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Syria and Weapons of Mass Destruction

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Table of Contents

The Middle East is the scene of an ongoing process of proliferation. Egypt, Iran, Iraq, Israel, Libya, and Syria all have significant capabilities to deliver weapons of mass destruction Israel, and Syria has made considerable progress in acquiring weapons of mass destruction since the mid-1970s.[1] Syria has never shown a serious interest in nuclear weapons, although it did seek to buy two small research reactors from the PRC in 1992, including a 24-megawatt reactor, and purchased a small 30-kilowatt research reactor from the PRC in 1991. It allowed inspection by the International Atomic Energy Agency for the first time in February 1992.[2] Syria does, however, deploy sheltered missiles, armed with chemical warheads, as a means of both countering Israel's nuclear forces and maintaining its rivalry with Iraq. As the attached article Syrian Defense Minister Gen. Mustafa Tlas shows, Syria has a major interest in biological warfare, and the fact his article first appeared in public in an Iranian journal may not entirely be a coincidence.

Syrian Missile Programs

Syria obtained the FROG 7 in 1972, and the Scud B missile as early as 1974, but Syria does not seem to have given these missile forces a major role until Israel's invasion of Lebanon in 1982. In the ensuing fighting, Syria lost much of its air force in two brief clashes with Israeli fighters, and saw Israel suppress its land based air defenses in Lebanon in a matter of hours. This experience persuaded Syria that surface-to-surface missiles were a potential means of overcoming Israel's advantage in the air, and furnished a means of attacking Israel's air bases and mobilization centers, and as a deterrent to Israeli conventional air attacks. Syria does not seem to have felt that any missile force it could develop would allow it to risk engaging Israel in a war that could escalate to Israeli nuclear retaliation, but it seems to have concluded that missiles were its only option. [3]

Syria reorganized its surface-to-surface missile brigades. It obtained the SS-21, or Scarab, in 1983, and steadily improved the readiness and effectiveness of its missile units. In 1999, Syria had a force of 18 SS-21, 18 FROG-7, and 26 Scud B and Scud C surface-to-surface missile fire units, plus additional Sepal SS-1B and SSC-3 coastal defense missile fire units.[4]

Syria also improved is missile production facilities. It can currently produce its own Scud B missiles with ranges of approximately 260-300 kilometers, and a theoretical maximum accuracy or CEP of around 300 meters. The warhead weighs 985 kilograms and is large enough to carry a chemical, biological, or nuclear warhead. Syria is believed to have an inventory of around 200 Scud B missiles.[5]

The Scud B does, however, have important limitations. It has a maximum range of about 290 kilometers, and can only cover Israeli targets deep in the south of Israel (as far south as Halserim air base and Dimona) from vulnerable forward positions. This seems to have led to its deployment in sheltered locations near Damascus and this may have aided Israel's ability to track and target Scud B unit movements, although firing the Scud B at such short-ranges might complicate Israel's detection and tracking problems in using theater ballistic missiles for defense.

The SS-21s in Syrian hands do not have chemical warheads and Syria would find it difficult to develop such a capability without Russian support. The problems of developing and testing an advanced missile warhead are beyond current Syrian capabilities. Given the accuracy of the SS-21, there is at least some long-term risk that Syria could eventually fire nerve agents successfully at Israeli air bases, C^4I sites, and mobilization centers -- and seriously degrade Israeli conventional capabilities.[6] The SS-21s do not have the range to hit Dimona and most suspected Israeli nuclear weapons and missile storage sites.

These problems may help explain why Syria has put so much effort into obtaining longer-range missiles. They give it the range to attack any target in Israel from sites as far away from Israel as possible, as well as a potential threat to Turkey. Such targets include the reserve assembly areas for Israel's ground forces, Israel's air bases in the south, and its nuclear facility at Dimona – although parts of the Dimona complex may be too well sheltered for such an attack. It would probably require missiles with nuclear warheads or with advanced penetrating conventional warheads and terminal guidance. These are weapons of a kind that Syria is unlikely to acquire in the near- to mid-term.[7]

From 1984-1989, Syria tried unsuccessfully to buy more SS-21s, and the SS-12 or SS-23 missile, from the USSR. It was particularly interested in the SS-23, which has a 500 kilometer range, and which could have hit targets throughout Israel and Jordan, and much of Iraq. It is clear that both President Hafez Assad and the Syrian Defense Minister actively sought such missiles, and they may even have asked for SS-25 ICBMs once it was clear that the USSR would agree to the INF treaty. The USSR, however, refused to provide any of these systems.[8]

Syria then sought M-9 missiles from the PRC. Reports surfaced in August 1989 that Syria ordered the new M-9 IRBM from the People's Republic of China.[9] While the PRC denied this, and the M-9 missile is still in development, it would meet many Syrian needs. It has a range in excess of 370 miles (600 kilometers), a projected CEP of around 600 meters, and a payload of

500 kilograms. There have also been reports that the PRC sold Syria the M-1B missile, with ranges of 50 to 60 miles, in March 1990.[10] The PRC is developing two other long-range mobile surface-to-surface missiles -- the M-11 and the M-12 -- and Syria may have an interest in these systems as well. Syria purchased 30-90 tons of solid rocket fuel from the PRC in 1991.[11] There were unconfirmed reports in March 1999 that Syria had created a production facility to build both the M-11 (CSS-7/DF-11) and M-9 missiles with ranges of 280 and 600-800 kilometers respectively. It reports that production of the booster stage of the M-11 began in 1996, and that missile production is expected to start "soon."[12]

Syria finally succeeded in obtaining substantial deliveries of North Korean "Scud-C" missiles. These deliveries began on March 13, 1991, when a freighter called the Al-Yarmouk docked in Syria. Two more deliveries took place in 1991. When the US protested such shipments in February 1992, North Korea shifted freighter movements to route them through Iran. The first such shipment took place when the North Korean freighter Dae Hung Ho reached Iran in March 1992, and missile parts and manufacturing equipment were then airlifted to Syria.

Up to 50-80 missiles and 15-20 launchers have been delivered and manufactured since 1992, and several Syrian tests of the missile have taken place.[13] These missiles give Syria a weapon with an estimated range of 500-600 kilometers, a CEP of around 650-850 meters, and a payload of 450-600 kilograms. Syria has cooperated with Iran in importing these systems, and both countries seem to be interested in manufacturing the missile as well as importing it. According to some reports, Syria has built two missile plants near Hama, about 110 miles north of Damascus, one is for solid fueled rockets and the other is for liquid fueled systems. North Korea may have provided the equipment for the liquid fuel plant, and Syria may now be able to produce the missile.[14]

The "Scud C" offers Syria significant advantages in addition to longer range. While the North Korean missile is generally referred to as a "Scud C", the name may be highly misleading. The original Scud A was first seen in 1953 when it entered service. The improved Scud B, with a range of 300 kilometers entered service in 1965, and the "Scud C", with a range of 450 kilometers, was deployed in 1968. It is likely that the North Koreans have redesigned the now obsolete Soviet missile, and have either extended the single stage liquid propelled motor or have added strap on boosters. It is nearly certain that they have improved the fusing options, and strap down inertial guidance system, and the reliability of the Scud's jet vane course correction system. These improvements are likely to produce a system not only superior to the Soviet Scud -- which

was being replaced by the SS-23 before the INF Treaty -- but one that has a higher payload, more accuracy, and more reliability than any Iraqi Scud variant.[15]

It is also likely that Syria has improved versions of the Soviet MAZ-583 eight-wheeled transporter-erector-launcher, the refueling process and ZIL-157 propellant tanker, and the command vehicle, and improved position establishing and meteorological gear. If so, the set up time for a Scud B or C unit being moved to a new position could be cut from a minimum of 45-60 minutes to as few as 15-20 minutes. This would not only greatly reduce the probability of detection and vulnerability to attack, but greatly improve operational accuracy as well. Commercially available Global Positioning Gear could further improve Syria's capabilities, particularly if reports of European GPS gear with military accuracy's of 10 meters are true.

The new North Korean missile gives Syria the capability to strike at any part of Israel as well as its other neighbors, and Syria has long-range drones that can assist in targeting such missiles. It can cover all 11 of Israel's air bases, all of the 15-odd main armories for Israel's armored forces, and all major reserve force assembly areas.[16] The new missiles have better range-payload, reliability, and accuracy than the extended range Scuds that Saddam Hussein used in the Gulf War. Most experts believe that these missiles are armed with VX nerve gas warheads -- joining the large number of sheltered Scud missiles with nerve gas warheads that Syria already deploys. They may well use bomblets to deliver such gas over a wider area. The possibility of biological warheads cannot be dismissed, although Syria is more likely to use the latter weapons in bombs or covert delivery systems.

Syria is also involved in a project to develop a long-range solid fueled missile, possibly with Iranian and North Korean assistance. The CIA reported in 1999 that Syria, “continued work on establishing a solid-propellant rocket motor development and production capability. Foreign equipment and assistance have been and will continue to be essential for this effort.”[17]

Syrian and Other Regional Use of Commercial Satellite Imagery

Syria has improved its targeting capability in recent years by making extensive direct and indirect use of commercial satellite imagery, much of which is now highly detailed and comes with coordinate data with near GPS-like levels of accuracy. This is equally true of Egypt, Iran, Iraq, Israel, Jordan, Libya, and even Lebanon, and it represents a fundamental shift in regional intelligence and targeting capability.

