BOOKS: VOLCANOLOGY

Not "A Piece of Cake"!

Haraldur Sigurdsson

Thousands of people have died in volcanic disasters this past century. The notable 1902 eruption of Mont Pelée in Martinique killed 28,000; the more recent in 1985 eruption of Nevado del Ruiz in Colombia, 25,000. We tend to attribute such death tolls to a combination of poor planning and the lack of response by the general public, who remain unaware of often obvious alarms. What is generally less known, however, is that those who should be best informed about volcanic hazards continue to die on active volcanoes around the world: at least 32 volcanologists have been killed in the field since 1947. Is volcanology such a primitive science, that repeatedly its practitioners die in action because of our poor understanding of this violent natural process? Or are these scientists a fool-hardy lot, whose hard-driving ambitions lead them to take unacceptable risks?

No Apparent Danger
The True Story of Volcanic Disaster at Galeras and Nevado del Ruiz
by Victoria Bruce
HarperCollins, New York, 2001. 251 pp. $26, C$39.50. ISBN 0-06-019920-2.

Surviving Galeras
by Stanley Williams and Fen Montaigne
Houghton Mifflin, Boston, 2001. 280 pp. $25. ISBN 0-618-03168-5.

In January 1993, an international group of scientists met in Pasto, Colombia, at the foot of Galeras volcano, to conduct a workshop on volcanic hazards. Galeras was one of fifteen volcanoes targeted for a decade of intensive study under a United Nations program for the reduction of natural hazards. The scientists included volcanologists, volcanic gas geochemists, seismologists, and other specialists on active volcanoes. The meeting's importance was greatly heightened by the 1985 Nevado del Ruiz disaster, because the death toll from the mudflows caused by that eruption could have been prevented altogether had Colombian civil authorities heeded a hazard-zone map and other warnings of scientists who were monitoring the volcano.

After a half century of inactivity, Galeras experienced several small explosive eruptions between 1988 and July 1992. But it appeared quiet when, for one of the workshop's field trips, 14 scientists descended into the caldera to examine the gases emanating from its inner cone. They were led by Stanley Williams, an American volcanologist who had convened the meeting. As they were winding up their studies on the floor and rim of the crater, the release of pent-up gas pressure inside the volcano ripped apart a dome that had plugged the vent. The small explosion ended the lives of six scientists and threw their remains hundreds of meters from the crater. Three tourists who had tagged along were also killed. Several survivors, some badly wounded, struggled up the caldera walls to safety. Two remarkably brave female volcanologists rushed up Galeras and descended without hesitation into the caldera to rescue others; their quick action clearly saved the lives of the most seriously injured, including Williams. Surprisingly, only two of the scientists had worn hard hats or used other safety equipment. The international volcanological community was dumbfounded over the disaster and the loss of their friends and colleagues, but the rest of the world wondered how so many "experts" could become the victims of the phenomenon they claimed to know so well.

Earlier eruption. May 1989 blasts propelled a plume of ash over Galeras.

CREDIT: STUDIO HERRARA, PASTO/COURTESY HOUGHTON MIFFLIN

The Galeras volcanic disaster is the topic of two recent books, which approach the tragedy from very different directions. In *No Apparent Danger*, former science writer and geologist Victoria Bruce offers a vivid picture of the event, one based on thorough investigation and extensive interviews with survivors and rescuers. A journalistic account, her riveting and suspenseful book is hard to put down. One of Bruce's main theses is that the scientists, and in particular Williams, had not fully evaluated the dangers before descending into the caldera and climbing the active cone. She raises sensitive issues of competition and professional jealousy among scientists, and she exposes the sad truth that available information is not always shared—sometimes, such as between the seismologists and gas chemists, with deadly results.

A peculiar type of low-frequency (2 to 3 Hz) or long-period seismic events, called *tornillos* (screws) by Latin American volcanologists, had been observed from Galeras for about two weeks before the fatal eruption. These events are thought to be caused by near-surface bubble formation in magmas or some sort of fluid pressurization process; they had been used successfully to predict an eruption elsewhere. While seismologists thought the *tornillos* could mean an eruption was imminent, the gas chemists could point to the low sulfur dioxide emission and therefore claim that there was little likelihood of an eruption. Sadly, volcanologists do not look good when each sub-speciality likes to promote its own predictive method and ignores the others.

