Appendix VII. Purchase and Theft

This appendix is largely based on a report to OTA from The Hudson Institute, "Routes to Nuclear Weapons: Aspects of Purchase or Theft," by Lewis A. Dunn, Paul Bracken, and Barry J. Smernoff, November 12, 1976.

Appendix VII

Purchase and Theft

Table of Contents

INTRODUCTION

A potential route to proliferation is by the direct acquisition of weapons or fissile material from abroad. This could involve purchase from an illegal black market, covert purchase or barter from a friendly nation in what is called grey market, or theft of another country's weapons. Each bypasses the need for the expensive and demanding technologies entailed by commercial power and dedicated facilities. Thus, if this type of transaction emerges, the scope of proliferation could be extended to technologically limited nations that otherwise have found the task difficult and risky. The pace of proliferation could be further accelerated by the relative ease of obtaining weapons, a general sense that the non-proliferation regime was crumbling and a specific concern that one's enemies were covertly obtaining weapons. In addition, this is almost certainly the route which non-state adversaries (NSA's) would have to follow. Hence this route has grave implications for the hopes of limiting proliferation.

1. Black Market

a. Commodities

A nuclear black market would center on the illicit exchange of fissile material, weapons designs or actual weapons. Most attention has focused on plutonium because under present plans for plutonium recycle, only a very small fraction would have to be diverted to fuel a very large market. As described in Section IV, the construction of a plutonium bomb is well within the capabilities of many nations and possibly some NSA's. An equally attractive commodity would be highly enriched uranium, as in the fresh fuel for high temperature gas cooled reactors. Other potential commodities such as low enrichment uranium used as fresh fuel for LWR's or spent fuel from almost any reactor would require much greater efforts to convert to

weapons material.

A black market might also involve a detailed design of an efficient bomb, which would reduce the time and risk to develop a weapon. NSA's capabilities and credibility would be particularly enhanced by a clever explosives design tailored to NSA construction capability.

Nuclear black marketeering could also entail the exchange of stolen nuclear weapons or fissile materials "mined" from such weapons. Particularly vulnerable targets of such thefts might be nations who have only recently acquired nuclear weapons. For political and technical reasons such countries may lack adequate command and control procedures for their nuclear forces and stockpiles.

b. Participants

Prospective buyers could include countries; subnational terrorist groups, and political or military factions; criminal groups; and perhaps even individuals. Each could have reasons for seeking access to nuclear weapons or their critical components.

Technologically limited but internationally ambitious countries might become active seekers of black market nuclear materials or bombs. Colonel Qaddafi's repeated efforts to purchase a nuclear weapon for Libya are well known.[1] Less well known, however, were the earlier comparable efforts of former President Sukarno to purchase a nuclear weapon for Indonesia from China.[2] A sudden crisis could also precipitate a desire for nuclear weapons without leaving time for their more conventional development. For example, if Israel reveals a nuclear arsenal, Egypt would be under great pressure to match it, but would not have the facilities or expertise to do so independently with sufficient speed.

Subnational groups of varying types also could emerge as buyers of stolen or diverted fissile materials or nuclear weapons if these became black market commodities. Much speculation has focused upon possible future efforts to gain

access to nuclear weapons by organizations such as the Irish Republican Army or the Palestine Liberation Organization (PLO) which consider terror a legitimate weapon. Appendix III deals with such subnational groups.

In a non-nuclear weapon state a faction of high-ranking military men or even a militaristic private army such as Yukio Mishima's now defunct group could engage in black marketing to acquire a nuclear weapon or its critical components to facilitate a coup.[3] Alternatively, such a group could conclude that their ability to unveil one or more nuclear weapons--whose acquisition would have been barred to the legitimate government perhaps due to external pressure--could turn out to be critical for national survival in a future crisis. The perpetrators might be largely motivated by a vision of their eventual emergence as national saviors.

Criminal groups--conceivably even individuals--might wish to acquire nuclear arms, most probably for extortion. Interest might be stimulated by the hoaxes in this vein that have been attempted (none successfully), as described in Appendix 111. A genuine explosive would not be hard to prove, and the ransom for its return could be sizable.

Corresponding to this variety of customers is a variety of potential suppliers whose identity depends on the commodity being marketed. Nuclear material might be diverted by a nuclear facility employee who is motivated by money, coercion, or ideology. This diversion could be gradual to avoid detection by safeguards measures or rapid and overt to permit escape. Terrorist and criminal groups could acquire fissile material by armed attack, especially on shipments of plutonium.

Nuclear weapons might be procured by theft, but the risk would be high even with insiders bribed or coerced to help. The tight physical security protection probably makes theft of weapons more difficult than that of commercial plutonium would be. The absence of attempts against American nuclear stockpiles

suggests that criminal organizations might shy away from such theft. Terrorist groups, however, might have greater motivation. If Nth country nuclear stockpiles prove somewhat easier targets or if the trade-offs among the risks and payoffs of such theft changed in the future, theft of weapons may occur. A more likely supplier of black market weapons--as opposed to gray market ones, where the government itself would be engaged--could be financially ambitious and dissatisfied officers within new nuclear-weapons states. These factors are discussed below.

A weapons design would most logically be supplied by someone in an existing weapons program. Relatively few designers have a comprehensive grasp of the entire design, however, and very few if any of these would be receptive to black market offers. Only if they were coerced or changed their ideology would they be likely to sell a weapons design illicitly.

If a transaction required an intermediary, likely candidates would be criminal groups (fences) or international terrorist groups. A distinction should be made between the emergence of intermittent transactions and the development of a full-blown market. intermediaries could be highly instrumental in the latter.

c* Characteristics

1. Factors Affecting Supply

Clearly no nuclear black market will develop unless material is available for diversion or theft and subsequent purchase via illicit channels. If fissile materials were freely traded in international commerce, scarcity would not be a significant constraint upon the possible emergence of such illicit transactions. More specifically, the extent to which various nations reprocess spent fuel and recycle plutonium will be the primary determinant of the magnitude of this international commerce. If, for example, plutonium is nowhere separated from spent nuclear fuel and recycled into light-water reactor fuel or stockpiled for breeder reactors, possibilities for its leakage onto a black market would be drastically reduced. Alternatively, if plutonium has become a normal international commodity in the sense that many countries

separate it from spent fuel for near-term recycle or future utilization in breeder reactors, the development of an illicit plutonium market, perhaps using some of the sources, distribution channels, and human resources of the legal plutonium market, would be more likely.

