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Intelligence Report

Office of Transnational Issues

Iraq's Biological Warfare Program: Well Positioned for the Future

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Intelligence Report

Office of Transnational Issues

Iraq's Biological Warfare Program: Well Positioned for the Future

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Iraq's Biological Warfare Program: Well Positioned for the Future

Key Findings
Information available as of 14 April 1997 was used in this report.

Despite six years of UNSCOM inspections, Iraq has only reluctantly offered details of its biological warfare (BW) program:

- Iraq did not acknowledge any work beyond basic research until Husayn Kamil's 1995 defection forced it to admit to an offensive program that had achieved large-scale production, weaponization, and deployment.
- Evidence from multiple sources indicates that Iraq still is hiding details of its prewar program, including additional agents, munitions, and a doctrine for use.

Throughout the postwar period, Iraq has continued weapons-applicable research in the guise of legitimate biological production. This research has allowed Baghdad to develop a better understanding of agent production and weaponization and to maintain the technical expertise of its BW personnel.

- Iraq has perfected techniques for drying organisms in a respirable particle size range.
- Dispersal trials with a biopesticide—a close analogue to anthrax—have provided Iraq with valuable data for BW agent dissemination.

Iraq is using sanctions and the inspection process as an opportunity to further its program and to increase its self-sufficiency. ***Iraq's new found strengths will increase the difficulty of detecting and tracking the program in the future.***

- Repeated questioning by inspectors has drawn Iraqi attention to more advanced munitions such as bomblets and to additional agents, specifically plague and smallpox.
- Iraq now has the design and manufacturing facilities to indigenously produce its own biological production equipment, thereby decreasing reliance on foreign suppliers.
- Iraqi officials have stated that a long-term goal was to build dual-use facilities that could be converted from civilian production to biological weapons production when needed.

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Barring a change in government or attitudes, Iraq will probably resurrect its BW program once sanctions are lifted or the UNSCOM presence is reduced.

- Approximately five years after sanctions cease, we estimate that Iraq will have a consolidated in-country expertise on agent production and will be moving toward more efficient and flexible dissemination systems.
- Iraq is likely to investigate the application of genetic engineering to BW agents and may continue earlier research on mixing agents.

