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Iraq's Biological Warfare Program: Saddam's Ace in the Hole

An Intelligence Assessment

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Iraq's Biological Warfare Program: Saddam's Ace in the Hole

An Intelligence Assessment

This paper was prepared by Office of Scientific and Weapons Research, with contributions by Office of Near East and South Asian Analysis; and (U)

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Iraq's Biological Warfare Program: Saddam's Ace in the Hole

Key Judgments

Information available as of 8 August 1990 was used in this report.

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Iraq's advanced and aggressive biological warfare (BW) program is the most extensive in the Arab world. The BW program is an integral part of Iraq's high-priority drive to become self-sufficient in the production of unconventional weapons and ballistic missiles.

we believe that Iraq has been producing large quantities of the agents anthrax and botulinum toxin since 1989. By the end of 1990, the Iraqis probably will have deployed significant numbers of biologically filled aerial bombs and artillery rockets. Iraq will eventually use BW agents to fill warheads for its indigenously produced Scuds. The Iraqis very likely are developing additional BW agents—probably viruses and additional toxins—but we have been unable to determine which ones.

Iraqi officials have stated that the use of any weapon is justified in defending their territory. Iraq, the first nation to use nerve agents on the battlefield, probably would not hesitate to use BW agents in extreme situations. Given the potentially greater than thousandfold increase in lethal area contamination for certain BW agents as compared with CW agents, Iraq presumably would use BW agents in extreme situations, such as strategic retaliation for nuclear or chemical attacks against Iraqi population centers.

Although Egyptian scientists seem to have provided the early technical guidance for Iraq's BW program, Western companies have supplied the majority of dual-use equipment and training. However, the Iraqi program is now so far advanced that little can be done to impede it. Much of the equipment involved is dual-use biomedical equipment.

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At least four facilities are associated with the Iraqi BW program.

This facility, located at Salman Pak, contains a specialized research building for work on extremely dangerous organisms. We believe that R&D, pilot-scale production, and storage of BW agents take place at this site. In addition, new construction at this site may be for consolidated large-scale production.

Iraq's BW program is now independent of its chemical warfare (CW) program, although initial procurements for the BW program were handled by CW cover organizations. Both the BW and CW programs are directly

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subordinate to President Saddam Husayn. The Ministry of Trade's Technical and Scientific Materials Importation Division (TSMID) is the front company for Iraq's BW program; TSMID also seems to administer the BW program.

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Iraq's Biological Warfare Program: Saddam's Ace in the Hole

Introduction

Iraq's aggressive pursuit of unconventional weapons—chemical, biological, and nuclear—and the means to deliver them (surface-to-surface missiles [SSMs]) underscore official Iraqi statements that justify the use of any weapon to defend its territory.[1] Moreover, Iraq's use of chemical weapons in its war with Iran shows that Iraq is prepared to back rhetoric with action—Iraq was the first country ever to use nerve agents on the battlefield.

Iraq's expertise and experience with chemical weapons almost certainly have reinforced its desire to develop additional unconventional weapons. We believe Iraq views its use of chemical weapons against Iran as a decisive factor in the outcome of the war. In addition, we believe the Iraqis were pleased with the minimal international response to its use of chemical weapons.

From a base of a well-established chemical warfare (CW) program, the development and production of biological weapons is the next logical step that a proliferating nation usually takes. Countries around the globe, including Iraq, have concluded that biological weapons offer much and require little:

- Effective defenses against biological weapons are nonexistent.
- Biological agents can be produced with relatively small expenditures of time and resources.
- Biological weapons provide the broadest area coverage per pound of any known weapon.
- The production of biological weapons is difficult to detect.
- Use of biological weapons can be masked in many ways so that the user may not necessarily be detected.

