India and Pakistan,
At the Crossroads

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by

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India and Pakistan's demonstration of their nuclear capabilities in May of 1998 has raised many questions about the countries' plans for their forces, doctrines, and policies. In the first part of the paper I examine certain evidence about the Indian and Pakistani tests to try to determine what may have transpired. In the second part of the paper I raise several fundamental questions that each nation will have to answer if they decide to become full-fledged nuclear powers.

Questions about Indian nuclear tests

India first tested a device on May 18, 1974. Advertised as a "Peaceful Nuclear Explosion" it obviously had military application and India may have produced a small stockpile based upon this basic fission design. The test, code named "Smiling Buddha," was carried out in a 107-meter deep shaft at the Pokharan test site in the Rajasthan desert in western India, nine kilometers north-northwest of the village of Khetolai.[1] Initially the Bhabha Atomic Research Center (BARC) claimed the explosive yield of the test was 12 kilotons. Later they reduced their estimate to eight kilotons.[2]

The magnitude of the seismic waves from the 1974 test, when combined with the announced depth and the formation of a subsidence crater at the surface, strongly suggested that the actual yield was less than five kilotons. At least one reputable Indian journalistic account placed the yield as low as two kilotons.

With regard to the 1998 tests, Indian officials claimed to have detonated three different devices on May 11: a "thermonuclear device" with a yield of 43 kilotons, a fission device with a yield of 12 kilotons, and a low-yield device on the order of 200 tons (0.2 kiloton). According to Indian scientists the blasts were set off simultaneously in three separate shafts. The two larger devices were in shafts, about one kilometer apart in an east-west direction, some three kilometers southwest of the 1974 test. The sub-kiloton device was in a shaft 2.2 kilometers away.[3]

If these devices actually produced the yields claimed by Indian weapon scientists, we would expect to observe a seismic signal strength corresponding to 55 kilotons or magnitude 5.76 on the Richter scale. Sixty-two seismic stations reporting to the prototype International Data Center recorded the seismic signal and the average magnitude was calculated to be 5.0, with some estimates as low as 4.7. In well understood regions where

[1] Vipin Gupta and Frank Pabian, "Investigating the Allegations of Indian Nuclear Test Preparations in the Rajathan Desert," *Science & Global Security* (1996, Volume 6, No. 2), pp. 101-189, locate the site.
[2] For a history of the Indian bomb program see George Perkovich, *India's Nuclear Bomb: Exploding Illusions of the Nuclear Era* (Berkeley: University of California Press, forthcoming).
[3] The discussion relies on Gregory van der Vink, et al., "False Accusations, Undetected Tests and Implications for the CTB Treaty," *Arms Control Today* May 1998, pp. 7-13; Terry C. Wallace, "The May 1998 India and Pakistan Nuclear Tests," *Seismological Research Letters* September 1998; Brian Barker, et al., "Monitoring Nuclear Tests, *Science*, September 25, 1998, pp. 1967-68. The definition of a test adopted by the U.S. and the Soviet Union/Russia is a single explosion, or two or more explosions fired within O.1 second within a circular area with a diameter of two kilometers. Using this definition the number of Indian tests in May 1998 was three and the number of Pakistani tests was two.

tests have taken place, seismologists have learned that a 5.0 magnitude in a stable region would indicate a probable yield of 12 kilotons, with the range possibly as low as five kilotons and as high as 25 kilotons. A mid-point of 12 kilotons is less than one-quarter of what Indian weapon scientists claimed.

Of major significance is the Indian claim that it set off a "thermonuclear" device. Some experts initially suggested that this might mean that they were "boosting" fission bombs by using tritium, a hydrogen isotope. Using a very loose definition a "boosted" fission device could qualify as "thermonuclear." Indian scientists tried to dispel that interpretation at a press conference held on May 17th. There they correctly defined a hydrogen bomb as one with two-stages, where a fission primary sets off a hydrogen fueled secondary, and, they claimed, that was what they had tested. When challenged that a 43 kiloton "thermonuclear" bomb was too small to qualify, they stated that they reduced the yield because the village of Khetolai was only five kilometers away. It was later reported that more than 40 percent of the structures in the village had sustained some damage.

The first successful tests of a modern (i.e., two-stage) hydrogen bomb by each of the five declared powers had yields from 1.6 Megatons to over 10 Megatons. All were detonated in the atmosphere in the 1950s and 1960s, though there have been multi-megaton underground tests conducted by the United States and the Soviet Union.

