Times Standard

# Not My Fault: Reports from people are an important part of understanding the 1954 earthquake

Lori Dengler for the Times-Standard
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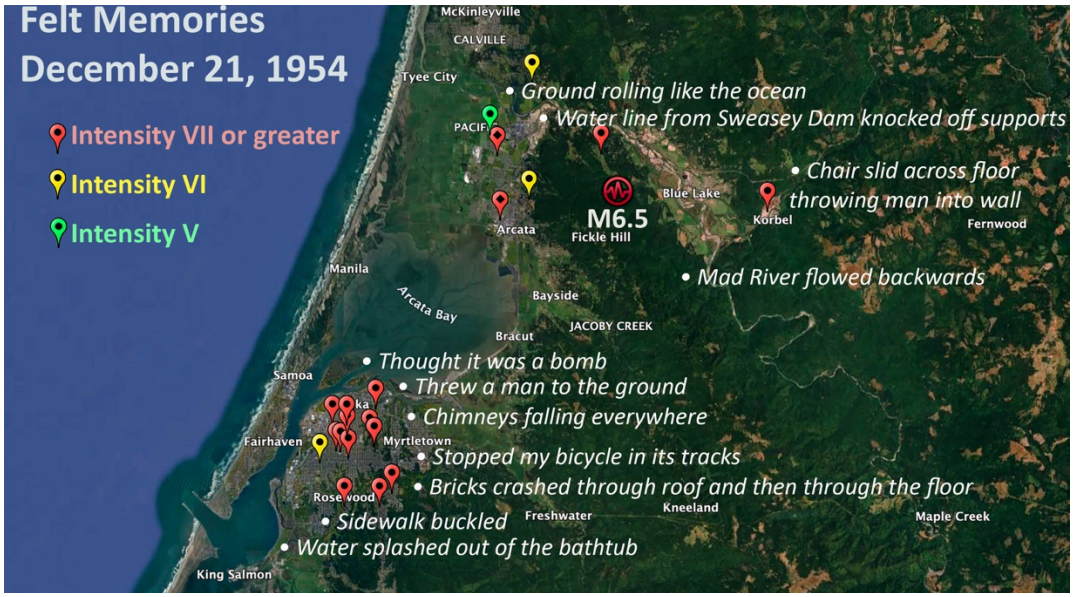


*Locations of people volunteering their experiences of the 1954 earthquake. Most likely epicenter location noted. Red denotes descriptions of Intensity of at least VII, yellow Intensity VI, green Intensity V. Abbreviated clips from a few of the over 30 responses shown. (Contributed)*

Last week I focused on how re-examining the seismic recordings from the December 21, 1954 magnitude 6.5 earthquake helped to locate it beneath Fickle Hill. Applying modern seismic analysis techniques to the old paper records was an important part of the sleuthing job Peggy Hellweg and her team used to determine that this earthquake has all the earmarks of being located on the Cascadia subduction zone interface (see link to the BSSA paper below).

My contribution to the study looked at a different type of data that is also important in studying earthquakes – both recent and old. Macroseismic analysis examines how earthquakes impact people, both the built environment and perceptions of shaking. Until the advent of seismographs in the late 19th century, this was the only systematic way to document earthquakes.

There have been a number of shaking scales (Intensity) used over the years. The U.S. adopted the twelve point Modified Mercalli Intensity (MMI) Scale in 1931 (see Not My Fault 4/16/22 for more background). The levels are designated by roman numerals and described in terms such as “felt by many people inside, although not always immediately recognized as an earthquake”

for intensity III and “Felt by all; frightens most; most find it difficult to stand or walk” for intensity VII.

Intensity data is inherently qualitative and much more time consuming to gather than determining magnitude. It requires sampling a large area and, for major earthquakes, detailed field studies. To streamline the process, the U.S. Coast and Geodetic Survey (USCGS) developed a postcard survey form for postmasters, asking them to summarize impacts in their communities. The USCGS had the responsibility for monitoring U.S. earthquakes until it was absorbed into other agencies in 1970 and the USGS took over that role, including the postcard intensity surveys.

The importance of macroseismic data such as the postcard surveys was deemed of lesser importance in the late 20th century as accelerometers, instruments that record how strongly the ground shakes, were installed more widely. The last earthquake for which the USGS sent out postal questionnaires was the 1994 Northridge earthquake. I worked closely with USGS seismologist Jim Dewey on comparing intensities inferred from postcards to develop the Community Intensity Scale, based on questions that could be more easily quantified and statistical sampling.

Jim and my study of Northridge would become the analytical framework for what is now the “Did You Feel It?” web site when the USGS group headed by Dave Wald would take it much further than we ever envisioned. It is now the main repository for felt reports – the April 2024 M4.8 earthquake in New Jersey garnered more than 180,000 postings – and is used internationally to estimate shaking strength in areas where instruments are sparse.

