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Notes from Underground

The June *Scientific American* offers as its lead article a suggestion by L. Don Leet, of Harvard University, for using seismic records to distinguish routinely between earthquakes and underground nuclear explosions. The article is essentially a research proposal, but Leet, on the basis of present evidence, is quite hopeful that further study will prove his suggestion to be the answer. Now, one of the points of disagreement in the East-West test-ban negotiations is over the American claim that, at least in the present state of the art, you cannot distinguish routinely between earthquakes and explosions, only between earthquakes and suspicious events—and that on-site inspection is necessary to determine whether a suspicious event is an earthquake or an explosion. Consequently, we thought it worth while to look a little further into the merits of Leet's suggestion.

The gist of the suggestion is this. Although you cannot distinguish between earthquakes and explosions on the basis of any single feature, you might be able to do so on the basis of a certain series of criteria, if the criteria are applied to the seismic records from a world-wide network of observatories. Consider, for example, differences in the relative amplitudes of P waves and S waves over a region—for the purposes of our limited considerations, we need not go into the nature of the two kinds of waves. For earthquakes, the article contends, as you travel away from the source of the disturbance, the P wave dies out first, then the S wave. For explosions, the article continues, as you travel away from the source, the S wave dies out first, then the P wave. At considerable distances you have nothing but P waves, what Leet calls the "Lonesome P."

In looking into the merits of Leet's suggestion, we first got hold of a copy of the report of the so-called Berkner Panel. This report, "The Need for Fundamental Research in Seismology," was prepared early in 1959 at the request of the State Department and was submitted on 12 June 1959 to the other delegations at the test-ban talks. The copy which we consulted was put out July 1959, by the State Department. We learned that what Leet has to say is not altogether new. The report expresses the hope that further research on a variety of effects will turn up some way to distinguish between earthquakes and explosions. On the specific question of the relative amplitudes of P waves and S waves, there are several references. Thus, Carl Romney, of the Defense Department and a member of the panel, offers in an appendix a list of six research proposals, the fifth of which reads: "What is the ratio of S/P in earthquakes? In blasts? What are the variations in these ratios?"

To find out how things are going, we then went to see some of the people connected with Project Vela Uniform, the Defense Department's research program charged with improving U.S. ability to detect underground explosions. We obtained a copy of a report on the project that Charles Bates, of the Defense Department, recently had presented publicly. We also got hold of the January 1962 report of the Wichita Mountains Seismological Observatory, a station supported by the Defense Department. We learned that Leet's specific suggestion offers little promise. Project Vela is going forward, but the various criteria that Leet suggests are viewed more as diagnostic aids than as together constituting a definitive test. There is too much overlap in the effects of earthquakes and explosions. Thus, regarding the "Lonesome P" criterion as helping identify explosions, of the 68 distant earthquakes detected during the first 5 days of 1962 by the Wichita Mountains Seismological Observatory, 26 had "Lonesome P's."—J.T.