It is technically feasible to scale back or "defuel" the second stage of a high-yield hydrogen bomb to perhaps 10-20 kilotons, but it is a sophisticated procedure and not something likely to be attempted on your first (and possibly last) thermonuclear test. It is also possible to design two-stage thermonuclear weapons with very low yield secondaries that would correspond to the observed yield of the May 11th test.

But this potential explanation is vitiated by the fact that the observed yield corresponds rather well with India's announced yield of 12 kilotons for a "fission device" involved in the test. The simplest explanation of the available evidence suggests that either a thermonuclear second stage, or perhaps the entire thermonuclear device, failed to explode. Several explanations are possible, however, and without more information it is impossible to conclude which is correct.

India claimed that it conducted two additional tests on May 13th, announcing the yields as 0.2 kilotons (200 tons) and 0.6 kilotons (600 tons). Although these tests are small by nuclear standards, they should have registered on some of the seismometers in the region, but they did not. The nearest station that reports its data publicly is in Nilore, Pakistan, 750 kilometers away from the Indian test site.

Based on the recorded signal-to-noise ratio for the earlier May 11 test, the minimum detection capability at Nilore for an explosion at Pokharan is calculated to be 10-15 tons for normally "coupled" explosions in most geologic media, and perhaps 100-150 tons for explosions in very porous (and dry) media, such as the "sand dunes" mentioned by the Indian press accounts of the May 13th event. Even assuming the latter "partial decoupling" scenario, the claimed yield of 600-800 tons for this event should have produced signals detectable at Nilore.

The absence of any seismic record for this test suggests that the actual yields were either far lower than planned, or that the announced yields were intended to confuse and mislead foreign observers as to the actual purpose of the tests, which may have been deliberately kept low to calibrate and validate computer models of the very early stages of nuclear device performance. As in the case of the May 11th tests, without further information from Indian officials, it is difficult to say with any degree of certainty what purposes were served by these explosions, or whether one or both occurred at all.

Questions about the Pakistani tests

In response to the Indian tests the Pakistani Prime Minister Nawarz Sharif announced that five devices had been exploded on May 28th. These explosions took place in the Chagai Hills in Baluchistan very near the Afghanistan border, apparently in a horizontal tunnel. A sixth device detonation was announced on May 30th, conducted some 100 kilometers to the southwest, according to seismic analysis, apparently in a vertical shaft. Pakistani officials, like their Indian counterparts, seem to have exaggerated the number and size of the explosions, announcing the first day's yield as 40 to 45 kilotons (including one of 30 to 35 kilotons) and a yield of 15-18 kilotons for the sole test on the 30th. Analysis of the seismic data does not support these claims. The average magnitude reported by the sixty-five stations recording the event on May 28th was 4.9, indicating an explosive yield in the 6-13 kiloton range. Fifty one stations recorded the event on May 30th with an average magnitude of 4.3, indicating an explosion in the 2-8 kiloton range.

As with the Indian case much more information is needed to determine exactly how many devices were used, how many went off, and what were the nature of their designs. It should be noted that often much bluster, exaggeration, and even outright lies characterize official statements by some Indian and Pakistani government officials and scientists.

Fundamental Questions

There is no doubt that each nation has a nuclear capability. The question now for the civilian and military officials is whether to create an operational stockpile of nuclear weapons. Many things are required if the answer is yes.

How many nuclear weapons should be built?

How many and what types of nuclear weapons should India or Pakistan produce? Each nation must decide whether to build 10, 50, 100, 500 weapons, or some other number, with some rationale as to why it is doing so.

How will the weapons be delivered?

India and Pakistan have several types of aircraft that could be used to deliver nuclear weapons, although the primary considerations of range and payload narrow their choice to one or two types.

Aircraft: India's two most likely nuclear carriers are the MiG-27 and the Jaguar.[4] The MiG-27 Flogger is a nuclear capable Soviet/Russian aircraft produced in the 1970s and 1980s. Hindustan Aeronautics assembled, under license, 165 aircraft which the Indians call "Bahadur" (Valiant). The single-seat plane weighs almost 18,200 kilograms when fully equipped and can fly to a range of approximately 800 kilometers. It can carry up to 3,000 kilograms of bombs on external hardpoints.

Hindan, north of New Delhi, is the most likely nuclear air base for dedicated MiG-27 aircraft. Some 50 MiG-27MLs are deployed at the base, which is less than 400 kilometers from Lahore, Pakistan. There is speculation that a few planes from Squadrons 2, 9, or 18 may be specially modified to carry one or more nuclear bombs.