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[1] See DI Intelligence Assessment SW 90-10053JX (Top Secret [redacted] August 1990, *Iraq's Chemical Warfare Program: More Self-Reliant, More Deadly*, and DI Intelligence Assessment SW 90-10045JX (Top Secret [redacted] July 1990, *Iraqi Ballistic Missile Developments*.

The Case Against Iraq

In the absence of detailed reporting from well-placed sources, we have developed an understanding of Iraq's biological warfare program through compilation of evidence from many sources. Our judgment that Iraq's program is large and advanced was formed by assessing a large number of pieces of evidence collected over a decade (see inset).

Biological Warfare Program Traced Back to Late 1970s

Iraq evidently began developing its offensive BW capability in the late 1970s, despite having signed the 1972 Biological and Toxin Weapons Convention (BWC) that expressly prohibits such activities.

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the Al Hazen Institute was the original front company for the Iraqi CW program. Fermenters, key equipment for the production of biological agents, are not used for the production of CW agents.

Construction of High-Containment Building Suggests Biological Warfare

Iraq's construction of a building at Salman Pak (see figure 1) designed to keep dangerous organisms from escaping into the environment provides key evidence of the country's BW effort. Salman Pak, 35 km south of Baghdad along the Tigris River, had been identified [redacted] in the early 1980s as involved in CW research and development. A high-containment facility is unnecessary in a CW program.

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Is That a Vaccine Plant or a Biological Warfare Plant?

The production of BW agents requires exactly the same equipment and materials necessary for making vaccines and other pharmaceuticals. The dual-use nature of the equipment makes the task of determining its ultimate end use difficult. Although precursors for CW agents have legitimate uses, certain combinations of them suggest the production of CW agents. It is this logic that led to placing certain precursor chemicals on the Australia Group list of export-controlled chemicals. Unlike the case of CW agent production, however, there are no "precursors" for the development of BW agents. Even though microorganisms grow on substrates that could be considered somewhat analogous to precursor chemicals, the substrates are typically too commonplace to be controlled (they are not unique to specific types of organisms).

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Front Companies Order Equipment and Materials for BW Program

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As noted above, the CW-front Al Hazen Institute ordered fermenters in 1979; it was the first entity identified as ordering materials for the BW effort. The State Establishment for Pesticide Production (SEPP) was created in about 1980 as a cover organization for Iraq's CW effort, replacing the Al Hazen Institute.

We believe that SEPP, in addition to managing the CW program, also directed the BW program in the mid-1980s.

As the Iraqi BW program progressed, that SEPP began identifying itself as the Biology Department of the University of Baghdad when seeking standard biological equipment. From

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Construction of the high-containment building at Salman Pak began in 1981

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High-Containment Laboratories

The designations P-1/BL-1 through P-4/BL-4 refer to (P)rotection or (B)iocontainment (L)evel, with level 4 being the highest level of protection or containment. Basically, these level designations represent the number of physical barriers that prevent an organism from escaping to the outside from the laboratory. By international agreement, P-4/BL-4 is required for work on dangerous agents that pose a high risk of life-threatening disease. High-containment laboratories (P-4/BL-4) are costly and difficult to maintain; there are only a handful of them around the world, with the majority conducting legitimate research on highly contagious diseases.

Conversely, it is not necessary to have a high-containment facility for work on BW agents. For example, production of botulinum toxin and anthrax requires only P-2/BL-2 levels of containment.

We believe that, as was the case with its CW program, the Iraqi State Security Organization (SSO) has oversight for Iraq's BW program. It is, therefore, reasonable that an intelligence-affiliated entity, such as TSMID, would be involved in BW procurement.

