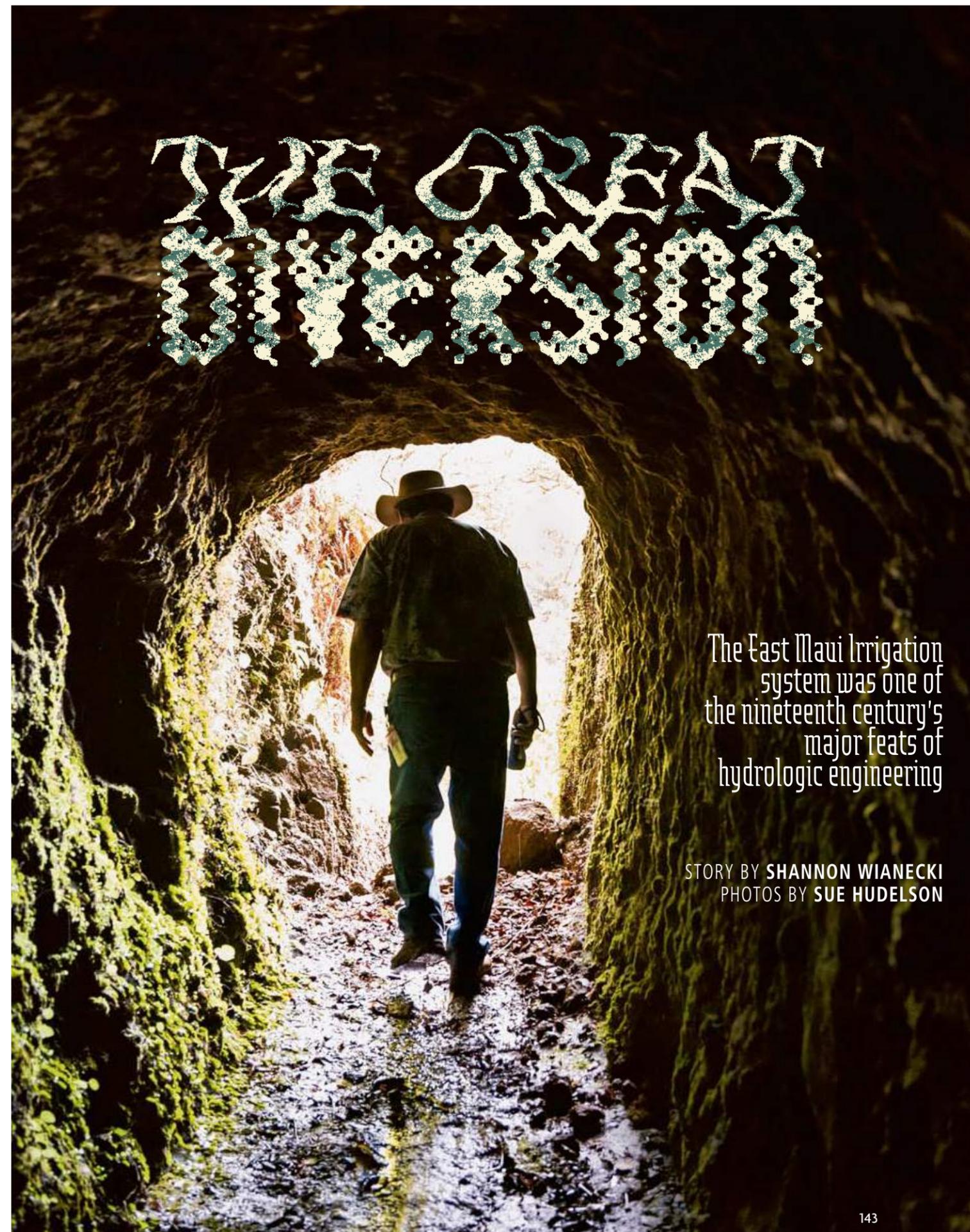


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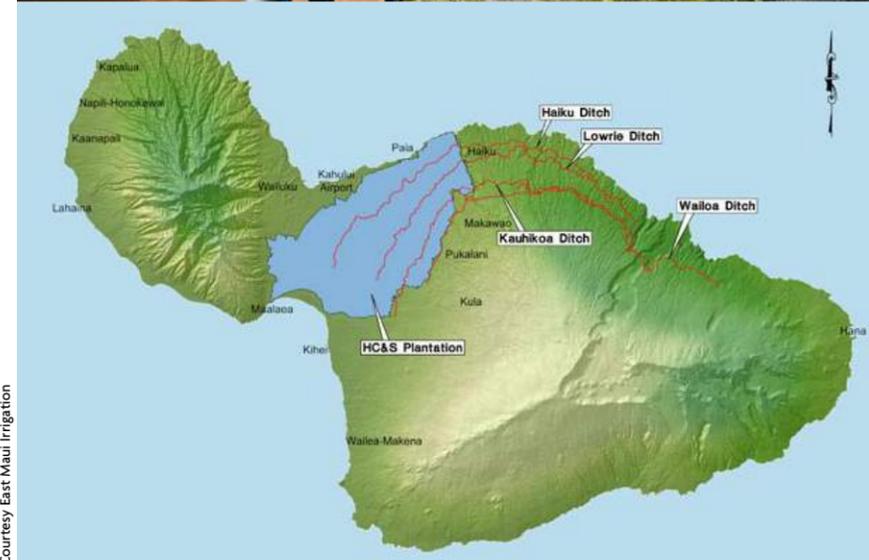
THE GREAT IRRIGATION

