IMPLICATIONS OF NUCLEAR PROLIFERATION

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IMPLICATIONS OF NUCLEAR PROLIFERATION

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PART I

Background

It has been said that the only atomic secret was revealed at Hiroshima, namely that the damned thing would work. That having been established, it was clear to many that there were enough sophisticated minds distributed around the world to render the question of expansion of the nuclear club a matter of "when" rather than "if." This assessment proved to be correct. Despite extraordinary measures taken by the United States to control the dissemination of weapons technology, e.g. the Baruch Plan, the Rosenburg executions, Britain, the Soviet Union, France, and China successively joined the ranks of the nuclear powers.

These developments were viewed with concern but not despair. After all, the group was confined to the five big victors of World War II. Perhaps it was inevitable that such major players in the international game would seek and acquire the image and leverage associated with a nuclear capability. Five was perhaps a manageable number, especially since Britain and France were closely associated with the United States. Furthermore, the governments of great powers, while not always congenial, have a great deal to lose and can probably be relied upon to assess risks in making policy calculations and, perhaps, to exercise a fundamental sense of responsibility in international dealings.

Such a rationale does not extend very far. First, there is the problem of simple probability. In this view, the more nations that there are with nuclear weapons, the greater the odds that one or more will eventually become engaged in serious conflict. Hence the risk of first use in an unidentified scenario increases geometrically with the number of such scenarios. This notion has been presented rather colorfully by comparing the relationships of two nuclear weapon states to international chess, those of four to bridge, five to poker, and a larger number to Russian roulette. An associated fear is that the use of a few nuclear weapons will very probably, perhaps inevitably, lead to the use of many, involving nations other than the original antagonists and likely leading to global destruction.

Then there is the very troublesome problem of the character of leadership in some of the countries presently outside the nuclear circle. The multiplicity of interests and ideologies, the fragility of controls, and the mercurial attitudes of some personalities would in many cases cause, if coupled with a national nuclear capability, grave concern. It is bad enough to contemplate a Brezhnev or a Mao with a finger on a nuclear button of sorts, but how about a Castro or a Quadafi? Could such be relied upon to do the rational thing in an emotionally charged situation? The United States view has been "obviously not," and the national policy effort has been to obviate such dangers by seeing to it that the proliferation of nuclear weapons stopped at the five level.

The high water mark of this effort came about in 1968 with the drafting of the Non-Proliferation Treaty. The document contains the customary obscurities but the salient features can be summarized as follows: Signatories, other than the present nuclear powers, agree to abstain from developing nuclear

weapons or even explosive devices for peaceful purposes. All indigenous nuclear facilities are subject to inspection by the International Atomic Energy Agency to insure compliance. For their part, the nuclear signatories (the U.S., U.S.S.R., and Great Britain) agree to diligently pursue a comprehensive nuclear disarmament agreement. Additionally they commit themselves to assist all other parties in the development of a peaceful nuclear capability and to provide full access to peaceful nuclear technology.

From the beginning it has been clear that the N.P.T. does not resolve the problem of proliferation. It has two very major deficiencies. First, although 92 nations have ratified it about 40 have not. Among the non-signatories are two nuclear weapons states, France and China, as well as a number of the most likely candidates for admission to the nuclear club including India, Brazil, Japan, South Africa, Egypt, Israel, Pakistan, Argentina, and Spain. Second, the "contract" is largely illusory since any party to the treaty has the right to unilaterally withdraw upon the expiration of a 90 days notification period. Such a voidable arrangement amounts to little more than a statement of present intent. While there was realization that the treaty might not provide sufficient incentives and moral suasion to indefinitely convince nations not to take the nuclear route, it was hoped that it might prove operative in the near and mid-term, a perhaps acceptable situation.

There were, after all, reasons to feel that nuclear proliferation, while an extremely crucial issue in the long run, need not be considered an immediate problem. Out of the mystique of the Manhatten Project had emerged the impression that the technology required to build a bomb was so complex and the necessary dedication of resources so enormous that few nations could hope to go nuclear any time soon, even if they wanted to. At one time as much as ten percent of the entire electric power generated in the United States had been consumed by its nuclear program. Surely, under forseeable economic conditions, few societies even in the industrialized world could contemplate taking on an ambitious program of atomic weapons development.

Not all signs encouraged this point of view. Since the post war era a fair number of nations had experienced dramatic growth becoming both economically and technologically rich by any objective definition. Several European states and Japan fit this description, with Brazil and others not far behind. Moreover, it began to appear that both the technology and resource demands of nuclear weaponry might be less than had been previously supposed. A college student, for example, published a very workable design for a bomb based on open shelf library research. Discussions began to center on bombs fueled with reactor waste rather than the very costly U-235. A widely circulated study by the RAND Corporation opined that the total investment from the decision point to a test explosion could be as low as $300 million.