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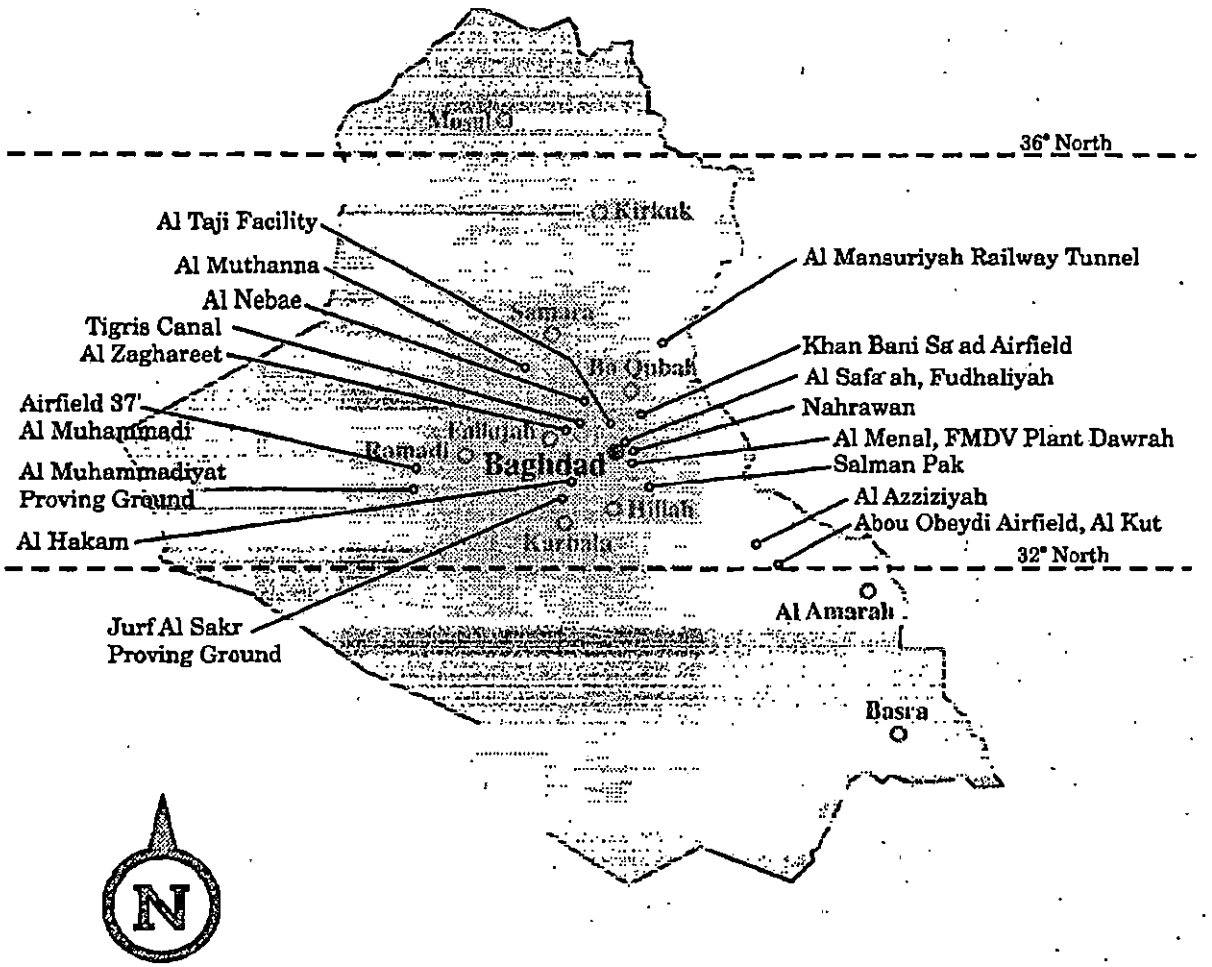
Figure 1

Sites Involved in Iraq's BW Program



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Iraq's Biological Warfare Program: Well Positioned for the Future

BW Program: More Sophisticated Than Declared

Before the Gulf war, we assessed that Iraq had the most extensive biological warfare (BW) program in the Middle East. We were confident that Iraq had produced anthrax and botulinum toxin and knew that it had the capability to weaponize those agents into bombs, missile warheads, and spray tanks. Multiple intelligence reports obtained after the war corroborated and expanded our assessments, pointing to Iraq's BW agent production and weaponization efforts.

For more than four years after the cease-fire, Iraq insisted that its BW program had never progressed beyond research. Despite the assistance of international intelligence information, UNSCOM was unable to show definitively that Iraq's BW program had progressed to production and weaponization. Iraq was successfully able to provide plausible, legitimate explanations for facilities with dual-use capabilities and equipment.

E.O. 13526, section 1.4(c)

Only after Husayn Kamil's August 1995 defection did Iraq disclose substantially new, albeit incomplete, information on its offensive program, including key personnel, facilities, types of agents, and munitions (see figure 1). Iraq claims that after an initial failed attempt in the mid-1970s, research for the BW program was reinitiated in 1985 and full-scale production of BW agents began in 1987. Although a number of facilities were used for agent R&D and production, a new dedicated site for biological weapons production was built at al Hakam in 1988. Weapons trials of bombs and artillery shells filled with anthrax simulant and toxin took place from 1988 through 1990.

After Iraq's invasion of Kuwait, a "crash" program was started to produce and deploy biological weapons. Iraq claims bombs and missile warheads were filled with anthrax, botulinum toxin, and aflatoxin and deployed to four locations for the duration of the war. In late 1990, Iraq produced spray tanks for both piloted and remotely piloted fighters that were capable of dispersing 2,000 liters of anthrax. Field trials of these tanks using an anthrax simulant were conducted in January 1991. Iraq claims that all biological agents and munitions were unilaterally destroyed in July 1991.

