The Flight To Nowhere:

Pakistan's Nuclear Trajectory

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Abstract
This chapter traces the early development of Pakistan's nuclear weapons, situates the weapons in the larger context of China and India, and goes on to discuss the crises that followed their operationalization after the 1998 tests. It argues that false assumptions, shifting goals, and a high level of risk-taking have made deterrence less effective with time. Using publicly available information, the current state of the nuclear arsenal, missiles, and aircraft is presented, together with a discussion of what might constrain further expansion. The loose nukes problem is discussed, together with Pakistani efforts to deal with it politically and technically. The prognosis for the next several years is that, barring a major US-led global denuclearization drive, both Pakistan and India will continue to rapidly expand their nuclear arsenals and delivery systems.

The author's Profile
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1. India-Pakistan Nuclear History – A Snapshot

South Asia's nuclear history begins in 1948. Prime Minister Jawaharlal Nehru, on the advice of the brilliant Cambridge-educated nuclear physicist, Dr. Homi Jehangir Bhabha, who was both his confidante and scientific advisor, ordered the establishment of the Atomic Energy Agency Commission of India. While the AEC's public position was to work towards generating nuclear energy for electricity generation, earth excavation, medical technology, and other peaceful purposes, Bhabha struggled to keep its mandate deliberately ambiguous so that the AEC could also do secret weapons-related research[i]. This freedom would eventually lead to the development of India's nuclear weapons. The Sino-Indian border war in 1962 was to create a new nuclear vigour and soon India quietly embarked on its quest for the Bomb. Violating the terms on which Canada had provided a CANDU-type nuclear reactor, plutonium was stealthily reprocessed from its spent fuel. In 1974, when Prime Minister Indira Gandhi was in deep political trouble, the Buddha suddenly smiled.

Apologists for India's bomb say that Pakistan's quest began in 1972. This is wrong, but it was indeed close to the beginning. A year earlier Pakistan had been decisively defeated by India, whose military intervention followed the bloody civil war in East Pakistan. Bangladesh emerged, leaving the "Two-Nation Theory" – the basis on which Pakistan had come into existence – in tatters. On 20 January 1972, in the city of Multan, an emotionally charged Prime Minister Zulfiqar Ali Bhutto called a meeting of senior scientists and engineers wherein he exhorted them to build the Bomb, fired the existing chairman of the Pakistan Atomic Energy Commission (Dr. Ishrat Usmani), and hired a new one (Munir Ahmad Khan). Nevertheless, some of my senior physics colleagues present at that meeting – including Dr. Riazuddin, who later received a high Pakistani award for being the Bomb's chief theoretician – are certain that nothing actually moved on the ground until the shock waves from the India's 1974 nuclear test reached Pakistan, now half its former size.

There was soon an all-out "Manhattan-style" effort in Pakistan to counter the Indian bomb[ii]. Bhutto raised money from Arab states such as Libya and Saudi Arabia, and crucial nuclear help from China. Alarmed at the Indian success, China willingly shared the designs of its first weapon, tested in Lop Nur in 1964, with Pakistan. It also supplied UF_6 gas for testing the centrifuges, before a UF_6 plant was secretly imported from Germany[iii]. This gas is the raw material from which the bomb material is ultimately extracted. By 1986, or possibly a year earlier, Pakistan too had the Bomb. Just 17 days after the Indian tests, on May 28 1998, the Chaghi mountains in Baluchistan turned white from five nearly simultaneous atomic blasts.

Contrary to what is widely assumed, both then and today, Pakistani leaders were not enthusiastic about demonstrating their Bomb after the Indian tests. The fear of international sanctions was a real one. But belligerent statements by Indian leaders after the tests, and strong domestic pressure – including inflammatory speeches by Benazir Bhutto (then in the opposition) – soon succeeded in forcing Prime Minister Nawaz Sharif and his cabinet over the hill.

Pakistan's reluctant leaders became instant heroes. They feasted in their new-found glory as massive celebrations, organized and spontaneous, erupted across Pakistan as well in some Muslim countries. Bomb makers became celebrities, school children were handed free badges with mushroom clouds, and poetry competitions extolled the great national achievement. Missile and fiberglass replicas of the nuclear test site mushroomed across the country. Most were eventually removed but many still stand in Pakistan's public squares and at crossroads. They are testimony to the delirium that had overpowered the country at a time when, for the man on the street, they stood as symbols of national glory and achievement but not of death and destruction.

The exhilaration overpowered the rational sensibilities of national leaders, both military and civil. Soon Pakistan was to see nuclear weapons as a talisman, able to ward off all dangers. Countering India's nuclear weapons with Pakistani nuclear weapons became secondary. Instead, the latter became the means for neutralizing India's far larger conventional land, air, and sea forces. Size no longer mattered. Bhutto's dream of avenging East Pakistan, and liberating Kashmir, now lay within the realm of possibilities.

2. Regional Nuclear Politics: China, India, Pakistan

It is quite likely that the development of nuclear weapons by Pakistan would have taken considerably longer without Chinese assistance. Although current assistance is largely in the power sector, in the early years the provision of the design of an implosion bomb was quite crucial. Subsequently, the design was improved upon. That process is still continuing.

The relation of nuclear India with nuclear China differs fundamentally from the relation with nuclear Pakistan. It is, on the one hand, less hostile and free from the kind of tension that makes a Pakistan-India confrontation an ever present possibility. In July 2009 China and India concluded their 13th round of border talks with a wide range of agreements such as the installation of a hot line between the Chinese and Indian capitals, an agreement to celebrate 60 years of diplomatic ties next year, etc. Their mutual trade, which amounted to a whopping $52 billion in 2009, is set to increase to $60 billion in 2010. In comparison, India-Pakistan trade – discounting smuggling and third party trading – amounts to less than $1 billion annually.

On the other hand, India and China are serious competitors for global markets and global prestige. This has fuelled intense nationalism. With competing territorial claims in Arunachal Pradesh and Aksai Chin, the two countries are no closer to resolution today than in 1962. So, once Pakistan firmly resolved to make the Bomb after the Indian test of 1974, China provided key assistance with the aim of creating an offset to India. Thus, even without the equivalent of a Kashmir dispute, regional ambitions are driving China and India towards potential conflict.

A recent article by Bharat Verma, the hawkish editor of Indian Defense Review, makes the dramatic prediction that China will attack India before 2012, leaving only three years to Indian government for preparation[iv]. He claims that a desperate Beijing is out "to teach India the final lesson, thereby ensuring Chinese supremacy in Asia in this century" and it is working towards an end game rooted in the "abiding conviction of the communists that the Chinese race is far superior to Nazi Germany". Verma's solution: India must arm itself to the teeth.

This is fear-mongering with a sinister purpose – that of militarizing India. The 1959-1962 conflict is the only recorded war between China and India in the long history of their civilizations. Even this was by no means an all-out war and was limited to the disputed areas. While Verma panders to the right-wing of the establishment, he is not alone in articulating the desire for major arms acquisitions and a blue-water navy.

On August 10, 2009, serving Naval Chief and Chairman of the Chiefs of Staff Committee, Admiral Sureesh Mehta, delivered a major speech on "India's National Security Challenges" wherein he stated that China will be India's primary challenge[v]. He drew the same corollary: India must arm itself. The recent launch of the nuclear submarine, Arihant is a step in that direction. The US-India nuclear deal – which dealt a stunning blow to arms control globally – purposefully gives India an edge over China. Apart from legitimizing India's nuclear status and giving its nuclear power industry a huge boost, India will be allowed to buy high technology defense equipment from the US but China will not have the option.

In a startling development eleven years after the 1998 test of India's purported hydrogen bomb test, a senior Indian official and technical expert, K. Santanam, has confirmed the long-suspected fact: the Bomb did not do as well as it should have. An irresistible urge to tell the truth or moral unease is scarcely the reason for this dramatic revelation. Santanam's "coming clean" has the stamp of approval of the most hawkish of Indian nuclear hawks. Among them are P.K. Iyengar, A.N. Prasad, Bharat Karnad, and Brahma Chellaney. By rubbishing the earlier test as a failure, they hope to make the case for more nuclear tests. This would enable India to develop a full-scale thermonuclear arsenal. As is well known, a thermonuclear (or hydrogen) bomb is far more complex than the relatively simple fission weapon first tested by India in 1974, and by Pakistan in 1998. Advanced weapons needs fine tuning to achieve their full destructiveness – France had to test 22 times to achieve perfection.

