

Letter to the Editor

DEONTOLOGICAL CODE, PROBABILISTIC HAZARD ASSESSMENT OR RUSSIAN ROULETTE?

As one of the “sundry geologists” who visited Guadeloupe three times at the specific request of the civil authorities, and spent a total of 14 days on the scene during the early stages of the 1976 eruption, I would like to make a few points which may not have been evident to the writer of the editorial of the August 1978 issue of the Journal of Volcanology and Geothermal Research.

Mr. Bostok in his second paragraph identifies “the basic question of the responsibilities of volcanologists who find themselves called upon to assess volcanic hazards”, and this indeed is the crux of the matter. These responsibilities include, in my opinion:

(1) *Admission that nuées cannot be specifically predicted.* It must be stated clearly that there are no specific precursors to nuée ardente emission, and hence that absolute predictive statements about the occurrence or non-occurrence of nuées cannot honestly be made. At any volcano judged to be capable of violent activity, the occurrence of abnormal earthquakes, fumarolic, phreatic or magmatic activity *greatly increases the probability* of destructive eruption in the early future. It is possible and extremely desirable for volcanologists to give quantitative estimates, even though crude, of this probability, in the form of a series of values relating to different future intervals of time, especially the minimum time necessary for complete evacuation of those zones which have been identified as exposed to significant risks.

From the above it follows that it is unscientific to have claimed that “there would be no catastrophe (sic) like that which occurred at St. Pierre in 1902”. Based on the available, very limited global statistics, namely 43 well-described nuée ardente and similar types of eruption, and weighted according to the ratio of nuée to all eruptions, including phreatic, which have taken place historically in the Lesser Antilles (4 to 15), my own quantitative estimate was that, with 5 weeks elapsed from the eruption onset, there was a probability of about 1 in 6 that the eruption would eventually emit nuées ardentes. Superimposed upon this there was a probability of 1 in 8 that in the event of the nuée emission, recognizable build-up activity would be of less than 2 hours’ duration, and a probability of 1 in 4 that this build-up activity would be of less than 12 hours’ duration. Hence in the second week of August 1976, there was a probability of about 1 in 24 that the Guadeloupe eruption would produce nuées at less than 12 hours’ notice, and a probability of about 1 in 48 that nuée ardente activity would develop at less than 2 hours’ notice. The above figures do not take into account (a) the fact that seismic and phreatic activity were increasing significantly during the first two weeks in August which immediately preceded the evacuation, and (b) the possibility of dangerous volcanic activity other than nuées ardentes.

It is noteworthy in the above context that the volcanologist who after the end of the eruption described the evacuation as "totally useless", had stated in a widely circulated letter dated 29 July 1976 (17 days before the evacuation) that "an absolute minimum of 2 hours would separate the beginning of threatening activity from any catastrophic phase". Among the suitably detailed accounts which I have found in the world literature, there have been at least 5 out of 43 nuée-type eruptions (Arenal, 1968; Hibok-Hibok, 1948; Lopevi, 1960; Mayon, 1814; Bezymianny, 1955) in which the "build-up" time from abnormal seismic, fumarolic or mild magmatic activity to potentially destructive nuées was less than 2 hours. It is also very dubious whether a period of warning as short as 2 hours would be sufficient for a complete evacuation, especially if this were during the night. The possibility of so brief a warning might not be an acceptable risk, the more so because in the Guadeloupe activity of 1976, government authorities in Paris had declared that no risk was to be taken for the population.

(2) *No gambling.* A second responsibility arises from the relatively high odds quoted above that activity will *not* become severely destructive at short notice. There may be a temptation for the volcanologist to seek to enhance his own reputation by disregarding the low probability of a catastrophe and giving firm reassurances that there is no danger. Such a volcanologist is playing a kind of Russian roulette, with somewhat better personal odds of survival than in the pistol game, but involving the lives of whole populations, not simply his own. In this context, Mr. Bostok's comment that "He was correct, of course" needs some qualification.

(3) *The need to remain on the spot.* A third responsibility is that any volcanologist-in-charge, or who claims to be in charge, should remain continuously on the spot. If he goes elsewhere, he should be available day or night for consultation at very short notice. This was not the case in Guadeloupe in 1976.

(4) *The need to deploy all relevant monitoring methods as soon as clearly abnormal activity develops.* One of the most serious scientific omissions in Guadeloupe was the failure to deploy a wide range of monitoring techniques when, by March 1976, the local earthquake swarm had reached major proportions. The assessment of hazard depends not only on historical precedent but equally on the measurements made of the activity in progress. It is the responsibility of the scientist-in-charge to establish rapidly, once clearly abnormal activity has started, the widest variety and highest quality of relevant monitoring techniques. This involves the planning of scientific co-operation in advance of any crisis, as well as the rapid response to the onset of clearly abnormal events, and the careful scrutiny of all scientific observations for accuracy.

(5) *The need to limit opinions to one's field of professional competence.* A final responsibility is that the volcanologist should remember, and if necessary remind the civil authorities, that the decision to evacuate involves not simply the numerical assessment of the hazard probability but also the off-

setting of this against the economic and social consequences of evacuation. Most volcanologists have little or no expertise in sociology or economics and are therefore not in a position to provide the best judgement as to what constitutes the limit of acceptable risk. This is emphatically not a case of avoiding a responsibility: it is a case of limiting one's opinion to one's field of professional competence. An analogy is that in a court of law, an expert witness is allowed to give opinions only on subjects within his field of expertise.

This indicates to me the need for a multidisciplinary team to decide upon the limit of acceptable risk, preferably in advance of any volcanic crisis. On the part of volcanologists, a readiness to present and discuss hazard estimates in quantitative, probabilistic terms will serve the public interest far more directly and will be a subject on which reasonable consensus can be achieved far more easily than the creation of a deontological code.

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