Multiple intelligence sources, UNSCOM inspections, and inconsistencies within Iraq's extensive BW declarations all indicate that the spectrum of Iraq's BW program—from R&D to BW agent production, to weapons testing, to munitions filling—was more sophisticated than admitted (see appendix). Furthermore, Baghdad's consistent obstruction of UNSCOM's information gathering and its denial or misrepresentation of the scope of its BW activities are designed to preserve those advanced capabilities deemed critical to restarting the program.

Agents: Incapacitating to Lethal

Iraq researched bacterial, viral, and toxin agents, producing effects varying from incapacitation to death. The range of agents declared by Iraq (see table 1) would allow a customized pairing of agent to munition for both tactical and strategic scenarios. Research encompassed not only human pathogens but also a plant pathogen, indicating an interest in economic warfare.

Growing evidence from intelligence and UNSCOM reports indicates that Iraq investigated additional undeclared agents, specifically plague, smallpox, and tularemia. Iraq has denied any research efforts on these agents and claims not to maintain any stocks. Iraq's admitted work on camelpox, however, has raised concerns that the agent was being used as a simulant for smallpox.

Suspect Agents Not Declared

Plague. Iraq initiated work on plague in 1985. Reportedly, plague was produced and weaponized, yet technical difficulties regarding delivery made the weapons ineffective.

E.O. 13526, section 1.4(c)

Table 1
Iraqi-Declared Agent Production

Agents	Location	Dates	Research/ Production Quantities	Production Amount
Aflatoxin	Salman Pak	Pre-1989	Research	None
	Al Safa'a	1989	Production	600L
		1990	Production	1,600L (2,200L)
Anthrax	Al Muthanna	Pre-1990	Research	None
	Salman Pak	Pre-1990	Research	None
		1990	Production	150L
	Al Hakam	1990	Production	8,350L (8,500L)
Bacillus subtilis (anthrax simulant)	Salman Pak	1988	Production	240L
		1989		300L
	Al Hakam	1989	Production	250L
		1990		100L (890L)
Botulinum toxin	Al Muthanna	Pre-1988	Research	None
	Salman Pak	Pre-1988	Research	None
	Al Taji	1988	Production	400L
	Al Hakam	1988	Production	400L
		1989-90		13,200L
	Al Menal	1990-91	Production	5,400L (19,400L)
Clostridium perfringens	Salman Pak	1988	Research	None
	Al Hakam	1990	Production	340L
Ricin	Salman Pak	Unknown	Production	300g
			Testing	None
	Al Muthanna		Testing	None
Tricothecene Mycotoxins	Al Safa'a	1990	Research	None
	Salman Pak	1990	Testing	None
	Al Muthanna	1990	Testing	None
Viruses (camelpox, acute hemorrhagic conjunctivitis, rotavirus)	Al Menal	1990	Research	None
Wheat Cover Smut	Al Safa'a	1983-86	Research	None
	Mosul	1984-90	Production	1,988.5 tons
	Salman Pak	Unknown	Testing	None

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Smallpox. E.O. 13526, section 1.4(c) biological weapons technology dealing with anthrax and smallpox was made available to Iraq in the late 1980s, when scientists from that institute traveled to Iraq to provide BW assistance.

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UNSCOM has discovered smallpox "seeds," smallpox vaccine, and freeze dryers labeled "smallpox machine." Iraq claims that the "seeds" are a vaccine strain needed in case the disease reemerges and the dryers were used in the 1950s to dry smallpox vaccine.

Tularemia. Iraq turned over strains of tularemia to the first UNSCOM BW team as a part of their "defensive" culture collection. Given Iraq's later admission of offensive work, it is likely that all organisms relinquished to that UNSCOM team also were investigated as part of the offensive program.

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BW Agent Production Enhancement

Production Techniques

Iraq has admitted to investigating production techniques that could increase the efficiency of dissemination and effectiveness of BW agents. Despite Iraq downplaying this research and claiming that significant progress was not made, it is clear that the value and importance of these techniques were recognized. Although reporting is not sufficient enough to allow an assessment of Iraq's actual progress, at a minimum, Iraq has positioned itself to make great strides in these areas.

