

home of Hessian flies seems to be in the leaves and on the stem of the plant they evolved to eat.

The fly remains. It eventually made its way into every state with a wheat patch. Pesticides never were that successful, and farmers have taken to planting around the breeding cycle of the fly and plowing infested fields under. Another strategy rises from those early 1780s reports of wheat varieties that stood straight and healthy in their fields while plants keeled over in adjoining plots. The larvae died on the resistant plants, unable to feed for one reason or another, and even as the fly pushed into new states, farmers uncovered more types of wheat that could live through the attacks. China, Red May, Red Chaff, and Mediterranean were some early resistant varieties. In the late 1800s farmers recorded that Palestine, Polish, Common March, Diamond, and Egyptian Imported proved at least somewhat resistant. At the turn of the century Prosperity, Democrat, and Red Russian joined the list. Pawnee, Omaha, Redcoat, and Ben Hur were recognized as resistant in the late 1920s. But in time the few Hessian flies that could thrive on these varieties predominated, and the breeders had to come up with something new. The Hessian fly and wheat have been together long enough to engage in an intricate evolutionary tango, and when natural selection encourages a wheat strain impervious to the fly, natural selection builds a better fly. Currently there are forty wheat varieties resistant to the Hessian fly, and others are under development all the time, as researchers try to outrun the one true fact about the fly's introduction: The hostile invader and welcome guest come traveling hand in hand.

FLIGHT OF THE MOSQUITO



WHEN HMS *Blonde* docked at Hawaii in 1825, it carried a heavy burden. The island's young king and queen, Kamehameha II and his bride, Kamamalu, had sailed to England two years before, seeking protection from King George for the Hawaiian Islands and anticipating the wonders of the civilization they'd seen reflected in nails, ships, and guns. Instead they found measles, another by-product of the great cities. Because they lived on a remote island, their bodies hadn't developed resistance to diseases that had brewed in Europe's water, air, and blood for centuries so that the English, French, and Spanish were braced against them on a cellular level. Kamehameha II and Kamamalu died two weeks after stepping off the ship, and the *Blonde*, under the command of George Anson Byron, the poet's cousin, brought their remains home to their subjects.

No one got what they expected, not the young king and queen traveling abroad, not the islanders waiting to welcome their rulers home, not the Europeans, some with visions of Hawaii as a primitive dreamland. Ever since Captain Cook landed there in 1778, a steady stream of whalers, sandalwood traders, missionaries, and diplomats followed in his wake, not dissuaded by the fact that Cook had been killed by natives on his last visit. In places, instead of lush tropical greenery, the *Blonde* crew found parched earth, stomped by cows and goats brought by earlier European

visitors. The natives frequently struck travelers as dirty or greedy and often sick.

Still, those on the *Blonde* with modest expectations were charmed by the feathery coconut palms and breadfruit trees clustered on the beaches and the waterfalls draining into the sea. In the mornings Mauna Loa volcano glowed with pink light, otherworldly and strange. In the afternoons the visitors could watch natives scooting canoes through the curl of a wave or pick the wild strawberries that pushed through the lava. In the evenings Hawaii's bright birds winged through the forest, pausing to coax nectar from lobelias with beaks curved to fit the flowers' long throats. If all that wasn't enough to lull the sailors into believing they'd found a scrap of heaven in the Pacific, there was this: not one mosquito.

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SLAP.

In 1826 Hawaiians living near Lahaina in Maui heard an unfamiliar whine. High and almost hysterical, it ripped the twilight like an arrow. Heavy with sleep, they'd be slipping away when the hum began, first distant, then ringing inside the whorls of their ears. Shaking their heads or waving their fingers brought only a moment's quiet. Swinging an arm toward the sound, they might catch an insubstantial insect, all legs and wings. Crush it, and their palms would cup a black smear of thorax, head, antennae, and a brushstroke of blood. In the silence they drifted into unconsciousness. In the morning red and itchy bumps mottled their bodies.

They brought their questions to Gerrit Judd, a doctor from America, and showed him their swollen arms and legs. While his main duty was treating the missionaries who came to Hawaii to offer Christianity to the islanders, he also tended the natives, performing surgeries, treating them for syphilis, measles, influenza,

and other diseases that slid into port with whalers and merchants. Indeed, by the time Dr. Judd arrived, the native Hawaiian population had dwindled to less than half of what it had been when Captain Cook first landed, dropping from 300,000 to little more than 130,000. For a people so wrecked by change, this new inconvenience could hardly have appeared significant. It was just one more inexplicable shift.

