Terrorism and the Threat From
Weapons of Mass Destruction
in the Middle East

The Problem of Paradigm Shifts

Working Draft

Anthony H. Cordesman
Senior Fellow and Co-Director
Middle East Studies Program
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The literature on terrorism tends to have an unfortunate ritual character. First, there are the "alarmists" who make every incident into a megatrend, every possible scenario into a cause for immediate action, every contact and liaison between extremists into a network, and every hostile political faction into a super-intelligent nest of demons. These "alarmists" are supported by "techno-alarmists" who exaggerate the ease of weaponizing and using new terrorist devices and the vulnerabilities of modern societies by several orders of magnitude. Finally, they are supported by the "totalitarian solutionists" who support the alarmists by advocating solutions that would force the restructuring of modern societies -- often in ways whose consequences would be worse than the real-world problem -- and who often advocate unproven and extremely expensive technologies.

This terrorizing approach to terrorism may well have begun with Aesop's fable about the "boy who cried wolf" -- the boy being the world's first counter-terrorist. The eventual triumph of the wolf may also have led to the first counter-terrorism conspiracy theorist. There are equally strong indications that many writers about terrorism trace their intellectual roots to the story of "Chicken Little," the first

counter-terrorism expert to turn a minor incident into an announcement that the sky was falling.

In all seriousness, these tendencies to exaggerate the threat do much to explain why many politicians and officials tend to ignore warnings about terrorism. They also help explain why governments tend to work on the basis of bureaucratic momentum and focus on the terrorist threats they already know. The flood of warnings about possible threats, technologies, and vulnerabilities creates a "noise level" of potential demands that is impossible for governments to deal with. The end result is that bureaucracies often deal with possible threats by focusing on clich,s like strengthening coordination, by sub-optimizing on solutions that can only deal with a narrow range of threats, and by focusing only on those types of threats that have already been proven to exist.

At the same time, any one who has spent any time working on the problems posed by terrorism is struck by the fact that even paranoids face real terrorists. It is impossible to ignore the growing vulnerability of modern society, and the fact that major risks do exist. Similarly, it is impossible to study the subject without being struck by the gap that exists between the past failure of most terrorists to go beyond routine acts of violence and relatively minor attempts to use new techniques and technologies and the potential damage more effective forms of terrorism could do.

Ridiculous as most novels and screenplays about super-terrorists may be, they conceal the same kernel of truth as exaggerated warnings from experts on counter-terrorism. The impact of terrorism is currently far more limited by the failure or unwillingness of terrorists to exploit new technologies and complex vulnerabilities than by the inherent difficulty in conducting much more lethal attacks. The problem is not a lack of credible means to an end, but rather the lack of a real-world "Dr. No" or "Professor Moriarity."

Weapons of Mass Destruction and the Problem of Paradigm Shifts

Even a real-world "Dr. No" or "Professor Moriarity," however, would normally have a limited impact. As long as the emergence of a "super terrorist" was tied to conventional means of attack, the resulting threat or damage would not have strategic importance. The cost and casualties of such attacks might be much higher than those of conventional terrorism, but they would not pose an existential threat to the state under attack or force that state to make dramatic changes in its policies.

This is why governments can normally accept the cost of taking a reactive approach to potential new terrorist threats. It may be unpleasant to face the fact that accepting moderate casualties as the result of a new form of terrorist activity is more cost-effective than attempting to prevent all new forms of terrorism. The fact is, however, that people do die and many die violently. Every activity in government -- whether it is counter-terrorism, road repair, or medical treatment -- involves a tacit or explicit acceptance of actuarial trade-offs in cost-effectiveness in which a government accepts the death of its citizens in order to save money, preserve personal freedom, or concentrate on higher priority problems. It is scarcely important to the dead whether they have been killed by government choices regarding counter-terrorism or the funding of kidney transplants, and killed as a result of deliberate bureaucratic choices or a decision to ignore the actuarial consequences of public policy.

Accepting "Unacceptable" Risks

Given these realities, scenarios dealing with "super terrorism" must be kept in careful perspective. It is possible to postulate relatively high levels of casualties from terrorism using conventional weapons and technologies. Exploding a jumbo

jet, blowing up a crowded office building, destroying an isolated urban water supply, and destroying a key tunnel or bridge during peak traffic periods are typical cases in point. It is equally possible to postulate serious economic costs from new forms of terrorism like cyberterrorism and successful attacks on governmental data systems, national financial systems, and controls of key utility, energy processing and export facilities. Attacks on key leaders can destabilize or paralyze some governments, and attacks on religious or highly sensitive political symbols can trigger levels of political disorder and violence out of any proportion to the casualties and physical damage involved.

Nevertheless, it may be necessary to accept the cost of "unacceptable" risks. Bad as the consequences of such attacks may be, they will normally equate to the impact of the natural disasters that most societies can face and adapt to. Governments can afford to wait until they either must deal with an actual contingency, or have clear evidence and strategic warning of the need to make major shifts in their counter-terrorist activities.

Weapons of Mass Destruction and the "Paradigm Shift"

Weapons of mass destruction, however, present a different problem. Under many conditions, a single act of terrorism can kill thousands of people and/or induce levels of panic and political reaction that governments cannot easily deal with. Under some conditions, the use of weapons of mass destruction can pose an existential threat to the existing social and political structure of a small country -- particularly one where much of the population and governing elite is concentrated in a single urban area.

The comparative seriousness of these risks are illustrated in Table One, which summarizes the potential casualties resulting from the use of a weapon of mass destruction in an urban area similar to the capital or major urban center of most Middle Eastern countries.

Table One

Comparative Effects of Biological, Chemical, and Nuclear Weapons Delivered Against a Typical Urban Target in the Middle East

Using missile warheads : Assumes one Scud sized warhead with a maximum payload of 1,000 kilograms. The study assumes that the biological agent would not make maximum use of this payload capability because this is inefficient. It is unclear that this is realistic.

	Area Covered in Square Kilometers	**Deaths Assuming 3,000-10,000 people Per Square Kilometer**
Chemical : 300 kilograms of Sarin nerve gas with a density of 70 milligrams per cubic meter	0.22	60-200
Biological 30 kilograms of Anthrax spores with a density of 0.1 milligram per cubic meter	10	30,000-100,000
Nuclear : One 12.5 kiloton nuclear device achieving 5 pounds per cubic inch of over-pressure	7.8	23,000-80,000
One 1 megaton hydrogen bomb	190	570,000-1,900,000

Using one aircraft delivering 1,000 kilograms of Sarin nerve gas or 100 kilograms of anthrax spores : Assumes the aircraft flies in a straight line over the target at optimal altitude and dispensing the agent as an aerosol. The study assumes that the biological agent would not make maximum use of this payload capability because this is inefficient. It is unclear that this is realistic.

		Area Covered in Square Kilometers	**Deaths Assuming 3,000-10,000 people Per Square Kilometer**
Clear sunny day, light breeze	Sarin Nerve Gas	0.74	300-700
	Anthrax Spores	46	130,000-460,000
Overcast day or night, moderate wind	Sarin Nerve Gas	0.8	400-800
	Anthrax Spores	140	420,000-1,400,000
Clear calm night	Sarin Nerve Gas	7.8	3,000-8,000

	Anthrax Spores	300	1,000,000-3,000,000

Source: Adapted by the Anthony H. Cordesman from Office of Technology Assessment, Proliferation of Weapons of Mass Destruction: Assessing the Risks , US Congress OTA-ISC-559, Washington, August, 1993, pp. 53-54.

The data in Table One must be kept in careful perspective. They are drawn from sources designed to estimate the impact of efficient and well-designed military weapons, and it is unclear how the effects of a terrorist attack using improvised, non-military weapons would compare with those of such a military attack. On the one hand, a terrorist weapon might be substantially less lethal. On the other hand, a terrorist potentially could use a much larger device than could be carried by a missile, and could chose the best sunlight light and weather conditions for an attack. They might well be able to deliver biological agents covertly under optimal "line source" or aerosol conditions.

Further complications exist because the lethality data on the effects of biological and chemical weapons are notoriously uncertain, and many such data are exaggerated by the tendency of "technical experts" to exaggerate the threat from the weapon that is in their area of expertise. At the same time, losses could be worse if an attack involved a highly persistent chemical agent like VX, or a more lethal biological agent than anthrax. Further, the nuclear data include only prompt casualties (within 48-96 hours), and ignore the increase in the longer term death rate from radiation and fall out because no reliable system exists for estimating such losses.(1)

Critical assumptions are made in Table One about medical and emergency response capabilities and about warning and civil defense. Table One may exaggerate estimated casualties because they assume that no warning and major civil defense activities take place. These assumptions reduce estimated casualties, because they assume that wounded and infected personal receive adequate medical treatment from the facilities of an advanced industrialized

nation and large reserves of medical and emergency response personnel from outside the area under direct attack. This assumption is likely to sharply exaggerate the available medical resources in most Middle Eastern countries. The assumption of adequate medical and emergency response personnel is often heavily dependent on medical and emergency personnel fleeing the area under attack or immediately recognizing the true character of the attack and taking suitable precautions. Properly characterizing the attack may be impossible even for the most advanced countries, particularly if a new biological agent is used, if an agent is used whose effects take several days to become apparent, or if "cocktails" are used of different agents where the agent whose effects initially become apparent may lead to an emergency/medical response that exposes and kills a Middle Eastern nation's limited cadres of trained personnel. Further, untrained or highly motivated medical and emergency personnel tend to rush in to provide treatment, become exposed, and die.

What is clear is that Table One shows that a well-planned act of terrorism involving the use of weapons of mass destruction could involve a "paradigm shift" in the nature of terrorism and counter-terrorism. Unlike other forms of terrorism, Middle Eastern governments and societies might not be able to ride out a new form of attack. A successful act of mass terrorism could destroy a political elite, key elements of an economy, a key elite or element of a Middle Eastern society, or popular willingness to remain in a threatened state. It could have a massive impact on immigration/emigration in a nation like Israel, or the foreign labor forces in a Gulf state. It could have a major strategic impact on US public support for the deployment of US power projection forces.

The Strategic Uncertainties Inherent in Terrorism Using Weapons of Mass Destruction

Terrorist attacks using weapons of mass destruction would also involve far more than physical or human destruction. They would have political and strategic

motives that could radically alter the strategic situation. In a region like the Middle East, they could provoke a level of political reaction and/or escalation that could lead to massive retaliatory escalation or destroy the prospects of conflict resolution for years. At a minimum, neither Middle Eastern governments nor their peoples would have any experience in dealing with such an attack, and they would not have the time to adapt and learn provided by wartime preparations or a series of more conventional terrorist attacks.

These risks are illustrated in Table Two, and it is important to put these risks in perspective. Novels, movies, and war games can assume that such attacks would lead to a proportionate and carefully judged response by calculating rational bargainers -- particularly since most such scenarios and games deal with the risk by preventing an attack, minimizing the effect of an attack, or immediately containing the situation. Novels and screen plays can imagine a far-sighted or luck hero for every "Abu Moriarity" or "Dr. Ben No."

However, human history does not inspire similar confidence. Terrorists are not always "rational" or capable of dealing with their enemies in terms of shared values or restraint. Governments do not organize to deal with unanticipated threats or organize well for new threats. Heroes and heroines are rare, and the reactions of an attacked Middle Eastern state or people could be extremely dangerous and unpredictable. At some point, the survivors might well lash out in a mix of panic, hatred, fear, and revenge, and this seems to be particularly true if an attack is perceived as posing an existential threat.

Consider, for a moment, the real world problems that would be posed by a large-scale and successful terrorist use of weapons of mass destruction:

Unlike military attacks in war, the source of the attack might well be unknown. In the case of a biological, chemical, or radiological attack, the victim might not

detect the attack for a period of days or weeks. This was certainly the case during the Gulf War. The US initially estimated that none of its troops were exposed to chemical weapons, only to reach an estimate that more than 15,000 might have been exposed some five years later.(2)

While no one can dismiss the possibility that the attacker(s) would be too much of an egoist to remain silent, the attacker(s) would have every possible incentive to conduct such an attack covertly and to lay the ground work for a covert follow-on attack capability. There would also be a strong motive to lay a false trail and blame another movement or government for the attack, or to launch such an attack at a moment of high tension between two governments that the attacker(s) opposed.

It would often be impossible to distinguish the level of support for such an attack by an enemy state. The use of terrorist proxies might be impossible to distinguish from loose ties between a hostile government and an extremist movement. Some governments might also support a range of terrorist groups, knowing that the net result could be a serious attack with plausible deniability. The problem of identifying the real enemy could be critical.

The government of an attacked state may well not be prepared to deal with the problem of escalation, and might lack any structure and plans for dealing simultaneously with the impact of terrorism and a crisis in inter-state relations. The use of such weapons might be intended to destroy or prevent a peace process, rather than exacerbate a conflict. At the same time, such an attack might be so crippling that the victim might feel it could not accept the resulting losses without attacking an enemy state.

There would be no easy way for any one to characterize losses and damage. It is virtually certain that the attacker would lack any empirical basis for estimating the

end effect of a given attack, as would any hostile government using a terrorist proxy. The victim might find it extremely difficult to estimate even prompt losses and damage effects, and would face critical problems in estimating the impact of biological weapons or long-term radiation. "Cocktails" of different weapons could be used with different effects and target mixes. Friendly and hostile governments would have to rely on guesswork or the victim government. Media reporting would be virtually certain to vastly exaggerate the effect of such weapons and present a constant series of video horror shows, and public opinion would probably pay only limited attention to expert analysis.

Defense can be extremely difficult because it will usually be impossible to predict the method of attack. For example, the US has decided to immunize its troops against Anthrax because of evidence that this agent has been weaponized in the Middle East. A terrorist attack can chose from a wide range of different agents. Similarly a terrorist attack may occur from within a defensive perimeter, bypass any air and missile defenses, and/or be tailored to defeat national holdings of NBC detection, protection, and decontamination gear.

Medical services would be at high risk as the victims of direct attack or because of efforts to treat initial casualties that led to the death of medical and emergency personnel, and outside emergency response capability is likely to be extremely limited. Few governments are likely to train medical teams to flee the area under attack, and such training or guidance is unlikely to have much practical impact until medical and emergency response teams learn the hard way. Some biological weapons have no treatment -- a problem that could be greatly complicated by a "cocktail" of different weapons and the risk that a terrorist would use an infectious agents. No medical or emergency response team would have any practical experience with the particular weapon involved -- if it could even be promptly identified. There would be no little or no basis for triage or assessing the scale of the attack and future risks.

Police, intelligence, internal security, and military forces could take serious casualties -- including their top leadership. At the same time, most such forces would have little or no training to deal with such attacks and the threat of further prompt attacks. They would have no practical experience, and often would lack enough understanding of the attack and threat to properly respond.
All of the actors involved in preemption, retaliation, and every aspect of the escalation ladder in the transition from terrorism to an inter-state conflict would be operating under intense pressure and with minimal understanding of the crisis. There might be a strong rational case for the Middle Eastern state that became the subject of such an attack to wait until it could fully characterize the attack and know the cause, but" response but such an argument might prove irrelevant in a crisis. Further, might refuse to delay and let an opponent gain a decisive edge. or feel that they had to launch an immediate attack to prevent follow-on attacks and/or restraint by outside countries. Terrorism might catalyze a series of attacks by hostile states like Israel and Syria -- or Iran and Iraq -- in which the process of escalation rapidly degenerated into near chaos.

Outside aid, however well intentioned, could take considerable time to mobilize and might have to enter a nation or major urban area in a state of crisis or collapse. Efforts to negotiate some form of restraint or conflict limitation would also be confused and might lag badly behind the action-reaction cycle of states with weapons of mass destruction.

Unlike relations and conflicts between governments, where communication and experience tend to limit conflicts and establish a structured basis of deterrence, terrorism involving weapons of mass destruction has no rules. Such terrorism could instantly achieve higher levels of damage than most regional conventional wars. It could attack virtually any target set. It would have no clear level of restraint, there might be little or no fear of retaliation, and governments would have no way to evaluate the risk and nature of follow-on attacks. The complex

mix of political, social, and military relations shaping and stabilizing most state-to-state conflicts would be missing.

Table Two

The Problem of Terrorism and Unconventional Warfare

Existing and projected detection and control technologies, arms control proposals, and concepts for missile defense assume that the primary threats are organized states and that relatively large efforts must be used.