Mixtures. Iraq investigated mixing various BW agents with mustard, tear gas, and skin penetrating chemicals, recognizing that these chemicals could enhance the toxicity of the BW agent.

E.O. 13526, section 1.4(c)

aerosolized aflatoxin was lethal, but when mixed with tear gas the mixture caused only minor intoxication, then complete recovery. However, mixtures with DMSO—a skin penetrating chemical—appeared to enhance the effects of the BW agents anthrax and *Clostridium perfringens*. Although preliminary, these investigations demonstrate that Iraq was interested in more sophisticated final agent mixes.

Dried. In general, drying a BW agent increases the efficiency of dissemination, extends the shelf-life, and concentrates the agent for higher weapons load. Iraq acknowledged performing only two enclosed tests with dried anthrax on sheep. It has denied UNSCOM's accusations that wheat cover smut spores were used as simulants for dried BW agent during field trials. Drying equipment capable of processing large quantities of agent was in place at BW production facilities, although Iraq claims it was not used to dry BW agents. Iraq did, however, produce dried biopesticide after the war, demonstrating the ability to successfully use this type of equipment.

Carriers and stabilizers. Carriers and stabilizers can be added to BW agents to increase the efficiency of dissemination, stabilize the agent over extended periods of time, and protect the agent from heat or explosive shock. Iraq acknowledged investigating the addition of silica to wheat cover smut to increase dissemination efficiency and had plans to test its addition to aflatoxin as well. Other countries, such as the former Soviet Union, used silica as a carrier for BW agents.

Genetic engineering. Iraq admitted to an interest in applying genetic engineering to the development of antibiotic resistant agents. Although Iraq presented its past research in this area as elementary, conferring antibiotic resistance to an organism is relatively simple

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and Iraqi personnel would have been technically qualified to conduct such research.

Production Capability: Above Declared Production

Iraq has been recalcitrant in providing details on the quantity, type, and timing of biological agent production. UNSCOM reported in December 1996 that Iraq had the potential for production far in excess of what it has claimed—two times higher for botulinum toxin, two to three times higher for aflatoxin, and five to six times higher for anthrax. Even Iraq keeps modifying its agent production quantities to correlate with the changing weapons production figures.

E.O. 13526, section 1.4(c)

E.O. 13526, section 1.4(c)

Iraq produced anthrax at the al Menal Facility—a facility Iraq claims was involved only in the production of botulinum toxin following the Kuwaiti invasion.

E.O. 13526, section 1.4(c)

Furthermore, Iraq has only admitted to production of botulinum toxin type A, and recent sample analysis shows evidence of botulinum toxin type B.

E.O. 13526, section 1.4(c)

Reportedly, four filling machines—two large and two small—were ordered in March 1989 and required spare parts by October 1989 because of heavy use. The large machines possibly were used for filling bombs, such as the R400A, and the smaller machines for filling bomblets.

Munitions: Less than Ideal

Iraq examined a wide range of munitions for BW dissemination but lacked the necessary expertise and time to develop efficient systems before the Gulf war (see table 2). Much of the weaponization expertise for BW came from the chemical warfare (CW) program using CW techniques and principles to modify conventional munitions for BW fill. BW and CW agents, however, require different delivery methods to maximize effectiveness. Filling CW-modified conventional munitions with BW agents probably contributed to Iraqi difficulties. The Iraqis described problems in several areas and provided other munitions data that suggest that the efficiency of their weapon's capability at the time of the Gulf war would have been limited. Despite problems (described in the following paragraphs), the munitions developed could still effectively deliver BW agents. Furthermore, Iraqi explanations of failure may have been designed to cover the exact nature of BW weaponization efforts.