It is impossible to determine the amount of photo coverage a given country has obtained from given commercial services, the quality of their photo interpretation, the links between data gathering and targeting, and national doctrine and procedures. A review of recent regional coverage does show, however, that photos are available of air bases, production facilities, and potential missile sites that offer considerable intelligence benefits. One thing is clear, the quality of coverage is improving steadily down to levels of resolution approaching a few meters, and 1-meter resolution should be broadly available by the early 2000s. No clear or enforceable policies exist regarding the sale of imagery that is crisis or war fighting relevant, and coverage can be used for both targeting weapons of mass destruction and conventional war fighting.[18]

In addition to commercial satellite imagery, several countries also have indigenous programs. Israel has the capability to launch military intelligence satellites for a wide range of missions. Egypt has launched its own commercial communications satellite and also has the potential to launch military satellites.[19] These satellites can only have a small fraction of the technical sophistication of US systems, but can still extend reconnaissance, surveillance, targeting, and SIGINT/COMINT capabilities far beyond the range of airborne sensors.

Syrian Missile Conversions and Cruise Missiles

Syria may also have tried to convert some of its SA-2 surface-to-air, SSC-1B, and SS-C-3 coastal defense missiles to deliver chemical agents.[20] This illustrates major potential problems in controlling missile technology. While the SA-2 Guideline is now an obsolete surface-to-air missile, it weighs 2,360 kilograms and is a fairly large system. The Soviet versions had nuclear warheads, and a 130-kilogram high explosive warhead. The slant range of the missile in the air intercept mode is about 50 kilometers, although the system would probably be accurate to over 100 kilometers in the surface-to-surface mode. It is not an ideal system for use against surface targets by any means, and would require substantial modification. It has been deployed in large numbers, however, and nations like Iraq have already developed major conversion programs to turn it into a surface-to-surface missile.

The SSC-1B Sepal is a relatively modern cruise missile in Third World terms. It entered Soviet service in 1970. It has a range of 450 kilometers and a warhead of up to 1,000 kilograms. While it receives little attention, it is a large 5,400-kilogram missile with radio command midcourse guidance, a radio altimeter to control altitude, command guidance at long ranges, and terminal active radar guidance. It can fly at preset altitudes from surface skimming to 3,000-5,000

meters. It is designed for attack against ships and the Soviet version has a 100-200 kiloton nuclear warhead. Its guidance system and accuracy make it difficult to modify for attacks on land targets that are much smaller than a large military base or small town, but its large warhead lends itself to chemical use against such area targets. Syria has several SSC-1B units, which normally have 16-18 missiles per battalion.

The SS-C-3 is another coastal defense missile based on the Styx. It is a modern system that was first deployed in Soviet forces in 1985. It has a much shorter range than the SS-C-1B. Its maximum range is only 80-90 kilometers and its warhead is unlikely to exceed 500 kilograms, although Soviet versions with yields of 1 to 200 kilotons have been reported. It uses inertial midcourse guidance (a programmed auto-pilot with precision accelerometers), and uses a mobile launcher based on the Soviet MAZ-543 8X8 all-terrain vehicle. It is specifically designed for export and has not been deployed with Soviet forces. It is normally used as a sea skimmer against naval targets, but can evidently be set for a high altitude cruise phase with accuracy sufficient to hit a small town or large air base. While converting such a system to chemical warheads would not normally be cost-effective, the resulting system would be relatively mobile and easy to deploy. The possibility cannot be totally dismissed.

Syrian Aircraft Delivery Systems

Syria is slowly acquiring a significant long-range air strike capability. It already has at least 20 Su-24 strike attack aircraft. The exact performance of its export version of the Su-24 is unclear, and its avionics seem to be far less advanced than the Soviet version. Nevertheless, it is probably still a precision all-weather or night attack capable aircraft with some similarities to the F-111 or Tornado. It has a powerful pulse Doppler radar and is capable of very low altitude penetrations. It is a two seat aircraft with a weapons/navigation officer sitting next to the pilot, and may be fitted with FLIR and electro-optical aids, and has good inertial navigation capabilities.

The Russian version has a moderate to good ECM/ECCM suite and radar homing/warning. It has the range/payload to attack Israel by flying around or through Jordan, or over the Mediterranean and from the south. It is a heavy aircraft that weighs 64,000 to 87,000 pounds loaded. It is a swing-wing aircraft with speeds of Mach 2.4 when clean of external munitions. Its LO-LO-LO combat radius with an eight-ton bomb load is 322 kilometers (200 miles). Its range with a 2.5-ton bomb load is 1,800 kilometers (1,115 miles). Its ferry range is about 6,400 kilometers (4,000 miles).[21]

The CIA reported in 1999 that Syria Damascus continued work on establishing a solid-propellant rocket motor development and production capability. Foreign equipment and assistance have been and will continue to be essential for this effort. In addition, Russia continued to deliver advanced antitank guided missiles to Syria. The vast majority of Syria's arsenal consists of weapons from the former Soviet Union. Russia wants to keep its predominant position as the key supplier of arms to Syria.[22]

While it is tempting to focus on missile systems, a well designed Syrian air raid on a city like Tel Aviv that saturated Israel's air defenses with other aircraft, and then raided with Syria's total inventory of Su-24s, might be able to deliver a considerable payload. Such an attack could be particularly lethal if that payload was toxins or biological weapons, rather than nerve gas. At the same time, it should be noted that a ship that took advantage of favorable winds, while sailing off the coast of Israel, could cover an area of up to several hundred square miles simply by releasing anthrax spores or some similar biological agent in a covert delivery mode.

Syrian Chemical Weapons

Syria probably acquired limited stocks of mustard gas shortly before or after the October War in 1973. It was only after Syria's clashes with Israel in 1982, however, that Syria seems to have started a major effort in chemical and biological warfare. As is the case with missiles, Syria saw weapons of mass destruction as a way of countering Israel's advantages and as a means of maintaining its status relative to its other regional military rivals.

Syrian troops steadily increased their NBC training after 1982, and Syria began to give chemical warfare training a serious priority. More significantly, Syria started a crash effort to produce nerve gas -- setting up at least two major chemical weapons plants. US experts indicated in 1984 that Syria had begun manufacturing and deploying non-persistent nerve and other gases in 1982 or 1983. By the late 1980s, Syria seems to have been operating two, and possibly three, facilities for the production of chemical weapons. One seems to be the CERS Institute, which may also play a role in biological warfare research, another is near Homs, and a third is near Saffirah (a village near Allepo).

Both US and Israeli experts believe that Syria is stockpiling nerve gas, mustard gas, and other chemical agents, including non-persistent nerve gases like Sarin (GB) and persistent nerve gas agents like VX. [23] It is believed that VX is being produced at a plant near Damascus.[24] A full

list of the kinds of chemical weapons Syria may have developed is shown in Table 15.3. The CIA reported in 1999 that, "Syria continued to seek CW-related precursors from various sources during the reporting period. Damascus already has a stockpile of the nerve agent Sarin and may be trying to develop more toxic and persistent nerve agents. Syria remains dependent on foreign sources for key elements of its CW program, including precursor chemicals and key production equipment."[25]

Syria was caught smuggling feedstocks from Russia in 1993 and 1994. It obtained 1,800 pounds of feedstocks for nerve gas in 1993, and attempted to smuggle out another 11,000 pounds in 1994. Ironically, the Russian responsible for the smuggling was General Anatoly Kuntsevich, once President Yelstin's chief military liaison officer for chemical disarmament.[26] While most people do not need to be reminded of the severe consequences, Table 15.4 provides a general profile of some of the missions that can be carried out using chemical weapons and the possible amount of an agent necessary for that mission.

As for delivery systems and weapons, Syria may have modified a variant of the Soviet ZAB series incendiary bomb to deliver chemical agents, and may have modified the PTAB-500 cluster bomb to carry chemical bomblets. Syria has probably developed chemical artillery shells, and may be working on chemical rounds for its multiple rocket launchers. Syrian FROG missiles also seem to have been given chemical warheads, although there is no precise way to date when they acquired them.

The primary emphasis of the Syrian program, however, seems to have been strategic. Syria modified its Scud missiles to deliver chemical weapons no later than 1987.[27] In fact, a number of experts believe some Syrian surface-to-surface missiles armed with chemical weapons began to be stored in concrete shelters in the mountains near Damascus and in the Palmyra region no later than 1986, and that plans have long existed to deploy them forward in an emergency since that date.[28]

Putting chemical warheads on the Scud missile gives Syria a relatively effective weapons system, although such a weapon would have nothing like the lethality of Israel's nuclear weapons. For example, if Syria copied the Soviet designs for chemical warheads for the Scud, designs which the USSR seems to have made available to a number of Third World states in the late 1970s, and successfully produced an agent as lethal as the VX chemical warhead used on the

Soviet version of the Scud missile, it would then have an 884 mm warhead weighing 2,170 pounds, of which 1,200 pounds would consist of chemical agent. The warhead would be fitted with a variable time fuse, and the agent would be dispersed by a bursting charge located along the center axis of the warhead.