3. Rattling the Nuclear Sabre

While China was the raison d'etre for India's nuclear weapons, these weapons created new dynamics of hostility in Pakistan-India relations. A fearful Pakistan acquired its own weapons with the obvious formula of balancing Indian nukes with Pakistani nukes. But this was to change very soon in Pakistan.

An enlarged set of objectives appeared even before the nuclear tests. A former director of the Inter-Services Intelligence (ISI), who was later Pakistan's ambassador to Germany put it this way: "If ", argued General Asad Durrani, "we were to make it clear that whatever nuclear deterrence we might have is primarily meant to deter the use of nuclear weapons from the other side, then by so saying we will fail to deter a conventional attack"[vi]. Therefore, he argued, the other side must be led to believe that "we are primed, almost desperate to use our nuclear capabilities when our national objectives are threatened, [as] for example, a major crackdown on [the] freedom movement in Kashmir...."[vii].

After their successful 1998 nuclear tests, Pakistani generals were quick to see that the calculus of power had changed. Now nuclear weapons could be used for more than just a boring stand-off with India. Drawing a lesson from the NATO-Warsaw Pact experience, they saw a way of equalizing scores with a much larger Indian conventional force. Convinced of an impregnable defence, they embarked on breath-taking adventurism in Kashmir. Just months after the Pakistan had established its nuclear credentials, the Chief of Army Staff, General Pervez Musharraf, sent troops out of uniform along with Islamist militant fighters across the Line of Control. They seized strategic positions in the high mountains of the Kargil area at the beginning of January 1999, setting of a war. This conflict was the direct consequence of Pakistan's nuclearization and almost certainly would not have happened otherwise. The war was to claim about 5000 dead on both sides.

As India counter-attacked, Pakistan stood diplomatically isolated[viii]. Gloomy and worried, Prime Minister Nawaz Sharif flew to Washington on 4 July 1999, where he was bluntly told to withdraw Pakistani forces or be prepared for full-scale war with India. Bruce Reidel, Special Assistant to President Clinton, writes that he was present in person when Clinton informed Nawaz Sharif that the Pakistan Army had mobilized its nuclear-tipped missile fleet[ix]. (If this is true, then the preparations for nuclear deployment and possible use could only have been ordered by General Pervez Musharraf at either his own initiative or in consultation with the army leadership.) Unnerved by this revelation and the closeness to disaster, Nawaz Sharif agreed to immediate withdrawal, shedding all earlier pretensions that Pakistan's army had no control over the attackers. This was key in poisoning relations between him and Musharraf, leading to his ouster months later. However, contrary to claims that he made a decade later, Nawaz Sharif had visited forward army posts near the Kargil area where he had given rousing speeches to jihad-shouting soldiers[x].

Despite the defeat in the Kargil War, Pakistan political and military leaders insisted that Pakistan had prevailed in the conflict and that its nuclear weapons had deterred India from crossing the Line of Control or the international border. This belief still remains strong in the military, which otherwise would have to concede that its "crown jewels" were of little utility (that nuclear weapons fuelled the conflict is denied even today by nuclear hawks). With a tense situation threatening to spiral into all out war, western diplomacy went into overdrive. The conflict eventually wound down after Pakistan ordered the withdrawal of its forces. Internationally, Pakistan was branded the aggressor.

But it did not take long to get back to the brink. On 13 December 2001, Islamic militants based in Pakistan struck at the Indian parliament in Delhi, sparking off a crisis that lasted for about seven months. While it is probably true that Musharraf's government did not order or was aware of the planned attack, there is little doubt that a free hand had been given to jihadists in Pakistan controlled Kashmir. Indian tempers soared again. Prime Minister Atal Bihari Vajpayee exhorted his troops in Kashmir to prepare for sacrifices and "decisive victory". This set off widespread alarm. It seemed plausible that India was preparing for a "limited war" to flush out Islamic militant camps in Pakistan administered Kashmir. That nuclear weapons were put on enhanced alert by both sides is a strong possibility, although direct proof has not been made public.

Tensions kept mounting during the stand-off. Sensing a global climate deeply hostile to Islamic militancy after the 11 September 2001 attack on the World Trade Centre, India's ruling BJP echoed the "war on

terror" slogan as a way to garner international support for their military campaign in Kashmir. Although an embattled Musharraf had little to do with the attack on the Indian Parliament, India cut off communications with Pakistan. The Indian ambassador in Islamabad was recalled to Delhi, road and rail links were broken off, and flights by Pakistani airlines over Indian territory were disallowed. Pakistan responded in kind.

Nuclear threats started flying in all directions. In May 2002, as fighter aircraft loudly circled Islamabad, in a public debate with me, General Mirza Aslam Beg, the former chief of Pakistan's army, declared: "We can make a first strike, and a second strike, or even a third." The lethality of nuclear war left him unmoved. "You can die crossing the street," he observed, "or you could die in a nuclear war. You've got to die some day anyway." Pakistan's ambassador to the UN in Geneva, Munir Akram, sent a threatening message by reiterating Pakistan's refusal of a no-first-use policy.

Indian aggressiveness was also in full display. Defence Minister George Fernandes told the International Herald Tribune "India can survive a nuclear attack, but Pakistan cannot."[xi] Indian Defence Secretary Yogendra Narain took things a step further in an interview with *Outlook Magazine*: "A surgical strike is the answer," adding that if this failed to resolve things, "We must be prepared for total mutual destruction.[xii] Indian security analyst, Brahma Chellaney, claimed "India can hit any nook and corner of Pakistan and is fully prepared to call Pakistan's nuclear bluff."[xiii] Fortunately, good sense prevailed and international mediation helped wind tensions down after a tense, months-long standoff.

Then came the Mumbai massacre. Carried out by the Pakistan-based Lashkar-e-Tayyaba, it began on 26 November 2008 and lasted 3 days, killing over 200 people and wounding at least 308. Indians describe it as their 911. Even in the first few days, it was fairly obvious that the Pakistani state, embattled as it was by other jihadist groups, could not have ordered the attacks. But Indian temperatures soared when Pakistan vociferously denied that its nationals were involved. The media in both countries poured fuel over the fire, with Indian television anchor persons repeatedly calling for military action against Pakistan.

A personal example from the Pakistani side: just days after the attack, General Hamid Nawaz (Retd), who served as Federal Interior Minister and Defence Secretary of Pakistan, in a widely-watched television program angrily attacked me for suggesting that one of the many Pakistan-based jihad groups could have been involved. Instead he recommended readying Pakistan's nuclear arsenal, and said that a nuclear first-strike should be among Pakistan's preferred options[xiv]. Others on Pakistani television channels were also casual in suggesting the use of nuclear weapons. These could be indicating that deterrence is losing value.

There has, of course, been no actual use of nuclear weapons since Hiroshima and Nagasaki. Although Pakistan and India have viciously clawed at each other, each time they have stepped back from the brink. Doesn't this constitute proof that deterrence "works"?

On the face of it, the answer is "yes". But there is an important caveat. What has worked a few times may or may not work the next time. And, there are strong indications that a kind of fear-fatigue has set in, reducing the value of deterrence. The efficacy of nuclear deterrence is predicated on the ability of these weapons to induce terror. It presupposes a rational calculus, as well as actors who, at the height of tension, will take decisions based on cold logic rather than emotion. Events in South Asia have put all these assumptions into question. Countries loitering close to the brink may begin to feel that they cannot fall into it.

An example: in early 2002, with a million troops mobilized and leaders in both India and Pakistan threatening nuclear war, world opinion responded fearfully, seeing a fierce and possibly suicidal struggle up ahead. Foreign nationals streamed out of both countries. But even at the peak of the crisis, few Indians or Pakistanis lost much sleep. Stock markets flickered, but there was no run on the banks or panic buying. Schools and colleges, which generally close at the first hint of disturbances, functioned normally. The indifference to nuclear annihilation was simply amazing.