Projections for the amount of plutonium that could be reprocessed in the future are shown in Appendix IV. Large quantities are anticipated to be moving in international commerce in the 1980's. It is quite impossible to estimate accurately how much might be diverted or stolen, but a small fraction (e.g., 1%) would be adequate for a significant number of weapons and might sustain a continuous market rather than intermittent transactions.

Although plutonium, if recycled, would be the most tempting target, black marketeers might steal spent fuel and subsequently extract plutonium from it. This reprocessing would be done in clandestine national reprocessing facilities or hotcell laboratories run by sub-national or criminal groups. Once the fuel has cooled for 150-200 days in reactor spent fuel pools,

it can be handled with caution and could be diverted into illicit channels as a source of black market plutonium. Alternatively, if advanced uranium enrichment technologies such as gas centrifuge and laser isotope separation become widespread, low-enriched uranium could become a more attractive target for nuclear black marketeers. Both these alternatives would be limited to very sophisticated and well financed black marketeers

The potential supply of material for a black market depends upon the viability and effectiveness of safeguards and physical security measures for nuclear materials. Should a major safeguards agreement violation occur and not be met by an adequate response sufficient to prevent an erosion of the morale and effectiveness of International Atomic Energy Agency (IAEA) inspectors, the safeguards system could erode markedly. Countries might become less ready to cooperate with the IAEA, inspectors might become less willing to challenge possibly suspect activities, material accounting requirements might be followed less rigorously, and so on. Such a deterioration of the safeguards system's viability then not only might facilitate covert diversion by governments for their own purposes, but also could facilitate diversion by nuclear facility employees for black market sale. Conversely, an increase in the effectiveness of existing safeguards procedures and systems, reducing the level of material unaccounted for (MUF) in the nuclear fuel cycle and otherwise restricting unauthorized access to nuclear materials, would increase the obstacles to successful slow diversion and increase the risks of attempting it. Concomitantly,

new fuel-cycle protection systems - emphasizing, for example, better containment concepts, limited personnel access, and discrete storage of only small quantities of material - would have a similar dampening impact upon potential supply. Such increased safeguards' effectiveness would reduce the feasibility of "trickle theft" as a source of supply, just as enhanced physical security measures and high guard morale can reduce large-scale facility break-ins and hijackings.

The adequacy of physical security measures for nuclear weapons, of course, would be an important determinant of black market supply. Those measures are discussed below in the context of a consideration of nuclear-weapon theft. Suffice it to suggest here that it appears that sufficient supply to fuel a continuing market in stolen weapons - even Nth country ones - as opposed to one-shot ad hoc exchanges appears lacking.

2. Demand-Related

A second set of factors influencing the emergence and extent of marketeering would be the level of demand for illicit nuclear weapons or their critical components. The price buyers would be willing to pay --both financially and in terms of risks assumed--would vary, of course, with the perceived utility of the black market nuclear commodity, as described in Appendices I and III. As more customers are willing to pay higher prices, more sellers will run *greater risks to meet demand.*

Specifically, the possible impact of *regional* warfare, or even its prospect, might generate sufficient demand to induce widespread nuclear black marketing. Because the buyer would be anxious to build a large arsenal in a short time. The result could be the emergence of many

individual diversion activities, continuing networks and criminal organizations providing necessary middleman services. If Egypt, for example, suddenly needed an arsenal of about 20 bombs, the required 250 to 500 pounds of plutonium would in itself be a major factor. Plutonium is not freely traded at present, but its approximate value might be estimated at $9,000/lb. ($20/gram)*,indicating a total transaction of $2,000,000. The future price may well be much higher, and the black market price could be several times that. Egypt may still feel this is a small price under the circumstances, especially if financial assistance is obtained from the richer Arab countries.

The future scope and pace of nuclear proliferation could also be a major factor affecting demand for a nuclear black market. If in the 1980s-1990s a growing number of countries have begun to acquire nuclear weapons, proliferation momentum--the belief that widespread proliferation was becoming inevitable--would increase. Low-technology countries, who believe that their neighbors would “go nuclear” but are unable to develop a matching capability, might seek to redress the balance by black market purchases. Whether such countries actually pursued this course of action, however, also would depend upon the perceived risks and existence of alternatives.

Non-state adversaries are unlikely to be rich or powerful enough to generate a sufficiently large demand to foster more than intermittent black marketing even if the supply is sufficient. Nevertheless, only one successful application of a nuclear weapon by a NSA would encourage others to follow suit. The emergence of this demand is, however, even more conjectural than that by nations. As suggested in Appendix III,

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groups that have both the will and the ability to use nuclear weapons evidently do not yet exist.

3. Initiation

Transactions could be initiated by buyers, sellers or middlemen. Because participants are generally quite disparate groups, both contact and trust would be difficult to establish. A country seeking to purchase fissile material or weapons would probably first approach a friendly nation as Indonesia did with China (unsuccessfully) in the example above. Such a government-government deal would have been typical of a gray market transaction described below. If it fails, a government might try Colonel Qaddafi's approach of publicly announcing that it wanted to buy fissile material and waiting for a supplier to show up. (This method apparently has not worked yet either.) Alternatively, a country might try to make contact directly with potential suppliers or criminal middlemen. This method is quite risky if secrecy is required, however, as North Korea recently demonstrated in Scandinavia by its inept attempts to act as a black market supplier of liquor and tobacco.

Suppliers would probably more easily initiate contact since the buyers are fairly obvious. An employee of a nuclear facility who believed he could divert material might contact a foreign government or nationals or a criminal group which might be interested. To establish his credibility, a supplier might have to produce an initial sample.

Terrorist and criminal groups might easily make contact with **their counterparts who would procure or use the** material. Both have **international links and appear to be relatively** secure against **surveillance.**

The participants will weigh the risks and costs against the potential gain before entering into black market transactions. The risk

that a nation might be detected while purchasing the material is fairly high, but the costs are very low. Libya seems no worse off for Colonel Qaddafi's nuclear efforts. NSA's run lower risks of detection of attempted purchase, and if an analogy with the illicit drug trade is valid, they probably would not face serious consequences unless caught with a substantial amount of material after the purchase. A seller may be able to arrange the transaction relatively easily, but he runs a substantial risk of detection in the diversion and very high consequences if caught.

