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ON PAGE 1

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Ambitious third-world states are learning to make nuclear weapons. Today's exclusive "nuclear club" could double in the next decade. Safeguards to stop the spread of nuclear weapons are under attack. This is the first of five articles examining the current dangerous trend.

Pakistan: crash program, secret bids for nuclear technology

By David K. Willis
Staff correspondent of The Christian Science Monitor

Vienna, Austria, and Karachi, Pakistan

A military-ruled Muslim country, sandwiched between powerful rivals, so undeveloped it cannot manufacture even a television tube or a radio set, has just made several dramatic, covert bids to buy cables and computers to help it build and test a nuclear device.

This newspaper has learned that the country – Pakistan – has secretly tried to get highly sensitive diagnostic coaxial cable from US and European suppliers.

The cable is used for monitoring underground nuclear tests. It runs from a test shaft in which a device is exploded to a monitoring center a safe distance away. Pakistan has dug just such a shaft in remote Baluchistan's Chagai Hills near the Afghan border, intelligence sources confirm.

Hearing about the attempts to buy the cable, alarmed United States officials jumped into action. They exerted enough pressure, direct and indirect, on the US and European firms to stop the sales.

But the very bid itself, reportedly made through "front" companies, indicates to officials how far toward a nuclear blast Pakistan has advanced after a clandestine crash program over the last decade.

They believe Pakistan will try again and again, under different covers. They estimate that Pakistan could have its first device built by the end of next year.

Islamabad has also tried to buy two big US computer systems. The first, it claimed, was for high-altitude atmospheric research. The second was said to be for analyzing crop rotation results.

When the US Commerce Department demanded that the Pakistanis sign a statement promising not to use the computers for any nuclear purposes whatsoever, peaceful or otherwise, they fell silent. Curious, US officials asked questions. Pakistani officials replied blandly, "What computers? We didn't want to buy any computers. . . ."

These developments, plus other more successful efforts to acquire nuclear technology (see below), are profoundly disturbing for diplomats, officials, and scientists around the world who oppose the spread of nuclear weapons to often unstable third-world countries.

The developments illustrate the lengths to which pride, vulnerability, ambition, fear, and internal struggles can push small nondemocratic leadership elites toward acquiring nuclear devices as a way to gain power and status.

Pakistan is just one of 10 countries on the nuclear threshold. Among the others are India, which exploded a nuclear device in 1974, Israel, and South Africa. None of these have signed the 1970 nuclear Nonproliferation Treaty (NPT).

Thus only part of their nuclear fuel cycles are subject to inspections by the International Atomic Energy Agency (IAEA) in Vienna. Other parts are not. All four have the know-how, the special skills, and the political incentives needed to build nuclear weapons. Right behind them are:

- Iraq, determined to push on with its nuclear program despite Israel's bombing of its nuclear reactor in June.
- Argentina and Brazil, the giants – and rivals – of Latin America.
- Taiwan and South Korea, skilled, determined, each with a fractious relationship with a communist neighbor.
- Libya, in a special, dangerous category of its own. Undeveloped but oil-rich and erratic, Libya tried to buy a nuclear bomb from China in 1970. It has been selling uranium to Pakistan and giving it money.

This correspondent set out three months ago on the trail of the atom bomb makers. It began in an idyllic open-air restaurant in a valley outside Geneva, where a top nuclear scientist provided a thorough briefing on technical data.

It was to lead through 12 cities in eight countries in the Middle East, Europe, and Africa, as well as in the US.

As a result, this newspaper has amassed new evidence to show that atomic devices, and the ability to detonate them, are spreading to volatile areas of the world where ambition and insecurities are high but safeguards are low.

Frequently questions put to officials in these nations about nuclear matters met with closed doors. But a number of thoroughly alarmed diplomats, scientists, and officials were willing in private to share details of the rush to nuclear weapons. They hoped they might slow it down by directing public attention to its dangers.

The nuclear trail leads through some of the deepest impulses of the human mind – from fear to moral outrage, from hope to a passionate commitment to nuclear power as cheap energy for the future.

This series is an effort to bring to light some of the maneuverings of would-be atom bomb makers. Two of them, Israel and South Africa, deny any nuclear tests so far, but have the diplomatic status that results from an almost universal belief that they already possess atomic weapons, either assembled or in pieces.

The series looks at the state of inspections, safeguards, and the IAEA. It looks at the flow of uranium and skilled technicians, and it looks at ideas for the future.

Should Pakistan or any of the other states on the threshold actually detonate a bomb, the nuclear club would expand for the first time since India let off an atomic blast in the Rajasthan Desert in 1974.

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The number of hydrogen-bomb powers has remained at five since 1964: the US, the Soviet Union, Britain, France, and China. Neither France nor China has signed the NPT.

If a state like Pakistan detonates a nuclear device, or if it becomes widely known that it has an undetonated bomb, other threshold states could be emboldened. Prospects for a rapid spread of nuclear weapons would grow as this century nears its end.

Regional rivalries in the Middle East, in Latin America, in Africa, and in Asia would be more dangerous. Other countries well able to build their own nuclear weapons – Italy, Australia, even West Germany and Japan – might announce a new willingness to look at their nuclear options. International fears would grow.

Even now the world must decide just how important stopping the spread of nuclear weapons actually is. Is it just one policy objective among others? Or is it a paramount issue ranking with inflation, oil prices, and foreign expansionism. Is it *the* issue of today?

Is it urgent now to draw up what is dramatically lacking in today's world: a list of agreed embargoes and other punishments to be taken against any country that makes or explodes a nuclear device?

The most urgent case today is Pakistan. President Zia ul-Haq could have a nuclear device – at least one – by the end of next year. He could decide to explode it in a desperate bid to hang onto personal power, or to defy and impress India, or to warn the Soviet Union, or to exert diplomatic blackmail against the United States.

There are four big reasons why Pakistan is in fact a crucial test case:

1. Pakistan has 83 million people and aspirations to lead the Muslim world. It has accepted money and bought uranium from Col. Muammar Qaddafi of Libya. Israel fears that the rich, unpredictable, terrorist-supporting Qaddafi could extract nuclear technology from a Pakistan that needs his cash and political support.

The US is also deeply concerned. Other Arab states could learn nuclear secrets from Pakistan. So Pakistan is part of global concern about the Middle East arms race.

2. Pakistan has fought three wars with its bitter rival, India. "How can we tell Pakistan to stop building a nuclear weapon when India detonated one in 1974?" one US official asks despairingly. "We can ask – but is Pakistan listening?" If Pakistan lets off a blast, Indian Prime Minister Indira Gandhi will be under severe pressure to respond in kind.

American, Israeli, and other experts say the logical Indian response – despite Indian denials – would be a hydrogen bomb. It is within India's capacity. It would expand the H-bomb club to six nations. It would alarm the superpowers. The subcontinent arms race, heating up again with Pakistan obtaining 40 ultrasophisticated US F-16 jets and India reported to be going after 150 French Mirage 2000s after buying Soviet MIG-23s, would take the most ominous of turns: a nuclear turn.

3. Pakistan is closely involved with the three superpowers. It is allied with the United States, opposed to Soviet troops next door in Afghanistan, and on fairly good terms with China. Any tilt on the subcontinent affects all three. A nuclear tilt would alarm all three. Consequences would be grave. The superpowers would try to contain a nuclear arms race. Pressures on them would be intense.

Right now, the clandestine Pakistani rush toward an atomic device is an embarrassment to the Reagan administration in Washington. It sees Pakistan as a key ally against Moscow. News of the bid to buy diagnostic cable and large computers for nuclear use has been tightly held in Washington, partly because so many members of the House and Senate are deeply suspicious of Pakistan.

The Senate has agreed to the first stage of a $3.2 billion economic-aid and military-sales package over the next six years. The House is considering it. Subcommittees in both chambers gave a green light to the sale of 40 F-16 jets. The sale is now approved.

The Senate says all aid will be suspended if Pakistan detonates a nuclear device, without the President being able to override the cutoff. The House may allow presidential discretion to remain, subject to two-thirds majority votes in both House and Senate.

Zia wants a bomb

Democrats will be angry if Pakistan does detonate. Knowledge that the aid may stop may make him wait until he has such aid before he pushes the button in Baluchistan.

4. Pakistan is also vital because any new nuclear test would inevitably weaken the framework of precautions against the spread of nuclear weapons.

So far, the framework has worked remarkably well, given the number of countries (Canada, Japan, and Australia) that could make weapons if they chose.

But now the framework is under fire. The system of safeguards, inspections, treaties, talks, export controls, and intelligence surveillance was jolted when Israel found it inadequate to prevent Iraq from building a bomb. Israeli F-16 jets streaked to Baghdad June 7 and bombed the Osirak reactor being built by France.

Many Israelis I talked with agreed with Prime Minister Menachem Begin's basic rationale. To sit in a living room in Jerusalem, and to be told in quiet, cultured tones that India should now bomb Pakistani nuclear installations is a chilling experience.

The Israeli raid has set a precedent of one state's taking direct action long before another state's nuclear capacities grow. The IAEA, along with US and other experts, says Iraq was six to seven years away from making a nuclear device.

Israeli officials say Israel would bomb again if necessary to keep nuclear weapons out of Arab hands. They don't answer a direct question on whether they would bomb Pakistani nuclear sites as they did Iraq's. Israeli intelligence keeps close tabs on Pakistan's progress.

"You're not talking about democracies here," says an Israeli official in Tel Aviv, on the sunny shore of the blue Mediterranean. "You're talking about states ruled by individuals. One bullet can change everything. Or a coup." Take Iran. If the Shah had lived five more years and acquired a bomb, what would [Ayatollah] Khomeini have done with it?"

Said another Israeli source: "We acted. Now it's time for other powers to stop this proliferation."

One of the questions this series will examine is: how? By 1990 Iraq may be able to explode a small device, since France is apparently planning to rebuild Osirak (insisting on strict safeguards and a lower-grade uranium fuel).

Libya is training unusually large numbers of engineers in the US (see next article in this series), Western Europe, and the Soviet Union.

Argentina and Brazil will also be on the verge of nuclear weapons in the 1990s. So will South Korea and Taiwan.

Some strategic thinkers, such as Indian government adviser K. Subramaniam, see world nuclear proliferation as a force for stability. They believe that just as the US and the Soviet Union have a nuclear stalemate, so subcontinent and Mideast rivals would balance into a standoff with nuclear weapons. World peace would not be threatened.

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But a far more widespread view is that when one side in a regional rivalry obtains nuclear weapons, its enemies will be under enormous pressure to stage preemptive strikes, as Israel did against Iraq.

Israeli Prof. Ya'ir Evron told me in Jerusalem, for instance, that the spread of nuclear weapons in the Middle East would be highly dangerous.

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For many a thoughtful analyst, the ultimate nightmare is a scenario outlined to me by a veteran European nuclear expert in Vienna:

"What worries me is the unknown, the end of the road, the system coming apart.

"If Pakistan gets a bomb, or Brazil, or Argentina, well, that's bad, but it's largely a regional matter.

"But it could lead, if world events continue to be as unstable as they are now, to South Africa being encouraged to warn black Africa to keep its distance. Or Israel might quarrel with the US, or vice versa.

"Then something terribly serious might happen: Western Europe might see the US as unreliable. Can you imagine the consequences if the world discovered West Germany was building a bomb – which it could do very quickly indeed?

"Or Japan?"

Experts almost literally shudder as they contemplate the Soviet reaction to intelligence about any West German move toward its own nuclear weapons. Moscow's overriding concern at the International Atomic Energy Agency in Vienna, sources report, is maintaining safeguards on the Germans. Moscow neither forgets nor forgives the Hitler invasion, which cost some 20 million Soviet lives.

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Dangers take other forms as well.

The era of fast-breeder reactors, which produce more nuclear material (plutonium) than they consume, is beginning. Larger quantities of uranium than ever before will be ferried between reactors and extraction plants. They will be targets for hijackers and terrorists.

The US and the Soviet Union have thousands of nuclear warheads in Europe. Experts at the IAEA and elsewhere worry that a Baader-Meinhof-style gang or a Libyan-financed Arab terrorist group might steal one, decipher the trigger mechanism, and hold a city for ransom.

The paperback thriller, "The Fifth Horseman" by Larry Collins and Dominique Lapierre, imagines Libya has blackmailed H-bomb secrets from French scientists and threatens to blow up New York City unless the US forces Israel to yield Palestinians a homeland. So far, it's only a novel.

Israel derides the ultimate effectiveness of inspections of nuclear plants carried out by the IAEA, the only international agency responsible for inspections. Two former IAEA inspectors, Americans Robert Richter and Emanuel Morgan, have issued widely quoted criticisms.

Many believe the IAEA is unique and irreplaceable, for all the faults inherent in a multinational organization.

Israel and South Africa accuse Arab and black states of playing politics with the IAEA. Developing nations demand the technical assistance (free nuclear technology) promised by the NPT in exchange for inspections. They also demand that the US and the Soviets cut their nuclear weapons stockpiles.

A growing number of developing countries argue that the nuclear club just isn't keeping its promises.

IAEA members have censured Israel for the Iraq raid. And they have expelled South Africa.

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Exclusive evidence amassed by this newspaper includes the Pakistani bid to buy the diagnostic coaxial cable for underground tests. The cable relays data from the blast site vital for scientists to know how efficient the fission process is and how to plan for the next test.

So far, the effort to stop the sale of the cable has succeeded. It is just one part in a long series of highly classified actions officials won't discuss in public. It is aimed at choking the flow of sensitive technology to countries like Pakistan. But Pakistan has been astonishingly successful in acquiring such technology from a dozen industrial countries.

(Officials were amazed and chagrined to discover that, even as they were squelching the sales, full details of an improved, late-model diagnostic cable, made with fiber optics, were splashed in full color across 11 pages of the September edition of Energy and Technology Review, published by the Lawrence Livermore National Laboratory in California.

(Title: "Optical Fibers in Nuclear Test Diagnostics." "Government dollars pay the salaries of officials stopping the sale," a source groans, "and tax money also finances a magazine telling everyone how to make the cable."

(Any embassy could do what I did: telephone Livermore and ask for the publication to be mailed. It was.)

But it is clear that President Zia does not intend to stop assembling a nuclear device and the means to test it.

Pakistan-watchers in Washington see President Zia playing a clever game. To Mr. Reagan he stresses the threat from Moscow. In fact, he has different reasons for wanting both the nuclear device and US aid. He wants to shore up Pakistan against its arch rival, India, and to hold onto power inside Pakistan.