The East Maui Irrigation system was one of the nineteenth century's major feats of hydrologic engineering

STORY BY SHANNON WIANECKI
PHOTOS BY SUE HUDELSON

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The Great Diversion



Garrett Hew's great-grandfather emigrated from China to work in Hawai'i's sugar cane fields; Hew himself is today president of the company that serves those fields, East Maui Irrigation. At top he is seen beside Honopou stream after a heavy rain; at right, at the entrance to the Haku Ditch on Honopou stream; above right, holding the rake he used to clean grates as a youth. Above left: water overflowing the intake at the New Hamakua Ditch.

Rain fell in drenching bursts last night, so today East Maui's streams are running high. The water's boisterous energy excites me. I stand over Honopou stream, watching its muddy whorls rush up to an intake grate. Half of the water disappears into a ditch running perpendicular to the stream, the other half continues down the shallow riverbed toward the sea.

Garret Hew waits for me at the opening of a small tunnel nearby. Fringed with lacy green uluhe ferns, the dark hole leads into the hillside where the ditch runs underground. I venture inside. In the near blackness, the roar of water a few steps ahead seems even louder. I follow Hew's thin flashlight beam to a concrete platform



where massive gears are mounted. They control the rate at which the collected stream water barrels through this tunnel. I feel as though I'm in the heart of the mountain, amid the valves and arteries that pump life to the rest of the island. But if this system is a heart, I realize, it's an artificial one, created more than a century ago by ambitious engineers and laborers with nerves of steel.

East Maui Irrigation is one of the nation's largest privately built and operated water systems—an engineering feat of epic proportion. Sugar growers constructed the network of ditches, tunnels and flumes between 1876 and 1923 to capture water on the rainy side of the island and deliver it to the cane fields planted in the parched central valley. These aqueducts produced far-reaching ripples. The engineers who built them used what they learned here to develop water systems across the Western

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United States. The East Maui ditches served as models for many more built in Hawai'i. And without irrigation, sugar couldn't have become the economic and political juggernaut that it was in the Islands.

Hew has taken the morning off to show me the storied ditch system. Underground, beyond the nagging reach of cellphones, he's in his element. Investigating tunnels has been his favorite undertaking since he began working for East Maui Irrigation thirty-two years ago. He's a fourth-generation Maui boy; his great-grandfather emigrated from China to work in the cane fields. Hew took jobs with Hawaiian Commercial & Sugar, the state's last operational sugar plantation, and its sister company, East Maui Irrigation. At the latter, he worked his way up from ditch supervisor to president. He started off raking leaves

out of intakes; he now handles everything from landslides to lawsuits.

We emerge from the tunnel to see loose clouds racing low in the sky. Rain showers are imminent. Hew explains that nine aqueducts wrap in four bands around the northern face of Haleakalā, the island's tallest peak. Twenty-four miles of open ditches and fifty miles of tunnels are linked by enormous snakelike siphons, redwood-timbered flumes, small concrete dams, steel pipes and mud-walled reservoirs that empty and fill according to the turns of a crank. Four hundred separate intakes feed the network, which stretches from Nāhiku to Hāli'imaile and draws water from fifty thousand acres of watershed.

Gravity drives the system. No electric pumps or motors boost the water along as it travels halfway around the massive

mountain. For perspective, consider the difficulty of constructing a simple driveway that doesn't puddle after a rainstorm. Now imagine that on a scale of seventy-four miles, across the side of a steep and buckled volcano matted in dense rainforest. Then build it during periodic flash floods, without electricity or modern machinery.

Hawaiian streams tend to be steep, shallow and "flashy," rising dramatically at the whim of tropical tempests. During heavy rain, the ditches can collect 455 million gallons per day. The easternmost ditch, Ko'olau, starts in a forest that receives 200 to 275 inches of rain per year; the ditch terminates in fields that receive a scant twenty inches or less. At Hāli'imaile the water passes through a weir, where it's cleaned of debris and continues onward into Hawaiian Commercial & Sugar's cane fields and the county water supply.

