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# **Iraqís Past and Future Biological Weapons Capabilities**

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**CSIS Middle East Dynamic Net Assessment**

**February, 1998**

## Table of Contents

INTRODUCTION .....	3
IRAQÍS BIOLOGICAL WEAPONS EFFORTS BEFORE THE GULF WAR .....	4
<i>Iraq Begins Major Research Activity</i> .....	4
<i>Importing Type Cultures</i> .....	4
<i>Imports of Growth Agent and Fermenters</i> .....	5
<i>Major Production Facilities</i> .....	6
<i>Work on Clostridium Perfringens, Aflatoxin, and Ricin</i> .....	7
<i>Mycotoxins, Haemorrhagic Conjunctivitis, Rotavirus, Yellow Fever Virus and Congo-Crimean Hemorrhagic Virus</i> .....	7
<i>Shift to Emphasis on Weaponization</i> .....	8
COALITION AIR STRIKES AGAINST BIOLOGICAL WEAPONS FACILITIES .....	9
IRAQI BIOLOGICAL CAPABILITIES AFTER THE GULF WAR.....	10
<i>Total Production of Biological Agents and Toxins</i> .....	11
<i>Total Production of Actual Weapons</i> .....	11
UNSCOM VERSUS IRAQ, AND THE ÌWAR OF THE SANCTIONSÍ .....	13
<i>The Discovery of the True Scale of Iraqís Program in 1995</i> .....	13
<i>Lies in Iraqís FFCDS</i> .....	14
<i>Issues Unaddressed in Late 1997</i> .....	15
THE CONTINUING UNCERTAINTIES REGARDING IRAQÍS BIOLOGICAL WEAPONS EFFORTS .....	17
<i>The Inherent Limits to UNSCOM Efforts</i> .....	17
<i>What Iraq May Retain</i> .....	18
<i>The Limits of Arms Control and Future Inspection</i> .....	19
THE WARFIGHTING EFFECTIVENESS OF IRAQÍS FUTURE BIOLOGICAL WEAPONS.....	19
<i>Possible Advances in Iraqís Biological Weapons Since 1990</i> .....	20

## INTRODUCTION

Iraq was ready to employ biological weapons against Iran if the Iran-Iraq War had continued. Similarly, Iraq had a major biological weapons program ready to use against the UN Coalition at the time of the Gulf War. Iraq had at least 90,000 liters of Botulinum toxin and 8,300 liters of Anthrax, as well as large stocks of an agent that causes cancer. It had loaded both Botulinum and Anthrax on Scud missile warheads and aerial bombs. Iraq was also experimenting with infectious agents and Mycotoxins. These programs were initially centered around Al Kindi and Salman Pak, but were moved to Al-Hakam and other facilities before the war, and were extensively dispersed before the fighting began.<sup>1</sup>

Iraqi biological weapons activity did not receive the same attention given to Iraqís other weapons of mass destruction since the end of the Gulf War until new evidence surfaced in September, 1995. This was evident from a comparison of the number of biological weapons inspections UNSCOM conducted relative to the number of inspections devoted to chemical and nuclear weapons, and ballistic missiles.<sup>2</sup>

Biological weapons, however, can be as effective as small nuclear weapons. One US study of the Gulf War notes that:

Experimental data indicate Botulinum toxin is about 3 million times more potent than the nerve agent Sarin. A Scud missile warhead filled with Botulinum could contaminate an area of 3,700 square kilometers (based on ideal weather conditions and an effective dispersal mechanism), or 16 times greater than the same warhead filled with Sarin. By the time symptoms occur, treatment has little chance of success. Rapid field detection methods for biological warfare agents do not exist. Although Botulinum can debilitate in a few hours and kill in as few as 12, and Anthrax takes two to four days to kill, Anthrax is much more persistent and can contaminate a much larger area using the same delivery means.<sup>3</sup>

The UN is still actively engaged in trying to discover and destroy Iraqís biological weapons capabilities. It has included 79 Iraqi facilities in its biological monitoring and verification regime. Of these, nine are considered Category A, requiring the most intense monitoring, while 15 are Category B, 10 are Category C and 45 are Category D. Many of the Category A sites were damaged during the Gulf War, but one facility at Al-Hakam was missed entirely by both Coalition intelligence and bombers.<sup>4</sup> The Iraqi government has admitted that these plants produced large quantities of anthrax, Botulinum, clostridium perfringens, and other agents prior to the Gulf War.

## **Iraqís Biological Weapons Efforts Before the Gulf War**

Virtually all Western experts agree that Iraq began working on biological weapons in the 1970s, conducted extensive research on Mycotoxins beginning in the mid-1980s and was producing some aspect of biological weapons in at least four different facilities when the Gulf War began.<sup>5</sup>

The conceptual origin of Iraqís biological weapons program dates back to 1974, when the government officially endorsed its development. At that time, the program was assigned to the Al Hazen Ibn Al Haytham Institute at Al Salman. By 1978, poor management and incompetence resulted in the termination of most activities and the effort remained at low levels until Iraqís defeats in the Iran-Iraq War led Saddam Hussein to reconsider the program. According to some reports, this reconsideration was triggered by a memo that Abdul Nassir Hindawi, one of Iraqís leading microbiologists and a graduate of Mississippi State, wrote for the Revolutionary Command Council and leading officials of the Baíath Party.<sup>6</sup> Copies of the paper have never been surrendered to UNSCOM, but it seems to have had a major impact on Iraqís leadership, particularly after Iranís offensives in 1984.

As a result, the directors of Iraqís poison gas program were instructed to revive the Iraqí biological weapons program in late 1984. The program achieved a presidential priority with almost unlimited funding. Its formal goals were to deter an Israeli nuclear attack, but it is clear that the program was actually directed against Iran.

### **Iraq Begins Major Research Activity**

The Muthanna State Establishment was made the primary facility responsible for chemical weapons development and production during either 1984 or early 1985. By the end of 1985, the program had a 150-liter fermenter and a staff of 10 who devoted themselves to investigating the character of the bacterium which produce Anthrax and Botulinum. While the details of Iraqís other efforts remain unknown, it began to import large amounts of biotechnology. For example, it imported a reference strain of wheat smut from the American Type Culture Center (ATCC) in Rockville, Maryland in 1985.<sup>7</sup>

### **Importing Type Cultures**

Iraq found that the ATCC placed few controls on the provision of such cultures other than a check to ensure that the user had suitable scientific experience and only charged at \$78 fee for each culture. As a result, Iraqís Ministry of Education imported two Class III fungus samples, and then began to import more lethal culture. During 1986, Iraq ordered 24 pathogens,

including 13 bacteria cultures. The US Department of Commerce cleared the order relatively rapidly, and it included the strains of anthrax, *Clostridium Botulinum*, and a gangrene-causing culture known as *Clostridium Perfringens* that Iraq later weaponized. Ironically, the Anthrax culture was derived from a British culture that had originally been developed for biological weapons in World War II. These cultures were sent to the University of Baghdad, but were then transferred to the Iraqi military.<sup>8</sup>

Iraq tried to order other cultures from the British research center at Porton Down and from the Pasteur Center in France. Porton Down rejected the order, but the Pasteur Center shipped many of the same toxins and agents shipped by the ATCC. An Iraqi researcher named Firal al-Saedi, and Iraq seems to have obtained British anthrax and Botulinum toxins from the University of Birmingham in 1988. Miss Saedi had left England in the early 1980s, but suddenly returned for her former tutor's funeral in 1988. Her tutor, Malcom Jeynes, had kept a selection of lethal cultures in his laboratory refrigerator, including anthrax, cholera, and bubonic plague. Miss Saedi also attempted to order cultures from the British Public Health Science Laboratory in London, but this order was blocked by a compliant by a British colleague. Miss Saedi then left England.

