this subject," Frosch says, citing about three dozen reports in the last 50 years. But he thinks the department is more receptive to technical advice now than in the past. "It's not difficult to get good scientific advice in Washington—you have to bob and weave to avoid it," Frosch says. "The real trick is knowing when to ask for it." And State Department officials say that this time they are listening closely: "The Secretary asked for it, so we are taking [the report] very seriously," says one diplomat. **–DAVID MALAKOFF**

NUCLEAR TESTING

Size of Indian Blasts Still Disputed

Four months after India and Pakistan surprised the world with twin sets of nuclear bomb tests, Indian and U.S. scientists remain sharply divided over the actual size of India's explosions. The debate—which flared up this week in two new papers—could affect the international test ban agreement, as its enforcement depends on the ability to detect even small nuclear tests with confidence.

In a Policy Forum published this week in *Science* (p. 1967), a group of 19 academic and U.S. government seismologists calculate that the yield from the 11 May Indian event—the larger of India's two sets of tests—was 9 to 16 kilotons with 50% uncertainty. (The Indian government reported that three devices were exploded simultaneously that day, the largest a fusion device.) However, a group of physicists at India's Bhabha Atomic Research Centre (BARC) in Mumbai claims this estimate is too low by a factor of 4. In a paper appearing in the 10 September issue of the Indian journal *Current Science*, Satinder Kumar Sikka and his colleagues in BARC's high pressure physics division report that the international monitoring system grossly understated the blast sizes by failing to account for the seismic patterns created by the overlapping explosions. Based on a computer analysis of the seismic recordings, they say the actual yield was 58 kilotons, even larger than the initial report of 55 kilotons.

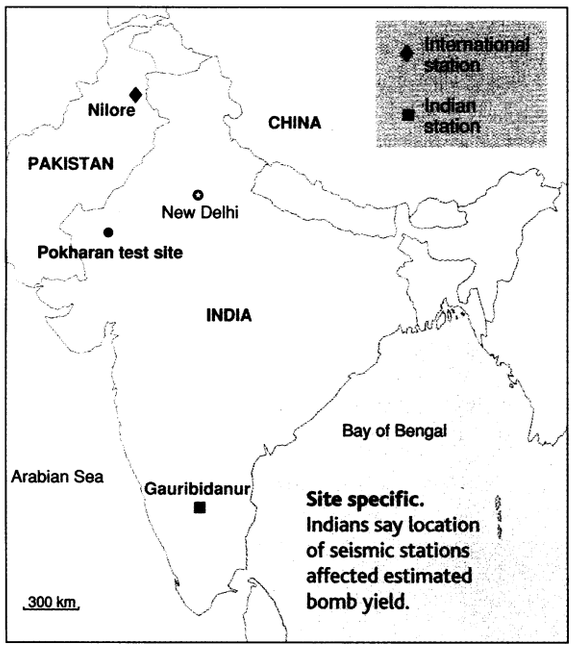
Neither the Indian nor U.S. paper casts any new light, however, on the most controversial test in last spring's series. That is the two low-yield explosions India says it detonated 2 days later, on 13 May. Indian officials said at the time that these small tests released nuclear energy equivalent to about 800 tons of TNT. But they produced no signals on remote seismic sensors, and some U.S. researchers concluded that no nuclear blast had occurred (*Science*, 26 June, p. 2038). The authors of this week's *Science* Policy Forum estimate that a blast larger than 30 tons would have been detected but that one 10 times larger could have escaped detection if detonated in sand, as reported. The BARC scientists do not mention this test in their analysis.

The U.S. seismologists base their estimate of India's 11 May test on earthquake data, an analysis of local geology, and a compilation of seismic recordings from dozens of stations around the globe. The BARC researchers argue, however, that seismic waves from the blasts may have interacted to produce misleading, attenuated signals at remote sites. Sikka, Falguni Roy, and G. J. Nair note that the major explosions on 11 May took place in two shafts separated in an east-west direction by 1 km. (A much smaller device was exploded in a third shaft 2.2 km away.) Delays between surface waves from these sites, Sikka told *Science*, could create "destructive interference of the waves in the east-west direction" as well as "constructive interference in the north-south direction." This could explain, he says, why some seismic stations—particularly those on an east-west line from the test site—actually recorded smaller signals. The BARC scientists say this phenomenon also explains a 30-fold variation, roughly three times larger than expected, in the size of the compression waves from the blasts.

In an effort to calculate the "true magnitude" of the signal created by the 11 May test, the BARC research team analyzed data from 51 stations of the International Data Center in Arlington, Virginia, and concluded that seismic stations east and west of the Indian test site at Pokharan (which recorded smaller signals) were not as reliable as those to the north or south. The BARC researchers combined information from the Indian seismic array at Gauribidanur (see map) with data from a select group of 11 other stations, excluding many stations that their paper says "could have underestimated the true [seismic wave]," to peg the magnitude at 5.4 on the Richter scale, not 5.0, as claimed by the U.S. group. Sikka says averaging the data is misleading but that it serves the interests of some seismologists: "They want to belittle our tests; at the same time they want to defend [the credibility of the seismic monitoring system]."

Terry Wallace of the University of Arizona, a senior author of the *Science* paper, says the BARC scientists "are choosing arguments clearly designed to make the yield as large as possible." He added that "half a dozen" teams of sesimologists participating in a Defense Department conference this week had reached roughly the same conclusion as his group: The upper bound on India's 11 May tests is 25 kilotons. A colleague, seismologist Jeffrey Park of Yale University, adds that most of the arguments presented in the BARC paper have been considered "very carefully" in the past. "There are some novel elements in the BARC paper," he notes, but "I don't find them persuasive." Sikka says his team is still analyzing cores from the test site for a more accurate measure of the yield.

–PALLAVA BAGLA,
WITH REPORTING BY ELIOT MARSHALL
Pallava Bagla is a correspondent in New Delhi.



SOURCE: INDIAN GOVERNMENT/IRIS

SCIENTIFIC COMMUNITY

Two More Scientists Died in Swissair Crash

The crash of Swissair flight 111 on 2 September claimed the lives of two prominent scientists who were not included in our initial coverage of the tragedy (*Science*, 11 September, p. 1587). Also aboard the flight were Eugenia Spanopoulou, an immunologist at Mount Sinai Medical School in New York City, and Thomas Kreis, chair of the Department of Cell Biology at the University of Geneva. Spanopoulou's research focused on the role of the immune system's recombination activating genes, *RAG-1* and *RAG-2*, in generating antibody and T cell receptor diversity. Spanopoulou, who was traveling with her husband and 16-month-old son, was selected as a Howard Hughes Medical Institute investigator and joined the institute last year. Kreis was an internationally known authority on proteins that regulate membrane traffic in cells.