Weighed against these risks are substantial gains. If an employee of a reprocessing plant smuggled out one gram of plutonium per day (an amount invisible to most accounting systems and difficult for present portal monitors to detect), he should realize at least $5,000 per year and maybe much more. An attack on a stockpile or transport of plutonium could net several million dollars worth of material.

The initial incidence of nuclear black marketeering might be quite unpredictable and localized--both in terms of supply and demand--but once several successful black market transactions had been consummated, the demonstration effect could produce a slow broadening of the black market. Thus, a global black market to which potential proliferators and subnational groups might turn for illicit nuclear materials and expertise ultimately could result. Hence, one of the most important factors affecting the emergence of a black market is the perceptions of the potential participants of the likelihood and severity of the alternative responses which could range, for example, from pursuit and capture of organizations and individuals serving as suppliers to invoking severe punitive sanctions against a country that purchased stolen nuclear material or weapons.

4. Operation

The distinction between intermittent transactions and a sustained black market is essentially the difference between amateur and professional operations. The latter is far more dangerous, not just because it involves a greater material flow, but because it seeks to expand itself. Despite its size, detection and control of a sustained market might be more difficult because of the greater expertise of the participants, especially the suppliers and middlemen.

The level of potential activity clearly is bounded initially by supply availability, and most importantly by whether or not plutonium emerges as a standard international commodity. Within that constraint, the extent of nuclear black marketeering would be influenced by the interaction of demand and response factors. In particular, the only customers who would be likely to sustain a market are LDC's with strong incentives, especially security. Some of these might continue arming indefinitely.

These regular customers together with occasional purchases by other nations and NSA's could support a market of several hundred pounds of fissile material worth millions of dollars per year. Although small by comparison to the drug market, these transactions would have a large impact on proliferation. The market might consist of a number of suppliers possibly in different countries working through one or more central exchanges. Because fissile material is easily concealed and smuggled across national borders, all countries must carefully protect their supplies and respond strongly when they detect a loss . An efficient black market will select the weakest link as its target.

d. Conclusions

At present, the supply of fissile materials is highly limited but would increase with widespread plutonium recycle. The inherent lack of prestige of nuclear weapons attained by this route may inhibit some nations, but those with intense security concerns will feel few compunctions. A continuing pattern of proliferation could lead some countries to the conclusion that they too shall have a few nuclear weapons “just in case”. Safeguards and physical security cannot be perfect. Some diversions will succeed, and early successes will breed more attempts, particularly if the response is limited. Thus, if supply is not controlled, the outcome is likely to be at the very least intermittent black market transactions.

2. Gray Market

a. Definition

A gray market differs from a black market in that the transaction may be technically legal but is nevertheless covert because it would be unacceptable if known publicly. The main reasons for the secrecy would be to avoid alerting an enemy or to forestall international stigma from furthering proliferation in violation of the NPT. Some countries may also wish to bypass domestic opposition. If the non-proliferation regime crumbles so that secrecy is not necessary, the transactions described here could become normal commercial ventures.

The transactions could involve weapons or fissile material as in a black market or technical assistance. Examples of the latter are help with the construction of facilities for weapons production (e.g., plutonium reprocessing plant), transfer of critical weapon components, or exchange of information (designs) or trained manpower.

b. Participants

The buyer in a nuclear gray market could only be a government because purchase by any non-national group would be illegal and, therefore, by definition, a black market activity. The supplier could be an allied government, a corporation or an individual. There would probably be no intermediaries.

A future new nuclear-weapon state might send several of its own engineers and technicians to another prospective proliferator to assist the latter in developing, for example, a production reactor or hot-cell reprocessing capability; or it might supply needed components or raw materials for building or operating either facility. New nuclear-weapon states might find the reduction of the size and weight of their early generation nuclear warheads to be critical to improve deliverability. More advanced proliferators could assist others in

doing so by transferring design information and test results.

The direct transfer of fissile material (accompanied again by weapon-design assistance) or actual weapons is possible if the motivation is high. In some cases, unsafeguarded fissile material, derived from indigenously built production reactors could be exchanged. Another possible source of supply is material from power reactors unsafeguarded following abrogation of the NPT. The use of material diverted from safeguarded facilities is less likely as the risk is higher and the motivation for supplying another country substantially less than one's own.

Companies in the international nuclear industry are also capable of rendering considerable covert assistance. They would probably not offer fissile material but important proprietary information, such as details of plutonium reprocessing, would be of use to a potential proliferator. Alternatively, corporate-to-country transactions might involve the covert supply of necessary technical manpower, loaned to a proliferator's program and hidden within the framework of a continuing commercial presence in the recipient country.

Technically trained individuals could participate in a nuclear gray market by becoming scientific mercenaries, i.e., selling their services to a foreign government. Such individuals might be skilled either in plutonium reprocessing, weapons design or even in general explosives or metallurgical work.

c. Characteristics

1. Government-Government

No nation yet has shown a willingness to transfer nuclear weapons directly to another, but some might reconsider under some circumstances. A weapons state would feel great pressure to covertly release a few bombs to a close and valued ally which was on the verge of annihilation. Under less dramatic conditions, few governments would be willing to take a step potentially risky to themselves and so flagrantly in violation of international agreements. A country would be more likely to deal with fissile materials than bombs, because it could rationalize the exchange as being for scientific purposes.

Technical assistance is the most probable transaction. Most importing nations would prefer to have their own production facilities and thus a guaranteed continuous supply. Many circumstances can be envisioned that make it seem plausible. The supplier of a vital resource such as oil might demand assistance as part of a trade. If proliferation becomes commonplace, a nation might view its nuclear expertise as a "service good," as do the suppliers of conventional arms. Economic pressures and manpower constraints could also suggest a cooperative development program, which would have the added advantage of being less apparent to third party intelligence since neither nation need have the complete requisite set of facilities.

Pursuit of narrow political advantage also might lead a state to engage in gray marketing. For a hypothetical example, a future nuclear-armed Pakistan might see provision of technical assistance or sale of a nuclear weapon as one means of acquiring or solidifying Arab, or perhaps Iranian, political support in its confrontation with India.

Conversely, India might find itself ready to trade such assistance for Arab or Iranian non-support of Pakistan. Reciprocal fears in India and Pakistan that the other might be thinking about how to use its nascent nuclear-weapon potential as an export commodity would increase the pressure on each to do so first. "Preemptive gray marketeering" could be the result.