Iraq carried out extensive testing on mice, guinea pigs, monkeys, sheep, beagles, and donkeys at Muthanna and a facility at Salman Pak. It used both sealed inhalation chambers, and animals tethered in fields which were sprayed with aerosols. Although Iraq had attempted to argue that these tests often had only limited success, the results seem to have been impressive enough to persuade the government to authorize the construction of major production facilities.

### **Imports of Growth Agent and Fermenters**

Iraq also ordered massive amounts of growth agent from Oxoid in Bedford, England, and Fluka Chemie AG in Bouch, Switzerland. There orders totaled 39 tons, or enough to produce at least four tons of biological weapons agents, and were ordered in 55, 110, and 220 pound packages, rather than the normal 10 pound boxes. Neither company expressed any concerns about the orders. Similarly, Iraq began to order the kind of larger fermenters used for making beer and other yeast-based products, and spray dryers that could be used to convert liquid slurries that required refrigeration into dried spores that could be stored for indefinite periods at room temperatures.

Iraq installed fermenters at three facilities: a factory located on the outskirts of Baghdad, an agricultural research institute west of Baghdad, and the Al-Hakam Single Cell Protein

Production Facility. Al-Hakam was located in the desert and was supposedly a chicken feed factory. The production program was managed by General Amer Saadi, who had a masters in chemistry from Oxford, and Rihab Taha, a woman with a doctorate from the University of East Anglia. Ahmen Murthada, a British educated engineer, managed the import procurement program. Hussein Kamel Majid had overall control of the program, as part of his role as the director of Iraqis Military-Industrial Corporation.<sup>9</sup>

### **Major Production Facilities**

In May, 1987, the core of the Iraqi program, with its fermenters and eight more staff, was transferred to Al Salman. Botulinum and Anthrax were tested on animals and this testing was followed by the first initial weapons field trials in early 1988. A second production facility with a 450-liter fermenter was established at Taji to concentrate on the production of Botulinum. The Taji plant produced Botulinum for about six months in 1988, while the Al Salman plant accumulated 1,500 liters of anthrax. The success of these small trial production runs convinced the Iraqi government to proceed with full-scale production and weapons tests.<sup>10</sup>

The first weapons tests occurred in early March, 1988, at al-Muthanna's weapons testing range. Aerial bombs were selected as the weapon of choice for this test and, according to the Iraqis, the results were considered a failure. A second test later the same month, however, proved to be successful. The next weaponization test occurred in November of 1989, when 122 mm rockets were filled with Botulinum, an Anthrax simulate and Aflatoxin, a naturally occurring carcinogen. These trials were considered successful as were identical trials held in May, 1990. These trials were followed by tests involving R400 aerial bombs filled with the same three agents.<sup>11</sup>

Construction of a main biological weapons facility started at Al-Hakam in early 1988 and was completed by the end of the year. The complex was constructed to look like ordinary industrial buildings and sheds, and lacked obvious signs of being a biological weapons plant, like sophisticated air filtration equipment. Iraq also avoided actions that might have signaled the true nature of the plant, like giving most workers vaccinations and masks with air filters.

To expand its production capabilities, the new plant was equipped with two 1,850 liter and seven 1,480 liter fermenters, which were transferred from the Veterinary Research Laboratories in November, 1988. The 450 liter fermenter from Taji was also transferred to Al-Hakam in October, 1988. By April, 1989, production of Botulinum had started, with an Anthrax simulate following in May for the purpose of weapons tests. Iraq claims that production of

Anthrax and Botulinum at Al-Hakam during 1990, amounted to 6,000 liters of concentrated Botulinum and 8,425 liters of anthrax.<sup>12</sup>

### **Work on Clostridium Perfringens, Aflatoxin, and Ricin**

In addition, research was started at Al Salman on a number of other agents. In April, 1988, a gangrene causing agent known as clostridium perfringens was added to the list, followed a month later by Aflatoxin, which was produced by growing the fungus aspergillus. Other agents included a grain destroying fungus known as wheat cover smut, a deadly protein toxin called Ricin, and debilitating tricothecene Mycotoxins, such as T-2 and DAS. Iraq experimented with the infectivity of Clostridium Perfringens and infected a number of fields in the Mosul area with wheat smut to test its effectiveness as an agent.

Research into clostridium perfringens was transferred to Al-Hakam in 1989, and at least 90 gallons of the toxin were produced. The production of Aflatoxin moved to a plant at Fudaliyah where 1,850 liters were produced between April/May, 1990, and December, 1990. Work on the wheat cover smut moved to Mosul, but according to the Iraqis, the infected wheat necessary to propagate the fungus was burned at Fudaliyah in 1990.<sup>13</sup>

Ricin appeared the most promising of these agents, and ten liters of concentrate were prepared for weapons trials using 155 mm artillery shells. According to the Iraqis, these trials were failures and the project was discontinued.<sup>14</sup> Iraq, however, was later found to have conducted a crash program to harvest Castor Beans for the production of Ricin in late 1990. The resulting production has still never been accounted for, and there are indications that Iraq continued the program through 1997. Professor Shakir Akidid of Baghdad University is a British-trained biologist who is associated with the Ricin toxin program. UNSCOM attempted to interview him in April 1997, and he fled the building as they arrived, carrying papers that he claimed belong to his wife. This program was to be a topic for Iraqi-UNSCOM review during an inspection that was scheduled for November 11, 1997, but which was canceled because of the sanctions crisis.<sup>15</sup>

### **Mycotoxins, Haemorrhagic Conjunctivitis, Rotavirus, Yellow Fever Virus and Congo-Crimean Hemorrhagic Virus**

There have been some charges that Iraq has used Mycotoxins against its Kurdish population since early in the Iran-Iraq War that have never been confirmed.<sup>16</sup> Most of the examples and symptoms cited in such charges can be explained more easily by the poor sanitary and health conditions affecting the population in the area. Iraq is known to have experimented with

tricothene Mycotoxins in 1990, and its use of Mycotoxins or "Yellow Rain" weapons against the Kurds cannot be ruled out. Nevertheless, reports that the Iraqi secret service used Biological agents or Toxins to poison the food in Kurdish refugee camps in mid-1989, and produce 700 dead and 4,000 casualties, seem dubious. Iraq does not seem to have produced such agents until 1990, and it is unclear that it produced more than 20 milliliters for animal experimentation.<sup>17</sup>

In July, 1990, while Al-Hakam became the center of toxin production, Al Salman started to conduct research into at least 17 different viruses. It acquired the Foot and Mouth Disease Facility at Daura and subsequently isolated three viruses indigenous to Iraq for possible weapons use. The first was haemorrhagic conjunctivitis, which results in extreme pain and temporary blindness. This was followed by research into a debilitating rotavirus and the virus which causes camel pox. The initiation of this research, however, occurred only months before the eruption of the Gulf War, and the Iraqis have maintained that very little progress was achieved. Yellow Fever Virus and Congo-Crimean hemorrhagic virus were tested, but were reportedly rejected because they needed human vectors for dispersal.<sup>18</sup>

### **Shift to Emphasis on Weaponization**

Iraq also imported two spray dryers from the Niro Atomizer Company in Denmark in 1989, claiming that the dryers were going to be used for civilian nuclear research. The use of the dryers is unclear. One was installed at Al-Hakam as late as 1992 for what Iraq claimed was a civilian use. The other was found in a warehouse in Northern Iraq 1997, but had previously been cleaned and disassembled and it was not possible to estimate whether it had been used for weapons production purposes.

