

- see also G. 't Hooft, *Nucl. Phys. B* **33**, 173 (1971); *ibid.* **35**, 167 (1971).
42. D. J. Gross and F. Wilczek, *Phys. Rev. Lett.* **30**, 1343 (1973); H. D. Politzer, *ibid.*, p. 1346.
 43. For a review of the situation on scaling violations at the end of the 1970s, see W. S. C. Williams, in *Proceedings of the 1979 International Symposium on Lepton and Photon Interactions at High Energies*, Batavia, IL, 23–29 August 1979, T. B. W. Kirk and H. D. I. Abarbanel, Eds. (Fermi National Accelerator Laboratory, Batavia, IL, 1979), p. 384.
 44. J. J. Aubert *et al.*, *Phys. Rev. Lett.* **33**, 1404 (1974).
 45. J.-E. Augustin *et al.*, *ibid.*, p. 1406; G. S. Abrams *et al.*, *ibid.*, p. 1453.
 46. G. Hanson *et al.*, *ibid.* **35**, 1609 (1975).
 47. M. L. Perl *et al.*, *ibid.*, p. 1489; M. L. Perl *et al.*, *Phys. Lett. B* **63**, 466 (1976).
 48. S. W. Herb *et al.*, *Phys. Rev. Lett.* **39**, 252 (1977).
 49. R. Brandelik *et al.*, *Phys. Lett. B* **86**, 243 (1979); D. P. Barber *et al.*, *Phys. Rev. Lett.* **43**, 830 (1979); C. Berger *et al.*, *Phys. Lett. B* **86**, 418 (1979).
 50. I thank J. I. Friedman of MIT for reading two drafts of this paper and J. Toll for support and encouragement during 1991, when I worked in Washington, DC, as Staff Scientist for Universities Research Association, Incorporated. Publication of this work was supported by Department of Energy contract DE-AC03-76SF00515.

New Approaches to Nuclear Proliferation Policy

Joseph S. Nye, Jr.

Nuclear proliferation is not one but a complex of problems. One relates to the collapse of the Soviet Union and its effect on the spread of nuclear weapons and knowledge. Second, Iraq's violation of its Non-Proliferation Treaty obligation has exposed certain weaknesses in the traditional regime of multilateral nonproliferation institutions and treaties. Third, Pakistan's achievement of a nuclear weapons capability in the late 1980s brings the postproliferation question to the forefront in South Asia. There is no single solution to this complex set of problems, but the beginning of wisdom is to build upon the successes of the past, add new policy procedures, and, above all, increase the priority given to the issue. Otherwise, we may be faced with the ironic outcome that the widely welcomed end of the Cold War may increase the prospect of nuclear use.

In the aftermath of the Cold War and the Gulf War, the problem of nuclear proliferation has risen to new prominence. The end of the Cold War has reduced the risk of a large-scale nuclear war, but it has also reduced control by the superpowers. Not only has the disintegration of the Soviet Union removed Soviet control over its client states, but it has also raised the question of how many nuclear states will succeed it. The Gulf War showed that Iraq, in violation of its obligations under the Non-Proliferation Treaty (NPT), had a massive program to develop nuclear weapons. The successful Iraqi deception raised questions about the adequacy of national intelligence efforts as well as of the International Atomic Energy Agency (IAEA) inspection system. Now there are questions about North Korea approaching a nuclear weapons capability.

The 1990s will see three major problems in nonproliferation policy. One is the traditional problem of slowing the rate of spread of nuclear weapons to additional countries such as Iraq and North Korea. The second revolves around what to do after proliferation has taken place in regions such as South Asia and the Middle East.

The third set of problems relates to the disintegration of the Soviet Union and its effect on the spread of nuclear weapons and knowledge. Each poses separate problems and questions about appropriate policy goals.

Policy Objectives

A policy to slow the spread of nuclear weapons is costly in terms of the friction it can create with other countries; witness the ill will created by the suspension of American economic and military aid to Pakistan. It is not surprising that skeptics raise questions about costs. Some political scientists even argue that nonproliferation policy may have the wrong intent (1). If nuclear weapons produced prudence between the superpowers during the Cold War, could they not do the same for other pairs of nations, such as Argentina and Brazil, India and Pakistan, and Israel and its Arab neighbors?

