THE IRAN-IRAQ WAR:

GAS WARFARE AND THE PROSPECTS FOR THE USE OF NUCLEAR WEAPONS

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The Iran-Iraq War has cost over one million lives. It is the bloodiest war in modern history, and it has set precedents that may haunt the world for generations to come. Although it may now be ending in lasting ceasefire or peace settlement, both Iran and Iraq began to make extensive use of gas warfare towards the end of the conflict. They engaged in a missile war against civilians and cities, and both have revitalized their effort to develop nuclear systems.

As a result, the Iran-Iraq War provides important insights both into the impact of gas warfare and the prospects for the proliferation of weapons of mass destruction.

IRAQI AND IRANIAN PRODUCTION OF CHEMICAL/BIOLOGICAL WEAPONS

Both Iraq and Iran have used poisoned gas in the Iran-Iraq War. While this never had a decisive impact on the fighting, it provides an important lesson in the risks inherent in the proliferation of weapons of mass destruction.

The only detailed data on the history of each side's effort to produce chemical weapons are those available on Iraq, although Iran is known to have followed a path somewhat similar to that of Iraq.[1] It is is not possible to precisely date Iraq's chemical warfare effort, but it seems to have begun in the late 1960s. Iraq paid close attention to the Egyptian use of poison gas during the civil war in North Yemen, and seems to have developed preliminary plans to process mustard gas and other agents.

These plans took on more definite shape after the October, 1973, fighting between Israel, Egypt, and Syria. This may have partly been in response to the fact that it became clear after the fighting that Egyptian and Syrian forces were extensively equipped with Soviet-made chemical defense gear, including the antidote for nerve gas. It is still unclear whether this equipment was intended for defensive or offensive use, or was simply provided because it was part of standard Soviet military equipment for land force units.

The main reason for the Iraqi action, however, seems to have been the scale of Israel's military victory, and press reports that Israel had at one point begun to arm nuclear weapons in response to initial Egyptian and Syrian gains. Iraq almost unquestionably saw poison gas as a potential equalizer to Israel's military superiority and as a deterrent against Israel use of nuclear weapons. It also probably saw chemical weapons as a potential counter to the Shah of Iran's access to superior Western military technology.

One of Iraq's first steps was to turn to the Pfaudler Company of Rochester, New York, for assistance in creating a major "pesticide" blending complex.[2] Pfaudler is a large producer of corrosion resistant, glass line steel vessels, of the kind suitable for producing large amounts of toxic chemicals. Iraq approached the Pfaudler Company in 1975, and asked about purchasing a relatively small production facility.

Once the company's representatives reached Baghdad, however, it became clear that Iraq sought to create a massive facility. It rejected the safety concerns of the Pfaudler experts, and asked for plans that meant with rushing ahead without a pilot plant. It also became clear that Iraq wanted to "blend" organophosphate pesticides with very uncertain value for agricultural purposes, and which are commonly recognized as "precursors" for the production of nerve gas.[3]

The Iraqi production goals called for the handling of 600 metric tons per year of Amiton, 300 metric tons of Demiton, 150 tons of Paraoxon, and 150 tons of Parathon. All of these agents are extremely toxic.[4] Amiton and Paraoxon are the most toxic agents, followed by Parathion and then Demeton. Even in 1974, all four were relatively outdated agents for agricultural purposes, and had been largely abandoned for safety reasons.[5]

During 1975-1976, Pfaudler sought to persuade the Iraqis proceed on a pilot plant basis. Iraq finally rejected this approached in mid-1976, and insisted on completion of a massive plant. The Iraqi negotiators also changed from the Ministry of Agriculture to the Ministry of Industry. The resulting impasse gradually led Iraq to break off negotiations.

Iraq then turned to Imperial Chemical Industries, PLC (ICI), with virtually the same proposal. Unlike Pfaudler, ICI was familiar with a British government list of items whose export was controlled because they could be used to produce gas weapons, and immediately recognized that Iraq was seeking the precursors for nerve gas. ICI refused to negotiate further.