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Other parts of new Monitor evidence that zeros in on Pakistan:

- Confirmation from a variety of intelligence and other officials that although the Baluchistan tunnel is empty so far, its size and configuration leave no doubt about its ultimate use.

An underground test would be harder to detect and more convenient than an atmospheric test, which would scatter radioactivity into India, Afghanistan, and perhaps China.

- Confirmation that Pakistan is working hard to complete a plutonium bomb trigger: a set of curved neutron reflectors and explosives to wrap around a plutonium core and compress it – "implode" it – into a detonation.
- Details of how Pakistan has orchestrated dummy companies, private individuals, and authentic trading corporations in Canada, Turkey, West Germany, Italy, Britain, the US, and elsewhere to provide parts for enrichment and reprocessing plants.

The parts include a West German fluoridation plant to convert uranium into a gas used by an enrichment plant; vacuum valves, evaporation and condensation systems, and filters from Switzerland; and special electrical inverters that keep steel "cascade" vessels spinning at unvarying speeds during the centrifuge enrichment process from Britain, Canada, and the US. Also, dissolvers, evaporators, and other equipment from France.

Clandestine suppliers have gone on trial in Canada and West Germany.

As recently as Oct. 31, a retired Pakistani Army officer reportedly tried to smuggle from New York 5,000 pounds of zirconium required to make fuel rods in large wooden crates labeled as mountaineering equipment.

- The US State Department's stern cables to US embassies in Ankara, Rome, Bonn, and a dozen other capitals that order diplomats to tell their host countries of the grave concern with which the US regards the Pakistani efforts to buy sensitive items.

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Turkey replied that it had little power over private companies and their dealings in items such as inverters, which are also in wide use for textile plants. Other countries answered in the same way.

• Pakistan's secret agreement with Turkey promising certain amounts of nuclear technology in return for help in acquiring the parts Pakistan needs. Pakistan and Turkey are both Muslim countries. Their respective officer corps have developed close links.

Thus Turkey, as well as Pakistan, presents a difficult problem for the US.

• Pakistan's success in buying the natural uranium it needs for its Karachi plant. Some is channeled via Libya. Niger's President Seyni Kountché said in April, "If the devil asks to sell him uranium today, I'll sell it to him."

This newspaper has learned that the US discounts speculation that China may offer a nuclear test site to Pakistan. Intelligence and other analysts don't believe China would do it, since it preaches the doctrine of "self-reliance" to other countries.

Nor do they believe President Zia wants to be seen by the Pakistani military as having to rely on a neighbor to carry out a test.

Nor do analysts think, some press reports notwithstanding, that either Libya or Saudi Arabia has provided Pakistan with vast sums for its nuclear program.

Intelligence sources told this newspaper the Pakistanis are spending only $50 million a year on its nuclear weapons program – some $250 million over the last five years.

US analysts believe Pakistan's decision to make a bomb was not made dramatically, on the spur of the moment, as the BBC's 1980 documentary "The Islamic Bomb" suggested.

Rather, American experts say the decision was almost certainly a more gradual process – "as irreversible," said one expert, "as US policy to strengthen its defenses. Zia can no more repudiate it – given Pakistan's inferiority complex toward India, the loss of Dacca and Bangladesh, and his own need to hang onto power among his own military caste – than any American president could suddenly stand up today and proclaim total disarmament."

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Will President Zia actually push the nuclear test button in the Baluchistan Desert?

No one yet knows. But experts looking on around the world are extremely worried.

"All we have is time," sighed one senior policymaker. "We're trying to buy as much time as we can. No one really believes we can stop him if he is determined. We can slow him down, and make his job much more expensive. That's about all."

Indian sources, highly suspicious of everything Zia does, nonetheless agree with US intelligence analysts on one point: Whether Zia decides to push or not to push will depend on his own hold on power.

If he feels that the US F-16s have bolstered his own political grip on the Pakistani military and elite, he may continue to prepare for a nuclear blast, but hold off. His progress toward a blast is itself one key stratagem he uses to impress his military elite.

An Indian diplomat said gloomily, "If he holds off, he will acquire 40 of your F-16 planes over the next five years. Then he can detonate his device. He'll have had time to make it into a smaller bomb, and he'll have the F-16s to deliver them. He will be even more dangerous."

An American official wrestling with the problem commented, "Yes, but he knows if he detonates, he'll get no more spare parts for the F-16s. He must have those parts to keep them flying."

"Maybe so," says another US expert with a frown, "but if we give him 40 F-16s, he can fly 20 and use the other 20 for spares."

Much depends, of course, on what happens in and around Pakistan.

Pakistani officials told this newspaper they needed the F-16s because they suspected the Soviets would force the Afghans to launch a limited strike across the Afghan-Pakistan border, using Soviet Central Asian troops dressed in Afghan uniforms, and Soviet MIG-25 jets flown by Soviet-trained Afghans or (more likely) Soviet pilots in Afghan uniforms.

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When pressed, Reagan administration officials say that, of course, stopping the spread of nuclear weapons is important. President Reagan announced July 16 it was a "fundamental national security and foreign-policy objective." But all he said about a state's detonation of a nuclear device for the first time was that he would view it with "grave concern."

The Reagan administration's idea is to try to remove from countries the fears and insecurities that lead to the desire for nuclear weapons.

The urgent test case is Pakistan. So far the evidence is inconclusive.

The President also stresses that countries will be tempted to test unless the US and other advanced countries show themselves reliable suppliers of technology and material for peaceful nuclear reactors. That's a sharp break with the Carter approach, which tried to deny other countries US know-how unless they committed themselves to international inspections and safeguards on all their nuclear facilities.

"Unless you lay out a clear set of guidelines – breaking relations, cutting off trade, suspending other links – states like Pakistan will continue on with their bomb programs, figuring no one will really penalize them," complains an IAEA official in Vienna.

So far, no major government has yet done this.

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Terrorism remains a threat. Authors Larry Collins and Dominique Lapierre claim their research revealed President Gerald Ford had considered clearing Boston in 1974 because of an alleged Palestinian nuclear threat to the city.

It is also said that the FBI maintains an around-the-clock nuclear terrorist alert desk at its headquarters in Washington.

According to Paul Leventhal, former staff director of the Senate Nuclear Regulation Subcommittee and founder of the Nuclear Club, Inc., in Washington, peaceful uses of nuclear energy already generate enormous amounts of plutonium. It is a byproduct when natural or low-enriched uranium is burned in a power reactor.

A typical plant produces a quarter of a ton of plutonium a year. This, reprocessed, is enough to make as many as 50 bombs the size of the one dropped on Nagasaki, Mr. Leventhal estimates.

Reckoning that a bomb can be made with 10 pounds of plutonium (the IAEA uses 17.6 pounds, or eight kilograms), Mr. Levanthal says the world's nuclear power plants today produce enough plutonium to make 7,700 atomic bombs every year.

By 1990, he estimates, the world will possess 760 tons of plutonium (167,200 bombs). By the year 2000, it will be 2,690 tons, or 591,800 bombs.

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Nuclear power is like the Chinese characters for "danger" and "opportunity" that combine to mean "crisis." It arouses intense fear, intense hope, an almost religious awe.

The word "uranium" comes from the Greek, meaning, in part, "heaven." The word "plutonium" comes from another Greek word that can mean "hades" or "hell."

Until 1941, plutonium existed only in traces connected with natural uranium deposits. The Manhattan Project in World War II produced the first manmade quantities.

Now hundreds of manmade tons exist. The IAEA in Vienna in 1980 safeguarded 83 tons — that's 83,000 kilograms, enough for 10,000 bombs. The world's plutonium consists of traces in the atmosphere from the bombs dropped on Hiroshima and Nagasaki and from nuclear tests, and of byproducts of the operations of nuclear reactors. Plutonium is produced when uranium fuel rods irradiated in the cores of nuclear reactors. Much of it remains locked up in spent (used) fuel rods in deep storage pools of water. Much of it has been extracted ("reprocessed") to make nuclear weapons in the US, the Soviet Union, Britain, France, and China.

A large reactor can produce eight kilograms (17.6 pounds) of plutonium every two weeks or so. Eight kilograms is the size of a large orange — enough to make a bomb as big as the one dropped on Nagasaki.

Plutonium retains its radioactivity for a quarter of a million years. Writing in Harvard's Divinity magazine, professor of religion and scientist Albert Blackwell says that if plutonium had been stored in the Great Pyramids of Egypt, it would still be 90 percent as lethal as it was then. It will remain lethal for 50 times as long as any civilization has yet endured on earth.

Scientists like him believe that by producing plutonium, the world is asserting self-interest without regard to future generations. They conclude that a more universal good is required. Nuclear disarmament and energy conservation and efficiency take on for them "the urgency of religious obligations."

Not everyone agrees. Other scientists see nuclear power as necessary to generate energy and keep the peace. They dismiss "ban the bomb" marches and antinuclear demonstrations.

The debate is intense. Scramble the letters that make up the word "nuclear" and you get "unclear." Humans grapple in search of a higher wisdom.

Next: Trying to stop countries from edging over the nuclear threshold.

ARTICLE APPEARED
ON PAGE 1.

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ON THE TRAIL OF THE A-BOMB MAKERS

Second of five articles

By David K. Willis
Staff correspondent of The Christian Science Monitor
Paradise Point, Pakistan, and Bombay, India

A crucial, unprecedented battle is being fought out in world capitals to stop an ambitious third-world country from building its own nuclear weapons – and detonating them.

It is the sternest test yet of whether the world possesses the means to stop or slow the spread of nuclear weapons into unstable countries.

The technology is no longer secret. Any determined country with enough money to spend can acquire it. The battle now being waged – mostly in secret – is to see if a range of international safeguards can be clamped down to prevent plutonium created in a peaceful reactor in Karachi, Pakistan, from being secretly diverted to fabricate nuclear explosives.

The safeguards include remote-control cameras, sensitive automatic counting devices, and more frequent visits by international inspectors.

Today this newspaper presents many details for the first time. They illustrate the complexity of stopping a determined country with sufficient money and skills from acquiring nuclear weapons. Pakistan happens to be the most obvious example of such a country today.

The battle is fast approaching a climax.

Some ground has been gained. But victory is still far from won. Unless it is won soon, it will be too late. Pakistan will have its nuclear device – perhaps even within 12 months. It may already have enough plutonium to explode one.

The story rivals a paperback thriller in suspense and intrigue. It has diplomats and scientists around the world sitting on the edges of their chairs.

In Pakistan, the battleground itself looks highly unlikely at first glance. I have just driven across it – a deserted stretch of coastline on the eastern edge of the Arabian Sea incongruously called Paradise Point. Camels pull carts. Donkeys wander. Women haul water from wells in yellow plastic buckets. A hot sun shimmers on a bright blue sea. Fishing boats bob. In the distance, a cluster of drab gray concrete buildings rises from the sand, encircled by barricades and barbed wire.

As I drove toward the cluster, I seemed to be utterly alone – yet a private US television film crew which tried to set up a camera outside the front fence the other day was surrounded by guards and intelligence agents within two minutes, manhandled, and ordered away.

The gray buildings comprise a nuclear reactor – the only commercial one in all of Pakistan. Its ostensible purpose: to generate electricity for the millions who live in Karachi, whose skyline is faintly visible around the bay.

But at this writing, analysts, officials, and scientists in a number of countries greatly fear that the plutonium generated as a byproduct in the reactor's fuel rods is being diverted for use in a nuclear device.

A number of scientists and officials are gloomily certain that President Zia ul-Haq will be able to detonate a device, if he wants to, before the end of 1982. He will be under enormous temptation to do so – to impress the Muslim world, of which he is part; to convince India that he is a diplomatic force to be reckoned with; to impress his own rivals inside Pakistan; and to warn the United States that although Pakistan is an ally against the Soviets in Afghanistan, it is an ally with a mind of its own.

Pakistan is by no means the only country in the world on the threshold of making nuclear weapons. This series will also look at the others. Israel is widely believed to have 20 or 30 already. South Africa is said either to have them or to be able to put them together quickly. India detonated a nuclear blast in 1974 and could react to a Pakistani detonation by loosing an even more powerful device – a hydrogen-bomb type.

There are other countries besides: Libya and Iraq, Argentina and Brazil, South Korea and Taiwan. Various methods are being used to keep them out of the nuclear club. Yet all will probably be able to build nuclear devices by the early 1990s.

Israel took matters into its own hands, shattered all precedent, and bombed Iraq last June 7 to stop its nuclear program.

The rest of the world is being more cautious in its efforts to halt proliferation. President Reagan, for instance, is trying to walk a policy tightrope. Ruling out military action so far, he has swung away from former President Jimmy Carter's approach of cutting off nuclear fuel and technology to countries that won't accept full international inspection.

But the American President does want to stop nuclear weapons from spreading. He wants the US to be a reliable supplier of nuclear technology. He thinks that will make countries like Pakistan feel more secure – if combined with economic and military aid (in Pakistan's case, a plan for $3.2 billion over the next six years).

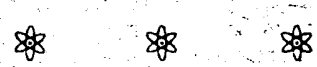
The Reagan experiment, just beginning, is a major part of a US carrot-and-stick campaign to stop Pakistan and other countries from going nuclear. The stick: if Pakistan detonates, it risks losing any American aid. Congress must appropriate aid each year. Under current law, no country is eligible for US aid unless the president certifies that it is not pushing toward building a nuclear device.

(There is, however, provision for a waiver if the president can convince Congress that it is in the national interest to continue aid to a country even once it has detonated a device. In any case, legislation on this issue is still pending.)

Meanwhile, the other part of the unprecedented battle consists of secret pressure from the US and other member countries of the International Atomic Energy Agency (IAEA) in Vienna. Pakistan is a member of the IAEA. Its Karachi reactor is already visited by Vienna inspectors, because the fuel originally came from Canada – and Canada insisted on such inspections as a condition of sale.

But since September 1980 Vienna has wanted much more surveillance.

Part of the reason is that Pakistan's rush toward a bomb has been an open secret for a decade. This article also gives details of how it has clandestinely acquired expertise.



Alarmingly, Pakistan has two tracks to a bomb, not just one.

The first: using the Karachi reactor to irradiate uranium fuel rods with neutrons and thus produce plutonium, it can then be chemically extracted ("reprocessed") for use in a nuclear weapon.

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The second: enriching natural uranium in a complex series of ways to turn it into weapons-grade explosive. This is done by separating out the isotope in uranium that is most useful for splitting, or fission: uranium 235. In nature, U-235 makes up only 0.7 percent of uranium. For a weapon, scientists need uranium that consists of 90 percent or more of U-235 – though a lesser percentage could also work.