After Iraqís invasion of Kuwait, it accelerated its biological weapons program, and placed a strong emphasis on production and weaponization. The Daura Institute was converted from viral research to Botulinum production and subsequently produced 5,400 liters of concentrate between November, 1990, and January 15, 1991. During the same period, Al Hakamís fermenters were converted from Botulinum production to anthrax, while its older 150 liter fermenter was used to manufacture 340 liters of clostridium perfringens concentrate.<sup>19</sup>

In December, 1990, three of the biological agents -- Botulinum, Anthrax, and Aflatoxin - were selected for weaponization. One hundred R400 aerial bombs and 13 Al Husayn Scud warheads were filled with Botulinum, 50 bombs and 10 warheads were filled with anthrax, and 16 bombs and 2 warheads were weaponized with Aflatoxin. These weapons were subsequently dispersed to four different locations, where they remained through the war. The bombs were

deployed at two sites -- evidently dispersal runways for immediate use by aircraft that could suddenly land on the airstrip, recover a buried bomb, and then fly a strike mission. A total of 25 Scud missile warheads (13 with botulinum toxin, 10 with Aflatoxin, and two with anthrax ) were deployed to the field. Ten were stored in a deep railway tunnel and 15 in holes dug along the Tigris River.

In addition to warheads and aerial bombs, the Iraqis attempted to develop a drop tank for either manned aircraft or RPVs that would dispense up to 2,000 liters of anthrax. Trials are said to have been conducted in January, 1991, and the Iraqis contend that the tests were a failure. Nevertheless, Iraq maintained three of the drop tanks in a ready-to-use posture until July, 1991, when it says they were destroyed. Iraq has several hundred Italian crop sprayers fitted with nozzles for generating 1-um to 5-um aerosols of the kind that are optimal for biological warfare. There are unconfirmed reports that it also has remote-controlled, Japanese-made crop spraying helicopters.<sup>20</sup>

Some spray systems were installed on aircraft and land vehicles. One MiG-21 was modified for use as an remotely piloted vehicle, and equipped with a 2,200 liter belly tank from a Mirage F-1 and one of the sprayer systems. This system was tested with a simulated agent in January, 1991. Iraq also filled an unknown number of 122 mm rocket warheads with Botulinum, Aflatoxin, and a simulant. It claims, however, that these weapons were field tested before the Gulf War, and were not deployed in 1990-1991.<sup>21</sup>

To date, Iraq had admitted that it produced a stockpile of some 19,000 liters of concentrated Botulinum, 8,500 liters of anthrax, 2,220 liters of Aflatoxin, 340 liters of clostridium perfringens, and unknown quantities of various other biological agents by the end of the war.<sup>22</sup> Iraq admits that 10,000 liters of Botulinum were weaponized, as were 6,500 liters of Anthrax and 1,580 liters of Aflatoxin. Iraq also admits, however, that it imported some 39 tons of growth media before the Gulf War. Each ton of growth media can be used to produce 10 tons of biological weapons, and only 17 tons of this growth media are unaccounted for.<sup>23</sup> UNSCOM inspectors estimate that Iraqis production of Botulinum could be two to three times the amount Iraq claims, that it could have produced far more Anthrax, and has no way of accounting for its true production of Ricin.

## **Coalition Air Strikes Against Biological Weapons Facilities**

The disclosure of Iraqis massive biological weapons effort in 1996 has revealed that the US could do little more than guess at how to strike Iraqi biological warfare facilities and had no

idea that Iraq had successfully weaponized and deployed large numbers of biological weapons. The US did detect research activity at Salman Pak and Taji, and potential production facilities at al-Latifayah and abu Ghurayb, and that special refrigerated bunkers had been built throughout Iraq that might hold biological weapons. UN inspection efforts after the war found no evidence that any target that the Coalition struck during the war contained biological weapons. A number of US and foreign intelligence experts feel, however, that this was because intelligence did not detect the removal of most equipment, technology, and possibly weapons from the full range of sites during the war.<sup>24</sup>

The end result was that Coalition targeting information on Iraqis biological weapons was as inadequate as its targeting data on chemical weapons. While the full nature of the problems in the intelligence effort have never been declassified, it is clear that the Coalition could at best broadly identify the nature of a major facility without characterizing what was occurring in a given building, or accurately describing the function of the complex. US intelligence coverage of Iraqi biological warfare capability seems to have focused on a few facilities, but was otherwise largely speculative.

This inability to characterize Iraqi capabilities affected warfighting. The much publicized attack on an Iraqi infant formula plant is an example of a case where uncertainty alone justified the Coalition attack. It was necessary to attack the baby formula plant as a "suspect" plant because it had many facilities similar to a biological warfare plant, and adjoined a major military installation. While UN inspection did not find containment or biological warfare facilities at the plant, Iraq often failed to practice such precautions, and may have dispersed much of its biological warfare equipment before Desert Storm began. The plant had been a suspect site since 1983, and had a manned security post and a nine foot security fence. The Iraqi authorities had applied mottled camouflage to two confirmed biological warfare sites in December, 1990. They applied this same camouflage to the infant formula plant at the same time.<sup>25</sup>

This seems adequate reason to attack the plant. Yet, the Gulf War indicates that very hard evidence was needed to deal with the politics of such attack and public opinion. This raises major challenge for intelligence since similar "hard" evidence may be needed to justify attacking targets related to weapons of mass destruction if they are located in populated areas, have a sensitive "front", or have dual use or a cover as civilian facilities.

## **Iraqi Biological Capabilities After the Gulf War**

There is no way to determine whether Iraq now has significant stocks of dry, storable biological agents. Robert Gates, Director of Central Intelligence in the Bush Administration, made this point as early as January, 1992. He responded to questions about Iraqís biological weapons effort by stating that "...the biological weapons program was also damaged, but critical equipment for it, too, was hidden during the war." He went on to note that Iraq could produce biological agents within "a matter of weeks," once the UN sanctions and constant intrusive UNSCOM challenge inspections ended.<sup>26</sup>

### **Total Production of Biological Agents and Toxins**

Some things are clear. The Iraqi government has admitted that it had at least five primary production facilities for biological weapons at the time of the Gulf War, including the Sepp Institute at Muthanna, the Ghazi Research Institute at Amaria, the Daura Foot and Mouth Disease Institute, and facilities at Al-Hakam, Salman Pak and Taji.

Iraq has also admitted that it manufactured 6,000 liters of concentrated Botulinum toxin and 8,425 liters of Anthrax at Al-Hakam alone during 1990. Iraq has admitted that it has manufactured 400 liters of concentrated Botulinum toxin at Taji, 150 liters of concentrated Anthrax at Salman Pak, and 1,850 liters of Aflatoxin in solution at Fudaliyah. Iraq has admitted it manufactured a number of agents it claimed it did not weaponize, although some were extensively tested.

