India and Argentina: Developing a Nuclear Affinity

Ten days after detonating its first nuclear explosion, India signed a 5-year cooperative agreement with Argentina providing for joint research projects and exchanges of both scientists and unclassified information. Brief and phrased in broad, general terms, the agreement of 28 May does not spell out the nature of the projects to be undertaken or the kind of information to be exchanged, except to describe it all as related to peaceful nuclear research.

Argentine diplomats in Washington insist that the timing of the agreement was coincidental and its motive entirely innocent. Even so, the new accord has rekindled concern in Washington over Argentina's traditionally ambiguous nuclear intentions. "Obviously," one diplomatic source says, "Argentina is one of those you want to keep an eye on."

With a sizable middle class and a relatively high per capita income of $850 a year, Argentina is not, in the usual sense of the word, underdeveloped. It has long been regarded as one of the most technologically advanced of Latin American nations, and its National Atomic Energy Commission (CNEA)—established by a Peron decree in 1950—has accumulated an impressive string of firsts. In 1958 Argentina became the first Latin American nation to operate a research reactor. A decade later the CNEA started up the continent's first, and so far only, chemical processing plant for reclaiming plutonium from spent reactor fuel. And last January, Argentina extended its string to include the first operating nuclear power plant in Latin America, a 319-megawatt facility near Buenos Aires.

The question now is whether Argentina will attempt to go the next step and become the first nation south of the equator to test a nuclear explosive.

In spite of a certain Argentine prowess in reactor technology, diplomatic sources familiar with Latin American science indicate that it would be stretching the evidence to suggest that Juan Peron's shaky government may be the next to go nuclear, even if it wanted to do so. At the same time, however, there seems to be general agreement that Argentina, perhaps more than any other Latin American nation, is keeping its options open while drifting slowly but directly toward a nuclear capability on a par with India's.

More than anything else, the new accord with India highlights a kind of natural affinity between the two nations, an affinity rooted in striking similarities in the evolution of the two nations' nuclear programs and their views on "peaceful" nuclear explosives. If Argentina has not deliberately followed in India's footsteps in the past, the possibility arises that it may want to do so in the future.

One of the strongest commonalities between the two nations lies in the nuclear power plant technology they have chosen. Spurning the more common light water reactors—which depend upon enriched uranium fuel available only under safeguard controls from the United States, Western Europe, or the Soviet Union—India and Argentina have opted instead for reactors that run on natural uranium. From the standpoint of energy self-sufficiency, the choice makes sense, for the two countries are relatively well endowed with uranium and are capable of turning it into reactor fuel. But natural uranium reactors also offer a significant military advantage over enriched uranium power plants: They lend themselves especially well to the production of explosive-grade plutonium.

All reactors that run on uranium, of course, produce plutonium. But natural uranium reactors do a more proficient job of it than most. What's more, they can be designed for frequent and easy replacement of fuel rods while the reactor is running, a feature not available in enriched uranium power plants. More than a mere convenience, this feature minimizes the buildup of plutonium-240, a spontaneously fissioning isotope that is a troublesome contaminant in explosive devices, for it can cause premature detonation.

India's adoption of natural uranium reactors was a predictable outgrowth of Canadian nuclear assistance, which emphasized this particular technology over others (*Science*, 7 June). Argentina's choice was more abrupt. Having built five small research reactors all of which are fueled with enriched uranium imported from the United States) in the decade since 1958, the CNEA switched courses when the time came to choose a design for Argentina's first nuclear power plant. In 1968, after mulling over 17 bids from five nations, the nuclear commission settled on a virtually experimental type of natural uranium reactor offered by Siemens of West Germany. (The only predecessor is a 50-megawatt prototype built in Germany.) The German plant is now operating at Atucha, near Buenos Aires, and Canada has tentatively agreed to sell Argentina one of its natural uranium reactors under strict international safeguards.

Explosives Aid Unlikely

U.S. analysts consider it almost unthinkable that India would directly help another nation build a nuclear explosive —and the new agreement's proscription against classified information would seem to rule this out.

But India is likely to help Argentina build its second natural uranium power plant, and possibly a third as well. Such help could go a long way toward giving Argentina an independent source of plutonium for use in ostensibly peaceful explosives. For India, having defined such things as being in the realm of peaceful research, is in a poor position to dissuade Argentina from following suit.

For the present, Argentina's plutonium stockpile is derived entirely from its collection of research reactors at two government research centers near Buenos Aires and a third near San Carlos de Bariloche, 1600 kilometers south of the capital. (The largest reactor is the 8-megawatt RA-3, at the Ezeiza Atomic Center next to the Buenos Aires airport. According to a recent CNEA report, this reactor is to be fitted with a "fertile blanket" for making plutonium to be used in fast reactor studies.) The stockpile is believed to be quite small. Kept in vaults at the Ezeiza center, it is under safeguard accounting controls supervised by the International Atomic Energy Agency. Safeguards agreements with Argentina prohibit using the plutonium for military purposes, but the agreements say nothing about "peaceful" nuclear explosives (see box).

How Safe the Safeguards?