Assuming a burst altitude of 1,100 meters, and a ground wind speed of three feet per second, and worst case conditions, the warhead could produce a contaminated area that would cover a band about 0.53 kilometers wide and 3.5 kilometers long -- beginning about one kilometer from the burst. Assuming a flat plain and no protection, up to 50% of the exposed personnel would be casualties. This is a very impressive lethal area, and a VX nerve agent might remain lethal for several days. It is important to note, however, that this lethal area calculation does assume exposed personnel, a flat plain, and optimal delivery conditions. Real world lethality might be only 5% to 20% as high, although this would still halt military activity in many targets.[29]

Syrian warheads would be even more effective if – as US and Israeli intelligence experts believe – they now use bomblets in cluster munitions to disperse VX. The US Department of Defense has given briefings indicating that an underground production line to manufacture VX-loaded bomblets was set up near Damascus in early 1997, which is collocated with the Syrian Centre d'Etudes et de Recherche Scientifique (CERS). This facility seems to manufacture bomblets that can be loaded into either Scud B or Scud C warheads and bombs, and which could be modified to disseminate biological weapons. The missile warhead design is believed to be matched to the Syrian production of the Scud C booster. The fusing, dissemination mechanism, and effectiveness of the bomblets is unknown.[30]

Syrian Biological Weapons

Syria has developed biological weapons, although it is not clear that it has attempted to produce or stockpile them. It established at least one major biological warfare facility, and possibly two. One facility seems to exist near the Syrian coast and another facility may have been built underground. According to Israeli sources, Syria was able to produce Botulin or Ricin toxins in 1991 and probably anthrax as well.[31] US intelligence sources also believe that Syria has biological weapons.[32] A list of the kinds of biological weapons Syria may have developed is shown in Table 15.5.

While Syrian biological warfare capabilities receive only limited attention, it is important to note that Syrian sources indicate that the program dates back to at least the early 1980s. The world was never able to detect the true nature of Iraq's massive program until the defection of a leading Iraqi official in 1995 – roughly half a decade after UNSCOM inspections had begun – and similar uncertainties may apply to Syria.

Syria's defense minister, General Mustafa Tlas. has made the following comments about biological warfare in a recent article published in Iran:[33]

> Biological warfare is the first and the most primitive war that Mother Nature has staged against human beings; at the end of this century, the fight between them still continues in the most severe way. Though man has been able to control and overcome diseases such as plague, smallpox, cholera, typhus, and dysentery, still many diseases and toxins destroy millions of people every year weather in war or peace.
>
> If we note that Nazi Germany under the leadership of Hitler—who didn't care about international organizations and regulations—didn't use such weapons in critical and difficult moments in World War II and didn't resort to such wars, it was merely because first, he was frightened that the opposing forces might have reacted similarly; second, he wasn't sure whether he would be able to cope with the consequences and control it.
>
> Generally speaking, in the history of war, resorting to biological warfare required that the violating party not be frightened of a similar reaction from the opposite party, and that biological and disease agents not be used against him in return. This was the case when a biological weapon was used in Japan's war against China before World War II, and also when the Americans used the same weapon in the Korean War.
>
> …there are means and tools that can be employed for biological warfare, and among them we refer to the following:
>
> - Bombs: For instance, an American-made bomb called the "M-114" is capable of carrying 320 cubic centimeters of a biological liquid. Another kind, the "M-32", is capable of carrying 108 times more than the "M-114," almost about 35 kg.
> - Mortar and tank ordnance is among other tools to carry such materials.
> - Airplane bomber systems (bomb launchers) frequently contain some liquid material and or a large quantity of harmful insects.
> - Sounds, boxes and containers that are thrown out of airplanes [as published].
> - Direct contamination of water and food resources by penetration and mercenaries.
>
> …Other methods include contaminating water and food resources. This is a serious danger, because first, it is done clandestinely and individuals are not aware of it; second, using this method will result in many more casualties. Of course this can be done when the enemy has no sanitation control over water and food resources. Obviously in this case the existence of chemical and biological agents will be revealed easily by the enemy.

Likewise, insects are also scattered in war zones. These insects are harmful to human beings, animals, and plants, and will cause various respiratory and in particular skin diseases. Of course, the existence of these insects in war zones is usually discovered immediately, because it is not normal to see insects in high numbers in war zones.

As for when biological weapons should be used, it must be said that at night or early in the morning is better. At this time of the day, wind speed reaches 2 to 4 meters per second, the temperature does not exceed 10 degrees Centigrade, and there is no rain either.

The range and infliction of biological bombs in comparison with chemical and nuclear weapons are different and could be cited as follows:

- The range of infliction of bombs by bombers (airplanes) carrying toxic chemical material is about 60 sq. km and this area is covering the region in which the biological materials are disseminated.

- This area for the airplane itself which is carrying an atomic bomb weighing up to 100 kilo ton [as published], is up to 100 to 1000 sq. km.

- Yet, the infliction range of the biological material reaches up to 2000 sq. km.

…A biological weapon is used on specific targets on enemy soil or it is used to remove some tactical problems in the battlefield. In both cases (use in the battlefield and or on enemy soil), weather a nuclear weapon is used or not, it is necessary to learn from the experiences. Also when using this weapon we must be aware of the consequences and potential problems it may cause.

To use these kinds of weapons many issues must be considered. If the price and value of the launching and firing tool and also the price of the bomb itself which is fired toward a specific target is more than the predicted damage inflicted on the enemy by using this weapon, it is not wise to take such action. (Otherwise it is “wise? “- Yael)

Former commander of the US armed forces Gen. Estabis [as transliterated] believes that current biological equipment could resolve many strategic problems and could target all facilities and installations of an area of one continent!! Therefore, it is necessary to use biological agents that are able to live a long time in order to provide the opportunity to form contaminated clouds over the desired region.

If we assume that the biological and disease-bearing material remains for a complete day and night and for the early morning hours, or approximately for 15 hours; and also that wind speed is about 40 km per hour, in that case the toxic cloud formed will cover more than 600 km. Yet for assurance it is necessary that the bombing continue until all of the clouds and toxic dust created by it covers the entire desired area. Also, the distance between each contaminated cloud should not be more than 600 km.

Whenever a nuclear weapon is used by a country that possesses this kind Of weapon against another country that [also] possesses nuclear weapons, inevitably the fire of nuclear war will be inflamed and will be followed by a reaction and similar confrontation by the violated country and or its allies. Such a country has at a minimum entered into a nuclear by-way from which withdrawal will be very difficult. But if, on the other hand, a biological weapon were used instead of a nuclear weapon, there would not be any of the above consequences.

In this case (use of a biological weapon), not only will the violated country not be able to discover the effects of infliction immediately, but also, international public opinion will not believe the claim of the violated country regarding the use of this weapon. Such a country also will have a hard time attracting the

attention of world public opinion and international organizations. Also, it is rarely seen that the violated country takes action against the aggressor by using a nuclear weapon. But the most dangerous thing that can happen is the lack of control of the biological weapon after its use. It is possible that the following day the wind direction will change and bring back all of the material to the aggressor country.

…Considering all these issues, it is necessary to pay attention in using such biological materials, namely: considering land conditions, climatic conditions, the lifetime of biological disease-bearing agents, and the effect of contaminated clouds on agricultural and fertile lands. In addition, the following appear necessary for study:

- Reinforcement and consolidation of existing forces in the targeted region and knowing whether or not there are any living creatures and also their nature. One must note whether there are only military individuals in the region, or civilians as well;

- The distance between the target and the forces, facilities, and installations of friendly countries, allies, and neutral countries;

- The duration of effects of the biological weapon;

- The essence of the objective pursued and its importance—to determine whether it is necessary to occupy the targeted area, or retreat from it, or just pass it by.

If military and civilian individuals live in the targeted region, a kind of biological weapon that has limited destructive impact must be used. But if there are only military individuals in that region, a biological weapon that has a strong destructive power must be used.

An equipped army that takes part in contemporary war must have an area 300 km deep at its disposal and accommodate itself in it, and it must not forget that at any given time the enemy's forces and groups may attack it. To recognize and identify the location and the situation of these groups, which will be scattered in a vast area, will be difficult. Justifying the use of biological weapons over a very far-reaching area or in wind blowing in the direction of fertile agricultural lands also is very difficult, because such action may cause a very severe reaction from the other side and or destruction of the enemy's fighting power in a way that will not realize even the direction of the infliction.

In reference to biological agents and disease-bearers, one must note the "Rabbit" germ, which destroys human beings and living creatures. Humans have no immunity [to it] and it can be transferred to the enemy in a very short time. This kind of weapon acts in such a way that until it reaches the area of dissemination, the enemy is not aware of its existence. Usually, tactical or operational missiles (with a range of several hundred kilometers) fire them.

Likewise, potassium poisons are used when the objective is to have an immediate impact on the enemy. In a targeted region where civilians live, normally a non-lethal biological weapon is used, such as mountain smallpox virus in which the casualties are fewer and non-contagious. Sometimes a type of biological weapon is used which is very difficult to treat and cure those who have been exposed to it.