The second type of Indian aircraft is the Jaguar. The Anglo-French Jaguar was nuclear-capable with the British Royal Air Force from 1975-1985 and with the French Air Force from 1974 to 1991. The first 40 were supplied to India by British Aerospace with the remaining 91 assembled or manufactured by Hindustan Aeronautics. With a gross weight of 15,450 kilograms the plane can fly to a range of 1,600 kilometers with a maximum external load of 4,775 kilograms. Ambala, 520 kilometers from Islamabad, is the most likely nuclear air base for Jaguars. Again there is speculation that a few planes from Squadrons 5 and 14 may be specially modified to carry one or more nuclear bombs.

In Indian Air Force organization Hindan and Ambala air bases are part of Western Command, headquartered at Palam, and reporting to headquarters in New Delhi. Central Air Command, headquartered at Allahbad, is possibly a nuclear air strike force command

The most likely aircraft in the Pakistan Air Force for a nuclear mission is the U.S.-manufactured F-16. The F-16 is widely used by U.S., Belgian, Dutch, and Turkish air forces for nuclear weapons missions. Twenty-eight F-16A (single seat) and 12 F-16B (two-seat) were delivered to the Pakastani Air Force between 1983-1986. These equip Squadrons 9 and 11 at Sargodha, 160 kilometers northwest of Lahore. The F-16 has a range of more than 1,600 kilometers (more if drop tanks are used). It can carry up to 5,450 kilograms externally on one under-fuselage and six under-wing stations.

Missiles: India and Pakistan are developing and may deploy one or more types of ballistic missiles for nuclear weapons delivery.[5] The Indian two-stage Agni intermediate-range ballistic missile has been tested to 1,400 kilometers and a longer range production version in the 2,500 kilometer range is under development. The first stage uses a solid propellant and the second stage is a shortened version of the Prithvi. The warhead section separates from the second stage during flight. India conducted the first flight in 1989 and two subsequent tests by early 1994. In 1996 the Indian government claimed the project was a technology demonstration and shelved the missile, but it could resume

[4] George K. Tanham and Marcy Agmon, *The Indian Air Force: Trends and Prospects* (Santa Monica, CA: Rand, 1992)

[5] Department of Defense, *Proliferation: Threat and Response* (November 1997, pp. 15-21.

development at any time. Now the Indian government says that serial production of the Agni is "security driven," that is, dependent on the situation on the subcontinent.

Until the Agni is deployed, India has two variants of the single-stage, liquid-fueled Prithvi ballistic missile that likely can carry a nuclear warhead. Prithvi was first flight tested in 1988. One version is a battlefield support version now being delivered to the army with a range of 150 kilometers and a warhead weight of 1,000 kilograms (the SS-150). A second is the air force version that may enter service next year with a range of 250 kilometers and a warhead weight of 500 kilograms (SS-250). A third version, the SS-350, with an even longer range is under development. The Prithvi is almost eight meters long, weighs some 4,000 kilograms, and is fired from a mobile launcher.

In June, word of another Indian missile development program, called "Sagarika ("Oceanic"), also emerged. Started in 1993, the super secret 300-500 kilometer range sea-launched missile is thought to be based on the Prithvi (there may also be a second track to develop a submarine-launched cruise missile). It is doubtful that India could have a submarine that could launch a missile before the year 2000.

The road-mobile Ghauri/Hatf 5 missile is thought to be Pakistan's main nuclear capable missile. The Ghauri was flight tested on April 6, 1998 to a distance of 1,100 kilometers (with a maximum assessed range of 1,500 kilometers), probably with a payload of up to 700 kilograms. The Ghauri is reportedly largely based on North Korea's No Dong: a dozen are thought to exist. Pakistan also possesses around 30 Chinese-made M-11 (CSS-7/DF-11) short-range missile deployed around Sargodha. Last year a third missile, the Hatf 3, was also tested to 500 kilometers, and there has been some speculation that it is a Pakistani version of the Chinese M-9 (CSS-6/DF-15).

What is the command and control situation in each country?

Both Indian and Pakistan have civilian governments led by a prime minister. The process of consultation used to arrive at a decision to test nuclear weapons was obviously highly motivated by a small circle in the ruling parties, with the decision taken quickly and without public discussion.