Conventional structures of deterrence assume identifiable and limited sets of opponents and similar values in dealing with issues like mutual destruction. Terrorist movements may be willing to take catastrophic risks, as may leaders who identify themselves with the state and/or see martyrdom as a valid alternative to victory.

War may not be between states or fought for limited strategic objectives. It may be a war of proxies or terrorists. It may be fought to destroy peoples or with minimal regard for collateral damage and risks.

The target of unconventional uses of weapons of mass destruction may not be military in the normal sense of the term. It may be a peace process, US commitment to the defense of a given region, a peacekeeping force, an election or ruling elite, or growing cooperation between formerly hostile groups. Terrorist organizations have already attempted to use crude chemical weapons. The development and use of chemical and biological weapons is well within the capability of many extremist and terrorist movements, and states can transfer weapons or aid such movements indirectly or with plausible deniability.

Covert or unconventional delivery means may be preferable to both states and non-state organizations. Cargo ships, passenger aircraft, commercial vehicles,

dhows, or commercial cargo shipments can all be used, and routed through multiple destinations. A well established series of covert transport and smuggling networks exist throughout the region. Biological weapons can be manufactured in situ.

The Marine Corps Barracks incident has already shown the potential value of "mass terrorism," as has the media impact of the Oklahoma City bombing and the disruptive effect of far more limited events like the suicide bombings by Hamas and the assassination of Yitzak Rabin.

Biological and chemical weapons present special problems because they can be used in so many ways. Chemical poisons have been used to contaminate Israeli fruit and Chilean food exports. Infectious biological agents could be used to mirror image local diseases, as well as agents with long gestation times. Persistent nerve agents could be used in subways, large buildings, shopping malls/bazaars, etc. to create both immediate casualties and long term risks. Mixes of biological and chemical agents could be used to defeat detection, protection gear or vaccines.

Arms control efforts assume large state efforts with detectable manufacturing and weaponization programs in peacetime. The development of a capability to suddenly manufacture several hundred biological and chemical weapons with little or no warning is well within the state of the art using nothing but commercial supplies and equipment, and much of the R&D effort could be conducted as civil or defensive research.

Unconventional and terrorist uses of weapons can involve the use of extremely high risk biological weapons transmitted by human carriers, commercial cargoes, etc.

The incentives for the unconventional use of weapons of mass destruction increase in proportion to the lack of parity in conventional weapons, the feelings of hopelessness of alienated or extremist groups, or the prospect of catastrophic defeat.

Similarly, the incentive for the unconventional use of weapons of mass destruction will increase in direct proportion to the perceived effectiveness of theater missile and other regular military defense systems.

Rogue operations will be a constant temptation for state intelligence groups, militant wings of extremist groups, revolutionary forces. etc.

Weapons of Mass Destruction and the Middle East

Many of the previous comments apply to any region in the world, but the Middle East is not any region. It is a region with a unique level of violence and a well established history of terrorism. It is also a region where Table Three shows that a process of creeping proliferation is becoming heavily institutionalized in nations such as Egypt, Iran, Iraq, Israel, Libya, Syria, and Yemen.

The Middle East is also a region where the lines between state activity and terrorism have long been blurred. Admittedly, the term "terrorist state" has become little more than an irritating strategic clich,, and there is no axiomatic correlation between state efforts at proliferation and terrorist access to weapons of mass destruction. At the same time, it would be naive to assume that states like Iran, Iraq, Libya, and Syria have no elements that would take the risk of supporting terrorists -- or "freedom fighters" -- that could be used as direct or indirect proxies and would never use the existence of such terrorists as covers for covert attacks.

Table Three makes such risks particularly clear in the case of Iraq, which has consistently proven it is a major risk taker. Table Three shows that Iraq deployed unsecured chemical and biological weapons in the desert, converted a vaccine plant to a major biological weapons plant in a matter of months, and deployed a "launch under attack" capability for its Scud missiles. Similarly, the risk of state terrorism clearly exists in Iran, Libya, and Syria -- risks that interact with the fact that Israel's reaction to a terrorist attack using weapons of mass destruction might involve miscalculation and massive escalation.

This process of creeping proliferation is also one that is almost certain to get worse with time. There currently are no meaningful prospects that arms control or peace negotiations will bring proliferation under control. Egypt and Israel have not been able to reach agreement to meet and discuss the issue. Iran, Iraq, Libya, and Syria show no interest in arms control. Iran and Iraq have already violated the Geneva Convention in using chemical weapons, and Iran and Iraq have both exploited the NPT and IAEA to obtain the nuclear technology needed for weapons. No meaningful means exists to control biological weapons technology, and efforts to control or delay nuclear proliferation may simply end in driving regional powers towards equally lethal efforts to develop biological weapons.

The end of the Cold War and break up of the Soviet Union has also given radical Middle Eastern states a new incentive to proliferate. No radical state can currently afford to maintain its present level of conventional forces or "recapitalize" them. Iran's annual weapons imports have dropped from a wartime peak of $3.1 billion in 1988, to $2.1 billion in 1991, $1.0 billion in 1993, and $390 million in 1994 (in constant 1984 dollars). Iraq's annual weapons imports dropped from a wartime peak of $12.9 billion in 1984, to $5.6 billion in 1988, $2.8 billion in 1990, and near zero ever since. Libya's annual weapons imports have dropped from a recent peak of $2.8 billion in 1984, to $1.3 billion in 1989, $410 million in

1991, and well under $50 million since 1992. Syria's annual weapons imports have dropped from a recent peak of $2.5 billion in 1987, to $1.1 billion in 1990, $825 million in 1991, $380 million in 1991, and well under $200 million ever since.

On the one hand, this is "good news" in terms of conventional war fighting capability. On the other hand, it further institutionalizes the process of proliferation and the value of "proxy wars" using terrorists, extremists, and "freedom fighters."(3)

Table Three
The Race for Weapons of Mass Destruction

Algeria

Delivery Systems

10 Su-24 long range strike aircraft.
40 MiG-23BN fighter ground attack aircraft.
Tube artillery and multiple rocket launchers.

Chemical Weapons

Possible development. No evidence of deployed systems.

Biological Weapons

Some early research activity.
No evidence of production capability.

Nuclear Weapons

Deliberately sought to create a covert nuclear research program under military control with Chinese support.
Exposure to public opinion and Western objections and economic/political crisis have largely halted further progress.

Libya

Delivery Systems

Has developed a liquid-fueled missile with a range of 200 kilometers.
Al-Fatih solid-fueled missile with 300-450 mile range reported to have been under development with aid of German technical experts, but no signs of successful development.

FROG-7 rocket launchers with 40 kilometer range.

Deployed 80 Scud B launchers with 190 mile range in 1976, but could not successfully operate system. Many of the launchers and missiles sold to Iran.
Purchased SS-N-2C and SSC-3 cruise missiles. Little operational capability.
Pursued other missile development programs with little success.
Tu-22 bombers with minimal operational capability.

Su-24 long range strike fighters. These are operational and have limited refueling capability using C-130s.

Operational Mirage 5D/DE and 10 Mirage 5DD fighter ground attack aircraft.

Mirage F-1AD fighter ground attack aircraft.

MiG-23BM Flogger F and 14 MiG-23U fighter ground attack.

Su-20 and Su-22 Fitter E, J, F fighter ground attack aircraft.

Tube artillery and multiple rocket launchers.

Fired Scud missiles against the Italian island of Lampadusa in 1987.

Chemical Weapons

Claims will not sign CWC as long as other states have nuclear weapons. May have used mustard gas delivered in bombs by AN-26 aircraft in final phases of war against Chad in September, 1987.

Nerve and mustard gas production facilities in an industrial park at chemical weapons plant at Rabta. This plant can produce both the poison gas and the bombs, shells, and warheads to contain it. There are probably two other research/batch production facilities.

Rabta Plant seems to have started test runs in mid-1988.

At least 100 metric tons of blister and nerve agents produced at Rabta.

Fabricated fire at Rabta in 1990 to try to disguise function.

Additional major chemical weapons plant in construction in extensive underground site near Tarhunah, a mountainous area 60 kilomters south of Tripoli.

Unconfirmed reports of shipments of chemical weapons to Syria and Iran do not seem valid. Very low quality weapons designs with poor fusing and lethality.

Biological Weapons

Some early research activity.
No evidence of production capability.

Nuclear Weapons

Has sought to create a development and production capability, but no evidence of any real progress or success. Small nuclear research reactor at Tajura acquired from the USSR in 1970s.

Ratified NPT in 1975. Declares all facilities under IAEA safeguards.

Continues to train nuclear scientists and technicians abroad.

Egypt

Delivery Systems

Cooperation with Iraq in paying for development and production of "Badar 2000" missile with a 750-1,000 kilometer range. This missile is reported to be a version of the Argentine Condor II or Vector missile. Ranges were reported from 820-980 kilometers, with the possible use of an FAE warhead.

Egyptian officers were arrested for trying to smuggle carbon materials for a missile out of the US. in June 1988. Covert US efforts seem to have blocked this development effort.

Cooperation with Iraq and North Korea in developing the Saqr 80 missile This rocket is 6.5 meters long, 210 mm in diameter, and weighs 660 kilograms. It has a maximum range of 50 miles (80 kilometers) and a 440 pound (200 kilogram) warhead. Longer range versions may be available.

Reports has developed plant to produce an improved version of the Scud B, with North Korean cooperation.

Reports in June, 1996 that has made major missile purchase from North Korea, and will soon be able to assemble such missiles in Egypt. US satellites seem to have detected shipments of Scud C missile parts to Egypt in February-May,

including rocket motors and guidance devices. The Scud C has a range of roughly 480 kilometers.

Has Scud B TELS and missiles with approximately 100 missiles with 300 kilometers range.

FROG 7 rocket launch units with 40 kilometers range.
AS-15, SS-N-2, and CSS-N-1 cruise missiles.
F-4E fighter ground attack aircraft.
Mirage 5E2 fighter ground attack.
Mirage 2000EM fighters.
F-16A and 80 F-16C fighters.
Multiple rocket launcher weapons.
Tube artillery.

Chemical Weapons
Produced and used mustard gas in Yemeni civil war in 1960s, but agents may have been stocks the British abandoned in Egypt after World War II. Effort was tightly controlled by Nasser and was unknown to many Egyptian military serving in Yemen.

Completed research and designs for production of nerve and cyanide gas before 1973.

Former Egyptian Minister of War, General Abdel Ranny Gamassay stated in 1975, that, "if Israel should decide to use a nuclear weapon in the battlefield, we shall use the weapons of mass destruction that are at our disposal."(4)
Seems to have several production facilities for mustard and nerve gas. May have limited stocks of bombs, rockets, and shells.

Unconfirmed reports of recent efforts to acquire feed stocks for nerve gas. Some efforts to obtain feed stocks from Canada. May now be building feed stock plants in Egypt. Industrial infrastructure present for rapid production of cyanide gas.

Biological Weapons
Research and technical base.
No evidence of major organized research activity.

Nuclear Weapons
Low level research effort. No evidence of more than basic research since the 1960s.

Israel

Delivery Systems
New IRBM/ICBM range high payload booster developed with South Africa.
Up to 50 "Jericho I" missiles deployed in shelters on mobile launchers with up to 400 miles range with a 2,200 pound payload, and with possible nuclear warhead storage nearby. Unverified claims that up to 100 missiles are deployed west of Jerusalem.

Jericho II missiles now deployed, and some were brought to readiness for firing during the Gulf War. These missiles seem to include a single stage follow-on to the Jericho I and a multistage longer range missile. The latter missile seems to have a range of up to 900 miles with a 2,200 pound payload, and may be a cooperative development with South Africa. (Extensive reporting of such cooperation was in the press during October 25 and 26, 1989).
Jericho II missile production facility at Be'er Yakov.

A major missile test took place on September 14, 1989. It was either a missile test or failure of Ofeq-2 satellite.

Work on development of TERCOM type smart warheads. Possible cruise missile guidance developments using GPS navigation systems.

F-15, F-16, F-4E, and Phantom 2000 fighter-bombers capable of long range refueling and of carrying nuclear and chemical bombs.

Lance missile launchers and 160 Lance missiles with 130 kilometers range.
MAR-290 rocket with 30 kilometers range believed to be deployed.
Popeye air-to-surface missile may have nuclear variant.
MAR-350 surface-to-surface missile with range of 56 miles and 735 lb. payload believed to have completed development or to be in early deployment.
Israel seeking super computers for Technion Institute (designing ballistic missile RVs), Hebrew University (may be engaged in hydrogen bomb research), and Israeli Military Industries (maker of "Jericho II" and Shavit booster).

Chemical Weapons
Reports that mustard and nerve gas production facility was established in 1982 in the restricted area in the Sinai near Dimona do not seem correct. May have some facilities. May have capacity to produce other gases. Probable stocks of bombs, rockets, and artillery.
Extensive laboratory research into gas warfare and defense.
Development of defensive systems includes Shalon Chemical Industries protection gear, Elbit Computer gas detectors, and Bezal R&D air crew protection system.
Extensive field exercises in chemical defense.
Gas masks stockpiled, and distributed to population with other civil defense

instructions during Gulf War.
Warhead delivery capability for bombs, rockets, and missiles, but none now believed to be equipped with chemical agents.

Biological Weapons
Extensive research into weapons and defense.
Ready to quickly produce biological weapons, but no reports of active production effort.

Nuclear Weapons
Director of CIA indicated in May 1989 that Israel might be seeking to construct a thermonuclear weapon.
Estimates of numbers and types of weapons differ sharply.
At least a stockpile of 60-80 plutonium weapons. May have well over 100 nuclear weapons assemblies, with some weapons with yields over 100 Kilotons, and some with possible ER variants or variable yields.
Stockpile of up to 200-300 weapons is possible.
Possible facilities include production of weapons grade Plutonium at Dimona, nuclear weapons design facility at Soreq (south of Tel Aviv), missile test facility at Palmikim, nuclear armed missile storage facility at Kefar Zekharya, nuclear weapons assembly facility at Yodefat, and tactical nuclear weapons storage facility at Eilabun in eastern Galilee.

Missile Defenses
Patriot missiles with future PAC-3 upgrade to reflect lessons of the Gulf War.
Arrow 2 two-stage ATBM with slant intercept ranges at altitudes of 8-10 and 50 kilometers speeds of up to Mach 9, plus possible development of the Rafale AB-10 close in defense missile with ranges of 10-20 kilometers and speeds of up to Mach 4.5. Tadiran BM/C4I system and "Music" phased array radar. Israel plans to deploy two batteries of the Arrow to cover Israel, each with four launchers, to

protect up to 85% of its population.(5)

Advanced Intelligence Systems

The Shavit I launched Israel's satellite payload on September 19, 1989. It used a three stage booster system capable of launching a 4,000 pound payload over 1,200 miles or a 2,000 pound payload over 1,800 miles.

Ofeq 2 launched in April, 1990 -- one day after Saddam Hussein threatened to destroy Israel with chemical weapons if it should attack Baghdad. Launched first intelligence satellite on April 5, 1995, covering Syria, Iran, and Iraq in orbit every 90 minutes.

The Ofeq 3 satellite is a 495 pound system launched using the Shavit launch rocket, and is believed to carry an imagery system. Its orbit passes over or near Damascus, Tehran, and Baghdad.(6)

Syria

Delivery Systems

Four SSM brigades: 1 with FROG, 1 with Scud Bs, 1 with Scud Cs, and 1 with SS-21s.

New long range North Korean Scud Cs, with ranges of up to 600 kilometers and possible nerve gas warheads, now being deployed. Seems to have 6-12 launchers deployed.

May be converting some long range surface-to-air and naval cruise missiles to use chemical warheads.

18 SS-21 launchers and at least 36 SS-21 missiles with 80-100 kilometers range. May be developing chemical warheads.

Up to 12 Scud B launchers and Scud B missiles with 310 kilometers range. Believed to have chemical warheads.

Short range M-1B missiles (up to 60 miles range) seem to be in delivery from

PRC.
Reports of PRC deliveries of missile components by China Precision Machinery Company, maker of the M-11, in July, 1996. The M-11 has a 186 mile range with a warhead of 1,100 pounds.
SS-N-3, and SSC-1b cruise missiles.
20 Su-24 long range strike fighters.
30-60 operational MiG-23BM Flogger F fighter ground attack aircraft.
20 Su-20 fighter ground attack aircraft.
60-70 Su-22 fighter ground attack aircraft.
18 FROG-7 launchers and rockets.
Negotiations for PRC-made M-9 missile (185-375 mile range).
Multiple rocket launchers and tube artillery.