There are 32 different types of agents and biological weapons that are used in warfare. Another 160 exist but are inactive and have not been used yet. Yet there are many types that are more active and are considered military secrets and have not been disclosed by the countries that have discovered them.

> The objective of every war is to destroy the enemy's military forces and to damage the economic system of that country in a way that paralyzes its fighting forces' support system. Biological weapons are used to destroy agricultural targets and particularly the enemy's food resources.
>
> Destruction of the enemy's agricultural resources and livestock weakens the industries and production of milk, cheese, dairy products, hide, wool, medical first aid, cotton, tobacco, and tea, and other resources will decrease. It must be mentioned that the grains (wheat and rice, which are among the most important food items) make up 75 percent of the world's food items. Therefore, biological agents as a tool and weapon capable of being reproduced and distributed over a vast area of agricultural lands and which will cause many people to become ill are used.

Major questions exist about Syria's biological strike capabilities. Older types of biological weapons using wet agents, and placed in older bomb and warhead designs with limited dissemination capability, can achieve only a small fraction of the potential effectiveness of dry agents in weapons with excellent dissemination capability. Dry micropowders using advanced agents – such as the most lethal forms of Anthrax – can have the effectiveness of small theater nuclear weapons. It is difficult to design adequate missile warheads to disseminate such agents, but this is not beyond Syrian capabilities – particularly since much of the technology needed to make effective cluster munitions and bomblets for VX gas can be adapted to the delivery of biological weapons.[34]

The design of effective biological bombs and missile warheads are probably now well within Syrian capabilities, as is the design of UAV, helicopter, cruise missile, or aircraft-borne systems to deliver the agent slowly over a long line of flight and taking maximum advanced of wind and weather conditions. US and Soviet texts proved that this kind of "line source" delivery could achieve lethalities as high as 50-100 kiloton weapons by the late 1950s, and the technology is well within Syria's grasp. So is the use of proxy or covert delivery.

This creates serious problems in understanding the balance, deterrence, and possible forms of war fighting. Both Israel and Syria may possess highly lethal capabilities, but nuclear weapons are largely a prompt and highly visible kill mechanism with few ambiguities. Biological weapons can be tailored to produce prompt or delayed kills, and different agents can be mixed to produce highly complicated effects that are very difficult to detect, characterize, and treat. The covert nature of both nations' programs makes it difficult for the other to fully understand either the enemy threat or exactly how it may be used. At the same time, Israeli nuclear capability is currently much more credible than a *potential* Syrian biological capability. Discussions with IDF and other Israeli experts indicate that they give comparatively little attention to the possibility

that Syria could conduct a strike that would be massively more effective than a Syrian use of chemical weapons.

Neither Syria nor Israel seems likely to deliberately take existential risks, but several forms of escalation are at least possible:

- Syria or Israel invokes the direct or indirect threat of using its deterrent in a crisis or conventional war. While the original intent is to limit escalation or terminate conflict, the result is that the other side responds – the crisis slowly climbs the escalation ladder.

- Syria arms its missile and other forces with chemical weapons. Israel attempts to preemptively destroy Syrian delivery capabilities. Syria responds by launching under attack and using cruise missile/UAV platforms unknown to Israel.

- Iran or Iraq uses missiles with chemical and/or biological warheads successfully against Israeli population centers. Israel retaliates and strikes preemptively against Syria to limit damage.

- Syria faces a major Israeli advance on Damascus. It escalates demonstratively. Israel responds. Neither side can halt the resultant process of escalation before serious use.

- Syria or Israel misreads the other state and preempts or massively escalates while under attack.

- A nuclear or biological weapon designed for tactical use against enemy forces actually strikes against a population center by mistake. The resulting process of escalation is driven by the resulting misperceptions of the original intent and inability to effectively communicate and find some mutually agreeable point at which to halt escalation.

The key point is not the risk posed by any given scenario, but rather the inability to predict escalatory patterns, the lack of mutual understanding of the other side's intentions and capabilities, and the severe problems in trying to deal with fundamental asymmetric strike forces. Third party or terrorist strikes add a further complication, as do the asymmetries in vulnerability and different incentives for a first strike or launch under attack. At some point, escalation will also tend to become existential for either state. At this point, all restraint may cease. The 20th Century also provides ample examples of the fact that the ability of leaders to act as rational bargainers in peacetime does not necessarily dictate crisis or wartime behavior.

Syrian Strategy, Doctrine, and Plans

While any use of long-range missiles would risk Israeli nuclear retaliation, some Israeli experts have suggested that Syria might risk limited strikes against Israeli air bases and mobilization assembly sites as part of a surprise attack on the Golan. Such an attack would not be designed to threaten Israel's existence or to capture the Galilee, but would rather attempt to establish new facts on the ground so rapidly that outside powers would force a cease-fire before Israel could counter-attack and under conditions where it could not risk massive retaliation.

Other Israeli experts believe that Syria will try to use its chemically armed missiles as a deterrent to Israeli strategic strikes and to allow it to attack the Golan using its armored forces without fear of massive Israeli retaliation. Such scenarios would certainly involve massive risks for Syria, but cannot be dismissed. In fact, some Israelis argue that Syria's efforts to double its T-72 force with new purchases from the Russian Republic and the Czech Republic could support this contingency.[35]

Experts on Syrian forces do, however, raise questions about the extent to which Syria's missiles will be survivable even after Syria fully deploys its North Korean missiles. Some experts feel that Syria has a first strike or preemptive force, and must use its missiles the moment that it feels they are under attack. Others feel it would use some of its FROGs and Scuds on Israeli air bases, command centers, and mobilization staging areas, while holding others in reserve. Either tactic could be extremely destabilizing in a Syrian-Israeli conflict.

Table One

Syria's Search for Weapons of Mass Destruction

Delivery Systems

- Four SSM brigades: 1 with FROG, 1 with Scud Bs, 1 with Scud Cs, and 1 with SS-21s.
- Has 18 SS-21 launchers and at least 36 SS-21 missiles with 80-100 kilometers range. May be developing chemical warheads.
- Some experts believe some Syrian surface-to-surface missiles armed with chemical weapons began to be stored in concrete shelters in the mountains near Damascus and in the Palmyra region no later than 1986, and that plans have long existed to deploy them forward in an emergency since that date
- Up to 12 Scud B launchers and 200 Scud B missiles with 310 kilometers range. Believed to have chemical warheads. Scud B warhead weighs 985 kilograms. The inventory of Scud B missiles is believed to be approximately 200.
- New long-range North Korean Scud Cs deployed
    - Two brigades of 18 launchers each are said to be deployed in a horseshoe shaped valley. This estimate of 36 launchers is based on the fact there are 36 tunnels into the hillside. The launchers must be for the Scud C since the older Scud Bs would not be within range of most of Israel. Up to 50 missiles are stored in bunkers to north as possible reloads. There is a maintenance building and barracks.
    - Estimates indicate that Syria has 24-36 Scud launchers for a total of 260-300 missiles of all types. The normal ratio of launchers to missiles is 10:1, but Syria is focusing on both survivability and the capability to launch a large preemptive strike.
    - The Scud Cs have ranges of up to 550-600 kilometers. They have a CEP of 1,000-2,600 meters. Nerve gas warheads using VX with cluster bomblets seem to have begun production in early 1997. Syria is believed to have 50-80 Scud C missiles.
    - A training site exists about 6 kilometer south of Hama, with an underground facility where TELs and missiles are stored.
- Syria can now build both the entire Scud B and Scud C. It has sheltered and/or underground missile production/assembly facilities at Aleppo, Hama, and hear Damascus have been built with aid from Chinese, Iranian, and North Korean technicians. Possibly some Russian technical aid.
- A missile test site exists 15 kilometers south of Homs where Syria has tested missile modifications and new chemical warheads. It has heavy perimeter defenses, a storage area and bunkers, heavily sheltered bunkers, and a missile storage area just west of the site. According to some reports, Syria has built two missile plants near Hama, about 110 miles north of Damascus, one is for solid fueled rockets and the other is for liquid fueled systems. North Korea may have provided the equipment for the liquid fuel plant, and Syria may now be able to produce the missile.
- Reports of Chinese deliveries of missiles but little hard evidence:
    - Reports of PRC deliveries of missile components by China Precision Machinery Company, maker of the M-11, in July1996. The M-11 has a 186-mile (280 kilometer) range with a warhead of 1,100 pounds.
    - Some sources believe M-9 missile components, or M-9-like components delivered to Syria. Missile is reported to have a CEP as low as 300 meters.
    - Jane's reported in March 1999 that Syria had created a production facility to build both the M-11 (CSS-7/DF-11) and M-9 missiles with ranges of 280 and 600-800 kilometers respectively. It reports that production of the booster stage of the M-11 began in 1996, and that missile production is expected to start "soon."
    - Washington Times reported on July 23, 1996 that the CIA had discovered that Syria's Scientific Studies and Research Center received a shipment of missile components from China Precision Machinery Import-Export Corporation, China's premier firm selling missiles (particularly M-11s) abroad.