When we first became aware of TSMID, we believed that it was acting on behalf of SEPP or SEPP's successor, SOCI. we now believe that TSMID's efforts have become independent of Iraq's chemical weapons development efforts and that TSMID administers the BW program. Although both the CW and BW efforts are directly subordinate to President Saddam Husayn, the two also seem to be treated as separate weapons development missions. And unlike many other Iraqi weapons development endeavors, we believe that Maj. Gen. Husayn Kamil al-Majid, Saddam's son-in-law and the head of the Ministry of Industry and Military Industrialization (MIMI), has little direct role in the BW program.

early 1986 through mid-1987. SEPP/University of Baghdad continued to seek and purchase biological research and production equipment, such as fermenters, incubators, and ultra-centrifuges.

in 1988, following widespread publicity about SEPP's activities, Iraq dropped the use of SEPP for CW- and BW-related procurement. SEPP's CW and BW procurement functions were then taken over by the State Organization for Chemical Industries (SOCI).

In mid-1988, a new organization involved in procuring BW-related materials—The Technical and Scientific Materials Importation Division (TSMID) of the Ministry of Trade.

TSMID has emerged as the front organization for the Iraqi BW effort. TSMID, however, is not responsible for BW procurement alone.

BW Agents Under Development Include Botulinum Toxin and Anthrax Bacteria

A variety of information leads us to believe that Iraq has developed botulinum toxin and anthrax bacteria as BW agents (see appendix A). Botulinum toxin is nonpersistent, degrading rapidly in the environment. Anthrax spores are very stable in the environment and can be considered persistent BW agents.

Botulinum Toxin. the Iraqi Government had developed botulinum toxin for military purposes.

Over the past two years, TSMID has been ordering spare parts for a *Clostridium* vaccine plant that Iraq had acquired in 1984. Botulinum toxin is produced by *Clostridium botulinum*, an organism that grows anaerobically, that is, without the presence of oxygen.

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indicate that SEPP had sought anaerobic incubators in 1987 and 1988.

A plant designed to produce *Clostridium* vaccines would first have to produce large quantities of toxin, for example, botulinum toxin (see inset).

Anthrax. TSMID's initial search for anthrax cultures in the spring of 1988,

led us to believe that Iraq planned to pursue production of anthrax in addition to botulinum toxin. TSMID's search

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Production of* Clostridium *Vaccines

The bacterium Clostridium botulinum *is the causative agent of botulism, a type of food poisoning. The* Clostridium *family of bacteria also produces tetanus and gas gangrene.*

The first step in the production of Clostridium *vaccines, such as tetanus, is to produce large quantities of the tetanus toxin. To accomplish this, large quantities of* Clostridium tetani *are grown in fermenters. As cells die and burst, the tetanus toxin is released into the material in which they are growing. The next step is to put the growth medium—containing the toxin—into another container to which formaldehyde is added. The formaldehyde inactivates the toxin, making it nontoxic but still capable of producing an immune response. (A toxin that is inactive but that can still produce an immune response is called a toxoid or an anatoxin.) The formaldehyde-toxin mixture is stirred, and, at various intervals, samples are taken out and injected into mice. When no toxic effects are observed in the mice, the toxin is considered to be inactive and ready for use in producing vaccine.*

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Western assistance in providing equipment and training has been critical to Iraq's efforts to develop an offensive BW capability. have supplied biological production equipment and have trained Iraqis in the use of that equipment. We do not believe that these firms were aware of the end use of the training or equipment.

Foreign Assistance Has Been Critical

Egyptian scientists may have provided the early technical guidance for Iraq's BW program. during the 1980s the Egyptians gave the Iraqis detailed information on development of offensive BW and CW capabilities. Egyptian military personnel provided technical expertise in CW to the Iraqis in the early 1980s.

Current Status of the BW Program

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Iraq probably began large-scale production of anthrax and botulinum toxin in 1989. In addition, that some limited weaponization probably has taken place already.

Production

We believe there are at least four locations in Iraq involved in the production of BW agents: Salman Pak, At Taji, Abu Ghraib, and Al Latifiyah (see figure 2). We have been able to identify only Salman Pak

Salman Pak—R&D, Production, and Storage.