The practical question of whether or not second or third tier powers could marshal the resources necessary to achieve a nuclear explosion was resolved in May, 1974, in the Rajasthan desert of India when that government detonated its first test explosion. Reactions were severe, India was excoriated for wasting its limited technological resources on such activities while its population is underfed. India's protestations that the explosion was only intended to support research into peaceful applications of atomic energy were received with cynicism, a cynicism no doubt exacerbated by the high moral purpose that had so often characterized India's criticism of the nuclear policies of others. The sound and fury notwithstanding, however, one

thing is clear. The genie is out of the bottle. If the infrastructure of India can produce a bomb, the nuclear club is open for membership. Neither national wealth, pious national pronoucements, nor the N.P.T. can be relied upon, per se, to prevent proliferation.

Plainly, the game has changed. What was a matter of speculation is now a matter of evaluation. Interested Parties, and that includes just about everyone, must reexamine their positions and policies. Have they been completely overtaken by this event? What can be salvaged? What new initiatives are called for? The United States as the major western nuclear power must be in the vanguard of this review process.

It would be too ambitious in any essay of this scope to attempt to deal with all of the issues. Nor is the purpose to assemble an exhaustive compendium of the extensive literature on the subject. The intent, rather, is to review several of the more significant questions posed by the recent course of events related to proliferation with a view toward identifying policy implications for the United States. A framework for analysis of possible Nth countries with respect to the spread of nuclear weapons might include the following questions:

- Can they build the bomb?
- If they can what should we do about it?

PART II

Can they Build the Bomb?

It is this area of capabilities that the bulk of available literature addresses. The problem of developing a nuclear weapons system sorts out into three basic sub-problems; acquiring the appropriate quantity and quality of fissionable material, designing and building a mechanism that will detonate the material, and marrying up the package with a vehicle that will deliver the weapon to or near the desired ground zero. The solution to each of these sub-problems can involve a wide range of technical sophistication, but any state that can manage even a primitive fix on all three can join at least the kiloton wing of the nuclear club.

Delivery Systems

The least problematical component of the equation is the delivery system, so long as the ultimate plan is not too ambitious. Some options employed by the high technology states, such as the free rocket or guided missile, would be beyond the capabilities of most, though not all, non-nuclear countries. Conventional or ships' artillery, though simple in itself, requires extremely high quality packaging of the round to meet the dimensional restrictions of the tube and the shock associated with firing. There are, however, any number of less demanding alternatives. A Canberra bomber or an F-4 jet is available to most governments. A palletized parachute delivered weapon could be launched from a cargo plane. A bomb could be introduced into a harbor or river port concealed in the hold of an expendable ship or it could, in many scenarios, be simply hauled around in the bed of a tactical vehicle or truck. In short, the delivery system represents no barrier to the development of at least a local or regional nuclear force by any nation.

Building the Bomb

Putting the bomb itself together would not be quite so easy. Still, the preponderant view seems to be that it is an engineering rather than a scientific problem. That is to say that there are no longer any atomic "secrets" as such. True, assembling a thermo-nuclear device complete with fission bomb trigger is probably more than most national programs could handle, but for the more modest the theory of the implosion or gun method of achieving a critical mass is well understood. As early as 1964 it was stated: "Basic problems connected with developing a nuclear device have been simplified in recent years . . . Nuclear researchers have eliminated much of the expensive and time consuming work . . . Aspiring nuclear scientists from all over the world can now find most of the information they need to build a bomb in their own public library. This fact together with the great reduction in costs of equipment and raw materials has taken away most of the difficulty of A-bomb constructions." A more recent analysis states: "Reliable, moderately efficient fission weapons that need not be very large or heavy could be produced on the basis of the open literature with little additional research and development and through relatively simple fabrication techniques."

The cost estimates associated with such an undertaking do not appear prohibitive although, of course, they vary from country to country. For nations with an ongoing nuclear program the guesses seem to average out in the $25-50 million range for the first few prototypes. For those starting from further back technologically, the investment might be close to $100 million. Even if these figures are several orders of magnitude off the mark such investment levels are well within the capabilities of a host of national economies.

The construction of a fission bomb, then, would seem to primarily involve a decision on the part of any number of states. Priorities would have to be adjusted to shift the human and fiscal resources to the task. For states which command a small pool of high quality engineering skill and limited capital the belt tightening in other areas might involve substantial sacrifices, but so long as only current state of the art, albeit tricky, technology is involved there is little reason to doubt that a long list of states could fabricate a bomb if they decided to do so. The product might only be a soft tooled low yield device incompatible with a high thrust delivery system, but this would be enough to disturb regional if not strategic or global power relationships.