It has admitted that it produced 5,400 liters of concentrated Botulinum toxin at the Daura Foot and Mouth Disease Institute from November 1990 to January 15, 1991, and there are some indications that it may have attempted to produce a variant of hoof and mouth disease for military purposes.<sup>27</sup>

### **Total Production of Actual Weapons**

The Iraqi governmentís admissions in the fall of 1995 have provided another indication of the massive scale of Iraqís massive weapons production effort. Iraqís known weaponization programs consist of at least 182 bombs and 25 missile warheads. Three of the bombs have been recovered largely intact and parts have been found for 23 more, but the rest are unaccounted for. At least some of the missile warheads are large components that are three feet wide and 10 feet long, which could hold up to 40 gallons, and which could be used by the Al Hussein missile at ranges up to 400 miles.<sup>28</sup>

There is no way to estimate Iraqís total weapons production with any precision, but various UNSCOM reports have described holdings of:

- 166 bombs loaded with Botulinum.
- 50 R-400 air-delivered bombs loaded with anthrax.
- 10 anthrax-loaded missile warheads for the Al Husayn missile.
- 15 Al Husayn missile warheads loaded with Botulinum.
- 16 missile warheads loaded with Aflatoxin, a natural carcinogen. These warheads were designed for operability with the Al Husayn Scud variant, and were loaded in December, 1990, for possible use during the Gulf War.<sup>29</sup>
- Field trials, weaponization tests, and live firings of 122 mm rockets armed with Anthrax and Botulinum toxin (carried out during March 1988 to May 1990).<sup>30</sup>
- Bombs, 122 mm rockets, and artillery shells filled with 10,000 liters of concentrated Botulinum toxin, and at least 1,580 liters of concentrated Aflatoxin.<sup>31</sup>
- Spray tanks prepared for use by helicopters, aircraft, or UAVs.
- Development of a 2,000 liter aircraft or RPV drop tank designed to dispense anthrax. While Iraq claims that its test on the drop tank was a failure, it stored three of them in a ready to use posture during the Gulf War.<sup>32</sup>

These Iraqi admissions are not supported by adequate records, evidence, or testimony. The details of each of these Iraqi production efforts remain uncertain. Furthermore, these same uncertainties apply to the disposition of the weapons and munitions that Iraq could fill with biological agents. The Iraqi government still claims that it took all of its biological bombs to an airfield at some point during May-June 1991, in order to use a chemical agent to deactivate them, and then to have explosively destroyed and burned them. The Iraqi government claims that it did the same with its missile warheads at a different site.

The Iraqi government has also said, however, it has no record of the precise dates it carried out such destruction, or even the sites. It took UN inspectors to one site that had no evidence of such destruction, and then changed its story and claimed it could no longer find the site. The Iraqi government also claims to have used such procedures to destroy about 8,000 liters

of concentrated Botulinum, over 2,000 liters of concentrated Anthrax, 340 liters of concentrated perfringens, and an unspecified amount of Aflatoxin that was stored at Al Hakam.<sup>33</sup>

This inability to determine which agents Iraq did or did not destroy presents the risk that Iraq may have retained lethal agents after the Gulf War, as well as the ability to manufacture them. Anthrax spores are extremely hardy and can achieve 65% to 80% lethality against untreated patients for years. Fortunately, Iraq does not seem to have produced dry, storable agents and only seems to have deployed wet Anthrax agents, which have a relatively limited life. Aflatoxin may be storable, but it is not particularly lethal, and the fact it is a carcinogen does not mean that it could produce a significant increase in the rate of cancer in human beings exposed to weaponizable amounts. Botulinum toxin is normally stored in solution. The shelf-life and lethality of Iraqi weapons is unknown, but it seems likely that the shelf-life was limited. In balance, it seems probable that any agents Iraq retained after the Gulf War now have very limited lethality, if any.<sup>34</sup>

## **UNSCOM versus Iraq, and the "War of the Sanctions"**

The problems raised by biological weapons also differ from those relating to chemical and nuclear weapons because the size of Iraq's effort was only detected a half a decade after the Gulf war. Iraq presented six versions of its supposed "full, final, and complete disclosure" (FFCD) regarding biological weapons. The first declaration was made in 1991, and was a few pages long. It did little more than deny the existence of any biological weapon program and proscribed biological activities. This position was maintained in all Iraqi FFCDs through March 1995.

### **The Discovery of the True Scale of Iraq's Program in 1995**

It was only after Hussein Kamel defected in 1995, that UNSCOM became aware of the advanced state of Iraq's biological warfare program. Rolf Ekeus has stated as much in an August, 1995, press interview, "I probably did underestimate the biological program."<sup>35</sup> In an October, 1995, report to the UN Security Council, Mr. Ekeus described the advances achieved in Iraq's biological weapons program as "remarkable."<sup>36</sup>

Iraq did destroy some of the biological warfare facilities whose existence had become public in 1995, and allowed the UN to inspect some of the sites where weapons had been destroyed -- where UNSCOM found some biological bombs "virtually intact." Nevertheless, Iraq would not allow UN teams to collect soil samples from the locations where Iraq had claimed it had destroyed its biological weapons. Key Iraqi personnel were not made available, and Iraq did not attempt to resolve many of the inconsistencies in its declarations.<sup>37</sup>

It also became apparent that Iraq's new disclosures told only part of the story. Although the Iraqi government released some 688,000 pages of new documentation after Hussein Kamel defected, it did so under conditions where it claimed the documents had been hidden in a chicken coop and were only found after Hussein Kamel defected. In fact, the documents were spotless and had clearly been moved to the area days before the UNSCOM teams were notified of their existence. These documents are very general, and Iraq seems to have held back most documentation that would reveal the level of sophistication it has achieved, data on any current suppliers, and data that might reveal the development of its program since 1991.<sup>38</sup>

Iraq repeatedly asserted that it destroyed all of its agents after the war, but it still failed to provide any documentation to verify such an action. The inconsistency of these Iraqi assertions regarding the destruction of biological weapons led UNSCOM to state in October 1995 that, "...it does not believe that Iraq has given a full and correct account of its biological weapons program."<sup>39</sup>

### **Lies in Iraq's FFCDs**

This pressure from UNSCOM pressure forced Iraq to issue a completely new FFCD in November 1995. The new draft was seriously flawed, however, and resulted in new drafts in March and May 1996. This helps explain why Rolf Ekeus warned that UNSCOM inspectors believed that Iraq might still have 16 operational Scud variants with biological warheads that Iraq kept moving around Iraq to evade inspection during his testimony to the US Congress on March 20, 1996.<sup>40</sup>

These challenges led Iraq to provide yet another FFCD on June 22, 1996. Although it was 622 pages long, the new FFCD proved to be little more than a copy of the May draft. Further, Iraq actively blocked the efforts of the UN inspection team to verify the contents of the new draft during a visit in July and forced the delay of a visit in August.<sup>41</sup> UNSCOM was able to find a concealed biological laboratory in Tuwaitha and critical undeclared pieces of dual-use equipment in spite of Iraq's efforts. However, inventory tags repeatedly disappeared from tagged equipment, and Iraq found many other ways to delay or block the UNSCOM effort.<sup>42</sup>

