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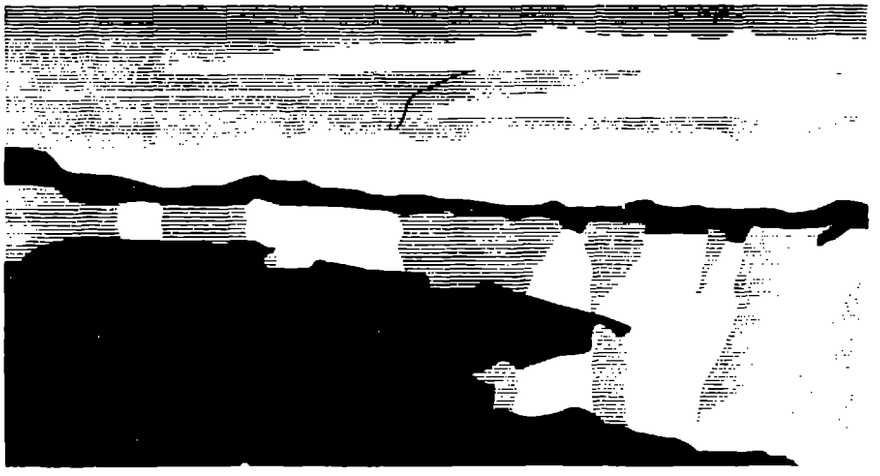

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Some Thoughts on the Nonproliferation of Nuclear Weapons

by

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The nuclear age and the genesis of proliferation began on the morning of July 16, 1945 at Trinity Site, Alamogordo, New Mexico with the explosion of a plutonium device. With the event, the United States had become the first Nth country and temporarily the holder of an exclusive monopoly of demonstrated nuclear power.

However the quest for such a capability during war time was not limited to the U.S. All the industrial nations -- Germany, the US, the United Kingdom, Japan, and Russia had all investigated the possibility with varying degrees of success.

Entry into the nuclear club demanded a large industrial base, a high gross national product and an established scientific community and all of the countries named possessed these prerequisites.

On August 29, 1949, the Soviet Union, which had also been working in secrecy on an atomic bomb since the middle of World War II, exploded a nuclear device and, thus, broke the American nuclear monopoly. In October 1952 and February 1960 respectively, the United Kingdom and France exploded nuclear devices and, for a while, the exclusive nuclear club stabilized at four.

However, the split atom represented a two-edged sword for not only did it portend destruction it also promised abundant energy. Thus by the early 1950's, visionaries were calling upon the superpowers to share their nuclear technology.

In response President Eisenhower delivered his Atoms for Peace to the UN General Assembly on December 8, 1953. The President said,

> The U.S. knows that the peaceful power from atomic energy is no dream of the future. That capability, already proved, is here- now- today. Who can doubt, if the entire body of the world's scientists and engineers had adequate amounts of fissionable material with which to test and develop their ideas, that this capability would rapidly be transformed into universal, efficient and economic usage. (1)

Under the auspices of the Eisenhower policy, the United States began to share nuclear materials and technology with the member states of the United Nations. The spread of nuclear knowledge for peaceful purposes continued unabated well into the 1970's.

Even during these times, when benign advocacy called for sharing nuclear knowledge and

technology for peaceful purposes, it was not long before the world also heard expressions of concerns regarding the potential proliferation of nuclear weapons. In 1961 President John F. Kennedy reflected such concerns and expressed his belief that 15 or 20 states might proliferate in the next twenty years.

Although Mao Zedong (Tse-Tung) had earlier decried nuclear weapons as "paper tigers", in October 1964 the People's Republic of China tested a nuclear weapon. This event had a sobering effect on the superpower nuclear cartel but the effect was short lived. After all it was contended, the Chinese had developed an indigenous capability. In fact, the Soviet Union, pursuant its own version of Atoms for Peace, had transferred a significant amount of basic nuclear technology and equipment to the PRC before the Sino Soviet rift in June 1959. (2)

However, the notion of the peaceful atom was irreversibly shattered with the May 18, 1974, Indian nuclear explosion. The Indians had utilized a safeguarded, Canadian-supplied, nuclear reactor; U.S.-supplied heavy water; and indigenous nuclear fuel to produce several tens of kilograms o lutonium (3). In the process the Indians had destroyed any residual myths that only superpowers could develop nuclear explosives and had irreversibly raised the specter of uncontrolled nuclear proliferation. The spread of peaceful nuclear knowledge had soured

Meanwhile another international development tilted nations toward increased nuclear activities. The oil embargo and price increases in the 1970's gave added impetus toward nuclear power to many states caught by the oil shortage. The realization of energy self sufficiency and independence lay in the pursuit of nuclear power. And the production of plutonium is the natural consequent to the production of nuclear power.