Nuclear Fuel

In most discussions of the capabilities of Nth countries to go nuclear the subject of access to weapons grade nuclear fuel receives the most attention. Other indigenous abilities notwithstanding, if a given nation could be denied the quality fissionable material to sustain an explosion the answer to the question of whether or not it can build a bomb would be no. Further, theories abound that hold that since comparatively few nations possess the capability of producing weapons grade fuel without substantial help from the heavily industrialized states, this dimension of the problem offers the most fruitful opportunity for effective international controls.

Uranium

Several isotopes are suitable for charging a fission bomb: uranium 235 (U-235), plutonium 239 (Pu-239) or uranium 233 (U-233). Since the production of U-233 from thorium requires U-235 or Pu-239 to be employed as additives it does not present a threshold question. U-235 is the most efficient fuel but also the most difficult to process. Natural uranium contains less than 1% of the U-235 isotope. If this concentration is increased to 2-20% the enriched material is suitable to fuel certain reactors. 80-90% pure U-235 is necessary for weapons use. This purification is accomplished by feeding the ore through as many as 4,000 stages of a gaseous diffusion plant, each barrier of which increases the concentration only slightly. The construction and operation of such plants is an enormous and costly undertaking and it was the operation of the three U.S. gaseous diffusion plants built at a cost of over $2 billion that at one time consumed over 10% of all electrical power being generated in

the entire country. The French plant at Pierrelatte cost over $1 billion. The combination of cost and energy consumption, as well as the fact that the technology involved in fabricating the separation barriers is very complex, probably means that, at present, the method is beyond the capabilities of nearly all non-nuclear countries except for Japan or West Germany.

The advantage of the gaseous diffusion method is that it produces large quantities of enriched uranium. If a country were, however, not interested in producing enriched fuel for power generating plants, but rather small quantities of high concentration U-235 for weapons there may be other possibilities. Electromagnetic isotope separation has been used in the United States and the Soviet Union. China apparently employs the method in conjunction with gaseous diffusion stages. Electromagnetic separation, however, also involves huge requirements of electric power to produce rather small quantities of fuel. The capital investment, while lower than for a gaseous diffusion plant, is still very substantial and the unit price for a given quantity of enriched fuel is high.

It may not be long before a truly economical method of enriching uranium is available. This technique, gas centrifugation, involves spinning uranium gas in a high speed rotor where gravity will force the heavier molecules to the outside. A lot more complicated than a cream separator, the principle is the same. The process is theoretically well understood and a number of countries are working on the engineering including Japan as well as Britain, Holland, and West Germany which in 1970 entered into a Tripartite Agreement for the joint development of the process. It has been estimated that if the centrifuge process works out enriched uranium can be produced at 10-15% of the capital investment and power consumption associated with gaseous diffusion. The result will be not only the breaking of United States dominance of the enriched uranium market but also a drastic lowering of the wealth barrier to uranium based weapons programs.

It should also be noted that there a couple of additional question marks attached to the concept that only the most wealthy nations can produce weapons grade U-235. For several years the Republic of South Africa has claimed that it has achieved an innovative break through in isotope separation and that by 1980 its production of enriched uranium will amount to 6,000 tons. How far along the process is, or even what it is, is heavily protected by South African security laws but it is a disquieting note. Additionally, following recent discussions of alleged Israeli production of 20 or so nuclear bombs during the October War, have appeared newspaper items claiming that Israeli scientists have perfected a laser method of separating uranium isotopes. Not enough information is available to form a basis for judgement but if the stories are true the estimates of which nations may be likely Nth country candidates are complicated further.

Plutonium

Recognizing the uncertainties introduced by the potential gas centrifuge method or other rumored break throughs, it is presently accepted that only a few of the most industrialized countries could reasonably aspire to produce uranium charged weapons. Unfortunately, this is not the only option. Plutonium 239, while not as efficient as U-235, is an adequate fuel for weapons applications. And Pu-239 is not nearly as difficult to isolate as is U-235. Moreover

it is an end product of nuclear reactor processes, although the type of reactor will have some influence on the product. In this connection the two most important types of reactors are the heavy water moderated variety which uses natural uranium as a fuel and the light water moderated reactor which is charged with enriched uranium.

In the case of the heavy water reactor the useful portion of the natural uranium fuel, the U-235, amounts to only about 0.7% of the whole. The balance is mostly U-238 which captures slow neutrons. As the reactor functions some neutrons released by the fissioning U-235 will strike other U-235 atoms thus sustaining the reaction. Others will, however, be captured by U-238 atoms which, after a couple of intermediate steps, are transformed into Pu-239. As the ratio of plutonium to U-235 increases, there are more and more "unsuitable" targets compared to the number of U-235 atoms in the fuel element and at the point that about 25% of the original U-235 has fissioned the process becomes so inefficient that refueling is necessary. The refueling of natural uranium reactors can be done continually without shutting the plant down for extended periods. This has two advantages. It makes the inspection and monitoring of waste disposal a continuous requirement, greatly enhancing the possibilities for cheating under the NPT. It also results in shorter periods of irradiation of given fuel elements which reduces the problem of Pu-240 build-up which will be discussed below. For each gram of U-235 consumed in a natural uranium reactor about .85 grams of plutonium are created.