Chemical Weapons

Major nerve gas, and possible other chemical agent production facilities north of Damascus. Two to three plants.
Building new major plant near Aleppo.
Unconfirmed reports of sheltered Scud missiles with Sarin or Tabun nerve gas warheads deployed in caves and shelters near Damascus.
Shells, bombs, and nerve gas warheads for multiple rocket launchers.
FROG warheads under development.
Reports of SS-21 capability to deliver chemical weapons are not believed by US or Israeli experts.
Israeli sources believe Syria has binary weapons and cluster bomb technology suitable for delivering chemical weapons.
Experts believe has stockpiled 500 to 1,000 metric tons of chemical agents.

Biological Weapons

Extensive research effort.
Probable production capability for anthrax and botulism, and possibly other

agents.

Nuclear Weapons

Ongoing research effort.

No evidence of major progress in development effort.

Iran

Delivery Systems

Has new long range North Korean Scuds - with ranges near 500 kilometers. May manufacture missiles in Iran in future, possibly as cooperative effort with Syria.

Probably has ordered North Korean No Dong missile which can carry nuclear and biological missile ranges of up to 900 kilometers. Can reach virtually any target in Gulf, Turkey, and Israel, although CIA now estimates deliveries will only begin in 1997-1999.(7)

Su-24 long-range strike fighters with range-payloads roughly equivalent to US F-111 and superior to older Soviet medium bombers.

Reports of North Korean delveries of 100 Scud Bs and 100 Scud C between 1990 and 1996.

Bought CSS-8 surface-to-surface missiles from China with ranges of 130-150 kilometers.

Used regular Scud extensively during Iran-Iraq War. Has 6-12 Scud launchers and up to 200 Scud B (R-17E) missiles with 230-310 KM range. Scud missiles were provided by Libya and North Korea.

May have placed order for PRC-made M-9 missile (280-620 kilometers range). More likely that PRC is giving assistance in missile R&D and production facilities.

Iranian made IRAN 130 rocket with 150+ kilometers range.

Iranian Oghab (Eagle) rocket with 40+ kilometers range.

New SSM with 125 mile range may be in production, but could be modified

FROG.
F-4D/E fighter bombers with capability to carry extensive payloads to ranges of 450 miles.
Can modify HY-2 Silkworm missiles and SA-2 surface-to-air missiles to deliver weapons of mass destruction.
Large numbers of multiple rocket launchers and tube artillery for short range delivery of chemical weapons.
Experimenting in cruise missile development.

Chemical Weapons

At least two major research and production facilities.
India is assisting in the construction of a major new plant at Qazvim, near Tehran, to manufacture phosphorous pentasulfide, a major precursor for nerve gas. The plant is front by Meli Agrochemicals, and the program was negotiated by Dr. Mejid Tehrani Abbaspour, a chief security advisor to Rafsanjani.
Made limited use of chemical weapons at end of the Iran-Iraq War.
Began to create stockpiles of cyanide (cyanogen chloride), phosgene, and mustard gas weapons after 1985.
Include bombs and artillery.
Production of nerve gas weapons started no later than 1994.

Biological Weapons

Extensive laboratory and research capability.
Weapons effort documented as early as 1992.
Bioresearch effort sophisticated enough to produce biological weapons as lethal as small nuclear weapons.
Seems to have the production facilities to make dry storable weapons. This would allow it to develop suitable missile warheads and bombs and covert devices.
May be involved in active weapons production, but no evidence to date that this

is the case.

Nuclear Weapons

In 1984, revived nuclear weapons program begun under Shah.

Received significant West German and Argentine corporate support in some aspects of nuclear technology during the Iran-Iraq War..

Limited transfers of centrifuge and other weapons related technology from PRC, possibly Pakistan.

Stockpiles of uranium and mines in Yazd area.

Seems to have attempted to buy fissile material from Khazakstan.

Russian agreement to build up to four reactors, beginning with a complex at Bushehr -- with two 1,000-1,200 megawatt reactors and two 465 megawatt reactors, and provide significant nuclear technology.

Chinese agreement to provide significant nuclear technology transfer and possible sale of two 300 megawatt pressurized water reactors.

No way to tell when current efforts will produce a weapon, and unclassified lists of potential facilities have little credibility. We simply do not know where Iran is developing its weapons. IAEA has found no indications of weapons effort, but found no efforts in Iraq in spring of 1990. IAEA only formally inspects Iran's small research reactors. Its visits to other Iranian sites are not thorough enough to confirm or deny whether Iran has such activities.

Timing of weapons acquisition depends heavily on whether Iran can buy fissile material -- if so it has the design capability and can produce weapons in 1-2 years -- or must develop the capability to process Plutonium or enrich Uranium -- in which case, it is likely to be 5-10 years.

Iraq

Delivery Systems

Prior to the Gulf War, Iraq had extensive delivery systems incorporating long-

range strike aircraft with refueling capabilities and several hundred regular and improved, longer-range Scud missiles, some with chemical warheads. These systems included:

Tu-16 and Tu-22 bombers.

MiG-29 fighters.

Mirage F-1, MiG-23BM, and Su-22 fighter attack aircraft.

A Scud force with a minimum of 819 missiles.

Extended range Al-Hussein Scud variants (600 kilometer range) extensively deployed throughout Iraq, and at three fixed sites in northern, western, and southern Iraq..

Developing Al-Abbas missiles (900 kilometer range) Al-Abbas which could reach targets in Iran, the Persian Gulf, Israel, Turkey, and Cyprus.

Long-range super guns with ranges of up to 600 kilometers.

Iraq also engaged in efforts aimed at developing the Tamuz liquid fuel led missile with a range of over 2,000 kilometers, and a solid fueled missile with a similar range. Clear evidence that at least one design was to have a nuclear warhead.

Iraq attempted to conceal a plant making missile engines from the UN inspectors. It only admitted this plant existed in 1995, raising new questions about how many of its missiles have been destroyed.

Iraq produced or assembled 80 Scud missiles it its own factories. Some 53 seem to have been unusable, but 10 are still unaccounted for.

Had designed work underway for a nuclear warhead for its long range missiles.

The Gulf War deprived Iraq of some of its MiG-29s, Mirage F-1s, MiG-23BMs, and Su-22s.

Since the end of the war, the UN inspection regime has also destroyed many of Iraq's long-range missiles. Iraq, however, maintains a significant delivery capability consisting of:

HY-2, SS-N-2, and C-601 cruise missiles, which are unaffected by UN cease-fire terms.

FROG-7 rockets with 70 kilometer ranges, also allowed under UN resolutions.

Multiple rocket launchers and tube artillery.
Several Scud launchers
Iraq claims to have manufactured only 80 missile assemblies, 53 of which were unusable.
UNSCOM claims that 10 are unaccounted for.
US experts believe Iraq may still have components for several dozen extended-range Scud missiles.
In addition, Iraq has admitted to:
Hiding its capability to manufacturing its own Scuds.
Developing an extended range variant of the FROG-7 called the Laith. The UN claims to have tagged all existing FROG-7s to prevent any extension of their range beyond the UN imposed limit of 150 kilometers for Iraqi missiles.
Experimenting with cruise missile technology and ballistic missile designs with ranges up to 3,000 kilometers.
Flight testing Al-Hussein missiles with chemical warheads in April 1990.
Developing biological warheads for the Al Hussein missile as part of Project 144 at Taji.
Initiating a research and development program for a nuclear warhead missile delivery system.
Successfully developing and testing a warhead separation system.
Indigenously developing, testing, and manufacturing advanced rocket engines to include liquid-propellant designs.
Conducting research into the development of Remotely Piloted Vehicles (RPVs) for the dissemination of biological agents.
Attempting to expand its Ababil-100 program designed to build surface-to-surface missiles with ranges beyond the permitted 100-150 kilometers.
Starting an indigenous 600 mm supergun design effort.
Starting additional long-range missile programs, with ranges of 900, 2000, and 3,000 kilometers. US and UN officials conclude further that:
Iraq is concentrating procurement efforts on rebuilding its ballistic missile

program using a clandestine network of front companies to obtain the necessary materials and technology from European and Russian firms.
This equipment is then concealed and stockpiled for assembly concomitant with the end of the UN inspection regime.
The equipment clandestinely sought by Iraq includes advanced missile guidance components, such as accelerometers and gyroscopes, specialty metals, special machine tools, and a high-tech, French-made, million-dollar furnace designed to fabricate engine parts for missiles.
Jordan found that Iraq was smuggling missile components through Jordan in early December, 1995.
US satellite photographs reveal that Iraq has rebuilt its Al-Kindi missile research facility.
Iraq retains the technology it acquired before the war and evidence clearly indicates an ongoing research and development effort, in spite of the UN sanctions regime.
The fact that the agreement allows Iraq to continue producing and testing short range missiles (less than 150 kilometers range) has meant it can retain significant missile efforts.

Chemical Weapons

In revelations to the UN, Iraq admitted that, prior to the Gulf War, it:
Maintained large stockpiles of mustard gas, and the nerve agents Sarin and Tabun.
Produced binary Sarin filled artillery shells, 122 mm rockets, and aerial bombs.
Manufactured enough precursors to produce 490 tons of the nerve agent VX.
These precursors included 65 tons of choline and 200 tons of phosphorous pentasulfide and di-isopropylamine Tested Ricin, a deadly nerve agent, for use in artillery shells.
Had three flight tests of long range Scuds with chemical warheads.
Had large VX production effort underway at the time of the Gulf War. The

destruction of the related weapons and feedstocks has been claimed by Iraq, but not verified by UNSCOM The majority of Iraq's chemical agents were manufactured at a supposed pesticide plant located at Muthanna.
Various other production facilities were also used, including those at Salman Pak, Samara, and Habbiniyah. Though severely damaged during the war, the physical plant for many of these facilities has been rebuilt.
Iraq possessed the technology to produce a variety of other persistent and non-persistent agents.
The Gulf War and subsequent UN inspection regime may have largely eliminated these stockpiles and reduced production capability.
US experts believe Iraq has concealed significant stocks of precursors. It also appears to retain significant amounts of production equipment dispersed before, or during, Desert Storm and not recovered by the UN.
Iraq has developed basic chemical warhead designs for Scud missiles, rockets, bombs, and shells.
Iraq also has spray dispersal systems.
Iraq maintains extensive stocks of defensive equipment.
The UN maintains that Iraq is not currently producing chemical agents, but the UN is also concerned that Iraq has offered no evidence that it has destroyed its VX production capability and/or stockpile.
Further, Iraq retains the technology it acquired before the war and evidence clearly indicates an ongoing research and development effort, in spite of the UN sanctions regime.
Recent UNSCOM work confirms that Iraq did deploy gas-filled 155 mm artillery and 122 mm multiple rocket rounds into the rear areas of the KTO during the Gulf War.
These weapons had no special visible markings, and were often stored in the same area as conventional weapons.
Now has the technology to produce stable, highly lethal VX gas with long storage times.

Has developed improved binary weapons since the Gulf War.

Biological Weapons

Had highly compartmented "black" program with far tighter security regulations than chemical program.

Had 18 major sites for some aspect of biological weapons effort before the Gulf War. Most were non-descript and have no guards or visible indications they were a military facility.

The US targeted only one site during the Gulf War. It struck two sites, one for other reasons. It also struck at least two targets with no biological facilities that it misidentified.

Systematically lied about biological weapons effort until 1995. First stated that had small defensive efforts, but no offensive effort. In July, 1995, admitted had a major offensive effort. In October, 1995, finally admitted major weaponization effort.

Iraq has continued to lie about its biological weapons effort since October, 1995. It has claimed the effort is head by Dr. Taha, a woman who only headed a subordinate effort. It has not admitted to any help by foreign personnel or contractors. It has claimed to have destroyed its weapons, but the one site UNSCOM inspectors visited showed no signs of such destruction and was later said to be the wrong site. It has claimed only 50 people were employed full time, but the scale of the effort would have required several hundred.

The August 1995 defection of Lieutenant General Hussein Kamel Majid, formerly in charge of Iraq's weapons of mass destruction, revealed the extent of this biological weapons program. Reports indicate that Iraq tested at least 7 principal biological agents for use against humans.

Anthrax, Botulinum, and Aflatoxin known to be weaponized.

Looked at viruses, bacteria, and fungi. Examined the possibility of weaponizing Gas Gangrene and Mycotoxins. Some field trials were held of these agents.

Examined foot and mouth disease, haemorrhagic conjunctivitis virus, rotavirus,

and camel pox virus.
Conducted research on a "wheat pathogen" and a Mycotoxin similar to "yellow rain" defoliant. The "wheat smut" was first produced at Al Salman, and then put in major production during 1987-1988 at a plant near Mosul. Iraq claims the program was abandoned.
The defection prompted Iraq to admit that it:
Imported 39 tons of growth media for biological agents obtained from three European firms. According to UNSCOM, 17 tons remains unaccounted for. Each ton can be used to produce 10 tons of bacteriological weapons.
Imported type cultures which can be modified to develop biological weapons from the US.
Had a laboratory- and industrial-scale capability to manufacture various biological agents including the bacteria which cause anthrax and botulism; aflatoxin, a naturally occurring carcinogen; clostridium perfringens, a gangrene-causing agent; the protein toxin ricin; tricothecene mycotoxins, such as T-2 and DAS; and an anti-wheat fungus known as wheat cover smut. Iraq also conducted research into the rotavirus, the camel pox virus and the virus which causes haemorrhagic conjunctivitis.
Created at least seven primary production facilities including the Sepp Institute at Muthanna, the Ghazi Research Institute at Amaria, the Daura Foot and Mouth Disease Institute, and facilities at Al-Hakim, Salman Pak Taji, and Fudaliyah.
According to UNSCOM, weaponization occurred primarily at Muthanna through May, 1987 (largely Botulinum), and then moved to Al Salman.
(Anthrax). In March, 1988 a plant was open at Al Hakim, and in 1989 an Aflatoxin plant was set up at Fudaliyah.
Manufactured 6,000 liters of concentrated Botulinum toxin and 8,425 liters of anthrax at Al-Hakim during 1990; 5400 liters of concentrated Botulinum toxin at the Daura Foot and Mouth Disease Institute from November 1990 to January 15, 1991; 400 liters of concentrated Botulinum toxin at Taji; and 150 liters of concentrated anthrax at Salman Pak. Produced 1,850 liters of Aflatoxin in

solution at Fudaliyah.
Produced 340 liters of concentrated clostridium perfringens, a gangrene-causing biological agent, beginning in August, 1990.
Produced 10 liters of concentrated Ricin at Al Salam. Claim abandoned work after tests failed. Had at least 79 civilian facilities capable of playing some role in biological weapons production still extent in 1995.
Took fermenters and other equipment from Kuwait to improve effort during the Gulf War.
Extensive weaponization program Had test site about 200 kilometers west of Baghdad, used animals in cages and tested artillery and rocket rounds against live targets at ranges up to 16 kilometers.
Armed 155 mm artillery shells and 122 mm rockets with biological agents.
Conducted field trials, weaponization tests, and live firings of 122 mm rockets armed with anthrax and Botulinum toxin from March 1988 to May 1990.
Tested ricin, a deadly protein toxin, for use in artillery shells.
Iraq produced at least 191 bombs and missile warheads with biological agents.
Developed and deployed 250 pound aluminum bombs coverage in fiberglass.
Bombs were designed so they could be mounted on both Soviet and French-made aircraft. They were rigged with parachutes for low altitudes drops to allow efficient slow delivery and aircraft to fly under radar coverage.
Deployed at least 166 R-400 bombs with 85 liters of biological agents each during the Gulf War. Deployed them at two sites, One was near an abandoned runway where it could fly in aircraft, arm them quickly, and disperse with no prior indication of activity and no reason for the UN to target the runway.
Total production reached at least 19,000 liters of concentrated Botulinum (10,000 liters filled into munitions);
8,500 liters of concentrated Anthrax (6,500 liters filled into munitions); and 2,500 liters of concentrated Aflatoxin (1,850 liters filled into munitions).
Weaponized at least three biological agents for use in the Gulf War. The weaponization consisted of at least 100 bombs and 15 missile warheads loaded

with Botulinum. There were at least 50 R-400 air-delivered bombs and 10 missile warheads loaded with anthrax; and 16 missile warheads loaded with Aflatoxin, a natural carcinogen. The warheads were designed for operability with the Al-Hussein Scud variant.