But, on second thought, perhaps it was not quite so amazing. India and Pakistan are still largely traditional, rural societies, albeit rapidly going through a great economic and social transformation. The

fundamental belief structures of such societies (which may well be the last things to change), reflect the realities of agricultural economies dependent on rains and good weather – precisely the factors that brought the Rain God and other deities into being. These pre-scientific beliefs encourage surrender to larger, supernatural forces. So conversations and discussions often end with remarks to the effect that fate shall triumph, after which people shrug their shoulders and move on. Risk-taking is natural once unseen forces can be brought to your defense.

There are other reasons for this nonchalance as well. In India and Pakistan, most people lack basic information about nuclear dangers. In India, a November 1999 post-election national opinion poll survey found just over half of the population had not even heard of the May 1998 nuclear tests.[xv] In the middle of the spring 2002 crisis, the BBC reported the level of awareness of the nuclear risk among the Pakistani public was "abysmally low"[xvi]. In India, it found "for many, the terror of a nuclear conflict is hard to imagine."[xvii]

First hand evidence bears out these judgments. Even educated people seem unable to grasp basic nuclear realities. Some physics students (and faculty!) in my department think that a nuclear war would be the end of the world. Others see nuclear weapons as just bigger bombs. Many said it was not their concern, but the army's. Almost none know about the possibility of a nuclear firestorm, about residual radioactivity, or damage to the gene pool.

With each new Pakistan-India crisis, there seems to be a lessening of political restraints and greater nuclear brinksmanship. A key factor is the absence of an informed and organized public opinion able to keep political and military leaders in check and restrain them from brandishing nuclear weapons. In spite of today's vibrant public media, critical discussion of nuclear weapons and nuclear war is not aired in either country. Terror of nuclear weapons was fundamental in moving the Cold War adversaries towards nuclear treaties such as SALT, and the winding down of their aggressive military posturing. But this feeling of terror is not to be found in the Pakistan-India nuclear situation. Instead, oftentimes one finds a casual denial of reality and an almost blasé indifference to what nuclear weapons do.

In the past top Indian and Pakistani political leaders and analysts seem to have deliberately chosen the path of ignorance in nuclear matters.

A personal example: two months before the May 1998 nuclear tests by India and Pakistan, a Pugwash delegation met in Delhi with Prime Minister Inderjit Kumar Gujral. As a member of the delegation, I expressed worries about a nuclear catastrophe on the Subcontinent. Gujral repeatedly assured me – both in public and later in private – that Pakistan was not capable of making atomic bombs. The Prime Minister was not alone. Senior Indian defense analysts like P. R. Chari had also published articles before May 1998 arguing this point, as had the former head of the Indian Atomic Energy Agency, Dr. Raja Ramana.

Although Pakistan's nuclear tests shattered this false notion, senior Indian military and political leaders continued to express doubts on the operational capability and usability of the Pakistani arsenal. Shortly after Pakistan's incursion into Kargil, India began to seriously consider making cross-border strikes on militant camps on the Pakistani side of the Line of Control. Proponents of this strategy cast doubt on Pakistan's willingness and ability to use nuclear weapons. This gained wide currency in Indian ruling circles, increasing risks of a misjudgment that could have led to serious miscalculations and an accidental nuclear war.

Many Indian commentators and analysts chose to believe – perhaps some still do – that Pakistan, as a client state of the US, had been forced to put its nuclear weapons under the control of the US. Their assumption was that, in case of extreme crisis, the US would either restrain their use by Pakistan or, if need be, destroy them. At a meeting in Dubai which I attended in January 2002, senior Indian analysts said they were "bored" with Pakistan's nuclear threats and no longer believed them. K. Subrahmanyam, an influential Indian hawk who has long advocated Indian nuclearization said that India can "sleep in peace."

But to fearlessly challenge a nuclear Pakistan in this manner requires an enormous leap of faith. The presumption that United States would have both the political will – and the capability – to destroy Pakistani nukes is simply wrong. The fact is that even tracking a handful of mobile nuclear-armed missiles is extremely difficult. During the Cuban missile crisis, the U.S. Air Force had aerial photos of the Soviet missile locations and its planes were only minutes away, yet it would not assure that a surprise attack would be more than 90 percent effective. In the first Gulf War, U.S. efforts to destroy Iraqi Scuds had limited success. And, as 2009 moves to a close, the US is extremely reluctant to move on Iran's nuclear weapons – or allow Israel to go for them. No country has ever tried to take out another's nuclear bombs. The consequences of a botched operation cause even the bold to shudder.

5. The Quiet Death Of Minimal Deterrence

In the early days of Indian and Pakistani nuclear development, minimal deterrence or "just enough" was the mantra of the times. In the 1980's, the late "nuclear visionary", General K. Sunderji, would emphasize that India needed only a handful of fission weapons to "take out" the major Pakistani cities – but should make no more. In my single encounter with him in 1993 at a Carnegie conference in Washington, he hugged me warmly after I introduced myself to him as a Pakistani nuclear physicist. He said that Pakistan too should have a few nuclear weapons because that would make war impossible. I felt it unnecessary to respond that Pakistan was well on its way to having a few at that time, or that his (Sunderji's) initiative, Operation Brasstacks, had nearly brought the two countries to blows in 1987.

But the times kept changing. General Sunderji's ideas died before he did. In August 1999, the Indian Nuclear Draft Doctrine came along. It omitted all mention of a minimum. Instead, after a preamble that nuclear weapons are "the gravest threat to humanity", it went on to say that India needs "sufficient, survivable and operationally prepared nuclear forces" together with "the will to employ nuclear forces and weapons". It spoke of a triad of aircraft, mobile land-based missiles and sea-based assets, and achieving survivability of the forces through a combination of multiple redundant systems, mobility, dispersion and deception. Now there was to be no fixed number of weapons, no restriction on delivery vehicles, and no limits to what flexible response might mean. Tactical nuclear war-fighting, once considered escalatory and way beyond minimal deterrence, is said to have been incorporated into current Indian military doctrine. In fact, the major Indian war game *Poorna Vijay* (Complete Victory) in May 2001, the biggest in over a decade, was reported to center on training the army and air force to fight in a nuclear conflict.[xviii] Taken together, Indian military options and Pakistani planning would seem to ensure that that any major India-Pakistan conflict would inexorably lead to the use of nuclear weapons.

6. The Race for Nuclear Superiority

Once upon a time, South Asian nuclear proponents were wont to take personal insult upon mention of an arms race, which they debunked as fear mongering. At a 1992 conference in Chicago, the Indian defence strategist K.Subrahmanyan, vehemently asserted that "arms racing is a Cold War concept invented by the western powers and totally alien to sub-continental thinking". His Pakistani counterparts happily agreed. In those days nuclear philosophies, like that of Mutually Assured Destruction (MAD), were often attributed to sick western minds which have invented the notion of destroying the world seven times over.

But the expected about-turn did not take long in coming. A full fledged, Cold-War style, nuclear race developed soon after the nuclear tests of 1998. Even a cursory glance at India's subsequent nuclear and conventional spending shows this to be true. More recently, India raised its defense budget in February 2008 by 10% to $26.5 billion for the fiscal year 2008-2009 while its capital defense expenditure of $11.4 billion in 2008 grew 12% over the previous year[xix]. It plans to spend between $50 billion and $55 billion between 2009-2014 on various big-ticket items, such as a $10 billion contract for 126 fighter jets being pursued by Boeing Co., Lockheed Martin Corp., BAE Systems PLC and European Aeronautic Defence & Space Co. India was the world's 10th-highest military spender in 2008, according to research by the Stockholm International Peace Research Institute, but plans to head even further upwards. In July 2009, Indian defence minister, A.K. Antony announced that for 2009-2010 India plans to raise its military budget by 50% to a staggering $40 billion, making military expenditure 3% of the annual gross domestic product (GDP)[xx]. Corporate India and foreign defence suppliers were thrilled.

Marking a quantum escalation, in July 2009, India began sea trials of its 7000-ton nuclear-powered submarine with underwater ballistic missile launch capability. The submarine is the first in a planned fleet of five, and is to be supplemented by a hunter-killer nuclear submarine soon. With an estimated annual budget of $7.8 billion in 2008 – nearly four times lower than India's – Pakistan obviously cannot match India weapon for weapon. Nevertheless, historically every Indian move somehow finds a counter move. Predictably, news of the Indian nuclear submarine was badly received in Pakistan. What should it do? A former diplomat who headed Pakistan's delegation in talks with India on nuclear and conventional CBMs between 2004-2007 gave his answer[xxi]: follow India into developing nuclear submarines; equip existing conventional submarines with nuclear-tipped cruise missiles; approach the Russians for leasing a nuclear submarine; and make more nuclear weapons by enhancing fissile material production.