There are several reasons to doubt such general replicability. Statistics show a much higher incidence of governmental breakdown through military coups and civil wars in many of the areas where nuclear weapons might spread. In addition, new nuclear weapons states might not be able to build enough survivable weapons to be confident of assured second-strike capability and thus

might increase the risk of preemptive attack by frightened neighbors. Few of the new nuclear powers could develop the elaborate system of command and control, the special safety devices, or the satellite verification that reduced the risk of nuclear war between the superpowers. Nuclear stability between the superpowers involved a long learning process (2). Opposition to nuclear proliferation is, therefore, not a question of elitism or racism. Some regional situations might see stable nuclear deterrence, but in many the risks of nuclear instability would be high. As more countries develop nuclear weapons, the probability of their use in war increases, as does the probability of their leakage into unauthorized hands or to terrorist groups.

A second sort of skepticism about nonproliferation policy doubts not its value but its feasibility. With time, technology spreads, and nuclear weaponry is a half-century-old technology. As the aphorism goes, "the horse is out of the barn." But such metaphors do a disservice to clear thinking about policy objectives. It matters how many horses are out of the barn and the speed at which they run. If the policy objective is to prevent any spread of technology, then the situation is hopeless. But if the policy objective is to slow the rate of spread so as to manage the destabilizing effects, there has been considerable success. Nearly 40 countries have the technical and economic capabilities to produce nuclear weapons, but fewer than a quarter of this number have done so. This is a sharp contrast to President John F. Kennedy's 1963 prediction of a world in the 1970s with 15 to 25 nuclear weapons states presenting "the greatest possible danger" (3).

The United States built the first atomic bomb in 1945, followed by the Soviet Union in 1949, Britain in 1952, France in 1960, and China in 1964. Israel probably developed its covert capability in the late 1960s, and in 1974 India detonated what it called a peaceful nuclear device. Since then the rate of proliferation has slowed, with only two potential cases. Pakistan probably completed a nuclear weapon in the late 1980s, and some observers believe that South Africa developed the capability to build a bomb in the mid-1980s. In 1991, however, South Africa renounced any ambition to become a nuclear weapons state, adhered to the NPT, and agreed to international inspections.

A number of countries have started but given up nuclear weapons programs, in part because of external pressure, but in large part because of the development of a regime of norms and conventions that have reinforced the attitude against the spread of nuclear weapons (4). Libya has been trying to develop nuclear weapons since the

The author is Director of the Center for International Affairs, Harvard University, Cambridge, MA 02138.

1970s, but it has been held back by its inadequate human infrastructure and by international rules and treaties that have inhibited its ability to purchase critical technology or weapons. In some cases, countries that seemed set for a nuclear arms race have desisted. For example, in the 1970s Brazil and Argentina both announced plans to develop facilities for enrichment and reprocessing that could provide the fissile weapons materials of highly enriched uranium and plutonium. Yet a decade later, civilian presidents in Brazil and Argentina renounced plans to develop weapons and signed an agreement providing for mutual inspection of each other's nuclear facilities (5). In short, history shows that buying time to manage destabilizing effects is a feasible policy objective.

Traditional Proliferation Policy

The United States began its efforts to restrain the spread of nuclear weapons in 1946 when it presented the Baruch Plan for international control of nuclear technology. When Cold War rivalry prevented agreement, the United States turned to a policy of strict secrecy, but its monopoly was broken by the Soviets in 1949 and the British 3 years later. In 1953, President Eisenhower changed the policy by announcing an "atoms for peace" program, which pledged U.S. assistance in promoting nuclear technology to other nations in return for their promise not to use that assistance for military purposes. In 1957, the IAEA was created to administer safeguards over peaceful nuclear facilities. These safeguards include automatic monitors, surveillance cameras, and regular visits by international inspectors. The IAEA currently has 200 inspectors, who together make more than 1000 visits each year, but their mission has been defined purely in terms of preventing diversion from declared civilian nuclear facilities.