For some years, Pakistan galloped along the enrichment road, trying to buy a complete plant (from France). When that was blocked by pressure from the US and elsewhere, it set up dummy companies to buy plant components under cover.

Lately the enrichment effort has run into trouble. But Israeli sources in Tel Aviv said that they believe an enrichment plant at Kahuta is well advanced; that uranium hexafluoride gas is being separated into U-235 isotopes in 1,000 spinning metal "cascades" or cylinders.

The Pakistani aim was 5,000 to 10,000 such cascades and a very high degree of enrichment.

US and other sources, however, doubt Pakistan has nearly that many cascades working. They say Pakistan has at least a decade of work ahead of it to make the cascades operate properly. It is a tricky business, requiring constant spinning speeds (achieved by regulating electric current with devices known as "inverters") and delicate precision in a dozen other fields.

"It took the West Germans 20 years to master it," said one US source, "the Dutch, 25, and the British, 30."

This means that the second route to the bomb is now the key one – making plutonium in the Karachi reactor (known as Karachi Nuclear Power Plant, or KANUPP for short), and reprocessing it.

Scientists and intelligence sources say Pakistan has a small reprocessing plant in operation. Because Pakistan has not signed the nuclear Nonproliferation Treaty of 1970, the reprocessor is not under inspection by Vienna.

What really made Vienna inspectors and officials sit up and take notice was an announcement in September 1980 that Pakistan could now make its own fuel rods (from natural uranium bought from the Saharan state of Niger, it is thought, and reportedly from Libya, which also buys from Niger. (See the next article in this series.)

This seemingly routine announcement was actually a bombshell for the IAEA. Shipments of Canadian fuel to Karachi could easily be checked: Canada told Vienna how much it had shipped, and Vienna inspectors counted the fuel rods at KANUPP to make sure the numbers agreed.

But if Pakistan makes its own rods, then Vienna depends on Pakistan's own figures for how many it has made and put into KANUPP. Given Pakistan's track record, and given Vienna's standard procedure of assuming plutonium has been diverted until it discovers otherwise, the need for more surveillance on KANUPP became plain – and urgent.

Canada cut off its own fuel to KANUPP in December 1976. It was suspicious of Pakistani activities, and alarmed that its fuel had helped India detonate a nuclear device in 1974.

Vienna is determined to find out what the Pakistanis are doing with their own fuel rods – and there's another crucial reason for urgency. The KANUPP reactor, originally supplied by Canada, is a special type. Fuel rods can be loaded in and taken out while the reactor keeps running. (Technically it is called a CANDU reactor, using deuterium.) Only short "burns" are required for generating plutonium in the rods.

Pakistan could be loading in its own fuel rods, exposing them to neutrons in the reactor for short periods, unloading them, and extracting the plutonium created.

"We have evidence of short burns at KANUPP now," one well-placed Indian diplomat told the Monitor.

Indignantly, the head of Pakistan's nuclear program, Dr. Munir Khan denies any such thing. But suspicions are widespread.

This newspaper has pieced together exclusive details of the battle so far to put KANUPP under stricter safeguards.

The details were provided in part by officials in a number of countries who felt publicity of the kind provided by a series like this might be more effective than pressure in secret.

The IAEA has already installed its own kind of special surveillance cameras at crucial areas in KANUPP. Specially adapted Minolta 8mm movie cameras, firing every eight to 10 minutes, are mounted in pairs, one wide angle, one telephoto, in sealed glass-fronted boxes.

They point down at the storage pond into which spent fuel rods are dumped after being taken from the reactor. They also cover a decontamination bay.

Inspectors visit KANUPP, check the seals, unload the film, develop it in a darkroom provided on site, check the film, reload the cameras, and reseal them in the boxes.

But the September 1980 announcement about locally made fuel rods caused Vienna to come up with a series of new requests. It wants cameras at the spent-fuel bay relocated and an extra camera installed. It wants the decontamination bay camera relocated.

It wants two new sets of cameras pointed at the maintenance area for the fueling machine (where plutonium might be siphoned off.) It wants trays of spent fuel rods stacked a different way in the storage pond. It also wants inspectors to be able to take film from cameras back to Vienna for checking if they need to.

Above all, it wants so-called "bundle counters" installed to record automatically how many times rods are taken in and out. These counters have just been developed and are being tested in Canada.

Vienna has also asked that inspectors visit Paradise Point much more often.

For months, Pakistan dug in its heels and refused to cooperate.

"Why single us out?" Pakistani officials asked in private. "We have cooperated in the past. We have an agreement with the IAEA. We've abided by that agreement. Besides, what are the Indians doing? They make their own fuel rods. Are you putting pressure on them?"

Vienna officials replied that India would cooperate only in tandem with Pakistan. "Please help us make India conform," they pleaded.

Privately, officials complained that the agreement between Vienna and Pakistan was an old one, signed in 1971. Pakistan, they said, ought to agree to extra "containment and surveillance" (the technical term) as other nonsignatories of the Nonproliferation Treaty had done.

Vienna was also alarmed at intelligence information being sent in by the US and India: a shaft for an underground nuclear test dug in the Baluchistan mountains; secret purchases of sensitive technology from 14 countries; a large budget for nuclear activities which Pakistani delegates to the IAEA don't mention.

On Sept. 17 of this year, the IAEA director general, Dr. Sigvard Eklund of Sweden, took an unprecedented step. He told the IAEA board of governors in private (as the Pakistani governor listened impassively) that he was no longer able to ensure complete reliability of inspections for some countries. He did not name them, but sources present at the meeting told the Monitor everyone knew the main target was Pakistan.

Since then, unprecedented diplomatic pressure has been exerted on Pakistan.

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"It is a test of Vienna's effectiveness," commented one agency source. "Already the fact the IAEA exists has spotlighted that one country is refusing to comply with safeguards. That's something."

It has been a time of suspense for Vienna. Israel, and two former IAEA inspectors, have sharply attacked safeguards following the Israeli raid on the Osirak reactor in Baghdad. But Vienna officials believe safeguards are vital to dissuade would-be atom bomb makers. Any undermining of safeguards, they say, endangers the entire world.

The IAEA's only remedy, if defied further, is to notify the United Nations Security Council in New York that a country is blocking requested surveillance. What would happen next isn't known: The IAEA has never gone that far.

In fact, Dr. Eklund's statement of Sept. 17 is said to be the first time he has even told the board of governors he had a surveillance problem.

Tension mounted as the months ticked by. The US exerted its own pressure, with the Reagan administration warning President Zia that any nuclear detonation would mean a probable cutoff of US economic aid and military sales.

"KANUPP is the only part of the plutonium fuel cycle we inspect," a senior Vienna agency source told the Monitor. "It's crucial we inspect it more thoroughly — for our credibility, for the credibility of nonproliferation."

According to one report, Vienna inspectors visited KANUPP Oct. 12 and 13 and asked that two cameras be moved. They repeated the request for "bundle counters." Pakistan refused.

Dr. Eklund referred to the situation again, in veiled terms, as he opened the UN General Assembly debate on the agency on Nov. 10 in New York.

In fact, this newspaper has learned, Pakistan had already made some concessions.

It had accepted silica gel treatment on surveillance cameras to prevent their breaking down in the high heat and humidity at Paradise Point. It agreed to some extra cameras. It accepted extra docimeters, which measure gamma radiation. It agreed to more frequent inspections. It even installed a closed-circuit video system around the spent-fuel bay.

But, at this writing it has not fulfilled Vienna's key demands. It has simply agreed to talk about them: extra 8 mm. cameras and relocated cameras, "bundle counters," and even more frequent inspections.

Time is running out. If Pakistan is diverting plutonium, it is doing so now. Pakistan could be stalling, to allow it to make enough plutonium to make a single device which President Zia could then detonate at will. Then Pakistan could accept extra safeguards, in the knowledge that its enrichment plant would be able to produce more nuclear explosive fuel soon.

Pakistan's agreement to detailed talks on extra cameras, on bundle counters, and other measures. This has heartened IAEA officials — but there's a long way to go yet.

Vienna believes extra inspection visits will be allowed and bundle counters installed. Some US sources are skeptical. Cameras remain a particular problem.

As made clear by Pakistan's ambassador to the United Nations, Niaz A. Naik Nov. 10, Pakistan objects to an extra camera on the spent-fuel bay and insists that "normal operations" in the maintenance area for the fueling machine cannot be upset by extra surveillance.

Developed film from the cameras will not be allowed out of Pakistan (official reason: in case it reveals industrial secrets). Trays of spent rods will not be rearranged to meet Vienna demands. Experts would discuss relocating cameras. They would "consider" bundle counters "in the light of our agreements with the agency" — deliberately vague phrasing.

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Revealed here for the first time is the fact that Western officials in Islamabad suspect Pakistan is using the Fauji chain of nonprofit import enterprises to buy sensitive nuclear bits and pieces from abroad under cover.

They are also watching with considerable alarm the progress of a Spanish company, Sener, of Bilbao, which is designing a new power reactor at Mienwali in the Chashma Barrage, or mountains, south of Islamabad.

Excellent sources told the Monitor that Pakistan had just asked Sener to increase design capacity from an already large 600 megawatts to a very big 900 megawatts.

"That's far too big for Pakistan's own power requirements," one source said. "You can't help being suspicious."

An estimated $1 billion is coming from Saudi Arabia to help build the new reactor. The Chashma location is right where the French were to have built a huge reprocessing plant in the late 1970s. The plant would have extracted plutonium from uranium fuel rods irradiated at KANUPP.

The French backed out of the deal under intense US and European pressure. But its blueprints had already been delivered. They weren't returned for many months — enough time to copy them.

"So the Pakistanis want a huge electricity generator right at the same place," said another Western source. "It makes you ask what they are planning to build next to it that will need all that electricity — another reprocessing plant? A plant to enrich uranium to weapons grade? Is the electricity to be piped to their enrichment plant further north?"

Cleverly, Pakistan chose the Bilbao company in bidding from which the US was excluded. The company is so anxious to keep its men working it has agreed that its planners in Pakistan will accept half their salary in Pakistani rupees.

A determined country can take advantage of competition and business conditions in the West to extract sensitive plans and technology.

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The Technology Flow:

How has a country like Pakistan been successful in buying and abstracting nuclear parts and know-how from the West, even as the West has tried to choke off the flow?

A determined nonnuclear state can find ways and means to break through the system of embargoes and export controls erected since World War II.

This reporter was told time and time again while researching this series:

"All that limiting sensitive exports does is make a country like Pakistan pay more, take longer, and buy subcomponents instead of already-assembled units. That's worth doing. But we can't stop it completely."

Take the case of the Canadian Caper.

Salam Elmenyawi is a young businessman from Egypt who moved to Montreal some years ago and took out Canadian citizenship. He set up an electronic company called Serabit, ostensibly dealing in printed circuits and alarm signals. He worked with another naturalized citizen called Muhammad Ahmad, a mechanical specialist from India, and yet another naturalized Canadian named Abdul Aziz Khan, an engineer from Pakistan.

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According to court documents and contacts in Canada, the three men began importing "condensers and resistors" from the US and shipping them right out again to Pakistan. This broke Canadian law, which says imports from the US must be integrated into larger components (have "value added") before export.

The company also sent the equipment to Pakistan without an export license. The three men faced 28 charges in a Quebec criminal court in September. After two weeks of closed hearings, the case was adjourned until Jan. 18, 1982.

Eleven charges were for exporting without a license. Fourteen were for exporting goods imported from the US without value added.

Both condensers and resistors were needed to manufacture heavy inverters — machines that regulate the flow of electricity so that metal canisters used to spin uranium hexafluoride gas at high speeds turn at absolutely constant speeds.

Canadian police picked up one shipment of items worth $56,000 Canadian (US $47,600) at Montreal's Dorval Airport in September last year. Sources say at least 10 other shipments had left by air from Dorval before that. They estimate total value of those air shipments was close to $560,000 Canadian.

The case has only just come to trial, sources revealed, because documents in the Serabit office were in Punjabi, and it took time to have them translated in a way acceptable to a court.

"The police had them cold," one source added.

Mr. Elmenyawi, however, is angry at the way the Canadian Broadcasting Commission reported his activities last December. He has launched a $175,000 (Canadian) defamation suit, claiming he was harassed and interviewed under false pretenses.

Or take the case of the West German margarine man.

The federal government in Bonn has confirmed that a Freiburg company, CES Kalthof GmbH, did, indeed, export a complete fluoride and fluoridation factory to Pakistan in 1977, without the requisite German license.

Key man in the deal, according to Stern magazine in Hamburg (July 2, 1981) was Albrecht Mingule, owner of CES Kalthof, an expert in fluoride who told Stern: "I will fluoridate anything, from toothpaste to uranium."

In 1967, Mingule reportedly widened contacts inside Pakistan by building a margarine factory for the son of a very high official.

Later, he received a license to search in Pakistan for fluorite. Still later, he contracted to build a factory in Pakistan to produce fluorine, for which fluorite is the basic source. Fluorine is required to help turn natural uranium into the gas called uranium hexafluoride. The gas is in turn fed into a centrifuge plant for enrichment.

Stern claims to have read documents connected with the contract. It quotes a company chemist as saying the fluoridation factory was built near Multan, a settlement in the southeastern Pakistan desert. Mr. Mingule told Stern everything was designed for peaceful purposes. He had known nothing about the need for export licenses.

After the article appeared, the government was asked about it during question time in the Bundestag, the West German parliament. The response was that the company had, indeed, violated export control laws.

The case is now in the courts.

Then there is the case of the British company-that-never-was.

All it consisted of was a brass plate bearing the name "Weargate" in Swansea, Wales. Operated by two Pakistanis in north London, it placed a large order for heavy electrical inverters with a highly reputable company called Emerson Electrical Controls Ltd. of Swindon, England. The Pakistanis did ship out a number of inverters in 1978.

A spokesman for Emerson confirmed that his company had begun building the inverters, but emphasized that Emerson itself did not ship them; rather the Pakistanis did.

Then an official of British Nuclear Fuels Ltd., which bought inverters from Emerson for uranium enrichment, noticed the Pakistani order was for inverters identical to his.

He raised the alarm. British Labour member of Parliament Frank Allaun asked a question in the House of Commons. Emerson said it had been told the inverters were for Pakistani textile looms, which also use them. Amid a flurry of publicity, the Energy Department slapped on export license requirements late in 1978. The Pakistanis disappeared. Weargate vanished along with them.

