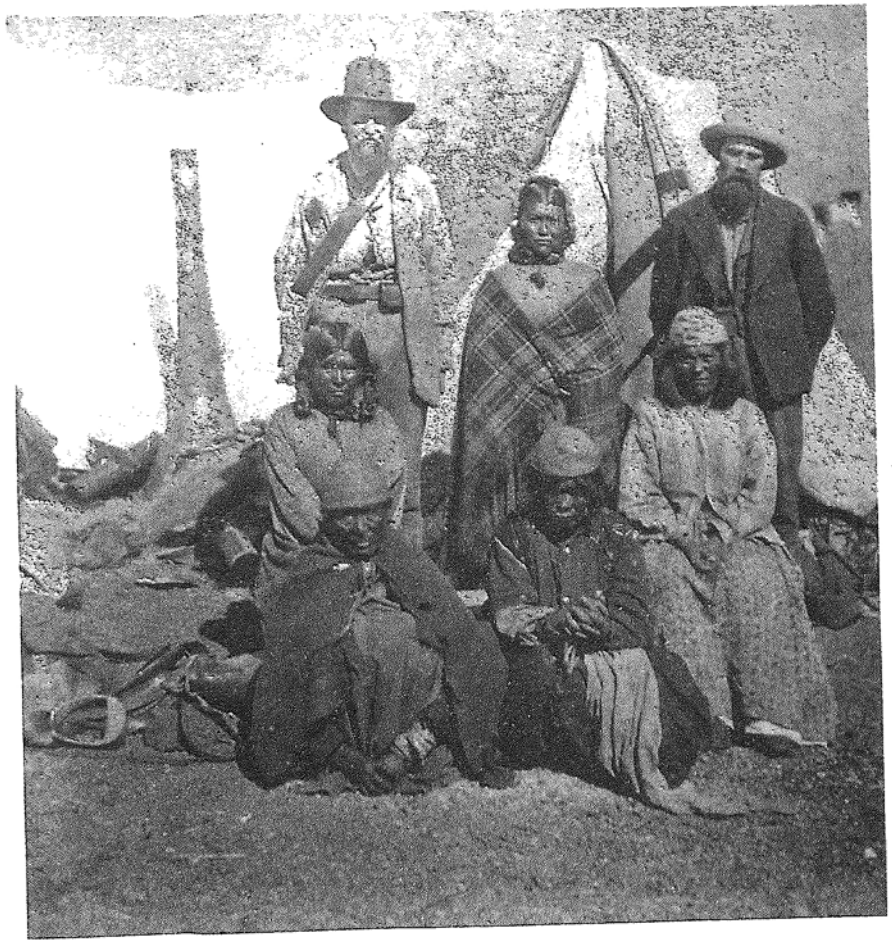
enough from the versions photographed by others to reveal his temperament and taste. He liked complex surfaces. He liked water, rock, and the emptiness of huge spaces. He was resisting the obvious commercial subjects when he chose the landscape effects over the famous landmarks, and he was resisting that common Victorian urge to locate a benign God in nature when he emphasized the region's danger and debris. He ignored the lush meadows and was clearly bored by the giant sequoias that presented neither the opportunities for spatial drama nor the dramatic contrast of light and dark he enjoyed in his views. The last photograph in the series, depicting the William H. Seward tree with a small cabin abutting one side of its colossal trunk, is an obligatory nod to the official Yosemite. The man who made those fifty-one photographs was informed about the debates of his time, from glaciers to Indians to aesthetics. But he stood apart from the mainstream ideology of Americans in the West, seeing the place as something more ambiguous than they did, ravishing but not redemptive. Indeed, throughout the photographs, an aloofness comes through, in the sense of space, the detached figures, the taste for the barren over the lush, the turbulent over the calm. Muybridge's Yosemite is lonely, uneasy, and a little tormented.

That a man could make landscape photographs that good and never do so again says more about Muybridge. Seldom has anyone with so much talent valued it so little. In 1873 he planned to work in the mammoth-plate format on the Columbia River and the transcontinental railroad line, but he never took on another landscape project of such ambition or applied such passionate originality to the subject again. Only his 1878 panorama of San Francisco is comparable in its scale, its originality, and its technical genius within an existing genre. For in 1872, just as he was achieving his greatest work as a landscape photographer, Muybridge began the project that would take him away from landscape altogether. At the time, the motion studies he made for Stanford seemed like a minor detour. Five years would pass before he would find the technical means to achieve more and the desire to make photographing bodies in motion his life's work. In those five years, he accomplished much as a photographer, destroyed much as a man.

LOST RIVER

The End of Time Ghosts and Machines
The Price of Defeat



Overleaf: *Toby (the Squaw Who Warned General Canby of His Impending Fate), and Four Old Modoc Squaws*, from the series *The Modoc War*, 1873 (one frame of stereo).

THE END OF TIME

In the Modoc version, the world was once nothing but water, until the creator, Kamookumpts, reached down to the bottom of Tule Lake for a handful of mud. He sculpted the mud into the world around the lake and around himself. "He had shaped and decorated the world as a woman shapes and decorates a basket," said Evangeline Schonchin, the daughter of a Modoc rebel. At the center of the world he sculpted was his seat, the peninsular bluff on the southeast shore of Tule Lake. Around its base are more than five thousand petroglyphs of human and animal figures, of celestial bodies, circles, lines, and zigzags incised in the pale stone, an alphabet of images hard to read now. This wall of markings went straight into the water when the petroglyphs were carved, and the carvers must have approached by canoe. Perhaps they used the same kind of reed canoes as the Modocs did when they fled from Lost River at the north end of Tule Lake to the Lava Beds across the water, at the beginning of the Modoc War, the war that took the Modocs from the center of the world. It was California's most spectacular Indian war, and Muybridge was its official photographer.

There are things that are hard to photograph: guerrilla warfare, the end of an era, the meaning of a place. And there are things it is nearly impossible to photograph: the subtle workings of the human heart, the wandering paths desire and fury take, the bonds of love and blood that tie people together, the decisions that tear them apart, the way that the most unprepossessing landscape can become home and thus speak of stories, traditions, gods that strangers cannot decipher from the rocks and streams. The Modoc War posed a simpler problem, though the meaning of the terrain was part of it. From the first battle in the Lava Beds until nearly the end of the conflict, the U.S. Army fought an enemy so well hidden in the folds and crevices of the landscape that the Modocs might as well have been invisi-

ble. Like Civil War photographers, Muybridge depicted no battles, no dramas unfolding, only soldiers in camp, civilians, battlefields, and backdrops, valuable information enough. He showed not a war unfolding but a war's raw ingredients: participants and locations. He appears to have been the first photographer the U.S. Army hired directly to document a war, and he produced its principal images, more than fifty stereoscopic images that were turned into *Harper's Weekly* magazine engravings, sold by Bradley and Rulofson, and later illustrated virtually every book on the subject.

It was his first major project since the Yosemite photographs. The news of his Yosemite and first motion-study pictures was announced in early April 1873; by the end of that month he had left San Francisco for the battlefields by train and then by horse in company with Captain Lydecker of the topographical engineers and Jefferson C. Davis, the commanding general of the *Columbia.* He photographed from, so far as the newspapers tell, May 2 to May 14 (and seems to have been in Sacramento beforehand, perhaps to wind up the first round of motion studies). The war was international news. Because of it, Joaquin Miller's *Life Amongst the Modocs* became a best-seller in England, and even the New York papers eagerly covered the story. "The wide spread and accurate knowledge" of the Modoc war's terrain and participants, Muybridge declared in one of his periodic fits of immodesty, "is due chiefly to the innumerable and valuable photographs" he had taken. Another photographer from the nearby town of Yreka, Louis Heller, got there before him and stuck around to make the photographs Muybridge missed, of the Modoc captives after the war was over.