It is not surprising, therefore, that UNSCOM summarized the situation as follows in late 1996:<sup>43</sup>

The current assessment is that the biological FFCD as written is not credible. Major sections are incomplete, inaccurate, or unsubstantiated. Biological warfare agent production figures are unsupported for the years 1987, 1988, and 1989. Expert

estimates of production quantities of biological weapons agents, either by equipment capacity or by consumption of growth media, would far exceed declared amounts. Data on weapons field trials are inaccurate. Weapons agent destruction is undocumented. A lack of documentation to substantiate declarations on the critical areas of biological warfare agent and munitions production, weaponization and destruction, is difficult to accept. Until Iraq is able to provide a full accounting of biological weapons produced and destroyed unilaterally, the Commission cannot report that such weapons and their components do not remain.<sup>44</sup>

By March 1997, UNSCOM's problems with Iraq had become so serious that UNSCOM called together an international panel of experts to examine Iraq's claims. This panel concluded that,<sup>44</sup>

...Iraq had failed to report all imports of equipment and materials, in particular growth material. It had underreported the production of bulk biological warfare agents. The stated production of Aflatoxin could not have happened as declared. The declarations on destruction was not supported by sufficient evidence and it failed to provide a fully accounting of procurement activities for the biological weapons program.<sup>44</sup>

Nevertheless, Iraq continued to ask UNSCOM to accept its verbal assurances that it destroyed warheads and weapons that include some 500,000 liters of botulism agent and 50,000 liters of anthrax. Iraq's Deputy Prime Minister Tariq Aziz reiterated this position on April 23, 1997, in spite of the fact that UNSCOM had declared it could not determine the status of Iraq's biological weapons programs, missile warheads, or bombs.<sup>45</sup>

Although UNSCOM was monitoring some 86 sites with resident biological weapons teams in April 1997, the Secretary General of the UN had just reported to the Security Council that several pieces of significant undeclared equipment, spare parts, and supplies were discovered in recent inspections of additional facilities, and that, Iraq has still not declared all sites where dual-use equipment is present. The Commission's resident team continues to identify such sites that should have been declared by Iraq...On a number of occasions, Iraq did not produce the required information on changes that have been uncovered (in key sites).<sup>46</sup>

### **Issues Unaddressed in Late 1997**

This intransigence led the Security Council to threaten further sanctions on June 21, 1997. This threat came at a time when Iraq was already experiencing serious difficulties in selling oil under the terms of UNSCR 986, and seems to have had some effect. Richard Butler,

Rolf Ekeus's replacement, visited Baghdad in late August, 1997, and Deputy Prime Minister Tariq Aziz agreed that Iraq would make yet another full and frank disclosure of its biological weapons effort. These politics, however, scarcely resolved the issue. Butler talked about receiving up to 800 pages of new material from the Iraqis, reporting to the Security Council in October, and visiting Baghdad again in November. It was obvious that the game would continue.<sup>47</sup>

Nevertheless, things did not improve. In October, 1997, UNSCOM reported that,

“Until July, 1995, Iraq totally denied it had any offensive biological warfare program. Since then, Iraq has presented three versions of FFCDS and four drafts.” The most recent FFCDS was presented by Iraq on 11 September 1997. This latest submission followed the Commission's rejection, in April 1997, of the previous FFCDS of June 1996

“...In the period since that report, the Commission conducted eight inspections in an attempt to investigate critical areas of Iraq's proscribed activities such as warfare agent production and destruction, biological munitions manufacturing, filling and destruction, and military involvement in and support to the proscribed program. Those investigations, along with documents and other evidence available to the Commission, confirmed the assessment that the June 1996 declaration was deeply deficient....

“The new FFCDS, received on 11 September 1997, contains fewer errata and is more coherent. However, with regard to the important issues...the report contains no significant changes from the June 1996 FFCDS. ...the Commission's questions are rephrased to in order to avoid having to produce direct answers, or are answered incompletely, or are ignored completely...Little of the information the Commission has gathered since June 1996 has been incorporated into the new document.”<sup>48</sup>

UNSCOM also reported that Iraq had never provided a clear picture of the role of its military in its biological warfare program, and had claimed it only played a token role. It had never accounted for its disposal of growth media. “Media unaccounted for is sufficient, in quantity, for the production of over three times more of the biological agent -- Anthrax -- stated by Iraq to have been produced...Bulk warfare agent production appears to be vastly understated by Iraq...Experts calculations of possible agent production quantities, either by equipment capacity or growth media amounts, far exceed Iraq's stated results....Significant periods when the fermenters were claimed not to be utilized are unexplained.”<sup>49</sup>

Iraqis accounting for its Aflatoxin and Ricin production still was not credible. Biological warfare field trials were underreported and inadequately described. Claims regarding field trials of chemical and biological weapons using R400 bombs were contradictory and indicated that, more munitions were destroyed than were produced. No documentation was provided on munitions filling. The account of Iraqis unilateral destruction of bulk biological agents is incompatible with the facts...The Commission is unable to verify that the unilateral destruction of the BW-filled Al Hussein warheads has taken place.<sup>50</sup> There was no way to confirm whether Iraq destroyed 157 bombs of the R400 type, some of which were filled with Botulin or anthrax spores.<sup>51</sup>

In summary, UNSCOM concluded that, "The September 1997 FFCD fails to give a remotely credible account of Iraqis biological program. This opinion has been endorsed by an international panel of experts."<sup>52</sup>

## **The Continuing Uncertainties Regarding Iraqis Biological Weapons Efforts**

Biological weapons rival VX gas as the most serious near-term threat Iraq can pose to its neighbors and US power projection forces. Iraq has had ample time to redistribute the equipment, personnel, and technology used to produce biological weapons since the Gulf War, and there is no way to know how many of Iraqis assets survived the war. While some of Iraqis biological weapons production facilities were damaged during the Gulf War, much of their equipment may have been dispersed before or during the war, and Coalition intelligence and bombers missed key facilities like the one at Al-Hakam.<sup>53</sup>

### **The Inherent Limits to UNSCOM Efforts**

It is also unclear how much of Iraqis equipment and material can be traced to known facilities. The Iraqi government admits it had imported extensive amounts of equipment and materials suitable for biological weapons production before the war -- largely from Europe. These imports have not yet been accounted for in any detail, and there is no way to know how many have been dispersed or have been used since the Gulf War in undeclared facilities. Iraqis imports also included tons of growth media for biological agents, which were obtained from three European firms. According to UNSCOM, 17 tons of these media remain unaccounted for. Further, Iraq imported a wide range of type cultures, which can be modified to develop biological weapons, and some came from the US.<sup>54</sup>

UNSCOM has noted some of the technical problems this presents in its reports:<sup>55</sup>

ì...for the monitoring system to be effective, it must cast a broad net and cover major facilities such as petrochemical and pesticide plants where chemical and biological warfare agents could be produced. However, such agents can also be clandestinely produced by Iraq in such facilities as breweries, brake fluid factories, and even university microbiology laboratories containing dual use equipment.î

Similarly, there is no way to be certain exactly what agents Iraq examined before the war, or has examined since. Outside experts add tularemia and typhoid agents to the list of agents Iraq has examined. Iraqís declarations admit to conducting research on a Mycotoxin similar to the ìyellow rainî defoliant. Iraq examined a wide range of viruses, bacteria, and fungi. It examined the possibility of weaponizing gas gangrene and other Mycotoxins, and some field trials were held of these agents. It also examined the use of haemorrhagic conjunctivitis virus, rotavirus, and camel pox virus.<sup>56</sup>

### **What Iraq May Retain**

This means that UNSCOM may never be able to determine the exact types of biological weapons Iraq did or did not develop, how much it modified them before the Gulf War, how well it weaponized them, or what it has done covertly in the five years since the Gulf War ended. Table One provides a comprehensive list of weapons that Iraq may have examined. It is important to stress that all pre-production research, testing, and weaponization for many of these weapons could be conducted in small covert facilities that have been established since the Gulf War.