Broader international trends also could either increase or engender pressures for gray marketeering. If current developments continue, Israel, South Africa, and Taiwan may become increasingly isolated within the international community. Should they truly become threatened as international outcasts, they might join together in a "pariah international." Building upon and transforming existing linkages among them--e.g., South African-Israeli cooperation in the fields of advanced scientific technology, conventional arms, and perhaps nuclear undertakings and Taiwanese purchase of uranium from South Africa[4]--this group might give serious consideration to nuclear-weapon cooperation and transactions. If such a "pariah international "emerged, moreover, its existence and cooperation in nuclear matters might stimulate other countries to think about comparable gray market activities.

Some nations might see a need to acquire covertly a small stockpile as a deterrent before risking detection as a producer. For instances, a marked erosion of American alliance credibility could significantly increase West Germany incentives to acquire nuclear weapons.[5] Fear of the Soviets, however, might constrain that decision and perhaps lead first to West German efforts to develop a covert nuclear-weapon capability before launching a full weapons program. Such a capability to be unveiled suddenly might be though necessary and sufficient to preclude a Soviet preemptive attack. One possibility would involve a covert gray market joint

venture with either Brazil or South Africa. The extensive existing contacts between these countries might be used to hide the presence of illicit activities.

At least in the early stages of nuclear gray marketeering, the most likely sources of government-to-government technical assistance, fissile materials, or weapon-design information are likely to be the new nuclear- and candidate nuclear-weapon states themselves. Not only are the above discussed pressures likely to emerge, but countervailing pressures operating on the major nuclear suppliers as evidenced by the Suppliers Conferences are likely to be only weak constraints. Taken together, Tables 1-6 suggest the growing, if still limited prospective capability of such new nuclear- and candidate nuclear-weapon states to enter into gray market transactions among themselves or with even weaker candidate nuclear countries. More specifically, for many prospective early proliferators these tables depict: increasing potential access to separable plutonium; a growth of trained elite manpower represented by their students studying within the United States; a greater capability for indigenous training of technical manpower; the start of exports of engineering products by some of them; a shifting international market for engineering products which again includes the emergence of some LDCs as not insignificant engineering exporters; and a growing consumption of engineering products, itself indicative of growing momentum behind the development of a technological infrastructure in many of these countries.

The pattern of engineering and industrial activity within less developed countries is indicative of their capability to utilize gray market transactions. Many have demonstrated a marked capability to adapt used machinery to specific purposes, to make do with what is available, and more generally to fabricate "jerry-built" operations that highly industrialized countries would consider totally inadequate for the task at hand. The Indian plutonium reprocessing plant was just such a jerry-built affair, adapting and combining equipment available from disparate sectors of the Indian economy.[6]

2. Corporation-Government

International nuclear corporations are less probable participants. Recent revelations of corporate bribing of foreign officials[6] give rise to speculation that this form of gray market assistance could occur, but it must be noted that only an exceptionally unscrupulous executive would authorize such a transaction. Not only would most find the idea abhorrent, but exposure of the transaction would have a devastating impact on the company. If a company has a large investment in another country, however, it could be placed under considerable pressure to provide assistance. If this could be done in such a way that the assistance appeared directed towards peaceful purposes, the initiation would be easier.

It is also not inconceivable that some companies could eventually use their expertise in pursuit of commercial advantage or even as an article of commerce. The likelihood of this happening would be enhanced if the nuclear activities of international corporations are constrained in their home countries.

The major nuclear companies are described in Appendix VIII. In general, the types that might be considered are reactor manufacturers, architect-engineers and consulting companies. If peaceful nuclear explosions are commercialized, companies dealing with them might be technically appropriate.

3. Individual-Government

Scientific mercenaries could emerge from the growing pool of nuclear industry and weapons personnel. The global nuclear industry by itself will require approximately 115,000 trained engineers in 1980.[8] Thus, a sizable pool of scientific and technical manpower, some of whom would be conversant with plutonium reprocessing, materials handling, and related fuel cycle technologies, can be expected to exist. Within the major industrialized nuclear suppliers there exists a group of professional nuclear scientists and engineers whose careers have been tied to the prospect of future plutonium reprocessing. If reprocessing is banned or severely limited in these countries, the combination of career shock and economic necessity might tempt or force some of these people to seek plutonium-related employment in other countries. Nuclear moratoria or even just lagging sales could add appreciably to the number of potential mercenaries. Precedents for the migration of

skilled manpower to nations with higher demand exist in the brain drain of earlier decades as shown in Table 7 . Migration to an LDC may seem less attractive than to a developed country and most individuals would feel a strong aversion to contributing to proliferation, but even a very low percentage of the whole pool could have a substantial impact on the rapidity of a weapons development program.

Of even greater value to a fledgling Nth country's weapon program would be individuals who had worked within the nuclear-weapon program of one of the existing nuclear-weapon countries. Depending upon such persons' level of expertise and prior responsibilities, this pool of potential nuclear mercenaries could number from tens to thousands. Even though virtually all of these persons would likely refuse any offers to sign on as scientific mercenaries, some might do so, especially under duress. Even one or two expert weapons designers can be crucial to some countries.

One factor that will work against these transactions is the desire of nations to keep their program a secret. The loyalty of foreigners in this situation is somewhat questionable, and the duration would generally be too long to keep a team sequestered voluntarily.

4. Precursors to Gray Market Activities

In the Fall of 1975, several European newspapers and magazines published "secret" documents supplied by the African National Congress and alleged to have been stolen from West German ministries and from the South African Embassy in Bonn, suggesting covert semi-official and private West German involvement in South Africa's development of uranium enrichment technology. These documents revealed the growth

after 1958 of extensive contacts between various West German semi-official bodies, e.g., the state-controlled fuel company STEAG, West German ministry members, and private West German companies and both the South African Atomic Energy Board and the South African Uranium Enrichment Corporation. Of particular interest was a letter dated July 12, 1972, from the West German State Secretary at the Ministry of Education to the president of the South African Atomic Energy Board referring to the secrecy of any West German participation in South African atomic energy matters. The Bonn Government maintains that "all speculation about cooperation between the two governments is unfounded,"[9] but both the fact that West Germany's representative to the NATO Military Affairs Committee, Lieutenant General Gunther Rail, was forced to resign in 1975 after these documents revealed he had clandestinely visited South Africa as a guest of its Defense Ministry in October 1974 and the similarity between the West German "Becker nozzle" uranium enrichment process and the South African "jet nozzle" process suggest that some, perhaps extensive, cooperation may have occurred.[10]

Other possible precursors of government-to-government gray marketeering include the training of Egyptian scientists at the Indian Bhaba Atomic Research Center at Trombay,[11] and reports of South African-Israeli nuclear cooperation, including the purported existence of a secret nuclear test center in South Africa at which technicians and scientists from Israel are supposedly working.[12]

d. Conclusions

Gray market transactions appear to be at least as likely as black market transactions. There are already potential suppliers for at least some types of assistance, and it is entirely possible that some examples

have already occurred.