Developed and stored drops tanks ready for use for three aircraft or RPV s with the capability of dispersing 2,000 liters of anthrax. Development took place in December 1990. Claimed later that tests showed were ineffective.
Found, however, that Iraqi Mirages were given spray tanks to disperse biological agents. Held trials as late as January 13, 1991. The Mirages were chosen because they have large 2,200 liter belly tanks and could be refueled by air, giving them a long endurance and strike range.

The tanks had electric valves to allow the agent to be released and the system was tested by releasing simulated agent into desert areas with scattered petri dishes to detect the biological agent. UNSCOM has video tapes of the aircraft.
Project 144 at Taji produced at least 25 operational Al Hussein warheads. Ten of these were hidden deep in a railway tunnel, and 15 in holes dug in an unmanned hide site along the Tigris.

Equipped crop spraying helicopters for biological warfare and held exercises and tests simulating the spraying of anthrax spores. Biological weapons were only distinguished from regular weapons by a black stripe.
The UN claims that Iraq has offered no evidence to corroborate its claims that it destroyed its stockpile of biological agents after the Gulf War. Further, Iraq retains the technology it acquired before the war and evidence clearly indicates an ongoing research and development effort, in spite of the UN sanctions regime.
UN currently inspects 79 sites -- 5 used to make weapons before war; 5 vaccine or pharmaceutical sites; 35 research and university sites; thirteen breweries,

distilleries, and dairies with dual-purpose capabilities; eight diagnostic laboratories.

Retains laboratory capability to manufacture various biological agents including the bacteria which cause anthrax, botulism, tularemia and typhoid.
Many additional civilian facilities capable of playing some role in biological weapons production.

Nuclear Weapons
Inspections by UN teams have found evidence of two successful weapons designs, a neutron initiator, explosives and triggering technology needed for production of bombs, plutonium processing technology, centrifuge technology, Calutron enrichment technology, and experiments with chemical separation technology.

Iraq used Calutron, centrifuges, plutonium processing, chemical defusion and foreign purchases to create new production capability after Israel destroyed most of Osiraq.

Iraq established a centrifuge enrichment system in Rashidya and conducted research into the nuclear fuel cycle to facilitate development of a nuclear device. After invading Kuwait, Iraq attempted to accelerate its program to develop a nuclear weapon by using radioactive fuel from French and Russian-built reactors. It made a crash effort in September, 1990 to recover enriched fuel from its supposedly safe-guarded French and Russian reactors, with the goal of producing a nuclear weapon by April, 1991. The program was only halted after Coalition air raid destroyed key facilities on January 17, 1991.
Iraq conducted research into the production of a radiological weapon, which disperses lethal radioactive material without initiating a nuclear explosion.

Orders were given in 1987 to explore the use of radiological weapons for area denial in the Iran-Iraq War.

Three prototype bombs were detonated at test sites -- one as a ground level static test and two others were dropped from aircraft.

Iraq claims the results were disappointing and the project was shelved but has no records or evidence to prove this. UN teams have found and destroyed, or secured, new stockpiles of illegal enriched material, major production and R&D facilities, and equipment-- including Calutron enriching equipment. UNSCOM believes that Iraq's nuclear program has been largely disabled and remains incapacitated, but warns that Iraq retains substantial technology and establish a clandestine purchasing system in 1990 that it has used to import forbidden components since the Gulf War. Iraq still retains the technology developed before the Gulf War and US experts believe an ongoing research and development effort continues, in spite of the UN sanctions regime.
A substantial number of declared nuclear weapons components and research equipment has never been recovered. There is no reason to assume that Iraqi declarations were comprehensive.

Source: Prepared by Anthony H. Cordesman, Co-Director, Middle East Program, CSIS

Terrorism and Weapons of Mass Destruction in the Middle East

It should be stressed that the risks of terrorism using weapons of mass destruction are now largely theoretical. There are few actual indicators of Middle

Eastern terrorist activity involving weapons of mass destruction. A few crude devices have been detected using explosives and chemical agents (grenades with a small canister of mustard gas). The Iranian Republic Guards, which are a key source of Iranian support to extremists, do operate many of Iran's chemical and biological weapons and missiles. Highly political elements of Iraq's armed forces, intelligence branches, and military procurement offices have purchased dual-use items or managed missile and WMD programs. There have been some scattered efforts by extremist movements to examine biological technology, and some crude efforts to modify insecticides, and poison fruit and vegetable exports. However, there have been no "Dr. Ben Nos" and "Professor Abu Moriarities", and there only have been hints that states are considering direct or proxy support of terrorism and unconventional warfare using weapons of mass destruction.
At the same time, the question arises as to whether Middle Eastern states can rely on effective strategic warning or a reactive approach to this problem. Most new terrorist groups get at least one "free ride" or attack before their existence and/or true character is detected. An effective "super terrorist" would also have a number of major advantages over any state or conventional enemy. Virtually any means of delivery could be used. The weapon would not have to be stable, reliable, or safe This would allow the use of chemical weapons that would not be safe to militarize, and even infectious biological agents. Damage effects could be highly unpredictable since the objective would often be terror, and not predictable tactical and/or strategic effects.

Delayed effects and prolonged contamination would often be desirable. Martyrdom and/or lack of attribution would sometimes be acceptable. States supporting proxy efforts could afford to work slowly and indirectly -- potentially preserving a high degree of deniability. Massive civilian casualties would often be desirable and many terrorist movements could act without fear of retaliation or any retribution greater than for a minor act of conventional terrorism that involved much more limited casualties.

Scenarios for Terrorism Using Weapons of Mass Destruction

Table Four provides a more tangible illustration of this point. It may seem to borrow from bad spy novels and science fiction, but it lists a group of scenarios that are at least technically possible and which illustrate the difference between the options open to terrorists and the carefully structured military efforts summarized in Table Three. These scenarios also illustrate the fact that terrorists do not need sophisticated military delivery systems, do not need highly lethal weapons, can use terrorism to pose existential threats, can use complex mixes of weapons of mass destruction, and can mix terrorism with elements of covert action and deniability.

Much again depends on the human dimension and the real-world difference between actual terrorist groups and the super-terrorist that would have to execute such scenarios. The danger of such scenarios is that they tend to overstate the willingness of terrorists to turn to extreme forms of terror, their willingness to risk dying, and their ability to undetectably engage in complex scenarios. They also depend heavily on the technical ability of terrorists to obtain and control weapons of mass destruction.

There are many hostile and extremist groups in the Middle East, and many governments that are led by proven risk-takers. What is less clear is that there are efficient and willing mass murders. The low-level efforts of Middle Eastern terrorists to use chemical and biological weapons that have been reported to date have not been particularly threatening. The principal case of actual acts of terrorism consists of a limited effort to poison Israeli agricultural exports, direct attempts at poisoning such as lacing champagne with cyanide at a Russian military New Year's day celebration in Takjikistan in January 1995, and PKK attempts to poison Turkish water supplies with cyanide.(8) Such efforts make a sharp contrast to the massive national efforts Iran, Iraq, Libya, and Syria are making to acquire weapons of a mass destruction.

There is nothing admirable about Middle Eastern extremists of any persuasion, but an examination of the groups so far described in US reporting indicates that most are likely to set clear limits to their actions.(9) Regardless of how one may feel about Islamic extremists, secular terrorists, and radical governments like Iran and Libya, there is little evidence that any known group would easily turn to mass murder. While terrorists are often stereotyped as acting without moral limits and as willing martyrs, few actually conform with such stereotypes. Most "terrorists" are someone else's "freedom fighters" and operate within significant self or group-imposed constraints. Similarly, it is far from clear that most regional states are willing to take the kind of risks inherent in the scenarios postulated in Table Four.

At the same time, the steady escalation of car and truck bombings is a clear demonstration of the willingness to indulge in indiscriminate killing. The rhetoric and ideology of a number of terrorist movements like the Palestine Islamic Jihad and Combatant Partisans of God scarcely rules out mass murder. Most of the scenarios in Table Four are not all that complex, and only a few require large numbers of people and complex technical activity. The actions of Aum Shinrikyo illustrate the fact that it can be extremely difficult to characterize the level of extremism and capability for sophisticated action within a group until it has committed at least one action of terror. The cell structure used by the violent elements of most Middle Eastern extremist groups also tends to encourage the creation of compartmented groups with different and unpredictable commitments to violence while the loose and informal chain of contacts between extremist movements, known terrorist groups, and radical governments creates the possibly of random or unpredictable transfers of technology or weapons.

The institutionalization of state violence in the Middle East also creates a cumulative risk that opposition elements will be provoked into such forms of terrorism. The interactions between secular governmental repression and Islamic

extremists, and the widespread repression of ethnic and religious groups create a climate which may lead to new forms of terrorism. Endemic conflicts like the Arab-Israeli struggle and Iranian-Iraqi search for hegemony in the Gulf are also breeding grounds for extremism in areas with growing technical sophistication. Put differently, there are many possibilities and no clear probabilities. Table Four shows that there are many credible scenarios for the first regional "Dr. Ben No" or "Professor Abu Moriarity," but that there are no groups or nations that can be singled out. In fact, the cumulative probability of the first terrorist use of weapons of mass destruction being carried out by an unknown or unsuspected group is almost certainly higher than the cumulative probability it will be committed by some group already identified as a terrorist.

Table Four

Attack Scenarios: "Dr. Ben No" and "Professor Abu Moriarity" At Work in the Middle East

A radiological power is introduced into the air conditioning systems of Cairo's high-rise tourist hotels. Symptoms are only detected over days or weeks or public warning is given several weeks later. The authorities detect the presence of such a power, but cannot estimate its long-term lethality and have no precedents for decontamination. Tourism collapses, and the hotels eventually have to be torn down and rebuilt.

Parts for a crude gun-type nuclear device are smuggled into Israel or bought in the market place. The device is built in a medium sized commercial truck. A physics student reading the US Department of Defense weapons effect manual maps Tel Aviv to maximize fall out effects in an area filled with buildings with heavy metals and waits for a wind maximizing the fall out impact. The bomb explodes with a yield of only 8 kilotons, but with an extremely high level of radiation. Immediate casualties are limited but the long-term death rate mounts steadily with time. Peace becomes impossible and security measures become

Draconian. Immigration halts and emigration reaches crisis proportions. Israel as such ceases to exist.

Several workers move drums labeled as cleaning agents into a large shopping mall, large public facility, subway, train station, or airport. They dress as cleaners and are wearing what appear to be commercial dust filters or have taken the antidote for the agent they will use. They mix the feedstocks for a persistent chemical agent at the site during a peak traffic period. Large scale casualties result, and Draconian security measures become necessary on a national level. A series of small attacks using similar "binary" agents virtually paralyze the economy, and detection is impossible except to identify all canisters of liquid. Immunized terrorists visit a US carrier or major Marine assault ship during the first hours of visitor's day during a port call in the Middle East. They are carrying anthrax powder in bags designed to make them appear slightly overweight. They slowly scatter the powder as they walk through the ship visit. The immediate result is 50% casualties among the ship's crew, its Marine complement, and the visitors that follow. The US finds it has no experience with decontaminating a large ship where anthrax has entered the air system and is scattered throughout closed areas. After long debates over methods and safety levels, the ship is abandoned.

A terrorist seeking to "cleanse" a nation of its secular regime and corruption introduces a modified type culture of Ebola or a similar virus into an urban area -- trusting God to "sort out" the resulting casualties. He scatters infectious cultures in urban areas for which there is no effective treatment. By the time the attack is detected, it has reached epidemic proportions. Medical authorities rush into the infected area without proper protection, causing the collapse of medical facilities and emergency response capabilities. Other nations and regions have no alternative other than to isolate the nation or center under attack, letting the disease take its course.

A terrorist group modifies the valves on a Japanese remote-controlled crop spraying helicopter which has been imported legally for agricultural purposes. It uses this system at night or near dawn to spray a chemical or biological agent at altitudes below radar coverage in a line-source configuration. Alternatively, it uses a large home-built RPV with simple GPS guidance. The device eventually crashes undetected into the sea or in the desert. Delivery of a chemical agent achieves far higher casualties than any conventional military warhead. A biological agent is equally effective and the first symptoms appear days after the actual attack -- by which time treatment is difficult or impossible.

A truck filled with what appears to be light gravel is driven through the streets of Tel Aviv or Cairo during rush hour or another maximum traffic period. A visible powder does come out through the tarpaulin covering the truck, but the spread of the power is so light that no attention is paid to it. The driver and his assistant are immunized against the modified form of Anthrax carried in the truck which is being released from behind the gravel or sand in the truck. The truck slowly quarters key areas of the city. Unsuspected passersby and commuters not only are infected, but carry dry spores home and into other areas. By the time the first major symptoms of the attach occur some 3-5 days later, anthrax pneumonia is epidemic and some septicemic anthrax has appeared. Some 40-65% of the exposed population dies and medical facilities collapse causing serious, lingering secondary effects.

A terrorist group scatters high concentrations of a radiological, chemical, or biological agent in various areas in a city, and trace elements into the processing intakes to the local water supply. When the symptoms appear, terrorist group makes its attack known, but claims that it has contaminated the local water supply. The authorities are forced to confirm that water is contaminated and mass panic ensues.

Immunized terrorists carry small amounts of anthrax or a similar biological agent onto a passenger aircraft like a B-747, quietly scatter the powder, and deplane at the regular scheduled stop. No airport detection system or search detects the agent. Some 70-80% of those on the aircraft die as a result of symptoms that only appear days later.

Several identical nuclear devices are smuggled out of the FSU through Afghanistan or Central Asia. They do not pass directly through governments. One of the devices is disassembled to determine the precise technology and coding system used in the weapon's PAL. This allows users to activate the remaining weapons. The weapon is then disassembled to minimize detection with the fissile core shipped covered in lead. The weapon is successfully smuggled into the periphery of an urban area outside any formal security perimeter. A 100 kiloton ground burst destroys a critical area and blankets the region in fall out.

The same device is shipped to Israel or a Gulf area in a modified standard shipping container equipped with detection and triggering devices that set it off as a result of local security checks or with a GPS system that sets it off automatically when it reaches the proper coordinates in the port of destination. The direct explosive effect is significant, but "rain out" contaminates a massive local area.

Iraq equips a freighter or dhow to spread Anthrax along a coastal area in the Gulf. It uses a proxy terrorist group, and launches an attack on Kuwait City and Saudi oil facilities and ports. It is several days before the attack is detected, and the attacking group is never fully identified. The form of Anthrax involved is dry and time encapsulated to lead to both massive prompt casualties and force time

consuming decontamination. Iraq not only is revenged, but benefits from the resulting massive surge in oil prices.

A terrorist group scatters small amounts of a biological or radiological agent in a Jewish area during critical stages of the final settlement talks. Near panic ensures, and a massive anti-Palestinian reaction follows. Israeli security then learns that the terrorist group has scattered small amounts of the same agent in cells in every sensitive Palestinian town and area, and the terrorist group announces that it has also stored some in politically sensitive mosques and shrines. Israeli security is forced to shut down all Palestinian movement and carry out intrusive searches in every politically sensitive area. Palestinian riots and then exchanges of gun fire follow. The peace talks break down permanently. The Iranian Revolutionary Guards equips dhows to spread Anthrax. The dhows enter the ports of Dubai and Abu Dhabi as commercial vessels -- possibly with local or other Southern Gulf registrations and flags. It is several days before the attack is detected, and the resulting casualties include much of the population of Abu Dhabi and government of the UAE. The UAE breaks up as a result, no effective retaliation is possible, and Iran achieves near hegemony over Gulf oil policy.

A terrorist group attempting to drive Western influence out of Saudi Arabia smuggles a large nuclear device into Al Hufuf on the edge of the Ghawar oil field. It develops a crude fall out model using local weather data which it confirms by sending out scouts with cellular phones. It waits for the ideal wind, detonates the devices, shuts down the world's largest exporting oil field, and causes the near collapse of Saudi Arabia.

Alternatively, the same group takes advantage of the security measures the US has adopted in Saudi Arabia, and the comparative isolation of US military personnel. It waits for the proper wind pattern and allows the wind to carry a

biological agent over a Saudi airfield with a large US presence from an area outside the security perimeter. The US takes massive casualties and has no ability to predict the next attack. It largely withdraws from Saudi Arabia.
A freighter carrying fertilizer enters a Middle Eastern port and docks. In fact, the freighter has mixed the fertilizer with a catalyst to create a massive explosion and also carries a large amount of a chemical, radiological, and/or biological agent. The resulting explosion destroys both the immediate target area and scatters the chemical or biological weapon over the area.