A nonproliferation treaty was negotiated in the United Nations in the mid-1960s and entered into force in 1970. Under the NPT, the nonnuclear states undertook not to transfer or receive any nuclear weapons and to submit all of their nuclear facilities to IAEA safeguards. The nuclear weapons states promised "the fullest possible exchange" of nuclear technology, provision of the potential benefits of any peaceful application of nuclear explosions, and good-faith negotiations on effective arms control and disarmament measures. Several significant holdout states, including China, France, South Africa, Argentina, Brazil, India, Israel, Pakistan, and Algeria, complained about the treaty's discrimination between nuclear haves and have-nots and refused to sign. In 1991, however, France, China, and South Africa reversed their positions,

and 144 states have adhered to the NPT.

In 1974, India used peaceful nuclear assistance from Canada and the United States to produce plutonium for a nuclear explosion. The "atoms for peace" agreement with India had been loosely written to permit peaceful uses but not excluding "peaceful explosions." The Indian test made suppliers more conscious of the fact that weapons and peaceful technology could not be easily insulated from each other. The result was the establishment of the Nuclear Suppliers Group (NSG), which published strict guidelines for nuclear commerce in 1978. Its 15 members, spanning the Cold War divide, agreed to exercise restraint in exporting enrichment and reprocessing technology, to safeguard all exports, and to consult in the cases that might require sanctions.

At the NPT review conferences held every 5 years, nonweapons states have complained that the nuclear powers have slowed the transfer of technology and have not agreed to a comprehensive test ban as a disarmament measure. Such issues are likely to arise at the 1995 conference, at which a majority of states must vote to extend the treaty. Despite such frictions, the NPT has succeeded in reinforcing the global presumption that proliferation is bad and that proliferators must pay some political costs for flouting an international consensus. Political scientists use the concept of "regime" to refer to the set of rules, norms, and institutions that govern an international issue (6). The basic norm in the nonproliferation regime reverses the a priori assumption that in a world of sovereign states, any measure of self-defense is legitimate. This regime is centered in the NPT, but it also includes institutions such as the IAEA and regional arrangements such as the Latin American Nuclear Weapons Free Zone (the Treaty of Tlatelolco). Regimes can affect both the domestic and international incentives of states. When proliferation is stigmatized as illegitimate, it is more difficult for domestic groups and bureaucracies to initiate a nuclear program. Internationally, treaty obligations make a nuclear program more costly to the state that violates its undertakings and provides a base for others to impose sanctions. Even in cases where a state is not a member of the NPT, sanctions can have some effect. For example, India's nuclear power program was severely set back by sanctions imposed by Canada, the United States, and Japan after the Indian explosion.

The Status of the Nonproliferation Regime

The current situation of the nonproliferation regime is mixed. In 1991, nuclear suppliers met to tighten controls on the

dual-use technologies that may be used for both nuclear weapons and civilian purposes, and Britain and France declared that they, like most major supplier countries, would require that any recipient state must place all of its nuclear facilities under IAEA safeguards, not merely those facilities that involve transferred materials. Also in 1991, after Iraq's defeat in the Gulf War, U.N. Security Council Resolution 687 provided for intrusive inspection and dismantlement of Iraq's facilities.

On the other hand, the U.N. inspections showed that a state that wants to cheat on its NPT obligations can make major progress in a nuclear weapons program. Iraq was long suspected of harboring nuclear weapons ambitions. Indeed, such fears led Israel to bomb the French-supplied research reactor at Tuwaitha in 1981. Most Western intelligence analysts, however, believed that Iraq was some 5 to 10 years away from being able to produce nuclear weapons. The U.N. inspection teams publicized the true scale of the Iraqi nuclear program as well as documents establishing the intention to develop nuclear weapons. Iraq's nuclear program is estimated to have employed 10,000 or more scientists, technicians, and other workers and to have cost some \$10 billion during the 1980s (7). Some members of the U.N. inspection team stated that Iraq may have been as little as a year away from a nuclear weapon, although some American weapons scientists believe that 2 to 3 years is a more accurate estimate. In either case, Iraq was closer to a nuclear weapons capability than the consensus intelligence prediction, and the size of its covert program eluded outside estimates.