In the following, I shall summarize the current Pakistani warhead, missile, and aircraft situation – to the extent that it is known – and then ask what stands in the way of a still larger increase.

a) Nuclear Warhead Development

The current size of Pakistan's nuclear arsenal is a secret. Various plausible estimates have placed it in the range of 60-100 warheads in the 5-20 kiloton range. Given that India has chosen not to announce limits upon the size of its nuclear arsenal, one can safely assume that Pakistan has also not set a fixed numerical target. The US-India nuclear deal has essentially removed all possibilities for a fissile material cutoff in the forseeable future. Subject to material and technical constraints, one assumes Pakistan will seek to make as many warheads as possible, as well as make them more powerful and efficient.

So what could be the constraints for future expansion of the nuclear arsenal?

The maximum number of uranium-based warhead cores that can be produced by Pakistan depends on the quantity of highly enriched uranium produced in centrifuges at the Kahuta enrichment facility, and perhaps at undeclared facilities elsewhere in Pakistan. The initial HEU production was achieved using replicas of the aluminum P-1 centrifuge, brought from Europe by A.Q.Khan in the mid-1970's, which had a capacity of less than 1 "separative work unit" (SWU). This was the mainstay of the centrifuge program initially, and was supplemented in the late 1980's by the P-2 model which had a throughput of 5 SWU's. Typically, centrifuges are cascaded together in groups of approximately 164.

More advanced centrifuges using faster rotor speeds, made possible by the indigenous development of stronger steels, or possibly by smuggled maraging steel, were subsequently made at the Kahuta Research Laboratory (KRL)[xxii]. The P-3 was the first of the two later centrifuges. It is a four-tube model with a throughput of just under 12 SWU/yr. According to the reference cited, the P-4, which is still more advanced, may have a throughput of slightly over 20 SWU/yr. Although there is information about the types of these centrifuges in operation, their numbers are not known but are almost certainly in the few thousands by now. One therefore expects that the yearly production rate of HEU is currently several times larger than in the mid 1980's and that it will keep expanding.

The amount of natural uranium mined from presently known deposits, principally in the district of Dera Ghazi Khan, is another constraint. Pakistan has declared to the IAEA that it mines 40 tons of uranium ore yearly. This is distributed between the fuel fabrication for the Karachi Nuclear Power Plant (KANUPP) and for fissile material production.

Pakistan almost certainly has a handful of plutonium-based warheads whose smaller weight makes them more suitable for delivery by missiles over longer ranges. Plutonium-rich spent reactor fuel is produced by the one non-safeguarded 50 MW (thermal) reactor in Khushab which has been functioning since 1998. It produces an estimated 10kg/year of plutonium, which is roughly 2 bombs worth. Recently disclosed satellite imagery shows that there are two similar units that are currently under construction, with the latest unit's construction having been activated in 2007.[xxiii] Reprocessing of the spent fuel, done at the New Labs near Islamabad (and now possibly at the Chashma nuclear complex too) is necessary for chemically extracting the weapons-grade plutonium.

Satellite images obtained in 2009 suggest an increase in plutonium separation capacity[xxiv], based at the New Labs section of the Pakistan Institute of Science and Technology (PINSTECH) near Islamabad. Earlier, defence analysts in the US had pointed out that a series of commercial satellite images from February 2002 through September 2006 showed the construction of what appeared then to be a second plutonium separation plant adjacent to the original one, suggesting that Pakistan was planning on increasing its plutonium stock. An assessment of fissile stocks in South Asia has been attempted using publicly available information[xxv].

The actual number of fission warheads constructed of either type will, in addition to the plutonium available, also depend on the existence of adequate facilities for metallization, explosives, electronics, mechanical component construction, etc. A nuclear weapon has typically about 2000 parts and is a highly complex piece of equipment. Much of the metallization and weapon fabrication work is done in and around the Heavy Mechanical Complex in Taxila, and the adjoining military city of Wah. Many stages of fabrication are involved, the first of which involves conversion of the fissile material in gaseous form into pure metal, then machining it to precise dimensions to make the core. None of this is trivial. But, once a design has been standardized, it becomes easily possible to produce many copies. At the current production rate of a few fissile cores annually, warhead production would most likely follow the same rate and further expansion of warhead production facilities is unlikely to be a major constraint.

Although the numbers of Pakistani warheads and delivery vehicles is a closely held secret, a former top official of the CIA is quoted in the September 2009 “Bulletin Of The Atomic Scientists” as saying “It took them roughly 10 years to double the number of nuclear weapons from roughly 50 to 100”[xxvi]. Pakistan has successfully blocked efforts at the Conference on Disarmament in Geneva to limit fissile materials. It says India’s nuclear weapons make this necessary.

Making more powerful nuclear weapons is the next logical step. Boosted nuclear weapons, which use the same fissile materials, are relatively easy to make[xxvii]. A few tens of grams of deuterium or tritium gas are inserted inside the bomb. The additional neutrons released result in more complete fission and can double or even triple the explosive power.

The Khushab reactor is also a source for tritium production. Earlier, the PAEC had attempted to produce it by irradiating lithium[xxviii]. By 1987, the PAEC was able to acquire from West Germany parts for a tritium purification facility. Later, Pakistan attempted to procure from Germany 30 tons of aluminum tubing, used to “clad lithium for irradiation in a reactor”[xxix].In a congressional record of May 1989, Pakistan is said to have “acquired from West Germany United States-origin tritium — originally destined for H-bombs – as well as tritium recovery equipment. It also obtained a United States-origin high-power laser, the latter as part of a package of equipment for making nuclear fuel”[xxx].

Composite core weapons, whose idea is over 60 years old, are another possibility. By combining two materials – a smaller plutonium sphere encased in a shell of highly enriched uranium – Pakistan could make more bombs than if the cores were made of plutonium and uranium separately.

The fusion bomb requires a qualitatively different science. There is little doubt that Pakistan is seeking to make such a weapon, although one has little idea of the progress made so far. A plasma physics group in the Pakistan Atomic Energy Commission (PAEC), established over 20 years ago, is known to be looking into fusion weapon matters. India claims to have already developed a fusion weapon – one of the devices tested on May 11, 1998 was announced to be of this type.

b) Missile Capability

Missile development is now part of a burgeoning, increasingly export-oriented, Pakistani arms industry that turns out a large range of weapons from grenades to tanks, night vision devices to laser guided weapons, and small submarines to training aircraft. Dozens of industrial sized units in and around the cities of Taxila and Wah, with subsidiaries elsewhere in the Islamabad-Rawalpindi region, are producing armaments worth hundreds of millions of dollars with export earnings of roughly 300 million dollars yearly in 2008[xxxi]. Much of the production is under license from foreign countries, some from CKD kits, and most machinery for the arms factories is imported from the West or China.

The Pakistani missile series can be categorized into two distinct sets. The Ghauri missile series, based on the North Korean Nodong missile, was developed at the Kahuta Research Laboratories (KRL) while the Shaheen series, based on the Chinese M-9 and M-11 missiles, was developed at the National Defence Complex (NDC).

Missile type	Range(km)	Fuel	Payload (kg)	Number of tests	Date of last test
Hatf-I	50-90	Solid	450		
Hatf-II (Abdali)	70-200	Solid	450		
Hatf-III (Ghaznavi)	100-290	Solid	800		
Hatf-IV (Shaheen-I)	200-650	Solid	850		
Hatf-V (Ghauri)	300-1300	Liquid	680		
Hatf-VI (Shaheen-II)	700-2200	Solid	1100		21 Apr 2008
Hatf-VII (Babur)	500-750	Liquid	500	2	26 July 2007

The mainstays of the Pakistani missile force are listed in Table I above[xxxii]. These include the short-ranged ballistic missiles, the Hatf-III (Ghaznavi, range 290 km); Hatf-IV (Shaheen-I, range 650km); the longer ranged Hatf-V (Ghauri, range 1300km); and the yet to be deployed Hatf-VI (Shaheen-II, range 2200km).