On either bank of Honopou stream, invasive eucalyptus and African tulip trees choke what was once native forest. Here and there, Hawaiian 'ie'ie vines climb knobby 'ōhi'a trunks and koa trees dangle leafy sickles in the intermittent breeze. While not pristine, this landscape is still wild. The porous ground is made of loose lava rock and iron-rich mud that stains like blood. Every mile or so, the forest floor drops off into a savagely steep ravine, etched into the mountainside over millennia by the passage of a small, seemingly insignificant stream.

I contemplate the hubris required to tame this territory. Who could imagine harnessing such volatile natural forces and bidding them to do your work? It's true that for over a thousand years Native Hawaiians diverted streams into lo'i (taro patches) and corralled silver-finned moi into fishponds. But kākā maoli manipulation of the environment was far less invasive than the radical redirection of water that followed.

Massive engineering projects were a global obsession at the turn of the nineteenth century: The Panama Canal was built during this era. Michael O'Shaughnessy, who oversaw construction of the Ko'olau ditch, went on to build California's Hetch Hetchy water system: The Irish civil engineer dammed a Yosemite river and transported its water over 150 miles to San Francisco—a project that reportedly broke John Muir's heart.

It makes sense that the sugar ditches were constructed during a time of tectonic change in Hawai'i. A century after the

Sugar growers were behind the creation of the East Maui Irrigation system, a network of ditches, tunnels and flumes built between 1876 and 1923 to deliver water from Maui's rainy side to cane fields in the parched central valley. The trestle seen here crosses the steep Māliko gulch, the most formidable obstacle to the construction of the system. Below left: EMI crews relied on candles, carbide lamps and hand tools to dig fifty miles of tunnels through the mountains. Below right: The versatile rickshaw used to cart debris out of the ditches hasn't been improved on since the old days; it's still in use.



All images on this page courtesy East Maui Irrigation

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arrival of Captain James Cook, the island nation was still experiencing aftershocks. Native Hawaiians were dying of Western diseases. Hawaiian forests succumbed to the hooves of introduced cattle. English began to eclipse ‘ōlelo Hawai‘i as the language of the land. In 1848 the Great Māhele legislated landownership—hitherto unknown in the Islands. Suddenly giant swaths of land could be bought and sold.

Hawai‘i’s early sugar growers needed land, laborers, a viable market and lots of water. The Great Māhele made land available. Labor was another story. Hawaiians—struggling to keep their own farms and fishponds operational—balked at the idea of harvesting cane for a pittance. Sugar plantation owners addressed this by negotiating for contract labor from China and Japan—men like Hew’s great-grandfather. A market for Hawaiian sugar materialized during the American Civil War, and the Reciprocity Treaty lifted US tariffs on Island-grown sugar. By 1876 all that Hawai‘i plantation owners lacked was water.

Sugar is a thirsty crop. The spindly, tasseled canes grow best in hot, sunny climates, but they suck up plenty of water. To flourish, an acre of sugar needs fifty-five million gallons of water per day. In 1872 the Hawaiian legislature considered funding a major irrigation project on Maui: an aqueduct to feed the dry central valley with water from windward Haleakalā. Beset by debt, the kingdom couldn’t afford the \$30,000 price tag. A few sugar growers volunteered to take on the task themselves in exchange for rights to the water from six streams at \$100 per year for twenty years. The legislators agreed to the deal with a caveat: The aqueduct must be completed within two years.

The sugar growers organized as the Hamakua Ditch Company (the precursor to East Maui Irrigation) and got to work digging a seventeen-mile canal. The tale of the Hamakua Ditch’s construction has become legend. According to Rick Volner, general manager of Hawaiian Commercial & Sugar, the crew lacked a trained engineer and relied on “a superintendent who was a carpenter by trade, shipwrecked sailors as overseers and a workforce that at times numbered two hundred.”

Samuel Alexander and Henry Perrine Baldwin led the effort. Sons of missionaries and classmates at Honolulu’s Punahou School, they teamed up to purchase a twelve-acre sugar plantation below Makawao. Alexander wasn’t an engineer, but he designed Hawai‘i’s first major aqueduct.

His partner oversaw its construction. Baldwin was, by all reports, a powerhouse who later owned the island’s first automobile—two, in fact. In addition to sugar, he invested in a pineapple plantation, railroad, newspaper and phone company. But before any of this could happen, he had a ditch deadline to meet.

It wouldn’t be easy. Baldwin suffered a serious injury at the sugar mill in March of 1876, just before the Hamakua project got under way. His right arm slipped between the cane rollers and was crushed to the elbow. Baldwin lost the arm but not his determination. Within a month, he was riding horseback, writing with his left hand and managing plantation business. A little over a year later, the community turned out to witness the Hamakua Ditch’s first milestone: water flowing to the east side of Māliko gulch.

