

Study: Largest historic fire death toll belongs to aftermath of 1923 Japan earthquake

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Fires that raged in the days following the 1 September 1923 magnitude 7.9 Kantō earthquake killed roughly 90% of the 105,000 people who perished in and around Tokyo, making it one of the deadliest natural

disasters in history—comparable to the number of people killed in the World War II atomic bombing of Hiroshima.

The story of the conflagration, not well-known outside of Japan, holds important lessons for earthquake scientists, emergency response teams and [city planners](#), according to a paper published in the *Bulletin of the Seismological Society of America (BSSA)*. The paper is part of an upcoming BSSA special issue on the 1923 Kantō earthquake.

The fires—which were foreseen and foretold by a contemporary seismologist—led to the first lessons in earthquake protection for schoolchildren in Japan after the earthquake. More recently, the history of earthquake-related fires in Japan has led to seismic shutoff valves being placed on gas meters throughout the country.

The threat of earthquake conflagrations has not disappeared. The authors say places with strong seismic shaking and a large inventory of wood-framed buildings—the U.S. West Coast including Los Angeles, San Francisco and Seattle, Japan and parts of New Zealand—must emphasize [fire prevention](#) and response as part of their earthquake mitigation plans.

The researchers found that fewer than 5% of the literature written about the 1923 Kantō earthquake discusses the fire in detail, despite that fact that fire storms caused the majority of damage and deaths compared to severe ground shaking and liquefaction. Recent calculations put the fire losses at a total of almost ¥ 1.5 billion. For comparison, Japan's total national budget for 1923 was ¥ 1.37 billion.

For these reasons, the authors say, the event should be known as Kantō Daikasai or the Great Kantō Fire Disaster instead of the more common name of Kantō Daishinsai or Great Kantō Earthquake Disaster.

Foreseen and foretold

The conflagration following the earthquake had been envisioned in 1905 by Imamura Akitsune, an assistant professor of seismology at Tokyo Imperial University. He theorized a seismic gap in the region and suggested a large earthquake was due. He warned that citizens of Tokyo would have no place to shelter from fires triggered by such an earthquake. He suggested measures such as abolishing kerosene lanterns and creating setbacks between new buildings to lessen the danger.

Imamura's warnings, however, were ridiculed by Japan's leading seismologist at the time, Ōmori Fusakichi, a senior colleague, who did not believe in the seismic gap theory. Ōmori also thought earthquakes rarely took place in stormy or windy weather, so there would not be enough wind to cause fires to spread.

The Kantō earthquake occurred two minutes to noon on 1 September, when many citizens were lighting traditional kamado cooking stoves and shichirin and hibachi grills to cook a midday meal. Ground shaking toppled many of these, and within the first hour after the earthquake there were one hundred fires across the city—"a city largely built up of cheek-by-jowl light wood and paper housing," said Charles Scawthorn, a researcher at the Pacific Earthquake Engineering Research Center, University of California at Berkeley.

"Under ordinary circumstances, the Tokyo fire department would not have been able to address all these fires, but compounding the situation were hundreds of breaks in the water mains, so that firefighters were largely powerless," said Scawthorn, co-author of "[Fire Following Earthquake](#)".

The fires merged until some were so large that they generated their own high winds, turning into fire whirls or cyclones that consumed everything in their path.

In the *BSSA* paper, Tomoaki Nishino of the Disaster Prevention Research Institute at Kyoto University helped to explore the big picture of the fires including wind-blown fire plumes and model the spread of the fires, especially their relationship to wind direction and velocity. Nishino also looked at how an urban fire might spread in Kyoto City after a possible magnitude 7.5 scenario earthquake along the Hanaore fault.

"Large fires after an earthquake depend not only on the strength of the shaking, but on other conditions like the weather and built environment," Nishino explained. "If the area consists of many fire-resistant buildings, or a low density of buildings, the conflagrations would not occur."

"The collection of those conditions is less frequent than strong shaking, so the devastating regional impact of fires following earthquakes is less frequent compared to that of earth shaking," he added. "But there can be a time when the number of simultaneous fires overwhelms firefighting capabilities."

History lessons

The *BSSA* authors also discuss the profound impact of the conflagration on urban planning, politics and education in Japan in the years following the destruction. Janet Borland, a historian at the International Christian University in Tokyo, became interested in studying the Kantō earthquake and [fire](#) after experiencing the 1995 Hanshin-Awaji or Kobe earthquake as an exchange student. She is the author of "[Earthquake Children: Building Resilience from the Ruins of Tokyo](#)", detailing the impacts of the 1923 event on children and education.

Borland has collected more than 2000 firsthand accounts of the event [written and illustrated](#) by children. "They give us a really valuable insight into the individual experiences of this catastrophic event in Japanese

history, all across Tokyo," she said, "of children who experienced fires, who watched parents drown in the Sumida River, or who were on the outskirts of the city and saw all these refugees evacuating."

Imamura "invested so much as a seismologist in public education" after 1923, including pushing for the very first earthquake safety lesson in the Japanese school curriculum, Borland said. "He convinced the Ministry of Education officials, 'we're an earthquake nation, we need to teach our children what to do when an [earthquake](#) strikes.'"

Charles Schencking, a historian at the University of Hong Kong, began studying the [Kantō event](#) by looking at "how the elites interpreted the disaster, how they attempted to use the disaster to not only rebuild the capital but to reconstruct the nation on a social or ideological level," he said.

But Schencking, author of "[The Great Kantō Earthquake and the Chimera of National Reconstruction in Japan](#)", also was drawn to the variety of stories about how people survived those terrible days.

"The harrowing personal accounts and the emotiveness of the material just drew me in and helped me become a different kind of historian," he said. "The broad range of approaches you could take to learn about society by studying a disaster and the response that follows is to me immensely rewarding."

"Imamura foresaw and foretold—science can warn, but economics, politics and resources must be mobilized if a warning is to have any effectiveness," Scawthorn said.

More information: Charles Scawthorn et al, Kantō Daikasai: The Great Kantō Fire Following the 1923 Earthquake, *Bulletin of the Seismological Society of America* (2023). [DOI: 10.1785/0120230106](https://doi.org/10.1785/0120230106)

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