A 2007 report says that fewer than 50 four-axled Transporter-Erector-Launcher (TEL) vehicles, needed for deploying the solid-fuelled Ghaznavi (Hatf-III) have been sighted[xxxiii]. Most are apparently stored at the Sargodha Weapons Storage Complex adjoining the PAF base. The same report refers to roughly 50 four-axled TELs existing for the Shaheen-I missile. About 15 six-axled TELs, suitable for the Shaheen-II, have been seen in satellite imagery.

Pakistan is also developing a 500km range, nuclear-capable, cruise missile named as Babur. A Pakistani government supported website[xxxiv] states that its design capabilities are comparable to the American BGM-109 Tomahawk cruise missile, and that a 1000km version is also being developed. The Babur is advertised as a "subsonic, low-level terrain-mapping, terrain-hugging missile that can avoid radar detection and strike with pinpoint accuracy". Rather than being GPS guided – which depends crucially on the integrity of satellite systems being preserved in times of conflict – it is said to use inertial guidance (and possibly laser gyroscopes). Launched from a TEL, it was test-flown on March 21, 2006 with President Gen. Pervez Musharraf in the audience.

According to a spokesman of the Inter Services Public Relations (ISPR), "Pakistan is looking into modification that will enable the missile to be launched from its F-16s, Mirage and A-5 air platforms and naval platform such as Agosta 90B attack submarines and its Tariq Class frigates." A test of the Babur on 26 July 2007 was declared successful with a range stated to have been enhanced to 700km[xxxv].

Pakistan has been surprisingly successful in creating a fairly large and diverse intermediate range missile force in a very short time. How is it possible for any developing country with a weak industrial and scientific infrastructure to do so? Making missiles that can fly over long distances is a highly complex technical task; even today "rocket science" is sometimes used as a synonym for the most difficult, cutting edge, science.

Making missiles requires acquisition of a broad range of technologies. Some of the key ones are:

- Chemical technology for liquid or solid fuel propellant manufacture, handling, and testing.
- Mechanical technology for rocket motor design, construction, and testing.
- Aerodynamic and structural engineering for design of structures such as missile body, fins, and re-entry cones.
- Special materials manufacturing and molding capability for high-temperature applications as well as for plastics and polymers. Heat shields for re-entry are essential for protecting the warhead from being rendered useless.

- Computational capability and specialized software for various applications including ballistics, navigation, flow rates, dynamic payload balancing, etc.
- Electronics for missile guidance and control, telemetry, and terminal guidance.

These are exacting requirements, but the design challenges are well understood and solutions may be found in specialized textbooks and monographs that are used as texts in graduate level university level courses taught in many countries including the US and China. Component design is no longer essential – the availability of ballistic missile technology, complete subsystems, navigational gyroscopes and GPS equipment, and powerful computers has allowed many third world countries, including Pakistan and India, to leapfrog across major developmental issues.

The details of missile development remains well under the wraps but intense friction between the two main Pakistani organizations, the Kahuta Research Laboratory and the National Defence Complex, headed respectively by Dr. A.Q. Khan and Dr. Samar Mubarikmand, had often led to each organization leaking information to the press in order to get a greater share of the glory. An Urdu newspaper gave a rare account in 1999 in a planted article entitled "How the Shaheen was Developed", wherein the achievements of the NDC group are extolled and that of the KRL group minimized[xxxvi].

What conclusions can we draw from this apparently phenomenal progress in missile making?

The sophistication of the Babur's propulsion system, a light-weight turbo-fan engine, as well as the complex control systems, electronics, sensors, aerodynamics, etc. places it well outside of any comparable achievements by Pakistani industry or other parts of its technological sector. Much the same can be said of the ballistic missiles in the Hatf series. There can be no doubt that Pakistan received substantial help from China, as well as components smuggled from Europe. North Korean help is an established fact for the Ghauri series, and may well be important for the Babur as well.

While Pakistan officially maintains that its missile fleet comes from indigenous development alone, this is not a tenable claim – or even one that is consistently held. A Pakistani author, evidently commissioned by the Pakistan Atomic Energy Commission to denigrate the achievements of A.Q. Khan and the rival KRL organization, wrote the following in a Pakistani defence journal:

> *"When the PAEC concluded an agreement with China to acquire the solid fueled M-11 ballistic missiles from China in 1989, A.Q. Khan soon after managed to get the liquid fueled Ghauri, from North Korea, and again hit the public imagination as the man who also gave Pakistan the delivery system for the bomb. The fact was that with the foundations of NDC having being laid in 1990, the PAEC was already on its way to start work on the solid fueled Shaheen ballistic missile, before the Ghauris or the Taepodongs and Nodongs became operational."*[1]

In this effort to bring credit to his parent institution, the PAEC, the author blows away the year after year denials by Pakistan of having obtained M-11 missiles from China, as well as of the Ghauri being indigenous and not of North Korean pedigree.

Nevertheless, to conclude that Pakistan's missiles are mere foreign imports would be wrong. Pakistan has moved on a two-track missile policy. The first track was acquisition of complete missile systems as CKD (completely knocked down) kits. These were brought as commercial cargo, mostly by sea but also through the Khunjarab Pass and down the Silk Route from China. The second track was to understand the systems, then reverse engineer the systems component by component. Once a successful overall system design – say, that of the Tomahawk – is taken as the basic template, the associated subsystems must be built or acquired. For designers and manufacturers in both advanced as well as developing countries, the modular nature of modern technology allows for separate units to be transported and then joined together to form highly complex and effective systems. One only needs to know how the units should be assembled, not very much about the principles on which they work.

[1] Pakistan's Nuclear History, op-cit.

Consider, for example, that 30-40 years ago an electronics engineer working on a missile guidance system had to spend years learning how to design extremely intricate circuits using transistors, capacitors, and other components. But now he just needs to be able to follow the manufacturer's instructions for programming a tiny microprocessor chip, available from almost any commercial electronics supplier. Modular technology applies also to rocketry, including engine design and aerodynamic construction. Computer controlled NC machines have made reverse engineering of mechanical parts easy. In this way, countries with negligible other technological achievements, such as North Korea, have been able to create rather advanced missile programs.

In a new development, Pakistan has announced that, in collaboration with Selex Galileo of Italy, it will soon start the manufacture of unmanned aerial vehicles (UAVs, commonly known as drones[xxxvii]. The march of technology, spread by the global commercial interests, appears unstoppable.

c) Aircraft Capability

The expansion of the army-controlled mobile missile force is being accompanied by expansion of air force capability. Chief of Air Staff, Air Chief Marshal Tanvir Mehmood Ahmed, announced in March 2009 that $9 billion would be spent on upgrading its "nuclear status"[xxxviii]. What this means is, however, unclear. Nor does it seem to be an efficient way of increasing nuclear offensive forces.

Fighter-bomber aircraft were once Pakistan's preferred means of delivering nuclear weapons to India, but they have certain definite limitations. First, their ranges do not permit many parts of India to be covered. Moreover they would have to run the gauntlet of an increasingly sophisticated Indian air-defense system. Nevertheless, they have the distinct advantage of being reliable, recallable, and reusable.

Pakistan had a deliverable nuclear weapon by 1987, and plans for aircraft delivery long preceded those for missile delivery. According to an officially inspired account,

> *"During the 1983-1990 period, the Wah Group [of the PAEC] went on to design and develop an atomic bomb small enough to be carried on the wing of a small fighter such as the F-16. It worked alongside the PAF to evolve and perfect delivery techniques of the nuclear bomb including 'conventional free-fall', 'loft bombing', 'toss bombing' and 'low-level lay-down' attack techniques using combat aircraft. Today, the PAF has perfected all four techniques of nuclear weapons delivery using F-16 and Mirage-V combat aircraft indigenously configured to carry nuclear weapons"*[xxxix].

Pakistan started receiving the first of a batch of 36 F-16 C/D block 50/52 fighter aircraft in July 2007, the most modern version currently flown by the US Air Force[xl]. It is also receiving assistance for modernizing all 34 of Pakistan's existing F-16 fleet to the same standard. F-16s are still said to be the mainstay for aerial delivery up to a range of about 1600 km, but two squadrons of A-5 Chinese built fighter-bombers are also suitable vehicles. There is, however, a caveat that has been added by the US: the F-16's sold under this deal will be specifically disallowed from carrying nuclear weapons. According to a US official, if Pakistan tried to do so then, "we have this extraordinary security plan with United States personnel, we have monitoring, we have leverage to convince them not to do this.[xli]" The modernized F-16's, however, would presumably be unaffected by this restriction.

