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"THE SWORD OF THE ARABS:" IRAQ'S STRATEGIC WEAPONS

MICHAEL EISENSTADT

THE WASHINGTON INSTITUTE FOR NEAR EAST POLICY
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THE AUTHOR

Michael Eisenstadt is a research fellow in political-military affairs at The Washington Institute for Near East Policy.

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PREFACE

The eight-year Gulf War imposed a horrifying toll on both Iran and Iraq. With the 1988 cease-fire that ended hostilities, many observers suggested that Iraqi President Saddam Hussein had been chastened by the war's costs; he would, it was argued, abandon the belligerency that had characterized Baghdad's foreign policy before 1980. Instead, Iraq would become a status quo power preoccupied with the pressing tasks of domestic reconstruction and development.

Unfortunately, these predictions were premised more on wishful thinking than reality. Since the 1988 cease-fire, Hussein unambiguously resumed his quest to make Iraq the Middle East's dominant power. Iraq intervened in Lebanon's civil war, bullied its Arab neighbors, and reinserted itself into the thick of the Arab-Israeli conflict as the leader of a radical bloc seeking to deal with Israel and the United States through bellicosity and threats rather than diplomatic cooperation.

This record of radical activism has now climaxed in Iraq's premeditated act of aggression against Kuwait. With the United States now confronting the possibility of an all-out war with Saddam Hussein, one of the most worrisome aspects of his quest for regional hegemony has come to the fore—Iraq's strategic weapons program.

Iraq emerged victorious from the Gulf War, possessing not only battle-hardened conventional forces, the largest in the Arab world, but also a significant chemical warfare capability that had been used with devastating effect against both Iran and Iraq's own Kurdish population. Since the cessation of hostilities, Iraq has accelerated its strategic weapons programs, augmenting its arsenal of chemical and biological weapons and long-range strike systems. In addition, Iraq is seeking to acquire strategic reconnaissance capabilities and, most ominously of all, nuclear weapons.

In this Policy Paper, Michael Eisenstadt details the status of Iraq's strategic weapons programs and assesses what impact these systems will have on the tenuous Middle East balance of power. He argues that in an already tense regional environment, Iraq's build-up, combined with its rhetorical excesses—including the threat to "make fire eat up half of Israel"—are creating a situation where the chances for miscalculation and military escalation are increasing.

Although this paper was completed before Iraq's invasion of Kuwait, its findings are all the more disturbing for U.S. policymakers now that American forces face Iraq's military arsenal. And even if Saddam Hussein is persuaded to withdraw from Kuwait, the United States and its regional allies may still have to find a way of countering the challenges posed by Iraq's strategic weapons. For all these reasons, this paper is a timely contribution to the policy debate.

The next Middle East war will be incalculably more destructive than its predecessors. The potential harm to U.S. interests—in oil, in Israel and the moderate Arabs, and in stability—would also be great. To avoid such a conflagration, U.S. policymakers must come to grips with the challenges posed by Iraq's strategic weapons programs. Toward that end, The Washington Institute is pleased to publish this paper.

Barbi Weinberg
President
August 1990

EXECUTIVE SUMMARY

Since the end of the Iran-Iraq war, Iraq has expanded and diversified its strategic capabilities to include the following components:

- A clandestine nuclear weapons program. Iraq will probably acquire a nuclear weapons production capability within five to ten years.

- The local production of chemical and biological weapons.

- The local production of a variety of short and medium-range ballistic missiles, including two types of missiles with sufficient range to reach targets throughout the region. Iraq is expected to commence production of chemical warheads for these missiles in the near future.

- The acquisition of long-range strike aircraft capable of reaching targets throughout the region.

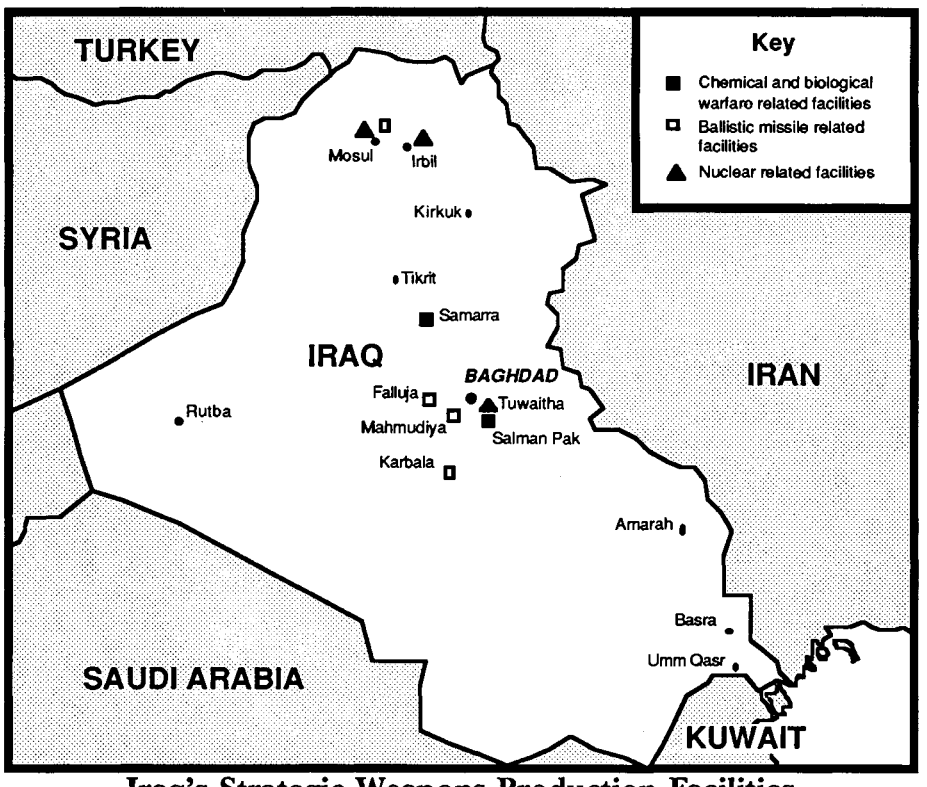
- The development of long-range artillery, or "superguns" capable of launching rocket-boosted projectiles at targets throughout the region, or placing satellites into earth orbit.

- The acquisition of a military reconnaissance satellite to

provide near real-time target data and other information vital for the effective utilization of its long-range strike systems.

Iraq's strategic capabilities provide it with a means of conducting coercive diplomacy against its smaller neighbors and dealing with Israel from a position of strength. These programs also enable Iraq to deter potential enemies while threatening their civilian population and economic centers.

The development of long-range strike systems capable of reaching Israel has led to the emergence of an uneasy deterrent relationship between Iraq and Israel. Israel now has to consider that a preventive strike against Iraq could prompt retaliation and produce unacceptable losses. Iraq's strategic deterrent thus provides a protective umbrella for its nuclear weapons program.



Iraq's Strategic Weapons Production Facilities

INTRODUCTION

Iraq emerged from its eight-year war with Iran with the most advanced array of strategic capabilities in the Arab world. These new capabilities—including ballistic missiles, long-range strike aircraft and chemical and biological weapons—have provided Iraq with a military foundation for an activist regional policy. In attempting to stake out a hegemonic role in the Arab world, Iraq has cast itself as the leader of pan-Arabism and has spearheaded efforts to diminish U.S. influence in the region and resurrect a military alliance against Israel.

The origins of Iraq's strategic forces date to the mid-1970s, when it initiated its nuclear and chemical weapons programs and acquired systems—such as the Soviet SCUD-B missile and Tu-22 bomber—capable of delivering large payloads over great distances. The Gulf War, however, provided the major impetus for the development of its strategic forces. From the outset, strategic bombing played a central role in the fighting and both sides attacked enemy population centers and economic targets. Moreover, as the war wore on and Iraq proved unable to force a decision on the battlefield, it increasingly resorted to strategic bombing in an attempt to bring Iran to the negotiating table.[1]

[1]In this paper strategic forces refer to conventional and unconventional weapons and associated delivery systems intended for use primarily against civilian and economic targets.

Since the end of the war in August 1988, Iraq has expanded and intensified efforts to develop and acquire unconventional weapons and long-range strike and strategic reconnaissance systems. These include:

- A clandestine nuclear weapons program, focusing on the acquisition of uranium enrichment technology and weapons components.

- The production of chemical and biological weapons, including mustard-type agents, the nerve agents sarin and tabun and botulin toxin.

- The production of the Al-Hussein and Al-Abbas missiles, which have sufficient range to reach targets throughout the region. Iraq is expected to commence production of chemical warheads for these missiles in the near future.

- The acquisition of long-range strike aircraft, such as the Mirage F-1E and the Su-24 Fencer, and a modest in-flight refueling capability.

- The development of long-range artillery capable of launching rocket-boosted projectiles at targets throughout the region.

- The acquisition of military reconnaissance satellites to enable Iraq to locate and identify potential targets at long range.

Iraq has traditionally aspired to be a regional power, and its new strategic capabilities provide it with the means to realize that ambition. Since the end of the Gulf War, Iraq has pursued an increasingly activist regional policy. This new activism is motivated by a belief—held by Iraq's President Saddam Hussein—that the decline of the Soviet Union has left the United States in a preeminent position in the international arena. Consequently, the United States and Israel will enjoy unprecedented freedom of action against the Arabs until a new international balance is established to offset their power.

Thus, according to Hussein, Iraq must establish itself as the undisputed leader of an Arab coalition in order to deal with the United States and Israel from a position of strength. This goal is

to be achieved primarily through the build up of its military strength.

Iraq sees its strategic capabilities as a means of exercising its dominance in the Arab world by exerting pressure on its weaker neighbors, such as Kuwait, which lack an ability to respond in kind. Iraq has never formally renounced its claim to Kuwaiti territory and has, on several occasions, tried to acquire footholds on Kuwait's Bubiyan and Warba Islands.

Iraq's strategic build-up has also been motivated by security concerns. Iraq borders several states which possess advanced unconventional arsenals and large conventional forces. This has prompted Iraq to develop its own strategic deterrent to neutralize the capabilities of its neighbors and enhance its margin of maneuver.

- Iran remains a long-term threat to Iraq. Iraq's strategic capabilities have provided it with an increased margin of military superiority over Iran and provide a means to deter Iran from resuming hostilities by effectively neutralizing its strategic capabilities and large conventional ground forces.
- Israel is perceived by Iraq as a potential military threat. Iraq has participated in nearly every major Arab-Israeli war, sending substantial expeditionary forces to the front in 1948, 1967 and 1973. For its part, Israel has in the past provided support to Kurdish rebels opposed to the Iraqi regime, sent military aid to Iran during the Gulf War, and set back Iraq's nuclear weapons program by several years when it bombed the Osiraq nuclear reactor in 1981. Iraq seeks to deter another Israeli strike and neutralize Israel's nuclear, chemical and conventional capabilities to enable it to deal with Israel from a position of strength.
- Syria is a traditional competitor with Iraq for primacy in the Fertile Crescent. The geopolitical rivalry between the two countries has been complicated by Syria's support for Iran during the Gulf War, differences over Syrian policy in Lebanon, disputes over Syria's use of the waters of the Euphrates river, and ideological competition between the two Ba'thi regimes. Iraq's desire to match and offset Syria's substantial unconventional capabilities, including missiles armed with chemical warheads, provides an additional impetus for its strategic build-up.

Taken together, these factors constitute a powerful set of incentives for Iraq's ongoing efforts to enhance its strategic

capabilities and assure that Iraq will continue to attach considerable importance and devote substantial resources to these programs for the foreseeable future.