Thus potential supply may be a less critical impediment to nuclear gray marketeering than to black marketeering. In particular, the increasing accumulation of plutonium-bearing spent fuel and the growing technological and manpower base of many prospective proliferators probably would suffice to permit them to enter into gray market transactions with other countries. At the same time, a growing pool of potential nuclear mercenaries, comprised of former nuclear weapons designers and technicians, surplus engineering manpower, and unemployed nuclear engineers, is not unlikely.

A major constraint is the difficulty of establishing trust. A criminal group might sell to anyone who could pay, but a nation would only assist a country whose political outlook and interests were compatible with its own. Thus a formal structure such as postulated for the black market is unlikely, and transactions would be on an individually negotiated basis.

Some black market characteristics, however, do have relevance. The demand motivations are approximately the same, but most nations would certainly prefer dealing with other nations and legitimate sources than black market operators. Both markets become far more likely if proliferation continues, and both will be encouraged if the international response to initial examples is weak. Finally, both would even further accelerate the pace of proliferation.

3. Countermeasures to Black and Gray Markets

a. Detectability

The first step in combating black and gray markets is to detect them. There are two general focal points: the participants and the

material. Intelligence gathering operations can serve to indicate who is participating in such transactions. The greatest difficulty will be to distinguish these from legitimate transactions. By way of illustration, the inflow of engineering talent to the oil-producing countries, the growth of world trade in engineering products, and the even faster growth of multinational corporations stimulate migration of highly trained technical manpower to a vastly greater degree than would any gray market. Penetrating this noise is nevertheless one of the keys to controlling the problem, and success will depend largely on the quality of the effort applied.

One potential difficulty with such intelligence gathering and storage, however, should be noted and ways of reducing its impact sought. Some of these measures, e.g., computer-storage of dossiers on former nuclear-weapon designers or nuclear engineers with critical skills, as well as efforts to track their movements, probably would conflict with important civil liberties. Additional detailed analysis of the potential civil liberties spillover of different intelligence measures and of the relative weighting of each case would appear warranted.

The second focal point basically means safeguards to detect when material has been diverted. The same considerations apply as for

national diversions, except that the function of the person who actually diverts and the route by which the material leaves the authorized location is likely to be different.

Both these methods can be enhanced and reoriented towards this threat. Increased effectiveness in detection would be a potent deterrent to potential participants.

b. Responses

Once an effective intelligence program is established, the information would be useful for adopting preventive measures, for taking prior counter-action in the case of unconsummated transactions or plans, and for responding afterwards in an attempt to limit the damage already done. To the extent feasible, intelligence data should be pooled among countries committed to non-proliferation.

A second realm of responses, particularly in relation to possible black market theft or diversion of fissile materials or nuclear weapons, would entail target-hardening. Recent and projected efforts to increase the rigorousness of physical security systems within the nuclear industry would fall under this category. So would measures designed to increase safeguards viability and effectiveness. As suggested earlier, however, such measures, taken alone, appear unlikely to be able to preclude the emergence of at least some instances of nuclear black marketeering.

Perhaps most important, a broad range of politico-military responses can be identified. Possible responses might include a readiness to adopt sanctions against countries engaged in nuclear gray marketing

police work to capture black marketeers, control of the activities of potential nuclear mercenaries and corporations abroad.

In addition, serious consideration should be given to reducing more directly the potential supply of black or gray market nuclear materials. Arrangements to limit national proliferation would generally be effective against black and gray markets. In particular, measures to avoid the emergence of plutonium as a freely-traded international commodity could be pursued. Some of these measures, such as multi-national fuel cycle facilities, would be more effective against gray than black market diversion.

There is obviously no certainty that these transactions will emerge, but plausible situations have been described. Strong responses could reduce their likelihood and limit their growth past initial sporadic examples.

4. Theft of Nuclear Weapons

a. Potential Attackers

The range of groups that could consider an attack on a nation's nuclear weapons stockpile or transport is much narrower than that of black market suppliers described above. Only highly motivated and well organized and armed groups could have much chance of overcoming effective military security precautions surrounding the weapons. Potential attachers include low technology nations, military factions and terrorist groups. Criminal groups probably have as great a capability as terrorist groups, but the near certain violent resistance and post facto reactions to a theft are strong deterrents. Criminals' motivation is financial rather than ideological, and equally profitable but less risky ventures are available to them.

The prospect of a successful theft is a powerful incentive. Theft is the most direct route to a nuclear weapon, and would probably result in a more sophisticated and effective weapon than obtainable by other routes,

b. Theft of U.S. Weapons

1. Description

It has been publicly reported that the U.S. has several tens of thousands of nuclear warheads with approximately 7,000 of these in Europe and a classified number in the Pacific Ocean area.[13] U.S. naval vessels also carry them. The warheads are used in bombs, missiles (land, air and sea launched), artillery shells, depth charges, torpedoes, and demolition charges. Some of these, such as demolition charges are small enough to be easily carried by one person. Artillery shells can be carried by two people, but are normally stored in packing cases which require four. Others, particularly those used in strategic weapons, are much larger.

All nuclear weapons have built-in protection against unauthorized use. A weapon must be armed manually with a coded key before it can be fired. Even then some can be fired only under certain conditions. For example, nuclear artillery rounds might contain built-in accelerometers that fully arm the shell only after detecting the very high acceleration that would accompany. normal firing. Such devices can be bypassed eventually. Hence, Permissive Action Links (PAL) were developed. These devices permanently but nonexplosively disable a weapon if it is tampered with. This key element of the physical security system is incorporated in all newer U.S. weapons abroad. The weapon may, of course, be rebuilt following activation of the PAL, but the delay would enhance the chances of recovery, and the rebuilt weapon would probably suffer a loss in efficiency. It could still be a highly effective weapon, however.

Whatever the technical value of these safety devices, however, the political value may be small. Informed that a terrorist group had stolen an A-bomb, the public would be hard to convince that the problem was minimal because of certain technical control devices of the particular model. Even if political leaders are convinced that these technical characteristics would prevent detonation, public pressure could induce political leaders to capitulate to the terrorist demands.