India's recent nuclear test was very much on the minds of U.S. officials as President Nixon announced agreements to supply Egypt and Israel with nuclear power reactors and fuel. Specific wording of the agreements is yet to be worked out, but officials of the Atomic Energy Commission say they intend to take special precautions to discourage Egypt and Israel from following the Indian example. "You can imagine, after India, that we're giving this very serious thought," one AEC safeguard expert said.

Much to the chagrin of the Canadian government, India was able to produce plutonium from a Canadian-supplied reactor, and then justify its use in the explosion of 18 May because of a semantic loophole in a bilateral agreement between the two countries. The nuclear aid agreement required only that the Canadian reactor be used for peaceful purposes. India—contrary to Canada's stated interpretation—defined the word "peaceful" to include explosives assertedly meant for mining and earth moving.

To discourage Egypt and Israel from following the Indian example, U.S. officials are considering requiring that spent reactor fuel—containing plutonium as a waste product—be processed either in the United States or another nation that is a party to the Non-Proliferation Treaty. (The treaty explicitly prohibits the nonnuclear parties from building peaceful or military nuclear explosives; Egypt has signed but not ratified the treaty; Israel has done neither.)

Short of requiring that fuel be sent elsewhere for processing, U.S. officials are thinking about writing a specific prohibition on Plowshare-type devices into the Egyptian and Israeli agreements.

The latter alternative—while justifiable—would be inconsistent with past practice. Since 1955 the United States has signed bilateral nuclear aid agreements with 29 nations, none of which contain explicit prohibitions on using American nuclear aid to build peaceful nuclear explosives. In effect, all of the agreements contain the "Canadian loophole."

Fourteen of the 29 nations have signed and ratified the NPT, so for them the possibility of a dispute over the terms of the agreements is moot. Eight others have signed the treaty, indicating their intentions to abide by it, but have not yet ratified it. Seven others—Argentina, Brazil, India, Israel, Portugal, South Africa, and Spain—have refused to sign the treaty and the first three of these have defended what they regard as their right to build peaceful explosives.

AEC officials concede, as one of them puts it, that "there's room for argument" over the meaning of the agreements, which specify merely that U.S. equipment and materials not be used for military purposes. Another official, William L. Yeomans, the AEC's assistant director for agreements and liason, acknowledges that Argentina and the other non-NPT nations "could make the same argument as India," but that to do so would "knowingly be contrary to the position we have made known." Like Canada, the United States considers peaceful and military nuclear devices to be one and the same and therefore forbidden under existing bilateral agreements.

In attempts to formalize this position, the State Department has quietly reiterated it in recent years in diplomatic notes to Brazil, Spain, Portugal, and South Africa. The notes have been sent without fanfare when a nuclear agreement has come due for renewal or when one of the non-NPT nations has requested an amendment. Egypt and Israel may receive similar notes.

"The way it works," one AEC source said, "is that we say, 'This is the note we're giving you.' They're rather compelled to say so if they disagree with it."

Asked whether the recipients had acknowledged the notes, this official said, "Some have and some haven't."

Three knowledgeable AEC authorities said they were not aware that Argentina had ever acknowledged the U.S. view that peaceful explosives are prohibited under the terms of the 1969 bilateral agreement signed with that country. Argentina has not received one of the reminder notes. The agreement, under which reactor fuel and heavy water have been sold to Argentina, comes due for renewal in 1999. Until then, it appears, safeguards on American aid will rest on the none-too-substantial foundation of an informal understanding to which Argentina may or may not subscribe.—R.G.

The lack of a specific prohibition on "PNE's" as they are called, is significant. For Argentina, like India, has refused to sign the 1968 Non-Proliferation Treaty (NPT), under which it would be obliged to renounce nuclear weapons as well as any interest in building its own "plowshare" type explosives for peaceful purposes. Past governments in Buenos Aires have disavowed any intention of developing nuclear weapons, but have adopted much the same stance toward the NPT as India and Argentina's regional rival, Brazil: The treaty is regarded as an unfair and discriminatory imposition on nonnuclear nations, particularly with regard to peaceful explosives, which the treaty holds to be technologically identical with weapons.

Brazil has not signed the NPT either. Government officials there have talked from time to time of using Brazilian-made nuclear explosives for massive earth-moving projects in the Amazon Basin. According to U.S. arms control authorities, Argentina has similarly defended its right to use peaceful explosives, though less vociferously than Brazil and never in the context of specific projects.

"Today, anyway," observes one Nixon Administration analyst, "we're talking more about theology than serious intent. Argentina's position is that they should have the right to develop indigenous PNE's [peaceful nuclear explosives]."

Certainly there have never been clear, public indications that Argentina was engaged in such research, although some scientists have expressed interest. "Our research has always dealt with nuclear power, nothing else," Hector A. Subiza, the minister-counselor of the Argentine embassy in Washington, told *Science*. He added that to develop an explosive as India has "you have to have a certain level of technology that we do not have. It is now impossible, though I can't tell you about the future."

Juan Peron, however, is not immune to nuclear hubris, or so the celebrated "Richter affair" of the early 1950's suggests.