- Sheltered or underground missile production/assembly facilities at Aleppo and Hamas have been built with aid from Chinese, Iranian, and North Korean technicians. Possibly some Russian technical aid.
- A missile test site exists 15 kilometers south of Homs where Syria has tested missile modifications and new chemical warheads. It has heavy perimeter defenses, a storage area and bunkers, heavily sheltered bunkers, and a missile storage area just west of the site.
- Syria has shorter range systems:
- Short range M-1B missiles (up to 60 miles range) seem to be in delivery from PRC.
- SS-N-3, and SSC-1b cruise missiles.
- May be converting some long range surface-to-air and naval cruise missiles to use chemical warheads.
    - Syria continues to seek more advanced long-range systems:
    - The CIA estimated in January 1999 that Syria continued work on establishing a solid-propellant rocket motor development and production capability. Foreign equipment and assistance have been and will continue to be essential for this effort.
- The DCI Nonproliferation Center (NPC) reported in February 2000 that Damascus continued work on establishing a solid-propellant rocket motor development and production capability with help from outside countries such as Iran. Foreign equipment and assistance to its liquid-propellant missile program, primarily from Russian entities, but also from firms in China and North Korea, also have been and will continue to be essential for Syria's effort. Damascus also continued its efforts to assemble-probably with considerable North Korean assistance-liquid-fueled Scud C missiles.
- The London Times and Haaretz report on May 29 and 30 that Syria has taken delivery of a new ballistic missile from North Korea which would enable it to hit any target in Israel from launchers deep inside Syrian territory. *Haaretz* newspaper reported that Damascus had recently equipped its forces with the Scud D, and that Libya and Egypt were also buying the new weapon. These article seem to refer, however, to the North Korea deliveries which had actually taken place some years earlier.
- Air assets include:
    - 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.
- Land force assets include:
    - 18 FROG-7 launchers and rockets.
    - Negotiations for PRC-made M-9 missile (185-375 mile range).
    - Multiple rocket launchers and tube artillery.
    - Syria has improved its targeting capability in recent years by making extensive direct and indirect use of commercial satellite imagery, much of which now offers 3 meter levels of resolution and comes with coordinate data with near GPS-like levels of accuracy. One meter levels of resolution will become commercially available.

Chemical Weapons

- First acquired small amounts of chemical weapons from Egypt in 1973. The FAS reports that Syria acquired CW artillery shells as a "gift" from Egypt prior to the 1973 war. Syria then purchased defensive chemical warfare gear from the USSR and from Czechoslovakia.
- Began production of non-persistent nerve gas in 1984. may have had chemical warheads for missiles as early as 1985.
- The FAS reports that Syria used the expansion of its pharmaceuticals industry as a cover for purchases relating to its CW program.

- Major German pharmaceuticals, chemicals, and machine-building companies helped Syria to establish its modest and well-dispersed production facilities, some with the support of official "Hermes" export credits from the German government. In addition to Schott Glasswerke, which continues to export licensed goods to Syrian chemicals plants, special mixing vats, high temperature furnaces, hot isostatic presses (HIP) and sophisticated machine-tools have been shipped with German export licenses to Syria's Scientific Research Council (CERS) by Ferrostaal, Carl Schenck, Leifeld, Weber GmbH, and other major German companies. It is not believed that these shipments were illegal under German law.
- Firms in the French pharmaceuticals industry were active in Damascus in the 1980s. Many opened branch offices and built production facilities in Syria, to make French pharmaceuticals under license. French firms increased their share from 13.11% of Syria's pharmaceuticals imports in 1982 to 23% by 1986. France only began applying controls on production equipment that could go into a chemical weapons plant in early 1992. The FAS reports that a senior French foreign ministry official said in May 1992, "Only in the past six months has there been a universal will to impose this type of controls,". "Before then, CW production equipment was freely available."
- The use of pharmaceuticals plants for poison gas production appears to have led to a series of accidents. In 1991, the Syrian Ministry of Health was compelled to close down five pharmaceuticals plants (three in Aleppo, one in Damascus, and one in Homs), following what were termed "complaints from citizens and doctors" that products "did not meet the required standards."

- CIA Director William Webster testified to Congress in 1989 that foreign assistance was of "critical importance in allowing Syria to develop its chemical warfare capability, and that West European firms were instrumental in supplying the required precursor chemicals and equipment. Without the provision of these key elements, Damascus would not have been able to produce chemical weapons".
  - In 1991, Syria signed a cooperation agreement with Libya in that called for Syrian experts to train the Libyans in pharmaceuticals production.
- Significant deployments of chemical weapons:
  - Believed to have begun deploying VX in late 1996, early 1997.
  - CIA reported in June 1997 that Syria had acquired new chemical weapons technology from Russia and Eastern Europe in 1996.
  - Unconfirmed reports of sheltered Scud missiles with unitary Sarin or Tabun nerve gas warheads, now being replaced by cluster warheads with VX bomblets, deployed in caves and shelters near Damascus.
  - Tested Scuds in manner indicating possible chemical warheads in 1996.
  - Seems to have cluster warheads and bombs.
    - May have VX and Sarin in modified Soviet ZAB-incendiary bombs and PTAB-500 cluster bombs.
    - Extensive testing of chemical warheads for Scud Bs. May have tested chemical warheads for Scud Cs. (Acquired design for Soviet Scud warhead using VX in 1970s.)
    - Shells, bombs, and nerve gas warheads for multiple rocket launchers.
    - FROG warheads may be 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.
  - FAS states thatr, “Syria's current CW stockpiles have been estimated at "several thousand aerial bombs, filled mostly with sarin," and between 50 to 100 ballistic missile warheads.”
- General Anatoly Kuntsevich, Russian President Yeltsin's personal adviser on chemical disarmament and Russia's highest official authority on the subject, dismissed for suspicion of smuggling nerve gas precursors to Syria in early 1995. The FAS reports that General Kuntsevich admitted in an interview in 1998 with the New York Jewish weekly The Forward

that shipments to Syria of small amounts of nerve gas components had indeed taken place. According to him, however, these shipments were only intended for "research purposes" and had been authorized by the Russian government under previously undisclosed terms of a treaty with Syria. The materials shipped to Syria were intended for the production of the Soviet/Russian version of the VX nerve agent - code-named Substance 33 or V-gas. Such a deal might have been made in the early '90s or late '80s during a visit to Syria by the then-commander of the Russian Chemical Corps, General Pikalov.

- Major nerve gas, and possible other chemical agent production facilities north of Damascus. Two to three plants.
- Syria is now believed capable of producing several hundred tons of CW agents per year.
    - Syria's principle suppliers of CBW production technology included large chemical brokerage houses in Holland, Switzerland, France, Austria and Germany, including many of the same companies that were supplying Iraq. At least one German company, Schott Glasswerke, has been subjected to an official inquiry, for its delivery of glass-lined reactor vessels, sarin precursors and production equipment to a suspected Syrian poison gas plant. And one French source suggests that the United States may have supplied Syria with precursors and CW production equipment prior to 1986, at a time when Syria was subjected to international sanctions for its attempt to plant a bomb on an El Al plane in London.
    - The FAS reports that four production sites have been positively identified, one located just north of Damascus, and the second near the industrial city of Homs. The third, in Hama, is believed to be producing VX agents in addition to sarin and tabun. Officials in Washington identified a fourth facility dedicated to the production of biological agents in Cerin, while Israeli intelligence is monitoring several additional "suspicious" sites.
    - Israeli Chief of Staff Ehud Baraq told an audience of leading industrialists in Tel Aviv on December 6, 1991 that Syria's chemical weapons capability was "larger than Iraq's."
    - Syria also runs a large urea and ammonia plant in Homs, and plans to build a $ 500 million super-phosphate complex in the desert near Palmyra.
    - Syria's CW plants tend to be relatively small, and as a result have been harder to detect..
    - One facility is located near Homs and is located next to a major petrochemical plant. It reportedly produces several hundred tons of nerve gas a year.
    - Reports is building new major plant near Aleppo.
    - Reports that a facility co-located with the Center d'Etdues et de Recherche Scientifique (CERS) is developing a warhead with chemical bomblets for the Scud C.
    - An industrial complex known as the Scientific Studies and Research Center is reported to have obtained expertise, technology and materials from Russian sources.
- Many parts of the program are dispersed and compartmented. Missiles, rockets, bombs, and artillery shells are produced/modified and loaded in other facilities. Many may be modified to use VX bomblets.
- The CIA estimated in January 1999 that Syria continued to seek CW-related precursors from various sources during the reporting period. Damascus already has a stockpile of the nerve agent Sarin and may be trying to develop more toxic and persistent nerve agents. Syria remains dependent on foreign sources for key elements of its CW program, including precursor chemicals and key production equipment.
- The CIA stated that Chinese entities sought to supply Iran and Syria with CW-related chemicals during this reporting period.
- The DCI Nonproliferation Center (NPC) reported in February 2000 that Syria sought CW-related precursors and expertise from foreign sources during the reporting period. Damascus already has a stockpile of the nerve agent sarin and apparently is trying to develop more toxic and persistent nerve agents. Syria remains dependent on foreign sources for key elements of its CW program, including precursor chemicals and key production equipment

Biological Weapons

- Signed, but not ratified the 1972 Biological and Toxin Weapons Convention. Extensive research effort.
- ACDA report in August 1996 indicated that, "it is highly probably that Syria is developing an offensive biological capability."