At least one Iraqi defector -- General Wafic al-Sammara, a former senior officer in Iraqi military intelligence has claimed that Iraq, ìretains 255 containers of biological warfare materials -- 230 with powder, which has no expiry date, and 25 with liquid, which will deteriorate over time.î<sup>57</sup>

British, French, German, Swiss, US, and UNSCOM experts are aware of ongoing Iraqi import efforts that seemed to be designed to produce biological weapons, and most experts believe that Iraq has created the same highly secret and compartmented program to carry on with its biological weapons program after the Gulf War that it created for its missile, chemical warfare, and nuclear programs.

Such an Iraqi program is particularly difficult to trace since all key components are dual use items that can be used for peaceful medical purposes and food processing and include everything from bio-medical equipment and micro-encapsulation equipment for cold tablets to brewery fermenters and dry food storage equipment for infant formula. Both Iraqís research and production efforts can be widely dispersed and can be concealed in relatively small buildings -- particularly if a government is willing to take moderate risks of contamination of the kind widely taken by the Soviet Union during the Cold War.

At this point, only another series of major defections is likely to reveal the full details of Iraqís accomplishments before 1991, or what it has done covertly since that time. At least one of the principal UNSCOM investigators of the Iraqi biological weapons program feels that no effort by UNSCOM can prevent Iraq from retaining a major biological weapons effort and resuming production and deployment within months of the end of the UNSCOM effort.

### **The Limits of Arms Control and Future Inspection**

Further, most experts agree that even if the UN could account for all growth media, cultures, and Iraqís overt biological weapons production facilities at the time of the Gulf War, Iraq could rapidly establish new covert production at university research centers, medical goods and drug manufacturing plants, or virtually any other facility that can maintain a secure biological research and production activity.

There is no current arms control treaty that could even begin to replace UNSCOM. The Biological Weapons Convention (BWC) has no enforcement provisions to parallel those of the Chemical Weapons Convention (CWC) and Nuclear Non-Proliferation Treaty (NPT). Although 136 countries have adhered to the BWC since it was agreed to in 1972, the US has not completed drafting a protocol on a possible enforcement regime -- in part because it is clear that an enforcement regime would have to be far more complex and intrusive than those now used to enforce the NPT and that even the most intrusive regime might be unworkable. There simply are too many types of dual-use biological research and production facilities that could suddenly be converted to making biological weapons and there is no way to clearly distinguish between legitimate research and weapons research.<sup>58</sup>

## **The Warfighting Effectiveness of Iraqís Future Biological Weapons**

Any covert stockpile of highly lethal biological weapons would give Iraq considerable potential to deter and intimidate the Southern Gulf states and the West. Iraq could make use of biological weapons in much the same way as chemical weapons. Iraq could also employ such weapons covertly, since they lend themselves to tailored attacks in terms of delay effects and are well suited to unconventional warfare, or terrorism. Biological weapons are Iraqís only near-term answer to the effectiveness of the UNís inspection and destruction regime of Iraqís far more visible nuclear, chemical and missile capabilities. Given Iraqís history, this makes biological weapons an option that Iraq is likely to choose.

### **Possible Advances in Iraqís Biological Weapons Since 1990**

There is no reason to believe that Iraq has not taken advantage of the war of the sanctions, and the years since the Gulf War. Iraq has probably retain some portion of the biological weapons that it produced at the time of the Gulf War, and has had ample opportunity to create small clandestine production programs or cells and/or to develop a program for rapidly reassembling production capabilities using dual-use items the moment UNSCOM inspection is halted. As a result, Iraq almost certainly retains some capability to deliver the kind of moderately lethal weapons it has at time of the Gulf War.

It is doubtful that any of Iraqís biological weapons -- particularly its missile warheads -- that date back to the Gulf War era can take full advantage of the lethality of the biological agents they carry. While the details of these weapon designs have not been disclosed, Iraqís chemical weapons were relatively unsophisticated and it seems doubtful that its biological weaponization programs were more advanced. Most of Iraqís pre-war weapons designs were rushed into service, and it seems likely that Iraqís missiles, bombs, and warheads were unreliable and inefficient in disseminating biological agents.

At the same time, Iraq has had well over half a decade to solve the technical challenges in the weaponization and deployment of more lethal munitions and warheads. It may well have developed advanced dry storable agents, and solved the problems of microencapsulation, dissemination at critical heights, and predictions of wind and temperature over the target area. Some of UNSCOMís discoveries -- like the new glassware production equipment in found between April and October 1997 -- indicate that Iraq has developed more biological lethal weapons, improved their storability and resistance to heat and light, and improved the design of its bombs and other dissemination devices

The ìterrorî effect of even crude and inefficient biological warheads cannot be dismissed. UAVs and slow flying civilian aircraft make excellent delivery systems for such weapons, require minimal amounts of advanced technology, do not produce major indications of testing and development, and are inherently difficult to detect and track to a given source and location. Furthermore, the potential consequences of even inefficient dissemination of biological weapons can be disastrous. The amount of Anthrax in the 10 missile warheads that Iraq had filled at the time of the Gulf War had the theoretical ability to kill some 60,000,000 people, while the Botulinum in the remaining 15 missile warheads could have contaminated an area of over 21,000 square kilometers.<sup>59</sup>

Iraqís is likely to have its most serious problems in designing and testing effective missile warheads. There are some experts that question whether Iraq can meet the challenge of developing a suitable combination of biological weapons and compatible warhead technology, and can develop a missile warhead that would achieve extremely high lethalties. Iraq, however, had a decade to work on this problem before the Gulf War and the UNSCOM effort has not been designed to prevent substantial additional further research and development since the war.<sup>60</sup>

A successful weaponization of highly lethal biological weapons with the lethality of theater nuclear weapons could give Iraq major political and strategic advantages in terms of both warfighting and intimidation. It would give Iraq the potential ability to deploy a force rapidly that could be used covertly in ìterrorismî, or used offensively, under launch-on-warning and launch-under-attack conditions, and/or in a retaliatory mode. Such weaponization could provide Iraq with the ability to launch strikes whose political impact is out of all proportion to their direct military value. The use of toxins or persistent biological agents, like anthrax, could achieve significant military effects or population damage. Such potential results could prompt Iraq to take the risk of using an agent that was a communicable disease, rather than military agents which require direct exposure to the original payload, or which are tailored to control their infectiousness.