According to one authoritative account, Ronald Richter was an Austrian nuclear physicist reputed to have worked in a Nazi laboratory before emigrating to Argentina after the war. In 1949 Richter is said to have approached Peron to set up a laboratory for producing energy by nuclear fusion. Peron as-

sented, and for 3 years Richter plugged quietly away in his laboratory on Huemul Island in Lake Nahel Huapi near Bariloche.* Suddenly, in March 1951, Peron summoned the press for a momentous but cryptic announcement: Richter had succeeded in his experiments, and Argentina would soon be generating electricity from an atomic source. Peron declined to name the source, but he hinted broadly that it was fusion—an assertion all the more remarkable for the fact that it preceded by more than a year the first U.S. thermonuclear blast.

Peron's grandiose claim succeeded mainly in making Argentina's fledgling nuclear program the butt of local jokes. (One local publication dubbed Richter's Huemul Island laboratory "huele a mula"—literally, "to pull a fast one.") Internal pressure in the CNEA led to Richter's sacking in late 1952, and Peron himself departed under unhappy circumstances 3 years later.

Argentina's nuclear program has long since shed its status of laughing stock. To some observers, its gradual accretion of a nuclear capability now poses much the same dilemma as India's first nuclear test on 18 May.

Developing nations urgently need new sources of energy, and preferably ones that allow a measure of self-sufficiency. Nuclear power plants—especially those using domestic natural uranium—are an obvious answer. But can the spread of reactor technology be policed well enough to control the ultimate uses of the resulting plutonium?

International safeguards may be effective insofar as they apply, but they do not automatically apply to reactors designed and built indigenously by nations that do not subscribe to the NPT. The case of India suggests that reactor technology has trickled around the ends of a Maginot line of safeguards. Argentina may, in time, provide a second case.—ROBERT GILLETTE

* Jorge A. Sabato, "Energia atomica en Argentina," *Estudios Internacionales*, **2**, No. 3 (1968). A respected Argentine technologist, Sabato for many years headed the CNEA's metallurgical branch. See also, John R. Redick, *Military Potential of Latin American Nuclear Energy Programs* (Sage Publications, Inc., Beverly Hills, Calif., 1972).

Con Edison: Endless Storm King Dispute Adds to Its Troubles

In 1962, the Consolidated Edison Company of New York announced plans for a 2000-megawatt hydroelectric facility about 40 miles north of New York City in the Hudson River highlands. This proposed pumped-storage facility was called the "Cornwall project" after the name of the village it would adjoin at the foot of Storm King Mountain. The project soon gave rise to one of the earliest and most noted cases in environmental law. The case was brought by conservationists who organized as the Scenic Hudson Preservation Conference to stop the project. *Scenic Hudson*, as the case is known, is still unsettled today even though nearly 10 years have passed since it was first heard in the courts.

As the name of the case suggests, the primary issue raised at the inception of *Scenic Hudson* in 1964 and 1965 was one of aesthetics. Early plans for the Cornwall facility called for the powerhouse to be built above ground, requiring a deep cut in the face of Storm King. This mountain is a prominent feature of the Hudson highlands, which are of unusual aesthetic appeal because nowhere else in the eastern United States does a major river cut through the Appalachian Mountains at sea level and give the effect of a fjord.

The Cornwall project (see Fig. 1) has long since been redesigned to make it less intrusive, however, and today the case turns not on aesthetics but on two other issues. One is whether the project would cause major fishery losses. The other is whether Con Edison is justified, in terms of economic efficiency and wise use of fuel, in investing in the proposed facility.

Its cost (including that of related transmission lines) has been variously estimated at between $537 million and $741 million. According to a staff study of New York City's Environmental Protection Administration, Con Ed could generate the same amount of peaking power at lower cost and substantial fuel savings by installing newly developed systems that combine gas- or oil-fired turbines with waste heat boilers that can be used to produce either steam or (with low-pressure steam turbines) more electricity.

The issues in *Scenic Hudson* and the evolution of that endlessly complicated case are best understood in the light of Con Edison's overall situation.

Con Ed's problems are such that the company recently escaped bankruptcy only by persuading the legislature to have the state buy two of its still unfinished generating units for about $500 million. In addition, the company reluctantly "passed" the spring quarter dividend, an action without precedent in its 89-year history. This caused Con Ed's stock to drop sharply and hurt stock prices and bond ratings throughout the utility industry.

Irving Kristol, professor of urban values at New York University, wrote in a recent article in the *Wall Street Journal* that Con Ed has been "mugged and robbed" by elected city officials who first "prepared themselves for self exculpation by giving their victims a bad name." Inasmuch as Con Ed is forced to bear an immense tax burden —the company pays 8 percent of all the property taxes collected by the city—that lurid characterization seems to contain more than a little truth.

Kristol also named environmentalists —whom he described as "upper middle class malcontents"—in his bill of indictment. They were accused of frustrating Con Ed's efforts to build needed generating capacity and of increasing power costs by insisting on the use of low-sulfur fuel, regardless of price. Con Ed has itself assigned the blame for many of its problems to environmentalists, accusing them of "harassment" for their continued actions opposing construction of the Cornwall facility and certain other projects.

Yet, even if politicians and environ-