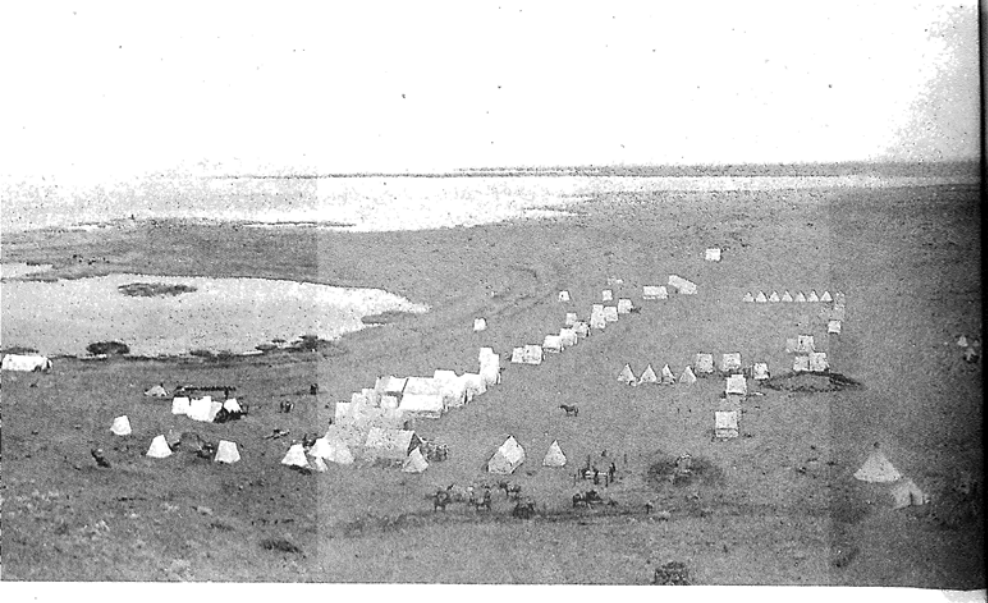
Though the Lava Beds lacked Yosemite's vertical splendors, Muybridge seems to have found the landscape there to his taste. Muybridge was always a lover of tangles, thickets, and rubble-heaps, of complexity and texture. He photographed three versions of Schonchin Rock, a dark, dramatic outcropping, and made a five-stereoscope-card panorama of the Tule Lake shoreline with the army's tents like little white cones in the distance. He made another panorama of the Lava Beds themselves, twelve images that may constitute one of the most ambitious panoramas in stereo. In the fifty-six-page catalog of his work Bradley and Rulofson produced that year, the war is described not as a history but as a landscape: "The extraordinary system of natural fortifications known as the Lava Beds, are situated in the northern part of the state, on the borders of Oregon. A few miles to the south of Tule Lake are several extinct volcanoes, and from these the lava

Captain Jack's Cave in the Lava Beds, from the series *The Modoc War,* 1873 (one frame of stereo).

probably flowed, which, in cooling, formed upon its surface numerous fissures, caves and rugged valleys and channels, surrounded by natural walls. There are many channels connecting the rivers and lakes of the surrounding country." It was a landscape war. That is, it was a war over land, and it was a war in which the Modocs' profound knowledge of the lay of the land gave them one great advantage. They spent most of the war within sight of Petroglyph Point, in the labyrinthine Lava Beds on the south shore of Tule Lake, a shallow reed-fringed body of water beloved of waterfowl.

During the war, much of this band of ancient petroglyphs was probably underwater, but the bank swallows who live higher up this west-facing cliff must have carried on as though nothing had changed. Even now they fly in

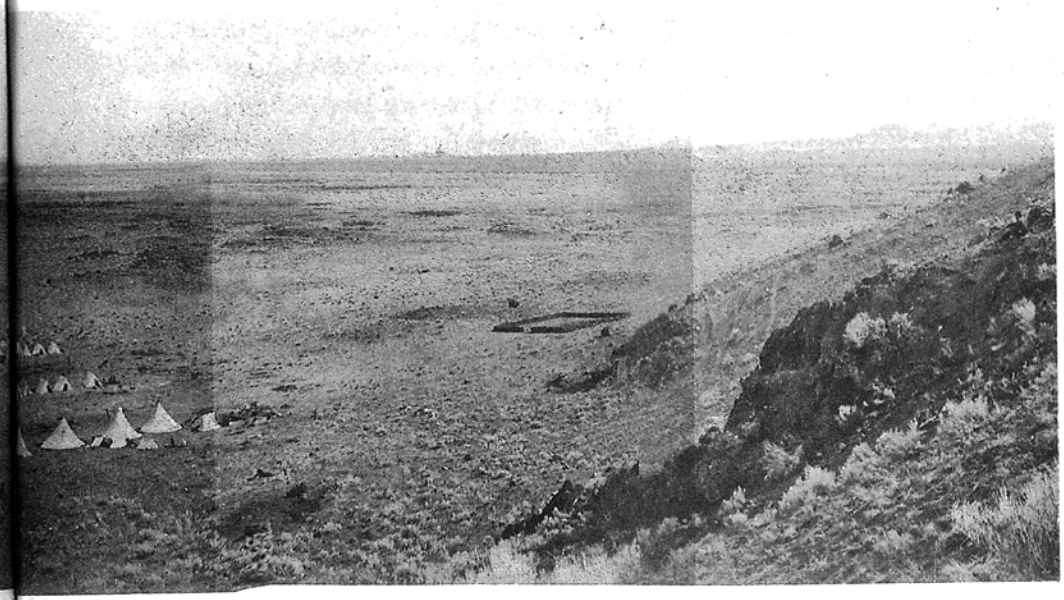
and out of their nests, swooping and climbing through the clear air of this arid place as their shadows slide smoothly up and down the rough wall. The flight of the swallows and the steady sound of the wind make it possible to believe that nothing more than this ever happened in this region now known principally for the hundreds of bald eagles that winter in it. But the sound of artillery shells must have echoed from the cliff in 1873, and history didn't start then. Before the whites came, the Modocs warred with their neighbors, and they were fierce fighters. Like the Plains Indians, they were impacted by the guns and horses of white culture before whites were a significant presence in the area, and some sources say that in the quest to find something to trade for horses they began to capture neighboring tribespeople to sell into slavery. But in the Tule Lake region they had bounty enough to stay home for. The area is rich in fish, in game, particularly waterfowl, and in the camas bulbs, water-lily seeds, and other plants that furnished the staples of their diet. From almost anywhere in their pine-studded uplands and sagebrush valleys the snow-covered volcanic cone of Mount Shasta is visible, a fourteen-thousand-foot-high landmark that makes it hard to get lost here (the Lost River is thus named because the river itself disappears and reappears on its route from Clear Lake to Tule Lake). With their guns and horses, the Modoc had already



Panorama of Lava Beds from Signal Station at Tule Lake, Camp South, from the series *The Modoc War,* 1873 (one frame each of five stereos).

embraced the accelerations brought from Europe; what they were not ready for was the concomitant detachment from ritual time and intimate space that came as part of the package. The part they accepted made it easier for them to resist the rest—that is, they could fight with the guns and horses.

The Modoc War had an end on June 1, 1873, but its beginning is hard to trace. Was it inevitable from when the first fur trappers came through the area in the 1820s, or only after the gold rush, when whites began to settle the area in earnest? Massacres, revenges, white encroachments, Modoc resistance, mutual fears, and suspicions piled up like the bones beneath the hawk nests at Petroglyph Point. Something immensely valuable was at stake, but those defending it were not innocents, nor were the lines clearly drawn. The whites were intruders, but some became friends and allies of the Modocs and stayed that way even in the thick of the war. There were atrocities on both sides, and some on each side seemed to believe that harm done by any member of that race could be avenged on virtually any other member of that race. There were also marriages, acculturations, friendships; and many of the Modoc men and some of the women were given nicknames by their white neighbors. The government's translators during the Modoc War and trial were Toby Riddle and her white husband



Frank Riddle. More than thirty of Muybridge's fifty or so pictures of the Modoc war were of the landscape, but he photographed the strong-minded Toby Riddle twice, once with her bushy-bearded husband, once with, according to the caption, four "Old Modoc Squaws." The caption doesn't mention that Frank Riddle and Indian agent Oliver Applegate stand behind the five women. It's a strangely symmetrical image, the figures fixed and impassive like those on playing cards, a royal flush of Modoc women and two of a kind of frontiersmen. Three of the women are wearing the patterned basket hats of traditional Modoc women, though their dresses are calico, and Toby Riddle's and the fourth woman's neatly parted hair shines as smooth as water.

In 1864 the Modocs had been pushed, without a treaty, onto a reservation north of their homeland. The reservation was on Klamath land, and both Klamaths and Paiutes were settled there with the Modoc. As one Indian agent put it, it was expected that "the efforts of efficient and conscientous instructors will advance them rapidly in the customs, arts, and laws of civilization." But they had been set up to lose. Year after year, late frost killed the crops they were instructed to count on for sustenence; the timber mill that was supposed to provide income and building materials never worked right; the conscientous instructors were often little more than profiteers, and the Klamaths, traditional enemies of the Modocs, harassed the latter as squatters and unwelcome guests. A young Modoc leader named Kientpoos but whom history remembers as Captain Jack led some of the Modocs back to the Lost River. They left for practical purposes—to remain was to be hungry and humiliated. But again and again, through years of negotiations, they repeated that they wanted to live on their own land and no place else. Captain Jack and his people remained in their homeland for three years. At the end of 1869, Indian agent Alfred Meacham came to negotiate their return to the reservation, and the forty-three members of Jack's band reluctantly went back.