With currently available technology, pilot-scale fermenters operated on a continuous basis could produce enough toxins or living agents each day to lethally contaminate hundreds of square kilometers.

Although the storage bunker area of Salman Pak was constructed in the early 1980s, we observed little activity there until the middle of 1989. Since that time—when a refrigeration unit was installed on the second of four bunkers—we have observed increased levels of activity, such as trucks backed up to the entrances of bunkers. These recent activities support our assessment that Iraq was beginning to produce large quantities of BW agents in 1989. Appropriate storage facilities—such as refrigerated bunkers—are required to store BW agents.

Since February 1989, we observed new construction activities at Salman Pak that may provide additional BW production capabilities. By July 1990, the new complex consisted of 11 externally complete buildings. It is unclear at this time what function these buildings serve.

We judge that there are no more CW-related activities ongoing at Salman Pak and that it is now entirely devoted to BW. All-source information indicates that the CW R&D and production efforts that once took place at Salman Pak currently take place at Samarra and Habbaniyah.

Abu Ghraib—Botulinum Toxin Production. Abu Ghraib, a few kilometers west of Baghdad, as the location of a BW agent production facility. we have been able to determine additional details about it from open literature.

Open literature indicates that Iraqi veterinary authorities signed a contract with an Italian firm in 1982 to construct a *Clostridium* vaccine plant near Baghdad. the plant was completed in 1984. We believe it was constructed fairly rapidly to give Iraq a crude operational BW capability during the war. Over the past year, TSMID has contacted the Italian firm several times to obtain spare parts for the plant. Although this information has not specified the location of the vaccine plant, we believe it is the Abu Ghraib plant and that it has been used to produce botulinum toxin from *Clostridium botulinum*.

At Taji—Pilot Production. We believe At Taji, in the northwestern suburbs of Baghdad, is a site of pilot-scale BW production.

TSMID has been seeking

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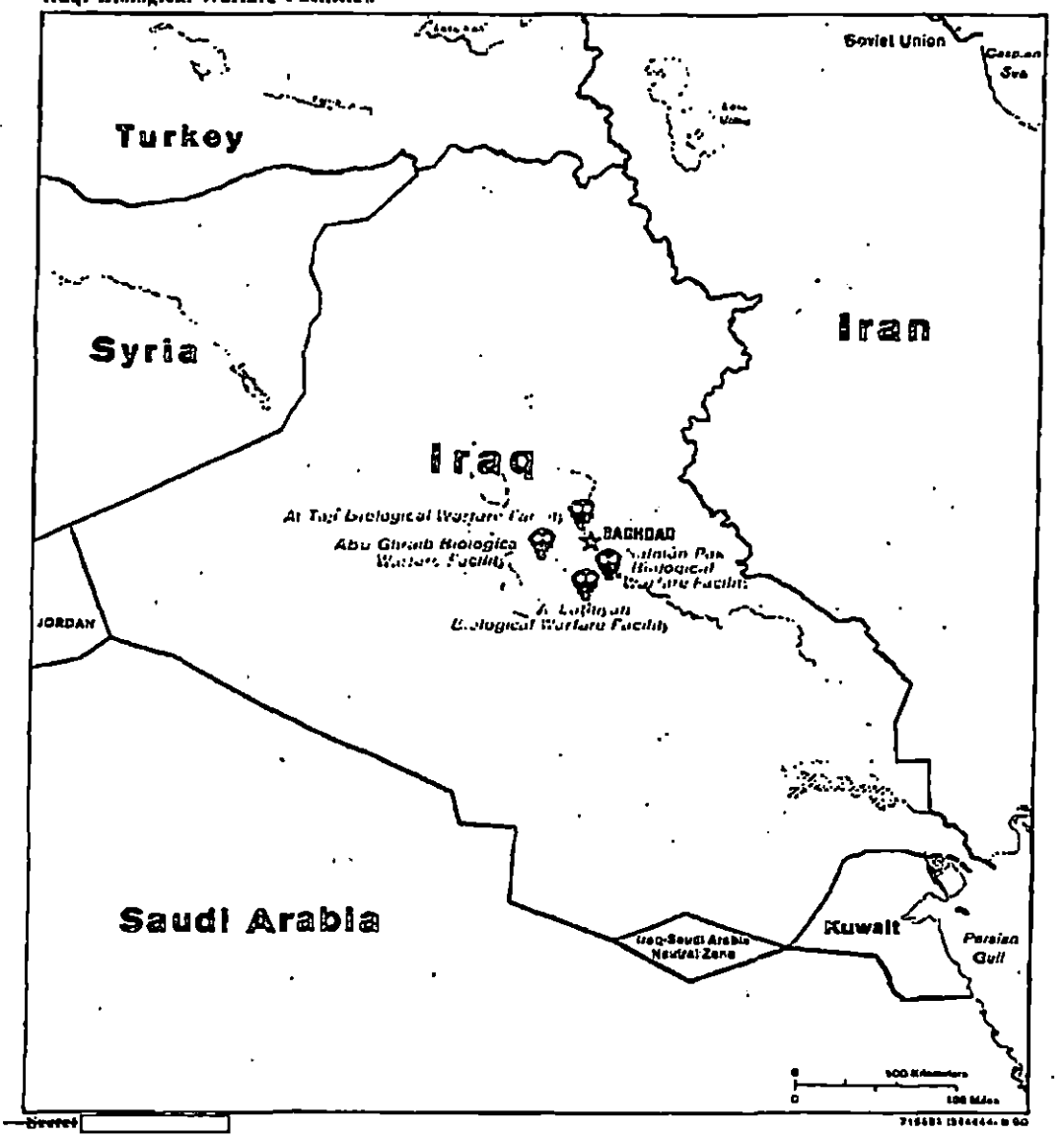
Figure 2
Iraqi Biological Warfare Facilities