Extreme believers in Eretz Israel move a "cocktail" of radiological and persistent biological/chemical agents to the Temple Mount to contaminate the Mosques. They use carefully designed devices which only scatter very heavy matter over a limited area, although they use explosives to ensure a high degree of contamination within the mosques. All prayer in the mosque area must be halted indefinitely and there are significant casualties among the Islamic faithful in Jerusalem. The Jewish group issues a statement demanding that the temple area be clear of all non-Jewish religious activity triggering mass violence.
A large terrorist device goes off in a populated, critical economic, or military assembly area -- scattering mustard or nerve gas. Emergency teams rush into deal with the chemical threat and the residents are evacuated. Only later does it become clear that the device also included a biological agent and that the response to this "cocktail" killed most emergency response personnel and the evacuation rushed the biological agent to a much wider area.

The Technology of Terrorism and Weapons of Mass Destruction in the Middle East

The technical options open to terrorists raise another important set of issues. Tables One and Four have already described the potential lethality of small weapons of mass destruction and how these weapons might be used. It is also

clear from Table Four that it is the nature of the actual weapon which is most likely to be important in determining its availability, lethality, and use and not the delivery system -- as is the case with military operations.

At the same time, different weapons of mass destruction vary greatly in character and in level of lethality. Most chemical weapons, for example, are only marginally more lethal in actual practice than conventional weapons -- although there are notable exceptions. Biological weapons can differ radically in lethality according to the disease or poison involved, the particular strain of the disease adapted for weaponization, and the quality of the weaponization process -- although biological weapons with the lethality of theater nuclear weapons are now well within the state of the art using native disease cultures and small commercial equipment. Radiological weapons are more "horror" weapons than efficient killers although they offer advantages in terms of "cocktails" with other weapons and in greatly complicating the process of contamination. Nuclear weapons can range from crude devices producing fractions of a kiloton to stolen weapons with yields of 100 kilotons or more, and differ radically in the lethality of their fall out.

Table Five illustrates the relationship between the different characters of weapons of mass destruction and their potential application to military targets. This table, however, does not explicitly address the application of such weapons to terrorism, and an understanding of these differences is important both to understanding Middle Eastern vulnerabilities and potential countermeasures. Further, many of the military limitations listed in Table Five do not apply to terrorist uses of such weapons.

Table Five

Strengths and Weaknesses of Weapons of Mass Destruction - Part One

Chemical Weapons:

Destructive Effects: Poisoning skin, lungs, nervous system, or blood. Contaminating areas, equipment, and protective gear for periods of hours to days. Forcing military units to don highly restrictive protection gear or use incapacitating antidotes. False alarms and panic. Misidentification of the agent, or confusion of chemical with biological agents (which may be mixed) leading to failure of defense measures. Military and popular panic and terror effects. Major medical burdens which may lead to mistreatment. Pressure to deploy high cost air and missile defenses. Paralysis or disruption of civil life and economic activity in threatened or attacked areas.

Typical Military Targets: Infantry concentrations, air bases, ships, ports, staging areas, command centers, munitions depots, cities, key oil and electrical facilities, desalinization plants.

Typical Military Missions: Killing military and civilian populations. Intimidation. Attack of civilian population or targets. Disruption of military operations by requiring protective measures or decontamination. Area or facility denial. Psychological warfare, production of panic, and terror.

Military Limitations: Large amounts of agents are required to achieve high lethality, and military and economic effects are not sufficiently greater than careful target conventional strikes to offer major war fighting advantages. Most agents degrade quickly, and their effect is highly dependent on temperature and weather conditions, height of dissemination, terrain, and the character of built-up areas. Warning devices far more accurate and sensitive than for biological agents. Protective gear and equipment can greatly reduce effects, and sufficiently high numbers of rounds, sorties, and missiles are needed to ease the task of defense. Leave buildings and equipment reusable by the enemy, although persistent agents may require decontamination. Persistent agents may

contaminate the ground the attacker wants to cross or occupy and force use of protective measures or decontamination.

Table Five Strengths and Weaknesses of Weapons of Mass Destruction - Part Two

Biological Weapons

Destructive Effects: Infectious disease or biochemical poisoning. Contaminating areas, equipment, and protective gear for periods of hours to weeks. Delayed effects and tailoring to produce incapacitation or killing, treatable or non-treatable agents, and be infectious on contact only or transmittable. Forcing military units to don highly restrictive protection gear or use incapacitating vaccines antidotes. False alarms and panic. High risk of at least initial misidentification of the agent, or confusion of chemical with biological agents (which may be mixed) leading to failure of defense measures. Military and popular panic and terror effects. Major medical burdens which may lead to mistreatment. Pressure to deploy high cost air and missile defenses. Paralysis or disruption of civil life and economic activity in threatened or attacked areas.

Typical Military Targets: Infantry concentrations, air bases, ships, ports, staging areas, command centers, munitions depots, cities, key oil and electrical facilities, desalinization plants. Potentially fare more effective against military and civil area targets than chemical weapons.

Typical Military Missions: Killing and incapacitation of military and civilian populations. Intimidation. Attack of civilian population or targets. Disruption of military operations by requiring protective measures or decontamination. Area or facility denial. Psychological warfare, production of panic, and terror.

Military Limitations: Most wet agents degrade quickly, although spores, dry encapsulated agents, and some toxins are persistent. Effects usually take some time to develop (although not in the case of some toxins). Effects are unpredictable, and are even more dependent than chemical weapons on temperature and weather conditions, height of dissemination, terrain, and the

character of built-up areas. Major risk of contaminating the wrong area. Warning devices uncertain and may misidentify the agent. Protective gear and equipment can reduce effects. Leave buildings and equipment reusable by the enemy, although persistent agents may require decontamination. Persistent agents may contaminate the ground the attacker wants to cross or occupy and force use of protective measures or decontamination. More likely than chemical agents to cross the threshold where nuclear retaliation seems justified.

Table Five Strengths and Weaknesses of Weapons of Mass Destruction - Part Three

Nuclear Weapons

Destructive Effects: Blast, fire, and radiation. Destruction of large areas and production of fall out and contamination -- depending on character of weapon and height of burst. Contaminating areas, equipment, and protective gear for periods of hours to days. Forcing military units to don highly restrictive protection gear and use massive amounts of decontamination gear. Military and popular panic and terror effects. Massive medical burdens. Pressure to deploy high cost air and missile defenses. Paralysis or disruption of civil life and economic activity in threatened or attacked areas. High long term death rates from radiation. Forced dispersal of military forces and evacuation of civilians. Destruction of military and economic centers, and national political leadership and command authority, potentially altering character of attacked nation and creating major recovery problems.

Typical Military Targets: Hardened targets, enemy facilities and weapons of mass destruction, enemy economy, political leadership, and national command authority. Infantry and armored concentrations, air bases, ships, ports, staging areas, command centers, munitions depots, cities, key oil and electrical facilities, desalinization plants.

Typical Military Missions: Forced dispersal of military forces and evacuation of civilians. Destruction of military and economic centers, and national political leadership and command authority, potentially altering character of attacked nation and creating major recovery problems.

Military Limitations: High cost. Difficulty of acquiring more than a few weapons. Risk of accidents or failures that hit friendly territory. Crosses threshold to level where nuclear retaliation is probable. Destruction or contamination of territory and facilities attacker wants to cross or occupy. High risk of massive collateral damage to civilians if this is important to attacker.

Source*: Adapted by the Anthony H. Cordesman from Office of Technology Assessment,* Proliferation of Weapons of Mass Destruction: Assessing the Risks, US Congress OTA-ISC-559, Washington, August, 1993, pp. 56-57.

Terrorism and Chemical Weapons

Much of the terrorist impact of chemical weapons is based on myth. Regardless of the theoretical lethality of given chemical agents, many cannot be weaponized in ways that are vastly more lethal than conventional bombs and explosions. Terrorists are not governments, and may well spend more terrorist money and man-hours per casualty on chemical weapons than if they concentrated on carefully planning conventional attacks. Contrary to a considerable amount of literature, chemical weapons also are not uniquely horrifying in terms of their killing, wounding, or incapacitating effects. Trauma from penetrating and ripping projectiles is likely to be as agonizing as the long-term effects of mustard gas. Nerve gases are relatively humane killers with few lingering effects. Once one strips away the rhetoric, gutted is gutted and dead is dead.

The problem is, however, that the myths surrounding chemical weapons do exist and shape popular perceptions. Regardless of actual casualties, terrorist attacks

using chemical weapons are likely to produce far more panic and fear than attacks using conventional weapons. Further, chemical attacks can easily be combined with large scale bombings and other terrorist "cocktails" -- an option that is described in detail in so much of the literature on counter-terrorism than only illiterate or truly stupid terrorists can be unaware of it.

The psychological dimension of chemical terrorism can also interact with the physiological dimension. The long US debates over Agent Orange and the Persian Gulf Syndrome have already shown that there also is no clear end game to an act of chemical terrorism. Even the threat of exposure can create political and medical problems for decades, and no government announcement that a given area or facility is safe will ever fully convince public opinion.

The deliberate smuggling of trace amounts of persistent chemical weapons like mustard gas, V-series agents, and toxins into a wide range of target areas would be an ideal strategy for a terrorist concerned with maximizing the effect of terrorism, minimizing the risk of detection, and avoiding the backlash from large numbers of real casualties. Terrorists might also use a number of ordinary consumer goods to produce small amounts of chemical poisons for such localized attacks. One highly publicized option in counter-terrorist literature is to burn Teflon in a closed space (the result is phosgene, hydrogen fluoride, and sub-micro polymeric fumes).(10)

Much would depend on the agent used and how well it was produced and deployed. For example, Aum Shinrikyo -- the Japanese cult that used Sarin in the Tokyo subway attack -- made a long series of mistakes. It produced Sarin using the German salt process, its production plant never functioned properly, and the agent was only 25% pure when first manufactured. One of its attacks occurred only days after 500 Japanese police had taken a chemical agent response course and under panic, unrehearsed conditions. The cult used a crude delivery

method. It placed punctured dual polyethylene bags on the subway rather than using the trucks it had modified to use sprayers. The agent was extremely slow to evaporate, giving many people time to leave the area. Even so, some 5,100 people had to be screened (4,073 the first day), 2,058 had to be observed in clinics, 984 had clear symptoms, 54 were hospitalized, 17 were critical, and 11 died.(11)

At the same time, useful descriptions of how to produce nerve weapons are available on the Internet and in a number of extremist handbooks. Most chemical weapons can be produced by a sophisticated terrorist. The basic technologies for first generation weapons are now more than 80 years old and some -- like mustard gas -- have persistent effects that may make them more attractive for terrorist purposes than more lethal, but short lived, agents like Sarin. The production of most chemical weapons is very similar to the production of other chemical processes and compounds that are common in the Middle East. Even Sarin is scarcely a complex product. In broad terms, it is a combination of sodium fluoride, isopropyl alcohol, and methyl phosphonic dichloride.

Both weapons and commercial equipment can use the same reactor vessels, distillation columns, heat exchangers, pumps and valves, and filters. In fact, the greatest similarities between weapons and commercial processes exist between second generation nerve gases and insecticides, because the compounds are so closely related.(12) While the Australia Group has created a list of equipment requiring special consideration -- emphasizing corrosion resistant equipment using Hastelloy and high nickel alloys -- the limited controls over such equipment are designed largely to deal with military-scale production. Further, the required equipment is available from a wide range of countries.

A terrorist might also accept the risk of limited production without such equipment on the grounds that corrosion would not be quick enough to affect the production

of limited amounts of agent. Similarly, the list of 54 precursor chemicals now used by the Australia Group is not exclusive -- particularly if the terrorist accepts unstable weapons with limited shelf lives and uncertain lethalities -- and often has no impact in restricting small purchases and deliveries.(13) There are also indicators that experts from the FSU have been involved in schemes to sell weapons technology and feedstocks. For example, the Russian Federal Security Service has announced that Anatloy Kuntsevich, a retired Soviet Lt. General, arranged for the delivery of 1,800 pounds of chemical to an unidentified Middle Eastern country in 1993.(14)

Terrorists might also use toxins, a category of weapons that falls into a gray area between chemical and biological weapons and which can be an order of magnitude more lethal than nerve gas. Toxins are poisonous compounds produced by living organisms like microbes, snakes, spiders, sea creatures, and plants, and are usually proteins that act upon specific receptors in the body. Most are relatively unstable in the presence of heat and other severe environmental factors. However, two toxins -- Botulin and Ricin -- are comparatively easy to make. The manufacture of Staphylococcal Enterotoxin may be within the capabilities of Middle East terrorists. The production of lethal mycotoxins and saxitoxin is more questionable.

Botulin is particularly lethal, although it still does not compare in lethality with biological weapons. It takes 512 kilograms of Botulinum to produce 50% casualties in a 1.5 square kilometer target versus only 0.09 kilograms of Anthrax spores. It is also difficult to produce a dried Botulinium toxin in a form that could be disseminated over a large area in lethal concentrations, and such an attack is probably beyond the capabilities of any Middle Eastern terrorist without state support.

Nevertheless, wet Botulin agents can easily be produced by altering food processing equipment and using milk products and other foods and spread through a closed area using a standard commercial fogger. One simulation indicates that Botulin could be grown in garbage cans in a large office building and dried for later dissemination through its air system. Botulin poisoning is difficult to treat effectively and its symptoms only begin to appear 24 hours to several days after an attack. These symptoms can be similar to those of nerve agents -- leading to the wrong treatment, particularly if a "cocktail" is used of different agents.

Ricin is even more difficult to weaponize in a form with area coverage than Botulin, but it can be produced using ordinary kitchen equipment. In fact, the Fort Detrick patent for producing Ricin from the Castor Bean has been a matter of public record since 1962. Two members of an American extremist group, a drug group, and a private individual have already shown that a very small group of terrorists can successfully produce Ricin, and that effective treatment is even more difficult.

There are a number of other toxins that might be used. For example, Staphylococcal Enterotoxin is more of an incapacitating agent than a killing mechanism, but terrorists could credibly manufacture and use it in some scenarios. The possible manufacture of mycotoxins has also been a subject of considerable controversy for years. For example, the US State Department has accused the Soviet Union of using such agents in Afghanistan and Vietnam, only to have many US experts immediately state that the evidence was lacking and that it would be almost impossible to create mycotoxins with the required lethality and dissemination characteristics. (15)

The range of potential chemical agents and their uncertain lethality also interacts with the difficulty of detection and defense. Even a Middle Eastern government

that sought to prepare a detection and reaction system would face major problems. A terrorist, who attacked inside the target area under conditions where major civil defense measures had not been taken, would probably succeed in achieving his goals before a government could detect the fact its population was under attack. Deploying detection systems that can provide timely warning over a large urban area, or which cover all area targets is costly -- if not impossible. Installing detection devices in all major buildings and enclosed areas is almost certainly impossible.

Many current detection devices are false alarm prone, and a terrorist could destroy the credibility of such warning systems by releasing trace amounts of an agent near such devices at intervals before an attack. Many devices only work with a limited list of chemical weapons, and advanced detection devices are only now becoming available. For example, the US is just beginning to field test the Automatic Chemical Agent Detector and Mark 21 Remote Sensing Chemical Agent Alarm in an effort to deploy systems capable of real-time detection of chemical attacks on at least point defense basis. (16)

Even an alerted population could remain vulnerable. Many Middle Eastern governments simply cannot afford civil defense, and the terrorist would have the advantage in choosing the place and time of attack. In many cases, governments cannot take civil defense measures without making their strengths and weaknesses public. Slow acting weapons like toxins would present major problems in terms of protection. Agents like dusty mustard can defeat most of the gear available for civil protection. A terrorist might also "spoof" a government into taking civil defense measures that would soon lose their credibility or into triggering the mass use of antidotes which are themselves terrorizing and debilitating, such as Atropine as an antidote for nerve gas.

Drug smuggling is only one example of how difficult it is to establish a perimeter defense of a country or populated area, and there are serious questions as to whether most of the high technology devices on the drawing board can ever handle the required volume of search with any cost-effectiveness and reliability.(17) All major Middle Eastern states are highly dependent on a large volumes of imports, and many of the feedstocks necessary for chemical agents are available as dual-use civil goods. Small amounts of critical specialized feedstocks would be relatively easy to smuggle in using containers or a variety of credible covers. Other agents could be manufactured in place. In short, it has yet to be demonstrated that any mix of potential technologies would be a cost-effective defense system, and Israel may be the only Middle Eastern state with the mix of resources and technical training capability necessary to credibly consider deploying such detection systems.