"We jumped on that one," said the British source. "A tricky case to handle. Emerson [was] perfectly decent about it, though they didn't like losing such a big contract, naturally."

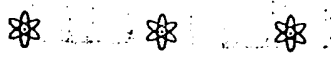
In Turkey, sources say, "four or five" companies have been buying US-made electrical and technical supplies from Europe and shipping them straight off to Pakistan.

The US State Department sent a cable to the American Embassy in Ankara in mid-June of this year, directing embassy officials to ask Turkey to stop Turkish companies from diverting US equipment from Europe.

The cable said the US had first informed Turkey about such diversions the year before, but that its appeals had failed to stop them.

It went on to say that Turkey's economic aid from the US could be threatened if it continued to insist that it had no power to control exports of such sensitive components for Pakistan's enrichment project.

So far, Turkey has replied that it is doing what it can, but can do no more.



The people flow

How does a country like Pakistan acquire such highly trained scientists to work on its nuclear program?

One answer: it sends students abroad. Those students are highly trained in the United States and in Western Europe. Then they return home.

In the case of Abdul Quader Khan, the student did much more than acquire basic skills.

According to sources familiar with his case (which was publicized at the time), Dr. Khan studied at a Dutch university. His professor recommended him in 1975 for a job at the giant URENCO centrifuge enrichment plant at Almelo, in the northeastern area of the Netherlands, not far from the German border. It is owned by the Netherlands, West Germany, and Britain.

To obtain the job, he had to be a Dutch citizen, or to be applying for citizenship. He began the lengthy paperwork and settled in. "He spent about three years there," one source said. "He was quiet, unobtrusive."

For one 16-to-18-day period, he was employed in the most secret part of the plant, translating details from German. Apparently he was permitted to do so without the necessary security clearances.

Shortly afterward, he disappeared, later to turn up in Pakistan in charge of the gas centrifuge plant there.

"What he brought Pakistan was not just his first-hand knowledge of the URENCO process, one of the most advanced in the world," one source told said. "He had in his pocket a shopping list of the parts needed to build a centrifuge, and who sold them. It was that list that formed the basis for secret Pakistani buying all over Europe in the late 1970s right up to today.

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"The list alone saved Pakistan at least two years' work."

The source doubts Pakistan sent Dr. Khan to the Netherlands deliberately to infiltrate URENCO or a plant like it. He considers, instead, that Dr. Khan was on a list of Pakistani students abroad at the time Pakistan needed expertise – and that Pakistani officials made the maximum use of the knowledge he happened to gain.

In next-door India, nuclear know-how is extremely sophisticated. India rejects the Nonproliferation Treaty of 1970 as unequal and restrictive. India detonated its own atomic device in 1974 and its nulear program stretches back to 1944. It has the capacity to detonate a hydrogen bomb.

But intelligence analysts tell this newspaper there is no evidence that India is making small military nuclear weapons that can be delivered by airplane or submarine or long-range missile.

"We would know," said one senior official in Washington. "The Indians would have to change their military command structure in ways we and others would detect."

Experts worry most about the temptation India would be under to detonate a hydrogen bomb if Pakistan should go nuclear. Indian officials, questioned at their Atomic Energy Commission in Bombay, denied outright any intention to explode anything in answer to a possible Pakistani bomb. "We are independent," they said.

India has stressed an independent nuclear power program with small (250-megawatt) power stations. At the moment, nuclear energy generates only about 600 megawatts in the whole country. Some 870 megawatts are under construction. A start has been made on 470 more. The chairman of the Indian Atomic Energy Commission, Dr. Homi Sethna, has just announced India plans to build 12 larger units of 500 megawatts each before the year 2000.

India concentrates on reprocessing plutonium from spent fuel rods, and has a plant at Tarapur able to do it. It makes its own fuel rods. Now that the United States will no longer supply low-enriched uranium fuel for the two reactors at Tarapur (the American Nuclear Nonproliferation Act of 1978 forbids it since India won't accept complete inspection by Vienna), the huge Bombay area is threatened with power cuts unless other fuel is found. Indian solutions are discussed in the next article in this series.

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ON THE TRAIL OF THE A-BOMB MAKERS

The uranium flow: who controls it?

To lay their hands on nuclear weapons, ambitious countries need uranium, skilled scientists, and know-how. How do they get them? Third in a five-part series.

By David K. Willis
Staff correspondent of
The Christian Science Monitor

New York and Tel Aviv

To and from far corners of the earth, a semisecret flow of uranium, skilled scientists, and technology helps spread the knowledge needed to build and detonate nuclear weapons.

This newspaper, in a three-month probe, has unearthed new facets of this flow. Involved are Libya, the impoverished Saharan state of Niger, Pakistan, the Soviet Union, India, South Africa, and Israel.

● Libya, led by ambitious, expansionist, terrorist-supporting Col. Muammar Qaddafi, is buying up and stockpiling uranium. He plans to try to sell it in exchange for know-how that could be a shortcut to his dream of owning nuclear weapons.

He has just bought 1,212 tons from Niger, which is outside the framework of international safeguards. That framework requires countries selling uranium to report all sales to the International Atomic Energy Agency in Vienna.

The tonnage figure is in Niger's Gazette Officielle, confirmed and relayed by US diplomats in the capital of Niamey.

This newspaper's research casts doubt on whether Niger reports all its sales.

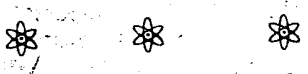
Israeli intelligence sources, experts in Vienna, and other analysts say Tripoli is selling hundreds of tons of "yellowcake" uranium (the first stage of refinement after uranium is dug from the ground) to eager buyers, including Pakistan.

Pakistan is driving hard toward its own nuclear device. It will be able to explode one by the end of next year.

Israeli and Arab sources say Libya provided Pakistan with money and uranium during the 1970s and is now pressing President Zia ul-Haq for nuclear secrets in return. President Zia, whose relations with Colonel Qaddafi are cool, has so far refused. Israel watches with the utmost anxiety.

"What if Pakistan needs money in a few years' time and does decide to sell Libya nuclear secrets?" one Israeli official asked in an interview in Tel Aviv. "Who will condemn Libya or Pakistan? Pakistan needs money. Islamic and third-world countries will oppose censure at the United Nations."

Israel sent F-16 jets over Baghdad June 7 to bomb the Osirak reactor being built for Iraq by France. A major question for the world now is whether the Menachem Begin government in Jerusalem, or another, would bomb other reactors or installations to stop other Arab or Muslim countries from going nuclear.



● Libya had 65 students enrolled in nuclear engineering courses in US universities in the 1980-81 year, according to a computer analysis performed for this newspaper by the Institute of International Education in New York. The percentage of nuclear to ordinary students for Libya was much higher than the same percentage for other countries. The previous year the nuclear figure was 23 — one more than the 22 students Libya sent here to study petroleum engineering.

Details of the computer analysis appear below. They make it clear Libya is trying hard to develop a body of trained nuclear engineers — in a country that is only now receiving its first research reactor (from the Soviet Union). Hundreds more Libyans are studying nuclear technology in Western Europe and in Moscow.

● Libya, the Monitor has learned, is also engaging in some remarkably sophisticated and ambitious physics research — helped by the Soviet Union. The research worries Israel and has raised some scientific eyebrows elsewhere.

Moscow is not only building a research reactor, but also is building in Tripoli a research device aimed at harnessing, through a process called fusion, the basic energy source of the universe and the stars, including the sun.

The device, first developed in the USSR, is called a "Tokamak." It uses magnetic fields to confine low-density plasma. Research in the Soviet Union, the US, and elsewhere is on the way to confining the plasma for one-third of a second. If that can be done, fusion of deuterium and tritium can take place. Enormous amounts of energy would be released. The process may not be commercially usable until early in the next century.

It may sound fanciful for an undeveloped state like Libya to even think of acquiring one. But sources close to British fusion research at Culham in Oxfordshire confirm that the Soviets are, indeed, building a research Tokamak device at the Libyan atomic research facility in Tripoli.

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In 1975, it is learned, Britain helped Libya start its fusion research by providing the Alfateh University with a device known as a "Theta pinch," which also confines plasma.

"What worries me," said an Israeli official, "is that a Tokamak can also produce plutonium by bombarding a mantle of natural uranium with neutrons."

Said an IAEA official in Vienna: "Yes, but there are much simpler ways of making plutonium." A British source agrees: "I don't see how a small Tokamak helps the Libyans build bombs."

But Israeli suspicions run deep. They believe Libya tried to buy a bomb from China in 1970 – an episode recounted in the book "Road to Ramadan" by Muhammad Heikal, confidant of the late President Nasser of Egypt.

Libya is so confident of its physics program these days that it applied for membership in the prestigious International Union of Pure and Applied Physics (IUPAP). According to IUPAP secretary Larkin Kerwin in a telephone interview from Ottawa, the application was accepted in Paris last summer. Professor Kerwin said he knew nothing of a Libyan Tokamak. But other sources confirmed it.

● Meanwhile, Moscow has been playing its own brand of nuclear politics with uranium.

Late last year the Soviets reportedly sent Libya 11.5 kilograms of highly enriched uranium for the research reactor it is building for Colonel Qaddafi.

"We wish Moscow had not shipped it so far in advance," said one US analyst.

"It's another example of how casual this shipment of dangerous nuclear material is becoming," another US source said. "Highly enriched uranium isn't cornflakes, you know.

"It's a holocaust in a box."

Approached for an explanation by US representatives, Soviet officials shrugged. "What can Libya do with only 11½ kilograms?" they asked. True, the IAEA in Vienna estimates 25 kilograms of uranium is needed for a bomb. But Washington frets, nonetheless.

The Soviets also tried to use their enriched uranium stocks to embarrass the US in India in 1970, the Monitor has learned.

In 1979, the late Premier Alexei Kosygin offered to supply the Tarapur reactor near Bombay with low-enriched uranium, for which New Delhi already had a contract with Washington. The reactors supply electricity for the huge Bombay region in southwest India.

Both Indian and US sources confirmed Mr. Kosygin had made the offer. The Indians refused it, saying they still hoped the US would honor a 1963 contract to supply the fuel for Tarapur (a US-built reactor). Mr. Kosygin made his move with what seemed shrewd timing: In 1978, the US Congress had granted President Jimmy Carter new legislation banning US fuel or technology exports to any country refusing to accept "full-scope," or complete, international inspection of all nuclear facilities. India, while a member of the IAEA, has refused such safeguards.

It has also rejected the 1970 Nonproliferation Treaty, the cornerstone of global safeguards against the diversion of enriched uranium or plutonium for nuclear weapons.

The years 1979 and 1980 were a grace period in which countries had to decide whether to comply with the new US law. India has refused. US fuel has been terminated, despite Indian protestations that the 1978 act violates international law because it cancels existing agreements between states.

● This newspaper has also been told India has decided once again not to accept the Soviet offer, despite the US fuel cutoff.

Instead, Indian sources say, it will fuel Tarapur with a mixture of uranium and plutonium oxide fuel – or MOX as it is known. MOX has never been tried on such a large scale before.

Meanwhile, the US wants to ensure that Tarapur remains under inspection by Vienna. Inspections were required by the US when it started selling fuel originally.

Indian sources say they reject the US legal position, but New Delhi plans to go "some way" toward meeting US concerns.

Meanwhile, the latest talks on Tarapur fuel in Washington, held last month, made little progress.

● A little-known fact about the global flow of uranium is that Britain received almost half of its uranium needs in recent years from the controversial strategic area known as Namibia (South-West Africa).

British officials confirmed to this newspaper figures dug out by a United Nations study group. Black African states regularly protest to London. But the British point out that no United Nations resolution bars nonmilitary trade with South Africa, which controls Namibia. The territory is one of the world's largest sources of uranium. Black Africans fume, because Britain is one of the countries that has blocked such resolutions in the Security Council.

The UN estimates that Britain gets 40 to 60 percent of its uranium from Namibia these days.

Uranium dug out of mines around the world is not subject to international safeguards. Countries that are part of the nonproliferation network (i.e., are members of the IAEA in Vienna, or have signed the 1970 Nonproliferation Treaty) are supposed to report uranium sales to Vienna.

Two loopholes: Niger, which has not signed the NPT (as the treaty is known for short), and Namibia, controlled by South Africa, which has likewise stayed away from the NPT.

Niger, however, is supposed to publish sales in its Gazette Officielle in Niamey, its capital.

Niger officials in Vienna had said I could talk about exports only in Niamey, the capital. Israeli sources had told me flatly that Libya was buying large amounts and had just sold 200 to 300 tons to Pakistan.

Some scientists and officials argue that Vienna should spend little time on uranium movements, since safeguards begin these days only when uranium is refined into hexafluoride gas or otherwise refined.

But others disagree.

"If Libya is selling Niger uranium to Pakistan, then Libya is helping Pakistan make fuel rods that produce plutonium that can make weapons," one senior US official pointed out.

It is also worth remembering that the original idea for safeguards was to control uranium from the moment it was dug from the ground. The Acheson-Lilienthal report of 1946, which formed the basis of the plan the US presented to the fledgling UN that year, proposed an international body to control all uranium as well as plants.

Joseph Stalin rejected that idea out of hand. He, too, was determined to possess the bomb the US already had. Ultimately, a decade later the Vienna agency was given the right to begin safeguards and inspections only when uranium had been refined.

"No country wants to yield enough sovereignty so that inspectors crawl in and out of its mines, getting in the way and snooping around," as one IAEA source says ruefully. "Anyway, we just don't have the inspectors enough to do it."

This correspondent asked the Arms Control and Disarmament Agency in Washington for a record of Niger's sales in recent years. The agency said it did not have the information on file.

But it sent a cable to US diplomats in Niamey, asking them to copy out all entries in the Gazette Officielle.

When the reply came in, it revealed that there have apparently been only 12 volumes of the Gazette so far. They began in 1980.

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It is not known whether sales made before then, and reported by the Agence France-Presse news agency, were recorded accurately – or, indeed, if even the Gazette Officielle tells the whole story.

Washington officials did some checking and supplied me with dates on which sales mentioned in the Gazette had been approved. The results were interesting, to say the least.

Niger is the fifth-largest producer of uranium in the world. Last Jan. 28 it approved 100 tons of yellowcake uranium for Iraq, a country determined to continue its nuclear ambitions despite the Israeli raid against it last June 7. The next day it approved 125 tons for West Germany.

One thousand tons went to France and another 693.3 tons to France, on March 3 – hardly surprising, since French interests control both major mining consortiums in Niger, SOMAIR and COMINAIR.