I UNCONVENTIONAL WEAPONS

CHEMICAL AND BIOLOGICAL WEAPONS

Iraq has the largest chemical weapons production capability in the Third World. It currently produces over a thousand tons of agents annually, including mustard-type blister agents (HD) and the nerve agents sarin (GB) and tabun (GA).[1] Iraq

[1]This figure was arrived at by extrapolating estimates of Iraqi chemical agent production for 1985 (10 tons per month), 1986 (50 tons per month) and 1988 (82 tons per month). Anthony H. Cordesman and Abraham R. Wagner, *The Lessons of Modern War: The Iran-Iraq War* (Boulder: Westview, 1990), p.512. Some reports indicate, moreover, that Iraq might soon produce the nerve agent VX. BBC Panorama, "The Secrets of Samarra," October 27, 1986. Other reports indicate that Iraq may have also produced or acquired limited quantities of several other agents, including lewisite (L) and chlorine gas, although reports that Iraq produced cyanide gas (AC and CX) during the war are apparently incorrect. Anthony H. Cordesman, "Creating Weapons of Mass Destruction," *Armed Forces Journal International,* February 1989, p.57; Cordesman and Wagner, *Lessons of Modern War,* p.512; Patrick E. Tyler, "Both Iraq and Iran Gassed Kurds in War, U.S. Analysis Finds," *The Washington Post,* May 3, 1990, p.A37. By comparison, total chemical agent stocks of the United States reportedly amount to about 30,000 tons and those of the Soviet Union about 50,000 tons. Under the terms of a U.S.-U.S.S.R. chemical weapons treaty concluded on June 1, 1990, both sides will reduce their stocks of chemical weapons to 5,000 tons by 2002. Assuming Iraq continues production at current levels, it could eventually possess the largest chemical weapons stocks in the world.

commenced development of an indigenous chemical weapons production capability in 1974. Its principal chemical weapons production facility is located near Samarra, about 70 km northwest of Baghdad. In addition, Iraq reportedly maintains several dispersed underground chemical weapons storage sites which are hardened against air attack.[2]

In the course of the Gulf War, Iraq violated its commitments as a signatory to the Geneva Protocol of 1925 which prohibits use of chemical agents during wartime. Iraq used chemical agents against Iranian troops as well as its own Kurdish insurgents and civilians. According to Iranian sources, chemical weapons accounted for about 50,000 Iranian casualties during the war, including about 5,000 killed. These weapons reportedly played a significant role in several battles.[3]

Initially, chemical weapons were used defensively to prevent Iranian breakthroughs at critical sectors and disrupt Iranian human wave and night attacks. Later in the war, chemical weapons were used during pre-assault preparations of Iranian positions.[4] By the end of the war, authority for the employment of chemical weapons had been delegated to divisional commanders, indicating the degree to which the tactical use of chemical weapons had become routine.[5] Although Iraq generally eschewed the use of chemical weapons against Iranian civilians, it threatened to do so toward the end of the war.[6]

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[2]Seymour M. Hersh, "U.S. Aides Say Iraqis Made Use of a Nerve Gas," *The New York Times,* March 30, 1984, pp.A1,A6.

[3]Speech by Iran's Foreign Minister, 'Ali Akbar Velyati, to the international conference on chemical weapons, January 7, 1989, reprinted in FBIS-West Europe, January 9, 1989, p.7.

[4]W. Andrew Terril, Jr., "Chemical Weapons in the Gulf War," *Strategic Review,* Spring 1986, pp.51-58; Cordesman and Wagner, *Lessons of Modern War,* pp.513-518.

[5]Hugh Carnegy and Victor Mallet, "Launch of Iraqi Space Rocket Fuels Fears in Israel," *Financial Times* (London), December 20, 1989, p.4.

[6]According to a report carried in the Jordanian press, "[a]n authorized Iraqi spokesman has said that in response to Iran's chemical weapons attack on . . . Halabjah [and] . . . villages and civilian[s] . . . in many areas in Iraq, Iraq may select a number of major Iranian cities as targets for chemical weapons as a deterrent and retaliatory measure . . . " *Al-*

Iraq's current annual production of over a thousand tons of chemical agents equates to between 250,000-500,000 tube and rocket artillery rounds of various calibers, as well as smaller quantities of bombs, depending on the mix of ammunition produced. Such a production capability is sufficient to support sustained combat operations.[7]

Iraq possesses a number of means for disseminating chemical agents. Most of these are relatively short-range tactical systems—tube and rocket artillery of various calibers, bombs and air-to-ground rockets—most of which it produces locally.

Iraq also has an active biological weapons program, even though it has signed (but not ratified) the Biological and Toxin Weapons Convention of 1972 which prohibits the development

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Ra'y, March 29, 1988, p.1, translated in FBIS-NES, March 29, 1988, p.34. Iraq observed few restraints in its use of chemical weapons against the Kurds since they were unable to appeal to international opinion or retaliate in kind.

[7]Iraq's chemical munitions reportedly include 152 mm, 130 mm, and 122 mm artillery rounds, 122 mm rocket rounds, 90 mm air-to-ground rockets, 81 mm mortar rounds and 45 kg bombs. Standard fills for Soviet produced ammunition of various calibers range from 1.3 kg to 5.4 kg for tube and rocket artillery rounds, 216 kg for FROG-7 rocket warheads and 555 kg for SCUD-B missile warheads. Conference on Disarmament, "Information on the Presentation at the Shikhany Military Facility of the Standard Chemical Munitions and Technology for the Destruction of Chemical Weapons at a Mobile Unit," *CD/789*, December 16, 1987, pp.9-26.

An annual production rate of over 1,000 tons (1 million kg) of chemical agents thus equates to an annual production of between 250,000-500,000 rounds of various types of ammunition (depending on the mix of calibers), as well as small quantities of aerial bombs and—in the near future—a small number of missile warheads. While these production estimates are conjectural, they provide a good indication of the potential of Iraq's chemical weapons production and stockpiles.

Likely wartime consumption rates of Iraqi stockpiles are impossible to assess, however, since ammunition expenditure norms vary drastically in accordance with variables such as doctrine, enemy posture and weather conditions. For instance, an artillery preparation by a division-size unit against a dug-in, defending enemy brigade might consume hundreds or even thousands of rounds of ammunition. Expenditure rates would depend on the effects desired, the level of enemy preparedness and weather conditions.

and possession of biological weapons. The principal biological weapons research center is near Salman Pak, about 35 km southeast of Baghdad. Iraq is reportedly producing and stockpiling botulin toxin in militarily significant quantities and has reportedly conducted research with anthrax, typhoid and cholera.[8]

Biological agents are more potent than the most lethal chemical agents and provide the broadest area coverage per pound of payload of any weapon system.[9] They can be delivered and disseminated by a variety of means, including missiles, tube and rocket artillery, bombs, vectors (living carriers—usually insects) and human agents.

Although there is no definitive proof that Iraq has used biological weapons, according to unverified press reports Iraq may have been responsible for an outbreak of typhoid fever in the Kurdish town of Al-Suleimaniyah in northern Iraq in 1988. The outbreak was reportedly caused by the contamination of drinking water by laboratory produced typhoid cultures.[10]

OUTLOOK

Chemical weapons constitute the backbone of Iraq's strategic weapons capability, as well as a key tactical weapon. Consequently it will continue to stockpile chemical weapons and possibly biological weapons for the foreseeable future. Moreover, it is expected to commence production in the near

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[8]Chemical warfare research is also reportedly conducted at Salman Pak. BBC Panorama, "The Secrets of Samarra," October 27, 1986; Stephen Engelberg, "Iraq Said to Study Biological Arms," *The New York Times*, January 18, 1989, p.A7; Cordesman, "Creating Weapons," *Armed Forces Journal International*, p.56.

[9]Statement of William H. Webster, Director of the Central Intelligence Agency, before the Senate Committee on Governmental Affairs, Hearings on Global Spread of Chemical and Biological Weapons: Assessing Challenges and Responses, February 9, 1989, p.3.

[10]Con Couglin, "New Evidence of Iraqi War," *The Sunday Telegraph*, September 25, 1988, p.1.

future of chemical missile warheads, vastly increasing the lethality of its strategic forces.[11]

Until recently, Iraq has been dependent on various foreign—largely Western European—sources for chemical agent precursor materials. By the early 1990s, however, Iraqi industry could be self-sufficient in the production of precursors for mustard-type agents, as well as sarin and tabun, reducing its reliance on external sources which are liable to disruption. The domestic production of precursors would permit Iraq to increase production on a surge basis in wartime or during periods of tension, to augment existing stockpiles or replace expended stocks. Financial difficulties, however, might prevent Iraq from achieving this goal within the desired time frame.[12]

NUCLEAR WEAPONS

Iraq has the most advanced and ambitious nuclear weapons program in the Arab world. The program dates to about 1974, with the conclusion of a nuclear cooperation accord with France which subsequently led to an agreement in 1976 for the provision of two nuclear reactors: the Tammuz I (Osiraq) 70 megawatt research reactor and the smaller Tammuz II 800 kilowatt research reactor. These deals were followed by the purchase of the 30 Tammuz research facility from Italy in 1978, which included three "hot cells" for the reprocessing of

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[11]According to Israeli Chief of Staff Lieutenant General Dan Shomron, while Iraq does not currently possess chemical missile warheads, "it will have [them] in the not too distant future." *Yediot Aharonot*, April 6, 1990, translated in *Mideast Mirror*, April 6, 1990, p.2.

[12]Seth Carus, *The Genie Unleashed: Iraq's Chemical and Biological Weapons Production* (Washington, D.C.: The Washington Institute for Near East Policy, 1989), Policy Papers No. 14, pp.16-17,19,22-23,27-28. Iraq is reportedly encountering problems in obtaining foreign loans and credits required for the construction of its planned $2.5 billion Petrochemical Complex No. 2 at Musayyib which will produce—among other things—ethylene oxide, a chemical which is necessary for the production of thiodyglycol, a precursor for mustard-type blister agents. "Iraq's New Chemical Weapons Plant," *MidEast Markets*, April 30, 1990, pp.9-10.

plutonium. These facilities are located at the Tuwaitha nuclear center, a complex approximately 30 km southeast of Baghdad.[13]

While Iraq is a signatory to the Nuclear Non-Proliferation Treaty (NPT) and its nuclear facilities are subject to International Atomic Energy Agency (IAEA) safeguards, strong circumstantial evidence indicates that during the late 1970s and early 1980s Iraq intended to acquire a nuclear weapons production capability:

- Iraq initially attempted to acquire a French 500 megawatt uranium gas-graphite power reactor which was capable of producing both electricity and significant quantities of plutonium. This type of reactor was a principal source of plutonium for France's nuclear stockpile. The French eventually refused the sale.[14]

- The Tammuz I reactor that Iraq subsequently acquired from France was designed primarily for nuclear power research and did not conform to any discernible peaceful Iraqi nuclear power requirement. Moreover, it was to run on highly-enriched (93 percent) uranium fuel which, if diverted, could have been used in a nuclear weapon.[15]

- Iraq rebuffed French attempts in 1980 to renegotiate an agreement to supply highly-enriched uranium fuel which France agreed to supply in 1976. The French wanted instead to supply low-enriched uranium (Caramel) fuel which is unsuitable for military use.[16]

- In the late 1970s and early 1980s, Iraq acquired massive quantities—some 250 tons—of uranium ore concentrate (yellowcake) from Brazil, Portugal and Niger. This material is

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[13]Iraq also operates the 14 Tammuz reactor, a Soviet-supplied IRT-2000 2 megawatt research reactor at Tuwaitha which became operational in 1968. It is reportedly used primarily for medical and other civilian research and has no connection with Iraq's nuclear weapons program.

[14]Jed C. Snyder, "The Road to Osiraq: Baghdad's Quest for the Bomb," *The Middle East Journal*, Autumn, 1983, pp.566-567.

[15]Snyder, "The Road to Osiraq," *The Middle East Journal*, p.569.