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materials for its maintenance and repair.

Consolidated Production Facility. we believe Iraq intends to establish a facility to consolidate production of its BW agents, although we are uncertain whether Iraq's other BW-related facilities will cease operation once the new plant begins functioning. we have observed TSMID negotiating with the Swiss firm Chemap for construction of a state-of-the-art fermentation facility, which was to include a 5,000-liter production fermenter. the plant was to be built at Al Latifiyah, about 70 km south of Baghdad. suspicion is a wholly owned subsidiary of a company) about the potential BW uses of the plant caused the firm to ostensibly cancel—in October 1989—its plans to build the plant in Iraq.

At the time the contract was withdrawn, however, Iraq had already paid several million dollars—70 percent of the contract—and was in possession of the floor plans and a civil engineering map of the plant. We remain uncertain, therefore, as to whether Iraq is proceeding with construction of the facility.[9] Although the new construction at Salman Pak began in early 1989 (several months before the deal ostensibly fell apart), it is possible that the equipment from the "canceled" plant will be installed in one of the new buildings there.

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Weaponization

Iraq has available a wide range of weapon systems that it could potentially use to deliver BW agents. The weapons range from simple aerial bombs and artillery rockets to surface-to-surface missiles (SSMs). We have some evidence that Iraq plans to use BW agents in cluster bombs and possibly in its SSMs.

Information from several sources, when combined, indicates that Iraq plans to put botulinum toxin into cluster bombs. in the summer of 1989, the Chilean arms manufacturer Cardoen Open literature indicates that Cardoen is coproducing 250- and 500-kilogram (kg) cluster bombs with Iraq. In about the same time frame, north of Baghdad, showed evidence of tests of a fragmentation-type device. Although a fragmentation bomb is not identical to a cluster bomb, the test observed at Al Hadre could have been used to determine how well the cluster bomb dispersed its contents. It is unlikely that the test at Al Hadre involved actual use of toxins. A cluster bomb is ideal for either CW or BW agent dissemination because it facilitates even distribution of such agents over a large area.