Dispersal Efficiency. Although Iraq declared that they deployed bulk-filled R400A aerial bombs and al Husayn missile warheads during the Gulf war, it is doubtful how efficient either of these weapons would have been. The charge required to rupture the 1-centimeter-thick bomb casing of the R400A would have created such an increase in internal pressure and temperature that it is likely much of the biological payload would have been destroyed. Likewise, the al Husayn warhead would have been a far better psychological terror weapon than an efficient disseminator of BW agent. Describing the warhead as a whim of Husayn Kamil, the Iraqis dismissed it as useless, believing the heat of reentry would destroy the bulk agent. In fact, most of the agent would likely have survived the reentry temperatures, as the warhead contained extra asbestos insulation. The warhead, however, may have faced rupturing problems similar to the R400A bomb.

Fuzing. Iraq's choice of an impact fuze for its BW munitions also limited the potential effectiveness. Iraq claims to have made the decision to outfit its warheads and bombs with impact fuzes based on a visual assessment of aerosol clouds generated during comparative static field tests mimicking proximity and impact fuzes. Although the dispersal efficiency from the ground burst of a low terminal velocity bomb would probably be superior to that of the high terminal velocity al Husayn, neither would generate efficiently a respirable aerosol. The rationale for declaring the use of impact fuzes may have rested more on the limited availability of proximity fuzes or the desire to withhold information from UNSCOM that indicated development of more sophisticated munitions.

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Table 2

Iraqi-Declared Munitions

Munition	Field Tested	Deployed
Al Husayn missile warhead	Simulants oil "spoilt" sarin	Anthrax Botulinum toxin Aflatoxin (25 total)
R400A bombs	Anthrax simulant Botulinum toxin	Anthrax Botulinum toxin Aflatoxin (166 total)
122-mm artillery shells	Anthrax simulant Botulinum toxin Aflatoxin	None
155-mm rockets	Ricin	None
LD-250 bombs	Anthrax simulant Botulinum toxin	None
Modified drop tanks for Mirage F-1 and remotely piloted aircraft	Anthrax simulant	4 modified

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Parachute-retarded warhead. In early 1995, UNSCOM uncovered Iraq's Meteo-1 project, a prewar attempt to procure hundreds of parachute systems for the Al Husayn warhead. The Meteo-1 project probably was an attempt at weaponizing BW agents for the Al Husayn. The parachute system would both stabilize and slow down the Al Husayn warhead to less than 10 meters per second. This slow speed significantly reduces the difficulties in fuzing and dispersing a BW agent. Furthermore, Iraq had a facility designed to fill parachute-retarded, aircraft-delivered bombs, and weapons filling had reportedly begun by at least the end of 1990. Iraq claims that the systems were to be used for one or two flight tests to recover video payloads used to monitor the break-up of Al Husayn missiles.

Aerosol Devices. The two spray systems designed by Iraq probably would have been its most efficient delivery system. The modified 2,200-liter fuel drop tanks fitted to the Mirage F-1 aircraft could have created a line source of a respirable aerosol and tests using a simulant for anthrax were conducted during the air war in January 1991, according to Iraqi declarations. The Zubaydi aerosol device was a standard pesticide sprayer, adapted with overlaying mesh screens to obtain smaller particle sizes, and was fitted to a helicopter. Iraq claims the results of 1988 tests in which this device was used were unsatisfactory, and the project was abandoned.

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Cluster munitions. Although Iraq claims that all its BW munitions contained bulk fill, growing evidence indicates that Iraq had an early interest in developing cluster bombs for BW.

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- Dr. Mukhlif—the project manager for the construction of al Hakam and the head of the Salman Pak Forensics section that included BW research—made an initial visit to the al Noaman cluster bomb factory in 1987 or 1988 to discuss weapons the biology group could use. He claims to have rejected the idea of cluster bombs because of high internal temperatures.

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- Brigadier General Mahmoud Bilal—former head of BW weaponization—claimed repeatedly that cluster bombs had been modified for biological agents and were tested, with two being produced. Presidential adviser LTG Sa'adi confirmed this statement. At a later meeting, Bilal alleged that his earlier statements were a mistake.