The Pakistan Air Force's technical capabilities are mostly limited to aircraft maintenance. The largest units are the Mirage and F-6 rebuilding factories, an avionics and radar maintenance factory at Kamra, and a factory for manufacturing small training aircraft. There is an Air Weapons Complex located near Wah that manufactures a variety of air-delivered weapons. The JF-17 Thunder, of which 150 will eventually be inducted and become the air force's mainstay, is formally a joint China-Pakistan venture but Pakistani technical input into its design is said to be small.

A recent statement by the PAF air chief revealed that an Airborne Warning and Control System (AWACS) was being obtained from Sweden and China, and agreements had been reached with the US to provide electronic warfare system, smart bombs and long-range missile system. He said air-to-air refuellers were being modified. The PAF had almost 550 aircraft, including helicopters and transport aircrafts. The number of fighter planes was around 350, he added. At the moment, he said, there were 46 F-16 aircraft in the PAF, including 14 F-16 aircraft obtained from the US "almost free of cost"[xlii].

d) The Skill Deficit

It would be too easy to ascribe Pakistan's success in bomb and missile-making to merely having allocated a large enough amount of money and resources. However, much wealthier Middle Eastern countries – Iraq and Iran in particular – have been less successful. The difference comes from a few hundred scientists and engineers working under the direction of effective and intelligent group leaders, an international buying network, as well as the strong will to do it all. Much of the work was reverse engineering, and there are no declared original applications, devices, or processes that have been declared. Nonetheless, Pakistani weaponeers understood developments in the literature and industry in sufficient detail and clarity. Trained almost entirely in the US, Canada, and Britain under a program initiated in the early 1960's by the Pakistan Atomic Energy Commission, only a few were high-class research scientists, or studied at the best universities. By now, many have retired, or are close to retirement.

The burgeoning demand from the principal defense R&D organizations PAEC, NDC, and KRL has resulted in a skill deficit that is perhaps the most serious constraint in the further development of Pakistan's nuclear and missile programs. Pakistan's public universities are in poor shape, and their graduates are ill equipped to understand modern engineering and technical problems. Manpower is being drawn principally from:

- Engineering institutes run by the defence organizations. Examples include the Pakistan Institute of Engineering and Applied Sciences (PIEAS), as well as the Centre for Nuclear Studies (CNS). These institutes offer graduate studies in nuclear engineering, chemical and materials engineering, process engineering, systems engineering, electrical engineering, mechanical engineering, applied mathematics, information technology, etc. They are located on the premises of the Pakistan Institute of Nuclear Science and Technology (PINSTECH) near Islamabad. The NDC is also in the process of creating various institutes and centres on the Quaid-e-Azam University campus.

- A handful of engineering colleges of relatively better quality such as the army-run National University of Science and Technology (NUST), Ghulam Ishaq Institute of Technology (GIKI), University of Engineering Technology (UET), etc.

- Training of Pakistani missile and weapon designers in Chinese universities and institutes where they undergo short, highly focused, courses on rocket dynamics, navigational techniques, telemetry, etc. These are offered only to employees of government organizations and not general members of the Pakistani public.

- Using the 12-fold increase in its budget over the past 5 years, the Higher Education Commission of the government of Pakistan has awarded many scholarships to Pakistanis for studying in Europe, Australia, and the United States. Among the beneficiaries are the employees, or former employees, of various defence organizations.

- Academics and engineers in advanced countries can occasionally be interested into solving difficult technical problems for a fee. This follows the widespread global problem of outsourcing technical problems.

Pakistan's Nuclear Diplomacy

Although it is a client state of the US and dependent upon it in many critical ways, Pakistan has resolutely rejected US efforts to move it away from nuclear weapons. It is currently under criticism for having blocked talks between 64 countries to limit fissile materials under the Conference on Disarmament (CD) in Geneva[xliii]. The current posture reflects Pakistani anger at the US-India nuclear deal and the subsequent enhancement in India's capacity to generate fissile materials. It also assumes – perhaps correctly – that the Afghanistan situation makes Pakistan too essential to the US for it to take a hard stance.

Indian and Pakistani diplomacy has reflected the desire within their military-civil establishments to ward off criticism, particularly that which followed periods of high tension. It has been particularly important to project the image of a state that is fully aware and in control of itself.

In fact, nuclear respectability is implicitly and jointly sought by Indian and Pakistan elites, both military and civilian. Their goal is to show that their nukes are in responsible hands, that they can handle nuclear weapons just as well as anyone else, are sternly opposed to proliferation, and they are victims rather than supporters of terrorism. Officials and experts from both countries meet at arms control workshops and seminars, behave civilly (if not cordially) towards each other, and appear to be rational actors. CBMs, nuclear risk reduction measures, etc. have become their standard vocabulary items. The underlying mistrust and hostility is thereby effectively concealed.

Indian establishment intellectuals had grasped the value of creating the "responsible actors" image much before their Pakistani counterparts. The clinching of the US-India nuclear deal in 2007 owes much to this. Indeed, the Indian strategic analyst C. Raja Mohan had observed years earlier that,

> *"New Delhi and Islamabad should know that the willingness of the rest of the world to accept them as part of the official nuclear club depends on the ability of India and Pakistan to responsibly manage their own nuclear relationship…..If India and Pakistan want to be taken seriously, they must show results from their nuclear talks."*[xliv]

Musharaf's predecessor as chief of army staff, General Jehangir Karamat, while he was ambassador of Pakistan to the United States, was also keen to show that Pakistan and India are not trigger-happy,

> *"For those who observe South Asia from the outside it is considered a most dangerous place and a region in which a nuclear exchange could be a reality. It is thought that the India-Pakistan confrontations in 1987, 1990 and 2002, as well as the Kargil conflict in 1999, all had a nuclear dimension of some sort. This is not what most South Asians think"*[xlv].

Nevertheless, Gen. Karamat did admit that during the Kargil crisis, as well as in the crisis that followed the attack by Islamic militants upon the Indian Parliament in December 2001, that "statements and signaling through missile tests could have had unintended consequences"[xlvi].

As argued in the earlier part of this essay, the velvet gloves are rapidly discarded once the going gets rough. The politeness of diplomats, while welcome, merely hides the visceral feelings beneath.

The success of diplomacy speaks for itself. Giving primacy to its geo-political interests, the US fundamentally changed its posture on India: sanctions imposed in 1998 were gradually withdrawn, criticism became inaudible, a grudging acceptance of nuclear status followed, and then – in a dramatic blow to the Nuclear Non-proliferation Treaty – the US ended up making a special deal that now makes it a supplier of nuclear equipment and materials to India. Pakistan, while faring not quite so well and not being privileged by a similar deal, was de-facto accepted as a nuclear power with the safety and security of its nuclear arsenal reduced to the level of a nagging, low-level worry.

Safety and Security Pakistan's Nuclear Arsenal

Determined to retain and expand its nuclear capabilities but shaken by the reaction to A.Q. Khan's global nuclear entrepreneurship, in 2004 Musharraf's government had sharply reversed its earlier policy of keeping all nuclear matters under the wrap. It hoped thereby to assure the world that Pakistan's nuclear weapons were in safe hands. A stream of highly placed official visitors made a beeline for Washington's think-tanks and military colleges across the United States. A few years earlier this would have been unthinkable. Visits from top officials of the Strategic Plans Division (SPD), which is charged with the possession, maintenance, and safety of Pakistan's nuclear weapons became routine, and still continue.

It is especially significant that the director general of the SPD, Lt. Gen. Khalid Kidwai, is a visitor to the US. He was, for example, invited to a special guest lecture to the faculty, students, and guests of the Naval Postgraduate School in Monterey where he sought to debunk the notion that Pakistani weapons could fall into the hands of religious extremists, were on hair-trigger alert, or be used irresponsibly[xlvii]. Other Pakistani military officers associated with the nation's nuclear program are paid by US funding sources for writing reports and papers for US think-tanks and research institutes. Still others are in the process of writing books that will reveal the "true history of the Pakistani nuclear program"[xlviii].