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Limited information suggests that Iraq may be planning to develop a biological warhead for its SSMs. Iraq's CW front company last summer ordered Scud nosecone pieces, suggesting that Iraq plans to develop a chemical warhead for its indigenously produced Scuds. We believe that the next logical step in this effort would be to develop a biological warhead. The location of the proposed large-scale fermentation plant at Latifiyah—one of several Iraqi missile project locations—further suggests that these plans may be moving ahead. Finally, on the plant indicated that the Technical Corps for Special Projects (TECO) would be involved in its construction. Affiliated with the MIMI, TECO has been heavily involved in expediting the construction of Iraqi missile facilities. TECO's role could be simply to expedite construction of the plant, or its involvement could be additional evidence of Iraq's plans to develop a biological warhead for its SSMs.

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We believe that, if Iraq does plan to put BW agents into an SSM, the most likely choice would again be its indigenously produced Scuds, which have claimed ranges of 600 and 900 km. Our current estimates place the payload of these missiles at about 200 kg.

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A system that could be used in the future for BW agent delivery is the Condor II—an SSM with a 750- to 1,000-km range and a payload of about 500 kg. the Condor has a submunition warhead. Such warheads are well suited for disseminating BW or CW agents.

Some limited field testing of Iraqi BW agent-filled munitions might take place before the weapons were deployed.

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Potential Iraqi Usage

Past Iraqi use of chemical weapons and statements by Iraqi officials justifying the use of any weapon to defend their country suggest that Iraq would consider using biological weapons under certain extreme circumstances. In clarifying earlier public statements about Iraq using chemical weapons in response to an Israeli nuclear attack, Saddam Husayn told a delegation of US senators in April 1990 that Iraq would use chemicals only in retaliation for an unconventional attack. Iraq will treat BW similarly, in our judgment, and probably would save its biological weapons as a retaliatory option for unconventional attacks on Iraq. Given the potentially more than thousandfold increase in lethal area contamination of some BW agents as compared with CW agents, Iraq, in our judgment, primarily views BW as part of its strategic arsenal, to be used as a terror weapon against military and civilian targets.

If Iraq decides to use unconventional weapons to attack strategic targets, it may be tempted to use biological instead of chemical warheads because of the greater area coverage provided by biological warheads. We believe, however, that Iraq is more likely to hold its biological weapons in reserve as an escalatory option to deter additional strikes from its opponent or to launch its own retaliation. For example, anthrax spores can contaminate soil for decades and may serve, in Iraq's view, as retaliation in kind for the radiation that accompanies a nuclear attack.

We cannot rule out that Iraq may have contingency plans to use biological agents covertly, although we have no reporting on this subject. Botulinum toxin and, to a lesser degree, anthrax bacteria lend themselves to covert dissemination because even small amounts placed in water or food supplies are sufficiently toxic to kill large numbers of people. Iraq also could covertly use spray tanks or aerosol generators purchased for its chemical warfare program to create large toxic clouds of biological agents upwind of a

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target area. 25X1, E.O.13526

Regional Implications

Biological weapons almost certainly will proliferate as other countries in the region, particularly Iraq's main enemies, focus on and react to Iraq's BW threat. Israel, Syria, and Iran already have CW and BW programs, and Saudi Arabia may attempt to develop these capabilities.

We believe that the Israelis have an advanced BW program because of their existing biotechnological skills and facilities.

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Syria's well-established unconventional warfare efforts are spurred primarily by the perceived threat from Israel.

Although Syria may be compelled to increase its BW efforts to keep pace with Iraq, the current status of its BW—and CW—development efforts probably will suffice to deter any near-term threats of Iraqi use of biological agents.