This refusal did not discourage Iraq, however, which turned to West German, Swiss, Dutch, Belgian, and Italian firms, and seems to have obtained most of the components it needed. While the precise source of its equipment is unclear, Iraq may have received enough support to build a special "pesticide" plant from Pilot Plant, a unit of Karl Kolb, which is a major West German laboratory equipment supplier. The Kolb plant had some of the special equipment necessary to make Sarin, but not special pumps. Iraq also received heavy duty pumps and chemicals from W.E.T. G.m.b.H of Hamburg.[6]

In any case, at least one major pesticide plant was being operated by the Iraqi "State Ministry of Pesticide Production" in 1980-1981. Iraq may also seems to have obtained

additional production equipment for the manufacture of plastics which could produce massive amounts of hydrogen cyanide as a byproduct. This equipment seems to have been modified for the production of cyanide gas.

While Iraq could produce and emply poison gas by the early 1980s, it does not seem to have actively acquired the massive amounts of feedstock it needed for large scale use of gas in warfare until 1983-1984. It was only after the Iran-Iraq War began, and Iraq suffered major defeats in the spring of 1983, that the State Ministry of Pesticide Production turned to a unit of Phillips Petroleum Company in Tessenderloo, Belgium, to obtain 500 metric tons of a chemical called thiodiglycol.[7]

Thiodiglycol is not suited for the production of nerve agents, but it can be easily combined with hydrochloric acid to produce mustard gas.[8] Mustard gas also offered Iraq certain military advantages. While mustard gas is 10 to 100 times less lethal than the simpler nerve agents, it is more persistent and consumes large amounts of medical services and support. This offered Iraq advantages in dealing with Iranian infantry which often spent considerable time in static exposed locations, and which had relatively poor rear area medical facilities.

Phillips claims it did not react to the order because it was placed by KBS Holland B.V., a Dutch trading firm. It was only after the trading firm began to ship its initial order in July, 1983, that Phillips learned that the actual customer was in Iraq, and then paid little attention because it was said to be a large "agricultural" organization. Phillips also claims it did not react to the order for thiodiglycol because such orders were routine. A number of experts disagree, however, and feel that only limited amounts are used in printing, textiles, and automotive manufacturing.

It was only in early 1984, when the State Ministry of Pesticide Production placed a second order for 500 tons that Phillips states it grew suspicious and cancelled the order. Phillips then notified the Belgian government, which reacted by cancelling Phillips' license to produce the chemical.[9]

By sheer coincidence, U.S. customs stopped another State Ministry of Pesticide Production order in February, 1984, for 74 barrels of potassium fluoride, another precursor of Sarin nerve gas. The order was placed by Al-Haddad Enterprises Incorporated, owned by Sahib al-Haddad, a naturalized Iraqi citizen. The shipment was not then illegal, because it was not yet controlled, and there is no clear way of determining how many other shipments occurred in the U.S. or other countries. However, at least one Dutch

firm -- Melchemie Holland B.V. -- has been convicted of export violations for selling phosphorous oxychloride, another precursor of nerve gas. [10]

Iran began to use the nerve gas Tabun in 1984, shortly after it used mustard gas. It began to use Sarin a few years later. Iraq also has produced mustard gas, hydrogen cyanide or cyanogen chloride, and Lewisite. In early 1988, it could produce up to 60 tons of mustard gas a month and six tons each of Tabun and Sarin. Iraq now seems to be working on producing a variant of VX, a persistent nerve gas agent.[11]

While the evidence as to the exact size of Iraq's current gas warfare production facilities is uncertain, it is clear that Iraq built up an extensive nerve and mustard gas production facility at Samarra by late 1987. This complex, much of which is sheltered, occupies 26 square kilometers, and is about 100 kilometers north of Baghdad. It is defended by troops and SA-2 missiles. There is another gas warfare complex at Fallujah, 65 kilometers west of Baghdad, and another plant may be under construction.[12]

Iraq now has a total of up to five major plants for chemical agent production.[13] The first Tabun nerve agents used by the Iraqis are believed to have been made at Iraq's Samarra chemical complex, at one of the insecticide plants obtained from the West..This facility is heavily sheltered, and is far more of a military facility than a civilian one. A further confirmation of the site may have been provided by a broadcast over Baghdad's Voice of the Masses Radio. In reference to the Iranians, Baghdad announced that there was "a certain insecticide for every kind of insect."[14]

It is also Iraq has purchased technical assistance from a number of firms. One is believed to be a West German firm called Fritz Werner.[15] The Iraqi research center for chemical and biological weapons seems to be at Salman Pak. This center includes underground and heavily sheltered facilities, and is known to work on nerve gas research. It is unclear whether it is to be the center of Iraq's biotoxin effort.