[16]Snyder, "The Road to Osiraq," *The Middle East Journal*, p.576.

not subject to IAEA safeguards and had no obvious application for Iraq's nuclear research program since Osiraq did not run on natural uranium fuel. However, these stocks of uranium ore concentrate could have been irradiated in the Osiraq reactor and reprocessed to extract plutonium for use in nuclear weapons.[17]

• The Italian reprocessing facility provided Iraq with a capability to separate plutonium from spent uranium fuel or irradiated natural uranium.[18]

• In 1980, Iraq attempted to obtain 25,000 lbs of depleted uranium metal fuel pins from the West German firm NUKEM, which could have yielded significant quantities of plutonium after reprocessing. The deal was eventually blocked by the United States which refused to grant export licenses for the materials to U.S. subsidiaries of the West German firm.[19]

• In 1982, senior Iraqi military officials attempted to purchase 33.9 kg of plutonium from an Italian arms smuggling ring claiming to have such materials for sale.[20]

Following Israel's bombing of the Osiraq reactor in June 1981, Iraq's nuclear program remained dormant for a number of years. In 1987, Iraq apparently decided to resurrect its nuclear weapons program and commenced efforts to acquire technology for the enrichment of uranium by the gas

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[17]Snyder, "The Road to Osiraq," *The Middle East Journal*, pp.576-577.

[18]Snyder, "The Road to Osiraq," *The Middle East Journal*, pp.573-576.

[19]Snyder, "The Road to Osiraq," *The Middle East Journal*, p.578.

[20]Leonard Spector, *Going Nuclear* (Cambridge: Ballinger, 1987), pp.160-169. For additional details about Iraq's nuclear program in the late 1970s and early 1980s, see Haim Shaked, "The Nuclearization of the Middle East: The Israeli Raid of Osiraq," in Colin Legum, Haim Shaked and Daniel Dishon, eds., *Middle East Contemporary Survey (MECS): 1980-81* (New York: Holmes and Meier, 1982), pp.182-213; Snyder, "The Road to Osiraq," *The Middle East Journal*, pp.565-593.

centrifuge method.[21] Work related to the program is reportedly being conducted at the Saad 16 facility near Mosul, at an unidentified facility located in a mountain near Irbil and at the Tuwaitha nuclear center near Baghdad.[22]

The gas centrifuge route offers three principal attractions for Iraq. First, Pakistan and Brazil have successfully constructed unsafeguarded gas centrifuge enrichment facilities, the former with hardware, technology and expertise acquired from abroad, the latter using indigenously developed technology.[23] Second, whereas Iraq's earlier nuclear weapons program was based on the vulnerable Osiraq reactor at Tuwaitha, the various components of a program relying on gas centrifuge enrichment—stocks of uranium ore concentrate, a conversion plant for producing uranium hexafluoride gas feedstock, the gas centrifuge enrichment plant and a reconversion plant—can be dispersed and located in hardened, concealed sites to enhance survivability against air attack. Finally, this route might enable Iraq to clandestinely develop a nuclear weapons production capability while formally

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[21]"Iraq and the Bomb," *MidEast Markets*, December 11, 1989, pp.13-15. For details about the gas centrifuge method, see Donald R. Olander, "The Gas Centrifuge," *Scientific American*, August 1978, pp.37-43; Thomas B. Cochran, William M. Arkin, Robert S. Norris, Milton M. Hoenig, *Nuclear Weapons Databook: U.S. Nuclear Warhead Production*, Natural Resources Defense Council, Inc., 1987, pp.122-131. By all accounts, the Osiraq reactor has not been rebuilt and does not play any role in Iraq's current nuclear weapons program.

[22]Work at Tuwaitha is presumably conducted in areas in which IAEA inspectors are not permitted access. Judith Perera, "Nuclear Race in the Gulf," *South*, July 1987, pp.99-100; Karl Guenther Barth, "What Is Being Tested Here, Will One Day Fly to Tehran," *Stern* (German), April 6, 1989, pp.214-217; "Iraq and the Bomb," *MidEast Markets*, p.14; "New Arms Scandal: Iraq Gets Technology for Building Bombs from West Germany," *Der Spiegel* (German), December 18-25, 1989, pp.93-94.

[23]Neither Pakistan nor Brazil, however, are signatories to the NPT. Leonard Spector, pp.103-105,199-201; Frank Barnaby, *The Invisible Bomb: The Nuclear Arms Race in the Middle East* (London: I.B. Tauris, 1988), pp.106-112; David Albright, "Bomb Potential for South America," *Bulletin of the Atomic Scientists*, May 1989, pp.16-20; David Albright and Tom Zamora, "India, Pakistan's Nuclear Weapons: All the Pieces in Place," *Bulletin of the Atomic Scientists*, June 1989, pp.20-26.

preserving its credentials as a signatory of the NPT and reaping the benefits of an ambiguous nuclear posture.[24]

What little evidence that is publically available supports the conclusion that Iraq is attempting to acquire technology required for the construction of an unsafeguarded gas centrifuge enrichment plant:

- Iraq has acquired drill presses required for the production of gas centrifuges from the West German firm H-H Metalform GmbH of Drensteinfurt.[25]

- Technicians associated with MAN Technologie GmbH of Munich, West Germany (which in 1979 built a gas centrifuge assembly plant in Gronau, West Germany) have reportedly assisted the Iraqis with an assembly plant for gas centrifuges built by H-H Metalform at Tuwaitha.[26]

- China is reportedly providing Iraq with technology essential to the manufacture of magnets used in the centrifuge.[27]

- Although it is not known if Pakistan has provided technical guidance or advice to the Iraqis, scientists and technicians from Iraq have visited Pakistan's centrifuge enrichment plant at Kahuta.[28]

- Iraq attempted to acquire vacuum pumps from an American firm—CVC Products, Inc. of Rochester, New York—

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[24]David Ottaway, "Strike on Iraq No Longer an Easy Option for Israel, Analysts Say," *The Washington Post*, March 31, 1989, p.A32.

[25]"New Arms Scandal," *Der Spiegel*, pp.93-94.

[26]"New Arms Scandal," *Der Spiegel*, pp.93-94.

[27]"Iraq and the Bomb," *MidEast Markets*, p.14.

[28]"Iraq and the Bomb," *MidEast Markets*, pp.13-15. Alternatively, Iraq may have received assistance from Brazilian firms with which it has ties. "New Arms Scandal," *Der Spiegel*, pp.93-94.

which can be used to circulate uranium hexafluoride gas through the gas centrifuges during the enrichment process.[29]

- Iraq's large, unsafeguarded stocks of uranium ore concentrate could be converted at its phosphate plant at Al-Qa'im into uranium hexafluoride feedstock required for gas centrifuge enrichment.[30]

In tandem with its efforts to acquire a uranium enrichment capabilty, Iraq is also reportedly working on the design of an implosion-type fission weapon. It has also unsuccessfully attempted to acquire krytons—small capacitors which are used in the detonator assembly of nuclear weapons—from U.S. firms.[31]

Iraq has a second nuclear option, which, however, it is unlikely to pursue at this time. It could construct one or two small, low-yield fission weapons using the 12.5 kg of highly-enriched uranium fuel in its possession.[32] This uranium is, however, subject to IAEA safeguards, such as regular inspection and accounting procedures, and could be diverted for use in a weapon only if Iraq was prepared to renege on its obligations as a signatory to the NPT or formally withdraw

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[29]Steve Mills, "U.S. Seizes Local Firm's Pumps Bound for Iraq," *Rochester Democrat and Chronicle,* March 28, 1989, pp.1A,10A; David B. Ottaway, "U.S. Bars Export of Pumps to Iraq," *The Washington Post,* May 5, 1989, p.A24.

[30]"Iraq and the Bomb," *MidEast Markets,* p.14.

[31]"Iraq and the Bomb," *MidEast Markets,* p.14; Paul Lewis, "Iraq Says It Made an Atom Trigger," *The New York Times,* May 9, 1990, p.A5. According to the latter report, Iraq's President Saddam Hussein announced that Iraq is able to produce versions of the krytons seized, although some experts discount this claim.

[32]Glenn Frankel, "Iraq Said Developing A-Weapons," *The Washington Post,* March 31, 1989, pp.A1,A32. Most experts agree that 12.5 kg of enriched weapons-grade uranium is sufficient for one or two rudimentary fission-type weapons. Spector, *Going Nuclear,* p.327. The 12.5 kg of enriched uranium Iraq currently holds was the first and only consignment of 72 kilograms of enriched uranium contracted for with France in the late 1970s for use in the Tammuz I reactor. "Defiant Paris Ships Uranium to Baghdad," *The Jerusalem Post,* July 13, 1980, pp.1,6.

from the regime.[33] Such an action would be unprecedented in the history of the NPT and could provoke international censure, hindering Iraq's efforts to acquire uranium enrichment and nuclear weapons technology.

OUTLOOK

Iraq's past success in obtaining controlled technologies necessary for enrichment of uranium and the production of ballistic missiles and chemical weapons, and the success of Pakistan and Brazil in constructing unsafeguarded uranium enrichment facilities provides reason to believe that Iraq will eventually achieve a nuclear weapons production capability.[34]

It took both Pakistan and Brazil about a decade to build their respective gas centrifuge enrichment plants and it took Pakistan about two years more to accumulate enough highly-enriched uranium for its first nuclear weapon.[35] Based on

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[33]Under the provisions of the NPT, each party to the treaty "[has] the right to withdraw from the Treaty" with three months advance notice "if it decides that extraordinary events . . . have jeopardized" its "supreme interests." *Arms Control and Disarmament Agreements*, United States Arms Control and Disarmament Agency (Washington: United States Arms Control and Disarmament Agency, 1980), pp.93-94.

[34]For details concerning loopholes in the NPT regime and the IAEA safeguard system see Richard Bolt, "Plutonium for All: Leaks in Global Safeguards," *Bulletin of the Atomic Scientists*, December 1988, pp.14-19; Dan Charles, "Exporting Trouble—West Germany's Freewheeling Nuclear Business," *Bulletin of the Atomic Scientists*, April 1989, pp.21-27; David Fischer, "Safeguards Controversy, Continued," *Bulletin of the Atomic Scientists*, June 1989, pp.38-40; Michael Brzoska, "Behind the German Export Scandals," *Bulletin of the Atomic Scientists*, July/August 1989, pp.32-35.

[35]It took Pakistan about nine years to build its gas centrifuge enrichment plant at Kahuta. The plant reportedly consists of about 14,000 centrifuges, although only about 1,000 are in operation at any one time because of technical problems. Work on the plant commenced in 1975, and production of enriched uranium commenced in 1984. By 1986, Pakistan was believed to have enough enriched uranium to produce its first atomic bomb. Similarly, it took Brazil about a decade to complete its comparatively smaller Aramar gas centrifuge enrichment plant, which commenced operation in 1988 with about 50-75 centrifuges. By late 1988, about 300 centrifuges had been installed, with interim plans to expand to 2-3,000 centrifuges. Brazil's program produces low enriched uranium for nuclear power and research reactors, and—in the future—for nuclear submarine reactors. Spector, *Going Nuclear*, pp.103-104; Barnaby, *The*

these precedents, Iraq could have a nuclear weapons production capability within 10 years. If it receives help from abroad—in the form of official assistance or technology transfer and advice from private firms or individuals—it could be producing nuclear weapons within as little as five years.

If thwarted in these efforts, however, Iraq could probably build one or two small nuclear devices, using the small quantity of highly-enriched uranium it currently possesses, if it was willing to renege on its obligations as a signatory to the NPT or formally withdraw from the regime.

Invisible Bomb, pp.106-112; Albright, "Bomb Potential for South America," *Bulletin of the Atomic Scientists,* pp.18-20; Albright and Zamora, "India, Pakistan's Nuclear Weapons," *Bulletin of the Atomic Scientists,* pp.20-21.

II LONG-RANGE STRIKE SYSTEMS

BALLISTIC MISSILES

Iraq is building a large, diverse inventory of ballistic missiles to provide it with an assured penetration capability against targets throughout the Middle East. During the Iran-Iraq war, Iraq employed missiles on an extensive scale, in strategic as well as tactical roles, to bombard Tehran and other civilian population centers.[1]

Missiles emerged as a significant independent factor in the fighting during the "War of the Cities" from February to April 1988. During this period, Iraq fired nearly 190 Al-Hussein missiles at Tehran and other major Iranian cities. The bombardment of Tehran led to the evacuation of more than one quarter of its population, compelled Iran to cease its bombardment of Iraqi cities and towns, and probably contributed to Iran's decision to accept a cease-fire later that year.

