers have written about its extreme flatness, can be considered as exaggeration. Yet I could never find a spot where, by slowly turning round, objects were not seen at greater distances in some directions than in others; and this manifestly proves inequality in the plain.

He could have done the same in the Great Central Valley. Much of it is near sea level, but it does rise. North from Interstate 80, the valley rises steadily, with a grade so imperceptible it is measured by laser. Moores compares this rise to the inclined sides of a mid-ocean ridge. With respect to the abyssal plains, the ridges rise about six thousand feet, but over so great a distance that, in his words, "if you were put down on a mid-ocean ridge flank and told to walk toward the ridge crest you would not know which way to go." The grade of a fast-spreading ocean ridge, like

the East Pacific Rise, is about the same as the grade of the Great Central Valley between Sacramento and Redding.

You watch magpies over the valley, larcenous even in flight. You watch crop dusters—buzzing up and down, up and down, like trapped houseflies. Rice is sown from the air. Where DDT was once laid down in an aerosol, fish—as living insecticides—are now dropped from airplanes. They live in the checks, as paddies are called, and eat larvae. In this essential flatness, where there is no visible relief, instruments can find a minuscule astonishing topography; as if on a smooth board very slightly weathered, the unevenness of the land is discovered. Your eye can't discern it, but if you were a rice rancher you would be dealing with it every day. Rice seedlings need to stand in enough water to cover them but not enough to kill them, and this delicate margin has caused rice fields —from the air—to reveal the structure of the valley.



When the rice was first planted, vehicles bearing surveyors' rods drove in circles around fixed transits to discover the valley's contour lines, and along them berms were nudged up a few inches to contain the shallow water. Sinuously paralleling the contours, the berms made the rice fields look, from the air, like supermagnified topographic maps. They showed tectonism expressible in centimetres. They showed the noses of anticlines, the troughs of synclines, microfolds, depressions—all too minimal to be detected by the human eye. Even very shallow water would run off these surfaces in every direction. So the rice plantations were terraced—each check, in altitude, scantly different from the next. Just as volcanologists use lasers to sense expansion in eruptive ground, rice ranchers have in recent years surveyed their rice fields with rotating beams. Contours are adjusted by the laser-controlled blades of earthmoving triplane levellers. The newer berms tend to be straight and less indicative of the geologic structures beneath them. There are five hundred thousand acres of rice in California. The climate is much the same as the climate in Egypt, which has the highest-yielding acreage of any rice country in the world. In the office of Jim Hill, who teaches rice at Davis, a sign says "Have a Rice Day."

The Great Central Valley is drained by two principal rivers, one flowing south and the other north. They meet in the valley and discharge themselves together into San Francisco Bay. The north-flowing river is the San Joaquin. The south-flowing river is the Sacramento, with its tributary the Feather River,

which is dammed to reserve the snowmelt of the Sierra Nevada, not only to flood the rice fields and irrigate the other crops of the valley but also to travel six hundred miles in a life-support tube that is taped to the nose of Los Angeles. Rivers with common deltas are rare in the world. It would be difficult to name more pairs of them than the Kennebec and the Androscoggin, the Ganges and the Brahmaputra, the Tigris and the Euphrates, the Sacramento and the San Joaquin.

The floodplains of the Sacramento and the San Joaquin are dozens of miles wide. Before they were drained, and checkered like kitchen floors in shades of patterned green, they were known as the tulares or the tules or the tule swamps, in honor of the tough bulrushes that (pretty much alone) were able to survive the scouring inundations of spring. Sacramento stands only a little higher than the tules. To the conventional wisdom that one ought never to build on a floodplain, California has responded with its capital city. Old houses of Sacramento are in a sense upside down. Long exterior stairways lead to porches and entrance halls on upper floors. Whole neighborhoods are on stilts.

Emerging from the Sierra foothills among the blue oaks of the grass woodland, Interstate 80 rests on gravelly loams until it reaches the silty clays and humic gleys of Sacramento. Now I-80 has become a long elevated causeway that reaches across rice and sugar beets, marsh grass and milo, as if it were in search of Key West instead of San Francisco. In years of exceptional floods, fifty million acre-feet of water have come under the causeway. Some row crops and tree crops are on the deeper lighter soils near the river—the natural levees, where floodwaters give up the larger part of the material they carry. Eventually, imperceptibly, the ground beyond the floodplain goes up a few inches onto the outer lenses of an alluvial fan, a fine loam that has spilled eastward from the Coast Ranges like thin paint. The difference it makes is widely expressed in field crops, truck crops, orchards. In soil taxonomy, there are ten groups in the world. Nine are in this valley. Each is suited to a differing roster of crops. Plums, kiwis, apricots, oranges, olives, nectarines—it is the North American fruit forest. In some parts of the valley, roots are inhibited by a zone of hardpan. The soil's B-horizon, firmly cemented with silica, is like a concrete floor. Farmers used to bore holes in it and grow trees in the holes. Now they use diesel-powered earth-rippers. Especially, this is the valley of beets and peaches, grapes and walnuts, almonds and cantaloupes, prunes and tomatoes. That is to say, the Great Central Valley of California grows more of each of those things than are grown in any other state of the union.