The remaining problem is to then remove the plutonium from the reactor waste. This, unlike uranium enrichment which is an isotopic process, can be accomplished chemically by a number of techniques which are widely understood. India's first reprocessing plant at Trombay cost about $7.5 million and her second much larger one about $20 million. The complexity of the process, at least on a small scale, has been compared to the refining of heroin from opium. After chemical separation, the plutonium is available for weapons production and the balance can be reused as reactor fuel with a resultant 25% overall savings in uranium consumption.

In the enriched uranium plant the cycle is similar but less attractive from the standpoint of plutonium production. With a 2.5% concentration of U-235 in the input fuel the multiplication factor is such that only about .6 grams of Pu-239 are created per gram of U-235 consumed. Since the ratio of "suitable" targets to U-238 atoms is higher the process is more efficient and a higher percentage of the U-235 is consumed than with the natural uranium fuel, resulting in more cost effective power production. Additionally, due to the greater quantity of U-235 per unit of fuel the irradiation process is much longer. This produces a key side effect.

In any reactor as Pu-239 is produced additional less stable isotopes such as Pu-240 and Pu-242 are also formed. The longer the period of irradiation, which is to say the greater the initial concentration of U-235, the higher the final ratio of Pu-240 to Pu-239 will be. Pu-240 or Pu-242 are considered to be contaminants to weapons grade plutonium due to their tendancy to fission spontaneously. The neutrons they emit can cause a chain reaction to start prematurely, i.e., preinitiate. As a result, the efficiency or yield of a weapon so fueled can be unpredictable and the speed of compression during implosion must be increased considerably, thereby complicating bomb manufacture.

There is a school of thought that any concentration of Pu-240 or Pu-242 in a fuel of over 1-2% renders the fuel unsuitable for weapons manufacture. Since the enriched uranium reactor produces such a waste, and since isotopes of plutonium cannot be separated chemically, this is equivalent to saying that only the plutonium produced by a natural uranium reactor is of weapons quality. This view is subject to question. It is conceded that a great power interested in only very high quality and control standards in weapons would avoid such fuel. This would not necessarily follow for a nuclear aspirant. If high Pu-240 content, say up to 8-10%, plutonium were the only available material, a country might accept the unreliability and fabrication complexities associated with such fuels in preference to having no weapons at all. While there is no evidence that this has ever been done, it should not be ruled out as a possibility.

Recapitulation

Virtually any nation can come up with a delivery system for a nuclear weapon. The construction of the device is considerably more difficult but, with the possible exception of an implosion mechanism suitable for high Pu-240 plutonium fuels, a long list of countries could manage a low yield solution if they were to decide to give priority to the task and if they will accept fairly low standards. It may be sometime before technology will permit refinement of weapons grade U-235 fuels for all but the very rich industrial nations. In the interim, however, enough plutonium can be processed by chemical methods from reactor waste to permit any country with even a very modest reactor program to charge a few bombs a year. The short answer to the question "Can they build the bomb?" would appear, except for very undeveloped fourth world countries, to be yes.

PART III

If They Can What Should We Do About It?

Treaties

The finding that many if not most third world countries have, or soon will have, the capability of developing nuclear weapons systems does not imply that any particular state will necessarily decide to do so. Each would have to satisfy its own benefit to cost calculus, and for many the utility of a nuclear arsenal may not appear to be worth the economic or moral investment. The perception of utility is, of course, conditioned by exogenous factors. High on the list is whether or not the state is under the protection of a treaty with a nuclear state and, if so, how confident it is that the protector will come through in a serious confrontation. In addition to other factors, France's decision to go nuclear was probably related to de Gaulle's stated doubts that the United States would sacrifice New York to avenge Paris. Japan, on the other hand, seems to place more faith in the U.S. assurances, although its anti-nuclear inhibitions also flow from World War II history coupled with Japan's particular vulnerability.

With reference to the United States' interest in limiting the spread of nuclear weapons this suggests two things. First, the disenchantment with treaty obligations that has emerged as a post Viet Nam side effect may have come at a very bad time. In reviewing the value of a given treaty the liklihood that the other party may, if left to its own devices, make the nuclear decision should be seriously weighed. The second point is that a mutual defense treaty is only useful in this context if the non-nuclear party credits the guarantor with the will and courage to implement it if necessary. United States' credibility is in this area unfortunately low these days. The late period in Indochina, the War Powers Resolution, the recent Angola affair, are only samples of indicators that neither the U.S. Congress nor public is inclined toward risk assumption. Although the issue of U.S. loss of will has been widely debated, few on either side of the question seem to have made the connection between foreign perceptions of U.S. reliability and nuclear proliferation. If proliferation is indeed a matter of grave concern, a concommitant concern should be devoted to measures to shore up such perceptions.