IRAQI AND IRANIAN USE OF GAS WARFARE

In terms of actual military use of gas agents, there is no evidence of large-scale use of lethal chemical synthetics and/or biological agents during the the initial stages of the Gulf War, although Iran claimed such Iraq used chemical weapons in the Susangard area during the first six weeks of the war.[16] These Iranian claims are uncertain, and may reflect Iranian propaganda or a botched Iraqi attempt to use lethal chemical or biological agents.

Iraq first began to make extensive use of chemical warfare against Iran when Iraq was put on the defensive. Beginning in 1982, Iraq began to use tear gas and non-lethal agents. Iraq made extensive use of lethal chemical weapons in July (Val Fajr 2) and October, 1983 (Panjwin offensive).[17] In December, 1982, Iraq seems to have begun to use mustard gas to deal with human wave and night attacks. Iraqi agents also bought large amounts of equipment from a West German manufacturer of equipment to make organophosphate fertilizer. The firm, located in Drereich, claims that it did not know that the Iraqis were buying extensive amounts of feedstock for nerve gas in other countries.

Fully credible accounts of Iraq's use of lethal chemical weapons emerged during the July 1983 Iran Val Fajr 2 offensive, and the Iranian offensive at Panjwin in October 1983. Chemical warfare seems to have been used extensively on August 9 near Piranshar, and in late October, and early November 1983, around Panjwin.[18] Two Iranian soldiers wounded by mustard agents during this campaign were sent to Vienna where they died. Two members of a second group of wounded soldiers were sent to Stockholm for medical treatment and also died.

Further Iranian charges were made of Iraqi use of chemical weapons during the March, 1984 offensive which led to the Iranian seizure of Majnoon Island.[19] These charges stated Iraq had killed some 1,700 Iranian troops and used GD and GB nerve agents, as well as mustard gas. Many of the Iranian allegations about the Iraqi use of lethal synthetic gases during the following months also related directly to the fighting on the Islands.[20]

Iraq does not seem to have made extensive use of chemical agents between March, 1984 and Iran's Faw offensive of early 1986. It did, however, sporadically use such agents when its forces have came under intense military pressure. Reports also surfaced in November, 1986, that Iraq had obtained Soviet nerve gas bombs, although the source was indicated to be Libya and such an arms transfer seems doubtful. What is clear is that Iraq could deliver gas using artillery shells, helicopter dispenser, multiple rocket launcher rounds, and aircraft bombs from at least 1982 onwards.

Iran first attempted to deal with this situation by mobilizing world opinion. After Iran's protests failed to arouse a significant world reaction, it flew chemical warfare casualties to London. A UN team then flew to Iran and found several bombs for dispersing chemical agents with Spanish markings. These weapons were later found to have contained mustard gas. Other investigations after the 1984 attacks confirmed a high probability that Iraq was using a nerve gas agent called Tabun.[21] These conclusions were validated by a

second UN investigation in 1986, and it later became apparent that Iraq also had Chlorine gas agents, and that Iraq had a major chemical weapons production complex.

Iran's efforts to make a propaganda issue out of Iraq's use of gas may have had some temporary success. Iraq made little use of chemical agents between 1984 and the new Iranian offensive in Faw in 1986. While this may have been because of the hostile reaction in the West and Third World, it may also have been because Iraq lacked the organization and dispensers to be effective. There are indicators that unfavorable winds caused Iraqi deaths at Majnoon, and that Iran became steadily more cautious after the U.S. formally condemned Iraqi use of chemical weapons in March 1984.

Whatever the reason, Iraq resumed extensive use of gas warfare in its defense of Faw in 1986, and made limited use of gas in its defense of Basra in 1987. Iraq seems to have used chemical weapons during its recapture of Faw in early 1988, and in some phases of its attacks on Meheran.

