BOOKS & ARTS

Why we cannot predict earthquakes

Roger Bilham enjoys a history of a potentially useful field in which spectacular failures can win accolades.

Predicting the Unpredictable: The Tumultuous Science of Earthquake Prediction
by Susan E. Hough
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J. SILVA/REUTERS

Haiti: a grim and embarrassing reminder of seismology's shortcomings.

The recent earthquake in Haiti is a grim and embarrassing reminder that seismologists cannot predict earthquakes. Susan Hough's book about earthquake prediction reminds us that many respectable scientists and numerous nutcases have tried — and failed. *Predicting the Unpredictable* tells us what has been tested and abandoned, and why. It follows the winding path taken by this potentially useful discipline in the past four decades, from the shadows to centre stage and back again.

Earthquakes do not recur with the precision of astronomical eclipses, nor do they have the signature of an inbound hurricane. But they do obey the laws of physics, so that in principle we should be able to forecast their approach. Technological advances are on our side: telemetered networks of seismometers that generate a vista of earthquake locations, magnitudes and mechanisms within minutes of their occurrence; a constellation of global positioning satellites that quantify the movements of Earth's surface; and a 10,000-year history of previous earthquakes caused by incremental slip in the fault lines that cut our continents.

Yet even if we know where and by how much a typical fault slips, we cannot predict the time, location or magnitude of the next earthquake. We are interested only in a small subset of earthquakes — those that are severe enough to cause human harm. But even the smallest tremor cannot be foreseen. Earthquakes occur all the time; the biggest unknown is why, without warning, little earthquakes grow to become big ones.

The idea that earthquakes should announce themselves with a precursory alarm is central to their prediction. "If stresses build up for hundreds or thousands of years, one imagines the earth sends out some sorts of signals as a fault reaches the breaking point," Hough suggests. She leads us through the litany of signals we have sought — accelerated strain changes, transient uplift of the ground, gas emanations, electrical and magnetic anomalies, changes in seismic velocity, micro-earthquakes and water-table changes — and shows how each has failed the critical tests that scientists have erected to distinguish between coincidence and consequence.

Famous moments in earthquake prediction are dissected for the reader through Hough's diligent research in obscure archives; history will thank her for following these abandoned threads. She discusses the apparently successful prediction of the 1975 Haicheng earthquake in China that emboldened the US prediction effort, but which is now considered to be a coincidence of the foreshocks and anecdotal traditions and beliefs.

California's Palmdale bulge, an uplifted region centred on the big bend of the San Andreas Fault, was a springboard for prediction research in the United States. The theory that it would be the site of a huge earthquake was deflated with the discovery of statistical errors in decades of hard-won levelling data from land surveys in the area. The prediction experiment that began in 1985 in Parkfield, California, established that some earthquakes lack any precursory signals, but must be congratulated for the clarity with which it did so. Most riveting is the account of the Brady–Spence prediction in 1981 of an earthquake in Peru. The earthquake never happened and the prediction was later withdrawn, but the archives of the discussions related to its evaluation provide astonishing and sometimes comical reading.

It is no small feat to write a history of earthquake prediction in which every attempt is associated with a named colleague who has, in one way or other, failed to deliver. Hough treads this difficult path with humour and intelligence, leaving the reputations of her colleagues untarnished. As examples of scientific integrity, some spectacular prediction failures win accolades of praise. After being made aware of a flaw in their promising method for predicting earthquakes, for example, the proponents of the 'accelerating moment release' theory were enthusiastic in refuting their own idea.

There is something for everyone in *Predicting the Unpredictable*, whether they are seismologists, students or senators. Even the nutcases will benefit from Hough's tactful discussions in this masterly summary of why we cannot predict earthquakes. Yet there is hope that we will. ■

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