Military Sanctions

The motivation for many Nth countries to acquire a nuclear capability would no doubt be reactive. If the survival of the nation state appeared to be in question, the motivation could obviously be very high. If threats to survival were to be eliminated, the motivation would diminish. There are no theoretical reasons why outside forces could not underwrite the survival of such states, at least from outside threats. This, in effect, would mean putting into operation the terms of the United Nations Charter. While it would be naive to expect the UN to play such a role under today's conditions, the concept might have application on a smaller scale, i.e., in conflicts in which one of the

superpowers could play the broker. The United States could, for example, either unilaterally or through the O.A.S., guarantee the territorial integrity of Western Hemisphere countries against attack from their neighbors. If Brazil were to invade Columbia, US military forces would intervene on Columbia's behalf and vice versa. The mission would be merely to restore the borders, without reference to political solutions. The problems with such a policy (such as who is the attacker and who is the defender? is the attack pre-emptive? etc.) are patent and the willingness of the United States to play such a role is admittedly miniscule, but if in the future the threat of proliferation becomes a dramatic issue, it has possibilities. In those areas, if any, that the Soviet Union and the United States could cooperate in the application of such a policy the odds on success might be very high.

Just because it has never proved possible to preserve the peace through such "world policeman" operations does not necessarily mean that the theory should be abandoned. The exercise of unbridled sovereignty in war making decisions may be just too dangerous a tradition for the nuclear era. The possible development of a more disciplined system of world, or perhaps only regional, order should not be dismissed out of hand.

A companion possibility to the above would be the adoption of an international rule that, independent of the merits of a dispute, any regime that engaged in first use nuclear tactics would be severely punished. The punishment could vary from an armed intervention to a retaliatory nuclear strike. The mode of punishment would not be crucial. Its certainty would be. In effect, the initiation of nuclear conflict would be regarded as a crime, the penalty for which would be the termination of the offending regime in one way or another. Governments faced with such a sanction might well hesitate to take such a risk. They might, indeed, question the logic of acquiring nuclear weapons in the first place.

Discouraging a few threshold states from making the nuclear decision could have a leveraged ripple effect. For example, a nuclear armed Egypt could cause Israel to arm accordingly (assuming it has not already). This could cause Saudi Arabia to follow which could influence Iran and then Iraq and so on. Similar chains can be constructed in other areas. A hard nosed policy that convinced one nation to abandon its program may return multiple benefits. It would not be necessary, therefore, to postpone the imposition of military sanctions until there were universal agreement that they were appropriate. Soviet concurrence would enormously enhance their effect, but even unilateral measures by the United States could be very significant. In this connection, an interesting proposal that has been advanced would set aside a portion of the United States nuclear arsenal. These weapons and crews would be earmarked for employment in appropriate numbers by <u>any</u> non-nuclear state in the event it were subjected to a nuclear strike by any other state. It would amount to a proxy nuclear force, the availability of which would be intended to obviate the necessity for Nth countries developing their own. While one can envision some bizarre scenarios, e.g., U.S. weapons being employed by Syria against Israel, the functional value of such an arrangement might be considerable.

Counterforce

The military sanctions discussed so far have been reactive in their application although, if taken seriously, they might serve to discourage development of Nth country weapons systems in the first place. Some mention should be made of counterforce methodologies. A counterforce attack, in the nuclear strategy jargon, is one directed against opposing military targets as opposed to one against civilian population or industry to which the term "countervalue" is applied. In the context of this discussion, it would involve the development by the United States of the capability of eliminating the Nth country nuclear force by pre-emptive strike. The strike could be conducted by nuclear or conventional force. In theory, if a country were faced with a high probability that any nuclear weapons it developed would be destroyed or seized it might decide not to bother. Collateral damage that could accompany such an attach would serve as an additional disincentive.

There are a number of problems with this concept in addition to the extreme unlikelihood that the United States would ever be morally or politically inclined to adopt it. In order for a target to be taken out, its existence must be known and its location fixed. Neither of these data bits would necessarily be available. If a nation had enough confidence in its technology that it were willing to develop nuclear weapons without test firing them, it might well be able to conceal their existence. A peaceful looking nuclear power program can serve as both a source of fuel and an excellent cover. The continual fueling characteristics of the natural uranium reactor could probably be exploited to defeat accounting systems oriented on fuel disposal. While we have not quite arrived at the bomb made in the basement phase as yet, the stages of fabrication other than the fuel preparation would not require highly visible or identifiable complexes. Rumors might surface, as they did for so long about Israeli weapons, but not even the most zealous would suggest that such rumors would justify a military operation.