In 1905, the College of Agriculture of the University of California, in Berkeley, set up an experimental farm in Davis, Yolo County, in the valley's center. In 1925, the farm itself became an agricultural college. In 1959, it became a general campus in the state's university system. The livestock-judging pavilion is now a Shakespearean theatre. Under skyscrap-

ing water towers, the ground-hugging university is of such breadth and grandeur that it has its own beltway. It may have more bicycles than Shanghai. But Davis is still the main agricultural research center in California, and just outside the glassy postmodern geology building are sties containing massive monolithic pigs.

From the geology-building roof, Moores has looked across the immense flat ground and picked out features of Yosemite, a hundred miles to the southeast. Fifty miles southwest, he sees the detached oddness of Mt. Diablo, protruding beside the Coast Ranges. Looking the other way, he has seen Lassen—a white cone on the northern horizon, a hundred and forty miles distant—and, on nearer ground, the Sutter Buttes, a recent volcanic extrusion that has left a ring of jagged hills standing in the valley like a coronet set on a table. These landmarks embrace more than six million acres, or—in one look around—a landscape larger than Massachusetts. It is less than half of the valley.

When Moores arrived, in the nineteen-sixties, ten thousand people lived in Davis. Although the number has increased fivefold, Davis is still a quiet town, still a field station. From its shaded streets, crops and orchards reach out in all directions. To an open-air market in Davis on Saturdays farmers bring their lime thyme, their elephant-heart plums, their lemon cucumbers, bitter melons, and peaches the size of grapefruit. They bring tomatoes that are larger than the peaches, and tomatoes of every possible size down to tomatoes the size of pearls. Yolo County grows about as many tomatoes as Florida does. Yolo County grows ketchup in the form of "processing" tomatoes that could sit on a tee and be driven two hundred yards.

The Mooreses' turn-of-the-century farmhouse is "in the county," down a long thoroughfare of black walnuts at the edge of town. Their street is named Patwin, for the tribe that preceded the farms and the walnuts. The house faces north, across tomato fields. From the east windows you can sometimes see the low line of the Sierra, and from the west windows the Coast Ranges, but there is no sense of valley. The word seems misapplied. As the edges of a flat so vast, those montane curbs fail to suggest the V that a valley brings to mind.

When Moores looks out upon landscapes, he sees beneath them other landscapes. Like most geologists, he carries in his head a portfolio of ancient scenes, worlds overprinting previous worlds. He sees tundra in Ohio, dense forestation on New Mexican mesas, the Persian Gulf in the Painted Desert. Once, after a day in the Sierra, while he was sitting outside at home beneath what appeared to be a chandelier of apricots, I asked him to describe this one particle of the planet, his own back yard, at differing times. He responded in the present tense, as geologists often do, while his narrative went backward, scene by scene—episodically, stratigraphically—disassembling and dissolving California.

In the late-middle Pleistocene, when pulses of

alpine ice are appearing on the Sierra, this place would be much the same, on the natural levee of a creek, surrounded not by fruit trees but by swamps. Valley oaks are on the dry ground, inches above the swamps. The mountains—east and west—are even lower. Mt. Diablo is not there. It has "scarcely begun to grow."

Three million years before the present—in the Piacenzian Age of late Pliocene time—neither the Coast Ranges nor the Sierra is above the horizon. From the hinge under the Great Central Valley, the Sierra fault block begins to rise. The tectonic behavior of the Coast Ranges is different. Sluggishly, they come up from the deep. They have no integral structure. They are a fragmentary mass, a marine clutter. They will be known in geology as the Franciscan mélange. Appearing first as islands, the Franciscan pushes against the level sediments of the coastal plain and bends them upward until they are nearly vertical. Up through the mélange come volcanoes that spew lava and tuffaceous ash in and around the Napa Valley. There are active volcanoes on the crest of the Sierra. And between the nascent ranges the Sutter Buttes erupt.

I have a question. Why all this Fourth of July geology as recently as three million years ago, when all we have in these latitudes now are run-of-the-mill earthquakes?

Because in the Pliocene a triple junction of lithospheric plates is just off San Francisco, Moores replies. A subduction zone is dying out as its trench turns into the San Andreas Fault. The volcanism relates to that.