2. Physical Security

Weapons are generally kept at special storage sites except for naval weapons on board ships at sea. The number and location of storage sites are not publicly reported, but there has been a trend to consolidate them to improve physical security. During 1974 and 1975, there was a net closure of 97 nuclear sites. A countervailing pressure, however, is the need to maintain security against destruction by a military attack.[14]

The sites are usually on military installations, isolated and surrounded by fences. The perimeters are monitored automatically and patrolled continually. Backup forces are available on short notice. The weapons themselves are kept in vaults.

These measures are significantly more stringent that is required for commercial fissile material, but they are recognized by the Department of Defense as being inadequate in light of the increasing threat from terrorists. Approximately $230 million is budgeted for FY76-77 to upgrade security at storage sites. This is being spent in part on training of

security personnel, improved perimeter sensors and lighting, additional guards, hardening of facilities and better communications. A psychiatric evaluation program (Nuclear Weapon Personnel Reliability Program) has also been instituted to identify and disqualify troubled personnel who might be receptive to approaches by would-be attackers seeking inside help.[15]

Transport is a weak link in the physical security system. It is, however, relatively infrequent except during alerts. Transport is generally accomplished by an escorted armed helicopter. Flights are unannounced and do not follow regular routes. Continual radio contact is maintained with the base and a contingency response is on alert.[16]

Some transport is intrinsic in the mode of use. Ships and submarines regularly carry many warheads. Bombers fly with the weapons only during alerts.

3. Attacks

No determined attacks on nuclear storage sites have been revealed to date. Several other examples, however, do show the difficulty of defending against well trained commando raids. Otto Skorzeny in 1943 led an assault party of only ten to fifteen in gliders on a mountain fortress to free Mussolini. In this case, the subject of the raid was eager to be liberated and the defenders mostly fled at the sight of the attackers, but in 1944 Skorzeny led another raid which is even more pertinent. He kidnapped Admiral Horthy, the Hungarian regent, by penetrating the Hungarian presidential palace which was surrounded by tanks and infantry.[17] More recently, the Black September

penetration of the 1972 Munich olympic compound, the North Korean capture of the Pueblo and Israeli raid on Entebbe are examples of the types of attacks to be considered.

Conclusions can be drawn from a study of such cases, as described in Appendix III. In attacks on nuclear storage sites, very small groups (l-4) are unlikely to gain entrance. Groups of 5-8 attackers may have a chance of gaining control of the site, but would have considerably more trouble removing the weapons. Larger groups (8-20) would more likely be effective in achieving their objectives. An imaginative approach, diversionary tactics and the cooperation of one or more insiders naturally increases the probability of success. Intelligence activities, however, are more likely to detect such large groups in time for reinforcement of defenses.[18]

Massive attacks such as the Entebbe raid, which are essentially acts of war, are least likely to be resisted successfully, but neither can they be accomplished anonymously. Consequently, political and military responses, if activated, should be expected to ensure return or destruction of stolen weapons. An appropriate military response was unavailable when the Pueblo was seized because of the ship's isolation. This should not be a factor in attacks on storage sites.

Attacks on transports would be hard to plan because the opportunity is not presented often. Insiders would almost certainly be required to provide information as to when opportunities will occur. Both air and ground forces would probably be needed. Thus in terms of manpower, financial backing and skill, this is probably equivalent to the groups of 8-20 above. The probability of success, however, may be higher.

Attacks on bombers, ships and submarines are the least possible. Nuclear weapons are no longer carried by planes on routine missions, but only on alerts. Naval vessels are heavily armed and difficult to approach unless aground or suffering mechanical difficulties. Thus assuming reasonable precautions are taken regarding routes and distance from assistance, only a large amount of luck would put these weapons within reach of attackers.

Some U.S. nuclear weapons are for the use of other NATO countries. These weapons are guarded by the host country although custody is maintained by small U.S. detachments. A sudden change in governments could leave these weapons highly vulnerable. Even U.S. storage sites in foreign countries would be much less secure following a sudden violent change in government. These weapons would have to be rapidly removed, a process which in itself would increase their vulnerability because of the predictability of the flights, the difficulty of mounting an effective response to an attack and the probable loss of most intelligence sources.

c. Theft from Other Present Nuclear States

The USSR and the People's Republic of China are probably relatively immune to externally mounted attack because of the nature of these societies. An Entebbe type of attack on the PRC might be considered by its neighbors, but the risks and problems would be great.

The United Kingdom and Franc probably have far fewer nuclear weapons than the U.S. has in Europe. Most or all of these are kept on national territory, further reducing the risk. There appears to be no reasons to think that security over these weapons is less stringent than that of the U.S. since their safeguards on commercial fissile material seem to be comparable to that in the U.S. Security sources

have suggested, however, that some of the hardware such as PAL's and perimeter sensors may not be as sophisticated as those of the U.S. forces.

do Theft from Nth Countries

If proliferation continues, opportunities for theft will arise in the new nuclear states. It is, of course, impossible to predict with a high degree of confidence, how tight the security would be in these Nth countries. Some potential Nth countries have experienced turbulent domestic politics, including military interventions. This will increase the pressure for tight control to avoid losing the weapons to military factions and other non-state adversaries, and thus as a side effect to external attackers. Some nations, however, may lack the sophistication to develop devices such as PAL's. Their control mechanisms would consist of means such as leaving the weapons disassembled and the parts separately protected. This will decrease operational readiness and, therefore, military effectiveness Insecure nations may prefer, therefore, to risk unauthorized access. Another problem, though less likely, could be a general unwillingness to worry about physical security. The U.S. has gradually upgraded its protection level as appreciation of the magnitude of the growing threat increased. Nth countries may be slower in coming to this view, especially since good security is expensive.

One other potential threat is that of a military faction stealing their own weapons and black marketeering them. If security is lax and control not strictly organized, this could be fairly easy to do.