Iraq has also shown that it is prepared to use biological weapons at both the strategic and tactical level. Iraq dispersed biological weapons to at least four sites in January, 1991, for use during the Gulf War. According to Iraqi sources, the commanders at these main storage sites were given authority in January, 1991, to use these weapons in the case of a devastating attack on Baghdad, and the collapse of the Iraqi command and control system. This release authority was granted in order to ensure that Iraq had a retaliatory capability. The release authority seems to have applied to massive conventional attack on Baghdad, as well as a nuclear attack, and may have applied to a successful attack on Iraqís leadership.<sup>61</sup>

Table OneKey Biological Weapons that Iraq May Have Examined: Part One

<u>Disease</u>	<u>Infectivity</u>	<u>Transmissibility</u>	<u>Incubation Period</u>	<u>Mortality</u>	<u>Therapy</u>
<u>Viral</u>					
Chikungunya fever	high	none	2-6 days	very low (-1%)	none
Dengue fever	high	none	5-2 days	very low (-1%)	none
Eastern equine encephalitis	high	none	5-10 days	high (+60%)	developmental
Tick borne encephalitis	high	none	1-2 weeks	up to 30%	developmental
Venezuelan equine encephalitis	high	none	2-5 days	Low (-1%)	developmental
Hepatitis A	-	-	15-40 days	-	-
Hepatitis B	-	-	40-150 days	-	-
Influenza	high	none	1-3 days	usually low	available
Yellow fever	high	none	3-6 days	up to 40%	available
Smallpox (Variola)	high	high	7-16 days	up to 30%	available
<u>Rickettsial</u>					
Coxiella Burneti (Q-fever)	high	negligible	10-21 day	Low (-1%)	antibiotic
Mooseri	-	-	6-14 days	-	-
Prowazeki	-	-	6-15 days	-	-
Psittacosis	high	moderate-high	4-15 days	Mod-high	antibiotic
Rickettsi (Rocky mountain spotted fever)	high	none	3-10 days	up to 80%	antibiotic
Tsutsugamushi	-	-	-	-	-
Epidemic typhus	high	none	6-15 days	up to 70%	antibiotic/ vaccine
<u>Bacterial</u>					
Anthrax (pulmonary)	mod-high	negligible	1-5 days	usually fatal	antibiotic/ vaccine
Brucellosis	high	none	1-3 days	up to 25%	antibiotic
Cholera	low	high	1-5 days	up to 80%	antibiotic/ vaccine
Glanders	high	none	2-1 days	usually fatal	poor antibiotic
Meloidosis	high	none	1-5 days	usually fatal	moderate antibiotic
Plague (pneumonic)	high	high	2-5 days	usually fatal	antibiotic/ vaccine

Table OneKey Biological Weapons that Iraq May Have Examined: Part Two

<u>Disease</u>	<u>Infectivity</u>	<u>Transmissibility</u>	<u>Incubation Period</u>	<u>Mortality</u>	<u>Therapy</u>
Tularemia	high	negligible	1-10 days	low to 60%	antibiotic/ vaccine
Typhoid fever	mod-high	mod-high	7-21 days	up to 10%	antibiotic/ vaccine
Dysentery	high	high	1-4 days	low to high	antibiotic/ vaccine
Fungal					
Coccidioidomycosis	high	none	1-3 days	low	none
Coccidioides Immitis	high	none	10-21 days	low	none
Histoplasma Capsulatum	-	-	15-18 days	-	-
Nocardia Asteroides	-	-	-	-	-
<u>Toxins<sup>a</sup></u>					
Botulinum toxin	high	none	12-72 hours	high neromusc- lar paralysis	vaccine
Mycotoxin	high	none	hours or days	low to high	?
Staphylococcus	moderate	none	24-48 hours	incapacitating	?

a. Many sources classify as chemical weapons because toxin are chemical poisons.

Source: Adapted by Anthony H. Cordesman from Report of the Secretary General, Department of Political and Security Affairs, Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use, New York, United Nations, 1969, pp. 26, 29, 37-52, 116-117; Jane's NBC Protection Equipment, 1991-1992; James Smith, "Biological Warfare Developments," Jane's Intelligence Review, November, 1991, pp. 483-487.

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<sup>1</sup> Office of the Secretary of Defense, Proliferation: Threat and Response, Washington, Department of Defense, April 1996, pp. 17-24.

<sup>2</sup> Arms Control Today, April 1993, p. 29.

<sup>3</sup> Eliot Cohen, ed., Gulf War Air Power Survey, Volume II, Part II, p. 327.

<sup>4</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, p. 20; Washington Post, July 6, 1995, p. A-17.

<sup>5</sup> For a range of sources on Iraqi capabilities, see the long series of UNSCOM reports on Iraqis programs, Raymond A. Zilinskas, Iraqis Biological Weapons, Journal of the American Medical Association, Vol. 278, No. 6, August 6, 1997, pp. 418-425; Anthony H. Cordesman, Weapons of Mass Destruction in the Middle East, Westview, Boulder, 1992; Anthony. Cordesman and Ahmed Hashim, Iraq: Sanctions and Beyond, Westview, Boulder, 1997; New York Times, December 30, 1992; Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 16-19; Andrew Terril, "Chemical Weapons in the Gulf War," Strategic Review, Spring, 1986; Washington Times, January 19, 1989, p. A-6; January 27, 1989, p. A-2; Baltimore Sun, August 19, 1990, p. 5E; Leonard Spector, Proliferation Today, New York, Vintage Books, 1984; Arms Control Today, April, 1992, pp. 7-8.

<sup>6</sup> Interviews with UNSCOM personnel; R. Jeffery Smithg, Iraqis Drive for a Biological Arsenal, Washington Post, November 21, 1997, p. A-1; Washington Times, November 24, 1997, p. A-12.

<sup>7</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, p. 22; Interviews with UNSCOM personnel; R. Jeffery Smithg, Iraqis Drive for a Biological Arsenal, Washington Post, November 21, 1997, p. A-1; Washington Times, November 24, 1997, p. A-12.

<sup>8</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, p. 22; Interviews with UNSCOM personnel; R. Jeffery Smithg, Iraqis Drive for a Biological Arsenal, Washington Post, November 21, 1997, p. A-1; Washington Times, November 24, 1997, p. A-12.

<sup>9</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, p. 22; Interviews with UNSCOM personnel; R. Jeffery Smithg, Iraqis Drive for a Biological Arsenal, Washington Post, November 21, 1997, p. A-1; Washington Times, November 24, 1997, p. A-12.

<sup>10</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, p. 23; Interviews with UNSCOM personnel; R. Jeffery Smithg, Iraqis Drive for a Biological Arsenal, Washington Post, November 21, 1997, p. A-1; Washington Times, November 24, 1997, p. A-12..

<sup>11</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, pp. 25-26; Interviews with UNSCOM personnel; R. Jeffery Smithg, Iraqis Drive for a Biological Arsenal, Washington Post, November 21, 1997, p. A-1; Washington Times, November 24, 1997, p. A-12.

<sup>12</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, pp. 23-24; Interviews with UNSCOM personnel; R. Jeffery Smithg, Iraqis Drive for a Biological Arsenal, Washington Post, November 21, 1997, p. A-1; Washington Times, November 24, 1997, p. A-12.

<sup>13</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, pp. 24-25.

<sup>14</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, pp. 24-25.

<sup>15</sup> Washington Post, November 21, 1997, p. A-1.

<sup>16</sup> Many sources classify mycotoxins as chemical poisons. Unfortunately, mycotoxins have become one of those weapons that are popular with journalists or propagandists seeking to sensationalize a given conflict, and countries are often accused of using mycotoxins in cases where ambiguous symptoms are present. Iran has also been accused of producing and using mycotoxins.