France bought another 600 tons four days later, and Spain 300 tons two days after that. Not long after (no exact date is known), 806.6 tons went to Japan. On June 8, Japan bought 10 more tons.

But the most interesting entry of all was another on June 8: a sale to Libya. It totaled 1,212 tons, an enormous amount for a country that has no commercial power reactor whatsoever, and whose highly enriched uranium fuel for a new research reactor comes, under safeguards, from the same country that built the reactor: the Soviet Union.

According to an Agence France-Presse report from Niamey last Aug. 27, Libya bought only 258 tons in 1978, 150 tons in 1979, and 180 tons in 1980. So the latest purchase is a remarkable jump.

Why?

One clue comes from an interview given by the President of Niger, Seyni Kountché, cited by United Press International last April.

Noting that uranium prices had fallen 30 percent because of a world oversupply, President Kountché said Niger's share of 1981 mining would be 800 tons. "It goes without saying that for the development of our country, we cannot store 800 tons of uranium," he remarked.

At the same time, Niger was important to Libya politically. The June 8 sale of uranium came just two weeks before the start of the annual meeting of the Organization of African Unity in Nairobi. Libya was scheduled to become chairman for 1982, which meant the 1982 meeting would be held in Tripoli – a splendid forum for Colonel Qaddafi to use.

But behind the scenes, he faced opposition to his chairmanship. Observers who followed events closely said Qaddafi badly needed Niger's swing vote in a crucial committee meeting to head off an open fight and debate. He got it.

The observers speculate Libya's large purchase of Niger uranium may have been designed, in part, to woo President Kountché by disposing of his surplus stocks, perhaps at prices above the depressed world market.

"I also think Qaddafi just wants to pick up influence wherever he can in nuclear matters," commented one US official. "He'll stockpile uranium, sell it to Pakistan, and France, and try to keep his hand in the nuclear game that way. He's constantly on the lookout to buy nuclear technology or even a bomb. . . ."

Colonel Qaddafi's nuclear ambitions are part of the exasperation the Reagan administration feels about him at the moment. Northern Chad, experts note, contains considerable uranium reserves, which Colonel Qaddafi is said to be eying with interest.

Between 1967, when mining began, and 1980, Niger produced 13,000 tons of uranium. According to Uranium Resources, a joint publication of the IAEA and the Organization for Economic Cooperation and Development, Niger's potential could rise to 5,000 tons a year by 1983 and 12,000 tons a year by 1986.

The underdeveloped desert country of 5 million people has little else to sell. The fall in uranium prices has hurt its mines, located near Arlit in the northern desert about 500 miles from the Libyan border.

Niger's ties with Libya were strained earlier this year: In January Niger suspended all sales of uranium to Tripoli after Libya attacked and occupied neighboring Chad.

But Niger needed cash badly, and those sales have clearly resumed.

Not far behind Niger in size or in uranium output is the territory of Namibia, farther south, sparsely populated but strategic, about twice the size of California, still administered by South Africa even though the UN is pressuring for it to be granted independence.

According to figures from the UN and industry sources, Namibia currently produces around 4,000 tons of uranium a year from the huge open-cut mine operated by Rossing Uranium Ltd.

Since South Africa is not a signatory of the Nonproliferation Treaty of 1970, it could in theory sell its own and Namibian uranium to anyone it chose – something black African states suspect. Sources say they believe – but cannot prove – that Namibian or South African uranium has been going to Israel, for instance, or even to be mixed with other shipments to Pakistan.

Black Africa is upset that Britain gets so much of its uranium from Namibia.

Asked about UN reports indicating that about 50 percent of Britain's commercial uranium supplies come from Namibia, a senior official in the British Department of Energy said, "Yes, something like that.

"And, yes, we are criticized at the UN about it, and at other international meetings as well," he added. "Of course, plenty of other countries trade with South Africa, you know."

Major industrial states are in too much need of uranium and other strategic metals and other goods to permit a formal UN ban on nonmilitary trade with South Africa.

According to figures cited in a 1981 UN document entitled, "South Africa's Plan and Capability in the Nuclear Field" (compiled by a group of Swedish, Soviet, Venezuelan, Nigerian, and French experts for the UN Center for Disarmament), about 65 percent of British requirements until 1982 will come from Namibia. That was said to work out to about 1,300 metric tons a year.

Another UN document, on the exploitation of Namibian uranium (Nov. 20, 1980), gives a different figure: 7,500 tons of uranium between 1976 and 1982, or 42 percent of Britain's needs for that period. Price: $72 million.

A contract with the British was held by Rio Tinto Zinc Corporation Ltd. (RTZ), which in turn owns 46.5 percent of Rossing, which operates the mine. South Africa also holds a large share. Smaller shares belong to Canadian and French companies.

British officials say when Britain signed its original contract with RTZ, the uranium was coming from Canada. RTZ

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has since switched to supplies from Namibia to fulfill its contract. The UN report alleged this was because labor costs at Rossing are lower.

The UN document leveled a battery of charges at almost everyone involved, reflecting general unhappiness among black and other UN member states.

It said the British contract was now held by British Nuclear Fuels because of parliamentary opposition to the Atomic Energy Agency's dealing with Namibia.

The document, drawn up for the UN Council on Namibia, said that until late 1979, uranium was flown from Windhoek by South African Airways Boeing 707 jets and French UTA DC-8s.

SAA flew across the ocean via Cape Verde and on to Marseille and Orly in Paris. UTA flew over Angola, Zaire, and Gabon to Marseille and Paris (to the Charles de Gaulle Airport). Onward shipments to Britain went by truck. After some unfavorable publicity, the flights ceased. Ships arenow used, the document alleged.

Moreover, South Africa itself mines and sells uranium. Figures from the IAEA and the Organization for Economic Cooperation and Development show that South Africa produced 5,195 tons and Namibia 3,692 that year — 23 percent of world production for that period.

The South African government has formally stated that it will not allow uranium sales to increase the number of nuclear weapons states. Black African and other critics, however, say it exports so much that the danger of theft and diversion is always present.

Clearly, sales of Namibian (not to mention South African) uranium are lucrative. One UN estimate is that Namibian sales alone, in 1977 prices (which have since risen) were worth about $440 million a year.

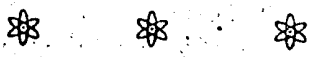
It is not known whether Namibian mine production and sales are registered with the International Atomic Energy Agency.

In a long interview at Pelindaba, headquarters of the South African Atomic Energy Board, located between Pretoria and Johannesburg, the president of the board, Dr. J. W. L. de Villiers, would not discuss Namibia.

(On his coffee table, however, lay an illustrated publication entitled "Rossing," the name of the Namibian uranium mine).

He did confirm the value of South African uranium exports, saying that production was running at around 5,000 tons a year. If production rose to 10,000 tons a year, he said, South Africa would have enough uranium reserves to last only about 50 years.

Again, he did not refer to the extremely large reserves in Namibia, which his country controls. Current talks on the independence of Namibia will need to confront Pretoria's desire to keep its access to Rossing output.



As for Libya — it "gives everyone the cold shivers," as one US diplomat puts it.

Israeli sources insisted to me in Vienna that Colonel Qaddafi was using Libya's stockpiled uranium to make sales to Pakistan, among other customers. Israel alleges the IAEA is unaware of such sales, and cites this alleged ignorance as one more reason it cannot put full faith in IAEA safeguards on Iraq or any other country hostile to Israel.

IAEA officials don't usually talk openly about information provided by member states. Libya has signed and ratified the Nonproliferation Treaty, but signed an IAEA safeguards agreement only last summer. In theory it is supposed to inform the agency when it sells uranium. Whether it does so is not known. IAEA officials say they are "aware" of Niger sales to Libya.

"Qaddafi is a wild card," comments one US official. "He's fishing around for influence, and for weapons."

The Libyan leader has contracted with the private West German company OTRAG (Orbital Transport-und-Raketen-Aktiengesellschaft) in Munich for a long-range rocket. He says it is designed to put into orbit weather or telecommunications satellites.

US sources estimate the rocket's range at between 1,200 and 1,800 miles. Still in the testing stage, it could be fitted with conventional and, ultimately, nuclear warheads, the sources say. US officials are studying OTRAG, which has been heavily criticized by the Soviets and others.

The company insists that it is not in the business of making "military rockets." The West German government is limited in its powers over a private company that has broken no law. US officials are in no mood these days to take a kindly view of Libyan intentions. They are concerned that Qaddafi wants the rocket as a way of gaining diplomatic leverage.

Libya has a surprising number of its students studying in the United States to be nuclear engineers. While the absolute numbers are small, computer analysis yields some reavealing percentages.

Libya had 2,290 students in the US in 1978-79. The figure leaped by one-third to 3,030 the following year and rose to 3,080 in 1980-81.

The computer analysis looked at percentages of Libya's nuclear engineering students to all its students on file. It came up with 2.4 percent. That was higher than the similar percentage for all countries combined — 0.3 percent.

The computer discovered that Libya's 23 nuclear engineers in 1979-80 accounted for 5.7 percent of all nuclear engineering students from abroad, even though Libya accounted for a mere 1 percent of foreign students.

By contrast, Pakistan had only three nuclear engineering students in the US in 1979-80. Iraq had only six. The figures in 1980-81 went up to four and eight, respectively.

So the analysis shows that Libya has a significantly higher percentage of its students in the US studying nuclear know-how than do other developing countries.

Added to that must be the Libyans studying nuclear engineering in Western Europe and the Soviet Union.

In 1979-80, 16 Libyan nuclear engineers were in US undergraduate schools, seven in graduate schools (five masters, one doctorate, and one unspecified).

An article in the Bulletin of Atomic Scientists (August-September 1981) estimated 200 Libyans studying nuclear engineering in the US. It put the number in Europe at 200-300, and more in the Soviet Union, "many times the number that could be realistically absorbed by a civilian nuclear program."

At least one American expert is convinced that Libya is trying to buy a bomb. He says the Libyans told him so in 1978.

Jeremy Stone is director of the Federation of American Scientists (FAS) in Washington.

In an interview with this newspaper he described his visit to Libya in 1978 and added details to an article he wrote on his return:

"I talked around a table with several senior Libyan officials, including Ahmad Shahati, who was head of the foreign liaison office of the People's General Congress.

"Their government uses different names than ours, but it's an important post. Shahati told me outright Libya wanted a bomb for its own defense. I pressed the point to be quite sure, and asked if he wanted the right to get a bomb, or a bomb itself.

"He was quite clear: Libya wanted a bomb.

"Well, I returned to the US and said I thought Libya, which had signed the Nonproliferation Treaty, was a false adherent of that treaty.

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"Then the Libyans denied they'd told me any such thing. But I know what I heard.

"You know Muhammad Heikal's 1975 book, 'Road to Ramadan.' " (Heykal is the journalist who was a close friend of Nasser.)

"He tells how Qaddafi sent his deputy, Major Jalloud, to Nasser in 1970 to ask if the Israelis had the bomb. When Nasser said he thought they did, Jalloud went off to Peking to try and buy one. The Chinese refused."

In the Bulletin of Atomic Scientists, August-September 1981, a Vancouver professor, Joseph Micallef, says Libya has looked to Argentina for technical aid. The Soviet Union is building a small power reactor, has promised both a 440-megawatt reactor under safeguards, and a 300-megawatt reactor to operate desalination plants and pump underground water.

With recycling, the article says, the desalination plant would yield enough fissionable material for 10 to 20 bombs per year — though such a prospect is still a long way off.

Also part of the uranium story are persistent reports that Israel obtained, by secret means, 200 pounds of enriched uranium from a nuclear processing plant in Apollo, Pa., in the mid-1960s — and 200 tons of natural uranium in cans marked "Plumbat," from a West German merchant ship that vanished for several weeks in 1968 en route from Antwerp, Belgium, to Genoa, Italy. When the ship reappeared, it had a new name, a new crew — and no uranium.

Former CIA senior official Carl Duckett said earlier this year on ABC-TV that the CIA had long since concluded Israel had probably fabricated nuclear weapons using the Pennsylvania uranium.

Paul Leventhal of the Nuclear Club Inc., who first released news of Plumbat, indicated to me his belief that the uranium was certainly stolen, but he would not say by whom.

Tomorrow: How South Africa and Israel are maneuvering for the bomb.

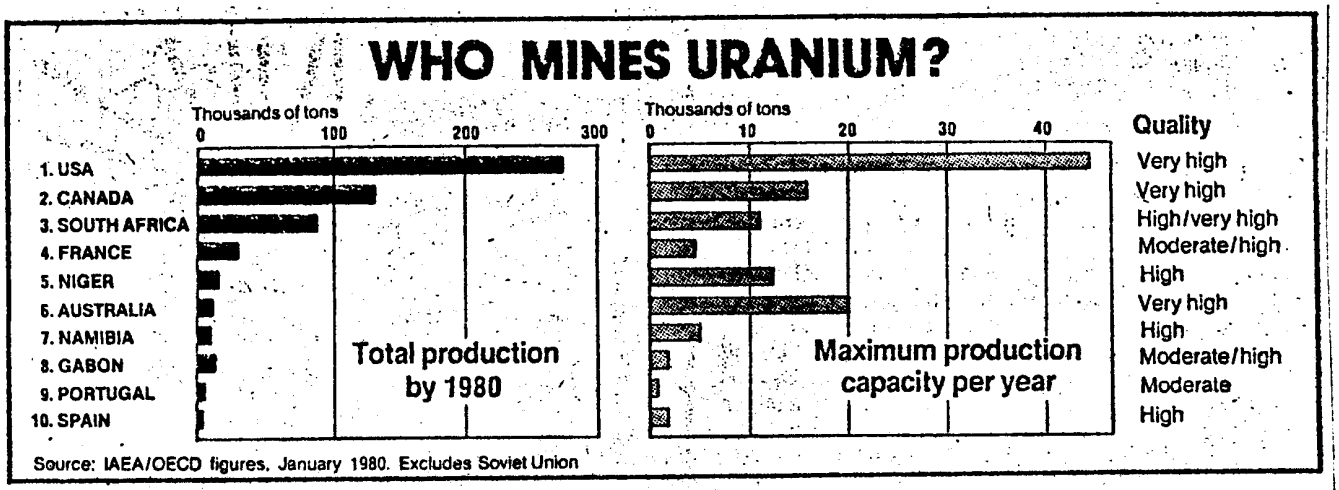

Photo by R. Norman Matheny, staff photographer; chart by Joan Forbes, staff cartographer

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CHRISTIAN SCIENCE MONITOR
3 December 1981

How South Africa and Israel are maneuvering for the bomb

By David K. Willis
Staff correspondent of The Christian Science Monitor
Pelindaba, South Africa, and Tel Aviv

Inside a ring of enemies put defiance, obduracy, fear of the future. Combine with pride, wealth, advanced skills, religious conviction. Result: a determination to go nuclear.