The Klamath resumed harassing the Modocs on the reservation, and in April 1870 Jack led 371 Modocs back to their land. About 130 more followed suit with Old Schonchin, another Modoc leader, and the Modocs began to move freely between the reservation and the Tule Lake region. Captain Jack obligingly offered to settle his people on a reservation on their own territory from this period through the climax of the war, but nothing came of it. Late in 1871 an Indian agent reported, "I was met by 'Capt. Jack' and 'Black Jim' with twenty of their young men, nearly every man armed with gun and revolver. I lost no time in opening the council: carefully explaining to 'Capt. Jack,' all your instructions; after I had concluded, I asked him to speak in answer to the several propositions, which he proceeded to do as follows.

"'I want to live in my own country, I will live on the East side of Lost River. People in Yreka tell me this is my country, though you want to talk with the President; I and all my people only want to be let alone. My father died here, I will die here, we do not want to kill whites; Soldiers kill for pay; they are not men with hearts; We do not want to live on any Reservation, we want no lines drawn around we [*sic,* meaning us?]; we do not want to see your diagram, giveing [*sic*] us a small place, that place is covered with cattle—we want our Country from Pit River to Lower Klamath Lake—whitemen may have timber, grass, and cold water, but the Fish, Ducks, Roots, and warm Springs we want, we will keep these. This is my talk, I am a good man, and never tell a lie.'

"He then said, 'I am glad you talk about opening farms in our country. . . .'

"I ask him if his people will all stay upon a Reservation, if established in his country. At this he becomes excited, all his men talk at once; after a little while he answers, that he wants the freedom of all his country;

"'We want to live in this Country, to travel and camp anywhere in it, to live among our white neighbors.' The council lasted about three hours, every proposition was answered throughout with about the same speech:

"'We want to live here in our own country.'"

Two different worldviews were in collision, as well as two sets of practical wants. The religion of most Native American communities was tied to specific places; to lose those places was to lose the connection to that power, that spirit, that religion. Stories were inscribed in the landscape; place had a symbolic meaning; seasonal activities were tied to specific locales. The Modoc world had a center. The Indian agents and soldiers with their diagrams, their boundaries, their time determined by the clock were living in a world of abstractions in which one parcel of land was interchangeable with another and religion was as portable as a Bible. (Administrating the Modoc War was made harder by the fact that the forty-second parallel, which is also the state border, runs through Tule Lake, so that the Lost River is in Oregon but the Lava Beds are in California.) After all, the

whites had all given up wherever they called home to come to the terra incognita of northeasternmost California and imposed upon it their agriculture with its foreign plants and animals. In photographing Yosemite, Muybridge had celebrated a landscape that was a superlative image and an ideal from Vienna to San Francisco, but to which almost no one in his society had a real relationship. In this light, Yosemite seems like the pinup a lonely soldier tacks up; it's not a place to which its audience has a deep connection but an ideal of place and nature for those who yearn for them. The Tule Lake region's value to the Modocs lay in entirely different qualities, in its familiarity, in its sustenance, in the accumulation of stories around its sites, in things that didn't show up in photographs.

What Europeans and European Americans had lost gradually as the Industrial Revolution loosened their ties to earthly place and celestial time, Native Americans would lose suddenly, as war took them away from familiar places and ancient practices, forcing them into dependence on the government, the cash economy, and domesticated plants and animals. The Europeans had mostly noticed what they were gaining; the colonized who had less to gain kept their eyes on what was being lost. In his speech, Captain Jack recognized the difference between what the two groups wanted from the landscape and proposed that, like two different species, they could coexist, the whites as ranchers and loggers, the Modocs as wide-ranging hunters and gatherers. He was trying to be reasonable. He tried to be reasonable till the end, and he was a peacemaker by inclination, but reasonableness doesn't do much for a person without rights. All he had left to rely on was his own land laden with stories, with meaning, with nourishment, with knowledge. As the situation between the settlers and the off-reservation Modocs deteriorated, topography was his last advantage.

Even when the U.S. Army rode all night through a freezing rain to arrest him at dawn at his Lost River winter camp on November 29, 1872, Captain Jack was moderate: the Modocs there declined to give up their weapons but didn't fire first. The soldiers did, and killed one man. The Modocs in Jack's camp fired back, killing a soldier and wounding several others before the U.S. Army could scramble out of the encampment of about a dozen huts. Across the river, a group of vigilantes who had ridden into Hooker Jim's camp started firing after a scuffle. They succeeded in killing a babe in arms with a shotgun blast. The members of Jack's camp ran for their canoes and paddled frantically for Tule Lake. The Modocs with Hooker Jim

scattered after killing another man, a civilian. Both villages were torched, and an old woman unable to flee burned to death in a blazing hut on that morning of hard rain and bitter cold. A local rancher, Henry Miller, had promised to warn Hooker Jim of any military approaches, but the incompetent military men had failed to warn the settlers in the vicinity that a war might break out. Thinking Miller had betrayed him, Hooker Jim vengefully killed him and eleven other men in the neighborhood but left the women and children alone. Always an advocate of violence, Hooker Jim had closed off any option but continued war. Another off-reservation band of Modocs at Hot Creek a dozen miles or so west of the battle, under the leadership of Shacknasty Jim, went to ask a friendly neighbor, the rancher John Fairchild, for advice. They knew that to join Captain Jack's band in the Lava Beds was, in the words of one historian, "to sign their death warrants." But when they tried to go back to the reservation with the helpful Fairchild, they ran into a lynching party and fled for the Stronghold in the Lava Beds, where Captain Jack's and Hooker Jim's bands had gathered.

The Lava Bed Stronghold is as close as nature ever came to making a full-fledged labyrinth. Even the ground is scattered with gray lava pebbles whose fretwork of curving holes seems to echo on a small scale the lacy intricacy of this harsh terrain. From a distance the terrain all across the Lava Beds looks relatively level, but in the Stronghold as elsewhere, pits, gullies, and the occasional twenty-foot chasm open up in the ground. Some of them are actually shallow caves slanting down at an angle into ground that was once hot volcanic magma, and the Modocs used these as shelters. Afterward, Muybridge made four pictures of Captain Jack's Cave, as it is still called, as a dark eye or mouth opening into the dusty landscape. Others of the caves contained water and ice. Higher than the surrounding landscape, the Stronghold gave the hundred and fifty or so Modocs in it superb views of their homeland, of Shasta's pure peak and of Tule Lake coming right to the northern edge of the Lava Beds. Made up of several rings of lava walls, mostly breast-height or higher with gaps that made excellent gun positions, battlements without a castle, the Stronghold was ideal ground to defend, terrible ground to invade.

The army waited until the bitter-cold dawn of January 17 to stage an attack, six weeks after the Modocs had holed up there. Thick fog was everywhere, and wiser commanders might have waited for clearer weather. Almost 350 regular soldiers and local militiamen plugged away until night,

but almost no Modocs were seen at all on that foggy day, even by the men who were wounded by them, and though only fifty-four Modoc men were fighting (with women loading guns and otherwise assisting) the soldiers, terrified by their unseen enemy, imagined that many times more held the miles of front line. Nine white men died, a dozen were wounded, and the Modocs easily persuaded the Klamaths who had been recruited to fight to leave guns and ammunitions behind in the Lava Beds. It was from beginning to end an intimate war, fought at quarters so close the Modocs could shout insults at individual whites and blandishments at the Klamath. Not a single Modoc was injured. Curly Headed Doctor, the Modoc shaman in the Stronghold, claimed credit. He had surrounded the Stronghold with a tule-reed rope painted red and promised that no Modoc within the rope's circle would be wounded or killed. The protective rope itself was apparently borrowed from the Ghost Dance religion the Modocs had taken up from their Paiute neighbors.

Despair and desperation had set in among the Indians of the Far West in those years. The 1870 Ghost Dance came out of that feeling, and it spread across western Nevada, southern Oregon, and northern California. It began at the Walker River Paiute Indian reservation in west-central Nevada (as did another version of the Ghost Dance a generation later, when it spread across much of the interior West). In 1869 or 1870 a Paiute prophet named Wodzibob, nephew of the great native-rights activist Sarah Winnemucca, began to preach that the Native dead were coming back and the whites were going to disappear. To bring these things about, believers were to paint their faces, to dance in a circle singing certain songs all night, usually for five nights, and to bathe after dancing. A similar doctrine was preached by a Wanapum Indian named Smoholla or Shouting Mountain, who came from where the Columbia and Snake rivers meet. The Ghost Dance seems to be about wish fulfillment more than anything else: desperate wishes born out of hideous circumstances, out of a sense that nothing less than the apocalypse was needed.