Inspectors in Iraq found foreign-made machines and tools to make gas centrifuges as well as two carbon-fiber centrifuges that had been successfully tested. In addition, they found a major electromagnetic isotope separation program similar to the calutrons that were used by the United States in the early stages of its efforts to enrich uranium for the first nuclear weapon. They also discovered large quantities of uranium tetrafluoride, the chemical used in the calutron process, uranium hexafluoride, a gas used to make enriched uranium, and HMX, a high explosive used in detonating nuclear warheads. The inspectors also found nuclear weapon parts, including firing circuits, shaped explosive charges, and foreign-made machine tools used to produce them. The IAEA had visited the foreign-supplied research reactors on a regular basis and certified that their highly enriched fuel was properly accounted for. Yet even at the Tuwaitha Research Center, which was subject to IAEA inspection, Iraq had violated its safeguards agreement by secretly isolat-

ing a (militarily insignificant) 3 grams of plutonium (8).

The scale of Iraq's deception has led observers to wonder if other countries have similar surprises in store. The case that has aroused the greatest concern is North Korea, which signed the NPT in 1985 but refused to permit IAEA inspectors to visit its nuclear facilities. North Korea argued that it would not sign the safeguards agreement as long as the United States stationed nuclear weapons in South Korea. After President Bush's October 1991 announcement of the removal of American nuclear weapons from South Korea, North Korea signed an IAEA safeguards agreement in 1992 but continued to find excuses to delay and restrict inspection. North Korea's nuclear program includes two gas graphite reactors ideally suited for production of plutonium and a large unfinished facility at Yongbyon, which could be a reprocessing plant for extracting plutonium from the spent reactor fuel (9). Some analysts believe that such a plant could provide enough plutonium for a bomb within 1 or 2 years; others believe that a longer time would be required. South Korean President Roh Tae Wu offered to make the Korean peninsula a nuclear-free zone, and the two sides agreed to mutual inspections, but North Korea insisted on restricting the locations. Japan indicated to North Korea that it must allow international inspection and dismantle part of its nuclear plant before Japan would provide foreign aid, and U.S. diplomats encouraged China to press North Korea into opening its facilities to inspection (10). Economic sanctions and military preemptive strikes against North Korean facilities have been discussed, but North Korea has little foreign trade, and South Korean officials worry about military retaliation against Seoul, which is only 35 miles south of the North Korean border (11).

The United States has also pressed China to be more restrictive in its nuclear export policy. China is not a member of the NSG, and it is widely believed that China supplied Pakistan with the design for a nuclear weapon as well as with important technologies. There has also been concern over Chinese exports to Algeria and Iran. In Algeria, China supplied a research reactor, which was not alarming except for the secrecy with which the deal was arranged. China also agreed to sell a single calutron to Iran, as well as a small research reactor.

Although not of major significance themselves, they still aroused concern given the change in Iran's approach to nuclear technology. In the 1970s, the Shah of Iran had a major nuclear energy program that was largely dismantled during the Islamic Revolution in 1978. Iran's nearly completed power reactors were badly damaged in the Iran-Iraq War, but the war also renewed Iran's interest in obtaining nuclear technology. As President Hashemi Rafsanjani declared in 1988, "we should fully equip ourselves both in the offensive and defensive use of chemical, bacteriological, and radiological weapons. From now on, you should make use of the opportunity and perform the tasks" (12). Iran has adhered to the NPT; Algeria has not.

The Postproliferation Problem

Governments are uncomfortable in dealing with the postproliferation problem, so they try to ignore it. Given the dangers of nuclear weapons being used in an unauthorized fashion or falling into the hands of terrorists, it might seem appropriate to provide technical assistance to new weapons states to improve their command and control systems. Yet doing so might appear to reward the proliferator and thus weaken the deterrent effect of the regime on other states. The policy dilemma is analogous to distributing clean needles to drug addicts in an effort to prevent AIDS. The problem is complicated by the fact that in the Middle East and South Asia, the two areas where proliferation has occurred since the signing of the NPT, it has not been openly acknowledged. Israel is suspected of having developed an arsenal of about 100 nuclear weapons, but its declaratory policy is that it will not be the first to introduce nuclear weapons into the Middle East. It has maintained this policy even after nuclear technician Mordecai Vanunu disclosed Israeli nuclear secrets to a British newspaper in 1986 (13). Israeli strategists believe that the diplomatic fiction reduces incentives for Israel's Arab neighbors to follow suit and avoids complications with the United States, which has to a large extent turned a blind eye to Israel's nuclear program.

