ARMS PROLIFERATION

Experts Search for Details After Indian Nuclear Tests

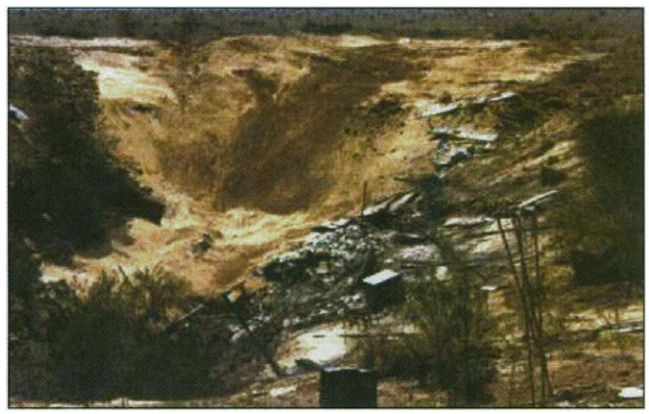
NEW DELHI AND WASHINGTON, D.C.—By exploding five nuclear weapons in a remote desert near the Pakistani border, India has underlined its ability to detonate multiple nuclear devices on short notice. But a week after the underground tests caught the world by surprise, scientists are still poring over incomplete and contradictory data that raise questions about the tests themselves and the state of India's weapons program. And although most Indian scientists say they are pleased that their country has joined the nuclear elite, at least one prominent weapons engineer worries that the program will rob civilian activities of scarce resources.

The tests in the Thar desert, which even the U.S. Central Intelligence Agency failed to predict, began on 11 May with three simultaneous explosions and were followed 48 hours later by two additional tests. The tests could push longtime rival Pakistan into testing its own weapons, and because at least two of the blasts were not picked up by seismographs around the world, they have underscored the difficulty of monitoring nuclear explosions—a cornerstone of the Comprehensive Test Ban Treaty, which India has refused to sign.

After nearly a week of silence, Indian physicists and engineers held a 70-minute press conference on 17 May in New Delhi to discuss technical details. They said that a thermonuclear and a large fission device were detonated, along with three low-yield fission weapons. The tests were done with remarkable speed, they revealed. "We were given T minus 30 days to commence the experiment ... after the political go-ahead was given," said A.P.J. Abdul Kalam, an engineer and scientific adviser to the defense minister. But the scientists refused to describe the kind of fuel, the depth at which the devices were placed, or the total number of scientists involved in the effort.

The 11 May tests apparently involved a thermonuclear warhead, a large fission bomb, and a low-yield device, set off simultaneously at two sites 1 kilometer apart. "It is much easier to press one trigger and all the explosions happen at one go," explained Rajgopala Chidambaram, a physicist who chairs India's Atomic Energy Commission (AEC). "We also feared that the shock wave from the thermonuclear test would damage the shaft of the fission test." He said the yield of the thermonuclear device was kept low—about 43 kilotons—to avoid damage to villages 5 kilometers away. "We certainly also have a higher capability," Chidambaram added.

Although the simultaneous explosions explain the fact that only one seismic event was seen by scientists around the globe, the yield of the combined explosion is in dispute. The trio packed roughly the same seismic punch as a much smaller 1974 test. Last week's blast registered about 5.0 on the Richter scale, as gathered from 94 monitoring sites by the Prototype International Data Center based in Arlington, Virginia. India initially claimed the 1974 test yielded 12 kilotons; U.S. weapons officials, however, later estimated that the yield was closer to 2 kilotons.



GOVERNMENT OF INDIA

Ground truth. Along with a crater, questions remain after Indian tests.

Last week, Indian officials said the three tests on 11 May totaled 55 kilotons, but U.S. weapons lab officials put the yield at about 15 kilotons. Gregory van der Vink, planning director at the Incorporated Research Institutions for Seismology—which runs an international network of seismic monitoring stations—estimates 25 kilotons, but notes it could be half or twice that. The Indian claim, he says, "is not an immediate match with what we've seen seismically, [but] we don't have a lot of experience measuring yields at the Indian test site." Indeed, until Indian scientists analyze test data and build an experience base, such estimates are extremely shaky, says Terry Hawkins, acting nonproliferation director at Los Alamos National Laboratory in New Mexico. "It's not an exact science," he adds. "And we would not declare a yield until after we drilled" into the test hole following an explosion.

Some experts—including at least one senior Indian engineer—are skeptical of the claim that the three tests were set off simultaneously because of the added technical burden they pose. "I have my doubts the three tests were done together," says Malur Ramaswamy Srinivasan, former AEC chair. Exploding all three together, he notes, would make it more difficult to model the tests and to differentiate among them. The United States, however, has frequently conducted simultaneous tests, most recently in June 1992. The reason was economy. "A shot day is expensive," says Jim Danneskiold, a Los Alamos spokesperson.

Chidambaram acknowledged that the combined tests posed a challenge for foreign seismologists. "They are confused because they do not know the distance between the two devices"—a factor that some weapons specialists say would have only a minimal effect on the seismic results. He also said that "data generated by the separate devices can be distinguished" by seismic recorders and seismometers less than 200 meters from the test site, as well as by ground surface photography and fiber optic collectors. "We are also going to do postshot drilling, and that will reveal a lot."

Neither of the low-yield tests in 13 May was detected by seismologists, likely because they were well below the 1 kiloton level widely regarded as the threshold of detectability, said Chidambaram. But Van der Vink says a nearby Pakistani station should have detected at least one of the smaller tests—but did not.

Another mystery is what fueled the devices. Indian officials refused to comment; Chidambaram would only say the material was "indigenous." Conventional chemical devices can produce a kiloton or more yield, notes one U.S. official. But Srinivasan told *Science* he suspects plutonium was used in the two larger bombs and enriched uranium in the low-yield devices. A combination of lithium and tritium also is a possibility for the thermonuclear blast, he added. Some U.S. weapons use a lithium and deuterium combination, U.S. officials say.

The Indian government has not ruled out additional detonations, although it has hinted that it might abide by the test-ban treaty now that its credentials as a nuclear nation are clearly established. Still, not everyone is celebrating their country's show of power. "There is no doubt national security is important," says Srinivasan. But so are a stable population, a clean environment, and eradicating poverty, he adds: "You cannot be a great country with a weak economy."

–Pallava Bagla and Andrew Lawler

Pallava Bagla is based in New Delhi.