But when the Modocs and the U.S. Army faced each other across ridges of lava, there were no other simple lines to be drawn than Curly Headed Doctor's rope. The Modocs with their rifles and their insults shouted in English do not represent some notion of native purity. They were in transition from a theocracy of shamans, and in Captain Jack's band there was no stable order, only uneasy shifting between fealty and argumentative majority rule. Even the Ghost Dance had much to do with Christianity's vision of the Last Judgment and the Resurrection. "Sometimes," writes one anthropologist, "the 'Supreme Ruler' was to bring the spirits of the dead back to earth; sometimes dead relatives would be returning from the south; . . . sometimes the dead would return in armies from the rising sun; and sometimes the dead would return from their graves." The Modocs were fighting a defensive battle, but perhaps it lasted so long because they kept hoping that the Ghost Dance would save them. Like Sitting Bull snatching a moment of stillness out of the middle of war, the Ghost Dancers during their many months in the Stronghold seemed to be trying to seize time itself, to make it stand still or turn back.

They had danced the Ghost Dance on the banks of the Lost River before the war began. One participant, the son of the leader Schonchin John, recalled half a century later that the Paiutes came to the Klamath reservation "and said all were to believe that the dead were coming back. Doctor George [a Modoc shaman] brought the word to Tule Lake at the mouth of Lost River where Captain Jack's people were. He came in the winter before the grass began to grow. He said the dead would come from the east when the grass was about eight inches high. The deer and the animals were all coming back, too. George said the white people would die out and only Indians would be on earth. The culture hero [Kamookumpts, he who had made the first land] was to come back with the dead. The whites were to burn up and disappear without even leaving ashes. The rules of the dance Doctor George brought were that you must dance or you would turn to rock. They danced in a circle with a fire in the middle and camps around the outside. They danced all night and in the morning they jumped into the river and swam. Some of the men would come out with ice on their hair it was so cold. Some Indians fell down dead [fainted] and began singing and telling what the coming-back people wanted them to do." Another source quoted Doctor George as adding that the dead "will come back, and people will never die anymore. Those who will come back have died once; but they will never die anymore." A man named Jake from the neighboring Shasta tribe was told that the ghosts summoned by the dance had only one more creek to cross before they reached Tule Lake. Apparently the dead were pictured as crossing the landscape on foot, an army of the past marching to cancel out a terrible future. The Modocs were living at the end of time.

GHOSTS AND MACHINES

The Ghost Dance was a technology. Literally, a technology is a systematic practice or knowledge of an art, and though we almost always apply the term to the scientific and mechanical, there is no reason not to apply it to other human-made techniques for producing desired results. Maybe the best definition would be: A technology is a practice, a technique, or a device for altering the world or the experience of the world. To propose annihilating the inexorable march of history and the irreversibility of death was to propose a technology as ambitious as a moon walk or a gene splice. The Ghost Dance had its parallels in the spiritualist movement that began in the 1840s and reached its heights in the years after the Civil War with millions of believers and practitioners in the United States. Spiritualism likewise sought to cross that great divide, death, and even the white raiment women spiritualists sometimes wore to funerals seemed a defiance of death, like the Ghost Dance shirts of the 1890s. This spiritualism had close ties to the feminist movement of the middle decades of the nineteenth century. Women were the principal mediums in spiritualism, and it was something of a women's religion, an alternative source of power and an alternative kind of spirituality. In calling back the souls of the dead to communicate, these spiritualists seemed to politely doubt that the dead were otherwise occupied with heaven, hell, and the authority of God.

The supernatural is nowadays often seen as opposed to technologies, but the technologies of the era often seemed supernatural themselves. In the well-known words of science-fiction writer Arthur C. Clarke, "Any sufficiently advanced technology is indistinguishable from magic." It is only because nature no longer seems so strong and immutable a force that changes no longer seem uncanny. In the beginning electricity seemed spiritual, a form of the life force: it is electricity that brought Frankenstein's fictional monster to life in the teens of the nineteenth century, and a spiritualist machine of the 1840s that was supposed to generate a soul was electrical. Telegraphy was sometimes thought to magically transmit objects rather than signals, and in 1878 the *San Francisco Chronicle* published a story about a man getting evening calls from the dead on that new electrical invention, the telephone, whose disembodied voices still seemed uncanny. "Spirit photography," or photography of the souls who were supposed to appear at spiritualist seances, was often discussed and denounced over the years in the *Philadelphia Photographer,* and even late in the 1870s the photographer John Thomson was reassuring a theoretical listener, "He may be tempted to inquire, What occult science confers on this mystic apparatus the power of picturing objects placed before it, producing an image so perfect that alike no point of beauty, no spot or blemish, escapes its miscroscopic observation? It is some solace to know that the camera and lens—names by which the apparatus are known—lend themselves to no sort of trickery. There is no medium—spiritual—within or without to link the process to the unseen world and works of darkness." The changes brought about by technology seemed supernatural at first, and photography was associated with death both in the many, many images of the dead made during the early years of the medium and in the way a photograph seemed to cheat death by making at least appearance permanent.

Muybridge, when he was photographing the Modoc War, was on his way to inventing a new kind of photography, a photography that with the aid of high-speed electric shutters would make it possible to recapture what had always been lost in the stream of time, not just an appearance but a gesture, a motion, an act, those immaterial events of which time itself is made. Even Thomas Edison, when he discussed the origins of cinema, invoked the supernatural. He wrote, "In the year 1887 it occurred to me that it was possible to devise an instrument which would do for the eye what the phonograph does for the ear and that, by a combination of the two, all motion and sound could be recorded and reproduced simultaneously. This idea, the germ of which came from a little toy called the zoetrope and the work of Muybridge and Marey and others has now been accomplished. . . . I believe that in coming years by my own work and that of Dickson, Muybridge, Marey and others who will doubtless enter the field, that grand opera can be given at the Metropolitan Opera House at New York . . . with artists and musicians long since dead." In other words, cinema would itself be a kind of Ghost Dance. It was and is a breach in the wall between the past and the present, one that lets the dead return, albeit as images of flickering light rather than phantoms in the dark or armies marching across the land. Anyone who watches old movies watches the dead, and Edison was not yet insulated as we are against what is macabre about this. In the first years of cinema, the Lumière brothers made a short film that showed a few men knocking down a wall and then ran in reverse so that the men walked backward and the wall arose whole from its own

rubble. For audiences then, it was deeply disturbing and more than a little magical. They were not yet used to time as a toy in men's hands. The Ghost Dance itself was an effort to make time run backward like a film, so the whites vanished, the game reappeared, even death reversed itself.

But the Ghost Dance, which by all objective accounts failed, would settle for nothing less than the return of the people themselves with their bodies, their love, their souls. The technological solution called forth by photography and later mutated into film, television, video, computer animations, succeeded so profoundly that it has become the medium in which we live, but it is only a medium of flickering light and darkness, a river of shadows. Still, electricity and photography were technologies linked and confused with spirituality, and the 1870 Ghost Dance had an ambiguous link to the transcontinental railroad. One apostle of Wodziwob reported long afterward that the prophet had said, "There are a lot of people telling this news but they aren't telling it right. What I said was that a train was coming from the east. My real dream was about that train, but people make it out different." Another member of Captain Jack's band recalled a half-Modoc man named Night Traveler who told them, "The dead were not coming back. He interpreted the message as meaning the whites were coming from the east. He told all about the whites, their churches and houses; how they were coming, like beavers mowing down the timber, like badgers and moles in turning up the earth for their mining, like grasshoppers in cutting down the grass. He said the whites were all around us and we were a little island of Indians, but the whites would come and we should see the truth of what he said. It was the whites and not the dead who were coming from the east." The railroad was bringing them in ever greater quantities. As for the builders of that railroad, grief could make them too turn to the supernatural. When Leland Stanford Jr. died in Italy at the age of fifteen, his devastated parents strove to make contact with him through spiritualism. Jane Stanford retained a lifelong interest in the supernatural, and her secretary remembered, "She prayed so earnestly for light, which meant to behold Leland, that it was pitiful."