South Africa and Israel are the two prime examples of such "garrison states," but Iraq, Taiwan, and South Korea share their determination.

Urgently needed are ways of convincing such states that nuclear weapons are not the ultimate answer, experts feel. These countries need to be shown that national security can be guaranteed in other ways: alliances, economic and military aid, conventional armed forces, and assured supplies of nuclear fuel and techology for reactors for peaceful uses.

● Cleverly hidden in a valley halfway between Johannesburg and Pretoria is a center where research is being done that has brought South Africa closer than ever before to being able to build and detonate its own nuclear weapons.

Officials have said they could enrich natural uranium from the 0.7 percent of the fissile (i.e., able to be split) isotope of uranium 235 that occurs in nature to 45 percent.

Sources in the United States say the South Africans have enriched to 80 percent. More than 90 percent is ideal for nuclear explosive, but a bang can be made from less.

So far, South Africa says it is not building nuclear bombs, but it is deliberately imprecise in its public statements. So is Israel. Both states possess what diplomats call the "nuclear option" — whether they possess bombs or not, their enemies think they do, or that they could make them very quickly. And both have strong reasons to hint they hold the ultimate big stick in reserve as a military and diplomatic weapon.

"Either a South African bomb is already made and exists in separate pieces that could be bolted together — or a bomb could be made in six months," comments a knowledgeable European source familiar with Pretoria's plans.

● South Africa has hired Israeli consultants to advise on the safety aspects of its first two commercial reactors, which are being built by the French consortium Framatome.

"You'd think it logical for them to ask French experts, or European ones, or American," comments one well-placed source. "Why Israeli?"

This kind of development fuels speculation among Arab and Muslim states, in black Africa, and throughout the United Nations that Israel and South Africa are helping each other's nuclear programs in an awesome mix of Israeli know-how and South African uranium and enrichment expertise.

● In an interview with this correspondent, a senior South African official has dropped an intriguing hint that South Africa intended to test some kind of powerful explosive device in the Kalahari Desert in late 1977.

Then Soviet spy satellite cameras detected a hole in the Kalahari of the kind usually dug for a nuclear test.

Former President Jimmy Carter ordered US satellite cameras switched to the scene. They confirmed the reports. The US and the Soviets orchestrated a diplomatic campaign against Pretoria to stop a possible test. South Africa furiously denied any plans to test. No detonation occurred.

In an interview, Pretoria's ambassador to the US, Donald Sole, denied outright that South Africa wanted or needed a nuclear weapon. But asked about Kalahari he said, "Well, we were going to test something — but not a weapon."

He would not be drawn further. He went on to doubt that nuclear power would play a large role in his country's total energy picture between now and the end of the century.

A number of other scientists and diplomats were keenly interested when I asked for their comments on the ambassador's remark. All speculated at length on whether South Africa had, in fact, gone ahead with a nuclear test in September 1979, when a US surveillance satellite picked up a flash of light in the darkness of a predawn southern Atlantic sky. No solid evidence to confirm such a test has yet been produced.

The ambassador's remark to me could be read as an indication that South Africa had intended testing what it would have called a "peaceful" nuclear device, as India did in 1974. The US sees no difference between a "peaceful" and a "military" explosion — both are lethal.

In 1977, Pretoria was extremely displeased with the Carter administration's stress on human rights and its determination to cut off nuclear fuel to any country that did not accept full international inspection on its nuclear facilities.

● Another development could illustrate one of the tools the US holds for convincing other countries that, even though they build nuclear weapons, they don't have to explode them.

The background: President Reagan has switched signals toward Pretoria. He ordered a US veto on a Security Council resolution in August condemning the South African raid into Angola. He has sent diplomatic signals recognizing South Africa's strategic location, anticommunist stance, and key role as a supplier of industrial minerals.

Pretoria has been pleased.

Now comes what could be a significant move. The presi-

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dent of the South African Atomic Energy Board, Dr. J. W. L. de Villiers, confirmed in an interview that Pretoria is "exploring" with the US what amounts to a nuclear trade-off.

South Africa might agree to international safeguards on the uranium enrichment plant it is building – if Washington agrees to release a long-term supply of enriched uranium for South African power reactors. US supplies are blocked today because South Africa does not accept full safeguards.

"I'm not saying we will accept safeguards," Dr. de Villiers said in his office at Pelindaba. "I'm not saying we will never accept them. Things change. . . . We are exploring the situation. We want to know just what's involved: How many inspectors? Do they have to go right into the plant? What do they have to see? Will they interfere with operations?"

Dr. de Villiers made it clear South Africa could not push ahead with more reactors (its first two are nearing completion) without an assured supply of fuel.

"You don't build a reactor unless you have 40 years' supply of fuel," he said. A 1,000-megawatt reactor can require 150 tons of fuel a year.

Under an existing contract, South Africans ship $30 million worth of uranium at a time to be enriched at Oak Ridge, Tenn. Oak Ridge does the work, but the Nuclear Regulatory Commission can't grant an export license because of the 1978 Nuclear Nonproliferation Act, which bars nuclear exports to countries refusing full safeguards.

Technically, South Africa takes title to the newly enriched uranium but not physical possession. The US is not requiring payment for the enrichment until the issue is settled.

All this gives South Africa a problem. It needs fuel for the two reactors under construction at a place called Koeberg (pronounced "koo-berg") near Cape Town.

It is building a large enrichment plant with its own carefully developed process. The plant could enrich enough fuel for Koeberg, but it will not be ready until 1985 at the earliest.

The first Koeberg plant is to be loaded in the middle of next year. But with what? If fuel doesn't come from the US, where is it to come from? China? France? Italy? (Italy has 1,100 excess tons of low-enriched uranium available these days.) Scientists the world over are watching for clues.

While I was in South Africa recently, Pretoria confirmed it had obtained enriched uranium fuel for the first Koeberg plant, but did not give the source. Johannesburg television said it was not "from France or the United States."

Dr. de Villiers would not provide an answer. He said the South African Electricity Supply Commission had placed the order. He appeared not to rule out France, however.

This newspaper understands that France is, indeed, supplying the enriched uranium. Technically, Paris can argue that it is not: The fuel is said to be coming from a large enrichment plant called EURODIF. This is a joint venture involving France, Italy, Iran, Spain, and Belgium. France has a 51 percent share in all enriched fuel produced during the first 10 years of operation – and the plant itself is located near Avignon in the Rhône Valley.

Although France has no enriched uranium to spare, Spain and Italy both have surpluses. A number of scientists say that either Spain or Italy could have agreed to provide enriched fuel for the French to make into fuel rods for Koeberg.

"I go for Spain," said one inside source.

The International Atomic Energy Agency in Vienna is trying to find out the source. Supplier countries are supposed to notify Vienna of uranium sales. But, in fact, it is extremely difficult for Vienna officials to discover where shipments of enriched uranium finally land. Many ways exist to falsify documents and otherwise cover tell-tale tracks.

It was clear from Dr. de Villiers that the French fuel is not a long-term answer to South Africa's nuclear fuel problems.

At one point he said, "We have to reach agreement with the United States and the Vienna agency at some point if Pretoria is to plan a nuclear energy program for the future."

Although South Africa possesses some 530,000 tons of uranium reserves, they could be gone in 50 years or so if mining continues to extract 10,000 tons a year from now on.

Besides, South Africa makes money from selling uranium. If it enriches its own, it loses income. Experts assume it won't be able to enrich enough in its own plant to cover the losses. The new plant will also be expensive to run.

All this gives South Africa a powerful incentive to talk to the US about safeguards.

In August, Pretoria sent the first signal: A two-man team visited Portsmouth, Ohio, accompanied by a South African Embassy man from Washington and a State Department official. They walked through construction that one day will be an enrichment plant. They saw nothing that was secret.

In October, four US observers visited Pelindaba. They were surprised at the amount of information they were given and the extent of their tour. (But they were not shown a pilot enrichment plant black Africans say makes weapons-grade fuel.)

Now Dr. de Villiers confirms that talks are continuing.

Many hurdles remain. No large enrichment plant in the world yet has full safeguards: The process is extremely tricky. "Why should we be the first?" Dr. de Villiers asked.

Even if South Africa should agree, US government policy is that countries buying US enriched fuel should not only accept safeguards but also should first sign the Nonproliferation Treaty of 1970. South Africa has refused.

A possible way out: If Pretoria accepts safeguards on its plant, President Reagan could simply drop the treaty-signing requirement. There would be criticism, but it could be done.

"Safeguards are a big step for us," de Villiers said flatly. But South Africa wants to plan another reactor complex for Durban.

Dr. de Villiers estimates that the cost of nuclear-generated electricity has already been brought down to the cost of coal-generated electricity at Cape Town. Coal fields are 600 miles north, and shipments, as well as transmission by power lines, are getting more expensive.

A strong political reason is also pushing Pretoria to locate energy sources farther south: If black African states launch guerrilla attacks in northern areas, or if South African black tribes rebelled, coal fields could be at risk.

Whether for the record or because he has deep doubts himself, Dr. de Villiers said he doubted Mr. Reagan could alter provisions of the Nuclear Nonproliferation Act of 1978.

He repeated previous South African denials of any plan to build nuclear weapons. He denied all knowledge of the 1977 Kalahari incident or of the 1979 flash in the sky. He was clearly concerned that I quote him accurately, reflecting a typical Pretoria caution when dealing with reporters from abroad, especially Americans asking about nuclear policies.

But he did volunteer a good deal about South African hopes and plans. "We cannot go into a big nuclear program," he said, "unless we have assured supplies of reactor fuel."

The message for the United States, and for others opposed to the spread of nuclear weapons, could be this: If a country needs outside supplies badly enough, it might cooperate.

Nonetheless, South Africa retains the ability to enrich uranium at its small pilot plant at Valindaba and would fight to exclude that from safeguards (inspection would be carried out by experts based at the IAEA in Vienna).

The white Afrikaner government is beleaguered, suspicious, apprehensive about the future. It doesn't mind speculation that it could detonate a nuclear explosion at any time. Publicity like that could give black Africa pause and make the US redouble efforts to strike a deal on safeguards.

Any probe into South Africa and Israel uncovers live coals

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of speculation about what really did happen in the south Atlantic in the early morning darkness of Sept. 22, 1979.

Two monitoring ("bhang") meters on a US Vela satellite recorded a "signature" of light consistent with a nuclear explosion near the earth's surface, at 3 a.m. local time. ABC-TV reported it. The State Department cautiously confirmed Oct. 25 it had "an indication suggesting the possibility that" a low-yield nuclear explosion had taken place.

Headlines blared. Scientists have disagreed ever since.

A CIA panel, including Dr. Edward Teller, the father of the hydrogen bomb, concluded it could have been a nuclear explosion. Black African and Arab states insist it showed South Africa and Israel collaborating in the darkest ways.

Sources have told this newspaper that a Naval Research Laboratory report concluded that hydro-coustic observations were consistent with a nuclear test.

But the White House, in a controversial report conducted by Dr. Frank Press, assessed the Navy lab report and other evidence and concluded the data were "ambiguous." The light the Vela had picked up was closer to the satellite than to the earth's surface, it said. The report asserted that the flash "probably was not from a nuclear explosion."

Those who accept that view told me standard practice is to test at dawn, to keep the radioactive cloud in sight for as long as possible. Not only was the 1979 flash detected at 3 a.m., they say, but no conclusive proof has ever been found of the radiation that would have resulted from a nuclear blast.

Other, more suspicious, scientists told me there was always a 50-50 chance of failing to detect low-yield radioactivity, especially when the precise test site was unknown.

"I think it was a clever joint test, South Africa and Israel," said one expert. "But I can't prove it."

The argument, the controversy, and the fears remain.

The ambassador gestured with one hand, as if to wipe the whole topic away. "Where would we use a bomb, anyway?" Ambassador Sole demanded in a Washington interview.

"Look at the psychological approaches nations take towards a bomb program, which costs a tremendous amount of money. Pakistan wants it because the Indians have it. Arab countries want it because they think Israel has it.

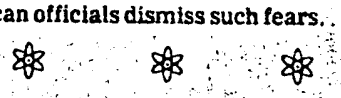
"South Africa doesn't have that kind of threat. Where would a bomb be useful? If it's some kind of guerrilla war you're talking about, we couldn't use one at all, not in our own country."

The worry of black African and other states at the UN was summed up this way in an August 1980 report for the UN Disarmament Center:

"The diplomatic and political costs of South African acquisition and deployment of nuclear weapons would be high, quite possibly disastrous, if those weapons ever were used.

"Nevertheless, desperate to preserve the apartheid system, South Africa's leaders may eschew a rational weighing of costs and gains. Instead, they might try to justify the acquisition of nuclear weapons as a last resort to attempt preserving white supremacy by intimidating neighboring countries or as a means to demoralize black South Africans, and, conversely, to buttress the morale of the white population."

South African officials dismiss such fears.



Israel is frequently linked to South Africa on nuclear matters. Black African and other states think Israel (visited by then South African Prime Minister John Vorster in 1976) has been giving Pretoria nuclear know-how for years.

Prime Minister Menachem Begin flatly denied allegations of Israeli collaboration in a 1979 test, saying in February 1981, "We have nothing in common with it."

Speculation is fueled partly because most experts believe Israel has been producing plutonium for weapons ever since its French-supplied reactor at Dimona began operating in December 1963. No US or other outside inspector has ever been allowed to examine Dimona.

With an annual plutonium production rate of some 10 kilograms (estimated by Swiss expert Theodor Winkler), Israel could have produced as many as 20 bomb cores.

Sit down in Tel Aviv, Jerusalem, and New York and talk to Israeli experts about the Nonproliferation Treaty of 1970, which it refuses to sign, and they make these points:

"Look, the treaty is fine for countries at peace. It works for Sweden and Norway. But in the Mideast, no one is really at peace. Iran and Iraq are fighting. Iraq calls for help in building a nuclear bomb. [Egyptian President Anwar] Sadat is dead, assassinated.

"What we need is some mutual confidence in the whole area. We say, start by agreeing to making the Mideast a nuclear-free zone. That means all of us, Arabs and Jews, must sit down and talk to each other.

"What do our critics say? 'Sign the Nonproliferation Treaty first.' So we are supposed to trust all our security to the hands of others, and accept the three ideas of the nonproliferation system: not to make nuclear weapons, full-scope safeguards, visits by outside inspectors.