Bruce makes relatively few judgments and manages to maintain her distance from the subject, leaving interpretation and conclusions to the reader. Regrettably, one gets the feeling that the actions of the volcano experts are often driven more by ego and infighting than by balanced judgment based on scientific information.

In *Surviving Galeras*, Williams, working with professional writer Fen Montaigne, provides a completely different perspective on the disaster. In his frank but admittedly unclear account, Williams honors those who died in the crater. He paints a wonderful picture of their lives and work, and he movingly describes the grief of their families. The flow of his narrative, however, is frequently interrupted by explanations about how volcanoes work and examples of famous eruptions. These distracting forays merely repeat published work. Regrettably, Williams emphasizes the bravado of work (sometimes with questionable goals) in and around craters at high risk. Thus, there are frequent references to "macho" elements, such as "sucking volcanic gas" as the proper rite of passage for a budding volcanologist. But the only heroes to emerge from his tragic story are those who entered the caldera to rescue the wounded.

For scientists, perhaps the most interesting details are the survivors' reports of geophysical changes that occurred shortly before the explosion. According to Bruce's sources, a *tornillo* was noted at the Pasto Volcano Observatory about four hours before the eruption, and the information was radioed to the group in the crater. At least a half hour before the explosion, microgravity expert (and victim) Geoff Brown started to detect "rapid fluctua-

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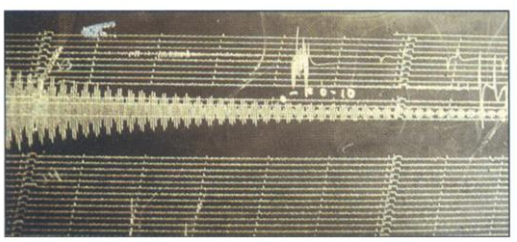
tions in gravity" inside the crater. At the time, he attributed them to instrument problems, but in retrospect these signals were probably related to near-surface bubbling or fluid pressure fluctuations in the magma below the dome that plugged the crater. Two other warning signs were a small ash emission from a small vent in the crater floor and a large number of rock falls from the crater walls in the "final minutes before the eruption."

In the months after the disaster, Williams was widely featured in the media, coverage that, he admits, "fed my not inconsiderable ego." Others in the crater that fateful day were increasingly concerned about how his version of the story tended to diminish their roles, and they were dismayed when Williams was referred to as "the sole survivor." To his credit, Williams is disarmingly frank in admitting an error of judgment on this issue. He speculates that his severe head injury may have affected his memory and subsequent actions.

Many volcanologists, including myself, strongly disagree with Williams's claim that "the best work...comes from those of us who walk into the crater." The 20th-century transformation of our discipline from a descriptive endeavor to a true science stemmed from the meticulous geologic observations and deductions of outstanding field geologists like George P. L. Walker on volcanic deposits from past eruptions and from the application of such observations by physics-minded volcanologists like Lionel Wilson to develop numerical and physical models of volcanic processes. None of these advances, nor our progress in understanding the origin and evolution of magmas, required setting foot in an active crater.



Unrecognized warnings. Small numbers of *tornillos* were recorded at Galeras in the weeks before the fatal eruption.

Does a young and evolving science learn from a tragedy like Galeras? As a result of the disaster, in 1994 the International Association of Volcanology and Chemistry of the Earth's Interior issued the first safety recommendations for scientists and the public. These guidelines encourage volcanologists to approach active volcanoes with greater caution and better preparation. But the deaths continue. On 27 July 2000, a large party of volcanologists was visiting the summit crater of Indonesia's Semeru volcano when an early-morning explosion killed two scientists and badly injured five others. Like the tragedy at Galeras, this incident reminds us that we know a lot about the workings of volcanoes, but clearly not enough to judge when an active volcano can be safely trodden on. Do we need to continue to take such huge risks? Let us hope that we can instead bring the concept of "telepresence" to bear on the world's most dangerous volcanoes. By developing and using robots and remotely controlled unmanned vehicles (for scientific instrumentation and for direct observation) we can better protect the public and those whose research may help reduce volcanic hazards.