- Extensive research effort.
- Reports of one underground facility and one near the coast. Several dual-use sites are of concern, including a pharmaceuticals plant in Aleppo that was left mysteriously "unfinished" in 1989 after the Syrian government had invested nearly $ 40 million in its construction.
- Syria can tap the potential of more than a dozen government-run pharmaceuticals plants spread across the country, which could be converted rapidly to produce a wide variety of CBW agents.
- Syria's principle suppliers of CBW production technology were large chemical brokerage houses in Holland, Switzerland, France, Austria and Germany, including many of the same companies that were supplying Iraq.
- Probable production capability for anthrax and botulism, and possibly other agents.
- Israeli sources claim Syria weaponized Botulin and Ricin toxin in early 1990s, and probably anthrax.
- Limited indications may be developing or testing biological variations on ZAB-incendiary bombs and PTAB-500 cluster bombs and Scud warheads.
- Major questions exist regarding the effectiveness of Syria's strike capabilities:
    - Older types of biological weapons using wet agents, and placed in older bomb and warhead designs with limited dissemination capability, can achieve only a small fraction of the potential effectiveness of biological weapons. Dry micropowders using advanced agents – such as the most lethal forms of Anthrax – can have the effectiveness of small theater nuclear weapons. It is difficult to design adequate missile warheads to disseminate such agents, but this is not beyond Syrian capabilities – particularly since much of the technology needed to make effective cluster munitions and bomblets for VX gas can be adapted to the delivery of biological weapons.[36]
    - The design of biological bombs and missile warheads with the lethality of small nuclear weapons may now be within Syrian capabilities, as is the design of UAV, helicopter, cruise missile, or aircraft-borne systems to deliver the agent slowly over a long line of flight and taking maximum advanced of wind and weather conditions. US and Soviet texts proved that this kind of "line source" delivery could achieve lethalities as high as 50-100 kiloton weapons by the late 1950s, and the technology is well within Syria's grasp. So is the use of proxy or covert delivery.
- The FAS estimates that Syria is rapidly expanding its biomedical injdustrial base:
    - Syria simplified the procedures for foreign investments in a May 1991 law, and companies are being set up to negotiate licensing and technology transfer agreements with foreign suppliers.
    - The largest project of this kind has been announced by Saeb Nahas, whose GAS group is partially owned by the Syrian state. GAS owns a 51% share in the newly-formed Ibn Zahr Pharmaceuticals Company, which claims to be negotiating to build "one of the largest pharmaceuticals plants in the Middle East" at a cost of $ 15 million. Discussions are currently under way with companies in Germany, Britain, and Holland to obtain production licenses and manufacturing technology, and with the European Community to obtain export financing.
    - The American medical supplier group, Baxter International, has contracted to build a factory to produce intravenous fluids for the Syrian military. Of concern in this case are the manufacturing processes, which could be applied to a broad-range of CBW activities, and the end-user, which is the Syrian army. Vigorous intervention by the Simon Wiesenthal Center with Baxter director, G. Marshall Abbey, caused the company to back off from this contract temporarily in 1991. However, it was subsequently reported that Baxter was attempting to complete the sale through the intermediary of an unknown supply house called Medport, located in Amhurts, Ohio.
    - Despite the attempts to attract private sector interest, the two largest pharmaceuticals conglomerates in Syria, Thameco and DIMAS, remain under rigid state control. Together they control a third company, Saydalaya, which serves as the foreign procurement board for all Syrian imports of chemicals and processed medicines
    - Thameco is controlled the Syrian Ministry of Industry and employs approximately 900 people at its principle production site in Damascus. A second plant, built in Aleppo at a cost of nearly $ 40 million by a consortium of French pharmaceuticals companies in the late 1980s, was reportedly "abandoned" in 1989 because of financial difficulties. However, suspicion remains that Syria may have simply switched suppliers, in order to better disguise conversion of the plant to the production of CW agents.

- DIMAS (the General Establishment for Blood and of Medical Industries) is directly controlled by the Syrian Ministry of Defense, and is the only manufacturer of serum in Syria. DIMAS is run by General Hikmat Tahrani, and controls a large production plant in Damascus.

- The CIA estimated in January 1999 that Syria continued to seek CW-related precursors from various sources during the reporting period. Damascus already has a stockpile of the nerve agent sarin and may be trying to develop more toxic and persistent nerve agents. Syria remains dependent on foreign sources for key elements of its CW program, including precursor chemicals and key production equipment.

Nuclear Weapons

- Syria is a party to the Treaty on the Non- Proliferation of Nuclear Weapons (NPT), and Syria has called for an area free of all weapons of mass destruction in the Middle East.
- Ongoing research effort.
- No evidence of major progress in development effort.
- Has miniature 30 kilowatt neutron-source reactor, but unsuitable for weapons production.
- Does, however, continue to seek larger reactors:
- Announced nuclear reactor purchase plans including 10 megawatt research reactor and six power reactors in 1980s, but never implemented.
- Research by the FAS cites several efforts:
    - In 1991, China reported to the IAEA the potential sale of a 30 KW research reactor to Syria. The IAEA blocked the sale and Syria subsequently reduced its nuclear activities.
    - In 1995 the United States pressured Argentina into abandoning a proposed sale of a reactor to Syria.
    - In 1997 Russian government reported to be interested in selling a nuclear reactor to Syria.
    - On 23 February 1998 Syria and Russia signed an agreement on the peaceful use of nuclear energy. In July 1998 the two sides agreed on the time table for the realization of a 25-MW light-water nuclear research center project in Syria with the participation of Russia's Atomstroyeksport and Nikiet.
    - The Syrian fertilizers plant under construction at Homs [34° 40' N 36° 40' E] is ownded and operated by the Atomic Energy Commission of Syria. The facility will engage in Uranium recovery from phosphates using the D2EHPA-TOPO process.

Missile Defenses

- Seeking Russian S-300or S-400 surface-to-air missile system with limited anti tactical ballistic missile capability.

Annex One

Syria's Interest in Biological Weapons: Article written by Syrian Defense Minister Gen. Mustafa Tlas, "Biological Warfare, A New and Effective Method in Modern Warfare"

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1. The Concept of Biological (Germ) Warfare.

Biological warfare means intentional military action and use of toxic material against living creatures to annihilate the enemy and to inflict damage to subsistence or agricultural resources, in order ultimately to weaken the enemy's fighting power. A number of experts have called this kind of warfare Bacteriological, Germ and Biological, but here we have borrowed the concept of biological warfare from the biology term and will use it as such.

Biological warfare is the first and the most primitive war that Mother Nature has staged against human beings; at the end of this century, the fight between them still continues in the most severe way. Though man has been able to control and overcome diseases such as plague, smallpox, cholera, typhus, and dysentery, still many diseases and toxins destroy millions of people every year weather in war or peace.

If we note that Nazi Germany under the leadership of Hitler—who didn't care about international organizations and regulations—didn't use such weapons in critical and difficult moments in World War II and didn't resort to such wars, it was merely because first, he was frightened that the opposing forces might have reacted similarly; second, he wasn't sure whether he would be able to cope with the consequences and control it.

Generally speaking, in the history of war, resorting to biological warfare required that the violating party not be frightened of a similar reaction from the opposite party, and that biological and disease agents not be used against him in return. This was the case when a biological weapon was used in Japan's war against China before World War II, and also when the Americans used the same weapon in the Korean War.

In continuing this discussion we will see how the United Nations banned this weapon and why most countries accepted the sanction.

2. Biological Weapon.

A biological weapon consists of all elements and biological components along with the necessary tools to use them, knowing that these materials are merely the kind that harm and hurt human beings, animals, and plants.

From the military point of view, biological weapons are divided into different groups:

A. Germs [or microbes]. These are very tiny creatures that have neither smell nor color and could be kept alive in the outside environment. These germs play their role as follows:

- Bacteria: These are microscopic creatures that have a vegetation and botanical origin; This is the basic material that causes diseases such as cholera and typhoid for human beings, a kind of plague for animals and birds, and a kind of Siberian smallpox harmful to human beings and animals.

- Viruses: These are creatures that are a hundred thousand times smaller than bacteria and cause typhoid fever, yellow smallpox, and so forth.

- Rickettsia [the Persian/Arabic term used is riketziyat]: They are intermediate segments and related to the two previous kinds. Their prevalence causes diseases such as smallpox and so forth and could be carried by many agents among them insects.

- Fungi [the Persian/Arabic term used is fotriyat]: These creatures are of a botanical origin and have more complicated structure than bacteria. They are found individually and in a group. These creatures can cause diseases such as Histoplavis [as published, possibly referring to Histoplasmosis].

B. Toxins [or poisons]. Toxins consist of those materials that have a high degree of poison and can disseminate germs, which, after they are dried up, can be kept for several weeks. Poisons cause various diseases. To develop poisons, it is necessary to observe a certain period of time, not less than two hours.

