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Szilard Prize Lecture: Seismic Monitoring of Nuclear Explosions

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Seismic monitoring of the more than 2000 nuclear test explosions since 1945 has been vigorously pursued, both to track the weapons development of potential adversaries, and to support initiatives in nuclear arms control, including various test ban treaties. Major funding from the US Department of Defense built up new global seismographic networks and over several decades established practical capability in monitoring nuclear explosions “teleseismically” (i.e. from distances more than about 1500 km), for tests that the testing nation did not attempt to conceal. What then is the capability to monitor compliance with, for example, the Comprehensive Nuclear-Test-Ban Treaty (CTBT) of 1996, particularly if evasion scenarios are considered? Note that the CTBT, though not ratified by some countries (including the US), is now being monitored by networks that include seismographic stations at “regional” distances (< 1500 km) from candidate explosion locations. Years of R and D have shown that regional signals can be used to monitor down to yields significantly lower than can be detected and identified teleseismically. A US National Academy of Sciences study in 2002 concluded that “an underground nuclear explosion cannot be confidently hidden if its yield is larger than 1 or 2 kt.” About 1000 earthquakes and chemical explosions are now detected per day, and documented via seismic data, providing plenty of challenges for nuclear explosion monitoring organizations. Explosion monitoring capability will improve in many parts of the world, due to the growth of networks that monitor even small earthquakes to study seismic hazard. But political problems can impede improved international explosion monitoring, due to national restrictions on data access.

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