The war dramatically demonstrated that while conventional weapons could not decide the outcome of wars, under certain conditions they could have a decisive impact on the enemy's conduct and will to resist.

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[1]In eight years of war, Iraq reportedly launched a total of about 430 Al-Hussein and Scud-B missiles and Frog-7 rockets, producing approximately 11,600 Iranian casualties. W. Seth Carus, "Missile Attacks in the Middle East," unpublished manuscript, September 18, 1989.

Apparently impressed by the strategic and tactical utility of missiles during the war, Iraq has greatly expanded its arsenal of these weapons and now meets all its requirements for missiles through local production.

INDIGENOUS MISSILE PROGRAMS

Aided by sizeable infusions of foreign technology and expertise—primarily German, Austrian and Italian—Iraq has established a modern industrial infrastructure for missile development and production. It is currently producing two major missile systems armed with conventional unitary warheads, the Al-Hussein and Al-Abbas. In addition, Iraq has reportedly tested another missile—the Tammuz I—and has another missile—the Fahd—under development.[2]

The Al-Hussein and Al-Abbas are extended-range SCUD-B derivatives which were originally produced by cannibalizing Soviet-supplied missiles. Both feature modified SCUD-B rocket motors built by expanding the capacity of the propellent tanks of the basic missile and reducing their high explosive weapons payload in order to extend their range.[3] Modification of the Al-Hussein was reportedly accomplished with the assistance of West German, East German and Egyptian scientists and technicians at a facility near Falluja called Project 124.[4]

The Al-Hussein was first tested in August 1987 and introduced into operational service in the spring of 1988 during the War of the Cities. It is credited with a maximum effective range of 650 km and a Circular Error Probable (CEP) of 500

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[2]Iraq also has modified an unspecified number of SA-2 and SA-3 surface-to-air missiles (known as the Baraq and Kassir) for use in the surface-to-surface mode. They reportedly have ranges of 250 km and 150 km respectively. For details, see "Iraqi Arms Production," *Middle East Defense News*, p.7.

[3]Three cannibalized SCUD-Bs were reportedly required to produce two Al-Hussein missiles. Friday prayer sermon by Iranian Majlis speaker 'Ali Akbar Hashemi-Rafsanjani, carried by Tehran Domestic Service, translated in FBIS-NEA, March 14, 1988, p.61.

[4]"Iraq Goes It Alone on Condor II," *MidEast Markets*, May 15, 1989, p.11.

meters.[5] Building on the Al-Hussein's success, the Al-Abbas reportedly features a range of 900 km and a CEP of 300 meters, although it probably retains the same reduced-yield conventional warhead carried by the Al-Hussein. The Al-Abbas was reportedly first tested in April 1988. Both the Al-Hussein and Al-Abbas are reportedly now produced in Iraq.[6]

While both the Al-Hussein and Al-Abbas offer impressive long-range strike capabilities, their relatively poor accuracy makes them suitable only against large area targets such as population centers. Moreover, their small explosive payload significantly degrades their operational effectiveness.[7] As a result, it would be necessary to fire a relatively large number of Al-Hussein and Al-Abbas missiles in order to obtain militarily significant results. However, due to their low sustained rates of fire, the effect of conventionally armed Al-Hussein and Al-Abbas missiles can only be measured in terms of the cumulative impact of a large number of missile strikes occurring over a relatively long period of time.[8] To rectify this

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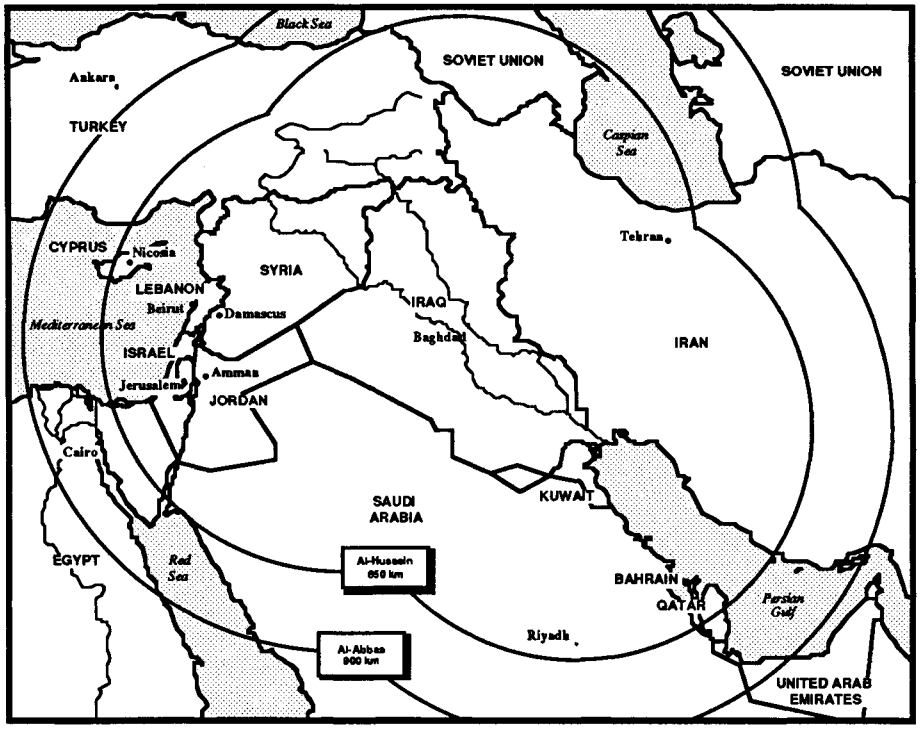
[5]Circular Error Probable is a measure of weapons accuracy. It refers to the radius of a circle within which half of the missile warheads fired at a particular aim point will fall. Early versions of the Al-Hussein probably had CEPs of about 2,000-2,500 meters at maximum effective range, although subsequent improvements to its guidance system and improved production quality controls have probably brought substantial improvements in accuracy.

[6]Referring to the Al-Hussein missile, Deputy Minister of Industry and Military Industrialization, Lieutenant General 'Amir Rashid Al-Ubeidi, stated: "Of course, we cannot manufacture every component of these missiles ourselves, and we have had help from other countries, especially for the more sophisticated components such as gyros. But I can say that the missile itself is Iraqi. We even make parts of the guidance system, using parts purchased abroad or adapted from other weapons systems . . ." Locally manufactured components used in the Al-Hussein and displayed at the Baghdad International Exhibition for Military Production in 1989 include missile body components, various internal fittings and hardware, electronic fixtures and warhead components. "Iraqi Arms Production," *Middle East Defense News*, pp.6-7.

[7]During the War of the Cities, it is likely that more damage was caused by the impact of the Al-Hussein's returning missile body than by weapons effects produced by its reduced-payload warhead.

[8]During the War of the Cities, the maximum number of Al-Hussein missiles launched by Iraq during a single day was eleven (April 7,

shortcoming, Iraq is expected to initiate production of a chemical warhead for these missiles in the near future, substantially increasing their lethality.



Range of the Al-Hussein and Al-Abbas Missiles

The Al-Hussein and Al-Abbas will probably comprise the mainstay of the Iraqi missile program until missiles currently under development—such as the Tammuz I and the Fahd—enter large-scale series production.

1988). Previously, the maximum number of SCUD-B missiles fired by Iraqi and Iranian forces in a single day amounted to thirteen (March 7, 1985) and seven (March 18, 1988), respectively. W. Seth Carus, "Missile Attacks," unpublished manuscript, pp.3,11,16. During the 1973 war, the maximum number of FROG-7 rockets launched by Syrian forces in a single day was seven (October 8, 1973). Arieh Itzhaki, Moshe Lissak, and Yehuda Wallach, *Carta's Atlas of Israel—The Third Decade: 1971-81* (Jerusalem: Carta, 1983), p.66. In each of these cases, sustained rates of fire rarely, if ever, exceeded one missile per launcher per day.

The Tammuz I is a 2,000 km range missile which is probably based, like the Al-Hussein and Al-Abbas, on SCUD-B technology. It was reportedly tested in December 1989. It is not clear, however, whether these were static tests or actual test launches and whether the Tammuz I is slated for operational service or is an experimental prototype.[9] The Fahd is a solid-fuel missile that reportedly will be produced in two versions: one with a range of about 300 km and another with a range of about 600 km. It will reportedly enter production within the next two years.[10]

In addition, until 1988 Iraq was a participant in a joint Argentine-Egyptian-Iraqi venture to develop and produce the Condor II, a two-stage, solid-fuel, medium-range missile with a range of 900 km, a payload of 500 kg and a CEP of about 100 meters. Problems with the program, however, delayed development. Initial test flights, which were reportedly scheduled for 1989, were postponed until 1991.[11] Due to U.S. pressure, Egypt and Argentina eventually withdrew from the program and Iraq proved uninterested in continuing on its own since it was by then well on its way to developing an indigenous missile production capability.[12]

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[9]Carnegy and Mallet, "Iraqi Space Rocket Fuels Fears," *Financial Times*, p.4.

[10]Amy Kaslow, "Iraq Banks on its Oil to Fuel Reconstruction," *Middle East Insight*, January/February 1990, p.44; Melissa Healy, "New Anti-Missile System to Go to Israel, U.S. Says," *Los Angeles Times*, March 9, 1990, p.A9.

[11]The Condor II reportedly had guidance, stage separation and propulsion problems. For details about the Condor II, see Alan George and Herbert Langsner, "The Flight of the Condor," *Profil* (German), March 6, 1989, pp.42-44, translated in FBIS-West Europe, March 7, 1989, pp.5-6; Alan George, "Flight of the Condor," *The Middle East*, April 1989, p.20; "Condor II: An Issue to Test U.S. Egypt Ties," *MidEast Markets*, April 17, 1989, pp.14-15; "Condor II Missile Upsets Israel and the West," *Defence*, May 1989, p.305; "Iraq Goes it Alone," *MidEast Markets*, pp.7,11; "Iraqi Bid to Buy Condor Kit Stopped," *MidEast Markets*, October 16, 1989, p.2; Alan Friedman, "The Flight of the Condor," *Financial Times*, November 21, 1989, p.10; Andrew Slade, "Condor Project in Disarray," *Jane's Defence Weekly*, February 17, 1990, p.295.

[12]W. Seth Carus and Joseph S. Bermudez, Jr., "Iraq's Al-Husayn Missile Programme," *Jane's Soviet Intelligence Review*, May 1990, p.204.

MISSILE DEVELOPMENT AND PRODUCTION FACILITIES

The Saad 16 technology center, located near Mosul in northern Iraq, is the country's primary ballistic missile research and development facility. It includes a missile launch range, high-speed wind tunnels, missile test facilities and chemical and electronics laboratories. Infrastructure for the facility reportedly cost Iraq $200 million and construction was completed in mid-1989.[13] In addition, Iraq has constructed missile production facilities as part of a program designated Project 395, which includes engineering workshops near Falluja (Project 073), a rocket propellent production facility near Mahmudiya (Project 096), and a missile test area for static testing of rocket motors and missile trials near Karbala (Project 1157). Infrastructure for Project 395 reportedly cost $400 million and construction was completed in early 1989.[14]

The Consen Group of companies—a Swiss-based consortium staffed by a large number of former employees of the West German firm Messerschmidt-Boelkow-Blohm GmbH (MBB)—served as prime contractor for both Saad 16 and Project 395. Until early 1989, it ran the international procurement network for acquiring foreign technology and expertise for Iraq's missile program through its subsidiaries in

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[13]Research related to nuclear weapons design is reportedly also conducted there. Barth, "What is Being Tested Here," *Stern*, pp.214-217.