More controversially, anti-Iraqi Kurdish factions have charged that Iraq used gas against Kurdish villages and areas some fifteen times between April 15, 1987 and February 26, 1988. Three of these attacks are claimed to have produced 100 or more casualties: An attack on Arbil, Kanibard, Zeenau, Balookawa, Shaikwassan, the Derasheer mountains, and the Sawseewaken area on April 16, 1987; the Dahok/Amadia area on May 6, 1987, and the Sulaymania/Sergaloo, Yakhsamar, Haledan, Gweezeela area on February 25, 1987.[22]

There is no way to confirm the details of such reports. It is clear, however, that Iraq used mustard and nerve gas extensively in defending against attacking Iranian troops in the north during their attacks on Iraq in 1987 and early 1988. In each of these cases, gas offered a potential solution to the problem of mountain or rough terrain warfare, and in many cases, it allowed Iraq to "secure" an area with relatively few troops. This was particularly true when Iraq used gas against hostile Iraqi Kurds, a group which the government regarded as nothing but traitors.

The worst single instance in which gas was used during the war seems to have occurred when both Iraq and Iran used gas during an Iranian attack on the Kurdish town of Halabja on February 26, 1988. Up to 5,000 Kurdish civilians were killed after Iran had already seized the area. Iraq first seems to bombed the town with a mustard gas agent that produced burning white cloud. There also are indications that Iraq also shot the gas victims that fled toward Iraq, rather than Iran. Iran then fired hydrogen cyanide agents into the town with artillery shells. Ironically, the cyanide agents may have done most of the killing,

and have accounted for most of the "Iraqi" caused casualties that Iran later showed on its state television network.[23]

These attacks were followed up with a number of additional Iranian and Iraqi gas attacks. These exchanges seemed to have paused after February, 1988, when the world reaction to Halabja reached a point where both countries felt further use of such weapons would be counterproductive. Nevertheless, Iraq began a major new offensive against its own Kurds on August 25, 1988, and seems to have made considerable use of gas warfare as part of an effort to depopulate hostile areas. While the exact scale of Iraq's use of gas is uncertain, some 65,000 Kurds fled to Turkey, and many of the refugees gave convincing reports of the use of gas warfare.[24]

As for Iran, it also actively developed its own chemical agents, and has purchased stocks of chemical defense gear. While rumors surfaced in November, 1986, that Iran had bought nerve gas bombs and warheads from Libya -- which had obtained such weapons from the USSR-- these reports seem false. Iran launched a crash gas weapons production effort in 1983-1984. It began limited production in 1985, and created a significant capacity to produce mustard, cyanide, and nerve agents by mid-1987. [25]

Iran made its first confirmed use of chemical weapons in 1985, using mortars and artillery to deliver gas rounds. Some of these rounds may initially have been captured from Iraq, but Iran established a significant chemical weapons production capability of its own, and began to obtain and manufacture surface-to-surface missiles that could be used for conventional, chemical, and nuclear strikes. The exact nature of all the chemical agents Iran has produced is unknown. In early 1988, however, Iran was actively produce phosgene gas and cyanotic agents and was at least on the edge of producing of nerve gas. According to some reports, Iran was also actively working on mycotoxins -- a simple biological agent that can be highly lethal, but which requires only limited laboratory facilities.

If the Iran-Iraq War resumes or Iraq's war against the Kurds continues at its present level of intensity, it is virtually certain that there will be further use of gas, and possibly of biological agents as well. It is important to note, however, that the use of chemical agents has so far had limited military impact in terms of direct casualties, even if one takes Iranian claims at face value. While gas attacks have been used successfully as a "horror weapon", this was because gas had a critical effect on morale. Too little is known about the conditions involved to talk about the impact of given agents or delivery means, but it is unclear whether either side consistently gained as much in ordinary warfare from the use of

gas as it would have gained from devoting the same resources to more conventional weapons.