If the existence of the bombs had been ascertained they would still have to be located. And that means virtually all of them. The dangers of a partially successful pre-emptive strike against a nuclear armed state need not be belabored. The possibilities for hiding objects of the size of a nuclear device are only limited by the imagination of the players. No matter how proficient the intelligence activities that would precede a counterforce raid, total coverage could not be expected. One need only cite the example of the Son Tay operation, probably one of the best planned and executed affairs of its type in history against a vacant prisoner of war camp in North Viet Nam, to make the point. Indeed, there is speculation in the press that the Soviets in the late 1960's weighed very seriously a surgical strike against the developing Chinese nuclear program. The negative decision was, supposedly, not made on moral grounds but rather in recognition of the virtual certainty that some Chinese weapons systems would survive. John Kennedy seems to have reached similar conclusions when he considered air strikes against Soviet missiles in Cuba. Such risks will always exist, even assuming that the offensive delivery systems were 100% efficient and accurate--which, of course, they are not.

A Common Characteristic

The military sanctions discussed above, and others that have circulated from time to time, have one outstanding characteristic in common from the perspective of United States policy formulation, simply that they are not feasible. That is not to say that if applied in a given scenario they would necessarily fail. If that were so there would be no justification for discussing them at all. The point is that the Americans like their wars to be defensive or eschatological, preferably both. The application of military force in pursuit of such a specialized objective as limiting the spread of nuclear weapons would be extremely foreign to the value system, a system that as a result of the Korean and Viet Nam misadventures has never been more strongly held. Further, to be successful in inhibiting nuclear proliferation the sanctions would have to be applied in a very pragmatic way. Today's friend could be tomorrow's enemy simply as a result of that country's nuclear policy. The United States citizenry is not that elastic in either its moral or emotional outlook. It is hard to imagine, for example, the public supporting, or even permitting, the use of US military assets to disarm or to punish Israel for violating (or) a no first use doctrine. Some rationale would be worked out that would excuse the violation as a special case.

A significant outcome of the Indo-China experience is a marked loss of public confidence in leaders' ability to predict or control events. The term "escalation" is in everyone's vocabulary and it is recognixed as a two sided game. Even were the people motivated to support an armed intervention somewhere, the questions of where it could lead and what the Russians might do would act as very effective brakes to enthusiasm, brakes which quite likely could not be released by an administration's protestations of confidence. In short, there is a high probability that, having issued ultimatums on nuclear proliferation, the United States Government would find itself unable to enforce them. Since the rest of the world is well aware of the limitations under which US leadership currently operates, the ultimatums would probably not have that much deterrent effect in the first place. There are lines which a new nuclear power had better not cross such as use against United States personnel, close allies, large population centers anywhere, or perhaps even employment in the Western Hemisphere, but, as a general proposition, the mere development of weapons, and perhaps their limited use, can probably be undertaken without fear of direct United States military intervention. Until such time as the question of nuclear proliferation is regarded by the American people as a survival issue or as evil incarnate, and there is no measurable trend in either direction, United States leadership should not rely on the military approach.

Economic Countermeasures

In a world where the desire to prevent nuclear proliferation were the overriding issue, economic countermeasures would be a very viable alternative. If it became known that a nation were producing weapons, the family of nations could simply suspend all aid, trade, and economic intercourse. Since hardly

many countries are economically self-sufficient, the offending government would be quickly brought to heel.

For a number of reasons, of course, it does not work quite that way. Interdependence cuts both ways. How could Japan boycott Iran which supplies most of her petroleum? The international system is a spider web of such economic relationships. And there is also the political aspect. Were the United States to terminate economic relationships, the Soviets in many instances would be more than tempted to pick up the slack--or the French, or somebody else. The difficulty of mobilizing joint international economic action was highlighted during the 1973 oil crisis when the United States was not able to interest even its closest allies in a common front which might have jeopardized some special interests. How much more difficult is it to envision a concerted approach by the much wider and more disparate international community? As a practical matter, the United States in assessing the utility of economic countermeasures to nuclear proliferation should primarily rely on those it could unilaterally impose.

Even at this level the prospects do not inspire optimism. As implied in the discussion of military sanctions, nuclear proliferation is not the single issue of concern to the United States. Other interests compete for places in the priority structure. Economic sanctions which would do damage to competing interests might not survive the competition. Leaders did not fail to note, for example, the severe reaction of the midwest grain farmers to President Ford's 90-day Soviet wheat embargo. No president would casually do that again.