Table Six

Major Chemical Agents - Part One(18)

NERVE AGENTS: Agents that quickly disrupt the nervous system by binding to enzymes critical to nerve functions, causing convulsions and/or paralysis. Must be ingested, inhaled, and absorbed through the skin. Very low does cause a running nose, contraction of the pupil of the eye, and difficulty in visual coordination. Moderate doses constrict the bronchi, cause a feeling of pressure in the chest, and weaken the skeletal muscles and cause filibration. Large doses cause death by respiratory or heart failure. (Can be absorbed through inhalation or skin contact.) Reaction normally occurs in 1-2 minutes. Death from lethal doses occurs within minutes, but artificial respiration can help and atropine and the oximes act as antidotes. The most toxic nerve agents kill with a dosage of only 10 milligrams be minute per cubic meter, versus 400 for less lethal gases. Recovery is normally quick, if it occurs at all, but permanent brain damage can occur:

Tabun (GA)
Sarin (GB) - nearly as volatile as water and delivered by air. A dose of 5 mg/min/m3 produces casualties, a respiratory dose of 100 mg/min/m3 is lethal. Lethality lasts 1-2 days.
Soman (GD)
GF
VR-55 (Improved Soman) A thick oily substance which persists for some time.
VK/VX/VE/VM/VG/VS - Persistent agents roughly as heavy as fuel oil. A dose of 0.5 mg/min/m3 produces casualties, a respiratory dose of 10 mg/min/m3 is lethal. Lethality lasts 1-16 weeks.
BLISTER AGENTS: Cell poisons that destroy skin and tissue, cause blindness upon contact with the eyes, and which can result in fatal respiratory damage. Can be colorless or black oily droplets. Can be absorbed through inhalation or skin contact. Serious internal damage if inhaled. Penetrates ordinary clothing. Some have delayed and some have immediate action. Actual blistering normally takes hours to days, but effects on the eyes are much more rapid. Mustard gas is a typical blister agent and exposure to concentrations of a few milligrams per meter over several hours generally causes blisters and swollen eyes. When the liquid falls onto the skin or eyes it has the effect of second or third degree burns. It can blind and cause damage to the lungs leading to pneumonia. Severe exposure causes general intoxication similar to radiation sickness. HD and HN persist up to 12 hours. L, HL, and CX persist for 1-2 hours. Short of preventing exposure, the only treatment is to wash the eyes, decontaminate the skin, and treat the resulting damage like burns:
` Sulfur Mustard (H or HD) A dose of 100 mg/min/m3 produces casualties, a dose of 1,500 mg/min/m3 is lethal. Residual lethality lasts up to 2-8 weeks.
Distilled Mustard (DM)
Nitrogen Mustard (HN)
Lewisite (L)

Phosgene Oxime (CX)
Mustard Lewisite (HL)
CHOKING AGENTS: Agents that cause the blood vessels in the lungs to hemorrhage, and fluid to build-up, until the victim chokes or drowns in his or her own fluids (pulmonary edema). Provide quick warning though smell or lung irritation. Can be absorbed through inhalation. Immediate to delayed action The only treatment is inhalation of oxygen and rest. Symptoms emerge in periods of seconds up to three hours after exposure:
Phosgene (CG)
Diphosgene (DP)
PS Chloropicrin
Chlorine Gas

Table Six Major Chemical Agents - Part Two

BLOOD AGENTS: Kill through inhalation. Provide little warning except for headache., nausea, and vertigo. Interferes with use of oxygen at the cellular level. CK also irritates the lungs and eyes. Rapid action and exposure either kills by inhibiting cell respiration or it does not -- casualties will either die within seconds to minutes of exposure or recover in fresh air. Most gas masks has severe problems in providing effective protection against blood agents:
Hydrogen Cyanide (AC) A dose of 2,000 mg/min/m3 produces casualties, a respiratory dose of 5,000 mg/min/m3 is lethal. Lethality lasts 1-4 hours.
Cyanogen Chloride (CK) A dose of 7,000 mg/min/m3 produces casualties, a respiratory dose of 11,000 mg/min/m3 is lethal. Lethality lasts 15 minutes to one hour .
TOXINS : Biological poisons causing neuromuscular paralysis hours or days after exposure. Formed in food or cultures by the bacterium clostridium botulinum. Produces highly fatal poisoning characterized by general weakness, headache, dizziness, double vision and dilation of the pupils, paralysis of muscles, and problems in speech. Death is usually by respiratory failure.

Antitoxin therapy has limited value, but treatment is mainly supportive:
Botulin toxin (A) Six distinct types, of which four are known to be fatal to man. An oral dose of 0.001 mg is lethal. A respiratory dose of 0.02 mg/min/m3 is also lethal.

DEVELOPMENTAL WEAPONS: A new generation of chemical weapons is under development. The only publicized agent is perfluoroisobutene (PFIB), which is an extremely toxic odorless and invisible substance produced when PFIB (Teflon) is subjected to extreme heat under special conditions. It causes pulmonary edema or dry-land drowning when the lungs fill with fluid. Short exposure disables and small concentrations cause delayed death. Activated charcoal and most existing protection equipment offers no defense. Some sources refer to "third" and "fourth" generation nerve gasses, but no technical literature seems to be available.

CONTROL AGENTS: Agents which produce temporary irritating or disabling effects. They cause flow of tears and irritation of upper respiratory tract and skin when in contact with the eyes or inhaled. They can cause nausea and vomiting: can cause serious illness or death when used in confined spaces. CS is the least toxic gas, followed by CS and DM. Symptoms can be treated by washing the eyes and/or removal from the area. Exposure to CS, CN, and DM produces immediate symptoms. Staphylococcus produces symptoms in 30 minutes to four hours, and recovery takes 24-48 hours. Treatment of Staphylococcus is largely supportive:
Tear
Chlororacetophenone (CN)
O-Chlorobenzyl-malononitrile (CS)
Vomiting: Cause irritation, coughing, severe headache, tightness in chest, nausea, vomiting:

Adamsite (DM)
Staphylococcus
INCAPACITATING AGENTS: Agents which normally cause short term illness and psychoactive effects (delirium and hallucinations). Can be absorbed through inhalation or skin contact. The psychoactive gases and drugs produce unpredictable effects, particularly in the sick, small children, elderly, and individuals who already are mentally ill. In rare cases they kill. In others, they produce a permanent psychotic condition. Many produce dry skin, irregular heart beat, urinary retention, constipation, drowsiness, and a rise in body temperature, plus occasional maniacal behavior. A single dose of 0.1 to 0.2 milligrams of LSD-25 will produce profound mental disturbance within a half hour that lasts 10 hours. The lethal dose is 100 to 200 milligrams:
BZ
BZ
LSD
LSD Based BZ
Mescaline
Psilocybin
Benzilates

Terrorism and Biological Weapons

Biological weapons represent the most dangerous risk of a "paradigm shift" in Middle Eastern terrorism. They offer a far more devastating option than chemical weapons at costs far lower than those of both chemical and nuclear weapons. The costs of biological weapons are much smaller per casualty than those of any other form of terrorism. A UN report estimated in 1969 that military-scale biological weapons only cost $1 per square kilometer of coverage of a civilian target versus $600 for chemical weapons, $800 for nuclear, and $2,000 for advanced conventional weapons. While terrorists can scarcely expect similar

production efficiencies and economies of scale, the savings would be roughly proportionate.(19)

Biological weapons do present the problem of uncertainty. They have never been used successfully in combat. At the same time, advances in commercial chemical and food processing equipment, and in biotechnology and medical equipment, are making it steadily easier and cheaper to produce effective weapons. Table Three shows that Middle Eastern states are steadily improving their capability to help proxies or conduct state terrorism, and the fact that at least some controls exist on chemical and nuclear technologies will tend to push terrorists towards biological weapons.

The technology of biological weapons also presents serious problems for detection and defense. One of the greatest problems in dealing with biological terrorism is that there is such a long list of possible weapons with so many different characteristics and effects. Table Seven illustrates this point by listing the biological weapons that might be used in the Middle East. It is clear from this table that a wide range of weapons exist, even though it only includes a selected list of traditional biological weapons and does not list any weapons which are contagious enough to create a self-sustaining epidemic.

Table Seven also does not portray the fact that biological weapons have radically different lethalities and area effects, and that the lethality of a weapon does not necessarily correspond to its area coverage. For example, if one assumes that a crop spraying helicopter, an RPV, or small aircraft released 50 kilograms of a Rift Valley Fever agent along a two kilometer line upwind of a city of around 500,000, the resulting agent would be heavy enough so that it would only reach about one kilometer downwind. It also would probably only kill 400, and incapacitate 35,000. Consider, however, the following examples of area coverage and lethality using a wider range of weapons:(20)

Agent	Downwind Reach	Casualties

	(kilometers)		
		Dead	Incapacitated
Rift Valley Fever	1	400	35,000
Tick-Borne Encephelistis	1	9,500	35,000
Typhus	5	19,000	85,000
Brucellosis	10	500	100,000
Q Fever	20+	150	125,000
Tularemia	20+	30,000	125,000
Anthrax	20++	95,000	125,000

In theory, a terrorist could credibly produce and use any of these weapons -- particularly if a state granted the terrorist group sanctuary, a secure facility, and/or state support. US studies and exercises have shown that the open literature and commercial equipment is adequate for such purposes -- particularly if the agent does not have to be stored in a stable form or weaponized.

The terrorist would also have the advantage that laboratory or pilot scale production of 50-500 liters of agent would be adequate for many types of terrorist attacks, and would involve far less detectable purchases of equipment and production efforts than commercial scale production of weapons using equipment with a capacity of over 500 liters. While there some guidelines of identifying dual-use biological equipment and related technology, there also are literally hundreds of suppliers scattered all over the world, and existing guidelines emphasize large scale or highly specialized equipment that terrorists either would not need or could buy with little fear of detection using different covers and suppliers.(21) The need for a special facility would vary sharply according to the agent used. Anthrax and Botulin, for example, could be produced safely in a comparatively unsophisticated level 2 facility with only limited special containment equipment. A terrorist might also use a university or small company laboratory as a cover to produce a more pathogenic agent, or accept the risk of relatively low levels of protection against accident. Both approaches would be less detectable than the

level 3 or level 4 production in a secure military facility that a government might insist upon.

A wide range of different fermentation equipment might be used, and standard commercial fermenters could be adapted for either batch or continuous fermentation. Anthrax, for example, might be produced on a one batch process from a commercial fermenter, and the facility might then be abandoned. Some of the largest fermenters are used for the production of microbial products for animal feeds. Controls are only beginning to be applied to the international sale of type cultures and most such controls offer little real security. A number of organisms can also be isolated from the environment in the Middle East, stolen or traded, or obtained in exchanges from a variety of laboratories other than type culture centers. The technology and equipment for genetic engineering is becoming commercially available, and a terrorist might lease such facilities in Europe or the US.(22)

A terrorist might also steal a virus from a government facility. Such facilities sometimes offer immediate access to very dangerous agents. For example, an Ebola virus incident occurred by accident in Reston Virginia in December 1989. Fortunately, the Ebola turned out to be a strain which was only fatal to monkeys. However, there is no guarantee that a targeted attack on a medical research facility would not give a terrorist access to a far more lethal weapon. Ebola outbreaks involving human beings have a history of 53% to 92% mortality, and there are at least five other viruses with similar lethality that might be stolen or cultured to produce a weapon.(23)

Once again, however, such potential threats must be placed in a real-world context. It must be stressed that are few cases where biological terrorist activity has been attempted, and none which make it possible to know whether a terrorist can actually achieve high lethalities. There are also significant technical

difficulties in weaponizing biological agents to achieve high casualties. It is difficult for terrorists to develop dry agents that can be scattered in the air, kill through inhalation, and which have just the right size and weight to ensure both proper concentration and proper lethality. Effective weapons use droplets smaller than 10 microns, and the effectiveness of most weapons is measured in terms of the number of infectious units that can be released of 1-5 micron size. The production of lethal agents also usually requires a significant amount of equipment and time, although the processing equipment involved is becoming steadily cheaper. The only way to be certain of lethality is through experimentation with live subjects -- although this might be done with limited risk of detection by "mini-attacks" on selected individuals.

The question also arises as to how many people real-world terrorists are willing to kill with what risks. A terrorist or "freedom fighter" attacking a regime is unlikely to use biological agents that end up attacking an entire people. Terrorists willing to attack enemy military targets and regimes may be willing to kill some civilians but may not be willing to indulge in mass murder. At the same time, there are a number of key enclave targets in the Middle East.

Israel, for example, has expelled many of its Palestinian workers and regularly closes its borders. An attack on Tel Aviv and many of Israel's coastal cities might involve Israeli Arabs, but a terrorist might find this to be an acceptable price to pay. Similarly, isolated exercises and reserve mobilization areas might be targeted from well outside normal perimeter defenses. US military enclaves in Saudi Arabia are another example of such a target as are key forces securing the regime, like the Saudi National Guard. Key districts of a Middle Eastern city may form an enclave target like the royal residences and embassy quarter of Riyadh. Isolated Egyptian and Algerian military and security force casernes are other examples of such targets, as are foreign compounds, oil facilities, etc. So are ethnic and sectarian areas where the geographic divisions in the population are

clear enough so that an attack could be containable. This might actually ease the problems terrorists face in deploying weapons with particles small enough to be efficient aerosols. A large particle with predictable limits to its area coverage might prove to be an advantage.

One thing is clear. If terrorists are successful in producing or obtaining a highly lethal biological agent, the payload involved could be so small that it would be easy to deliver much larger amounts than the 50 kilograms discussed in Table Seven, or to deliver a mix of agents with radically different effects and treatments and do so in a relatively small delivery system. Many agents listed would be equally effective if scattered from a ship, from a truck, or off the top of several tall buildings. The US Army, for example, has tested the scattering of Anthrax like particles from a ship off of Atlantic City, on commuters in Grand Central station, from the back of trains, and in a covert attack on Egland Air Base. All four simulated attacks were conducted without any questions or challenges, and gathering of particles from test subjects showed that they would have had high lethality.

Line source delivery does not require an aircraft or platform detectable by radar, and the urban sprawl of cities like Tel Aviv and Cairo now means that sufficient high rise buildings exist so that a terrorist could select three or four buildings, take a suitcase or trunk to the roof, release the agent an optimal distance from the main area of attack and leave. Alternatively, a wet agent and nebulizer/fogger could be moved to the roof disguised as cleaning equipment or some other service device. Further, security against this form of attack would not affect using a truck or vehicle in a more open area and no current detection device could prevent exposure. Even the new US Interim Biological Agent Detector (IBAD), for example, takes at least 45 minutes to detect and analyze an agent -- provided it is set to recognize the agent used. The first real field tests of this system are being funded in South Korea in 1997.(24)

Terrorists could also use much less ambitious forms of biological warfare. One American in Fairfax, Virginia, for example, exploited the fear of biological weapons by spraying liquid over his neighbors and telling them they had been infected with anthrax. While this case borders on the absurd, a terrorist could cause a great deal more fear by using an actual agent in non-lethal amounts or inserting detectable amounts of agents into a water system and making the action public. While most agents are ineffective once sent through water purification systems, this fact is not known to most physicians and the announcement could cause considerable disruption. Similarly, agricultural exports can be disrupted by contamination of food with toxins or pathogenic agents (this was done with Chilean grape exports to the US). Medical and other widely used consumer goods could also be tampered with in the target country (done with Tylenol in the US, and threatened against Pepsi Cola).(25)

In short, the problems of detection, defense, and response would be even more difficult than in dealing with chemical weapons and the risk of a breakdown or collapse of national emergency and medical services would be much greater. Effective surveillance of known potential facilities would be extremely difficult for all of the Middle Eastern states with modern research and food processing facilities, and tracking all relevant imports would be almost impossible. Detection and warning systems would be even more prone to false alarms, the use of "cocktails," and gaps in coverage. Even effective systems would at best provide medical and emergency response teams with warning of the protection methods they should use and the need for immediate treatment. As a result, more might depend on the willingness of the terrorist to kill than on a Middle Eastern government's effort to detect and defend.