Military Doctrine

Iraq has given UNSCOM little insight into the thought process behind the development of biological weapons and even less into the doctrine for their use. It has denied any military doctrine for developing and using its BW program. It has admitted only that the drop tank spray device was developed in response to an Israeli article accusing Iraq of developing such a dissemination device. Iraq claimed that the device could have been used against Israel, Saudi Arabia, or the Coalition forces. E.O. 13526, section 1.4(c)

- Iraq had a plan to use BW during the war. The plan called for an initial air raid on Riyadh with conventional high explosives, which, if successful, would be followed by a second mission containing a BW dispersal aircraft. Reportedly, the first mission was shot down and no other efforts were made to deliver the BW agent.
- Thus far, Baghdad has only admitted to a retaliatory doctrine. The commanders entrusted with the biological weapons during the Gulf war were authorized to counterattack with BW only in the case of first strike with weapons of mass destruction by the Coalition forces against Baghdad.

Lessons Learned Since 1991

Continued Covert Weapons Research

Despite intrusive UNSCOM inspections, Iraq has continued to conduct weapons-applicable research in the guise of legitimate, commercial work, preserving the technical expertise of BW personnel. From 1991 until mid-1996, the al Hakam facility—Iraq's principle BW agent production facility before the Gulf war—produced the biopesticide *Bacillus thurengiensis* (Bt)—a close analogue to anthrax. During this time, Iraq was able to:

- Perfect the technique of drying liquid suspensions of harvested spores by spraying directly into bentonite—a material that overcoats spores. The resultant end-product had extended stability and excellent handling and dispersal qualities.

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- Successfully produce the Bt in a respirable particle size ranging from 1 to 10 microns. This size is ideal for the dissemination of BW agents in which the aerosol produced can be inhaled; it is not ideal for a biopesticide that must be at least 10 times this size to effectively coat crops.

- Conduct dissemination trials in conjunction with biologists from the Tuwaitha Nuclear Facility. These tests—carried out under differing climatic conditions—would provide Iraq with valuable data for agent dissemination.

Although UNSCOM recently destroyed al Hakam, the past five years of research at the facility greatly enhanced Iraq's capability to produce and disseminate anthrax and other BW agents.

Self-Sufficiency: A Negative Product of Sanctions

Since the cease-fire, sanctions have seriously, but only temporarily, crippled Iraq's ability to conduct biological research. They also have forced Iraq to become more self-sufficient. On the basis of successful reverse-engineering efforts, Iraq now has the design and manufacturing facilities to indigenously produce its own biological production equipment, specifically fermentation units. It is virtually impossible to know where these fermentors may now be located. Developing the ability to manufacture these fermenters minimizes reliance on foreign equipment suppliers in the future and complicates international efforts to track biological activities through procurement orders.

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it was Iraq's long-term plan to have dual-use facilities that could convert to chemical and biological weapons production. This plan was devised in reaction to compromises of the al Muthanna State Establishment chemical warfare facility and the Salman Pak biological warfare facility. Some other countries, particularly Russia, use mobilization concepts that would enable specific civilian institutes to convert to the production and weaponization of BW agents in a wartime situation.

Denial and Deception Lessons for the Future

Iraq has learned valuable lessons from the war and the inspection experience.

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Iraq also has gained new insights into weapons development because of the inspection process. Through specific and repeat questioning, well-meaning international inspectors have highlighted areas of concern in biological weapons development.

- inspectors have queried the Iraqis extensively on past work on plague and smallpox. Although Iraq has repeatedly denied any research on either agent, the continued dialogue denotes the importance and potential effectiveness inspectors believe such agents would have if used offensively.

- Multiple inspections and interrogation sessions have been devoted in part to questioning the Iraqis about cluster bombs for biological agents.

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Iraq developed a security committee to act as the primary command and control organization for deception operations—hiding material, providing false documents, camouflage, and delay tactics—mounted against UN inspectors visiting Iraq. These coordinated deception efforts contributed to Iraq's four years of success in hiding the true nature of its offensive program. Even after Husayn Kamil's defection and the subsequent disclosures, Iraq still has attempted to deny certain BW activities.