THE MOVE TO ACQUIRE NUCLEAR WEAPONS

Both Iran and Iraq are actively trying to acquire nuclear weapons. The Osiraq reactor that Iraq purchased from France in 1976 was unusually large. It had special features for irradiating Uranium which allowed it to be used to produce significant amounts of Plutonium -- enough to produce a bomb over a several year period. In 1981, when Israel attacked and destroyed the reactor, Iraq was negotiating to buy a heavy water power reactor from Italy and a sizable reprocessing facility whose purpose was almost certainly Plutonium production.

Earlier, in 1980 and 1981, Iraq had brought large amounts of natural uranium from Brazil, Portugal, Niger, and Italy. Iraq also placed an order in early 1980 for 25,000 depleted uranium fuel pins from a West German firm called NUKEM. The pins were sized for irradiation in the Osiraq reactor, and had no other real purpose than to produce about ten to twelve kilograms of weapons grade plutonium. While the reactor was under IEA inspection, and French technicians were to remain until 1981, Iraq seemed to be following the bomb development plan Sweden had used in the early 1960s. It was openly developing an ability to handle Plutonium technology while seeking to stockpile weapons grade material for weapons purposes. Iraq also seems to have tried to buy Plutonium illegally from Italian sources after the Israeli raid on Osirak.

Iraq seems to have had little success since 1981 in either obtaining aid in building new reactors suitable for weapons purposes, or obtaining fissile materials. It seems highly likely, however, that it will continue to try to find a replacement for Osirak, and try to expand its facility at Tuwaitha to create some capability to process Uranium or Plutonium. Iraq still has a 10 megawatt reactor built by the Soviet Union operating at Tuwaitha, but this is under tight Soviet control. Tuwaitha has also acquired massive new surface-to-air missile defenses since the Israeli attack.[26]

In the longer run, Iraq may be able to use larger power reactors. It is seeking to provide 10% of its power needs with nuclear power, and contracted with the Soviet Union in 1984, to build at 440 megawatt plant at a cost of $2 billion. The plant will be built by the Soviet Atomenrgo group. Iraq is also evidently seeking Latin American support in building

an uncontrolled reactor somewhere in Northern Iraq. In the long run, Iraq is likely to succeed in obtaining at least some fissile material and in becoming a nuclear power.[27]

Like Iraq, Iran has an extensive nuclear effort, and for all its rhetoric about popular warfare, the Khomeini regime seems to have revived the nuclear weapons program begun under the Shah. The Shah established the Atomic Energy Organization of Iran in 1974, and rapidly began to negotiate for nuclear power plants. By the time he fell in January, 1979, he was attempting to purchase some 12 nuclear power plants from the FRG, France, and U.S. Two 1,300 megawatt German plants at Bushehr were 60% and 75% completed, and work had begun on two 935 megawatt French plants at Darkhouin. Thousands of Iranians were training in nuclear technology in France, the FRG, India, the U.K., and U.S. In addition, Iran had negotiated for long term supplies of enriched fuel with France, the U.K. and U.S, had bought a 10% share of EURODIF in 1975, and was negotiating to by a share of COREDIF.[28]

Far less publicly, the Shah began a nuclear weapons research program. This included a laser enrichment program which began in 1975, and led to a complex and highly illegal effort to obtain laser separation technology from the U.S. This effort continued from 1976 until the Shah's fall, and three lasers operating in the critical 16 micron band were shipped to Iran in October, 1978. At the same time, Iran worked on ways to obtain Plutonium. It created a secret reprocessing research effort to use enriched uranium, and and set up a small nuclear weapons design team. In 1976, Iran also began to try to purchase 26.2 kilograms of highly enriched uranium. The application to the U.S. was still pending when the Shah fell.

The Khomeini government initially let the Shah's program slide, but revived it in 1981. It kept a small 5 megawatt reactor working under IAEA safeguards at Tehran University. Iran revitalized its laser separation program in 1983, and held several conference on the subject, including an international conference in September, 1987. It opened a new nuclear research center in Isfahan in 1984, and sought French and Pakistani help for a new research reactor for this center.