"But how can we have confidence in Arabs who say they want to destroy us?

"Look at Iran. For two years after Khomeini came to power, he allowed no IAEA inspectors at all into Iran." (The IAEA says it was only for one year and adds that there was "nothing to inspect since Iran was in revolution.")

". . . Well, maybe not much was going on. But what if the Shah had had nuclear weapons in there? What happens in Iraq if [President] Saddam Hussein is killed like Sadat was? Any country can withdraw from the Nonproliferation Treaty in three months, you know.

"We have said and we keep on saying that Iraq could have had nuclear weapons by 1984-85. That's why we felt we had to destroy the Osirak reactor in June.

"Actually, many an Arab delegate to the UN was privately glad we raided Osirak — the Syrians, for instance, are no friends of the Iraqis. Nor are the Iranians, of course. They condemned us in public. In private, intermediaries tell us it was a different story."

For Israel, Arab recognition is a precondition to any progress. It could lead to discussions on surveillance of one another's nuclear operations, they suggest, or other ideas.

Iraq's nuclear plans were set back several years by the Israeli raid. Iraq runs the risk of another Israeli bombing as it rebuilds Osirak. But it says it is determined to press on.

President Hussein is highly ambitious to lead the Arab world. He openly referred to what he said was the need for an Arab bomb last June 23.

"Regardless of Iraq's intentions and capabilities at present and in the future," Hussein told his Cabinet in a speech broadcast by Baghdad Radio, "any country in the world which seeks peace and security, respects peoples, and does not wish those peoples to fall under . . . oppression . . . should assist the Arabs in one way or another to obtain the nuclear bomb. . . ."

This statement, condemned by US Secretary of State Alexander M. Haig Jr. soon afterward, claimed Arabs needed bombs "to confront Israel's existing bombs."

As long as Iraq lacks a sense of security and its own identity, and has a vaultingly ambitious leader, it will be tempted to pursue nuclear weapons.

Scientists and analysts contacted for this series say Iraq's nuclear program has definitely been "suspicious," though they don't agree with Israel that Iraq was on the verge of obtaining a nuclear device.

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Iraq first tried to buy a large gas graphite reactor from France. Paris, which had stopped making that model, sold the Osirak instead: Iraq remains heavily dependent on outside help. As a new Congressional Research Service report for the Senate Foreign Relations Subcommittee on Arms Control points out, Iraq "lacks chemical, metallurgical, and electrical and electronics manufacturing industries needed to establish a nuclear industry."

The report indicates the range of contacts Iraq has made with outside suppliers:

Brazil: a 1980 agreement for technology, reactors, training.

Italy: "hot cell" units, heavily shielded, where elements can be handled by remote control.

Portugal: 120 tons of uranium in 1980, 130 more tons reported set for 1981.

One US intelligence analyst commented: "Iraq will be able to build a nuclear bomb by 1990 if it rushes."

Analysts are watching France and Italy with particular concern. French Foreign Minister Claude Cheysson said Nov. 9 in Paris that talks on safeguards for Osirak were continuing. Italy is said to be renegotiating the agreement under which it has been building the hot cells.

US experts fear that a hot cell building could be made so large that a reprocessing unit could be fitted inside — "invisible" because of the heavy shielding on the walls. They don't say that this is happening — only that it could happen.

Four other names are high on any list of nuclear threshold states: Argentina. Brazil. Taiwan. South Korea.

The next (and final) article in this Monitor series will cover the two South American giants. Meanwhile, most analysts seem to feel that the dangers posed by Taiwan and South Korea can be contained, for the moment at least, because of one basic fact:

Both rely heavily on US protection for survival — and Washington firmly opposes their acquiring nuclear weapons.

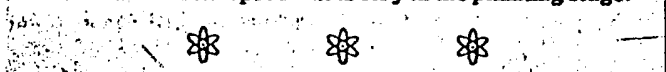
Both have highly sophisticated scientists and access to advanced technology. Both are signers of the Nonproliferation Treaty of 1970. Both are members of the IAEA in Vienna.

South Korea has one large (564-megawatt) power reactor, supplied by the Westinghouse Electric Corporation in 1977, under safeguards. Two even bigger ones are under construction. The biggest, Wolsung I, comes from Canada complete with the latest safeguard device: a "bundle counter" to detect how many times uranium fuel rods are removed.

If they are removed every few months, it could be to extract plutonium for weapons. To generate electricity, rods are left in place for a "long burn" of 18 months or more.

"Nuclear weapons will only look attractive to South Korea if the credibility of the US commitment to the country's defense will vanish," writes Swiss analyst Winkler.

However, Seoul is said to remain convinced it needs to be able to extract plutonium from spent fuel rods if its ambitious nuclear energy program is to grow. It supports plans that might lead to a regional reprocessing plant in the Pacific area. So far the concept remains only in the planning stage.



Taiwan was a full IAEA member until 1972, when Peking took over its seat. In theory, this means less comprehensive safeguards for Taiwan.

In fact, the US keeps strict watch over Taiwan's two power reactors (US supplied) and two more under construction. Both Canada and the US have built research reactors — and safeguard them.

Taiwan has tried to set up its own reprocessing plant, at Lung Tan. But the US brought heavy pressure to bear in 1976 after suspicions arose that Taipei was using it to extract plutonium from fuel rods in its Canadian TRR research reactor. Reluctantly, after secret talks, Taipei dismantled the plant under IAEA supervision. Mr. Winkler says that since then, Dr. Liu Hai-Pei has directed laser isotope enrichment studies (extremely advanced and sophisticated) at Chung San.

Taiwan might reconsider its nuclear choices if Peking significantly boosts its own defenses or comes to believe that the US defense shield is unreliable.

Tomorrow: Strengthening nuclear safeguards

CONTINUED

NUCLEAR BALANCE SHEET

	Pakistan	India	Israel	South Africa	Libya	Iraq	South Korea	Taiwan
Power reactors	One	Three (plus five*)	None	Two*	None	None	One (plus two* plus six**)	Two (plus four*)
Research reactors	One	Four (no safeguards)	Two (one not under safeguards)	One	One*	One (plus one*)	Two	Five
Plutonium produced, 1980	30 kg	220 kg	100-150 kg	None	None	None	Unknown	Unknown
Plutonium on hand by 1984 (projected)	605 kg	2,531 kg	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Reprocessing plants	Two*	Two (plus one*)	One	None	None	None	None	None
Enrichment plants	One*	None	None	One (plus one*)	None	None	One	One***
IAEA member	Yes	Yes	Yes	No (expelled)	Yes	Yes	Yes	Yes
Nonproliferation Treaty signer	No	No	No	No	Yes	Yes	Yes	Yes
Has accepted some of IAEA's safeguards, but not NPT's	Yes	Yes	No	No	—	—	—	Yes
Scientists	Very good	Very good	Excellent	Very good	Very few	Small but growing numbers	Very good	Very good
Delivery systems for a possible bomb	Canberra bombers, Mirage IIIs, Mirage 5s, MIG-19s, C-130s	Canberra bombers, Jaguars, MIG-21s, SLV-3 missiles	F-15s, F-4Es, A-4s, Mirage IIIs, F-16s, Kfir C-2s; Lance and Ze'ev missiles	Canberra bombers, Buccaneers, Mirage F-1s, Mirage IIIs	Tu-22s, MIG-23s, MIG-25s, MIG-21s, Mirage IIIs, C-130Hs, Boeing 707, Ilyushin 76s, Scud B missiles, Frog-7 missiles	Tu-22s, Ilyushin 28s, MIG-23Bs, Scud B missiles, Frog-7 missiles	F-4 jets, Nike Hercules surface-to-air missiles	F-104Cs, Honest John battlefield support missiles

*Under construction **Planned ***For research only

Sources: Library of Congress, Theodor Winkler (International Institute of Strategic Studies, London)

By Joan Forbes, staff cartographer

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ON THE TRAIL OF THE A-BOMB MAKERS

How nuclear safeguards can be strengthened

What strategies are being used to stop nuclear weapons from spreading to distant and unstable corners of the world? Last in a five-part series.

By David K. Willis
Staff correspondent of The Christian Science Monitor
Washington and Vienna

In Hollywood the story might have been advertised as "The Mystery of the Broken Seals." It was kept secret at the time. It has never been fully explained.

Now published for the first time, it turns out to have had a "happy ending" – but it also raises urgent questions about methods used to prevent what many diplomats, scientists, officials, and ordinary citizens see as one of the world's pressing problems: keeping nuclear weapons from spreading into unstable, dangerous countries.

In late December 1978, a US government inspector began routinely examining four metal containers at Kennedy Airport in New York. The four carried a total of five kilograms (11 pounds) of highly enriched uranium fabricated into fuel rods in California and in transit to a nuclear reactor in Bucharest, Romania.

The government seal on each container had broken.

The inspector could have stopped the shipment, opened the containers, and checked to see if any of the bomb-grade uranium fuel had been stolen or tampered with. But he did not. Other locks and fastenings appeared secure, so he simply attached new seals and sent the containers along.

Five days later, an inspector from the International Atomic Energy Agency in Vienna examined the containers in Bucharest. The new seals were intact. Nothing inside was missing.

Alarm signals rang on Capitol Hill when word of the episode leaked out in early 1979. Had the New York inspector failed in his duties? If someone had tried to steal the uranium between California and New York, it would have gone undetected for five days later: too late.

The Nuclear Regulatory Commission defended its man. It claimed the seals had broken in flight, accidentally. Eventually Congress let the issue drop.

But there are still questions. Among them: Are the precautions taken to prevent the theft or diversion of nuclear materials good enough? The IAEA is testing a new, US-developed system using automatic sensors to store and relay data to Vienna.

The superpowers could do much to help stop the spread of nuclear weapons. They could sign a comprehensive test ban treaty and limit strategic nuclear weapons. But prospects still seem distant.

Solutions suggested so far include:

- Stopping the exports of reactor, enrichment plant, and plutonium reprocessing components, plus enriched uranium and plutonium fuel (the approach favored by former President Jimmy Carter).
- Trying to strengthen the Vienna agency by providing more money and training for inspectors, upgrading surveillance cameras, counting fuel-rod loadings automatically, and increasing the number of inspections.
- Supplying economic and military aid to try to ease the fears of insecure countries.
- Creating regional nuclear-free zones.
- Making individuals more aware and concerned.

The right answer seems to be a combination of all these. Where experts differ is on deciding which methods to emphasize.

The need for intensified prevention methods is urgent. Nations like Pakistan, South Africa, Israel, and India reject pressure aimed at restricting their own freedom of choice, and regional hatreds and rivalries run deep. Knowledge about nuclear explosives is more freely available than ever.

Even an unknown free-lance writer named Howard Morland was able, after six months' research, to write an article in 1979 for a Wisconsin magazine called the Progressive entitled: "The H-bomb secret – how we got it, why we're telling it."

Imagine the resources a state like Pakistan has.

"Pay a visit to the library at the IAEA in Vienna," a US scientist advises. "Look up 'Weapons, nuclear' and just see what is available. You can't recall that knowledge. It exists."

The world is entering the era of the fast-breeder reactor, whose plutonium production exceeds its fuel consumption.

President Carter tried to stop the US and its allies from building them. President Reagan is attempting to reverse that process, while keeping safeguards. He has ordered work to resume at the Clinch River breeder reactor in Tennessee.

Paul Leventhal, former staff director of the Senate Nuclear Regulation Subcommittee in Washington and now director and founder of an antiproliferation group called the Nuclear Club, whipped out a pocket calculator.

"Safeguards inspectors agree," he said, "that 1 to 1.5 percent of all plutonium or highly enriched uranium is a normal operating loss. They start worrying only when they find more than that amount missing in some way.

"A regular reprocessing plant can process about 1,500 tons of spent fuel rods from reactors. That's 3.3 million pounds.

"That contains 1 percent, let's say, of plutonium – 33,000 pounds. After it has been extracted, inspectors allow, let's say, 1 percent for so-called normal losses. That's 330 pounds.

"So anything less than 330 pounds of plutonium from this reactor is considered 'normal.'

"But, assuming about 16 pounds of plutonium is enough to make a plutonium bomb [the figure is actually smaller], that's 20 warheads and a half – nuclear warheads."

At the moment, commercial-scale reprocessing plants are few and far between. There's one at La Hague, in France, and a pilot plant at Tokai Mura in Japan. India has a plant.

The Reagan administration has decided to try to undo President Carter's 1977 ban on reprocessing plants. Nothing will happen soon: The three US plants (West Valley, N.Y.; Morris, Illinois; and Barnwell, S.C.) are inoperative. But on

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Oct. 8, 1981, Reagan officials announced sweeping new plans that included lifting Mr. Carter's ban on these plants.

Soon, says Mr. Leventhal, "There'll be more plutonium than ever before being transported from plant to plant.

"It's just a matter of time before you have diversions, or outright theft, or nuclear terrorism in our cities."

How effective – and important – is the web of inspections and safeguards under the direction of the IAEA?

This newspaper's probe indicates they are essential – but that they should not be overrated or oversold. They have a role – to detect possible diversions of nuclear material. The IAEA is not a policeman – or a prosecutor.

All the IAEA has is a whistle. At first it blows the whistle softly, to its own members. If it detects diversion of plutonium, the director general can name the country to the IAEA board. Ultimately he can give a piercing blast and inform the United Nations Security Council.

After that, it's a political matter for the rest of the world.

In fact, the agency has never named anyone, either to its own board of governors, or to the Security Council.

Former inspector Roger Richter resigned from the agency to testify on Capitol Hill June 19 that agency safeguards were "totally incapable" of detecting whether plutonium was being illicitly produced in a large test reactor.

Countries, he said, could exclude key plants from inspection by saying they were not being used. The Osirak reactor in Iraq, he said, could have secretly produced 17 to 24 kilograms of plutonium a year. Inspectors visited only three times a year. No cameras had been installed.

IAEA safeguards chief Dr. Hans Gruemm visited the US to argue his rebuttal: His inspectors would have seen any attempt to siphon off nuclear materials from Osirak. Surveillance cameras and inspections would have been routinely heightened once a critical mass of highly enriched uranium had been delivered – it hadn't been when Israel attacked.

In fact, Dr. Gruemm has only about 140 inspectors, from various countries, and a safeguards budget of $25 million a year – less than the cost of a single F-16 jet.

To him, that reflects the state of the world – the wishes of IAEA member states, not the wishes of the IAEA. He believes the ratio of his safeguards budget to world spending on arms is 1:20,000.