As with its CW program, Iran probably began its own BW program to counter Iraq's effort. Iran has suffered Iraqi chemical attacks and probably holds no illusions about the likelihood that Iraq would use BW if it provided any battlefield advantage. Since the cease-fire, reporting indicates Iran has been focusing its military rebuilding efforts in the field of chemical weapons and delivery systems as the quickest and least expensive means to deter future Iraqi aggression and use of CW.

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Outlook

By the end of 1990, we believe that Iraq will have deployed a militarily significant number of biologically filled bombs and artillery rockets.* In addition, we believe that Iraq will develop a BW warhead for its indigenously produced Scud and may have already done so. We judge that this weapon could be operationally ready within the next few years.

We also believe that Iraq has been developing other BW agents that we have not yet identified. Likely candidates include viruses and additional bacteria and toxins. Lacking specific information on other agents, we cannot predict a time frame in which they would be ready for deployment. We cannot rule out the possibility that Baghdad has already developed additional agents.

In the future, Iraq may attempt to develop genetically engineered BW agents.

TSMID has been seeking materials that have applications to genetic engineering, and we believe that Iraqi scientists have the technical expertise—from experience in their BW program and from training in the West—to successfully develop such agents within a relatively short period of time. Such research could take place at the nuclear research center at Tuwaitha, southeast of Baghdad on the Tigris River.

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* Because of the large area of coverage provided by biological weapons, even a few dozen would be militarily significant.

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We believe that Iraq will continue to place emphasis on its BW program. Saddam, in his quest to be the leader of the Arab world, probably believes that his BW program places him in an elite group of nations; he has already stated that he is the third leader to develop binary chemical weapons. Given that Saddam already has the dubious distinction of being the first to use nerve agents on the battlefield and that he successfully weathered the limited international response to this use, he probably has little fear of the political consequences of using biological weapons.

Iraq's aggressive BW program is an integral part of Saddam's high-priority drive to develop and produce unconventional weapons and ballistic missiles. And, as is the case for its nuclear, chemical, and missile programs, the ultimate goal for Iraq's BW effort is to become independent of foreign assistance. Iraq is already well on the way toward this goal.

The Iraqi BW program will continue to progress because little can be done by the West to stop materials, equipment, and expertise from being exported to Iraq. In fact, the Iraqi program is so far along that Baghdad probably requires only spare parts; it has already obtained most of the materials it needs. Although it may be possible to convince nations not to supply biological production equipment or training to Iraq, it would be very difficult to convince suppliers not to sell spare parts for equipment they have already provided. In addition, Western efforts to stop the sales of dual-use biomedical equipment and spare parts to Iraq could generate adverse publicity. Iraq could claim that these embargoes are further evidence of unfair Western tactics against Arab nations and that the West was depriving it of its sovereign right to protect the health and welfare of its people.

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Appendix

Characteristics of Botulinum Toxin and Anthrax Bacteria

Botulinum Toxin

Botulinum toxin is produced by *Clostridium botulinum*. This baterium grows anaerobically, that is, without the presence of oxygen. Although there are eight different types of the toxin, the toxin most studied and characterized is botulinum toxin A, one of the most toxic substances known. On the basis of data regarding the toxicity and dissemination characteristics of the toxin in dried form, a missile filled with botulinum would lethally contaminate an area at least 16 times larger than the same missile warhead filled with the nerve agent sarin.

According to experimental data on laboratory animals and from cases of human exposure, botulinum toxin A is about 300,000 times more potent than the nerve agent VX. (VX, a persistent nerve agent, is 10 times more potent than the nonpersistent nerve agent sarin.) In fact, humans seem to be more sensitive to botulinum toxin than most other species. Exposure to botulinum toxin usually occurs when food containing the bacterium in ingested. Experimental data, however, indicate that respiratory (inhalation) exposures are at least 10 times more toxic than for oral (ingestion) exposure. By the time botulinum toxin symptoms develop—about 12 hours after aerosol exposure—treatment has little chance of success. Rapid field detection methods do not exist for botulinum toxin or for other BW agents.