<sup>17</sup> Task Force on Terrorism and Unconventional Warfare, Chemical Weapons in The Third World: 2. Iraq's Expanding Chemical Arsenal, House Republican Research Committee, US House of Representatives, May 29, 1990, p. 12; Wiener Zeitung, June 25, 1989.

<sup>18</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, p. 25.

<sup>19</sup> United Nations Special Commission, Report to the Security Council - S/1995/864, 11 October 1995, p. 26; Raymond A. Zilinskas, Iraqis Biological Weapons, Journal of the American Medical Association, Vol. 278, No. 6, August 6, 1997, pp. 418-425.

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- <sup>20</sup> United Nations Special Commission, "Report to the Security Council - S/1995/864," 11 October 1995, pp. 26-27; Raymond A. Zilinskas, "Iraqis Biological Weapons," Journal of the American Medical Association, Vol. 278, No. 6, August 6, 1997, pp. 418-425.
- <sup>21</sup> United Nations Special Commission, "Report to the Security Council - S/1995/864," 11 October 1995, pp. 26-27; Raymond A. Zilinskas, "Iraqis Biological Weapons," Journal of the American Medical Association, Vol. 278, No. 6, August 6, 1997, pp. 418-425.
- <sup>22</sup> Some reports indicate 3,117 gallons of Botulinum toxin and 2,265 gallons of Anthrax.
- <sup>23</sup> Jane's Defense Weekly, January 3, 1996, p. 19.
- <sup>24</sup> Eliot Cohen, ed., Gulf War Air Power Survey, Volume I, Part II Washington, GPO, 1993, pp. 242-254, and Volume II, Part II, p. 326.
- <sup>25</sup> Interviews and "Intelligence Success and Failures in Operations Desert Shield and Desert Storm," Subcommittee on Oversight and Investigations, US House of Representatives, 103rd Congress, 1st Session, August, 1993, pp. 37-39.
- <sup>26</sup> The Atlanta Constitution, January 16, 1992, p. 1.
- <sup>27</sup> Interviews with UN personnel and UN Security Council; Note by the Secretary General, S/1995/864, 11 October, 1995.
- <sup>28</sup> Washington Post, November 21, 1997, p. A-1.
- <sup>29</sup> New York Times, August 26, 1995, p. 3; Washington Post, August 26, 1995, p. A-1.
- <sup>30</sup> Policywatch, Number 175, November 20, 1995; UN Security Council, Note by the Secretary General, S/1995/864, 11 October, 1995.
- <sup>31</sup> UN Security Council, Note by the Secretary General, S/1995/864, 11 October, 1995.
- <sup>32</sup> Jane's Defense Weekly, November 11, 1995, p. 4.
- <sup>33</sup> UN Security Council, Note by the Secretary General, S/1995/864, 11 October, 1995, p. 27.
- <sup>34</sup> Raymond A. Zilinskas, "Iraqis Biological Weapons," Journal of the American Medical Association, Vol. 278, No. 6, August 6, 1997, pp. 418-425.
- <sup>35</sup> Washington Times, August 30, 1995, p. A-10.
- <sup>36</sup> Reuters Ltd., October 11, 1995.
- <sup>37</sup> United Nations, Note by the Secretary General, S/1997/301, April 11, 1997, pp. 16-17.
- <sup>38</sup> Interviews with UN personnel.
- <sup>39</sup> United Nations Special Commission, "Report to the Security Council - S/1995/864," 11 October 1995, pp. 27-28.
- <sup>40</sup> Jane's Defense Weekly, April 10, 1996, p. 15.
- <sup>41</sup> UN Security Council, Note by the Secretary General, S/1996/848, 11 October, 1996, pp. 22-24.
- <sup>42</sup> UN Security Council, Note by the Secretary General, S/1996/848, 11 October, 1996, pp. 22-24.
- <sup>43</sup> UN Security Council, Note by the Secretary General, S/1996/848, 11 October, 1996, p. 24.
- <sup>44</sup> United Nations, Note by the Secretary General, S/1997/301, April 11, 1997, p. 17.
- <sup>45</sup> Reuters, April 23, 1997, 05:43; United Nations, Note by the Secretary General, S/1997/301, April 11, 1997, pp. 16-17.
- <sup>46</sup> United Nations, Note by the Secretary General, S/1997/301, April 11, 1997, p. 17.
- <sup>47</sup> Reuters, August 26, 1997, 0717, September 9, 1997; September 10, 1997, 1954.
- <sup>48</sup> Note by the Secretary General, "Report of the Secretary-General on the Activities of the Special Commission," S/1997/774, October 6, 1997, paragraphs 69-72, Annex 2.
- <sup>49</sup> Note by the Secretary General, "Report of the Secretary-General on the Activities of the Special Commission," S/1997/774, October 6, 1997, paragraphs 74-76, Annex 2.
- <sup>50</sup> Note by the Secretary General, "Report of the Secretary-General on the Activities of the Special Commission," S/1997/774, October 6, 1997, paragraphs 79-80, Annex 2.
- <sup>51</sup> Note by the Secretary General, "Report of the Secretary-General on the Activities of the Special Commission," S/1997/774, October 6, 1997, paragraphs 81-82.
- <sup>52</sup> Note by the Secretary General, "Report of the Secretary-General on the Activities of the Special Commission," S/1997/774, October 6, 1997, paragraph 83.
- <sup>53</sup> Washington Post, July 6, 1995, p. A-17.

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<sup>54</sup> Confirmed by interviews with UN and US State Department personnel. Also see UN Security Council, Note by the Secretary General, S/1995/284, April, 1995.

<sup>55</sup> United Nations, Note by the Secretary General, S/1997/301, April 11, 1997, p. 8.

<sup>56</sup> Washington Post, August 26, 1995, p. A-1.

<sup>57</sup> Janeís Pointer, September, 1996, p. 6.

<sup>58</sup> Christian Science Monitor, May 21, 1997, p. 3; Janeís Defense Weekly, June 25, 1997, p. 6; Brad Roberts, Terrorism with Chemical and Biological Weapons. Calibrating Risks and Responses, Alexandria, Chemical and Biological Weapons Control Institute, 1997

<sup>59</sup> Calculated based on estimates from the Office of Technology Assessment as cited in Newsweek, September 4, 1995, p. 34, and figures provided by the Pentagon as cited in Time, September 4, 1995, p. 41.

<sup>60</sup> After the Storm: The Changing Military Balance in the Middle East, Boulder, Westview, 1993; working material on biological weapons prepared for the United Nations, Office of Technology Assessment, Proliferation of Weapons of Mass Destruction: Assessing the Risks, United States Congress OTA-ISC-559, Washington, DC, August, 1993; Kenneth R. Timmerman, Weapons of Mass Destruction: The Cases of Iran, Syria, and Libya, Simon Wiesenthal Center, Los Angeles, August, 1992; Dr. Robert A. Nagler, Ballistic Missile Proliferation: An Emerging Threat; Systems Planning Corporation, Arlington, 1992; and translations of unclassified documents on proliferation by the Russian Foreign Intelligence Bureau.

<sup>61</sup> UN and US experts commenting on the evidence to date. No clear documentation is available to define the scope of Iraqi release authority.