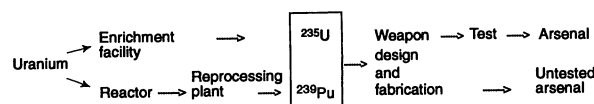
The other region of covert proliferation is South Asia. One of Pakistan's top nuclear scientists, Abdul Qadeer Khan, has said that whether anyone believed it or not, Pakistan has become a nuclear power and is

now concentrating on manufacturing sophisticated arms to fill its requirements (14). In spite of Pakistani government denials that it was developing nuclear weapons, the United States cut off economic aid to Pakistan in 1990 when President Bush was unable to certify to Congress that Pakistan did not possess nuclear weapons. India, on the other hand, exploded a nuclear device in 1974, but there is little public evidence that India has gone on to deploy a nuclear weapons arsenal. India has done enough preliminary work and separated enough plutonium to be able to develop an arsenal within a relatively short period, but it may have chosen not to do so.

One of the dilemmas of postproliferation policy is whether to encourage or discourage the covert nature of the new weapons programs. The diplomatic fiction of being a nonweapons state makes it more difficult for a new nuclear country to deploy nuclear weapons in war-fighting postures. This in turn may make it more likely that the weapons will be kept under tight central control. As another aphorism goes, "better a bomb in the basement than bombs spread all over the front lines." In cases like that of India, a short waiting period before the assembly of weapons may add to stability in a time of crisis as well as greater robustness against loss or theft. On the other hand, because the nuclear programs are secret, countries are not compelled to state a formal nuclear doctrine to make clear what kinds of events, military or otherwise, might provoke nuclear use. Secrecy may retard nuclear learning. General K. Sundarji, India's retired Chief of Army Staff, argues that "lack of doctrine is a very dangerous thing. The Indian High Command must think through that they should not go past a certain threshold, but they cannot be sure what Pakistan thinks the threshold is. One must go with impressions and guesses" (15).

Another policy issue after proliferation is the relation of nuclear testing to advanced weapons design. Proliferation is more like a staircase than a cliff. While the first explosion is a clear signal in terms of the NPT, there are still a number of significant steps before a country has a modern, deliverable arsenal (Fig. 1). By using tritium to boost the yield of fission devices or by developing thermonuclear weapons, countries can reduce the size of their weapons and thereby increase their deliverability. While new proliferators can generally have a fair degree of confidence in their ability to explode a fission device without testing, there is greater uncertainty about the success or yield of a fusion device. Thus, diplomatic fictions or formal test bans that inhibit testing may retard development of advanced nuclear devices and

Fig. 1. Several steps are required before a nuclear weapon can be added to a country's arsenal. Weapons-grade material can be derived from nuclear power reactors or from dedicated enrichment facilities.



slow the march up the nuclear staircase even after the initial threshold of weapons capability has been crossed.

Postproliferation policy also needs to focus on delivery systems. In 1989, former CIA Director William Webster reported that some 15 countries might have the ability to produce ballistic missiles by the end of the century, but that estimate looks high (16). The majority of these countries are highly dependent upon external technology. Only two—Israel and India—have significant programs to develop ballistic missiles with ranges beyond 1000 kilometers. In 1990, the Argentine-Egyptian-Iraqi Condor missile project was terminated, in part because of the 1985 Missile Technology Control Regime (MTCR), in which advanced countries agreed to restrain export of technologies for missiles with ranges beyond 300 kilometers. Although 16 countries now adhere to the guidelines, neither China nor the former Soviet Union is a member of the MTCR. And because of its limited membership, the MTCR could not provide a legal basis for stopping North Korea's shipment of Scud missiles to Iran in 1992.