The government began to restart work at the Bushehr in 1984, although the FRG officially refused to support the effort until the war ended. Iran got around this by obtaining Argentine support in completing the Bushehr 1 reactor, which is 75% finished. Reports surfaced in April,1987 that the Argentine nuclear power agency, CNEA, had signed an agreement with Iran. CNEA works closely with West Germany's Kraftwerke Union (KWU), which had the original contract for the reactor. The Spanish firm Impressarios

Agupados may also be part of the consortium.[29] While the FRG firm Kraftwerk Union pulled out of the Bushehr project in September, 1980, it was working on the reactor when Iraqi aircraft bombed it on November 17, 1987. Several Kraftwerk technicians were injured and one was killed.

Argentina also sold Iran enriched uranium for its small Tehran university reactor in May, 1987. The five megawatt university reactor uses a core with 93% enriched uranium, which is suitable for some forms of nuclear weapon. A CENA team visited Iran in late 1987 and early 1988. Argentina has not ratified the nuclear non-proliferation treaty, and there are significant uranium deposits in the Sarghand region of Iran's Yazd Province.[30]

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[1] Iran retained Lurgi G.m.B.H. of West Germany to build a large pesticide plant in October, 1987, of the kind necessary to produce nerve gas. Lurgi claims the plant will only produce agricultural insecticides. Iran has adapted plastics plants built under the Shah to help produce hydrogen cyanide gas.

[2] For a good discussion of the early Iraqi effort to acquire chemical weapons, see David Ignatius, "Iraq's 13-year Search for Deadly Chemicals," Washington Post, Outlook section, September 25, 1988.

[3] The building block at the base of the organophosphorus industry is elemental phosphorus. Thus, at a minimum, a supply of phosphorus would be needed to make nerve agents such as the G agents, Tabun (GA), Sarin (GB) and Soman (GD), and the V agents, such as VX and Edemo (VM).

There is a very wide range of possible chemical precursors to the production of gas warfare. Ones which may have been sent to Iran and Iraq include Thiodiglycol and chloroethanol (mustard gas); dimethalmine, dimethalmine hydrochloride, and phosphorus oxychloride (Tabun or GA nerve gas); and dimethyl methylphosphonate, difluoro or methylphosphony, and potassium flouride (Sarin or GB nerve gas). For a good description of the technology of proliferation see Lois R. Ember, "Worldwide Spred of Chemical Arms Receiving Increased Attention," C&EN, April 14, 1988, pp. 8-16.

[4] All are useful in the production of Tabun nerve gas. The corrosion resistant reactors, pipes, and pumps need for processing these pesticides can be rapidly converted to nerve gas production. See Ignatius, "Iraq's 13-year Search for Deadly Chemicals," Washington Post, Outlook section, September 25, 1988.

[5] Tabun and the more lethal Sarin nerve gases were discovered in Germany in 1936, as part of an effort to develop more advanced pesticides. They could not be used for this purpose because they proved to be as effective in killing people as insects. The Nazis produced some 12,000 tons of nerve gas in World War II, but never used it because they believed that Britain and the U.S. were also aware of the technology. See John J. Fialka, "Fighting Dirty", Wall Street Journal, September 15, 1988, p. 1

[6] Some thirteen West German firms are now under investigation by the West German government. W.E.T

[7] John J. Fialka, "Fighting Dirty", Wall Street Journal, September 16, 1988, p. 1.

[8] Mustard gas can be made by three easy routes. The first is the reaction of vinyl chloride (readily available or which can be made from ethylene or acetylene) and hydrogen sulfide. The second is the reaction of ethylene and sulfur monochloride. The third is reacting thiodiglycol with hydrogen chloride after making the thiodiglycol from ethylene oxide (from ethylene) and hydrogen sulfide. The sulfur and ethylene feedstocks can be drawn from a typical refinery and hydrogen chloride or chlorine gas are simple to make from a source of chlorine, such as salt, seawater, or produced brines from petroleum operations.

[9] John J. Fialka, "Fighting Dirty", Wall Street Journal, September 16, 1988, p. 1.

[10] Ibid.

[11] "Iraq's Scare Tactic," Newsweek, August 2, 1982; Washington Post, April 5, 1988, p. A-1.

[12] Jane's Defense Weekly, January 9, 1988, p. 3; February 27, 1988, p. 336.

13 Peter Dunn, "The Chemical War: Journey to Iran", NBC Defense & Technology International, pp. 28-37 and "Iran Keeps Chemical Options Open", pp. 12-14.
14 "Iraq's Scare Tactic," Newsweek, August 2, 1982.