TABLE 1 SEPARABLE PLUTONIUM WITHIN RESEARCH AND POWER REACTOR SPENT FUEL

COUNTRY	ACCUMULATED (KG) OF SEPARABLE PLUTONIUM						ANNUAL PRODUCTION (KG) SEPARABLE PLUTONIUM					
	1974	1979	1984	1989	1994	1999	1974	1979	1984	1989	1994	1999
ARGENTINA	0	350	1,228	4,089	7,340	10,066	0	70	334	598	598	598
AUSTRALIA	11.9	15.4	18.9	22.4	25.9	29.4	.7	.7	.7	.7	.7	.7
BELGIUM	3.7	4.7	5.7	6.7	7.7	8.7	.2	.2	.2	.2	.2	.2
BRAZIL	0	85	866	7,101	16,874	26,619	0	113	329	1,715	1,949	1,949
CHILE												
CUBA												
DENMARK	9.9	13.2	16.5	19.8	23.1	26.4	.7	.7	.7	.7	.7	.7
EGYPT	0	0	216	1,836	3,456	5,076	0	0	108	324	324	324
GREECE												
INDIA	402	1,032	2,424	4,204	6,009	7,814	117	213	361	361	361	361
INDONESIA	0	0	216	2,592	5,202	7,812	0	0	108	522	522	522
IRAN	0	0	1,242	5,022	29,502	53,982	0	0	594	756	4,896	4,896
ISRAEL	18.7	27.2	33.7	648	1,188	1,728	1.7	1.7	1.7	108	108	108
ITALY	935	1,941	6,099	26,024	45,929	65,834	90	243	931	3,981	3,981	3,981
JAPAN	1,460	10,126	26,585	43,705	60,855	77,945	694	2,528	3,424	3,424	3,424	3,424
LIBYA												
NIGERIA												
NORTH KOREA												
NORWAY	26.5	35.2	43.9	52.6	61.3	70.0	1.8	1.8	1.8	1.8	1.8	1.8
PAKISTANM	64	201	605	1,405	2,205	3,005	28	28	160	160	160	160
PHILIPPINES	0	0	226	1,356	5,006	12,076	0	0	226	226	730	1,414
RUMANIA	0	0	316	1,791	3,266	4,741	0	0	79	295	295	295
SAUDI ARABIA												
SOUTH AFRICA	0	0	513	2,220	3,930	5,640	0	0	342	342	342	342
SOUTH KOREA	0	281	1,951	8,457	15,287	22,117	0	102	650	1,366	1,366	1,366
SPAIN	588	2,613	12,192	18,636	32,101	66,446	165	1,133	2,333	2,693	2,693	6,869
SWEDEN	212	3,169	10,654	20,589	30,524	40,459	228	962	1,987	1,987	1,987	1,987
SWITZERLAND	622	1,617	6,366	12,271	18,221	24,171	181	347	1,011	1,190	1,190	1,190
SYRIA												
TAIWAN	5.3	206	1,961	6,241	11,198	15,478	2.7	206	856	856	856	856
TURKEY	0	0	0	540	1,080	1,620	0	0	0	108	108	108
VENEZUELA												
WEST GERMANY	1,657	7,621	21,6$3	42,782	62,697	82,612	376	2,067	3,212	3,983	3,983	3,983
YUGOSLAVIA	9.9	13.2	915	2,370	3,825	5,280	0.7	0.7	291	291	291	291
ZAIRE												

SOURCES: DERIVED FROM PAN HEURISTICS, MOVING TOWARD LIFE IN A NUCLEAR ARMED CROWD?, PREPARED FOR THE U.S. ARMS CONTROL AND DISARMAMENT AGENCY, ACDA/PAB-263, APRIL 22, 1976 AND ATOMIC INDUSTRIAL FORUM NEWS RELEASE, "NUCLEAR POWER-PLANT COMMITMENTS OUTSIDE THE U.S. CLIMB17% IN YEAR," WASHINGTON, JUNE 2, 1976.

TABLE 2

FOREIGN STUDENTS IN THE UNITED STATES

COUNTRY	1972-1973		1973-1974		1974-1975
	TOTAL	ENGINEERING	TOTAL	ENGINEERING	TOTAL NON-IMMIGRANT
ARGENTINA	702	77	703	67	560
BRAZIL	1,560	266	1,713	258	1,970
CHILE	870	154	997	150	950
EGYPT	1,148	335	1,163	302	980
INDIA	10,656	4,615	10,168	3,912	9,660
INDONESIA	695	151	768	139	1,080
IRAN	7,838	3,744	9,623	4,393	13,780
IRAQ	361	103	376	93	420
ISRAEL	2,113	486	2,070	488	2,390
LIBYA	573	187	690	242	980
PAKISTAN	2,690	1,291	3,301	1,339	3,140
SAUDI ARABIA	943	297	1,074	300	1,540
SOUTH AFRICA	418	43	403	39	510
SOUTH KOREA	3,730	757	3,612	669	3,390
SPAIN	612	98	630	79	580
TAIWAN	9,633	2,676	8,416	2,018	10,250

SOURCE: OPEN DOORS, 1973,1974, 1975; INSTITUTE OF INTERNATIONAL EDUCATION.

(1) ESTIMATES FOR 1972-1973 AND 1973-1974 INCLUDE IMMIGRANT STUDENTS.
(2) COUNTING PROCEDURE SIGNIFICANTLY MODIFIED FOR 1974-1975 ESTIMATES PROVIDING A MUCH GREATER ACCURACY IN COUNT; EARLIER YEARS INCLUDED FOR ILLUSTRATIVE PURPOSES.

TABLE 3

INDIGENOUS TECHNICAL MANPOWER PRODUCTION (1)

POTENTIAL NTH COUNTRIES	ANNUAL OUTPUT (OF EARLY 1970s) NATURAL SCIENCE	ENGINEERS	TOTAL
Algeria	315	94	409
Argentina	617	2,486	3,103
Australia	4,704	3,288	7,992
Brazil	6,092	8,129	14,221
Chile	189	1,840	2,029
Cuba	350	646	996
Egypt	7,627	1,085	8,712
Greece	1,919	825	2,744
India	67,546	18,090	85,636
Indonesia	140	1,120	1,260
i ran	2,693	3,734	6,427
Iraq	'1,305	1,069	2,374
Israel	1,378	1,003	2,381
Italy	8,214	5,727	13,941
Japan	11,031	79,638	90,669
Libya	73	88	161
Nigeria	156	60	216
North Korea	NA	NA	--
Pakistan	5,746	1,169	6,915
Phillippines	1,431	4,256	5,687
Rumania	2,705	7,743	10,448
Saudi Arabia	73	82	155
South Africa	NA	NA	--
South Korea	2,968	10,080	13,048
Spain	2,657	6,332	8,989
Sweden	1,971	1,944	3,915
Switzerland	1,015	784	1,799
Syria	438	300	738
Taiwan	MA	NA	--
Turkey	2,081	3,797	S,878
Venezuela	71	664	735
West Germany	5,199	20,771	25,970
Yugoslavia	1,614	6,679	8,293
Zaire	78	71	149
Total	142,396	193,594	335,990

SOURCE: UNESCO Statistical Yearbook 1974, Table 5.3.