The missionaries, though they knew their tormentor's name, still suffered. Craving relief from the voracious newcomers, Laura Judd sewed mosquito nets for her family out of calico, which kept the bugs away but almost smothered the children. In a letter to the missionary board, Dr. Judd wrote, in the tone of a man near the brink, "O the mosquitoes! Do buy all the mosquito curtains necessary for the use of all who are bitten."

Dr. Judd and the missionaries tracked the newcomer to the *Wellington*, a merchant ship that had come from Mexico to the port at Lahaina, one of the main stops for whalers seeking to restock supplies. A rowdy village, Lahaina catered to the tides of sailors that flooded in, frantic with shore leave, demanding sex and alcohol and quickly, and then drained away again. According to shipping records, 138 whalers docked at Lahaina in 1826. Merchant and government ships swelled that total. Hosting both a mission and a constant stream of sailors, Lahaina was a microcosm of the tensions that wracked the island chain. The scraps of ground and the Hawaiian people themselves were wrestled over with the ferocity of two dogs at a rope, though the missionaries and sailors were not playing. The merchants needed the natives for crews, entertainment, and sandalwood harvest, while the missionaries urged the Hawaiians to stay home, plant crops, and save their souls.

Before sailing away, the *Wellington* crew emptied the dregs of the ship's water barrels into Maui's streams. Mosquito larvae squirmed in the water, surely visible to the naked eye. Some accounts say that the crewmen, upset that the missionaries had

convinced the Hawaiian women not to sleep with them, dumped the insects out of spite. Or maybe the Hawaiian government was too deep in debt in the sandalwood trade and the frustrated merchants decided that if they couldn't recoup their money, at least they could share the misery.

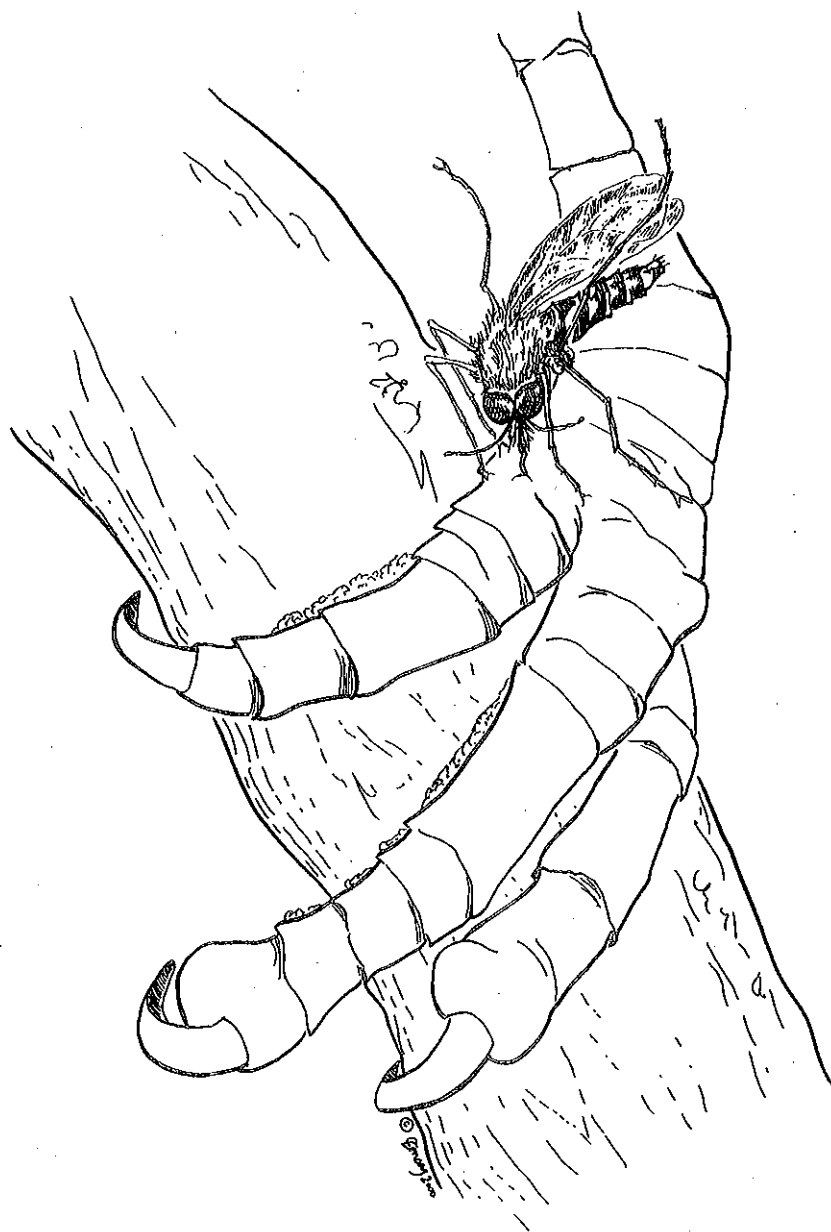
The revenge motive seems farfetched and reeks of myth. Innocence or indifference is a much more likely reason for the mosquito's introduction. But a small voice says, "Why not?" Sailors, furious when missionaries discouraged native women from visiting the ships, attacked the house of the Reverend William Richards in Lahaina repeatedly in 1825 and 1826. Crewmen assaulted the governor and stormed the jail in order to release women held there. In 1827 the *John Palmer* blasted the mission with a cannon.

