# Letters

## "Nuclear Winter" Models

Discussions abound over what would be unleashed on our planet during a "nuclear winter" (Articles, 23 Dec. 1983, p. 1283 and p. 1293; Editorial, 24 Feb. 1984, p. 775; News and Comment, 6 July 1984, p. 30; Letters, 25 Jan. 1985, p. 356; News and Comment, 15 Mar., p. 1320; Research News, 12 Apr., p. 163). The thought of such an event is indeed serious from the standpoint not only of the human tragedy but the effect on atmospheric-oceanic balance.

In this same realm it would seem prudent and appear within the capability of our great technological and modeling expertise to carry the "nuclear winter" simulation one step further. McCracken and Luther (*1*) have shown that smaller amounts of aerosols—typical of Mother Nature's injections from volcanic sources such as El Chichón, Agung, or Krakatau—cause shifts in atmospheric circulation patterns high into the troposphere and even into the stratosphere. Would a "doughnut-like ring" of soot in the atmosphere over the Northern Hemisphere amplify such alterations? Such a shift could have major impacts on oceanic circulation with redirected heat distributions from these currents. Might it be possible that results from such modeling work would reveal effects, in addition to those already described so vividly, that would be more devastating than those attributed to the recent record El Niño?

Our study of the past 100 years of record shows statistically that warm oceanic conditions along the Pacific coast of South America are enhanced after injections into the stratosphere from sulfur-rich volcanoes located between 20°N and 20°S (*2*). We have found that for the 2 years after strong eruptions (70 events) sea-surface temperatures (SST) responded positively 86 percent of the time, whereas, for those years without major eruptions (34 events), only 65 percent gave positive SST indications. These initial results suggest a "nuclear winter" might perturb atmosphere-ocean interactions such that certain upwelling cold currents (for example, those off the west coast of the Americas) would cease and the affected areas would be anomalously warm, as in intensified El Niño–like conditions. These modifications together with Arctic-like weather over the continents would enhance storminess through promotion of strong meridional circulations in the atmosphere.

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**References**

1. M. C. McCracken and F. M. Luther, *Geofis. Int.* **23**, 385 (1984).
2. A. E. Strong, *EOS* **65**, 965 (1984).

## Verification of Nuclear Testing

Although I have no serious disagreements with the recent article by W. J. Hannon (18 Jan., p. 251) when it is considered within the conditions posed, I have profound disagreements with the appropriateness of those conditions and, therefore, with his conclusions. This letter is a brief account of where I think his assumed conditions are in error, what conditions are correct, and the resultant impact on his stated conclusions.

Fundamentally, Hannon follows many of the same procedures I followed in 1976 (*1*) and in 1982 (*2*) when I calculated network capabilities. In those articles, I assumed, as Hannon does today, that the seismic network is designed to detect signals around a frequency of 1 hertz. However, in my 1976 article, I specifically excluded from consideration, for reasons that I explained (but that Hannon deems unacceptable), (i) great areas of thin-bedded salt in central U.S.S.R. as sites for decoupling; and (ii) the granitic areas of the U.S.S.R. as sites for decoupling at greater than a factor of 10. Hannon, however, allots high decoupling potential to all salt deposits and to all granitic terrains, thus reaching results that are less optimistic than those I reached.

A point that has been widely made and discussed among American seismologists during the past year is that the initial condition of both my 1976 analysis and of Hannon's analysis, which assumes detection at around 1 hertz, leads to the calculation of the comparatively low capabilities found by both of us. This condition is known to be out-of-date and in gross error if maximum monitoring capability is desired.

New data allow a drastic change in the initial condition of network analyses. These include the realizations that (i) explosions generate much higher high-frequency amplitudes than do earthquakes; (ii) these high-frequency signals are effectively transmitted for many hundreds of kilometers in terrains such as those in most of the U.S.S.R; and (iii) high-frequency noise levels are always very low at many sites within the U.S.S.R. (known by analogy with sites in Scandinavia and North America). If these recent understandings are incorporated quantitatively into the network analyses, with the network consisting of 25 simple internal stations and 15 stations external to the U.S.S.R. and detection assumed at around 30 hertz, one can predict that, even with 200-fold decoupling (not 60- to 70-fold as Hannon assumes) at all salt and granitic sites within the U.S.S.R, multistation detection of fully decoupled 1-kiloton explosions would be achieved with high probability. This result, when combined with other empirical and theoretical seismological considerations, leads to further conclusions: (i) simple nonarray stations are all that is required, not arrays, as suggested by Hannon; (ii) signal-to-noise ratios would be so high that identification at or very near this threshold would be possible, negating Hannon's conclusion about many unidentified small events of interest; (iii) the relative character of explosion and earthquake signals, as well as the distribution of Soviet seismic activity, would make the analytical load of the monitors easily manageable; (iv) there would be no problem from seasonal or aperiodic changes in microseismic levels, thus removing a proposed opportunity for potential cheating; (v) the problem of hiding explosion signals in those of earthquakes, whether near or distant, disappears; and (vi) the concept of cavity decoupling at yields of 1 kiloton or greater becomes passé because the resultant signals would be detected and identified as explosions.

Therefore, subsequent to deployment within and surrounding the U.S.S.R. of a network capable of detecting frequencies of 30 hertz or so, any fully decoupled test at or near 1 kiloton would be detected and identified with high confidence.