To safeguard Pakistan's "crown jewels" is a relatively recent preoccupation that dates to the September 11, 2001 attack. Although Pakistan's military government insisted that there was no danger of any of its nuclear weapons being taking for a ride, it did not take chances. Several weapons were reportedly airlifted to various safer, isolated, locations within the country[xlix]. This nervousness was not unjustified – two strongly Islamist generals of the Pakistan Army (the head of Pakistan's ISI intelligence agency, Lt. General Mehmood Ahmed, and Deputy Chief of Army Staff, General Muzaffar Hussain Usmani), close associates of General Musharraf, had just been removed. The seriousness of betraying the progeny of Pakistan's intelligence services was something that Musharraf feared – and for good reason.

Internationally, there are widespread fears that instability in Pakistan could make its nuclear weapons and stocks of nuclear explosive material dangerously vulnerable to theft. As could be expected, Pakistan's position has been one of emphatic denial: the Foreign Ministry claims that "our [nuclear] assets are 100 percent secure, under multiple custody".

Soothing words, however, have not taken away a general sense of worry. Pakistan is now in the grip of a full-fledged insurgency by Islamic groups. Some of these view Pakistan's nuclear weapons as belonging to the *Ummah*, rather than Pakistan alone[l]. This has enhanced the feeling internationally that Pakistan's nuclear weapons, fissile materials, and other nuclear components are unsafe.

The dangers to Pakistan's nuclear weapons are potentially four-fold:

- From India and the US, separately or together. Israel is a distant possibility but not to be ruled out[2].
- From outside: Islamic militants attacking a nuclear storage site or facility with the purpose of capturing a nuclear weapon.
- From inside: Islamic elements in the army who have responsibility for protecting and operating nuclear sites or facilities.
- From a collaboration between insiders and outsiders.

[2] There is concern in Pakistan of the growing Israeli-Indian strategic alliance, underscored by the supply of four Phalcon AWAC-type systems. These have the capability of tracking Pakistani aircraft over the entire geographical area. India has already acquired two Israeli Green Pine radars, capable of tracking missiles at a distance of 400 km. These are normally used in conjunction with the Arrow II anti-missile system. These early-warning systems could be effectively used by Israel to launch a pre-emptive strike at Pakistan's nuclear facilities with India's direct assistance or by using India as a base.

Only an extreme crisis would result in India or the US, whether acting together or separately, to attack a nuclear armed state with all the obvious dangers this contains. Even a massive use of force is unlikely to net all of well-hidden and well-protected Pakistani nuclear weapons. Moreover, the job would be incomplete unless the major nuclear weapon facilities, reactors, and uranium enrichment plants were also destroyed completely. This would involve nothing short of total war.

On the other hand, Islamic extremists may seek a weapon for ultimate use against a US or European city. But, because it would be much easier to arrange, they may seek the destruction of an Indian or Pakistani city, with the hope of provoking total war between Pakistan and India. This would be consistent with the suicide bombing strategy followed by Al-Qaida elsewhere. In the extremist mindset, it is best if infidels are killed. But if Sunni Muslims are killed, they will simply make it to heaven a bit earlier.

Defending against other nations as well as internal enemies poses a difficult security dilemma: Pakistan would like to keep the location and details of its nuclear weapons secret in order to increase their chances of a strike by India, the US, or Israel. On the other hand army insiders are already, by definition, in the know. Perhaps in collusion with an external Islamic group they could be plotting a move unknown to the Nuclear Command Authority (NCA), the SPD, or the Chief of Army Staff. How could such an attempt be foiled?

Only partial safety is possible no matter what the technical fix. One obvious mechanism is to reduce the readiness level. Pakistan is widely believed to store the fissile core and bomb mechanisms separately in safely guarded vaults. As early as December 1999, it had requested senior US officials visiting Islamabad for Permissive Action Links (PALs) that are directly integrated into the firing mechanism and electronics of a nuclear weapon, as well as Environment Sensitive Devices (ESDs), in order to enhance protection against unauthorized use or accidental nuclear detonations. At that time, the US had declined for obvious reasons: these devices make it possible for the weapons to be maintained at a higher state of alert for the same level of safety, thereby increasing the threat perceived by India. But subsequent to a reversal of Pakistan's relationship with the US after 911, it is possible that the US may have acceded to Pakistan's request without demanding that Pakistan reveal the location or details of its nuclear weapons.

According to an ISIS report, US Secretary of State Colin Powell had offered nuclear protection assistance to Pakistan after 911[li]. Pakistan found the offered technology to be quite rudimentary but nevertheless accepted it under the condition that the end point usage would remain opaque. Other aspects of the assistance included training courses for Pakistani nuclear weapons personnel in US labs where they were instructed on nuclear safety and security issues.

David Albright, a US nuclear security analyst, prescribed the following forms of additional assistance to Pakistan in the aftermath of 911:

> *"Generic physical protection and material accounting practices; theoretical exercises; unclassified military handbooks on nuclear weapons safety and security; more sophisticated vaults and access doors; portal control equipment; better surveillance equipment; advanced equipment for materials accounting; personnel reliability programs; and programs to reduce the likelihood of leaking sensitive information. In addition, aid could focus on methods that improve the security of nuclear weapons against unauthorized use through devices not intrinsic to the design of the nuclear weapon or through special operational or administrative restrictions. Excluded assistance would include nuclear weapons design information aimed at making more secure, reliable or safer nuclear weapons or devices, PALs, coded launch control devices, and environmental sensing devices.[lii]"*

While technical measures to reduce the chances of nuclear sabotage and accident must undoubtedly be implemented, there is a fundamental tension that cannot be avoided – a perfectly safe nuclear weapon is

also one that cannot be used. Hence, by definition, it is useless. In times of crisis and war, when casualties and passions run high, there will be a strong urge to weaken the safety mechanisms in place.

Predicting Pakistan's Nuclear Direction

Looking at the next 5-10 years, one can make reasonable guesses for where Pakistani nuclear forces are likely to be, and the direction of its nuclear policy.

Unless a global fissile material cutoff is somehow agreed upon and implemented, Pakistani production of fissile materials and bombs, as well as intermediate-range ballistic missiles, will continue at the maximum possible rate permitted by technological and resource limitations. A shift towards smaller plutonium weapons, or composite warheads, will accelerate as the Khushab military reactors come on line.

The increasing number of warheads will demand increasing number of delivery vehicles. In spite of the substantial induction of JF-17 aircraft, as well as newly purchased F-16's, missiles will steadily replace aircraft as delivery vehicles for nuclear weapons. Flight tests and command post exercises will continue to be periodically conducted. Although Pakistan will make efforts to match India's efforts in using outer space for reconnaissance and early-warning systems, it will not be able to do so.

If India is successful in acquiring and installing an anti-ballistic missile system, MIRVing, or in deploying submarine launched nuclear-tipped missiles, Pakistan will counter by lowering the strike-threshold and wider dispersion of its mobile launchers, as well as employing decoys and moving towards SLBMs.

In the past, Pakistan had securely hitched its nuclear policy to India's. It had assumed that India's nuclearization would be allowed to justify its own. But the "de-hyphenation" of Pakistan from India – a word that gained particular currency after the visit to India and Pakistan by President George W. Bush in 2006 – has now forced its nuclear policy to be more than a mirror image of India's.

New challenges are now appearing because of the Obama administrations initiatives to reduce nuclear weapons held by the US and Russia. US ratification of CTBT, which was rejected by the Senate in the Bush years, will put pressure on India and Pakistan to sign. Would Pakistan go along? The answer is: probably yes. Unless India resumes nuclear testing, Pakistan will not test further.

It is also certain that the US will go forward with talks on a "verifiable" Fissile Material Cut-off Treaty [the Bush administration had not supported verification]. Pakistan is already seen as being obstructive. Would Pakistan be ready to negotiate? Sign the FMCT? What about on-site inspections? The future does not look promising in the absence of a move that is widely accepted as genuinely proceeding towards global nuclear disarmament.