This concern with plutonium production was manifested in a 1976 publication by Alfred Wohlstetter et.al. (4). In this publication they projected the growth in plutonium availability predicated on the increase in nuclear power. The projection indicated that in the next ten years thirty-six countries could be expected to have enough plutonium to make 30-60 nuclear weapons. He did not state that there would be thirty-six proliferants. Thus we have President Kennedy's number of 15 or 20 possible proliferants in twenty years and potentially an even higher number that could be inferred from Wohlstetter's figures.

However in spite of these real or perceived concerns, the pessimistic expectations have not taken place! In the twenty year period following President Kennedy's pronouncement only China and India admitted to testing nuclear weapons. Thus one should look for the reasons that may have contributed to the better than hoped for turn of events. Hopefully this analysis should help us in creating the political and technical developments that might further discourage nuclear nonproliferation. But first let us briefly review the factors leading to a country's desire to become a nuclear state.

A given country's quest to become the Nth nuclear state is governed by two principal factors. First, the country must have a desire to develop a nuclear explosive capability. Secondly, once having decided to develop a nuclear option, the country must have access to the financial resources, technologies and nuclear materials necessary for the fabrication of a nuclear device.

The first factor is likely to represent a complex mixture of real external threats; perceived phobias; national pride; or outright scientific curiosity (5). In any case, in a frenzied world, splintered by contrived and ancient animosities, impetus for the first factor seldom goes wanting.

The chief brake on nuclear proliferation falls on the second factor. Primarily, a lack of fissile material has tended to blunt the nuclear ambitions of many would-be nuclear states (6).

Beginning with the unsuccessful attempts to adopt the Baruch plan for the international control of the atom, advocates have finally agreed to political and technical restraints to detect and deter the efforts of potential proliferants. The formation of the International Atomic Energy Agency (IAEA) has been a major step. In spite of criticism that the IAEA is ineffective, even the very existence of such an agency establishes a commitment for controls and a framework for monitoring the inventory of fissionable materials at declared facilities.

Other examples for limiting the transfer of nuclear technology are the various international export control committees and organizations. The Nonproliferation Treaty Exporters Committee (Zangger group) and the Nuclear Suppliers Groups (NSG) are examples of functioning entities that have curbed and deterred suspicious transfers of nuclear materials and technologies.

It is satisfying to note that through the USDOE sponsored effort of the export control element at Los Alamos, twenty-seven countries are now tied together in a computerized system to help control the sale of dual-use nuclear technologies that could be used by would-be proliferants.

From a historical and political perspective (and in hindsight) one can argue that in spite of the description of the US and the USSR as "two scorpions in a bottle," both countries have had a common goal to minimize nuclear proliferation. With both countries regarded as defense umbrellas in their political spheres of influence -- the Soviet Union deterred proliferation in the Warsaw pact nations while West Germany and Japan enjoyed the protection of the US nuclear umbrella and could focus their efforts on economic growth. And with the dissolution of the Soviet Union in 1991, three additional nuclear states could have emerged. It is to the credit of the Ukraine, Belarus and Kazakhstan that they acceded to the denuclearization processes led by the U.S. and Russia and supported by actions of the UK, France and the PRC.

Technical factors may also have helped, deterred or discouraged the emergence of nuclear proliferants. A convincing argument can be made to show that the fact that the US chose the difficult and expensive process of diffusion technology for the separation of uranium- 235 from natural uranium may have contributed to the control of proliferation. A complex process which demanded huge amounts of power and massive buildings could not go undetected on the world scene. It must be remembered that essentially the total electrical output of the Tennessee Valley Authority was fed into Oak Ridge electrical grid to expedite the diffusion based uranium separation project during World War II. The massiveness of the efforts and the industrial/technological support necessary to complete this work was prodigious. At similar costs and resources and power the Soviets emulated the Oak Ridge facilities at Sverdlovsk-44. The sheer scale of these projects undoubtedly retarded proliferation because it involved resources well beyond those available only to the world's major industrial states. However in spite of these barriers, the PRC successfully met the challenge and produced uranium- 235 for its first test in 1964.