But it was the *west* side of Māliko gulch that sorely needed water. The 450-foot-deep gulch presented a treacherous obstacle. Alexander and Baldwin intended to shuttle water across by means of a massive siphon. Their crew was skeptical, balking at the idea of rappelling hand over hand down the sheer cliff to construct the iron monster. When no one was willing, Baldwin took the first step off the ledge, lowering himself down with one arm. Moved by his courage, the workers followed suit. Baldwin repeated the feat every day.

The pressure to finish the ditch intensified with the arrival of California sugar magnate Claus Spreckels, who was granted rights to any water on Haleakalā’s northern slope that wasn’t developed by September 30. The date wasn’t chosen arbitrarily. It corresponded with the Hamakua deadline—which meant that if Alexander and Baldwin didn’t finish in time, their ditch and the associated water would transfer to their competitor. But they did finish, with a few days to spare.

Spreckels went on to build his own aqueduct, twice as long and six times more costly than the Hamakua Ditch. For a short time, he reigned as Maui’s sugar king. But ultimately his company, Hawaiian Commercial & Sugar, was absorbed by Alexander & Baldwin’s growing empire.

Back then sugar plantations had more people than equipment. Working by the light of candles or carbide lanterns, bygone ditchmen broke through lava rock with pickaxes. They dynamited tunnels through hills to meet precisely in the middle and built wooden trestles across dizzying gulches. Without the benefit of laser transits,

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they measured distances using a rod and twenty-foot chain. Along the way they graded everything on a 1/4 percent slope so that the water would run downhill mile after mile. "Water always finds the lowest spot," Hew says. "Gravity doesn't lie."

The old Hamakua Ditch has long been out of commission, so Hew takes me to view its replacement. We stand at the mouth of a seventy-two-inch diameter pipe that plummets down steep, forested Māliko gulch to reappear on the opposite side nearly a thousand feet away. Hew once had to inspect this siphon from inside. His boss at the time was Stephen Cabral, a Portuguese old-timer who worked for East Maui Irrigation from age 18 to 70. Cabral lowered Hew down into the siphon in a cart. About halfway down, the cart suddenly lurched. The winch key had sprung. "Can you see the bottom?" Cabral hollered to Hew from above. "No." "Can you climb out?" "No." "Just hold on then." Hew clung to the safety rope for what felt like an eternity while the crew up top banged the winch back together. "It takes a special kind of person to work the ditches," says Hew.



No kidding. Today's crew is a tight-knit, loyal bunch, but one can only imagine what the original ditchmen endured if even the boss felt compelled to scale a cliff at the start of each day. Historic records are scant, but O'Shaughnessy's report from the Kohala Ditch on Hawai'i Island in 1905 gives a clue to general conditions: seventeen men died during its construction. Countless mules fell from the steep cliffs. Even the sturdiest ditchmen were so exhausted after weeks of toiling in the dark,

cold environment they required hospitalization. Workers paid for candles and dynamite out of pocket (to encourage thriftiness) and received wages according to their ethnicity. In 1886 Chinese laborers were paid \$13.56 per month and Japanese \$9.88. Workdays averaged ten hours, twenty-six days a month.

Until fairly recently a dozen or so ditchmen lived with their families along remote sections of the East Maui ditch system. That way, when flash floods or rock slides busted the flumes or breached the ditch walls, workers could readily respond and make repairs. The three-wheeled rickshaw they used to haul rocks from tunnels hasn't been improved on; Hew's crew still uses it. But the ditchmen and their humble cabins are now gone. Machines are slowly gaining on people at East Maui Irrigation. These days Hew relies on radio telemetry to monitor stream flow and a large, rotating mechanical rake has replaced the hand tool he once used to scoop leaves out of intakes.

Hew's warm, expressive face is the same milky tan color as the storm water rushing through the gates he supervises. At 60 years old, he bridges two eras. Pu'unēnē Hospital, where he was born, and the old Maui High, where he attended his first years of high school, are long gone; the plantation villages they belonged to have vanished. Hew spent most of March in court. Water politics are turbulent worldwide, and Hawai'i is no exception.

From the start, Hawaiian taro farmers opposed the removal of water they had relied on for generations. In September of 1881 thirteen Hawaiians petitioned commissioners not to turn water rights over to Spreckels. Again, in 1902, Nāhiku homesteaders protested a water lease awarded to HP Baldwin. They haven't stopped.

Today taro farmers are pleading with government officials to return water to the mountain. In response, East Maui Irrigation volunteered to restore Waiokamilo stream to 100 percent of its natural flow. Twenty-six other streams await review. As Maui enters its sixteenth year of drought and the growing population seeks water, Hew acknowledges the need to share the precious resource. Hawaiian scholar Mary Kawena Pukui captured the essence of what is at stake in a 1975 interview. "The Hawaiian word for water is wai," she said. "The Hawaiian word for wealth is waiwai; wai doubled, or said twice. When you have wai, you have life." HH

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