The spread of ballistic missile technology has raised interest in theater and continental ballistic missile defense. In 1991, Congress agreed to fund 100 missile interceptors at Grand Forks, North Dakota, partly in response to the threat of accidental Soviet launches and partly because of concerns about new proliferators. It will probably be decades before new proliferators have ballistic missiles that could reach the United States. While research on ballistic missile defense makes sense, it should not divert attention from the more likely air delivery of nuclear weapons or the smuggling of nuclear weapons into American cities in commercial aircraft or in the holds of freighters. The most relevant policy responses in this decade are improved intelligence, improved border monitoring, and emergency response procedures. Since none of these measures will be perfect counters, the difficulty of the postproliferation problem suggests the importance of the traditional policy of maintaining the nonproliferation regime in the first place.

The Soviet Disintegration Problems

The third major set of problems for proliferation policy in the 1990s relates to the disintegration of the Soviet Union. Empires have declined throughout history, but never has the world seen the decline and disintegration of an empire possessing some 30,000 nuclear weapons (17). Strategic weapons with intercontinental range were based in four republics: Russia, Ukraine,

Byelorussia, and Kazakhstan, each of which has a large nuclear arsenal on its territory. Soviet tactical nuclear weapons posed even more of a problem, as they have been stationed in many more republics in the past (18). In September 1991, Presidents Bush and Gorbachev announced reciprocal plans for unilateral withdrawal and destruction of most ground-based tactical nuclear weapons as well as nuclear weapons on surface naval ships. In January 1992, Russian officials announced that tactical nuclear weapons had been withdrawn from most republics and would exist only in Russia by July 1992 (19), but Ukrainian and Kazakh statements have raised questions about that timetable.

There are two aspects to the proliferation problem caused by Soviet disintegration. One is the number of new nuclear weapons states that may succeed the Soviet Union. An increase in the number of successor nuclear weapons states raises many of the same questions as does an increase in the number of new nuclear weapons states. Since most experience and components of the command and control system are located in Russia, there is ground for concern over the control capabilities of the other nuclear republics (20). If hostile relations evolve, preemption could be a problem. The adherence of the new states to international arms control and proliferation arrangements, as well as the adequacy of their export controls, is also a concern. While rational deterrence optimists might argue that a system of stable nuclear deterrence among several countries may evolve in Central Eurasia, the risks are considerable in a period of revolutionary social and political instability.

The second problem depends not on the number of nuclear successor states, but on the political and social conditions in the former Soviet Union, especially in Russia. Command and control systems have technical components, but in the large, they are social systems embedded in their larger social context. If Russian society disintegrates, it will be impossible to keep nuclear control systems intact. The drastic condition of the post-Soviet economies creates great incentives for nuclear leakage. Not only is there a danger of black market sale or theft of Soviet weapons or fissile material in a time of disintegration, but even without such dire scenarios, unemployed nuclear personnel are finding opportunities to transfer their skills to the proliferators at great personal profit. There is already a company formed by nuclear experts, Chetek, that is offering to sell nuclear explosions for commercial purposes. Russian experts report that representatives of would-be proliferators are already in Moscow inquiring about the

availability of nuclear technology components, and, by one account, 60 former Soviet scientists have left to work in India, Pakistan, Iraq, Iran, and Brazil (21). In 1992, Western countries discussed financial assistance and the establishment of an institute designed to keep former Soviet scientists from emigrating.

Policy Responses

Each dimension of the proliferation problem requires different policy responses. The Soviet problem is the most urgent. With regard to the number and type of successor states, technical and financial assistance from the United States and the other G-7 countries can help the central military authorities to speed up the removal of nuclear weapons to central and internationally monitored storage sites in Russia. The United States should inform Ukraine, Byelorussia, and Kazakhstan that assistance will depend on their adherence to the NPT as nonweapons states, as well as on their observance of existing arms control agreements. The successor republics should also be encouraged to develop export controls for sensitive technologies and to join the NSG and MTCR. Implementation of the 1991 Strategic Arms Reductions Talks (START) agreements should focus initially on the strategic weapons outside the Russian republic. Arms control talks, technical missions, and nongovernmental contacts can help to educate the successor republics about the problems of nuclear control.