Table Seven

Key Biological Weapons that May Be in the Middle East: Part One

Disease	Infectivity	Transmissibility	Incubation Period	Mortality	Therapy
Viral					
Chikungunya fever	high?	none	2-6 days	very low (-1%)	none
Dengue fever	high	none	5-2 days	very low (-1%)	none
Eastern equine encephalitis	high	none	5-10 days	high (+60%)	developmental
Tick borne encephalitis	high	none	1-2 weeks	up to 30%	developmental
Venezuelan equine encephalitis	high	none	2-5 days	Low (-1%)	developmental
Hepatitis A	-	-	15-40 days	-	-
Hepatitis B	-	-	40-150 days	-	-
Influenza	high	none	1-3 days	usually low	available
Yellow fever	high	none	3-6 days	up to 40%	available
Smallpox (Variola)	high	high	7-16 days	up to 30%	available
Rickettsial					
Coxiella Burneti (Q-fever)	high	negligible	10-21 day	Low (-1%)	antibiotic
Mooseri	-	-	6-14 days	-	-
Prowazeki	-	-	6-15 days	-	-
Psittacosis	high	moderate-high	4-15 days	Mod-high	antibiotic
Rickettsi (Rocky mountain spotted fever)	high	none	3-10 days	up to 80%	antibiotic
Tsutsugamushi	-	-	-	-	-
Epidemic typhus	high	none	6-15 days	up to 70%	antibiotic/vaccine
Bacterial					
Anthrax (pulmonary)	mod-high	negligible	1-5 days	usually fatal	antibiotic/vaccine

Brucellosis	high	none	1-3 days	-25%	antibiotic
Cholera	low	high	1-5 days	up to 80%	antibiotic/vaccine
Glanders	high	none	2-1 days	usually fatal	antibiotic
Meloidosis	high	none	1-5 days	usually fatal	antibiotic
Plague (pneumonic)	high	high	2-5 days	usually fatal	antibiotic/vaccine
Tularemia	high	negligible	1-10 days	low to 60%	antibiotic/vaccine
Typhoid fever	mod-high	mod-high	7-21 days	up to 10%	antibiotic/vaccine
Dysentery	high	high	1-4 days	low to high	antibiotic/vaccine

Table Seven

Key Biological Weapons that May Be in the Middle East: Part Two

Disease	Infectivity	Transmissibility	Incubation Period	Mortality	Therapy
Fungal					
Coccidioidomycosis	high	none	1-3 days	low	none
Coccidiodes Immitis	high	none	10-21 days	low	none
Histoplasma					
Capsulatum	-	-	15-18 days	-	-
Norcardia Asteroides	-	-	-	-	-
Toxinsa					
Botulinum toxin	high	none	12-72 hours	high neromuscular paralysis	vaccine
Mycotoxin	high	none	hours or days	low to high	?
Staphylococcus	moderate	none	24-48 hours	incapacitating	?

a. Many sources classify as chemical weapons because toxin are chemical poisons. Source: Adapted by Anthony H. Cordesman from Report of the Secretary General, Department of Political and Security Affairs, Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use, New

York, United Nations, 1969, pp. 26, 29, 37-52, 116-117; Jane's NBC Protection Equipment, 1991-1992; James Smith, "Biological Warfare Developments," Jane's Intelligence Review, November, 1991, pp. 483-487.

Terrorism and Nuclear Weapons

Nuclear weapons are simultaneously the most threatening weapon terrorists might use and the most difficult weapon for terrorists to obtain. Most nuclear weapons are extremely sophisticated devices requiring extremely advanced machining, electronics, and safety procedures during their manufacture and handling. They are far more expensive, and much more difficult to manufacture. They sometimes involve detectable levels of radiation, and are much heavier than biological weapons.

Single gun devices are the least sophisticated nuclear weapon that a Middle Eastern terrorist might assemble. It is possible to use conventional ordnance technology in assembling the mechanism and fabricating the explosive for such a weapon. Commercial industrial techniques can be used to manufacture a tungsten or tungsten carbide reflector, and a neutron initiator can be made if a modest reactor is at hand for polonium production. A gun weapon could do without such a device and could even use near weapons grade levels of enrichment at the cost of lower yields and increased risk of misfires and partial fission. (26)

At the same time, even single gun devices still require relatively sophisticated neutron reflectors. They are extremely heavy relative to implosion weapons, and are wasteful of enriched material. For example, an efficient implosion weapon with a 10-15 kiloton yield might use only 6-8 kilograms of plutonium while even an efficient version of a single gun device using weapons grade plutonium might use 60 kilograms and require machining down from a total of 70-90 kilograms. Further, an effective gun device must use weapons grade U-235 or U-233 and

cannot use plutonium. Weapons grade plutonium is more common and easier to process, and the fact that gun devices must use uranium will restrict terrorist capability to actually manufacture a weapon.(27)

Implosion weapons are more efficient, but are far more complex to design and manufacture -- even if weapons grade uranium or plutonium are available. The two principal problems are the development of an effective implosion system and a suitable neutron initiator. The basic techniques and designs necessary to solve both problems are well known, but actually designing a reliable weapon and fabricating working components is still extremely difficult and is likely to require either a large, high-technology clandestine organization or a state-sized entity. High efficiency implosion devices are even more sophisticated and require the design to maximize the compression of the fissile material by using a levitated core, or flying plate design, with a sufficiently high HE/driver mass ratio to achieve velocities approaching the theoretical limit. This requires techniques such as the use of an efficient tamper and reflector (preferably non-moderating); the use of a composite core (if two different fissile materials are isotopes); and fusion boosting. (28)

Building a weapon with minimal fissile material and no testing also imposes serious constraints. Reducing the amount of fissile material diminishes yield and further increases the risk of failure without testing or types of simulation that normally require a state-sized entity. The mass of the implosion system, and the tamper/reflector must be increased, which will result in greater overall mass and volume, even though the fissile material weight is reduced.

The only variation in weapons design that seems to offer a terrorist the ability to use minimal amounts of fissile material is an advanced flying plate design that would compress a one kilogram plutonium mass sufficiently to produce a yield in the 100 ton range. This design, however, places important limits on the type of

fissile material that can be used. The high compression required implies fast insertion times, and relatively pure weapons grade plutonium. (29)

At the same time, one should not exaggerate the difficulties. Several trials have shown that a number of graduate physicists could design workable gun type weapons that could be assembled using commercially available parts, explosives, electronics, relatively small facilities and readily available tools. There are weapons designs that can use a higher plutonium-240 content than normal weapons grade plutonium without affecting performance. In fact ordinary reactor grade plutonium can be as effective as weapon grade material in some very low yield weapons. While it seems unlikely that terrorists can ever hope to make such a weapon, fusion boosting would allow low-enrichment weapons to produce yields exceeding 1 kiloton.

While it is also extremely unlikely that anything smaller than a state-sized entity could produce weapons grade plutonium or uranium, massive amounts of fissile material exist in the Former Soviet Union, as do thousands of relatively small nuclear weapons. In late 1995, Russia had a stockpile over 1,200 tons of highly enriched uranium and 150 tons of weapons grade plutonium, the Ukraine recently had a stockpile of 100 kilograms of highly enriched uranium, and Kazakhstan has a stockpile of 300 kilograms of highly enriched uranium and 100 kilograms of weapons grade plutonium. The FSU was also operating 46 commercial power reactors which produce plutonium 239 as a byproduct. While extracting this plutonium-239 requires complex and dangerous processing, no developing nation that has ever attempted to acquire such technology has failed, and a number of facilities in Russia could perform the task.

Nations like China and Pakistan might also be the source of such material, but the FSU stands out because it already has a substantial nuclear black market. Work by the CSIS Transnational Threats Initiative indicates that Russian law

enforcement agencies dealt with 21 cases of theft of fissile material (some enriched) between mid-1992 and mid-1995, and prosecuted 19 Russian citizens. The Russian Ministry of the Interior reported 27 cases of theft in 1993 and 27 in 1994 -- all by Russians inside the apparatus for producing and securing such material. There were five recoveries of small amounts of weapons usable (87% enriched) uranium in 1994, although the largest recovery totaled only 2.7 kilograms. Germany investigated 158 cases of nuclear smuggling in 1992, 241 in 1993, and 267 cases in 1994, and German officials estimated that at least half of these cases involved smugglers with some access to real radioactive materials. In contrast, the US has had only one confirmed case of domestic nuclear smuggling or extortion involving actual nuclear material out of the 100 odd cases it has investigated over the last 20 years.

Nuclear smuggling also involves far more serious risks than the transfer of fissile material. The FSU recently had nearly 30,000 nuclear weapons and the problem terrorists face would be greatly eased if one or more nuclear weapons became available. There seems good reason to question whether the safety devices on most FSU weapons -- particularly tactical weapons -- would be as difficult to defeat as those on most US weapons. In any case, the safety devices on most nuclear weapons are not intended to protect them against weeks or months of dedicated effort by trained engineers and physicists. Access to several weapons of the same type would allow the terrorist to disassemble one to determine the exact nature of the weapon's safety and protection system and then develop the best way of bypassing such protection in the other weapons. In some cases, it might be possible to substitute new components for protected components, though possibly at the cost of reliability or yield.(30)

Delivery of smuggled or stolen nuclear weapons would not require a sophisticated military delivery system. Even a large gun type device could be easily moved in a truck or small ship, and a fully shielded Russian designed

nuclear weapon could be shipped in a relatively small container weighing less than 500 kilograms. In broad terms, the protection systems built into Russian nuclear weapons seem to be less sophisticated than those in US weapons, and no protection system is a guarantee against several weeks or months of patient effort to defeat it.(31) The terrorist would also have several potential advantages in the delivery of a weapon that are not available to a state making a military attack. A sophisticated terrorist can chose the exact time and place of attack, can chose the moment for maximum political or escalatory provocation or when civil defense and emergency response measures are unprepared.

Once again, one has to be careful about treating state terrorism or non-state terrorist groups as mass murderers. However, it is at least possible that a Middle Eastern terrorist group might see the fall out from a ground burst as a significant bonus from an attack. A terrorist could also map a city or area target with great precision. Like terrorists using chemical and biological weapons, terrorist using nuclear weapons can now draw on sophisticated weather and wind data to chose the optimal moment of attack. Wind patterns can be confirmed or monitored very cheaply using remote devices linked to the Internet or cellular phones. The vast uncertainties that military planners face in dealing with collateral damage from the long term death rate from fall out and rain out (or underwater/surface explosions) may have little meaning to terrorist who may want massive casualties to die slowly and agonizingly over a period of decades and wounded societies which must endure the human consequences. A terrorist willing to kill a hundred thousand people with the prompt effects of nuclear weapons is unlikely to have humanitarian niceties about longer term deaths.

A terrorist does not have to use high yields to deal with uncertainties in accuracy and it is important to understand that the effects of even small nuclear weapons are extremely severe. Table Eight shows that a 10 kiloton weapon has roughly 25% to 33% of the blast and thermal effects of a 100 kiloton weapon that is 10

times larger. While it is impossible to quantify fall out effects in equally simple terms, an urban ground burst from a 10 kiloton weapon might well produce fall out equal to 40-50% of that of a 100 kiloton weapon, and a well-designed exploitation of its fall out pattern would probably produce a prompt and long-term death rate in excess of 20-30% over the greater Riyadh, Amman, Cairo, or Tel Aviv areas. It is also possible that a terrorist might increase the radiological fallout from such a weapon by packing it, or adapting its tamper, to use a non-weapons grade fissile material like uranium 238 or plutonium 240.

There are no precedents for knowing what would happen to a Middle Eastern state whose major population center took both devastating immediate losses and then would have to deal with the longer-term medical consequences over a period of 20 years or more. There is no way to know how much of its ruling elite would be lost, how its people would deal with the political and economic shock, what the impact would be on immigration and emigration, and how it will deal with decontamination and rebuilding.

Work done by US and British civil defense planners during the 1950s and 1960s suggests that the technical aspects of recovery could be dealt with relatively rapidly, and the Japanese experience at Hiroshima and Nagasaki indicates that human beings are relatively resilient in dealing with the shock of nuclear attack. Both the civil defense studies and Japanese experience, however, are based on recovery by developed countries with careful planning for recovery -- or wartime readiness and preparations -- and the existence of a stable national political structure and a relatively unified political system.

There also is a significant possibility that a terrorist nuclear device could explode in ways that involved little planning by the terrorists involved. Under some conditions this could lead to a misfire or explosion in an area where the weapon would do comparatively limited damage. Under other conditions, it could vastly

complicate the already unpredictable political and strategic consequences of a terrorist use of nuclear weapons. A nuclear device is inherently unstable. It must bring fissile material into near proximity for critical mass and be surrounded by high explosives. A one of a kind explosive device may detonate by accident -- as a have many terrorist bombs.

A stolen nuclear weapon whose safety devices are bypassed by terrorists is scarcely a secure system for transit or cargo purposes and a stolen high efficiency design might be vulnerable to sudden core collapse. Terrorists may ignore or fail to understand fall out patterns which can easily reach across borders, and explosions can produce skip effects where winds and weather lift up fall out and deposit it in lethal concentrations and up to several hundred kilometers away. The impact of an explosion in Jerusalem that terrorists had intended for Tel Aviv is just one of the countless "wild card" cases that might occur.

Finally, terrorists can use nuclear materials in other ways. Most radiological weapons do not offer the extreme lethality of biological weapons and are closer to chemical weapons in lethality. It is also difficult to manufacture weapons with wide area coverage, which present the same general problems as manufacturing very small particles as biological weapons and the manufacture of such weapons would be easier to detect at a distance. Highly sophisticated plutonium particulates that could be delivered like Anthrax spores would be an extraordinarily dangerous weapon to manufacture and handle. However, the inhalation of even trace amounts of plutonium would cause an agonizing death, and plutonium 240 -- a non-fissile material -- would be as lethal as plutonium 239.

Terrorists might exploit their very possession of nuclear materials. For example, terrorists may acquire a credible capability to threaten the use of a nuclear device

long before they actually possess a working nuclear weapon -- if they ever acquire one. A nation that detects the transfer of a large amount of fissile material or smuggled weapon -- and/or the acquisition of materials for making a weapon -- will be vulnerable to threats and blackmail and will have to take Draconian security measures to have credibility for dealing with the attack. The mere existence of a credible threat could provide terrorists with a high degree of leverage in some contingencies and change the rules for dealing with such groups and counter-terrorist activity. Terrorists are as capable of preemption, or "launch under attack," as states. As is the case with highly lethal biological agents, states would be confronted with the risk that counter-terrorist activity could trigger an unacceptable act by the terrorist group that the state was attempting to counter.

The final technical dimension shaping nuclear terrorism is the risk of nuclear cocktails that mix radiological poisons with biological and chemical weapons or very large explosive devices. Terrorists seeking to complicate and/or kill emergency response efforts might add radioactive contaminants to other weapons knowing that -- at a minimum -- even limited levels of radiation can cause panic and disrupt efforts to deal with other forms of damage. Mixing types of weapons could also greatly complicate decontamination, further the weaken the credibility of announcements that an area or facility is safe, and force governments to deal with lingering after effects and investigations that stretch out the public impact of an act of terrorism for months or years. As has been discussed in Table Four, this could lead to attempts to use radiological agents against military facilities with US or local military personnel as well as civil targets.

Once again, one cannot discount the resulting problems of contamination and fear. Most radiological poisons may be no more lethal than a host of other killing mechanisms but radiation inspires the same unique level of fear as an exotic

disease. Even trace amounts of radiation can inspire high levels of fear and trigger massive security measures and decontamination exercises. There is little authoritative basis for deciding what level of exposure is or is not safe and what level of decontamination is successful. Even when Middle Eastern governments can declare that a radiation level is safe, they are not likely to encounter trust and public confidence. Combined with the long half-lives of many radioactive agents, this could make even radiological weapons that have little lethality potentially effective as panic and facility/area denial weapons.

Detection, defense, and response would again present problems. As has been discussed earlier, coastal facilities can be attacked without a weapon formally entering national territory and container shipments would have to be inspected outside ports to prevent the shipment of booby-trapped devices. While airport detectors, vehicle monitoring detectors, and area search equipment are likely to be more effective than the equipment available to deal with chemical and biological weapons, it may be possible for terrorists to effectively shield radioactive material, and detection of a single weapon in maritime cargo would be uncertain without on-ship inspection.

Few Middle East countries can hope to acquire the capabilities and technical support of the US Nuclear Emergency Situation Team (NEST). Even US experts would find it difficult to quickly characterize a given radioactive contaminant and decide on a decontamination strategy. A terrorist presumably would time an attack to avoid any effective civil defense and evacuation measures -- which would differ in detail from the measures required to defend against biological and chemical attack. The treatment of nuclear weapons effects would require massive medical capabilities to deal with direct physical injury from blast, burns and radiation poisoning and might quickly saturate regional response capabilities. Triage, the fear of further attacks, and the psychological/physiological impacts of radiation would further expand the social and political impact of nuclear weapons.