Apart from competing interests, the viability of economic sanctions is greatly dependent on the target. They would only work with those countries where the United States has economic leverage and against which the United States is able and willing to use leverage. This list may, for a variety of reasons, be surprisingly short. Some economies, that of South Africa for example, are less dependent on international trade than most and demonstrably less vulnerable to economic warfare. Others provide the United States with resources that may be too critical to give up, even for an important cause. Rhodesian chrome and Saudi Arabian or Venezuelan oil come to mind. Another larger group does substantial business with the United States but could, if necessary, shift that business to Europe or elsewhere. Most Latin American countries probably fit in this category. Still others already do most of their business elsewhere. A number of countries, e.g., NATO members, Israel, the Philippines, possibly Spain, are so closely associated with the United States through alliances, valuable basing agreements, or historical ties that the political costs of economic sanctions may well be deemed unacceptable. Finally, there are instances where the needs of the population are so critical in human terms that, policies of the government notwithstanding, economic duress might be regarded as inappropriate. It is difficult to imagine that the United States would suspend food shipments to India, especially during a bad year for indigenous crops, for any reason short of open hostilities.

The above discussion is not presented as anything approaching an economic analysis. The economic relationships between the United States and potential Nth nuclear powers are complex and diverse. It is clear, however, that the old Marshall Plan days when the United States had almost absolute power to orchestrate the policy formulation of a large number of the nations of the world are over. Other powerful economic poles have developed presenting the highly nationalistic third world states with choices. Dependency upon the United

States has largely evolved into a state of interdependency with the United States. The economic pressures have mostly disappeared or have become mutual. A Senate sub-committee recently conducted a thorough study on the precise question of employing economic influence to limit the proliferation of nuclear weapons. It concluded that the leverage available was insufficient to support such a policy. In an interview with this writer, one staff member expressed the opinion that the Republic of Korea might be the only likely nuclear candidate that would be susceptible to such measures.

Technology Controls

The Indian test in 1974 triggered more than an explosion. The impact on United States' attitudes was profound. Something had to be done--and fast! A good deal of what seemed immediately possible fell in the area of limiting foreign access to US technology and hardware. After 20 years of leadership in the distribution of technology under the Atoms for Peace Program, the United States decided that things were getting out of control and that retrenchment was necessary. A number of adjustments have been made. Export licenses for reactor equipment are being subjected to very close scrutiny and approval is not automatic. Many proposed transactions have been stymied including a $4 billion sale to Brazil, a $7 billion sale to Iran, and others to South Korea, Libya, and Taiwan. Similar review has been extended to shipments of enriched uranium, a fuel on which the United States enjoys a near monopoly and which is essential for the continued operation of light water reactors, most of which were purchased from the United States. The US capacity to produce enriched uranium has been taxed for over two years and a backlog of orders has built up. Plans to expand this capacity have, however, been blocked in Congress due, in the opinion of some observers, to its concern with nuclear proliferation. The export of technology for uranium enrichment is proscribed, even at the unclassified level. Finally, the United States Government is hedging on promoting industrial nuclear waste recycling. The old Atomic Energy Commission was on record as favoring private development of recycling plants both in the interest of fuel economy and because they reduce the waste disposal problem. The new Nuclear Regulation Commission has rescinded the AEC recommendation and has tabled the proposition "pending futher study" for at least a year.

No one, then, can criticize the United States for not reacting to the problem posed by India's nuclear move. The real question is whether or not the US response will accomplish anything or, perhaps, make matters worse. There are three important and adverse consequences that will flow from the attempt to slow down the dissemination of American nuclear technology. The first is that it could lead to a serious loss of business. Nuclear energy is becoming a big money affair in the wake of the world-wide petroleum crisis. From 1956-1973 a total of 58 major reactors were sold in world trade. In 1974 and 1975 alone the total was 24 with some orders turned away because of a lack of construction capacity in Canada and elsewhere. The United States' share of the market during these two time periods declined from around 80% to just over 50%, and experts predict that this decline will continue. Indeed, Dixie Lee Ray, former chairman of the AEC and Assistant Secretary of State, has stated that "ACDA and State are taking the US out of the world nuclear market." The implications of this for trade and payment balances are substantial, considering that that market will, according to some estimates, cumulatively total $120 billion in the next 15 years.

The second disadvantage of the current United States policy is that it is in conflict with the promise made in the NPT to provide all other parties full access to peaceful nuclear technology. The United States is committed by treaty, hence by law, to help, not hinder, the other 91 signatories in nuclear power applications. It is not easy to square the increasingly restrictive US policies on technology exports with this committment. An ironic exception to these policies arose when the Nixon/Kissinger team, in the practice of Real-politik in the Middle East, offered US reactors to both Egypt and Israel, neither of which are parties to the treaty. Other governments may fairly question why they should be overly concerned with living up to the treaty terms if the United States is not and if non-signatories are to be favored over signatories. This could bode ill not only for the NPT but for general acceptance of the United States as a reliable treaty partner, an issue that is already being discussed for other reasons. For one who feels, as this writer does, that future global complexities will impose an even higher value on treaties as a method of managing, if not solving, international problems than has the past, this is a disquieting development.