(1) THIS DATA REPRESENTS PRODUCTION OF COLLEGE LEVEL ENGINEERS. IT NEGLECTS INDIGENOUS EDUCATION OF TECHNICIANS AND ENGINEERING SUPPORT PERSONNEL.

Table 4

TRADE IN ENGINEERING PRODUCTS
1974
(IN MILLIONS OF U.S. DOLLARS)

BRAZIL	SOUTH AFRICA	9.5
	LIBYA	2.1
	ARGENTINA	52.3
	CHILE	25.5
	IRAN	1.2
	ISRAEL	.9
	SAUDI ARABIA	3.1
	INDONESIA	1.8
	SOUTH KOREA	.3
	PAKISTAN	.1
	SPAIN	1.8
	TURKEY	.1
SOUTH KOREA	SOUTH AFRICA	.2
	LIBYA	1.1
	ARGENTINA	4.0
	BRAZIL	.4
	CHILE	.2
	IRAN	1.3
	SPAIN	.2
	TURKEY	.1
	YUGOSLAVIA	.4
INDIA	SOUTH AFRICA	.1
	LIBYA	2.0
	IRAN	6.8
	SAUDI ARABIA	1.8
	INDONESIA	2.8
	SOUTH KOREA	.4
	YUGOSLAVIA	3.7
ISRAEL	SOUTH AFRICA	3.1
	ARGENTINA	.3
	BRAZIL	.1
	IRAN	21.9
	SOUTH KOREA	1.3
	SPAIN	.8
	YUGOSLAVIA	.1

Table 5

GROWTH IN THE WORLD TRADE OF ENGINEERING PRODUCTS
(IN CURRENT U.S. DOLLARS)

	REGIONS OF ORIGIN	
	DEVELOPED MARKET ECONOMIES	DEVELOPING COUNTRIES
1963	$ 31.0 BILLION	.2 BILLION
1965	39.2	0.3
1970	78.4	1.0
1971	91.1	1.3
1972	108.4	1.9
1973	142.0	3,2
1974	179.0	3.4

SOURCE: BULLETIN OF STATISTICS ON WORLD TRADE IN ENGINEERING PRODUCTS, Economic COMMISSION FOR EUROPE, UNITED NATIONS, E/F/R.76.11.E.7, 1976. TABLE 1A, PAGE 20.

Table 6

TRADE IN ENGINEERING PRODUCTS
(1974 TRADE IN MILLIONS OF U.S. DOLLARS)

SOURCE / DESTINATION	UNITED STATES	SOVIET UNION	WEST GERMANY	FRANCE	ITALY	UNITED KINGDOM	CANADA	JAPAN
ARGENTINA	192.9	1.9	146.3	51.6	92.5	42.9	25.9	55.6
BRAZIL	1,298.0	8.6	702.1	141.6	181.8	146.4	38.1	577.6
CHILE	139.8	---[1]	59.0	28.9	8.9	22.9	19.0	22.2
EGYPT	55.5	165.2	83.6	42.2	29.2	58.2	2.1	31.2
LIBYA	65.5	2.0	247.4	248.3	255.0	80.9	4.7	143.4
SAUDI ARABIA	424.2	1.2	177.9	50.9	57.7	135.3	9.8	298.8
INDIA	127.5	107.1	173.8	54.8	26.6	168.4	15.2	151.0
INDONESIA	236.7	5.1	200.5	61.6	29.5	64.3	8.8	602.3
PAKISTAN	145.8	14.8	58.2	28.9	20.0	66.1	8.6	98.0
SOUTH KOREA	367.8	---	90.5	24.4	11.4	70.2	7.8	1,046.5
IRAN	570.4	217.0	658.4	114.6	165.9	317.3	18.2	196.8
SOUTH AFRICA	547.5	---	839.7	202.9	193.4	652.2	39.0	455.6
IRAQ	123.6	120.3	252.8	91.9	46.4	64.9	1.1	95.9
SPAIN	584.9	3.3	840.7	464.5	385.5	230.9	29.4	114.0
ISRAEL	351.0	---	232.5	86.0	76.5	110.9	6.9	21.3
TURKEY	191.7	36.7	390.7	102.1	179.7	149.2	21.5	73.5
YUGOSLAVIA	141.1	110.8	740.2	132.7	324.3	105.5	7.9	24.4

[1]---INDICATES MAGNITUDE ZERO.

[2]DATA FOR TAIWAN NOT AVAILABLE FROM UNITED NATIONS SOURCES.

SOURCE: BULLETIN OF STATISTICS ON WORLD TRADE IN ENGINEERING PRODUCTS, 1974, UNITED NATIONS, ECONOMIC COMMISSION FOR EUROPE, E/F/R.76.11.E.7, NEW YORK, 1976.

Table 7

PRECEDENTS FOR THE MIGRATION AND MOBILITY OF TECHNICAL MANPOWER

	ENGINEERS	NATURAL SCIENTISTS
TO UNITED STATES, 1962-1966, FROM DEVELOPING NATIONS	19,055	7,793
TO UNITED STATES, 1972, FROM TAIWAN; INDIA, PAKISTAN, AND SOUTH KOREA	3,716	1,371
TO ISRAEL, 1967-1968, FROM UNITED STATES*	~3,000	

*OF WHICH THE NEW YORK TIMES [FEBRUARY 28, 1972, PAGE 2] SAID "... IS QUIETLY EMERGING AS ONE OF ISRAEL'S MOST IMPORTANT NATIONAL ASSETS FOR DEVELOPING THE COUNTRY'S LONG-RANGE POTENTIAL."

SOURCE: BRAIN DRAIN: A STUDY OF THE PERSISTENT ISSUE OF INTERNATIONAL SCIENTIFIC MOBILITY. PREPARED FOR THE SUBCOMMITTEE ON NATIONAL SECURITY POLICY AND SCIENTIFIC DEVELOPMENTS OF THE COMMITTEE ON FOREIGN AFFAIRS, U.S. HOUSE OF REPRESENTATIVES, U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON, SEPTEMBER 1974.

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