When our research group began to dig into the 1954 earthquake, I quickly thought about all those postcard reports and what information they may have contained. Fortunately, one member of our group has taken over the mantle for macroseismic studies at the USGS and was several steps ahead of me. Sue Hough immediately turned to the data repositories to see what she could retrieve.

Sue found the summary reports where USGS or the Coast and Geodetic Survey staff analyzed the postcards and listed the likely shaking strength. The postcards themselves were digitized a number of years ago but we don’t know their location and Sue has not been able to find the original 1954 data. Our quake is not the only one to have vanished – other notable earthquake years like 1952 (Kern County M7.5) and 1971 (San Fernando M6.6) are also MIA. Sue is planning a more detailed examination of the data archives and I’m crossing fingers she will be able to eventually recover the originals.

The summary reports augmented by newspaper accounts still provide a rich data resource, including over 500 locations where the 1954 earthquake was reported felt or not felt. One of the challenges in estimating shaking strength for rural areas with few large buildings is macroseismic intensity scales’ dependence upon damage to structures. There are many 1954 reports of downed chimneys (indicating MMI≥VII) but the epicentral region was undeveloped and were no buildings.

Here's where I entered the study. A year ago, I began requesting memories of people who experienced the 1954 earthquake. I put out a query in this column (7/27/2024), in the Senior

News, and in several Facebook groups. I talked to friends and acquaintances who grew up in Humboldt. I received over thirty stories of what had happened. All of my respondents were children at the time, several as young as three. Their memories weren't comprehensive like the postcard reports, but they recalled had stuck for the past 71 years and were surprisingly vivid. Their stories provide a glimpse into that moment in 1954 when an ordinary day turned extraordinary.

One of my favorite accounts was a girl looking out of the window of her house on the Arcata Bottom only to see "cows from the dairy across the street running across the field. The land was rolling like ocean waves which seemed about twenty feet deep. The cows looked like camels, all distorted with their haunches several feet above their heads as they all staggered to the east in one mass." Boys in Eureka saw the sidewalk momentarily bulge up, crack, and then return to where it had been. An 11-year-old girl on a bike was suddenly jerked to a stop and amazed to see the ground undulate, chimneys topple and a woman in curlers and a dressing gown run out of her house.

Almost everyone who was outside at the time commented on the ground rolling. Visible undulations of the ground caused by the passage of seismic waves has been described in some of the earliest accounts of earthquakes. "Waves seen on ground surfaces" rated the highest intensity XII in the 1931 version of the MMI. It hasn't received much scientific attention in recent years but has certainly been observed in a number of large earthquakes including Loma Prieta in 1989 and the 1992 Cape Mendocino earthquake at intensities in the VI and VII range.

There were several 1954 newspaper accounts of fishermen seeing the Mad River reverse flow. I was able to corroborate these stories when a friend saw my request for 1954 information. For many years he lived next door to Mark Rhea, a former soils professor at Humboldt and he recalled how Mark would tell him about his fishing experience. He was near Blue Lake when he felt the earthquake and water suddenly began to flow upstream. I wasn't able to talk to Mark directly as he died in 2010, but I trust this account.

How does an earthquake reverse river flow? Most likely by causing a seiche – an oscillation in water bodies that can be triggered by a number of causes including seismic surface waves. The most famous example of a river flowing backwards are descriptions of the Mississippi after the 1812 New Madrid earthquake centered in SE Missouri but there are other accounts as well including the 1932 earthquake near Lodi, California.

Hamid Haddadi who runs California's Strong Motion program used the postcard summaries, newspaper accounts, and my collated memories to create a new ShakeMap for the 1954 earthquake in the Fickle Hill BSSA paper. This macroseismic data bolsters the conclusions from the seismic analysis that it is unlikely to be shallow and centered on a near-surface fault. Shallow earthquakes are felt very strongly in the epicentral area and die out fairly quickly with distance away. Conversely, a very deep earthquake exhibits weaker epicentral shaking and a slower decay of shaking strength with distance.

Can we now close the book on 1954? Like many projects, this study has opened up more questions. Peggy Hellweg is now searching more distant seismic records to see if they can confirm our conclusions. Sue Hough hopes to find the original postcard data, and I am still soliciting memories, not only of 1954 but other earthquakes as well. It is time for a more

serious investigation of visible earthquake surface waves – how big and how shallow does an earthquake need to be to see them? Did those same waves that people saw in 1954 trigger the seiche in the Mad River as well? I'm hoping to collar one of my tsunami modeling friends to help me find the answer.

For links to the BSSA paper, visit https://www.seismosoc.org/news/mysterious-fickle-hill-earthquake-in-northern-california-may-have-unexpected-source/. The recent Intensity accounts are posted at https://kamome.humboldt.edu/sites/default/files/SuppMaterial-Appendix-S1-Intensity-Reports.pdf

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Lori Dengler is an emeritus professor of geology at Cal Poly Humboldt, and 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 or to request copies of the preparedness magazine "Living on Shaky Ground."