Table Eight

The Thermal and Blast Effects of Nuclear Weapons

	Radius of Effect in Kilometers					
Yield in Kilotons	**Metals Vaporize**	**Metals Melt**	**Wood Burns**	**3rd Degree Burns**	**5 psi/ 160 mph Winds**	**3 psi 116 mph Winds**
10	0.337	0.675	1.3	1.9	1.3	1.6
20	0.477	0.954	1.9	2.7	2.0	2.5
50	0.754	1.6	3.0	4.3	2.7	3.3
100	1.0	2.0	4.3	5.7	3.5	4.3
200	1.5	2.8	5.7	8.0	4.5	5.4

Source: Adapted by Anthony H. Cordesman from the Royal United Services Institute, Nuclear Attack: Civil Defense, London, RUSI/Brassey's, 1982, pp. 30-36.

Terrorism and Counterproliferation in the Middle East

There is no way to put an analysis of truly horrifying possibilities without clear probabilities into perspective. There is no way to distinguish the "boy who cried wolf" from "chicken little," and either from a rational warning. It is should obvious, however, that nations inside and outside the Middle East should at least begin to consider terrorism and unconventional warfare as potential means of delivery of weapons of mass destruction and as independent causes of proliferation.

The costs of a "paradigm shift" in terrorism to the use of weapons of mass destruction are so high that any structure of regional arms control and defense that ignores such risks leaves gaping holes and vulnerabilities. There is no point, for example, in creating a vastly expensive missile defense system to deal with a vastly expensive missile threat and then leave a nation vulnerable to terrorism and unconventional warfare. The end result is simply to create a major new incentive for such attacks and state-sponsored terrorism.

At a minimum, regional states and their allies need to make such terrorism part of their counterproliferation policy. In broad terms, this means extending the actions in Table Nine to cover state terrorism and independent terrorist groups as well as regional military forces.

Table Nine

Illustrative Counterproliferation Policies

Dissuasion to convince non-weapons of mass destruction states that their security interests are best served through not acquiring weapons of mass destruction.

Denial to curtail access to technology and materials for weapons of mass destruction through export controls and other tools,

Arms control efforts to reinforce the Nuclear Non-Proliferation Treaty, Biological and Chemical Weapons Conventions, nuclear free zones, conventional arms treaties that stabilize arms races, confidence and security building measures, and Anti-Ballistic Missile Treaty clarification efforts to allow US deployment of advanced theater ballistic missile defenses.

Region-wide arms control agreements backed by intelligence sharing and ruthless, intrusive challenge inspection without regard for the niceties of sovereignty.

International pressure to punish violators with trade sanctions to publicize and expose companies and countries that assist proliferators, and to share intelligence to heighten awareness of the proliferation problem.

Defusing potentially dangerous situations by undertaking actions to reduce the threat from weapons of mass destruction already in the hands of selected

countries -- such as agreements to destroy, inspect, convert, monitor, or even reverse their capabilities.

Military capabilities to be prepared to seize, disable, or destroy weapons of mass destruction in time of conflict.

Improve tracking and detection of sales, technology transfer, research efforts, extremist groups.

Defensive capabilities, both active (theater missile defenses) and passive (protective gear and vaccines) that will mitigate or neutralize the effects of weapons of mass destruction and enable forces to fight effectively even on a contaminated battlefield.

Declared and convincing counterstrike options ranging from conventional strikes devastating a user nation's economy, political structure and military forces to the use of nuclear weapons against the population centers of user nations and groups.

It also requires regional states and their allies to consider adapting a suitable mix of force improvements of the kind listed in Table Ten, which is adapted from the US counterproliferation program. Table Ten also illustrates the practical problems Middle Eastern states will face in dealing with the combined mix of threats from the military forces of hostile states, state terrorism, and independent terrorism. It is important to stress that threatened states cannot afford to focus on one aspect of the threat of weapons of mass destruction, any more than they can afford to ignore the need to maintain and improve their capability to deal with more conventional threats.

This list of force improvements also illustrates the real-world problems that Middle Eastern governments are likely to have in dealing with a range of

problems that is an exercise in complexity or "chaos" theory. Any review of the literature on the threat of terrorism from weapons of mass destruction quickly reveals a wide range of individually useful suggestions -- in addition to a wide range of "scare" suggestions and "sales pitches."

The problem lies in determining how a developing Middle Eastern state -- even one as advanced as Israel -- can combine a suitable mix of measures to cover the unique terrorist threat from all weapons of mass destruction along with the need to respond to all other threats. Counter-terrorist experts may be able to focus on their specialty and avoid the kind of ruthless trade-offs discussed earlier, but governments must use limited resources to deal with all the risks they face.

There currently do not seem to be good or cost-effective answers to dealing with this problem. In fact, one is sometimes reminded of the Chinese proverb, "No solution. No problem!" There are, however, several key starting points:

National and international intelligence and counter-terrorist experts, involved in concert with technical experts and emergency and medical personnel, need to begin to fully study the risks. At a minimum, intelligence efforts need to be refocused to train personnel to recognize long-term and technical indicators, and to provide strategic warning of a paradigm shift in regional terrorist activity to focus on weapons of mass destruction. This effort must break down internal bureaucratic barriers to coordination, over-compartmentation of security, and a tendency of sub-optimize around known terrorist groups and a particular set or type of weapon of mass destruction.

Study is needed of existing medical and emergency response capabilities -- including civil defense and public warning -- to determine what low cost steps can be taken. At the same time, some form of emergency response team should be established that can begin to improve detection and response capabilities and

which can coordinate efforts to deal with the combined nuclear-biological-chemical threat. A clear concept of emergency and medical response operations should be developed to use existing resources effectively, avoid the self-destruction of the medical and emergency response effort, and establish priorities for investment in a balanced overall response effort.

The US and other states with advanced counter-proliferation programs and medical capabilities need to begin planning for the transfer of suitable intelligence, detection and warning systems, and emergency response aid. The developing states of the Middle East have little prospect of cost-effectively evaluating all of the possible approaches and technologies. Massive outside medical and emergency response aid may often be the only way in which a developing state can ever deal with an effective terrorist attack using such weapons.

Technology transfer control efforts outside the Middle East need to be restructured to explicitly consider terrorism, and not simply the creeping proliferation in regional military forces.

Regional and outside states need to recognize that arms control and counter-proliferation efforts cannot be divorced from counter-terrorism, or focused on one weapon of mass destruction. Any such arms control efforts virtually create a vacuum or gap that serves as an incentive for terrorist or unconventional attacks that exploit the weaknesses or rigidity in the arms control regime.

That said, it is difficult to dismiss the probability that governments will only really begin to react after one or more terrorists demonstrate that the possibility of such terrorism is an actual fact. Governments do not do well with paradigm shifts, and the sheer complexity of the potential threat makes a response even more difficult. In practice, one can only hope that Middle Eastern terrorists continue to have mediocre competence, are slow to take advantage of such options, are noisy

enough to provide considerable strategic warning, and that the price tag of their initial strikes is low enough so that the resulting casualties and damage are an acceptable form of the unacceptable.

Table Ten

Key Force Improvements Affecting Counterproliferation Policy

Detection and characterization of biological and chemical agents. Accelerate the fielding of stand-off detection, point detection and characterization systems. Addresses the integration of sensors into existing and planned carrier platforms, emphasizing man-portability and compatibility with UAVs.

Detection, characterization, and defeat of hard, underground targets. Seek new sensors, enhanced lethality, and penetrating weapons to increase the probability of defeating the target while minimizing the risk of collateral damage.

Detection, localization and neutralization of weapons of mass destruction inside and outside the nation. Identify and evaluate systems, force structures, and operational plans to protect key military facilities and logistic nodes, and to conduct joint exercises to improve the capability to respond to potential biological and chemical threats.

Development and deployment of addition passive defense capabilities, including development and production of biological agent vaccines. Develop and field improved protective suits, shelters, filter systems, and equipment Develop improved decontamination methods.

Support for weapons of mass destruction related armed control measures include strengthening the NNPT, CTB, and BWC. They include establishing a COCOM successor regime, and improving controls on exports and technology by strengthening the MTCR, Nuclear Suppliers Group and Australia Group.

Missile defense capabilities, with primary emphasis on theater ballistic missile defenses. This activity involves improvements in active and passive defenses, attack operations, and improvements in BM/C4I as well as the deployment of theater missile defenses. The primary focus, however, is on anti-ballistic missile defenses, and in the near term, this involves the development of the Patriot Advanced Capability Level-3 (PAC-3/ERINT), Navy area theater missile defense (Aegis), and theater high altitude area defense (THAAD).

Publicized counterstrike options. Options ranging from a convincing declared capability to conduct precision mass air and missile strikes with conventional weapons that can destroy critical strategic and economic targets to the use of nuclear weapons against population centers.

New force tailored to dealing with terrorist and unconventional threats. New intelligence and tracking systems dedicated to the prevention of mass terrorism, and tailored special forces to detect and attack terrorist groups and to deal with unconventional uses of weapons of mass destruction.

1.n spite of extensive research dating back to the nuclear attacks on Japan, estimates of fall out effects vary so sharply by source that it is virtually impossible to model a credible estimate of the impact of fall out on long-term death rates. It is obvious that fall out immediately down wind of an explosion will produce a high number of casualties within a month of an explosion, but it is extremely difficult to generalize as to how many will die. The problem of longer term deaths is almost impossible to estimate because studies produce such different estimates of the added impact of radiation-related cancer, leukemia, and other diseases and because the long term death rate will apply to the entire life expectancy of those exposed and to some of their children. As a result, most recent nuclear weapons effects studies caveat their estimates by saying they only include prompt casualties. Such estimates are suitable for military purposes because few attackers would deliberately use ground bursts on an urban or densely populated target, and the key criteria is prompt damage to the opponents military forces. They are not valid for counter-terrorism purposes because the terrorist might see them as a key form of "bonus damage" or even a primary killing mechanism.

2.Washington Post, October 2, 1996, p. A-12.

3. US Arms Control and Disarmament Agency (ACDA), World Military Expenditures and Arms Transfers, 1995, GPO, Washington, 19956, Table II.
4. Al-Ahram, July 25, 1975; Al-Akhbar, July 25, 1975.
5. Jane's Defense Weekly, May 6, 1995, p. 15.
6. Washington Post, April 6, 1995, p. 1.
7. Jane's Defense Weekly, May 13, 1995, p. 5.
8. Testimony of Gordon C. Oehler, Director, Nonproliferation Center, CIA to the Permanent Committee on Investigations, US Senate, October 31, 1995.
9. The danger inherent in this statement is that terrorists groups have usually been in existence for some time before they acquire the visible profile necessary to be described in documents like the Department of Defense's "Terrorist Group Profiles" and in the US State Department report on "Patterns of Global Terrorism." By this time they have acquired some form of bureaucratic structure and "predictability." Further, such unclassified reporting does not report in detail on internal divisions and break away elements, or assess the risk of ultra-extreme movements within such terrorist groups.
10. Uniformed Services University of Health Services Report on "Responding to the Consequences of Chemical and Biological Terrorism," July 11-13, 1995.
11. A wide range of conflicting medical statistics have been issued. These are taken from presentations to the Uniformed Services University of Health Services Report on "Responding to the Consequences of Chemical and Biological Terrorism," July 11-13, 1995.
12. CIA Non-Proliferation Center, The Chemical and Biological Warfare Threat Handbook, Washington, CIA, 1995, pp. 5-9.
13. "Global Proliferation of Weapons of Mass Destruction," Hearings Before the Permanent Subcommittee on Investigations of the Committee on Governmental Affairs, US Senate, October 31 and November 1, 1995, pp. 507-525; CIA Non-Proliferation Center, The Chemical and Biological Warfare Threat Handbook, Washington, CIA, 1995, pp. 5-9.
14. AP, October 23, 1995, 1332.

15. Uniformed Services University of Health Services Report on "Responding to the Consequences of Chemical and Biological Terrorism," July 11-13, 1995.
16. Jane's Defense Weekly, October 9, 1996, p. 5.
17. For a discussion of some of the technical options, see "Briefing" Chemical and Biological Terrorism," Jane's Defense Weekly, August 14, 1996, pp. 16-21.
18. Adapted from Matthew Meselson and Julian Perry Robinson, "Chemical WarfarChemical Warfare and Chemical Disarmament," Scientific American, Vol. 242, No. 4, April, 1980, pp. 38-47; "Chemical Warfare: Extending the Range of Destruction," Jane's Defense Weekly, August 25, 1990, p. 267; Dick Palowski, Changes in Threat Air Combat Doctrine and Force Structure, 24th Edition, Fort Worth, General Dynamics DWIC-01, February, 1992, pp. II-335 to II-339; US Marine Corps, Individual Guide For NBC Defense, Field Manual OH-11-1A, August, 1990; and unpublished testimony to the Special Investigations Subcommittee of the Government Operations Committee, US. Senate, by Mr. David Goldberg, Foreign Science and Technology Center, US. Army Intelligence Center on February 9, 1989. Also see For more detailed descriptions of such effects see Mark H. Killinger, Chemical/Biological Incident Handbook, Seattle, Pacific Northwest Laboratory, 1993; Harvey J. McGeorge, Chemical./Biological Terrorism Threat Handbook, Woodbridge, Public Safety Group, 1989; Satu M. Somani, Chemical Warfare Agents, New York, Academic Press, 1992; Edward Spiers, Chemical Warfare, Urbana, University of Illinois Press, 1986; and Dr. Michael G. MacNaughton and Joseph H. Brewer, Environmental Chemistry and the Fate of Chemical Warfare Agents, San Antonio, Southwest Research Institute, 1994.
19. Testimony of Lt. Colonel Edward Eitzen before the Permanent Subcommittee on Investigations of the Committee on Government Affairs, US Senate, October 31, 1995.
20.Adapted from testimony of Lt. Colonel Edward Eitzen before the Permanent Subcommittee on Investigations of the Committee on Government Affairs, US Senate, October 31, 1995 and Health Aspects of Biological Weapons, World

Health Organization, 1970. For more detailed descriptions of such effects see Mark H. Killinger, Chemical/Biological Incident Handbook, Seattle, Pacific Northwest Laboratory, 1993 and Harvey J. McGeorge, Chemical./Biological Terrorism Threat Handbook, Woodbridge, Public Safety Group, 1989.

21. See the lists in pages 533-542 of Hearings Before the Permanent Subcommittee on Investigations of the Committee on Governmental Affairs, US Senate, October 31 and November 1, 1995.

22. CIA Non-Proliferation Center, The Chemical and Biological Warfare Threat Handbook, Washington, CIA, 1995, pp. 26-29.

23. Uniformed Services University of Health Services Report on "Responding to the Consequences of Chemical and Biological Terrorism," July 11-13, 1995; CIA Non-Proliferation Center, The Chemical and Biological Warfare Threat Handbook, Washington, CIA, 1995, pp. 33-34.

24. Jane's Defense Weekly, October 9, 1996, p. 5; "Briefing" Chemical and Biological Terrorism," Jane's Defense Weekly, August 14, 1996, pp. 16-21.

25. Testimony of Lt. Colonel Edward Eitzen before the Permanent Subcommittee on Investigations of the Committee on Government Affairs, US Senate, October 31, 1995.

26. Adapted from "Nuclear Weapons Frequently Asked Questions," by Carry Sublette, Version 2.15, August 23, 1996, MILNET - Nuclear Weapons, NFAQ Offical Mirror Site.

27. US Department of Energy working estimate.

28. Adapted from "Nuclear Weapons Frequently Asked Questions," by Carry Sublette, Version 2.15, August 23, 1996, MILNET - Nuclear Weapons, NFAQ Offical Mirror Site.

29. Adapted from "Nuclear Weapons Frequently Asked Questions," by Carry Sublette, Version 2.15, August 23, 1996, MILNET - Nuclear Weapons, NFAQ Offical Mirror Site.

30. For a detailed description of these risks, see the CSIS Task Force Report, The Nuclear Black Market, Transnational Threats Initiative, Washington, CSIS, 1996 - ISBN 0-89206-287-8.

31. For a detailed description of these risks, see the CSIS Task Force Report, The Nuclear Black Market, Transnational Threats Initiative, Washington, CSIS, 1996 - ISBN 0-89206-287-8.