They were all technologies of grief, technologies for building a bridge across the painful divide between the living and the dead, between what had been and what is, for defeating the trauma of time itself. The Modocs' grief was for a whole relationship to the natural world and to a specific place, for their culture and community, while the grief of those who produced and profited from their loss was purely personal. While the Stanfords were hosting a pair of spiritualists in their vast estate at Palo Alto, a wealthy neighbor not far to the south was pursuing her own manic version of spirituality through the material medium of architecture. Sarah Winchester, the widow of the man who manufactured the Winchester repeating rifle—"the gun that won the west" as the superb 1873 edition was called afterward—was an ardent spiritualist who spent the last decades of her life, from 1884 to 1922, building a house to ward off the spirits of the Indians killed by her husband's rifles, the technologically advanced repeating rifles whose sale gave her the funds to pay the craftsmen who worked without cease for nearly four decades. A spiritualist medium had told her she would be safe as long as construction continued, and the house came to seem like the emigrant West itself in its insatiable desire for expansion. Her labyrinthine house is often written about as a prefiguration of Silicon Valley, at whose heart it sits, and if all Silicon Valley's suburban sprawl and corporate campuses can be imagined as a larger labyrinth, then Sarah Winchester and her house were the monster, the minotaur, at its center. The house grew to cover six acres and contain 160 rooms, and it was not built to plan, so that skylights open into floors, windows look into other rooms, stairways lead nowhere. It was a labyrinth designed to baffle the souls whose enemy she was, and at its heart was a blue room in which the solitary Sarah Winchester held her séances (and spied on her servants).

The Modocs were at the center of a lava labyrinth surrounded by a shaman's red rope, and there they stayed from their triumph in the January battle through the peace negotiations that stumbled along into spring. Relations worsened during the truce. The Modocs moved freely in and out of the Stronghold, and in the army camps they heard rumors that led them to distrust the appointed peace commissioners. Both sides squabbled among themselves. Captain Jack was for compromise and peace, and many members of his band, particularly Hooker Jim and Curly Headed Doctor, attacked him bitterly for it. Messengers, mostly Modoc women and white friends of Captain Jack, went back and forth through February and into March. At a meeting in late March, Captain Jack reiterated his demand for a home on the Lost River, and afterward the army camps moved in closer to the Stronghold. Another meeting was held. Meacham reported of Jack, "After sitting in silence for a few moments, he replied, 'I give up my home on Lost River. Give me this lava bed for a home. I can live here; take away

your soldiers and we can settle everything. Nobody will ever want these rocks; give me a home here.'"

Meacham replied, "No peace can be made while you stay in the Lava Beds; we can find you another place, and the President will give you each a home."

And Jack declared, "I don't know any other country. God gave me this country; he put my people here first. I was born here,—my father was born here; I want to live here; I do not want to leave the ground where I was born."

The stalemate changed at the meeting on April 11, Good Friday. The Modocs had danced the Ghost Dance all night, and the morning was clear and cold. Toby and Frank Riddle warned the three peace commissioners and General Canby to stay away, but they went to the rendezvous site at the western edge of the Lava Beds at eleven in the morning. There Captain Jack, Hooker Jim, Schonchin John, Ellen's Man, Black Jim, and Shacknasty Jim awaited them at a sagebrush fire, and Bogus Charley and Boston Charley were nearby. As usual, Jack asked for land and the removal of the troops. The talks foundered. As Meacham, one of the three peace commissioners, recalled, Schonchin John, "eyes burning with passion," shouted, "Take away your soldiers and give us Hot Creek, or quit talking. I am tired of talking. I talk no more." At a signal, Jack pulled a pistol out of his clothes and turned General Canby into the only U.S. Army general to die in an Indian war. Boston Charley shot the Reverend Thomas, one of the peace commissioners, who died, and four Modocs went after the fleeing Meacham, who was wounded in several places and partially scalped but survived. The third peace commissioner ran for it and lived, as did the Riddles, who weren't targets.

Jack had been pushed into cooperating by the extremists in his band, and he knew that after the murders at the peace tent, they had no good way out of the Lava Beds. It was springtime, the great sky-darkening flocks of waterfowl were migrating over the Lava Beds and landing in Tule Lake on their way north, and normally the Modocs would have been shooting ducks with their sophisticated arrows faceted to skip like stones over the surface of the water. Easter Sunday, the corpses were sent away and seventy-two Indian scouts from central Oregon arrived to join the several hundred troops. The war resumed on Tuesday. Curly Headed Doctor continued to dance, and the Modocs continued to seem indestructible. Their

invulnerability and their widespread—but hardly universal—belief in the Ghost Dance made them unwilling to compromise, though their resources were so finite and the government's so vast. A prisoner of war who was allowed to escape so the soldiers would have the pleasure of finally killing a Modoc instead outran the rain of bullets without injury. Eight Modocs held off a battery all day, and the shelling that continued into the night caused no casualties until the second night, when a mortar shell landed without detonating and a naive Modoc blew himself to pieces by examining it. After that, faith in Curly Headed Doctor's power waned, and the

A Modoc Brave on the Warpath, from the series *The Modoc War,* 1873 (one frame of stereo). This image actually depicts a Warm Springs Scout working for the U.S. Army.

Modocs, who were running low on water, left the Stronghold after five months there.

The army was dumbfounded when they gingerly stormed the site the next morning, April 17, only to find it abandoned. The Modocs seemed to have vanished from inside the siege, though they had only walked south one night through the lava trenches. By this time, there was not much mercy left in the Modoc War. When the Modocs captured a young packer, Hooker Jim flattened his head with a rock. When the army found an old Modoc man left behind in the flight from the Stronghold, they cut off his head and kicked it around like a football. Finally on April 26, sixty-four soldiers who set out to look for the Modocs marched into their hiding place without seeing them and sat down for lunch. The ensuing battle was as close to an even match as the Modocs and the U.S. Army ever got: twenty-four Modocs against nearly seventy, and the result was twenty-four dead and many wounded soldiers, no Modoc casualties, and Scarfaced Charley shouting, "All you fellows that ain't dead had better go home. We don't want to kill you all in one day."

It was his own men who finally did in Captain Jack. Black Jim and Hooker Jim argued with him so bitterly that they could not proceed together, and the renegade Modocs split into two bands. The army found Hooker Jim's band first, the Modoc women negotiated a surrender, and Hooker Jim, who would otherwise have been hung for his Lost River murder rampage, made a pact. In exchange for amnesty, he and three others would deliver Captain Jack. They led the army to his encampment. Jack was furious that the men who had refused to let him negotiate when there was more to gain in April had capitulated at his expense and threatened to shoot them like dogs. But the uncaptured Modocs were exhausted and hungry after weeks on the run. In the end, Captain Jack walked out onto a ledge holding his rifle, and the lieutenant in command of the scouting expedition climbed up to receive it. "Jack's legs gave out," he said and handed over his gun, and that was the end of the war. It was June 1.

THE PRICE OF DEFEAT

Afterward, the photographer Louis Heller took Hooker Jim's picture: it shows a youth with a beaded collar whose face is made up of smoothly curving planes and elegantly delineated lines of eyes, nostrils, mouth, a face

more graceful than one expects for violence and treachery, though it is a little masklike. Captain Jack, in Heller's portrait, was a tired man in his prime with the same clearly delineated features, high cheekbones, and thick hair cropped at his ears; wearing blue jeans in another portrait, he looks very modern. At ten-twenty in the morning of October 3, after a farce of a trial, Captain Jack, Schonchin John, and two others were hung at Fort Klamath. Two of the Modoc rebels were pardoned from the scaffold and sent to the grim prison on Alcatraz Island in San Francisco Bay. The executed four were buried there on the reservation they had fled, though some stories suggest their heads were sent east as scientific specimens or that Captain Jack's body was preserved and turned into a sideshow attraction.

For the rest of the Modocs the price was not death or prison, but a long ride far beyond the horizon of their native land, to Indian Territory in what is now Oklahoma. Their belief system included a world with a center and places that were irreplaceable, tied to the sacred time of the beginning of the world and perhaps to its end; their war had been against being assimilated into the industrialized world, against the annihilation of this sense of place, this sense of time. The price of their defeat was a ride on the very emblem of the changed world, the transcontinental railroad, shuttling them beyond everything they had known. For the first riders of the railroad the speed of the trains had seemed to annihilate the landscape, drawing them into a limbo that was something new in the world, a being nowhere; the Modocs were now delivered into this limbo. A contemporary Modoc from that eastern Oklahoma territory, Cheewa James, writes on her Web site, "It is doubtful that any of them had even been on a train before. This, coupled with the fact that no one, prisoner or the general public, was to know the destination of the Modocs, must have been a frightening and depressing experience to the subdued group. The Modocs, taken to Baxter Springs, Kansas, were exhausted when they disembarked on November 16, 1873. Records are clouded as to their exact condition. Accounts state that the Modocs arrived half-starved in boxcars." Wodzibob had stated, "What I said was that a train was coming from the east," and it was going back east too. Instead of the glorious end of the world in a spate of resurrections and erasures, there was the quiet end of a world. Most of the Modocs outlived the end of their world, which they must have found harder to imagine than the dead coming back, and more painful. "The lava beds," wrote the historian Hubert Howe Bancroft not long afterward, "which can never be removed or

changed, will ever be inseparably connected in men's minds with Captain Jack and the Modocs in their brave and stubborn fight for their native land and liberty—a war in some respects the most remarkable that ever occurred in the history of aboriginal extermination."