New methods of uranium enrichment have continued to emerge driven by the desire to make enrichment less expensive. These technologies include gas centrifuges (7), laser isotope separation (8), the Becker nozzle process (9) as well new ion resin exchange methods (10).

With the notable exceptions of South Africa, Iraq and the PRC history suggests that the most likely path to be followed by a nation embarking on a deliberate course to acquire a nuclear explosive would be through the plutonium route. Both a simple plutonium production reactor

and a fuel reprocessing facility for recovering the plutonium can be constructed. This route was precisely that followed by India in achieving a nuclear explosive capability (11) Of course, Light Water Reactors (LWR) and Heavy Water Reactors (HWR) are both prolific plutonium producers and could be substituted for the simple plutonium production reactor mentioned above. Both the LWR'S and HWR'S are utilized extensively in all major nuclear energy programs. As a result, the world's fuel cooling ponds constitute enormous and increasing caches of recoverable plutonium The major obstacle to a nation's intent on achieving a nuclear weapon using this plutonium has been the reprocessing facility.

REPROCESSING CENTERS AND THE FUTURE

Obviously all the declared weapon states as well as undeclared states have reprocessing facilities. Moreover several nations that rely on nuclear power now also possess national reprocessing centers. Most of these facilities are subject to IAEA surveillance and inspection as signatories of the nuclear Nonproliferation Treaty (NPT). Perhaps it is time to broaden our thinking to the future by considering international reprocessing centers as a means of reducing suspicion and increasing transparency.

With the inevitable reduction in the availability of fossil fuel, and growing awareness of the ecological impact of fossil fuel combustion products mankind will ultimately need to increase its use of clean nuclear power. With this development will come the burgeoning production of plutonium that can be utilized for further future power production. However this plutonium production will require the development and deployment accountability and controls beyond those already in place.

Unfortunately, given the proper set of political circumstances, these peaceful facilities could be used just as aptly to supply martial plutonium. Indeed, in the case of plutonium, the plowshare and the sword are one and the same.

To keep the plowshare as the dominant choice one should consider the establishment and development of international reprocessing centers as a means of creating transparency and increased confidence, and simultaneously reducing suspicions. A trusted international body with control over these centers could serve to reduce the regional tensions such as we have seen

between Pakistan and India Regional reprocessing centers could be developed to serve the future nuclear power needs of the Pacific Rim and South Asia, the Middle East, South and Central America, and the Scandinavian/ Baltic states

TERRORIST DIVERSION

The end of the cold war and the benign interactions of Russia and the US have revealed the massive amounts of enriched uranium and plutonium in our stockpiles The tons of plutonium moved from French reprocessing plants to Japan were closely followed and reported by the international news media The security methodology used to guard fissile materials in the US has relied on sensors, surveillance and accountability. This was in strong contrast to the Soviet system that relied on internal control through state security authorities.

With the dissolution of the Soviet Union, the scenario has changed The threat of terrorism, always prevalent and manifested in Europe and America and Asia had not been a threat in the Soviet culture. Today's Russia quickly recognized terrorism as a possibility in their new world. The Russian Ministry of Atomic Energy has been quick to recognize the potential problem and has willingly responded by beginning to adopt the American methods and technology for materials protection, control and accountability (MPCA). The actual adoption and emplacement of MPCA technology and methodology has however been slow and limited by funds and training.

The world wide traffic in nuclear materials in commercial channels has also increased and with this increase has come a greater concern for theft of nuclear materials by armed terrorists or criminals. This is perhaps the greatest problem facing not only the US but the nuclear world. The motivation for terrorist acts are varied and complex and requires much more effort and analysis than can be given here.

REVIEW AND DISCUSSION OF PROLIFERANTS

By the mid 1970's there were only five declared nuclear weapons states: the US, UK, France, USSR, and the PRC. The situation remains so today.