Virtually nothing is known about the individuals or organizations that might be consulted if nuclear use in South Asia were contemplated or imminent. Indian Defence Minister George Fernandes told *Jane's Defence Weekly* that the country is working toward a nuclear command and control system under the exclusive control a national security council which is being formed. The defense minister, three service chiefs, head of the Defense Research and Development Organization (as well as other senior bureaucrats) would probably be consulted, but the ultimate authority will rest with the prime minister and the council.

In Pakistan, where the military has played a larger role in governing the nation (and in initiating and supporting the bomb program) the decision is likely to be even more firmly lodged within an exclusive uniformed circle. The Defense Committee of the Pakistani Cabinet, chaired by the prime minister, is believed to have taken the final deliberations to test the nuclear devices to respond to India.

War Plans and Targets

To go to the effort to build and deploy any arsenal of weapons inexorably brings forth some sort of plan to use them. The more weapons a nation has, and the more types, the more involved and complex the planning becomes. In creating a war plan one starts with a target list. As nuclear war plans evolved by the United States and Soviet Union, for instance, there were two basic kinds of targets, "countervalue" and "counterforce."

In the 1950s and 60s the accuracy of the weapons--whether dropped by plane or by delivered by missile--was not very good, and thus cities became the "countervalue" targets of choice. As the weapons became more accurate and sophisticated, military, or "counterforce," targets took precedence. The goal of counterforce targeting is to destroy enemy nuclear forces before they can be fired (and destroy yours).

However targeting and deployment do not take place in a vacuum, and in the history of the Cold War, the ability to target enemy missiles precipitated its own crisis and countermeasures. The temptation—at least in the theory of deterrence--to launch first was heightened. "Use-'em-or-lose-'em" was the popular description of this predicament. This might describe Pakistan's doctrine, given its military inferiority to India. After the nuclear tests, Pakistani Prime Minister Sharif stated that, "Pakistani nuclear weapons will deter aggression, whether nuclear or conventional," suggesting a first-use stance.

Counterforce targeting has always been justified as a more "humane" deterrent policy, for in theory it spares civilians from being the deliberate objects of attack. However, it should be remembered that although population centers may not be deliberately targeted, many military and "leadership" targets happen to be in or near cities.

Nuclear targets may be broken down into three major categories: military targets; infrastructure, economic and industrial; and cities. Military targets include military bases and headquarters, airfields, naval bases, and specific nuclear weapons concentrations of missiles or aircraft, both storage sites and operational units. Infrastructure and economic targets include energy facilities, nuclear reactors, dams, tunnels, bridges, highways, railroad hubs, factories and the like.

Many military targets are close to major urban concentrations, of which South Asia has no shortage. Mumbai (Bombay), Calcutta, and Delhi have populations of 12, 11, and eight million respectively. Karachi, Lahore, and Rawalpindi have populations of eight, five and two million respectively.

The effects of a nuclear attack on a city are profound. Of the estimated 350,000 people in Hiroshima on August 6, 1945 some 140,000 died by the end of the year from the effects of one 15-kiloton bomb. Of the estimated 270,000 people in Nagasaki on August 9, 1945 some 70,000 died by the end of the year from the effects of one 21-kiloton bomb. One bomb dropped on a large Indian or Pakistani city could cause millions of casualties.[6]

What safety and security features are there to minimize accidents and prevent unauthorized use?

How safe and secure are Indian and Pakistani nuclear weapons? Safety must be the first priority of any nuclear weapon designer. One goal is to prevent a nuclear weapon from exploding accidentally if it is involved in an accident. Other safety features should be built-in to the arming and fuzing mechanisms so that only a precise sequence of steps must occur or the weapon will not explode.

To prevent unauthorized use several nations have developed special security devices and procedures. The U.S. has the most sophisticated devices, called Permissive Action Links (PALs). The standard procedure is to have a "two-man rule," that is, two persons who watch one another while performing certain activities involving nuclear weapons. PALs are basically a kind of sophisticated combination lock. Early ones were mechanical. Modern ones are electronic and may have up to 12 digits, with a "limited try" feature. For example, to ready a bomb for use each of the two persons is provided with six authorized numbers, obtained from higher officials. When all 12 numbers match the prescribed set the weapon is ready for use. If after several tries the numbers entered fail to match the correct code, the electrical circuitry of the bomb will burn up, disabling the weapon. It is unlikely that the Indian or Pakistani weapons have such devices or procedures to prevent unauthorized use.

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[6] S. Rashid Naim, Aadhi Raat Ke Baad "After Midnight," ACDIS Occasional Paper, University of Illinois at Urbana-Champaign, reissued June 1998.