The whites who administered Native American subjugation claimed to be recruiting the Indians to join them in a truer, more coherent worldview—but whether it was about spirituality and the afterlife, the role of women, the nature of glaciers, the age of the world, or the theory of evolution, these white Victorians were in a world topsy-turvy with change, uncertainty, and controversy. Deference was paid to Christianity and honest agricultural toil, but more than a few questioned the former, and most, as the gold rushes, confidence men, and lionized millionaires proved, would gladly escape the latter. So the attempt to make Indians into Christian agriculturalists was akin to those contemporary efforts whereby charities send cast-off clothing to impoverished regions: the Indians were being handed a system that was worn out, and it is no surprise that they had trouble wearing this cultural certainty so full of holes. Though the whites were trying to destroy the Indians, by killing them and their culture and by displacing them from the sites for which their skills and beliefs shaped them, the Indians and the whites were ultimately united as, so to speak, passengers on the railroad heading to an unknown destination, to doubt, to destabilization, to our time.

In Europe this state of affairs is called modernism, the cultural reaction to modernization. "Modernization," writes the visual theorist Jonathan Crary, "is a process by which capitalism uproots and makes mobile that which is grounded, clears away or obliterates that which impedes circulation, and makes exchangeable that which is singular." Out west, the complex responses to industrialization and its transformation of time and space include things never dealt with by the impressionist painters and avant-garde poets usually talked of as modernist, include Indian wars and identity shifts, a landscape being claimed and named, photography as art, and a comic literature. But perhaps they were all, cowboys and Indians and impressionists, on the same train anyway. Muybridge was photographing the journey to modernization, for this is what his series of pictures—of the mysteries of movement, of remote landscape, of an Indian war, of an instant city, of the transcontinental railroad line, and other developments of the West add up to. His Modoc pictures are not great expressive works of

art; what is important in them is his act of witness and how it connects this history to the other histories he was tied to: the transformation of a world of presences into a world of images. It's usual to talk about artists standing aside, to talk about them being neutral because they observe rather than act directly on what they see. Muybridge's relationship to the history that came through his camera is more complex. He was working for railroads and armies, for tourists and easterners. But he gave them imagery that called their attention to what was just out of reach: the landscapes they wouldn't explore, the cultures they wouldn't encounter, the lives they wouldn't live, the motions they couldn't see, the questions they couldn't answer. Muybridge wasn't neutral. He was independent. He was complicating the record as he made it, inviting doubt into the house.

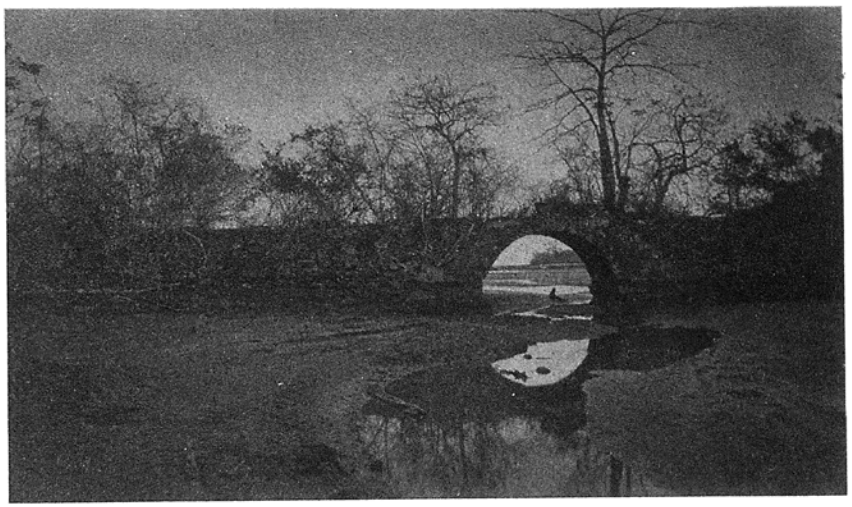
What was being lost as the real thing was returning as imagery: thus nature was almost the dominant subject of the nature-conquering nineteenth century, and Indians who were chased out of their homeland were finding a shadow home in art and entertainment. The Modocs survived on their reservation, or enough of them did to convert to the Quakers' pacifist version of Christianity. Early in the twentieth century some came back to the Oregon reservation. Few if any seemed to find a home in the northeasternmost corner of California now called Modoc County. Meacham survived his assassination attempt to write a book about the Modoc War and go on a speaking tour with the Riddles, Shacknasty Jim, Steamboat Frank, and Scarface Charlie. He got them to wear face paint and dress up in more "Indian" clothes than they had worn, and he adorned Toby Riddle with the name "Winema, the Woman Chief." Everything spectacular in the West was always being sent east for exhibition: cowboys, Indians, and herds of buffalo in the traveling circuses, stories of the peculiar society of the mining camps, great loads of gold and silver, furs and hides, photographs of Yosemite Valley, the 1878 motion studies that went straight to France.

In the heyday of the gold rush, the immigrants were busy building California's physical infrastructure: dams, roads, cities, farms. At the same time, a more subtle project of construction was launched, of California as a distinct culture. Immigrants bent the place's meanings to suit their needs and dreams, and when they were done, something entirely new had been invented, something that would change the world, a kind of headstrong, rootless sense of heroic possibilities and glamour still summed up by the word *California.* And much that was ancient had been lost, including the

way that Modoc culture was tied, with a thousand threads of food and story and name and knowledge, to the place where the Modocs had been as long as they remembered. There are at most two or three speakers of the Modoc language left in the world, and a language is itself a world, creating distinctions and connections, describing time, kinship, place in a unique way. Does something have to come to an end for something else to be born? Did the Modocs make way not only for settlers and miners, but for a new idea of California? Was there room for both a world with a center and California as the center of technological and cultural innovation, or did the latter require a kind of decenteredness and the annihilation of what had come before? To ask this is to ask if there could have been another history, a parallel universe—but the history we have is the history in which the center was uprooted and the machines evolved.

A DAY IN THE LIFE, TWO DEATHS, MORE PHOTOGRAPHS

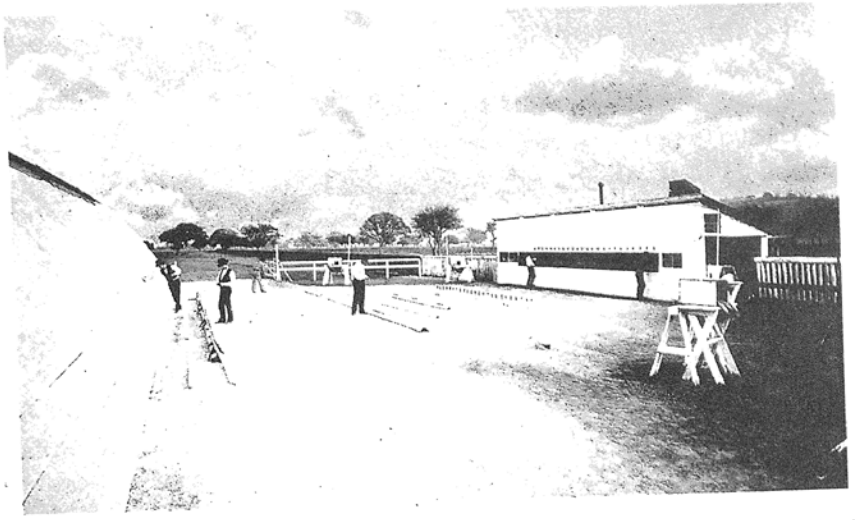
Family Pictures ▪ *A Hand of Cards* ▪ *The Trial* ▪ *Flora's Conclusion* ▪ *Laundresses and Ruins*



story behind the substitution. Perhaps like quilt makers and Navajo weavers who traditionally subvert the flawnessness of their patterning with one reversed or divergent detail, he wanted to take one step back from perfection. No one will ever know. It means that the panorama is not what it appears. To the casual eye, the panorama seems to be what Hollis Frampton described, "an impossible simultaneity." To the careful observer, this great panorama is a discontinuity that appears to be a continuity, many hours of the day masquerading as a single supreme moment, like a film in which segments shot at various times are edited into a believable narrative. The most careful observer of the panorama in modern times, the photographer Mark Klett, who in 1990 made his own panorama of a very different San Francisco from the same location, says, "If he had to remake a photo due to this technical limitation, or even if he had to remake a broken or scratched plate 7, I like the result visually and conceptually. It blows holes in the notion of a seamless and omnipotent view and opens the door on space and time."