[14]For details on Saad 16 and Project 395, see George and Langsner, "Condor," *Profil*, pp.42-44, translated in FBIS-West Europe, March 7, 1989, pp.5-6; "Everything Completely Harmless," *Der Spiegel* (German), March 27, 1989, pp.170-173, translated in FBIS-West Europe, March 29, 1989, pp.5-6; Alan George and Herbert Langsner, "Death Through DOT," *Profil*, April 24, 1989, pp.38-42, translated in FBIS-West Europe, April 24, 1989, pp.4-6; Alan George and Herbert Langsner, "Rocket Merry-Go-Round," *Profil*, March 20, 1989, pp.36-38, translated in Joint Publication Research Service (hereafter JPRS), Nuclear Development (hereafter TND), May 5, 1989, pp.31-34; "Iraq Goes it Alone," *MidEast Markets*, pp.7,11; "The Same Plant is Under Construction in Romania," *Der Spiegel* (German), May 8, 1989, pp.166-168, translated in JPRS Arms Control (hereafter TAC), May 17, 1989, pp.54-55; Alan George and Herbert Langsner, ". . . And Tomorrow the Entire World," *Profil*, May 8, 1989, pp.29-31, translated in JPRS TAC, May 17, 1989, pp.56-59; Alan George, "Saddam's Secret Weapons," *The Middle East*, June 1989, p.21; "Big Explosion in Iraq, Many Dead—But Was It Important?" *MidEast Markets*, September 1989, pp.11-12.

Germany, Switzerland, Monaco and Argentina.[15] Consen closed down operations in early 1989 having found that as a result of adverse publicity it could no longer conduct business. Consequently, Iraq reportedly reorganized its clandestine missile technology purchasing effort which is now being handled by a Swiss firm, Vufvaltun und Financierung AG (VUFAG).[16]

OUTLOOK

As a result of Iraq's experience during the Gulf War, missiles will continue to comprise the mainstay of its strategic forces. Iraq will continue production of the Al-Hussein and Al-Abbas until a follow-on missile enters series production. Future missiles such as the Fahd will likely offer improvements in terms of accuracy and lethality:

- The use of solid-fuel rocket motors will permit greater mobility, shorter launch preparation times and higher sustained rates of fire.

- Greater accuracy will permit targeting of specific high-value targets.

In addition, Iraq is likely to commence production in the near future of chemical and possibly biological missile warheads, which will greatly enhance its striking power.[17]

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[15]For details about the Consen group see George and Langsner, "Condor," *Profil*, pp.42-44, translated in FBIS-West Europe, March 7, 1989, pp.5-6; George, "Condor," *The Middle East*, p.20; George and Langsner, "DOT," *Profil*, pp.4-6; "The Same Plant," *Der Spiegel*, pp.166-168, translated in JPRS TAC, May 17, 1989, pp.54-55; George and Langsner, ". . . And Tomorrow," *Profil*, pp.29-31, translated in JPRS TAC, May 17, 1989, pp.56-59; George, "Secret Weapons," *The Middle East*, p.21; Friedman, "Condor," *Financial Times*, p.10.

[16]George, "Condor," *The Middle East*, p.20; George, "Condor II Missile Upsets Israel," *Defence*, pp.305-306; Andrew Slade, "Condor Project in Disarray," *Jane's Defence Weekly*, p.295; "The Iraqi Connection," *Middle East Defense News*, April 2, 1990, pp.1-4.

[17]Iraq may also develop more lethal conventional warheads with submunition and fuel-air explosive (FAE) payloads. It already produces submunition rocket warheads and FAE bombs and presumably could

Finally, Iraq will continue to expand and modernize its missile force and may eventually transfer some of its older, less capable systems to third countries. Iraq's unsuccessful attempt to transfer FROG-7 rockets to elements of the Lebanese army in the summer of 1989 may foreshadow future Iraqi actions.

BOMBERS AND STRIKE AIRCRAFT

Iraq's long-range aerial strike capability consists of a mix of older bombers and smaller, more modern and capable strike aircraft. These include Tu-16 Badger and Tu-22 Blinder bombers and the Mirage F-1E and Su-24 Fencer strike aircraft. Iraq has also developed a modest in-flight refueling capability to extend the striking range of its air force.

Iraq is the only Arab country with a combat-proven, operational, long-range aerial strike capability. During the Gulf War, its air force routinely bombed civilian population centers, military installations, industrial facilities, power stations, oil refineries and export terminals and tankers. These bombings inflicted substantial damage on Iran's industrial infrastructure and economy, while causing heavy civilian losses.

In addition, it is worth remembering that, in 1967, Iraq conducted one of the few attempts to bomb an Israeli population center in wartime. On the second day of the Six Day War, four Iraqi Tu-16s attempted to bomb Tel Aviv. Three returned to base prior to entering Israeli airspace while the fourth aircraft dropped its bomb load on Natanya and Afula before being downed by air defense artillery fire on the return leg of its flight.[18]

Iraq operates seven Tu-16 Badger and eight Tu-22 Blinder twin engine bombers. The venerable Tu-16 has a maximum unrefueled combat radius of 3,220 km and can carry a weapons payload of two AS-5 Kelt air-to-surface missiles and up

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produce submunition and FAE missile warheads. *Middle East Defense News*, May 8, 1989, pp.2,3. FAE weapons are reportedly capable of producing, within a limited area, effects approaching those of small-yield nuclear weapons. Chris Bellamy, "Soviet Artillery and Missile Force Challenge," *International Defense Review*, April 1988, pp.347-349.

[18]Ze'ev Schiff, *The Israel Defense Forces Encyclopedia: The Air Force* (Tel Aviv: Revivim, 1981), p.105.

to 9,000 kg of bombs. The Tu-22 has a maximum unrefueled combat radius of about 2,900 km and carries an AS-4 Kitchen anti-radiation missile and up to 9,000 kg of bombs.[19]

While both the Tu-16 and Tu-22 have sufficient unrefueled range to reach targets throughout the region, they are relatively large, slow and vulnerable aircraft. Originally designed for the medium or high altitude bombing role, they are unsuited for penetration missions against modern, integrated air defenses and are not capable of delivering modern ordnance with great accuracy. However, they retain some utility as strategic bombers for penetration missions in relatively benign air defense environments or for the delivery of large payload stand-off air-to-surface weapons. In this role, these aircraft could deliver large conventional or unconventional payloads against area targets.[20]

The mainstay of Iraq's long-range aerial strike capability consists of about 87 French-made Mirage F-1E fighter aircraft. The Mirage F-1E is a modern, multi-role combat aircraft which has an impressive air-to-ground capability. Mirage F-1E variants in service in Iraq are equipped with a range of advanced avionics systems for the ground attack role, including provisions for the delivery of precision-guided munitions such as the French Aerospatiale AS 30L and the Soviet AS-14 Kedge air-to-surface missile.[21] In addition, some variants are equipped with in-flight refueling probes and are configured to carry centerline buddy refueling pods, reconnaissance pods and laser designator pods.[22]

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[19]John W. R. Taylor, ed., *Jane's All The World's Aircraft: 1989-90* (London: Jane's Publishing Incorporated, 1990), pp.280-281,284-285.

[20]Iraq's Nasr ordnance factory reportedly produces a 9,000 kg bomb which can be delivered by the Tu-22. "Iraqi Arms Production," *Middle East Defense News*, p.3.

[21]Iraq has reportedly modified a number of AS-14 Kedge (X-29L) air-to-surface missiles for use with Mirage F-1Es equipped with the Thomson-CSF ATLIS II laser designator pod. *Middle East Defense News*, May 8, 1989, p.2.

[22]Paul Jackson, "Dassault's Mid-life Mirage," *Air International*, March 1988, p.154; Taylor, ed., *Jane's All the World's Aircraft*, pp.69-70.

During the Gulf War, Iraqi F-1Es operating from Qayyarah air base in the north regularly conducted bombing runs against Tehran. Iraqi F-1Es supported by aerial tankers also conducted several long-range raids against Iranian oil rigs and export terminals at the far end of the Gulf during the latter phase of the war. These raids demonstrated Iraq's ability to master in-flight refueling techniques, enabling it to hit targets previously thought to be beyond its range.[23]

However, Iraq's modest in-flight refueling capability can support operations of only limited scope and duration. Its small tanker fleet consists of four converted An-12 transport aircraft fitted with palletized fuel tanks and a single point hose-and-drogue type refueling system. In addition, it possesses a number of large capacity centerline buddy refueling tanks for the Mirage F-1E which likewise rely on a single point hose-and-drogue arrangement.[24] Iraq also suffers from a lack of experience in in-flight refueling operations. It can be expected, however, to improve its proficiency with additional training and experience.[25]

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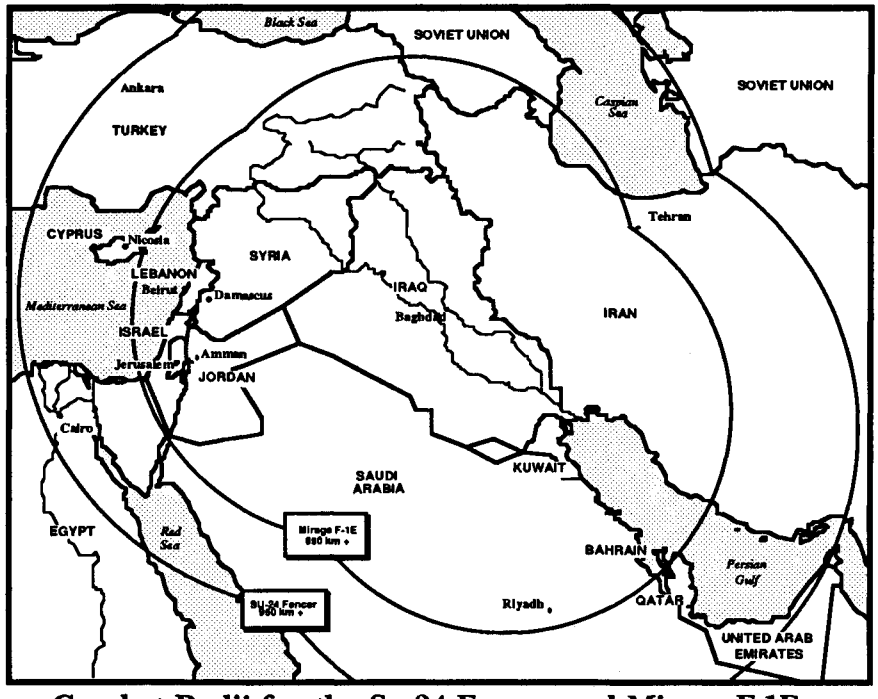
[23]Anthony Cordesman, *The Iran-Iraq War and Western Security* (London: Jane's Publishing Incorporated, 1988), pp.183-185; Edgar O'Ballance, *The Gulf War* (London: Brassey's, 1987), pp.106,114. The straight line distance from Qayyarah to Tehran is approximately 750 km. By comparison, the straight line distance from H-2 air base in western Iraq to Tel Aviv is approximately 575 km. Thus, Mirage F-1Es based at H-2 could reach Israel carrying a reduced combat load without in-flight refueling. According to Dassault data, the Mirage F-1E's lo-lo-lo combat radius with one centerline mounted AM 39 Exocet, two Matra Magic air-to-air missiles, two ECM pods and two 1200 liter external fuel tanks is 700 km (including the 60-70 km range of the AM 39). Substituting a 500 kg bomb for the AM 39 (which weighs 652 kg) the Mirage could deliver the payload equivalent of three Al-Hussein or Al-Abbas warheads, at ranges greater than 650 km—the maximum effective range of the Al-Hussein. Its payload could be increased if it were to carry less fuel and more ordnance and refuel in Jordan during the return leg of its sortie. Paul Jackson, "Mirage," *Air International*, p.154.

[24]Cordesman, *The Iran-Iraq War*, p.114.