C. Potassium Toxins [as published]. Potassium poison is one of the strongest poisons; the percentage of its active toxin is at least tens of thousands of times (Footnote 1: 432 grams of this material is enough to destroy the entire population of the world). Potassium poison is capable of inflicting serious damage to the central nervous system as well as optical and circulatory systems; it can even destroy these systems and cause death.

D. Contagious Carrier Creatures. Among these creatures, insects such as ticks, blood-sucking insects, and lice could be named.

E. Harmful Insects and Plants. Many harmful insects and some plants are available that could be used against the enemy in order to inflict harm on enemy forces.

Yet there are means and tools that can be employed for biological warfare, and among them we refer to the following:

- Bombs: For instance, an American-made bomb called the "M-114" is capable of carrying 320 cubic centimeters of a biological liquid. Another kind, the "M-32", is capable of carrying 108 times more than the "M-114," almost about 35 kg.

- Mortar and tank ordnance is among other tools to carry such materials.

- Airplane bomber systems (bomb launchers) frequently contain some liquid material and or a large quantity of harmful insects.

- Sounds, boxes and containers that are thrown out of airplanes [as published].

- Direct contamination of water and food resources by penetration and mercenaries.

3. Methods of Exploitation, Range, and Effectiveness.

Biological agents and materials are used in two ways:

- Wind-borne dissemination of these materials toward the desired target in order to contaminate a vast area. This method is among the most effective ways and is used widely.

- Direct dissemination of these materials over the desired target by airplane. This method on one hand has more precision but inevitably more materials must be used to contaminate a vast area.

Other methods include contaminating water and food resources. This is a serious danger, because first, it is done clandestinely and individuals are not aware of it; second, using this method will result in many more casualties. Of course this can be done when the enemy has no sanitation control over water and food resources. Obviously in this case the existence of chemical and biological agents will be revealed easily by the enemy.

Likewise, insects are also scattered in war zones. These insects are harmful to human beings, animals, and plants, and will cause various respiratory and in particular skin diseases. Of course, the existence of these insects in war zones is usually discovered immediately, because it is not normal to see insects in high numbers in war zones.

As for when biological weapons should be used, it must be said that at night or early in the morning is better. At this time of the day, wind speed reaches 2 to 4 meters per second, the temperature does not exceed 10 degrees Centigrade, and there is no rain either.

The range and infliction of biological bombs in comparison with chemical and nuclear weapons are different and could be cited as follows:

- The range of infliction of bombs by bombers (airplanes) carrying toxic chemical material is about 60 sq. km and this area is covering the region in which the biological materials are disseminated.

- This area for the airplane itself which is carrying an atomic bomb weighing up to 100 kilo ton [as published], is up to 100 to 1000 sq. km.

- Yet, the infliction range of the biological material reaches up to 2000 sq. km.

In reference to how long the effects will continue, it must be said that the effects are not less than two days. It must be noted at the same time that lice, which sometimes can be used to harm the enemy, can survive for a year.

4. Prevention Against Biological Agents.

What we mean by prevention is to prevent the exposure of individuals to these agents and materials. But if an individual comes down with an illness, inevitably he must seek medical treatment as with ordinary illnesses. For this reason, individuals use various tools and equipment to avoid such exposure, such as use of a mask.

To prevent contact with harmful insects and animals and so forth group-oriented equipment such as shelters and dormitories equipped with special air-filtration and ventilation may be used. In addition, vaccination is widely used nowadays, in which one vaccine can prevent disease and provide immunity for up to 10 to 15 people. Also, group vaccinations, which are disseminated in the air, could be used. These kinds of vaccines provide coverage to more individuals and decrease the percentage of those infected with disease.

Therefore, inevitably there must be severe control in health and medical systems, whether it is in reference to safeguarding the water resources or to place the food items in secured places, for example by placing them in secured and tight containers.

If individuals become contaminated, they should take measures to clean the contamination and change their clothing. Luckily, most items used for cleaning off toxic materials can be used for biological contamination as well. The list of contamination cleaning materials includes chlorine compounds, oxidation materials, phenol, furmalin [as published] and so forth.

Discovering the existence of biological materials and contamination resulting from these materials is accomplished with the use of special tools able to recognize tiny particles in the air—of course, they are not able to establish the nature of these materials. Yet, to run a laboratory test we must have a sample of the biological agents.

5. Usage and Application of a Biological Weapon in War

A biological weapon is used on specific targets on enemy soil or it is used to remove some tactical problems in the battlefield. In both cases (use in the battlefield and or on enemy soil), weather a nuclear weapon is used or not, it is necessary to learn from the experiences. Also when using this weapon we must be aware of the consequences and potential problems it may cause.

To use these kinds of weapons many issues must be considered. If the price and value of the launching and firing tool and also the price of the bomb itself which is fired toward a specific target is more than the predicted damage inflicted on the enemy by using this weapon, it is not wise to take such action. (Otherwise it is "wise? "- Yael)

Former commander of the US armed forces Gen. Estabis [as transliterated] believes that current biological equipment could resolve many strategic problems and could target all facilities and installations of an area of one continent!!

Therefore, it is necessary to use biological agents that are able to live a long time in order to provide the opportunity to form contaminated clouds over the desired region.

If we assume that the biological and disease-bearing material remains for a complete day and night and for the early morning hours, or approximately for 15 hours; and also that wind speed is about 40 km per hour, in that case the toxic cloud formed will cover more than 600 km. Yet for assurance it is necessary that the bombing continue until all of the clouds and toxic dust created by it covers the entire desired area. Also, the distance between each contaminated cloud should not be more than 600 km.

Whenever a nuclear weapon is used by a country that possesses this kind Of weapon against another country that [also] possesses nuclear weapons, inevitably the fire of nuclear war will be inflamed and will be followed by a reaction and similar confrontation by the violated country and or its allies. Such a country has at a minimum entered into a nuclear by-way from which withdrawal will be very difficult. But if, on the other hand, a biological weapon were used instead of a nuclear weapon, there would not be any of the above consequences.

In this case (use of a biological weapon), not only will the violated country not be able to discover the effects of infliction immediately, but also, international public opinion will not believe the claim of the violated country regarding the use of this weapon. Such a country also will have a hard time attracting the attention of world public opinion and international organizations. Also, it is rarely seen that the violated country takes action against the aggressor by using a nuclear weapon. But the most dangerous thing that can happen is the lack of control of the biological weapon after its use. It is possible that the following day the wind direction will change and bring back all of the material to the aggressor country.

Another point of view believes that if a country possesses biological weapons, it will never use them until it has the equipment and the tools to neutralize and control the consequences. The

issue of "Greenyard" island, which is located northwest of Scotland, still is remembered. During World War II, when British scientists were conducting their tests and created the anthrax virus, it was realized that this germ would contaminate this island up until 1966, and it is still believed that the contamination will continue for another 100 years.

It is basically possible to employ carrier vectors for diseases, but the possibility of contaminating individuals is rare; therefore, they are not among the most leading tools of biological warfare. There is a fear that if a disease is transferred to insects and other animals, the balance in nature may change and may have grave and irreparable consequences.

Considering all these issues, it is necessary to pay attention in using such biological materials, namely: considering land conditions, climatic conditions, the lifetime of biological disease-bearing agents, and the effect of contaminated clouds on agricultural and fertile lands. In addition, the following appear necessary for study:

- Reinforcement and consolidation of existing forces in the targeted region and knowing whether or not there are any living creatures and also their nature. One must note whether there are only military individuals in the region, or civilians as well;

- The distance between the target and the forces, facilities, and installations of friendly countries, allies, and neutral countries;

- The duration of effects of the biological weapon;

- The essence of the objective pursued and its importance—to determine whether it is necessary to occupy the targeted area, or retreat from it, or just pass it by.

If military and civilian individuals live in the targeted region, a kind of biological weapon that has limited destructive impact must be used. But if there are only military individuals in that region, a biological weapon that has a strong destructive power must be used.

An equipped army that takes part in contemporary war must have an area 300 km deep at its disposal and accommodate itself in it, and it must not forget that at any given time the enemy's forces and groups may attack it. To recognize and identify the location and the situation of these groups, which will be scattered in a vast area, will be difficult. Justifying the use of biological weapons over a very far-reaching area or in wind blowing in the direction of fertile agricultural lands also is very difficult, because such action may cause a very severe reaction from the other side and or destruction of the enemy's fighting power in a way that will not realize even the direction of the infliction.

In reference to biological agents and disease-bearers, one must note the "Rabbit" germ, which destroys human beings and living creatures. Humans have no immunity [to it] and it can be transferred to the enemy in a very short time. (Nb: recent isolated outbreaks of the Rabbit germ - Yael)

This kind of weapon acts in such a way that until it reaches the area of dissemination, the enemy is not aware of its existence. Usually, tactical or operational missiles (with a range of several hundred kilometers) fire them.

Likewise, potassium poisons are used when the objective is to have an immediate impact on the enemy. In a targeted region where civilians live, normally a non-lethal biological weapon is used, such as mountain smallpox virus in which the casualties are fewer and non-contagious. Sometimes a type of biological weapon is used which is very difficult to treat and cure those who have been exposed to it.