Sweden: Even before 1970 the Swedes had embarked on nuclear weapon research, but recognizing the magnitude of the ultimate huge burden of going nuclear had soberly retreated on

its plans and abandoned the effort

Argentina-Brazil The initiation of nuclear proliferation activity seems to have started in the 1970's Subnational elements on Argentina (Air Force) and Brazil (Navy) encouraged nuclear materials research and production as well as some isotopic separative work. After walking the path toward nuclear weaponry both countries found reconciliation and abandoned the pursuit The enrichment of uranium and reactors remain in their nuclear inventory however.

South Africa. South Africa began its uranium enrichment program in the 1970's and actually admitted in the 1990's to having fabricated seven gun-type weapons. In 1994 it reportedly dismantled them

Thus we have four countries that began nuclear weapons programs but have abandoned them

India: The undeclared status of India after its 1974 test has continued but it has not tested again. The capability of deploying nuclear weapons exists and it still is not a party to the NPT.

Pakistan: The United States in effect forced the disclosure of the Pakistani program. Pakistan has admitted and even at times boasted of its prowess in acquiring nuclear technology. The book on the Islamic Bomb published in 1981 describes the evolution of this program (12).

Israel: In spite of the disclosure of Mordecai Vanunu in October 1986, Israel has not admitted to having nuclear weapons. Indeed its undeclared status has had political-military advantages in dealing with its Arab neighbors. There is some evidence that the weapon development program started in 1956 and a stockpile of as many as 200 devices might exist (13).

Iraq: The nuclear weapon program of Iraq went largely unnoticed by the world at large until the bombing of the Osirak reactor by the Israeli Air Force. Indeed many nations condemned Israel for its aggressive stand. Only after the Gulf War was the world to learn that Iraq, an, oil-rich dictatorship, had a secret massive nuclear weapon program in place. It also became apparent that even the power-consuming electromagnetic separation technology that had been abandoned and totally declassified by the US was one of the prime methods under research by the Iraqis for the enrichment of uranium. Even now the inspections by the United Nations Commission (UNSCOM) are still going on.

Libya: Although an NPT signatory Libya is suspected of having nuclear weapon ambitions

(14). International controls, such as export controls have effectively restrained technology transfer and deterred these ambitions

North Korea The North Korean recalcitrance and refusal to allow IAEA inspectors to carry out a routine inspection precipitated the focus of the world on it's proliferation related activities (15) The US in particular harshly condemned their behavior, but offered to extend the olive branch to bring North Korea back to the family of nations The aftermath continues with promises of technical help to restore the economy -- but only time will tell of the effectiveness of the agreement.

Iran. Iran is suspected perhaps justly of having nuclear weapon ambitions After disregarding and denigrating the nuclear developments under the late Shah Mohamed Reza Pahlevi, the ruling mullahs are now pushing for enhancing nuclear knowledge and technology. Whereas the US and Russia have generally shown an agreed upon stance on nuclear proliferation -- the pathways now differ on this issue. To the US, Iran is a potential proliferant while the vision of the Russians seems to be colored by the $8B in hard currency payable to Russia through MINATOM. This same myopic view of proliferation by Western suppliers eager for sales was the mid-wife in Iraq's nuclear weapon program

SUMMARY AND CONCLUSIONS

Although the atomic genie was wrenched from its lamp over fifty years ago, (16) the dire predictions on nonproliferation have been tempered, attenuated and restrained by a growing sense of sobriety by governments and leaders. This restraint has been the result of developing an international understanding of the magnitude of the nuclear problem. In this brief talk we have pointed out some factors controlling the dissemination of nuclear technologies and especially fissile materials. The difficulties of diffusion as a separative technology except by a industrially capable nation may have contributed to the slow down. The forming of technology based organizations to control materials through export control actions, limiting and controlling computer codes, sharing material protection, control and accountability of fissile materials have had a benign impact on restraining and possibly reversing the projected growth of the 1960's and

1970's toward nuclear proliferation

In a sense the very massiveness of the programs of the two nuclear superpowers. brought a sharp focus to the magnitude of the problem that the world faced for potential disaster As active scientists we have bought the time necessary for government leaders to learn and implement the political actions necessary to develop the international controls that have deterred the expansion of nuclear developments The problems ahead are many to keep rogue states and terrorists groups from picking up and rekindling the Promethean fire of nuclear weapons Only vigilance and cooperation on the international level will insure the nuclear tranquility which has prevailed despite cataclysmic political changes which are a part of the heritage of man

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