For tens of millions of years, a lithospheric plate of considerable size lay between North America and the Pacific Plate. It is known in geology as the Farallon Plate. By the late Pliocene, this great segment of crust and mantle, possibly at one time a tenth of the shell of the earth, had in large part been consumed. Fragments of it remain: in the north, the Gorda Plate and the Juan de Fuca Plate, whose subduction under North America has produced Lassen Peak, Mt. Shasta, Mt. Rainier, Mt. St. Helens, Glacier Peak, and the rest of the volcanoes of the Cascades; in the south, the Cocos Plate and the Nazca Plate, whose subduction has created Central America and elevated the Andes. For tens of millions of years, the Farallon Plate went under the western margin of North America, while North America gradually scraped off the Franciscan mélange of coast-range California. To the west, under the ocean, was the spreading center that divided the Farallon Plate from the Pacific Plate. As the Farallon Plate, moving eastward, was consumed, the spreading center came ever closer to California. At Los Angeles and Santa Barbara, the Pacific Plate first touched North America, twenty-nine million years before the present. Where it touched, the trench ceased to function, the spreading center ceased to function, and the plate boundary became a transform fault. It was only a few miles long at first, but steadily the great fault propagated from Los Angeles and Santa Barbara to the north and to the south, shutting the trench like a closing zipper. The triple junction of the Farallon Plate, the Pacific Plate, and the North American Plate

migrated northward with the northern end of the fault. And so, in the Pliocene, three million years ago, the triple junction was off San Francisco. The volcanoes in the Sierra were the dying embers of Farallon subduction. The volcanoes in the Napa Valley and adjacent coastal ranges were a result of the new fault pulling the earth apart at kinks and bends. The eruption of the Sutter Buttes almost surely relates to the dying subduction or the new plate motions but is, as they say, not well understood. Now, in the Holocene, the triple junction is still moving north. For the moment, it is at Cape Mendocino, where the San Andreas ends and what is left of the Farallon Trench continues. That is how things appear, anyway, in present theory.

Six million years before the present, in the late Miocene, Moores and his apricot tree would be in or beside a saltwater bay that covers most of the Great Central Valley. It is full of tuna and other large fish, because an upwelling of cold water (like the upwelling in the Humboldt Current off modern Peru) has filled the bay with nutrients. There is no Golden Gate. The bay's outlet is at Monterey. A terrane is moving along the west side of the San Andreas Fault. Carrying with it the sites of San Diego, Los Angeles, Santa Barbara, San Luis Obispo, Big Sur, Monterey, and Salinas, it will someday be known as Salinia.

In the Eocene, fifty million years ago, Moores' back yard in Davis is mud at the bottom of the Farallon ocean, some thirty miles offshore, on the continental shelf. As Eocene rivers pour into these waters—having advanced their gravels from Tibet-like altitudes and across the low country that will one day rise as the Sierra—they cut submarine canyons through the future Great Valley. The rock that preserves this story is a marine shale, loaded with shelf creatures of Eocene age. Below Davis, in the Great Valley Sequence of sediments, it lies about twenty-five hundred feet down.

In the Cretaceous, some eighty or ninety million years ago, Moores' address is a precariously inclined deep-sea fan—a spilling of sediment down the continental slope toward the trench where the Farallon Plate is disappearing. About sixty miles wide, the trench lies in the space that will one day separate San Francisco and Fairfield. As the slab of the Farallon Plate melts beneath North America, it contributes to the magmas of the great batholith and the superjacent volcanoes of the ancestral Sierra Nevada.

At the end of the Jurassic, about twenty million years after the docking of the Smartville Block, another island arc comes in and docks against Smartville, more or less directly under Moores and his tree. Geology will call it the Coast Range Ophiolite, and it will lie under forty thousand feet of Great Valley sediments and be warped into the coastal mountains. One of its large fragments will end up in the Oakland hills.

When Smartville docks, in the Jurassic, its individual islands possibly resemble Hokkaido, Kyushu, and Honshu. The trench closes east of Sacramento and a new one opens west of Davis and begins to consume the Farallon Plate. The downgoing slab of

the Farallon Plate depresses the region and creates the structural basin that will fill up with sediments and become the Great Central Valley. Since there will be no Sierra Nevada and no Coast Ranges for nearly a hundred and fifty million years to follow, the result will be a valley that is not a conventional river valley but a structural basin filled to the brim with sediments that (almost wholly) do not derive from the mountains around it.

Before Smartville, blue ocean—extracontinental, abyssal ocean. In the earliest Triassic, the site of Davis is far out to sea. The continental shelf is back in Idaho and Nevada. North America in these latitudes has been growing. Two terranes have already come in. But here at the dawn of the Mesozoic the continent has not yet received so much as a hint of California.