[25]For instance, during the first raid on Larak Island (November 25, 1986), two Mirage F-1Es were forced to land in Saudi Arabia during the return leg of the flight when they ran out of fuel following an unsuccessful refueling attempt. O'Ballance, *The Gulf War*, p.185. Iraq has also fitted fixed in-flight refueling probes to some of its MiG-23s, presumably to enable them to escort Mirage F-1Es and Su-24s during



Combat Radii for the Su-24 Fencer and Mirage F-1E (Unrefueled)

Iraq also operates 16 Soviet-built Su-24 Fencer strike aircraft received in 1989. The Su-24 is a formidable two-seat strike aircraft that offers a good combination of range and payload,

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long-range missions. "Iraqi Arms Production," *Middle East Defense News,* p.2.

with a high-speed, low-level penetration capability. The Su-24 represents a significant enhancement in Iraq's military capabilities. It is cleared to carry a variety of Soviet ordnance currently in Iraqi inventories, including AS-7 Kerry, AS-9 Kyle, AS-10 Karen, AS-12 Kegler, and the AS-14 Kedge air-to-surface missiles. It can reach Israel as well as targets at the far end of the Gulf and beyond—Sirri or Larak Islands and Iran's planned oil export terminal at Jask on the Gulf of Oman, for example—from airbases in Iraq without aerial refueling.[26] With the arrival of the Su-24, Iraq's air force has increased its long reach and will be able to reduce its reliance on the relatively short-legged Mirage F-1E.

OUTLOOK

Iraq's air force can deliver greater payloads, with greater accuracy, over greater distances than any missile currently in Iraqi inventories. Although it lacks an assured penetration capability against a modern, integrated air defense system, it would pose a major threat to any potential adversary.[27]

Moreover, the introduction of a new generation of highly accurate, long-range stand-off munitions in the mid-1990s—for example, the British Hunting Engineering SWAARM, the Italian Aeritalia/BPD CASMU and the French Matra APACHE 50—could have a significant impact on Iraqi military capabilities.

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[26]Mike Spick, *Illustrated Guide to Modern Attack Aircraft* (New York: Prentice Hall Press, 1987), pp.80-81; Taylor, ed., *Jane's All the World's Aircraft: 1989-90*, pp.276-277. According to *Jane's*, with 2,500 kg of ordnance on a lo-lo-hi mission profile, the Su-24 fencer has a combat radius of 950 km, while with 3,000 kg of ordnance and two external fuel tanks on a hi-lo-hi mission profile, it has a combat radius of 1,300 km.

[27]Iraq's possible procurement of an unspecified number of French Mirage 2000S strike aircraft (as part of a possible buy of 50 Mirage 2000 multi-role fighters) would further enhance Iraq's aerial strike capability. The Mirage 2000S is a two-seat low-level strike aircraft. It is expected to become available for export by 1993. Taylor, ed., *Jane's All the World's Aircraft: 1989-90*, pp.70-72.

The first example of this new generation of air-to-surface weapons—the French Matra APACHE 50—is expected to enter operational service in 1994 and be available for export soon thereafter. The APACHE 50 is a subsonic cruise missile with an expected range of 150 km (although there are plans for a 400 km version). The APACHE 50 will reportedly be cleared for use by a number of aircraft, including the Mirage F-1 and Mirage 2000.[28]

The acquisition of systems such as the APACHE 50 would enable Iraqi aircraft to attain extended stand-off ranges, enhancing their survivability and effectively extending their combat radii. Such systems would allow Iraq to accurately deliver large volumes of ordnance against high-value targets in an enemy's rear areas—air bases, armories and economic targets, for example—without penetrating enemy airspace. The acquisition of this and other systems like it could finally endow Iraq with a credible aerial strike capability against Israel and thereby have a tangible influence on the Arab-Israeli military balance.

LONG-RANGE ARTILLERY

Iraq has reportedly been developing large "superguns" based on prototypes developed in the 1960s as part of the joint U.S.-Canadian High Altitude Research Project (HARP). Project HARP employed modified 16-inch naval guns to test the concept of using gun-launched rockets as an economical means of placing satellites into earth orbit.[29] In addition, HARP

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[28]The APACHE 50 consists of a rectangular body section (which houses the munition container) fitted with two folding wings capable of carrying a payload of up to 770 kg of anti-runway, anti-armor and anti-personnel submunitions. These submunitions could be used against airfields, SAM sites, command, control and communications facilities, concentrations of armor and troops and industrial targets. The incorporation of radar-defeating stealth features, a terrain-following radar and a vertical reference system to enable low-level flight profiles, will reduce the likelihood of detection. Brian Wanstall, "Flying Dispensers for Stand-off Attack," *Interavia Aerospace Review*, July 1989, pp.717-720; Louis Belian, "APACHE: A Submunition Dispensing Cruise Missile That Will Be Operational in 1994," *Defense and Armament–Heracles*, November 1989, pp.66-68.

[29]In one test, a HARP gun fired a 16-inch sounding projectile to the record altitude of 180 km. Lieutenant General Arthur G. Trudeau,

reportedly demonstrated that the guns could accurately fire rocket-boosted artillery rounds over extremely long ranges—up to 2,000 miles.[30] Project HARP was eventually terminated by the U.S. government in the early 1970s.

Iraq enlisted the assistance of Dr. Gerald Bull, a Canadian engineer and ballistics expert who had been a senior participant in Project HARP, to coordinate and oversee its own effort.[31] Iraq intended to build four prototypes, two possessing 40 meter long barrels with 1 meter bores, and two other guns possessing barrels with smaller 350 millimeter bores. The guns were intended for installation in static firing positions located on or within a hillside and each one was to have been capable of hitting a single target. One of these small bore prototype guns has reportedly been assembled and unsuccessfully test fired at a range near Mosul in northern Iraq.[32]

For Iraq, the principal attraction of these "superguns" was their cost effectiveness (a single unit could reportedly be built for under $10 million) and their potentially high sustained rates of fire compared to missiles. Bull, however, was

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"Project HARP: An Idea Whose Time Has Come?" *Army*, December 1989, p.26. For additional details about the HARP project, see Gerald V. Bull and Charles H. Murphy, *Paris Kanonen: The Paris Guns and Project HARP* (Herford: E.S. Mittler, 1988), pp.219-234.

[30]According to a former chief of Army research and development, "HARP demonstrated that . . . a relatively small solid rocket could deliver a payload of 600 pounds an astonishing 1,150 miles . . . a 400-pound payload could be accurately fired more than 1,600 miles, and a 200-pound payload, almost 2,000 miles." Trudeau, "Project HARP," *Army*, p.26.

[31]Bull had previously assisted the Iraqis in several projects, including the development of Iraq's Majnoon and Fao self-propelled howitzers. Alan George, "Aiming For a Long Reach," *The Middle East*, March 1990, p.17.

[32]"Wide Network of Firms was Working on Iraq Supergun," *The Sunday Times* (London), April 22, 1990, p.A28; Richard Donkin, Simon Henderson, and Peter Bruce, "Spanish Link," *Financial Times*, pp.1,22. See also "Fog Shrouds Death of a Weapons Genius," *The Wall Street Journal*, April 23, 1990, pp.A2,A10.

murdered in Brussels in March 1990, while in March and April of the same year British, Greek, Turkish and Spanish authorities seized steel pipes and other components apparently earmarked for additional "supergun" prototypes. These two events have almost certainly dealt a death-blow to the program.[33]

[33]George, "Long Reach," *The Middle East*, p.17; Michael Evans, Robin Oakley and Stewart Tendler, "MoD Experts Back Super Gun Theory," *The Times* (London), April 13, 1990, pp.1,22; Michael Evans, "Expert's Ballistic Skills Attracted Countries Keen to Build Big Guns," *The Times*, April 14, 1990, p.2; David White, "Inquiry into Iraqi Big Gun Aims at Three Broad Targets," *Financial Times*, April 17, 1990, p.3; Victor Mallet and David White, "Gulf War Origins of the Super-Gun," *Financial Times*, April 18, 1990, p.8; "Wide Network," *The Sunday Times*, p.A28; Donkin, Henderson and Bruce, "Spanish Link," *Financial Times*, pp.1,22.

III STRATEGIC RECONNAISSANCE SYSTEMS

As Iraq enhances its long-range strike capabilities with missiles with greater range and accuracy and more capable strike aircraft, locating and identifying targets at long range in real or near real-time will become increasingly vital. To date, Iraq has relied largely on aerial reconnaissance systems and commercial satellite imagery for strategic intelligence. It is also attempting to develop, with Brazilian assistance, its own military reconnaissance satellite.

Overhead imagery can play a particularly important role in locating and identifying strategic targets. Because most strategic targets are in the enemy's rear, overhead reconnaissance systems are sometimes the only available means for acquiring detailed, accurate and timely target intelligence. Moreover, for aerial strike missions, overhead imagery can provide intelligence concerning the target, enemy air defenses, penetration and egress routes, the terrain and battle damage.[1]

[1]Imagery from overhead reconnaissance platforms has applications beyond situation and target development and battle damage assessment. It can provide information for digital terrain data bases to produce highly accurate digital maps used by navigation and attack systems in some modern strike aircraft. Digital terrain data can also be used to produce various topographic products which illustrate the effects of terrain on enemy air defense capabilities and line-of-sight, assisting in the selection of optimal penetration and egress routes for attack aircraft. Finally, it provides computer-generated images for air-to-ground

During the Gulf War, Iraq's poor long-range reconnaissance capabilities and its failure to effectively exploit what reconnaissance capabilities it did possess prevented it from exploiting its tremendous airpower advantage and conducting effective target development, situation development and battle damage assessments.[2]

AERIAL RECONNAISSANCE SYSTEMS

Aerial reconnaissance systems (manned aircraft and unmanned aerial vehicles) are flexible and responsive collection means, capable of providing detailed, high-resolution imagery on a timely basis.[3] Iraq's primary long-range aerial reconnaissance platform is the Mirage F-1E, which can be fitted with externally mounted reconnaissance pods; the OMERA/Dassault COR2 all-altitude reconnaissance pod for penetration missions and the OMERA/Dassault HAROLD long-range oblique reconnaissance pod for stand-off reconnaissance missions.[4] The HAROLD provides imagery of

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mission simulators which pilots can use for pre-mission rehearsals. For additional details concerning applications for digital terrain data bases, see Pierre Condom, "Mission Simulators," *Interavia Aerospace Review*, November 1989, pp.1295-1299; Colonel Alan L. Laubscher and Sandra J. Cleve, "Improved Topographic Support for the Commander," *Miltary Intelligence*," June 1987, pp.23-26; "SPOT: Acquisition Flexibility + Revisit + Flexibility + Stereo Capability + High Spatial Resolution = Surveillance," SPOT Image Corporation, 1988.

[2]Cordesman and Wagner, *Modern War*, pp.82-84,489,492,540,543.

[3]Often within three hours after recovery. Brian Wanstall, "TacR Moves to Real Time," *Interavia Aerospace Review*, February 1989, p.139.

[4]Iraq also possesses a number of less capable MiG-25Rs. The MiG-25R was originally designed for high-altitude reconnaissance over denied areas and was employed in this role extensively by Iraq during the war with Iran. It mounts four oblique cameras and one vertical internal camera. At a cruise altitude of 24,000 meters, it can provide area coverage of a 70 km wide swath of ground below the aircraft or a limited side-look capability of up to 35 km for stand-off reconnaissance missions. Georg Panyalev, "The MiG-25 Foxbat Weapon System," *International Defense Review*, February 1977, pp.255-260; Cordesman and Wagner, *Modern War*, p.483. In addition, Iraq possesses a number of Marakeb 100 (locally assembled Italian Meteor Mirach 100) remotely piloted vehicles (RPVs) for long-range reconnaissance.

enemy territory from friendly airspace to depths of about 100 km.[5]

In July 1989, Iraqi Mirage F-1Es based in Jordan carried out a number of reconnaissance sorties along the Israeli border. As a result of Israeli demarches to Jordan, these flights soon ceased. In addition to their symbolic purpose, these flights most likely yielded practical information that Iraq could use in a strike against Israel's nuclear reactor at Dimona or other strategic targets in Israel.[6]

COMMERCIAL OBSERVATION SATELLITES

Iraq, like a growing number of countries, has used commercial satellite imagery to supplement intelligence derived from other sources.[7] High quality medium-resolution satellite imagery of almost any part of the world is now available at affordable prices from several commercial sources.