Overworked and weary, his inspectors fly off to reactors and spent fuel ponds and reprocessing plants around the world, checking the records kept by member states, taking gamma-ray readings, peering through the bluish hue of water surrounding reactor cores or spent fuel ponds, changing film in automatic movie surveillance cameras, checking metal seals of stored nuclear material and camera cases.

Former inspector Emanuel Morgan, an American, has just told the US Nuclear Regulatory Commission that many inspectors don't speak the languages of countries they visit.

It's easy to poke fun at the inspectors: They have too much to do, too little time. They can't drop in unannounced: They have to apply for visas, like everyone else. Pakistan and other countries keep local officials with the inspectors at all times. Any country can reject an inspector because of his nationality – "which means many of our Soviet inspectors sit around Vienna a lot with nothing to do," an IAEA source said.

(Iraq allowed only Soviets and Hungarians to visit Osirak, raising Israeli suspicions to even higher pitch.)

But the "fault" lies, not only with the inspectors (who can, over a period, build up a pattern of surveillance by checking and cross-checking records, just as an internal revenue service cross-checks tax returns), but mainly with a world where states remain jealous of the last ounce of sovereignty.

Since 1968, 111 nonnuclear countries, plus the US, the Soviet Union, and Britain, have signed the Nonproliferation Treaty, or NPT.

Nuclear states keep their bombs but agree to negotiate "in good faith" to reduce them. Nonnuclear states accept international inspection, in return for freedom to keep using nuclear power for peaceful purposes.

They are also guaranteed a flow of technical assistance to help them develop nuclear programs.

But nonnuclear states are becoming more and more restive. Superpower arsenals are growing all the time. SALT II is in limbo. Nuclear countries sell technology at commercial rates: They don't give it away.

These smaller states are not impressed with new US-Soviet talks on reducing forces in Europe. They tend to be cynical about President Reagan's "zero option" plan for eliminating all missiles in Europe if the Soviets agree.

They were upset when former President Carter persuaded Congress to pass the 1978 Nuclear Nonproliferation Act, because its effect was to deny fuel and technology to any country unwilling to accept full-scope safeguards. To them, this showed the US owning massive nuclear arms and determined not to share nuclear know-how.

"If we tried to negotiate the NPT today, we couldn't," one expert in Vienna says.

Major nonsigners of the NPT: France and China, Pakistan and India, Israel and South Africa, Argentina, Brazil, Chile, and Cuba.

France remains controversial. It says it behaves as though it had signed the NPT. But, in fact, scientists and officials in the US and Britain, and even some in France itself blame Paris for selling two of the most controversial reactors in the world today. One went to Dimona in Israel's Negev Desert in 1963. It has been used to create plutonium ever since. The other was Osirak.

France also agreed to sell Pakistan a large reprocessing plant in the mid-1970s. It backed away from the deal only under US and European pressure. But blueprints had already been delivered. Pakistan, sources say, copied them and used them to build a smaller reprocessor – an essential part of the cycle needed to make nuclear bombs from plutonium.

A spokesman for the Atomic Energy Commission in Paris says that France had agreed to rebuild Osirak. But talks about the site, the type of reactor, the fuel, and safeguards could take up to a year. Privately, French officials acknowledge heavy world pressure to tighten safeguards and to substitute "caramel" fuel, which is harder to use in a bomb.

Nonetheless, the system has its uses. A state like Pakistan, which refuses the degree of inspection Vienna officials want, is automatically spotlighted.

No state has yet given the requisite three-month notice to withdraw. To do so would be to confess openly it intended to build a bomb.

The IAEA does not work in a vacuum. It is just one part in a wider system that includes (1) military intelligence from

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the US, Israel, India, and other states; (2) the knowledge that spreads like wildfire on the unofficial "gossip" network of nuclear scientists around the world; (3) pressure by the superpowers on states like Pakistan (and West Germany, which Moscow watches like a hawk).

The US will not sell any nuclear material to a country that does not subscribe to NPT full-scope safeguards. Many other countries demand IAEA inspection only on material they themselves provide.

On a desktop in Vienna sits a white metal box. Once a week it flashes an automatic signal to seven black boxes sitting on other desktops around the world.

One black box is at a nuclear storage site at Lucas Heights, Australia; others are at a reactor outside Sofia, Bulgaria; in Manitoba, Canada; outside Cologne, West Germany; north of Tokyo near the city of Mito; at a research reactor in Cambridge, Mass.; in the rolling countryside of Harwell, outside Oxford, England.

When the tamper-proof black boxes receive the command signal, they release coded information they have already retrieved and stored from tiny automatic sensors. The sensors are on automatic surveillance cameras in sealed metal boxes, at the entrances or exits of nuclear reactors, and on stockpiled nuclear material.

Within three minutes, all the boxes have released their stored data and zipped it back across thousands of miles to the master white box in Vienna.

Now the white box knows whether film in the cameras in Australia, Bulgaria, Canada, West Germany, Japan, the US, and England has been broken . . . if the video system is working . . . if the power is still turned on inside the cameras . . . whether sealed boxes or sensors have been tampered with.

This is dizzying technology. It has been developed by the American firm, TRW, in answer to a US idea to peer more efficiently and more often into countries' nuclear sites.

But it is also a problem.

So far, it is only a pilot plan — Operation RECOVER (for Remote Continual Verification). It has cost $3.5 million. Failures and random signals have occurred at a rate of a mere 0.5 percent, US officials on the program report.

It is real Buck Rogers material — except that the system might work too well.

The USSR won't accept it (as a nuclear weapons state, it doesn't have to). Other states could also reject it as too intrusive.

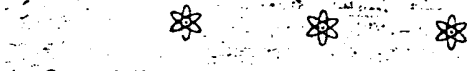
Already poorer countries on the board of governors of the IAEA are raising a host of questions — what will it cost? Who pays for installing the black boxes and the sensors? How often can Vienna call up stored data? How many sensors should be affixed to how many reactor sites? What control will each country retain? (Inspectors have to be issued visas — but an electronic signal is a different matter.)

Detractors say, "Too much machinery, too much reliance on wires and circuits, too much danger of false signals and equipment failure. . . ."

A similar system is being developed to cover nuclear materials — plutonium, enriched uranium — in transit. It is called Operation TRANSEAVER.

Japan prefers instruments to inspectors at Tokai Mura because the plant could keep working while sensors operated. Australia is interested in TRANSEAVER as a way of safeguarding long sea voyages.

But many other countries may reject the new gadgetry. There's such a thing as a too-super supersleuth.



One solution to spreading weapons is the setting up of regional nuclear-free zones. So far, however, progress is slow.

There is one nuclear-free zone: Latin America. In 1967 a number of nations there signed a treaty with an almost unpronounceable name: Tlatelolco, named after the place in Mexico where it was drafted.

Today, 14 years later, Cuba, Chile, Guyana, and the two hemisphere giants, Argentina and Brazil, still have not accepted the treaty.

Twenty-two states in the area have signed, plus the US.

The five nuclear-club members in the world (US, Soviet Union, France, Britain, and China) have agreed not to introduce nuclear weapons into the zone. The US, Britain, and the Netherlands have agreed not to station nuclear weapons on their Latin American territories.

France has a constitutional problem. Since all French *départements* are equal, France could not forswear nuclear weapons in Martinique without doing so in Marseille.

Much depends, of course, on Argentina, Chile, and Brazil. Why haven't they accepted the treaty?

The answer lies in a mixture of regional rivalries, insecurities, and ambitions.

Chile and Brazil say everyone else must ratify first. Translation: They won't sign before their rival, Argentina.

In fact, Chile and Brazil have signed, and ratified — but they have not waived a provision that says the treaty takes effect only when everyone has signed. The 21 other states have waived this provision and accepted the treaty for themselves and all other signers already.

What about Argentina?

It has signed — but not ratified. It has offered a variety of reasons over the years. The latest: It has to negotiate safeguards with the IAEA first. (Other states have ratified first, then talked about safeguards.)

Adm. Castro Madero, head of Argentina's Atomic Energy Commission, puts his view of the IAEA in a nutshell: He tells newsmen that every country "has the right to develop the technologies it needs." Buenos Aires refuses to give up its right to peaceful nuclear explosions.

Partial translation: Brazil must agree first, please.

The US "continues to be hopeful" that Argentina will accept Tlatelolco. Translation: Don't hold your breath.

All those who don't accept the treaty worry about the possibility of Soviet nuclear warheads in Cuba. Cuba might come under heavy pressure from Moscow to sign if everyone else does so first. Without that, Moscow won't insist.

Argentina is moving steadily toward an independent fuel cycle. It leads the field in Latin America.

Experts say its power reactor Atucha 1 has produced 200 kilograms of plutonium since January 1974 — still in spent fuel rods and safeguarded by the IAEA under a three-way agreement with Vienna and West Germany, which provided the reactor.

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Argentina is ambitious. It has plans to spend $5 billion to $7 billion in this decade alone. Its scientists are well-trained.

Canada has built a second reactor. West Germany is working on a third. Canada insists on safeguards, and would have demanded even stricter ones had it landed the contract for the one it lost to Bonn. Bonn is asking safeguards only on the reactor it is building – not full-scope safeguards on everything in Argentina.

Switzerland is building a heavy-water plant (also asking for safeguards only on its own plant). Argentina is working toward making its own fuel rods and building a small reprocessing plant.

Ambitious, wealthy, determined, it is a country to watch.

Brazil entered the field much later, and less efficiently.

Almost all its nuclear eggs are in one West German basket: a gigantic agreement signed in 1975 for a total of nine reactors, a reprocessing plant, and two enrichment plants.

Bonn has also agreed to build a plant to make fuel rods.

The US and others have made clear to Bonn that they have grave doubts about this huge scheme.

In fact, Brazilian uranium is to be enriched at the URENCO plant in the Netherlands, run by Holland, West Germany, and Great Britain. The Dutch are adamant they will not agree unless ultra-strict safeguards are clamped on.

Nonetheless, if the deal goes through, the Brazilians will have considerable knowledge by 1990. The more it has, the more Argentina will worry – and the less likely it may be that Tlatelolco will be fully accepted.

But there is a bright side to the story. "Yes," said Jeremy Stone, director of the Federation of American Scientists in Washington, in an interview. "Yes, the dike could be breached. Weapons could spread.

"But so far the process of proliferation hasn't happened automatically or quickly. It's been slower than people thought, and that gives hope that it can be further restrained and even halted.

"The whole name of the game is to buy time, until the security problems of the world – the Mideast, South Korea, Taiwan, and others – might be eased. . . .

"The superpower arms race has gone worse than anyone had expected.

"Proliferation has gone far better."

The list of states that could take a quick step across the nuclear threshold is limited – though experts agree that by 1990 it will have two dozen or so names.

Experts like Jeremy Stone say you have to deal with these states on an individual basis, rather than looking for some kind of global, overall strategy.

Three of the many ideas offered to this correspondent:

Israeli scientist and member of parliament Dr. Yuval Neman: "No country should sell highly enriched uranium to another. It should lease it, guard it, inspect it on site, and repossess fuel rods containing plutonium."

Paul Leventhal of the Nuclear Club Inc.: "Ban the use of highly enriched uranium and plutonium in commercial reactors. Use only natural or low-enriched uranium. Lock up all spent fuel rods, which contain plutonium, in some kind of international storage." (Talks on such a storage system have bogged down.)

US defense consultant and research professor Edward Luttwak: "Concentrate on the countries trying to get the bomb. Collect intelligence. Put pressure and publicity onto the big companies that sell nuclear components. Other governments might resent US pressure; the people of the world would welcome it. Don't use armed force – unless Libya starts to get nuclear weapons. In that one case, you would have to strike."

The last word, perhaps, should come from a man who was close to having the first: Bertrand Goldschmidt of France, the grand old man of safeguards and nonproliferation, author of the book "Le Complexe Atomique."

Small, wiry, neat, precise, he worries as much these days about the nuclear stockpiles possessed by weapons states as he does about other countries or terrorists or Libya getting a bomb.

"The 11,000 tactical nuclear warheads stored in West and East Germany could be stolen," he told me in Vienna.

He paused, thinking back as well as forward.

"Don't forget the positive aspects," he reminded me. "There have been three miracles."

Miracle No. 1: "August Lindt of Switzerland and I struck the compromise that allowed the IAEA to be born in October 1956," he recalled. "States were allowed to keep fissionable materials they needed for research or in existing reactors or those being built – before then, the idea was that states had to yield their stocks to an international body. France and India and others saw that as exploitation. After all, in those days, the US controlled most of the world's uranium, along with Britain.

"Safeguards were accepted – a political revolution!

"For the first time countries gave up some sovereignty to get the nuclear materials they wanted – unprecedented."

The USSR after 1963 supported the US on the need to stop other nonnuclear countries from getting the bomb.

Miracle No. 2:

In the first decade after World War II, three countries got the bomb: the US in 1945, the USSR in 1949, the United Kingdom in 1952.

In the second decade, two: France in 1960, China, 1964.

In the third decade, one: India, 1974.

In the fourth decade: none – if the flash in the sky on Sept. 22, 1979, between South Africa and Antarctica was not a bomb. No one seems to know.

"The fact is that no one has embarked on an open nuclear arms campaign since 1964," Mr. Goldschmidt said.

Miracle No. 3:

The five countries that could easily have built a bomb after the war did not.

West Germany, Japan, and Italy had to renounce nuclear weapons as part of settlement agreements after the war. Canada decided it was secure and didn't need a bomb. Sweden had a long struggle, but eventually went the same way.

Romania, Hungary, Finland, and Bulgaria also had to renounce nuclear arms after the war to obtain peace treaties.

But the "pause" in proliferation of recent years may be coming to an end – unless much more is done.

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What can YOU do to help halt the spread of nuclear weapons?

Experts, including Paul Leventhal, suggest:

Take an interest in the issue. Become involved.

Contact your representatives in Congress and ask what their views are. Let them know you support arms control.

Find out more about what the International Atomic Energy Agency is and what it does.

Look into nuclear power in your area. Whether or not you think nuclear energy is desirable, there are other issues:

How safe is your local reactor (if you have one) against sabotage and theft? What is happening to the spent fuel rods taken from the reactor every two years or so? Are they being held for reprocessing (to extract plutonium from them) or are they being kept in cooling ponds with the plutonium still locked up harmlessly inside?

"Proliferation is ultimately a home-town problem," Mr. Levanthal says. "Stolen plutonium can be used anywhere, including Main Street."

Mr. Leventhal's organization, the Nuclear Club Inc., is at 1742 "N" St., NW, Washington, DC 20036.