15 Christian Science Monitor, April 13, 1988, p. 32
16 Loren Jenkins, "Iraqis Press Major Battle in Gulf War," Washington Post (November 17, 1980), p. 1, and Taylor and Francis, SIPRI Yearbook, 1985, (Philadelphia, 1985), pp. 206-219. W. Andrew Terrill, "Chemical Weapons in the Gulf War," Strategic Review (Spring 1986), pp. 51-58.

17 Loren Jenkins, "Iraqis Press Major Battle in Gulf War," Washington Post, November 17, 1980, p. 1; Taylor and Francis, SIPRI Yearbook, 1985, pp. 206-219; W. Andrew Terrill, "Chemical Weapons in the Gulf War," Strategic Review, Spring, 1986, pp. 51-58.
18 "In the Pipeline," The Middle East (December 1981), p. 72; "Iraqis Trained for Chemical Warfare," Washington Post (November 3, 1980), p. 313. The Iraqis may also have been favorably impressed by the effectiveness of tear gas in instilling panic in Iranian troops. An August 1982 report in Newsweek stated an entire Iranian division fled in panic when they were exposed to Iraqi tear gas. The Iranians had no idea as to what type of agent they were being exposed to, and had no defenses against any kind of chemical agent.
19 "In the Pipeline", The Middle East, December, 1981; "Iraqis Trained for Chemical Warfare", p. 72; Washington Post, November 3, 1980.
20 Beginning in 1982, Iraqi agents bought extensive amounts of equipment from a West German manufacturer of equipment to make organophosphate pesticides. The manufacturer, located in Drereich, claims it had no way to know the Iraqis were buying extensive feedstock for nerve gas in other countries, including the U.S. There may now be five major chemical agent production plants in Iraq. See Gustav Anderson, "Analysis of Two Chemical Weapons Samples from the Iran-Iraq War," NBC Defense and Technology International (April 1986), pp. 62-66; Peter Dunn, "The Chemical War, Journey to Iran," Ibid., pp. 28-37; and "Iran Keeps Chemical Options Open," Ibid., pp. 12-14.
21 "Report of the Specialists Appointed to the Secretary General to Investigate the Allegations of the Islamic Republic of Iran Concerning the Use of Chemical Weapons, United Nations Security Council, Document S 16433, March 26, 1984. Also see the April, 1986, edition of NBC Defense & Technology International.
22 Congressional Record, U.S. Senate, September 9, 1988, p. S12135
23 Washington Times, March 23, 1988, p. 1; Toronto Globe and Mail, March 24, 1988, p. 1; Washington Post, March 24, 1988, p. 1 and April 4, 198, p. 24; Wall Street Journal, September 16, 1988, p. 1.
24 See Peter W. Galbraith and Christopher Van Hollen Jr., "Chemical Weapons Use in Kurdistan: Iraq's Final Offensive", A Staff Report to the Senate Committee on Foreign Relations, September 21, 1988.
25 Washington Times , October 29, 1986, p. 9-A.

26 James Bruce, "Iraq and Iran: Running the Nuclear Technology Race," Jane's Defense Weekly, December 5, 1988, p. 1307.
27 This analysis is based on the work of Leonard Spector of the Carnegie Endowment, and Steve Weissman and Herbert Krosney, The Islamic Bomb, New York, New York Times Books, 1981, pp. 94, 100, and 266-268; Jed C. Snyder, "The Road to Osiraq: Baghdad's Quest for the Bomb", The Middle East Journal, Autumn, 1983; and Richard Burt, "U.S. Says Italy Sells Iraq Atomic Bomb Technology", New York Times, March 18, 1980, p. 1.
28 The bulk of this analysis is based on research by Leonard Spector of the Carnegie Endowment.
29 Washington Times, April 22, 1987, page 6; Economist, Foreign Report, April 2, 1987, p. 7.
30 Washington Post, April 12, 1987, p. D-1; James Bruce, "Iraq and Iran: Running the Nuclear Technology Race," Jane's Defense Weekly, December 5, 1988, p. 1307..