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[5]The OMERA/Dassault COR2 mounts four high-level vertical OMERA 35 cameras with focal lengths of between 44 and 600 mm, one OMERA 70 panoramic camera and a Super Cyclope IR linescan for night reconnaissance missions. The OMERA/Dassault HAROLD mounts a 1,700 mm focal length OMERA 38 camera which provides 2 meter resolution at ranges of 100 km. Jackson, "Mid-Life Mirage," *Air International*, pp.129,154.

[6]Because of Israel's lack of geographic depth, reconnaissance aircraft equipped with long-range oblique cameras can image strategic targets deep in Israel from along the Jordan-Israel border. This recent episode illustrates how a system developed for tactical purposes elsewhere can, within the geographic context of the Middle East, be employed in a strategic role. For more about these flights see Ze'ev Schiff, "The Iraqis are Provoking Israel and the United States," *Ha'aretz*, August 21, 1989, p.2, translated in FBIS-NES, August 21, 1989, p.26; Kenneth Kaplan, "Israel Warns Jordan on Iraqi Military Assistance," *Jerusalem Post International Edition*, September 2, 1989, p.1; *Economist Intelligence Unit (EIU) Country Report-Iraq*, No. 4, 1989, p.7.

[7]During the Gulf War, Iraq reportedly purchased commercial satellite imagery of the combat zone and there is circumstantial evidence that it has purchased imagery of the Israeli reactor at Dimona. Peter D. Zimmerman, "From the SPOT Files: Evidence of Spying," *Bulletin of the Atomic Scientists*, September 1989, pp.24-25; Cordesman and Wagner, *Modern War*, p.418.

The two leading commercial sources of satellite imagery are the French SPOT Image Corporation, which offers 10 meter resolution panchromatic (black and white) and 20 meter resolution multi-spectral (color) resolution imagery, starting at roughly $1500 per scene, and the U.S. Earth Observation Satellite Corporation (EOSAT), which offers 28 meter resolution panchromatic and 80 meter resolution multi-spectral imagery, starting at about $750 per scene. Although resolutions of ten meters and less are generally considered essential for most military applications, sensors with resolutions of 10-30 meters have military applications, such as targeting, maritime reconnaissance, digital mapping and terrain analysis.[8]

Despite their unique capabilities, commercial observation satellites possess certain drawbacks:

- They have a limited revisit capability (the SPOT 2 satellite can revisit a particular target area only once every 3-4 days), precluding continuous coverage of a given area of interest. Moreover, processing and distribution delays limit the timeliness of commercial imagery. More responsive collection systems must be used for detailed, real or near real-time coverage.[9]

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[8]Resolution corresponds to the dimensions of the smallest detail on the ground that a sensor can distinguish. Most commercial observation satellites currently are capable of producing 10-30 meter resolution imagery, although resolution can be increased by employing computer enhancement techniques. For an example of how militarily useful data can be derived from SPOT 10 meter resolution imagery, see William A. Kennedy, "A Peek at the French Missile Complex," *Bulletin of the Atomic Scientists*, September 1989, pp.20-21.

[9]Priority requests for imagery from the SPOT Image Corporation are usually filled within 48 hours, while standard requests from EOSAT are usually filled in 10-12 weeks. However, access to a ground station allows receipt of imagery on a near real-time basis. Saudi Arabia has both SPOT and LANDSAT ground stations which permit it to receive near real-time image data acquired by these satellites anywhere within a 2,500 km radius of the station. Thus, Saudi Arabia obtains real-time SPOT and LANDSAT satellite imagery of Israel, Iraq, Iran, the Persian Gulf and the Red Sea, and if it served Saudi interests it could provide Iraq with direct access to this imagery.

• The operation of commercial observation satellites and the dissemination of their products may be controlled or regulated by foreign governments. Consequently, open access to satellite imagery products cannot always be assured. Requests for imagery considered by these governments to be politically or militarily sensitive might be delayed or denied in certain circumstances. Dependence on a foreign source for satellite imagery could also reveal a country's intelligence requirements or its intentions.[10]

MILITARY RECONNAISSANCE SATELLITES

Iraq's interest in acquiring a dedicated military reconnaissance satellite probably dates to the Gulf War when it received, on a select basis, satellite intelligence from the United States. Iraq was reportedly dissatisfied with the U.S. assistance, maintaining that the satellite intelligence it was provided was often tailored to support politically driven assessments serving U.S. interests.[11]

While satellite reconnaissance systems lack the flexibility and responsiveness of aerial reconnaissance systems, they can provide imagery of denied areas which cannot be overflown by, or are beyond the range of aerial reconnaissance systems. Consequently, they can be an important component of a country's total national intelligence system.

Iraq's efforts to acquire a military reconnaissance satellite have reportedly focused on the purchase of a Brazilian satellite equipped with a French electro-optic sensor package. Since October 1988, Iraq's Scientific Research Center (SRC) has been negotiating with Brazil's Institute for Space Research (INPE) and a private firm, Orbita Aerospace Systems (a joint venture involving several major defense contractors including Embraer, Engesa and Imbel), for the purchase of a military reconnaissance satellite. Negotiations have been delayed by a shuffle in INPE's board of directors and opposition from the Brazilian Foreign Ministry, which has slowed government

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[10]Leonard Spector, "Keep the Skies Open," *Bulletin of the Atomic Scientists*, September 1989, pp.15-20.

[11]Cordesman, *The Iran-Iraq War*, pp.36-38; O'Ballance, *The Gulf War*, p.198.

approval. A contract had not yet been signed as of late 1989, although negotiations were reportedly continuing at that time.[12]

Iraq's military reconnaissance satellite will almost certainly be based on INPE's SSR Remote Sensing Satellite. The SSR, which is currently under development, reportedly will weigh about 150 kg and carry a 40 meter resolution sensor package. It is expected to be placed into orbit by 1994.[13] In addition, Iraq appears to be interested in acquiring a facility to build and test its own satellites.[14]

Even a relatively low resolution sensor package could yield data that could be used for targeting industrial facilities or transportation centers and tracking or targeting maritime traffic such as oil tankers and cargo vessels plying the Persian Gulf. Moreover, a relatively low resolution broad area coverage system could be used to cue other collection assets, such as aerial reconnaissance systems capable of acquiring detailed high resolution imagery. However, in order to achieve ongoing coverage of a given area of interest on a daily basis, Iraq would require a constellation of at least three satellites.

In February 1990, Deputy Minister of Industry and Military Industrialization, Lieutenant General 'Amir Hammud Al-Sa'di, stated in an interview that Iraq's first satellite was "ready for launch." Since Iraq's Brazilian-produced satellite is not expected to be ready before 1994, it is not clear whether the satellite referred to is a technology demonstrator vehicle or a

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[12]*Folha de Sao Paulo*, April 7, 1989, p.G3, translated in FBIS-Latin America (hereafter LAT), April 10, 1989, pp.35-36; Alan George, "Iraq's Sky Spy," *The Middle East*, November 1989, p.19.

[13]For details about Brazil's space program and the SSR Remote Sensing Satellite, see David M. North, "Brazil Plans to Launch its Own Satellites," *Aviation Week & Space Technology*, July 9, 1984, pp.60-61; Pierre Condom, "Brazil Aims for Self-Sufficiency in Space," *Interavia Aerospace Review*, January 1986, pp.99-101; Andrew Wilson, ed., *Interavia Space Directory: 1989-90* (Coulsdon: Jane's Information Group, 1989), pp.4-5.

[14]For details concerning the satellite and negotiations between Iraq and Brazil, see *Folha de Sao Paulo*, March 19, 1989, p.C7, translated in JPRS-NEA, May 10, 1989, pp.49-50; "Brazil in Final Stages of Satellite Contract Talk," *Middle East Economic Digest*, March 31, 1989, p.14; *Folha de Sao Paulo*, April 7, 1989, p.G3, translated in FBIS-LAT, April 10, 1989, pp.35-36; George, "Iraq's Sky Spy," *The Middle East*, p.19.

research vehicle to gather data on space environment conditions.[15]

In accordance with its goal of military self-sufficiency, Iraq is also developing an independent satellite launch capability. On December 5, 1989, it launched a three-stage satellite booster from the space research center at Al-Anbar, west of Baghdad. The Al-'Abed satellite launch vehicle reportedly consisted of a cluster of five strap-on SCUD-B booster rockets topped by a second and third stage and reached an altitude of approximately 63,000 feet during its test launch—too low to place a satellite into orbit. It is not clear whether the purpose of the flight was to validate the booster concept or whether technical problems prevented the separation of the second and third stages.[16]

In either case, the flight of Iraq's 'Abed demonstrated that it does not now have a satellite launch capability. If necessary, it could, however, engage a foreign firm to launch its satellite if it is ready before it can develop an operational booster.

OUTLOOK

Anticipated developments in the technology of aerial reconnaissance and the structure of the remote sensing industry will insure that aerial reconnaissance systems and commercial observation satellites will retain their utility as sources of strategic intelligence for developing countries such as Iraq:

- The introduction of electro-optical aerial reconnaissance systems in the mid-1990s will enhance the responsiveness and timeliness of aerial reconnaissance systems by permitting near real-time receipt of imagery.[17]

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[15]"Iraq Readies Satellite," *The Washington Post*, February 7, 1990, p.A20.

[16]"Satellite-carrier Rocket System Tested," in FBIS-NEA, December 8, 1989, p.23; Carnegy and Mallet, "Iraqi Space Rocket Fuels Fears," *Financial Times*, p.4; "Did Iraq's Rocket Work Properly?" *MidEast Markets*, January 8, 1990, p.10; Patrick E. Tyler, "U.S. Acts to Lessen Tension with Iraq," *The Washington Post*, April 23, 1990, pp.A1,A16.

[17]Electro-optical reconnaissance systems currently being developed will be able to provide imagery products within one minute of an event. The French firm OMERA is reportedly considering development of an

• With the launch of the U.S. LANDSAT 6 in 1991, the Chinese-Brazilian Earth Resources Satellite (CBERS) in 1992, and the Canadian-U.S. Radarsat in 1994, 10-20 meter resolution imagery will become the commercial standard in the remote sensing industry.[18]

• The proliferation of commercial observation satellites will result in more frequent revisits of a given area of interest and provide the consumer with greater choice in the range of capabilities, products and services available.

• The planned launch in 1994 of the first commercial radar satellite, the Canadian-U.S. Radarsat, will, for the first time, provide commercial customers with a near real-time, day and night, all-weather observation capability.[19]

Finally, acquisition of a military reconnaissance satellite in the early or mid-1990s will provide Iraq with a modest near real-time targeting, maritime surveillance and battle damage assessment capability, allowing it to more effectively employ its long-range strike capabilities, cue more flexible and capable reconnaissance systems, and provide expertise and experience for more ambitious and sophisticated future efforts.

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electro-optical version of the HAROLD reconnaissance system currently used by Iraq. Presumably, like most French products, it would be available for export. Jeffrey M. Lenorovitz and Keith F. Mordoff, "Europeans Seek Interoperable Battle Reconnaissance Systems," *Aviation Week & Space Technology*, September 7, 1987, pp.83,85; Wanstall, "TacR Moves," *Interavia Aerospace Review*, pp.139-143.

[18]LANDSAT 6 will provide 15 meter resolution panchromatic imagery, CBERS will provide 19 meter resolution panchromatic and 80 meter resolution multi-spectral imagery, and Radarsat will provide 10 meter resolution panchromatic imagery.

[19]The Radarsat will reportedly provide 10 meter resolution panchromatic imagery, will have a revisit cycle of about 3-4 days, and will not be affected by cloud cover or darkness. In addition, Radarsat International intends to establish a network of ground stations to provide customers with real-time imagery. David Hughes, "Team of Canadian, U.S. Firms Begins Detailed Design Work on Radarsat," *Aviation Week & Space Technology*, February 12, 1990, pp.111,115.