STOPPING TIME

Speed Pleasure and Joy Revolutionizing Photography Time Does Not Stand Still After Stanford



Overleaf: Photograph F: The Experimental Track at Palo Alto, from the album *The Attitudes of Animals in Motion,* 1881, showing, on left, the whitewashed wall and, on right, the studio from which Muybridge photographed the equestrian motion studies.

SPEED

Picture a racetrack in 1877 with a racehorse running its oval circuit of brown earth. For the horse the race is from nothing but perhaps a touch of the whip to nothing but the end of the exercise. For the driver, the trainer, the owner, the horse is attempting to minimize the amount of time it takes to travel from one place to another, to defeat the limits that nature places on the movement of bodies, to dissolve the weight of matter and the binding force of gravity, to fly, to become instantaneous, to annihilate time and space. The horse is training. That is, it is alone on the track, racing the clock rather than other horses. Muybridge will seize hold of that running, stop it on film, take it apart and put it back together like a Chinese puzzle. It takes the speed of a technological breakthrough to capture the speed of the horse so that like a machine it can be understood, and this speed is not a change in degree but a change in kind, a speedup that takes humanity across the threshold into a new world of knowledge and representation. Past a certain point everything, anything, disappears into the visible imperceptibility we call a blur, a veil of speed covering up the erotics of motion. Muybridge would bring the blurred back into sharp focus, and it would turn out that stripping speed of its veils had more far-reaching possibilities than anyone had imagined.

Speed is a basic survival skill for both predator and prey. But races have neither predators nor prey, only competitors. The race simulates the conditions of survival and awards those found most fit not with survival itself but with glory and money. In the nineteenth century a confusion of language arose between the activity and the category of the race, for Europeans and European Americans perceived progress as a race that they, the white race, were winning. The fundamental metaphor of this culture is one of travel, movement, progress, exploration, discovery, of going somewhere

in search of something new, a metaphor that links Columbus in his boats and Fremont on his trails with the Faradays, the Edisons, the Bells, in their laboratories. Muybridge's restlessness seems partly personal, an unhappiness or dissatisfaction that keeps him from standing still, but partly cultural, a curiosity and ambition that keeps him moving onward, both geographically and technically. For a culture that believed it was exactly where it ought to be and had everything it needed, the race could never be so resonant, and this may have been one of the huge differences between the two sides in the Indian wars.

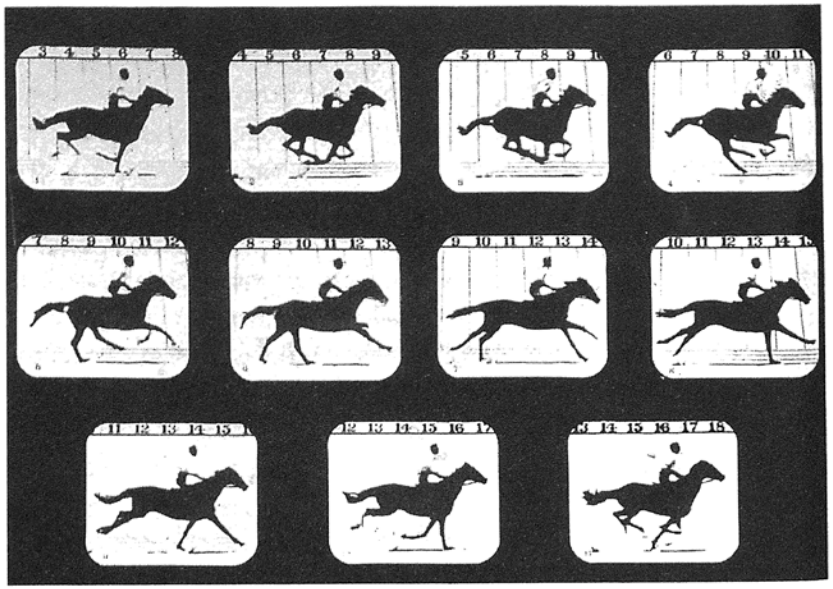
Speed hovered below the horizon of consciousness and culture as an absolute virtue questioned by only a few poets and theologians. Endurance was admired too, and the 1870s were full of pedestrian races of up to 500 miles, in which for days on end the competitors could not break into a run and could only stop for brief intervals. The point of the races was obscure, for they were not glorious like a horse straining to do his utmost, though there were ladies' races that provided, as contemporary accounts make clear, at least the reporters with voyeuristic pleasures. These races on sawdust tracks were numbingly repetitious, and they must have in some faint way echoed the repetitious labor in the factories where men, women, and children performed ever-more-reductive tasks as servants of the machines, working twelve or more hour days, six days a week, every week of the year, until the body failed as those of the pedestrian racers sometimes did when they literally dropped from the competition.

In the Industrial Revolution speed becomes efficiency: time is money, and the less time used in manufacturing or shipping, the more money amassed—the annihilation of time and space Marx spoke of. The competitors strive to smooth the world for their own advantage and to outrace each other, and the clock is made out of money, the ticking of dollars into the till. The Union Pacific and the Central Pacific raced each other to build the most track across the great American outback because they were paid by the mile. Eventually immobilized by poor health, the lumbering Stanford built his fortune on speed, on the incredible global speedup that the transcontinental railroad provided, even the speed with which it was built, epitomozed by that famous competition in which the CP workers laid ten miles of rail in a day. The race was a metaphor for industrialism too, but nobody said what the goal or the prize was, except riches for the owners. The theory of machinery is that it saves time, but Stanford himself noted of

such machinery that "if you could limit man's wants it might be called 'labor saving,' but as there are no limits to his wants, the machinery really increases the power of production." That is, the industrialized world wants more goods, not more time, and so the machinery doesn't increase freedom and leisure, it increases production and consumption.

In the summer of 1876 Stanford had bought the first portion of his Palo Alto estate from George Gordon, the developer of San Francisco's South Park, and in subsequent years he bought more and more surrounding land until he held 8,000 acres of what is now Stanford University. Most millionaires spend their profits on something that disguises, gilds, or contradicts their source: paintings that speak of the leisure, education, and joy so far from the harsh labor that bought them, tranquil estates built on armaments profits. Sometimes anxiety about the source of the fortune is revealed in its expenditure, as with Sarah Winchester's fearful house. But Stanford's most visible expenditure, even beyond his $2 million pile on Nob Hill or his 55,000-acre Vina Ranch in north-central California, was his racing stable, and these horses enacted as pleasure and recreation what the railroad enacted as business: speed. They set nineteen world records and even eventually became profitable. The railroad business was full of bodily destruction—Chinese men killed in dynamiting, railroad workers missing fingers and limbs from operating dangerous machinery, the occasional boiler explosion that killed stokers and engineers, the squatter-farmers shot down in Mussel Slough by agents of the Southern Pacific. The Palo Alto ranch was a peaceable kingdom celebrating the perfectibility of the equestrian body. The estate staff, which eventually numbered a hundred and fifty (one-third Chinese), was forbidden even to speak harshly to the horses, which eventually numbered near eight hundred. A man was fired for striking one. "Few of Stanford's charges knew the meaning of fear," a biographer writes: tenderness in sight, brutality over the horizon, and speed everywhere.

To race the clock is to race time itself in the present and the historical record of the past, to attempt to break the record as though it were a real thing like the ribbon broken at the finish line of a race. It's to race against an idea. To encourage that possibility, the terrain over which the horses run is reduced as far as possible to a smooth, even surface. Just as railroad lines smooth out the landscape to make a straight track—one that neither ascends nor descends too steeply nor turns too sharply—so the racetrack



Horses, Running, Sallie G., plate 43 from *The Attitudes of Animals in Motion*, 1881.

allows the horse optimum conditions, only the horse is going nowhere, going in circles. It is as though the ideas of time and competition become more and more real, the actualities of place and substance less and less so. Muybridge, a man who had spent his life photographing somewhere, whether it was a cliff face or a war zone or a pleasure garden, was going to give the rest of his life over to nowhere, to the neutralized places in which he could match the machine speed of photography to the cadences of bodily movement. Time in his photographs had been expansive too—the time of history, of geology, of a passing day—but he was to shift his focus to events that unfolded in a second or two. To represent movements in real time, machinery had to move faster than the human eye, both in capturing fragments of motion and in reassembling them into a continuity. This is what cinema would be made out of, the speed of the projector matched to the speed of the camera. It took extraordinary speed to reproduce, say, the plume of cigarette smoke slowly uncoiling above a heroine's face, the tail of a hero's coat swinging as he turned around. But it didn't begin as heroines, as fictions, as cinema. It began as photographs of horses in motion.