In an Ideal Position for Future Biological Weapons Production

Barring Saddam's overthrow or a sea change in Iraq's military posture, it is highly unlikely that Iraq will relinquish plans to resurrect its offensive BW program.

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The lessons Iraq has learned over the past six years, coupled with its experience before the war, place Baghdad in an ideal position to resume production and weaponization of BW agents once sanctions are lifted or UNSCOM's presence is diminished.

Short-Term Prospects

In the one to two years after sanctions are lifted, Iraq probably will work toward regaining its prewar status by pursuing many of the same agents and improving upon munitions from its prewar program. UNSCOM's destruction of facilities and equipment associated with the past program have made near-term start up of offensive activities more complicated. Even with minimal UNSCOM interference, Iraq is likely to locate the program to unmonitored sites, and it will take some time to overcome inevitable start-up problems. Iraq, however, has a number of remaining capabilities that will ease the resurrection of its offensive program:

- The technical cadre of scientists and engineers formerly involved in BW work have been maintained. Many are associated with the National Monitoring Directorate—an analogue to the UN's Baghdad Monitoring and Verification Center—and have been involved in the UNSCOM inspections and discussions.
- Facilities remain that are capable of conducting biological production and metal/munitions manufacturing.
- Iraq's reliance on foreign technology and expertise is far less than before the war and it has the capability to produce biological production equipment indigenously.

Mid-Term Prospects

By five years after sanctions cease, Iraq probably will have consolidated in-country expertise on agent production. Having mastered production of traditional BW agents such as anthrax and botulinum toxin, Iraq probably would investigate additional agents. Iraq admitted that much of its early research on anthrax and botulinum toxin was accomplished through literature searches of the old US offensive program. If the Iraqis continue that approach, Iraq may investigate agents such as Q-fever and tularemia. It may also elaborate upon the prewar research conducted on mixing agents.

Finally, Iraq would likely concentrate on ways to enhance the efficiency and effectiveness of the BW agent by perfecting the production of dried agents in the correct particle size and expanding the prewar research conducted on carriers, such as silica and bentonite.

Iraq also probably will move toward more sophisticated and flexible dissemination systems. Although the Iraqis probably will continue to modify conventional weapons for BW fill, they will likely attempt to progress beyond terror weapons and strive for an efficient dissemination of agents.

- Spray type devices can be designed to deliver an aerosol by nonexplosive means and can be fitted to virtually all aircraft including remotely piloted vehicles and cruise missiles.
- Submunition development would increase the efficiency of agent dissemination for both air bombs and missile warheads.

Iraq may develop a military doctrine to include use of BW with special forces. Baghdad probably will continue to view the use of BW primarily as a deterrent and secondarily as a retaliatory or last resort weapon. Iraq may view the use of BW by special forces, however, as ideally suited for covert, first-strike missions.

Long-Term Prospects

Long-term projections on how Iraq's program will progress are difficult to predict. Iraq may continue the application of genetic engineering to BW agents. Genetic engineering can be used effectively to increase the virulence of and confer antibiotic resistance to organisms. It is also possible that Iraq could investigate transferring toxin genes from one pathogenic organism to another, in essence creating an organism with characteristics of both. Although the techniques for conferring antibiotic resistance to an organism are not difficult, Iraq would have to vastly improve its general capabilities in the field of molecular biology to carry out more sophisticated research such as increasing virulence or toxin gene transfer.

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Iraq may also move beyond dedicated BW facilities and [redacted] create true dual-use facilities that would only produce biological weapons in time of necessity. To ensure a smooth transition, this concept would be possible only after many reliable and reproducible production and munitions filling runs had been accomplished. (S NF)

Just as Iraq's prospects for rebuilding its BW program are promising, Intelligence Community (IC) prospects for identifying, monitoring, and penetrating that same program have been greatly diminished. Iraq has improved not only the technical capabilities needed for a sophisticated BW program, but also has learned how to protect that program from foreign intelligence services. Iraq will likely develop new procurement networks taking into account the tracking methods the IC used before the war.

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Appendix

Iraqi-Declared Organizational Structure of Biological Warfare Program

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