BOOKS: CLIMATE AND HISTORY

The Shadow of Droughts' Deaths

Vaclav Smil

Mike Davis's latest book is a peculiar hybrid, and my task as a reviewer would have been easier had *Victorian Holocausts* simply been ideological and misleading. It is both, yet most of it is actually also objective, accurate, and revealing. The book's very title hints at these frustrating dichotomies. There is no doubt that the large-scale famines that repeatedly swept late-19th-century India and China and also severely affected parts of Africa and Brazil, added up to one of the greatest tragedies of modern era, with the combined (and never to be accurately quantified) toll of tens of millions. Many historians have documented these events with widely differing degrees of exactitude and detail. Davis—relying extensively, and skillfully, on their work—provides a comprehensive, comparative account of these tragedies. Most of these famines were obviously tied to prolonged droughts, and perhaps the key contribution of Davis's book is to demonstrate that these natural disasters represented the worst imaginable climatic teleconnections arising from the El Niño–Southern Oscillation (ENSO). But were these famines "Victorian holocausts"?

Late Victorian Holocausts
El Niño Famines and the Making of the Third World
by Mike Davis
Verso, London, 2001. 474 pp. $27, C$38, £20. ISBN 1-85984-739-0.

The adjective is justified when looking at India's suffering. A great deal of British and Indian research (much of it mined by Davis) has demonstrated the terrible long-term consequences of some colonial policies and the incredible blunders and obtuseness of many British officials confronted with these human catastrophes. But Davis uses the adjective in a deliberately global sense. His book implies that nearly every poor person who died of hunger during the closing decades of the 19th century was a victim of a "new world order" devised by that most despicable of all species, a "liberal capitalist" resident in London. Indeed, Davis concludes that many of these poor people "were murdered...by the theological applications of the sacred principles of Smith, Bentham and Mill." And the thrust and the tone of his arguments make it possible to go one step further, as Immanuel Wallerstein has in a dust-jacket endorsement of the book, and to claim that Davis shows "how capitalists used the vagaries of the climate to create underdevelopment in the late-nineteenth-century world." Here is a mind-boggling conspiracy of London mega-criminals, men who not only ran the world but also used adverse weather to their advantage.

And then there is the key titular noun: holocausts. Is it not clear, without engaging in definitional minutiae, that the term implies at least a large degree of premeditation, if not an entirely conscious design to inflict unimaginable suffering on entire populations? Davis clearly believes so, as his culprits are not called just "liberal capitalists" and worshippers of "the Gold Standard and the New Imperialism," but are bluntly labeled "El Niño's murderous accomplices." And finally, what are we to make of the dubious term "the Third World"? Only in a naïve perspective are the complexities of today's economies neatly divided into three "worlds."

Davis's view of the late-19th-century world as a vast stage peopled by millions of passive, innocent victims preyed on and deliberately destroyed by a small band of theologically zealous and murderously scheming Londoners is particularly inappropriate for analyzing the fate of Chinese peasants. During the late 18th century, Qing emperors felt confident to dismiss any Western overtures. A century later, they succumbed surprisingly easily to limited foreign intervention, while the neighboring (and poorer and weaker) Japan not only did not dissemble when faced with Western pressure but commenced its impressive rise toward modernity. I cannot imagine any moral justification for selling opium to China, and hence I would never defend the 19th-century British taipans whom Davis gives a decidedly modern label of narcotraficantes. But China's late-19th-century miseries (including the famines in a state that only a few generations earlier had possessed excellent capacities to moderate the impact of droughts and floods through distributions from well-maintained imperial granaries) were much more the result of a domestic collapse—of an imploding, spent, and irresolute civilization—than of any

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