In comparison to this violence, the scattering of mosquitoes might have seemed like the throbbing of unsatisfied lust—sleep-wrecking, unbearably irritating, but ultimately harmless.

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THE mosquito larvae wriggled in these new pools on Maui, not as ideal a cradle as barrels of stagnant water, but not lethal either. Warm air buffered their arrival, and the water crawled with food. Segmented like an earthworm, each larvae displayed an enlarged thorax and head that disrupted the sinuous shape. Sweeping in bacteria and other microscopic organisms with their brushy mouthparts, they grew and molted, pushing through larger and larger larval forms.

Eventually the infant bloodsuckers turned into pupae, curved like bean sprouts. Here they didn't eat, just breathed and swelled. Inside the newly hard shells they developed wings, legs, and mature sex organs, then finally broke through the casings, splitting them down the back, stepping out as adults. A few moments after emerging, one rested on the surface of the water or on a



scrap of pupal case, slim and almost graceful, six long legs supporting the frame, drying in the warm air.

In the first days, trying out her new wings, she fed on nectar and fruit juice, like her male counterparts. The sugar energy readied her for mating almost as soon as she left the water. But after copulation she needed to eat in a way that would push her eggs to develop and mature; she looked for blood.

The mouth of the female mosquito is deceptively simple. The basic needle encases a toolbox of appliances: barbs to pierce the skin and capillary, a syringe to inject saliva that dilutes the blood, and a feeding tube to suck up the meal. Humming through the night forest, she sensed blood, taking in the smell, the carbon dioxide wafting from exposed skin. Near a village she might have found a colony of rock doves, introduced in the 1790s, dozing on the branches. Probing one dove until she discovered a vulnerable spot, the mosquito then shot her lancets through the skin and into a capillary and eased the feeding tube and syringe in alongside. As the blood pooled and the saliva thinned it, she fed until her insides bloated or the dove shivered to dislodge her.

With the blood-fed eggs maturing, the female searched for a spot to set them. Any basin of still water would do. After sending out a raft of several hundred eggs, she zipped back through the trees, looking for blood to nourish another batch. This time the mosquito might have sniffed out an amakihi, a greenish yellow bird native to Hawaii, sought skin on the foot or the corner of the beak as the bird shifted in sleep, and pushed the needle mouth in.

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HELPED by wind and more and more ships, mosquitoes spread to other islands. Twenty years after the *Wellington* had emptied its barrels, an island-hopping traveler named Chester S. Lyman stopped at Kealakekua Bay on the island of Hawaii and stayed overnight with a missionary. His joy in the morning gives an indi-

cation of what the rest of the trip was like. He wrote, "A kind greeting, a shower bath, a change of raiment, an excellent supper and after family worship a good bed free from fleas and mosquitoes were all very desirable and delightful." Another visitor, in 1868, commented on the influx of exotics in general: "The bad and the good have been introduced into that country in very equal proportions—the most beautiful trees, loveliest flowers, and delicious fruits, with the most annoying insects and loathsome diseases. . . . As for mosquitoes and white ants, words could not do them justice—the former devour you and the latter devour your furniture and books."

By the turn of the century, mosquitoes had evolved into stock scenery for dramas about Hawaii, like tropical breezes and coconut groves. Characters chided one another for discussing the insects; it was as boring as talking about the weather. The pesky bugs provided a dash of authenticity to Hawaii-based travel stories with titles like "Halcyonian Hawaii" and "Love-Life in a Lanai." No one remembered where they had come from.

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THE Hawaiian Islands, crests of submerged mountains far taller than Everest, created by lava piling up from the ocean floor, were first colonized by storms. Wind and waves brought their offerings: a pinch of fern spores, a wave of beetles, a flock of geese dazed by a hurricane. Estimates say a new species may have arrived only once every hundred thousand years, but there was no hurry.

About three million years ago a handful of small, adaptable birds arrived in the Hawaiian Islands. At least twenty-five hundred miles from the rest of its kind, the species mutated and shifted, changing so drastically that it is difficult to tell what it originally was, where it came from, what ancestor on the mainland can claim it. Time, like a sculptor with only one shade of