There are 32 different types of agents and biological weapons that are used in warfare. Another 160 exist but are inactive and have not been used yet.

Yet there are many types that are more active and are considered military secrets and have not been disclosed by the countries that have discovered them.

The objective of every war is to destroy the enemy's military forces and to damage the economic system of that country in a way that paralyzes its fighting forces' support system. Biological weapons are used to destroy agricultural targets and particularly the enemy's food resources.

Destruction of the enemy's agricultural resources and livestock weakens the industries and production of milk, cheese, dairy products, hide, wool, medical first aid, cotton, tobacco, and tea, and other resources will decrease. It must be mentioned that the grains (wheat and rice, which are among the most important food items) make up 75 percent of the world's food items. Therefore, biological agents as a tool and weapon capable of being reproduced and distributed over a vast area of agricultural lands and which will cause many people to become ill are used.

Another kind of biological material called Fungi [fotriyat] immediately upon attacking the target, spontaneously split and break up and are disseminated over a vast area. These materials, among the disease-bearing and biological agents, play a considerable role in destroying plants and agricultural fields, and destroy wheat, rice, and potatoes. These agents, which are normally in a dense and compressed form (footnote 2: These are biological and disease-bearing agents that form a very hard layer around themselves and can live and reproduce even in very unsuitable conditions), are conveyed over long distances by wind, and contaminate a vast area; for a short time they will remain in the primary region just to be transferred to other places, then be relocated again and again to other places. Rain, natural waters, insects, animals, as well as human beings could be the transfer vectors.

[1] This section draws extensively on interviews in the US, Britain France, Switzerland and Israel, and Anthony H. Cordesman "Weapons of Mass Destruction in the Middle East," Washington, CSIS, March 7, 1999, internet edition; Anthony H. Cordesman, Perilous Prospects, Boulder, Westview, 1996, pp. 230-2671; the "Syria" sections of the 1996, 1997, and 1998 editions of Office of the Secretary of Defense, Proliferation: Threat and Response, Washington, Department of Defense, and the "Syria" sections of Rodney W. Jones, Mark G. McDonough, Toby F. Dalton, and Gregory D. Koblenz, Tracking Nuclear Proliferation, Washington, Carnegie Endowment, 1998.

[2] Michael Eisenstadt, "Syria's Strategic Weapons," Jane's Intelligence Review, April, 1993, pp. 168-171; Agence French Presse, computer print out, February 10, 1992; Christian Science Monitor, March 10, 1992, p. 1; Washington Post, December 7, 1991, p. A-26, February 11, 1992, p. A-16; Daily Telegraph, November 23, 1991, p. 10; London Financial Times, March 27, 1992, p. 4; Washington Times, November 24, 1991, p. A-17.

[3] Office of the Secretary of Defense, Proliferation: Threat and Response, Washington, Department of Defense, 1997, pp. 37-40.

[4] J. M. Moreaux, "The Syrian Army," Defense Update, No. 69, p. 31.

[5] Jane's Defense Weekly, September 3, 1997. P. 3.

[6] New York Times, 6 June, 1986, p. 11; Washington Post, 11 June 1986, p. 36, and Defense Week, April 14, 1986, p. 5; Michael Eisenstadt, "Syria's Strategic Weapons," Jane's Intelligence Review, April, 1993, pp. 168-171.

[7] Jane's Defense Weekly, July 26, 1982, p. 92.

[8] Although various other press reports have appeared at different times that Syria has established an SS-23 site, had a brigade of SS-23s, and even had deployed the SS-25, none of these reports are true. See J. M. Moreaux, "The Syrian Army," Defense Update, No. 69, p. 31.

[9] The Sunday Correspondent, October 15, 1989, p. 3; Al-Ittihad, July 31, 1989, p. 1; Hong Kong AFP, 0629 GMT, August 7, 1989.

[10] Washington Post, March 30, 1990, p. 1; Washington Times, November 22, 1989; Defense and Foreign Affairs, August 14-20, 1989, p. 2.

[11] Jane's Defense Weekly, December 23, 1989, pp. 1384-1385, , September 3, 1997. P. 3; Washington Post, June 23, 1988, p. A-2, March 29, 1990, pp. A-1 and A-34; New York Times International, March 30, 1990, p. A-7; New York Times, June 22, 1988, p. 1, January 31, 1992, p. A-1.

[12] Jane's Defense Weekly, March 10, 1999, pp. 50-69.

[13] Jane's Defense Weekly, January 15, 1997, p. 3.

[14] Wall Street Journal, July 10, 1991, p. 12; Washington Times, March 10, 1992, p. A-3, March 11, 1992, p. A-3, July 16, 1992, p. A-3; Time, March 23, 1992, p. 34; Washington Post, February 22, 1992, p. A-15, March 11, 1992, p. A-11, March 13, 1992, p. A-18; July 14, 1992, p. A-1, August 14, 1992, p. A-25; New York Times, January 31, 1992, p. A-1, February 21, 1992, p. A-9; Sunday Times, December 21, 1991, p. 1.

[15] Defense News, October 16, 1989, p.60; Washington Times, June 18, 1990, p. A1; Lora Lumpe, Lisbeth Gronlund, and David C. Wright, "Third World Missiles Fall Short," The Bulletin of the Atomic Scientists, March, 1992, pp. 30-36.

[16] Michael Eisenstadt, "Syria's Strategic Weapons," Jane's Intelligence Review, April, 1993, pp. 168-171.

[17] CIA, Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions 1 January Through 30 June 1998, January 1999, Internet edition.

[18] The author examined actual imagery of the region from a number of commercial sources. For a regional discussion of this issue see Gerald M. Steinberg, "Dual Use Aspects of Commercial High-Resolution Imaging Satellites," BESA Security and Policy Study No. 37, Ramat Gan, Bar-Ilan University, February , 1998.

[19] Middle East Economic Digest, June 19, 1998, p. 3.

[20] The following analysis involves considerable technical speculation by the author. It is based on various Jane's publications, and General Dynamics, The World's Missile Systems, Pomona, General Dynamics, 8th Edition, 1988.

[21] Adapted by the author from various editions of Jane's and Ray Bonds, Modern Soviet Weapons, New York, ARCO, 1986, pp. 432-435.

[22] CIA, Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions 1 January Through 30 June 1998, January 1999, Internet edition.
[23] Jane's Defense Weekly, August 21, 1996. P. 15.
[24] Office of the Secretary of Defense, Proliferation: Threat and Response, Washington, Department of Defense, 1997, pp. 37-40 and 1998 edition; Washington Times, March 4, 1997, p. A-19; United Press, November 18, 1996, 1227, Reuters, April 29, 1997, 0651; Reuters, September 24, 1999, 0644.
[25] CIA, Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions 1 January Through 30 June 1998, January 1999, Internet edition.
[26] Baltimore Sun, October 24, 1995, p. 1A.
[27] London Sunday Times, January 10, 1988, p. 1; Washington Times, April 8, 1988, p. 9, January 11, 1988, p. 1; Los Angeles Times, January 14, 1988, p. 13.
[28] Syrian units deploy as close as 10 kilometers from the front line versus 20-25 kilometers for Soviet units.
[29] The FROG with a VX chemical warhead carried much less agent. The Soviet version is 540 mm in diameter, and weighs about 960 pounds, of which 475 is VX agent. The FROG with a chemical warhead has a maximum range of 40 miles versus 190 miles for the Scud. Michael Eisenstadt, "Syria's Strategic Weapons," Jane's Intelligence Review, April, 1993, pp. 168-171; Shuey, Lenhart, Snyder, Donnelly, Mielke, and Moteff, Missile Proliferation: Survey of Emerging Missile Forces, Washington, DC, Congressional Research Service, Report 88-642F, February 9, 1989, pp. 34-35; Jane's Defense Weekly, February 27, 1988, pp. 370-371; Defense Intelligence Agency, Soviet Chemical Weapons Threat, DST-1620F-051-85, 1985, p. 8.
[30] Interviews, Jane's Defense Weekly, September 3, 1997. P. 3.
[31] The analysis in this section is based largely on various interviews. Also see Jane's Defense Weekly, July 26, 1986, p. 92, April 2, 1988, p. 613; April 30, 1988, p. 853; Washington Post, June 23, 1988, p.33; September 7, 1988, p. A-25; Los Angeles Times, July 14, 1988, p. I-1; Washington Times, September 18, 1987, p. 2; New York Times, June 22, 1988, p. A-6.
[32] Jane's Defense Weekly, August 21, 1996. P. 15; Office of the Secretary of Defense, Proliferation: Threat and Response, Washington, Department of Defense, 1997, pp. 37-40.
[33] Gen. Mustafa Tlas, "Biological Warfare, A New and Effective Method in Modern Warfare"FBIS Translated Text: IAP20000501000119 Tehran SAFF in Persian 04/25/2000 pp 38-42 [Article translated by First Lieutenant Mohammad Motahhari, Published in SAFF Issue No.235 [22 Nov-21 Dec 99].], [FBIS Translated Text]
[34] Jane's Defense Weekly, September 3, 1997. p. 3
[35] Interviews in Israel, January, 1992 and 1994.
[36] Jane's Defense Weekly, September 3, 1997. P. 3