A horse in 1877 was still state-of-the-art power for war, agriculture, and transportation, a biological technology that had been much improved with

careful breeding and such inventions as stirrups, bits, and harness. None yet foresaw that within half a century the horse's practical uses would be largely superseded in the industrialized world. Relying on horses for everyday transportation meant that human beings were still in collaboration with the organic world, a world of unpredictability and mystery. Muybridge and Stanford were approaching the horse in an ambivalent way, seeking to study it to make it more like a machine. A machine must first be imagined and understood before it can be set to work, while nature can be utilized for millennia without giving away its secrets. It was a contrary impulse akin to the one that reveres wilderness while planning to map and develop it. And understanding the gaits of a horse in a mechanical way enhanced the possibility of tinkering with it, through breeding, training, and other forms of management. For Stanford, the experiment would allow him to further shift the essence of the horse from the mysteries of nature to the manageable mechanics of industrialism.

PLEASURE AND JOY

It isn't clear whether this second time around Stanford approached Muybridge or Muybridge approached Stanford, though the latter seems more likely. The photographer had, he said, engaged in some "very rapid work in the southern country" of Central America that made him eager to resume pursuit of what he had attempted with limited success earlier in the decade: images of Occident in motion. Another time he said he had "had occasion to make a series of experiments in photographing scenes offshore from the deck of a rolling vessel. These experiments resulted in the construction of an apparatus and the preparation of chemicals so as to permit the photographing in outline of a rapidly moving body." Thus far, little had changed; he was attempting to take a single image, and his main breakthrough was apparently in the area of chemistry—not in a new chemical formula but a new precision, concentration, or other shift in the existing formulas ("iron was employed in their development," one source reported). This time around, the shutter was triggered when the horse broke a thread across the racetrack. At first, Muybridge apparently worked at the Sacramento Union Racetrack; evidently Stanford had not finished moving his racehorse operation to the ranch he called Palo Alto, Spanish for "tall tree," after some redwoods there. During the interim, Occident may have

He understood that the next stage would be to make rapid sequences of photographs of motion. Muybridge ordered a dozen superb lenses from the English firm of Dallmeyer, and Stanford directed the Central Pacific Railroad's chief engineer, S. S. Montague, to provide whatever assistance Muybridge required. What he required was a better way to trigger his shutters. His "guillotine" shutters each consisted of two wooden bars held in place by what he decorously called a spring but appears to be a powerful rubber band. He had tried taking a pin out of these shutters with limited success, and he had already set up the shutters triggered by a thread across the track the horse broke (if it was running) or wires the sulky wheels contacted (if it was trotting)—but he needed them to be faster yet, and smoother. Early that August of 1877, Muybridge visited Montague at the railroad's headquarters in San Francisco, and Montague sent him across the bay to the Oakland workshops. There superintendent of bridges and buildings Arthur Brown gave an order to make up some shutters according to Muybridge's specifications and set a young draftsman with a knack for invention named John D. Isaacs to work on a device to operate them. Brown went off to take care of some railroad business on the Colorado River, and Isaacs put his sketches in his pocket and went home for the weekend.

He brought them out that Sunday to discuss with a friend, recalling later, "I discussed this business with him, and we came to the conclusion that no mechanical contrivance of sufficient delicacy and rapidity to accomplish the purpose could be devised. We did not believe it could be done. And we had just about concluded our conversation on the subject and I think Mr. Palmer was about to change the subject when I said 'I have got it sir; it is electricity,' and the details of the whole thing just flashed into my mind in an instant, I thought of putting a magnet on the outside of the apparatus to pull out a catch, connecting that magnet with a battery on one side and with a wire which should reach over the track with the other; also connecting the battery with another wire which should run over the track and lie parallel with the first wire." *Electricity* was a magical word then, one that evoked speed, modernity, vital force, mystery, and power. It was used primarily for telegraphy and for the electrical time service that kept multiple clocks in multiple locations telling the same time.

One of the spectacles at the 1876 Philadelphia Centennial Exposition had been such an electrically linked collection of clocks, and a few years later *Scientific American* enthused over New York City's electric time service. That city, like many others, had a time ball that dropped at noon, triggered by a system from the National Observatory in the nation's capital. But, *Scientific American* asserted, "to reap the full benefit of the time ball, a great number of people must watch for its fall; that takes time, and time is money." Thus the electrical time service supplanted it and kept time "within a few hundredths of a second. The reader must not be incredulous; it is possible to measure, nay more, to record, the hundredth part of a second." Electricity, lightning harnessed, was a resonant word at the time, linked to simultaneity and to the accurate measure of tiny intervals of time. The same article noted that "where once men were satisfied to know the hour, they had recently begun to specify the time down to the nearest second." A new awareness of minute increments of time had arisen, and it was in this context that Muybridge began to make exposures of a thousandth of a second.

The electrical triggers helped. According to Muybridge scholar Phillip Prodger, their main merit was that they combined strength and smoothness; they did not jar the instrument in the act of releasing the shutter. The electrical current caused a magnet to move the catch that held the shutter, and the speed of electricity made the elapsed time between the wire contact and the shutter moving almost nothing. The California newspapers later linked this use of electricity to the moment in 1869 when Stanford hammered the last electrically wired spike to generate a simultaneous experience across the nation. It was the instantaneousness of the moment, the electrical transcendence of human limits, that seemed to link the two events, that and their expense. Stanford's costs for salaries, equipment, and supplies at the end of the two years of motion studies at Palo Alto were estimated at about $20,000.

Two carpenters constructed the electrical device that triggered Muybridge's shutter, and one of them, Charles Knowles, recalled afterward how Muybridge came to the shop to "see how we were getting along." A conversation arose, and Knowles said, "'It was a very happy thought of Isaacs in suggesting electricity for working this apparatus for getting instantaneous pictures by having a series of shutters or slides to work up and down as the horse passes in front.'

"And he remarked: 'Yes, it was a very bright thought.' And he said, 'Moreover it is going to revolutionize photography.'"

Various Animals, Deer, Running, plate 86 from *The Attitudes of Animals in Motion,* 1881.

Here Knowles may have shifted the emphasis from Muybridge's several inventions to Isaacs's single invention, for it was the combination of the triggers, the shutters, the photochemistry, and their orchestration with the horses on the whitened track that made the instantaneous photographs of 1878 possible. Muybridge was to make photographs with both mechanically and electrically operated shutters. He also used another invention, and it is not clear whether Stanford's engineers helped (though if they had, they surely would have mentioned it). It was a revolving cylinder reminiscent of those in of music boxes: "For recording the successive attitudes of animals not under control, an apparatus is used, comprising a cylinder, around which are spirally arranged a number of pins; upon the cylinder being set in motion . . . these pins are consecutively brought into contact with a corresponding number of metal springs; a succession of electrical currents is thereby created," which again triggered the shutter releases. It was used for animals "not under direct control"—for virtually everything except horses. The electrical devices only worked with movements that could trigger them at regular intervals. The cylinder was autonomous, but it was hard to calibrate to the movements of horses, and this is why the electrical triggers were valuable.

Though he used the railroad's resources, Muybridge was himself an inventor, as the skyshade had shown long ago, and in the summer of 1878 he took out patents on an "Improvement in the Method and Apparatus for Photographing Objects in Motion" (and in the early 1880s took out two other patents related to motion-studies inventions). He also invented a strange pneumatic clockwork apparatus himself, in which a series of pumps attached to the master clock control the motion of slave clocks, a device performing the same function as the electrical time delivery systems allowing clocks to be synchronized. After playing with time in so many ways, Muybridge had arrived at the central icon and device for the control of time and the metaphor for a mechanical universe.

Knowles recalled the rest of the conversation with the photographer-inventor: "I said: 'Can you take other objects aside from horses? Could you take a steamboat moving or a vessel sailing?'

"'Yes, take anything even of a flag flying—'

"I said: 'The trouble heretofore has been for instance if a person moves it mars the picture.'

"And he said, 'Yes but this won't do it. I know it is going to be successful in everything that moves. It is going to make a thorough revolutionizing in photography.'"

REVOLUTIONIZING PHOTOGRAPHY

"We began our experiments the next May," wrote Muybridge, and in June they released the results. He had often worked with assistants, but with the motion studies he had grooms and trainers handling the horses and up to eight men helping him. The motion studies already resembled film in that they were a collaborative project far more than almost any previous photography. Stanford functioned as the producer who put up the money and oversaw the project; Muybridge, as the director who made the key technical and aesthetic decisions; the aides for both horses and instruments, as gaffers and grips. The horses, riders, other animals and, by 1879, gymnasts were the actors before the cameras. And as with a film, there were arguments over credit—but that came afterward.

It's easy to see why the magnificent mammoth-plate panorama was never publicized or released commercially. Muybridge had once again overshadowed one achievement with another. During the winter between the 1877 large-plate panorama and single-image motion study and the