The Case For De-Nuclearization[liii]

Eleven years ago a million Pakistanis danced in the streets after six nuclear weapons had been successfully tested. They had been told that making nuclear bombs was the biggest thing a country could do. But North Korea's recent nuclear test once again give rock-solid proof that this was a lie.

North Korea is a country that no one admires. It is unknown for scientific achievement, has little electricity or fuel, food and medicine are scarce, corruption is ubiquitous, and its people live in terribly humiliating conditions under a vicious, dynastic dictatorship. In a famine some years ago, North Korea lost nearly 800,000 people. And it has an enormous prison population of 200,000 that is subjected to systematic torture and abuse.

Why does a miserable, starving country continue spending its last penny on the Bomb? On developing and testing a fleet of missiles whose range increases from time to time? The answer is clear: North Korea's nuclear weapons and missiles are instruments of blackmail rather than means of defence. Brandished threateningly, and manipulated from time to time, these bombs are designed to keep the flow of international aid going.

Surely the people of North Korea gained nothing from their country's nuclearisation. But they cannot challenge their oppressors. But, Pakistanis — who are far freer — must ask: what have they gained from the Bomb? My friends in India who have opposed their Bomb ask precisely this question on their side of the border.

Some Pakistanis had imagined that nuclear weapons would make their country an object of awe and respect internationally. They were told that Pakistan would acquire the mantle of leadership of the Islamic world. Indeed, in the aftermath of the 1998 tests, Pakistan's stock had shot up in some Muslim countries before it crashed. But today, with a large swathe of its territory lost to insurgents, one has to defend Pakistan against allegations of being a failed state. In terms of governance, economy, education or any reasonable quality of life indicators, Pakistan is not envied by any one.

Contrary to claims made in 1998, the bomb did not transform Pakistan into a technologically and scientifically advanced country. Again, the facts are stark. Apart from relatively minor exports of computer software and light armaments, science and technology remain irrelevant in the process of production. Pakistan's current exports are principally textiles, cotton, leather, footballs, fish and fruit. This is just as it was before Pakistan embarked on its quest for the bomb. The value-added component of Pakistani manufacturing somewhat exceeds that of Bangladesh and Sudan, but is far below that of India, Turkey and Indonesia. Nor is the quality of science taught in Pakistani educational institutions even remotely satisfactory. But then, given that making a bomb these days requires only narrow technical skills rather than scientific ones, this is scarcely surprising.

What became of the claim that the pride in the bomb would miraculously weld together the disparate peoples who constitute Pakistan? While many in Punjab still want the bomb, angry Sindhis want water and jobs — and they blame Punjab for taking these away. Pakhtun refugees from Swat and Buner, hapless victims of a war between the Taliban and the Pakistani Army, were tragically turned away by ethnic groups from entering Sindh. This rejection strikes deeply against the concept of a single nation united in adversity.

As for the Baloch, they deeply resent that the two nuclear test sites — now radioactive and out of bounds — are on their soil. Angry at being governed from Islamabad, many have taken up arms and demand that Punjab's army get off their backs. Many schools in Balochistan refuse to fly the Pakistani flag, the national anthem is not sung, and black flags celebrate Pakistan's independence day. Balochistan University teems with the icons of Baloch separatism: posters of Akbar Bugti, Balaach Marri, Brahamdagh Bugti, and "General Sheroff" are everywhere. The bomb was no glue.

Did the bomb help Pakistan liberate Kashmir from Indian rule? It is a sad fact that India's grip on Kashmir — against the will of Kashmiris — is tighter today than it has been for a long time. As the late Eqbal Ahmed often remarked, bad politics helped "snatch defeat from the jaws of victory". Pakistan's strategy for confronting India — secret jihad by Islamic fighters protected by Pakistan's nuclear weapons — backfired terribly in the arena of international opinion. More importantly, it created the hydra-headed militancy now haunting Pakistan. Some Mujahideen, who felt betrayed by Pakistan's army and politicians, ultimately took revenge by turning their guns against their sponsors and trainers. The Bomb helped Pakistan lose Kashmir.

Some might ask, didn't the Bomb stop India from swallowing up Pakistan? First, an upward-mobile India has no reason to want an additional 170 million Muslims. Second, even if India wanted to, territorial conquest is impossible. Conventional weapons, used by Pakistan in a defensive mode, are sufficient protection. If the mighty American python could not digest Iraq, there can never be a chance for a middling power like India to occupy Pakistan, a country four times larger than Iraq.

It is, of course, true that Pakistan's nuclear weapons deterred India from launching punitive attacks at least thrice since the 1998 tests. Pakistan's secret incursion in Kargil during 1999, the Dec 13 attack on the Indian parliament the same year (initially claimed by Jaish-i-Muhammad), and the Mumbai attack in November 2008 by Lashkar-i-Taiba, did create sentiment in India for ferreting out Pakistan-based militant

groups. So should Pakistan keep the bomb to protect militant groups? Such means of conducting foreign policy are dangerous and suicidical.

It was a lie that the Bomb could protect Pakistan, its people or its armed forces. Rather, it has helped bring the country to this grievously troubled situation and offers no way out. The threat to Pakistan is internal. The Bomb cannot help Pakistan bring Waziristan back to Pakistan. More nuclear warheads, test-launching more missiles, or buying yet more American F-16s and French submarines, are of no use in thwarting suicide attacks on soldiers and civilians.

Pakistan's security problems cannot be solved by better weapons. Instead, the way forward lies in building a sustainable and active democracy, an economy for peace rather than war, a federation in which provincial grievances can be effectively resolved, elimination of the feudal order and creating a tolerant society that respects the rule of law.

It is time for Pakistan to become part of the current global move against nuclear weapons rather than opposing it. India — which had thrust nuclearisation upon an initially unwilling Pakistan — is morally obliged to lead. Both must announce that they will not produce more fissile material to make yet more bombs. Both must drop insane plans to expand their nuclear arsenals.

Europe and the United States, while helping Pakistan in its internal struggles, must curb the enthusiasm of their defense industries in supplying military equipment to the two protagonists. India's military expansion deserves a harsher condemnation than Pakistan. This unnecessary militarization naturally creates tension, as well as diverts critical resources away from the actual needs of India's people. On the other hand, there is no need for Pakistan to fear an Indian invasion. Instead, it must focus upon destroying Islamic terrorist groups – some of its own making – that attack targets in India as well as inside Pakistan.

Eleven years ago a few Pakistanis and Indians had argued that the bomb would bring no security, no peace. They were condemned as traitors and sellouts by their fellow citizens. But each passing year shows just how right we were.

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[liii] This section is based on my article "Yet Another Nuclear Anniversary" published in Dawn on 28 May 2009, the 11th anniversary of Pakistan's nuclear tests.

Abbreviation

AEC	Atomic Energy Agency
BJP	Bharatiya Janata Party
BBC	British Broadcasting Cooperation
CANDU	Canadian Natural Deuterium Uranium
CBM	Confidence Building Measures
CKD	Completely Knocked Down
CNS	Centre for Nuclear Studies
CD	Conference on Disarmament
CTBT	Comprehensive Nuclear Test Ban Treaty
ESDs	Environmentally Sensitive Devices
FMCT	Fissile Material Cutoff treaty
GDP	Gross Domestic Product
GIKI	Ghulam Ishaq Institute of Technology
HEU	Highly Enriched Uranium
IAEA	International Atomic Energy Agency
ISPR	Inter Services Public Relations
ISIS	Institute for Science and International Security
KRL	Kahuta Research Laboratory
KANUPP	Karachi Nuclear Power Plant
MAD	Mutually Assured Destruction
MIRV	Multiply Independent Reentry Vehicle
NUST	National University of Science and Technology
NCA	Nuclear Command Authority
NATO	North Atlantic Treaty Organization
NDC	National Defence Complex
NC	Numerically Controlled
PINSTECH	Pakistan Institute of Science and Technology
PAEC	Pakistan Atomic Energy Commission
PAF	Pakistan Air Force
PIEAS	Pakistan Institute of Engineering and Applied Sciences
PALS	Permissive Action Links
SALT	Strategic Arms Limitation Treaty
SWU	Separative Work Unit
SPD	Strategic Plans Division
SLBMs	Submarine Launched Ballistic Missiles
TEL	Transporter Erector Launcher
UAVs	Unmanned Aerial Vehicles
UET	University of Engineering Technology
US	United States of America