The danger of a collapse of the command and control system should be met with both broad and narrowly focused policies. Broad policies of humanitarian and technical assistance that help stave off economic and social chaos can be seen as nonproliferation policies. Specifically, outside assistance can be provided in building new storage and deactivation sites for nuclear weapons. Late in 1991, Congress appropriated \$400 million that could be used for such purposes. It has also been suggested that such funds be used for projects to provide employment for former Soviet nuclear personnel. An international role in monitoring weapons and fissile materials storage could help to diminish leakage. Intelligence sharing and technical cooperation with authorities charged with the recapture of nuclear materials from unauthorized parties would also be appropriate.

Policies for postproliferation will have to be tailored to the specific circumstances of interests and instruments in each region, while at the same time the effect on the global regime will have to be considered. In some cases, reversal may be possible. Diplomatic pressure and domestic

social change may lead governments to reverse their policies, as in South Africa. At the other extreme, if a new proliferator threatens the peace, it may be subject to reversal by economic and military sanctions, as occurred in Iraq. Most cases will fall between these extremes. In keeping with the objective of slowing rates so as to manage destabilizing effects, postproliferation policy should focus on discouraging the development of large arsenals and delivery systems, obtaining assurances that the new proliferator will not transfer nuclear weapons or technology to third countries, and enlarging indigenous control capabilities to prevent leakage into unauthorized hands.

The bilateral policy instruments to achieve these goals include a mix of sticks and carrots such as sanctions (used in the case of Pakistan), security guarantees (as in Israel), and covert technical assistance (which the United States provided to France). Indirect or secret assistance can help to reduce the negative effects on the overall regime. Multilateral instruments include U.N. sanctions against NPT violators, regional confidence-building and inspection measures to reduce incentives for conflict (often suggested for South Asia), and a cutoff of fissile materials production and monitoring of storage of fissile materials by the IAEA (suggested for the Middle East). A phased-in comprehensive test ban would have some cost in restricting safety improvements and reliability tests of our weapons, but it would have the benefit of inhibiting a proliferator's development of advanced weapons capabilities.

Traditional proliferation policy must build upon past accomplishments with four types of instruments: security guarantees, technical restraints, unilateral measures, and multilateral institutions. The security guarantees extended by the superpowers have been critically important in persuading many countries to forego nuclear weapons. With the end of the Cold War, Soviet guarantees are finished, but U.S. guarantees to South Korea, Japan, and North Atlantic Treaty Organization (NATO) countries remain essential for an effective nonproliferation policy. The new challenge will be to develop institutions such as the Conference on Security and Cooperation in Europe (CSCE) or extend expressions of NATO's concerns to fill the security vacuum left in Eastern Europe by the Soviet collapse. In light of Iraq's imports, technical restraints embodied in the Nuclear Suppliers Guidelines and the MTCR need to be extended to more

dual-use items. Some states, such as Germany, have begun to tighten their export control legislation. Equally important will be seeking adherence of countries such as China and the post-Soviet successor states. Technical and legal consultations can help improve the implementation of control in Eastern Europe and former Soviet states.

Unilateral policies include the whole panoply of diplomatic measures from messages to sanctions. Perhaps the most important unilateral measure is the gathering and analysis of intelligence. A much larger investment in targeting nonproliferation is needed to provide early warning and avoid the intelligence failures evident in the Iraq case. Increased gathering of human intelligence is particularly important. There is an important synergistic interaction between national intelligence efforts and the international inspection system. National intelligence can both verify the effectiveness of international inspection and alert international inspectors to problem areas. The effectiveness of the U.N. special commission in Iraq depended heavily upon such efforts.