The third and most important limitation on the current governmental attitude toward technology export is that it will probably be counter productive. Up until now the American light water reactors have, because of their efficiency, been the most popular type of reactors in the world. Not only do they produce power at a lower cost than any other variety but they have, as was discussed earlier, several advantages from the point of view of limiting the spread of weapons.

To review:

- They feed on enriched uranium most of which is produced in the United States, and therefore, easy to keep track of.
- If the United States is the main source of fuel it can, as a condition of sale, impose reasonable controls on the buyer.
- US personnel would normally, as part of the sales package, be colocated with a reactor of US origin to furnish technical assistance and, not incidentally, could keep an eye on moves in the direction of weapons development.
- The LWR is shut down once a year and refueled. Inspection of waste disposal can be scheduled at this time, a much more effective process than the continual monitoring necessary with heavy water reactors.
- The LWR produces only about half as much plutonium per kilowatt of power as does the natural uranium type.
- The irradiated waste from a LWR is comparatively high in Pu-240 content. While bombs can theoretically be fueled with such material, they would be unreliable and cumbersome. The fabrication process would be quite complex and so far as is known no explosive device fueled with the type of material put out by a LWR has ever been detonated. Chemical reprocessing does not reduce the Pu-240 concentration.

All things considered, the light water moderated enriched uranium fueled reactor, while not fool proof, seems to be much "safer" with respect to weapons applications than the competition. Fortuitously, it is also the most desirable from the standpoint of power production and many nations will buy it if it is available and if a continued supply of fuel is assured. It would seem that the United States, realizing all of this, would be promoting rather than restricting the sale of these plants. Instead, by hesitating until a perfect solution can be worked out, the US Government is driving energy starved customers into the arms of the competition where the worst of both worlds obtains. Monitoring and control, if any, will be done by others such as the French who are long on record that nuclear proliferation is not really such a problem and may even have advantages. The machines will frequently be of the natural uranium fired "plutonium factory" variety which provided the fuel for the nuclear foray by India.

PART IV

Summary

The best answer to the question of how to stop proliferation is that the situation is hopeless but not yet desparate. A substantial number of countries have or can buy the expertise to put together at least moderate yield nuclear systems and their is no way to recapture this capability from them. Further, it has been estimated that in 25 years or so, nuclear power plants around the world will be generating enough plutonium to fuel 50,000 bombs a year. International treaties will not dissuade a country from exercising the capability to go nuclear if it feels that such a course is dictated by self-interest or defense requirements. Military threats or economic duress will not forestall proliferation, not only because the bombs can be made in secret but also because of the problems involved in trying to apply such methods. The best course for the United States in limiting proliferation would be:

A. Attempt to eliminate the incentive for weapons development through bilateral defense treaties that are credible and meaningful and which will, if necessary, couple the forces of the United States with those of the indigenous government. This will necessitate seizing every opportunity to demonstrate US will and reliability as an ally.

B. Limit the convenience of transferring atoms for peace to atoms for war by promoting foreign reliance on US nuclear technology --specifically the enriched uranium reactor. This will involve easing the present restrictions on export of technology and expanding domestic production of enriched uranium so that the United States will be regarded as a reliable long-term supplier of fuel for the reactors that are purchased.

C. Support the NPT by living up to its terms. Try to convince non-signatories to sign on by giving preference in nuclear arrangements to parties to the treaty.

The above approach is not dramatic. The dramatic solutions that are discussed invariably include features that make them relevant only to a world in which nuclear proliferation is accepted as the overriding problem facing humanity. The real world does not assign the problem nearly that priority. Nor will the modest steps suggested prevent proliferation. The odds are that in the next decade or so the nuclear club will inevitably take in a number of new members. Probably the best that can be hoped for is to prevent the process from becoming too casual while working out ways of living with the situation as it develops. This will require, undoubtedly, considerable rethinking. There is, after all, no law of nature that requires the great powers to expand a local war into World War III just because nuclear weapons are employed. The use of one does not necessarily mean the use of many. There could even be something to the French "porcupine theory" which holds that a wide distribution of nuclear weapons would lead to a peaceful world since agression would be too risky to contemplate. As one nuclear strategist stated the concept "With the defense of its borders entrusted to nuclear weapons, any nation without ambitions of territorial aggrandizement can walk like a porcupine through the forests of international affairs, no threat to its neighbors and too prickly for predators to swallow." It is this writer's personal view that the statement is longer on naivete than probability, but when the options are limited perhaps a pious hope is as useful as forebodings of doom.

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