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Not My Fault: Remembering a horrific earthquake a century later and building disaster resilience for the future

Lori Dengler for the Times-Standard

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Tokyo Imperial Hotel 1923

Imperial Hotel by Frank Lloyd Wright on the left, shortly after the Great Kantō Earthquake of 1923. Wikimedia Commons.

Every September first is Disaster Prevention Day (防災の日 Bousai no hi) in Japan. It's a day to take stock of hazards, conduct drills, and promote awareness. Like most commemoration, Bousai no hi was born of catastrophe, the deadliest disaster in Japan's history. This year the remembrance is even more poignant, marking a century since the Great Kanto earthquake leveled Japan's most populous area.

The September 1, 1923, earthquake is memorable in many ways. At least 140,000 people died or went missing, the tenth deadliest quake of all time. As in many earthquakes, ground shaking wasn't the only problem. Impacts were exacerbated by liquefaction, tsunami, landslides, fires, a typhoon, aftershocks, and societal chaos in the minutes, hours, and weeks after the earthquake.

Japan sits in a complex tectonic environment where four plates (Pacific, Eurasian, North American, Philippine) interact. The Great Kanto earthquake, (magnitude 8), was near the quadruple junction area where these plates come into the closest proximity. The primary rupture occurred where the Philippine plate underthrusts the southeastern edge of the North American plate. A M7.9 a day later ruptured a different fault about 50 miles away from the mainshock. Over the next year, 15 earthquakes of magnitude 6 and larger were reported but only two were on the same rupture as the 8.0, suggesting that numerous faults were involved with the sequence.

All of this would be academic except for location. The mainshock was centered in Sagami Bay just offshore of Kanagawa Prefecture, only 20 miles from the center of Yokohama and 55 miles from Tokyo. In 1923, this was the most populous area of Japan, home to over 8 million people. Engineers have estimated that half of all brick buildings and 10% of concrete structure in the Yokohama – Tokyo area collapsed. Liquefaction, the phenomenon of saturated sediments behaving like a liquid, made low lying port areas like Yokohama particularly vulnerable.

Much of the fault rupture in the M8 mainshock occurred beneath the deep waters of Sagami Bay. Thrust faults shove the rocks up over each other and the Great Kanto earthquake caused nearly 30 feet of slip, deforming the sea floor, and lifting the water in the Bay above it. The result was a tsunami that struck the Izu Peninsula and areas of the coast south of Tokyo only minutes after the earthquake with peak water heights of nearly 30 feet. Over 2000 of the casualties are attributed to the tsunami.

Anyone who has visited Japan knows that the terrain is rugged. The four-plate interaction has produced steep mountains and unstable slopes. The 1923 earthquake and aftershocks triggered landslides throughout the mountain areas of Kanagawa Prefecture. A large landslide near the city of Hakone pushed an entire village, a passenger train carrying over 100 passengers, and the railway station, into the sea.

All earthquakes are affected by time of day and time of year. We were fortunate last December 20th that the Ferndale earthquake struck while almost everyone was in bed. In California, our homes are resilient and being asleep meant no one had time to race out of buildings during the strongest shaking. The result was far fewer injuries than in other recent quakes. Japan in 1923 was unlucky. The earthquake struck two minutes before the noon hour on a busy Saturday.

Lunch time on that Saturday 100 years ago meant preparing lunch over small charcoal-burning hibachis. The shaking upended the stoves, triggering fires. To make matters worse, the earthquake coincided with a typhoon that fanned the fires, turning a number into infernos. Like the 1906 San Francisco earthquake, shaking disrupted water supplies and the ability of fire fighters to reach fires. It took at least two days to contain the blazes. Most assessments attribute the greatest loss of life and structures to the fires.

An uglier consequence of the 1923 earthquake was attacks on people thought to be of Korean ancestry. Rumors run rampant in the aftermath of all disasters and in 1923 word spread that Koreans were taking advantage of the disaster and looting shops. Violence quickly escalated fueled by anti-Korean sentiment at the time. There are conflicting reports of casualties in what historians call the “Kanto Massacre,” and the Japanese government still denies that it ever occurred (<https://www.barrons.com/news/it-hurts-my-heart-japan-s-kanto-massacre-100-years-on-5a15de14>), but numerous scholarly articles document the event and estimate at least 6000 deaths from rampaging mobs in the days following the earthquake.

The Great Kanto earthquake is not only a story of loss. A notable survivor was Frank Lloyd Wright’s Imperial Hotel. There were no earthquake building codes when Wright proposed his designs for the building, but he recognized both shaking resilience and the fire threat. His autobiography recounts a debate with hotel directors in 1921 about the importance of the pool, “I told him via interpreters that it was the last resource against the quake. In a disaster, the city

water would be cut off, and the window frames being wood in the 500---foot building front along the side street where wooden buildings stood, fire could gut the structure even though it withstood the quake.”

The Imperial Hotel did not escape unscathed. Pieces of stonework fell, and a small fire began in the kitchen when stoves toppled, but it remained useable and housed several diplomatic missions including the American Embassy in the aftermath of the earthquake.

Many of the principles that Wright employed have become part of building codes in earthquake country today – broad footings to resist liquefaction, tapered walls with added strength on lower floors and a copper roof with no heavy tiles. Unfortunately, the hotel itself no longer stands. After 40 years, it was deemed out of style and replaced.

A less reported consequence of the Great Kanto earthquake is the role of the military in the disaster. Jeff Beck at the University of Nevada Reno has researched the history of Japan’s military and notes that before the earthquake, the popularity of the military was at a low point as the middle class grew and support for democratic institutions rose. In the chaotic aftermath of the earthquake, the military restored order and public support quickly followed. One can argue that the Great Kanto earthquake was one piece leading to the ascendance of Japanese militarism ultimately resulting in World War II.

If any country in the world understands the challenges of living with natural disasters, it is Japan. One hundred years after the Great Kanto earthquake, Japan is the most densely instrumented, has the most stringent earthquake resistant construction codes, and spends a greater percentage of its GDP on disaster research than any country in the world. Bousai no hi is an annual reminder that not only engineers and scientists are part of the resiliency effort, but all of us are too.

Note: listen to this podcast that puts you in Tokyo on September 1, 1923

<https://www.japantimes.co.jp/podcast/2023/08/31/deep-dive/tokyo-kanto-1923-earthquake/>

Lori Dengler is an emeritus professor of geology at Humboldt State University, an expert in tsunami and earthquake hazards. The opinions expressed are hers and not the Times-Standard’s. All Not My Fault columns are archived online at <https://kamome.humboldt.edu/taxonomy/term/5> and may be reused for educational purposes. Leave a message at (707) 826-6019 or email Kamome@humboldt.edu for questions and comments about this column. Downloadable copies of the North Coast preparedness magazine “Living on Shaky Ground” are posted at <https://rctwg.humboldt.edu/prepare/shaky-ground>.