Botulinum toxin affects the nervous system. When exposure takes place through ingestion, gastrointestinal symptoms are observed before the onset of neurological symptoms. Once these systems begin, they include weakness, dizziness, blurred or double vision, fixed and dilated pupils, impaired reaction to light, drooping eyelids, facial muscle weakness, and speech difficulties. When exposure to botulinum takes place through the respiratory route, gastrointestinal symptoms are absent.

Botulinum toxin will most likely be used as an aerosol for BW purposes. Although the toxin is fairly stable for a year when stored at temperatures below 27°C, experimental studies have shown that it decays fairly rapidly—generally within an hour—in bright sunlight.

There are antisera to botulinum toxins, but they are effective only if administered before the onset of symptoms. Because there are no detectors for the toxin, it is highly unlikely that exposure to botulinum would be diagnosed until clinical symptoms appear, and treatment at that time would be too late. Conversely, immunization to botulinum is possible but requires multiple injections of inactivated toxins over a period of several months. Thus, a country that had developed botulinum toxin as a BW agent could protect its troops from exposure to the toxin.

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Anthrax

Anthrax is produced by the bacterium *Bacillus anthracis*. Unlike botulinum toxin, anthrax symptoms result when the bacteria multiply in the body, producing toxins. Although each bacterium produces and releases only a small quantity of anthrax toxin as it grows, as the bacteria multiply, more toxin is produced. Anthrax is a living BW agent, and it must reproduce in the body to cause an effect.

There are three forms of anthrax, characterized by the mode of entry into the body: through cuts in the skin (cutaneous), through ingestion (gastrointestinal), or through inhalation (pulmonary). Anthrax is a naturally occurring disease of livestock, and humans most

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frequently contract the cutaneous form of the disease when they come into contact with infected animals. The gastrointestinal form of the disease results from ingesting contaminated meat. Of these three forms, pulmonary anthrax is fatal nearly 100 percent of the time. Gastrointestinal anthrax is fatal about 75 percent of the time, and cutaneous anthrax is fatal less then 10 percent of the time and only if untreated. All forms of the disease respond well to penicillin if the drug is given shortly after the onset of symptoms. The disease is fairly rare, however, and often the diagnosis of either gastrointestinal or pulmonary anthrax is made only after death.

Anthrax would most likely be used as an aerosol suspension of spores for BW purposes. After anthrax spores are inhaled, there is an incubation period of one to five days before nonspecific symptoms—such as fatigue and mild fever—appear; at this point the illness is frequently diagnosed as a respiratory infection. These initial symptoms usually improve two to four days later, followed by the sudden development of respiratory distress. Pulse, temperature, and respiratory rate become elevated, and the victim becomes cyanotic—blue-black colored. Death usually occurs within 24 hours after the onset of the second phase.

Anthrax spores are very hearty in the environment and in storage: it is this specialized form of the bacterium that infects humans. Growing bacteria, when exposed to adverse conditions—such as extreme heat or cold—produce spores. The spores, which can be thought of as seeds, remain in an inert state until they enter the body and encounter conditions suitable for them to begin multiplying. Data from human exposures indicate that an infectious dose of anthrax is about 10,000 spores. Although this may seem like a large quantity, the spores are quite small, and a teaspoonful contains as many as several million infectious doses. In addition, because the spores remain viable in the environment for long periods of time, an attack with anthrax spores could lethally contaminate an area for years.

As is the case for botulinum toxin, there are no detectors for anthrax. In addition, because the onset of symptoms of pulmonary anthrax are so nonspecific, diagnosis in time for successful penicillin treatment would be highly unlikely. Conversely effective vaccines to anthrax do exist so that a country that had developed anthrax as a BW agent could protect its troops.

Withheld under statutory authority of the Central Intelligence Agency Act of 1949 (50 U.S.C., section 3507)