Multilateral instruments include the set of institutions and treaties that make up the nonproliferation regime. Because the NPT is necessary (although not sufficient) for an effective policy, it is essential to extend the treaty in 1995. Formal amendments to the NPT would open a diplomatic Pandora's box, but the regime can be strengthened by two practical measures: challenge inspections and sanctions. The IAEA Board of Governors has agreed to extend special inspections whereby its inspectors could visit suspect rather than only pre-agreed sites. While this is a useful step, it is not enough, because the IAEA bureaucracy has tended to define its role in terms of civilian nuclear power. When permission is refused to the IAEA or when NPT violations are alleged, the U.N. Secretary General should send a special group of inspectors that would report directly to the Security Council. In the Iraq case, the U.N. commission was able to communicate instantly with the Security Council when it encountered Iraqi resistance. The Security Council should impose mandatory sanctions under Chapter 7 of the U.N. Charter if the resisting or violating NPT party refuses to allow access or to take remedial measures. In addition, the Council should publicize the names of companies that violate export controls and should recommend nationally imposed fines against them.

Conclusion

Nuclear proliferation is not one but a complex of problems. With the end of the Cold War, the decline and collapse of the Soviet Union have added a new set of issues. Iraq's violation of its NPT obligations has exposed certain weaknesses in the traditional regime of multilateral instruments. Pakistan's achievement of a nuclear weapons capability in the late 1980s brings the postproliferation question to the forefront in South Asia. There is no single solution to this complex set of problems, but the beginning of wisdom is to build upon the existing regime, add new instruments such as challenge inspections and sanctions, and, above all, increase the priority given to the issue. Otherwise we may be faced with the ironic outcome that the widely welcomed end of the Cold War may increase the prospect of nuclear use.

REFERENCES AND NOTES

1. K. Waltz, *The Spread of Nuclear Weapons: More May Be Better* (International Institute of Strategic Studies, London, 1981).
2. J. S. Nye, *Int. Organ.* **41**, 371 (summer 1987).
3. Quoted in G. Seaborg, *Kennedy, Khrushchev and the Test Ban* (Univ. of California Press, Berkeley, 1981), p. 199.
4. M. Reiss, *Without the Bomb: The Politics of Nuclear Non-Proliferation* (Columbia Univ. Press, New York, 1988).
5. Programme for Promoting Nuclear Non-Proliferation, *Newsbrief* **15**, 2 (autumn 1991).
6. S. Krasner, Ed., *International Regimes* (Cornell Univ. Press, Ithaca, NY, 1983).
7. P. Lewis, "Iraq is said to have hidden nuclear records," *New York Times*, 14 October 1991, p. A6.
8. M. Wines, "U.S. is building up a picture of vast Iraqi atom program," *ibid.*, 27 September 1991, p. A8.
9. J. Bermudez, Jr., *Jane's Intell. Rev.* (September 1991), p. 404.
10. *Economist* **322**, 39 (16 November 1991).
11. D. Sanger, "How to press North Korea," *New York Times*, 18 March 1992, p. A4.
12. E. Sciolino, "Report says Iran seeks atomic arms," *ibid.*, 31 October 1991, p. A7.
13. L. Spector, in *New Threats*, Aspen Strategy Group, Eds. (University Press of America, Lanham, MD, 1990), p. 49.
14. G. Graham, "U.S. wary on nuclear claim by Pakistan," *Financial Times*, 23 October 1991, p. D4.
15. S. Coll, "In India and Pakistan, the nuclear trigger still gleams," *Washington Post*, national weekly edition, 7 to 13 October 1991, p. 17.
16. A. Karp, *Survival* **33**, 517 (1991).
17. W. Gates, Director of Central Intelligence, testimony before House Armed Services Committee Defense Policy Panel, Washington, DC, 10 December 1991; see also B. Frankel, Ed., *Opaque Nuclear Proliferation* (Frank Cass, London, 1991).
18. E. Warner III, testimony before House Armed Services Committee Defense Policy Panel, Washington, DC, 31 July 1991.
19. P. Hiltz, "Tally of Ex-Soviets' A-Arms Stirs Worry," *New York Times*, 16 March 1992, p. A3.
20. K. Campbell, A. Carter, S. Miller, C. Zraket, *Soviet Nuclear Fission* (Harvard Univ. Center for Science and International Affairs, Cambridge, MA, 1991).
21. A. de Borchgrave, "Gorbachev seeks vote to save Union," *Washington Times*, 11 December 1991, p. 1.