IV IRAQ'S NEW STRATEGIC CAPABILITIES: IMPLICATIONS

IRAQ: THE NEW ACTIVISM

Iraq emerged victorious from its eight-year war with Iran with new-found confidence, the largest and most experienced armed forces in the Arab world, and new strategic capabilities which have provided it with increased political freedom of action. Since the conclusion of its cease-fire with Iran in August 1988, moreover, Iraq has increased its margin of military superiority over Iran and no longer faces a substantial military threat from this quarter. As a result of its improved strategic situation, Iraq has embarked on an increasingly aggressive and dangerous regional policy.

Immediately following the cease-fire, Saddam Hussein exploited his military advantage in an attempt to once and for all resolve the Kurdish problem. The resolution of this issue by force—the government launched a brutal military offensive and then resettled remaining Kurds—marks a major turning point in modern Iraqi history and substantially improves Iraq's internal security situation.[1] At about the same time, Iraq pressured Kuwait in an unsuccessful attempt to obtain long-term leases of Kuwait's Bubiyan and Warba Islands at the

[1]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.

mouth of the Shatt Al-'Arab, to secure its access to Umm Qasr, its sole serviceable port on the Persian Gulf.

In late 1988, Iraq commenced deliveries of large quantities of arms to units of the Lebanese army fighting Syrian forces in Lebanon, to punish Syria for its support for Iran during the war and undermine its influence in Lebanon. These arms shipments ceased in September 1989.[2]

Iraq, moreover, has abandoned its wartime policy of disengagement from the Arab-Israeli conflict and has enhanced its military cooperation with Jordan. It is motivated by a desire to secure its own western flank, shore up an increasingly insecure Hashemite regime, and lay the foundation for a rejuvenated Eastern Front against Israel. It has taken a number of steps to achieve these ends, including:

- The transfer to Jordan of captured Iranian arms and Iraqi ammunition.[3]

- The integration of air defense systems and the sharing of early warning data.[4]

- Increased intelligence cooperation.

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[2]As of October 1988, arms transferred reportedly included T-55 tanks, 20 armored personnel carriers, 18 multiple rocket launchers, 3 batteries of artillery, 30 heavy machine guns and approximately 100,000 rounds of ammunition of various types. Beirut Domestic Service, October 18, 1988, translated in FBIS-NEA, October 19, 1988, p.44. Testimony of John Kelly, Assistant Secretary of State for Near Eastern and South Asian Affairs, concerning U.S.-Iraq relations before the Europe and Middle East Subcommittee, House Foreign Affairs Committee, April 26, 1990.

[3]Iraq reportedly transferred 90 Chieftain tanks, 60 M-47 tanks, 19 Scorpion armored reconnaissance vehicles, 35 M113 armored personnel carriers, and quantities of ammunition. The total value of the arms transferred has been estimated at about $500 million. Amman Domestic Service, translated in FBIS-NEA, August 17, 1988, p.14.

[4]Initial steps to enhance air defense cooperation reportedly date to the aftermath of the Israeli raid on Iraq's Osiraq reactor in 1981.

• Efforts to promote force standardization and interoperability.

• Periodic reconnaissance flights along the Israel-Jordan border by Iraqi aircraft.

• Plans to form a joint air force squadron and possibly a joint armored brigade.

• Visits by Iraqi division commanders to the Israel-Jordan border area.[5]

Iraq's growing military involvement in Jordan creates a heightened potential for a confrontation. Israeli aircraft frequently overfly Jordan and the presence of Iraqi pilots there creates the potential for a miscalculation which could lead to a clash. Such an incident could not only spark a crisis between Iraq and Israel with the attendant threat of escalation, but it undoubtedly would heighten tensions throughout the Middle East and could undermine the already delicate peace between Egypt and Israel.

The area in which Iraq's new strategic capabilities have yielded the greatest benefits have been in providing Iraq with a credible deterrent vis-a-vis Israel. Saddam Hussein's self-confident declarations notwithstanding, Iraq clearly feels increasingly threatened by Israel and the United States.[6] The combination of its fear of an Israeli preventive strike against its strategic weapons facilities and its acquisition of missiles and aircraft capable of reaching Israel has impelled Hussein to attempt to define, through words and actions, the parameters of Iraq's deterrent relationship with Israel:

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[5]These visits enable Iraqi commanders to familiarize themselves with the terrain along the border and plan the wartime deployment of Iraqi ground forces there.

[6]In January 1989, *The New York Times* reported that "Israel has asked the United States to pass a warning on to Iraq that if it continues [its] biological weapons program, the Israelis will act to destroy it." Stephen Engelberg, "Iraq Said to Study Biological Arms," *The New York Times*, January 18, 1989, p.A7.

• In June 1989, Iraq commenced construction of a number of missile bases consisting of static launchers for its Al-Hussein and Al-Abbas missiles at various locations throughout Iraq. Beyond the obvious military purpose of these bases, they also serve a symbolic purpose by tangibly underscoring Iraq's ability to retaliate against potential adversaries. The vulnerable forward location of two of these bases at H-2 and H-3 in western Iraq sends a message to Israel of Iraq's ability to retaliate, as well as its perception of a need to counter a threat from that quarter.[7]

• In July 1989, Iraq commenced aerial reconnaissance flights along the Jordanian-Israeli border, employing Iraqi Mirage F-1E aircraft based in Jordan. These flights reportedly ceased as a result of Israeli demarches to Jordan. Against the background of Iraqi fears of an Israeli preventive strike, these flights may have been intended, in part, to warn Israel that the road to Baghdad is a two way street. They may have also yielded information about Israel's nuclear reactor at Dimona, which is no more than 35-40 km from the border and well within the swath covered by the Mirage F-1E's reconnaissance cameras.

• In April and May 1990, Hussein issued a series of verbal warnings to Israel—at times using inflammatory language which exacerbated tensions—intended to reinforce earlier non-verbal signals and deter Israel by threatening retaliation in response to an attack.[8] Hussein was reacting to what he

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[7]Bill Gertz, "Baghdad Deploying Missiles," *The Washington Times,* March 29, 1990, pp.A1,A8; Michael R. Gordon, "Iraq Said to Construct Launchers for Missiles in Range of Tel Aviv," *The New York Times,* March 30, 1990, p.A4; Bill Gertz, "Iraqi Bases Capable of Firing Missiles at Israel, U.S. says," *The Washington Times,* May 18, 1990, p.A7.

[8]According to Hussein, the anti-Iraq campaign included criticism of Iraq's execution of British journalist Farzad Bazoft in March for espionage, accusations that krytons it attempted to smuggle from the United States later that month were intended for use in nuclear weapons, and claims that pipes seized in the United Kingdom in April were gun barrel sections for a HARP-type "supergun." Hussein claimed that "this campaign is intended to create the psychological, media and political cover for Israel to attack us the way it did in 1981. The campaign also is similar to that which took place in 1981, though this one is

construed as a U.S.-British-Israeli campaign to sully Iraq's reputation and prepare international opinion for an Israeli preventive strike. Taken together, these statements comprise a doctrine of deterrence and retaliation:

1. Iraq would retaliate for any Israeli strike against its territory.

2. Iraq would respond to an Israeli nuclear strike with chemical counterstrikes.

3. Iraq would come to the assistance of an Arab state threatened by foreign aggression if requested to do so.

4. Authority to retaliate with chemical weapons for an Israeli nuclear strike has been delegated to commanders of missile units and air bases.[9]

Hussein's heated rhetoric, particularly his threat in early April 1990 to "make fire eat up half of Israel" if "it tried (to attack) Iraq" sparked a mini-crisis which abated only after Israel conveyed assurances to Iraq via Egypt that it was not planning to attack.[10] This episode demonstrated the potential for instability inherent in the current situation and underscored the depth of Iraq's deep-seated insecurity and suspicion of U.S. and Israeli intentions. Moreover, the basic conditions which led to the crisis—Iraq's regional ambitions, its growing involvement in the Arab-Israeli arena and its fears of the United States and Israel—remain.

As a result, the potential for a future crisis remains. President Hussein's offer to extend a security umbrella to any Arab state "from the East to the West" which is a victim of

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harsher." Baghdad Domestic Service, translated in FBIS-NEA, April 17, 1990, p.7.

[9]For the text of these statements, see the Appendix.

[10]Speech by Saddam Hussein on April 1, 1990 at a ceremony honoring the minister of defense, minister of industry and military industrialization, and members of the general staff, translated in FBIS-NEA, April 3, 1990, p.35; David Makovsky, "Israel to Egypt: No Attacks Planned," *The Jerusalem Post International Edition*, May 26, 1990, pp.1,2.

"foreign aggression" provides an indication of the breadth of Hussein's ambitions and the enhanced regional role he is seeking for Iraq. It also creates uncertainties about Iraqi intentions.[11] In addition, his statement that "commanders of . . . air bases" and "missile formations" have been authorized to employ chemical weapons "once they hear Israel has hit any place in Iraq with the atomic bomb" raises questions about Hussein's ability to effectively control his subordinates and escalation in the event of a crisis.[12] Finally, Israel now has to consider that any preventive strike against Iraq would prompt automatic retaliation, raising questions about Israel's options and future conduct.

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[11]Speech by Saddam Hussein, translated in FBIS-NEA, April 3, 1990, p.32.

[12]Remarks by Saddam Hussein on April 12, 1990 to a delegation of U.S. senators, carried by Baghdad Domestic Service, and translated in FBIS-NEA, April 17, 1990, p.7.

V IRAQ AND ISRAEL: EVOLUTION OF THE DETERRENT RELATIONSHIP

ISRAEL: FROM PREVENTION TO DETERRENCE

Iraq has played a major role in nearly every Arab-Israeli war, having sent ground forces to fight against Israel in 1948, 1967 and 1973. Consequently, Israel has traditionally perceived Iraq as a conventional threat. In the late 1970s, however, the Israeli perception of the Iraqi threat began to change as a result of Iraq's progress in developing the infrastructure for a nuclear weapons program.

Israel initially attempted to block the progress of Iraq's nuclear program through diplomatic demarches to France and Italy, the primary suppliers of nuclear technology and expertise to Iraq. It also undertook covert actions such as the destruction in France in April 1979 of two reactor cores awaiting shipment to Iraq. When these efforts succeeded in delaying but not blocking the program's progress, Israel launched the 1981 raid on the Osiraq reactor.[1]

The success of the operation obscured the difficulties in its planning and execution. The Osiraq raid was conducted by eight F-16s, each carrying two conventional 1,000 kg free-fall bombs, escorted by six F-15s. The aircraft flew the 2,000 km round trip without refueling. Though the mission was

[1]Schiff, *The Air Force*, p.199.

conducted under nearly ideal conditions—a surprise attack by a relatively small number of aircraft against a single, relatively large and vulnerable target—it was one of the most difficult and dangerous operations Israel's air force has ever conducted.[2] The aircraft were in hostile airspace for the duration of the mission and the F-16s were operating at close to their maximum combat radius. They would have lacked endurance to engage in sustained aerial combat or evasive maneuver had they been challenged by Jordanian, Saudi or Iraqi aircraft.[3]

For these reasons, it would be wrong to assume that Israel will inevitably resort to preventive military action in the future to thwart Iraqi nuclear proliferation.[4]

Moreover, while the decision to resort to preventive military action fit in with Israel's preference for prevention and preemption, it did not reflect a traditional tenet of the country's national security doctrine.[5] There was, in fact, substantial

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[2]Spick, *Modern Attack Aircraft*, pp.96-97.

[3]For insights into the difficulties associated with long-range operations in general and the Osiraq raid in particular, see LTC Yehuda Weinraub and Tony Gadot, "Long-range Operations in the Israeli Air Force," *Israel Defense Forces Journal*, Spring 1986, pp.27-33, and Major General David Ivri, "The Attack on the Iraqi Nuclear Reactor: June 1981," in the *The War Against Terror* (Hebrew), (Tel Aviv: Revivim, 1988), pp.31-35.

[4]A preventive strike is launched to avert a perceived future threat by an adversary or enemy, while a preemptive strike is launched in response to specific indications of an enemy intent to attack. The rationale for Israel's preventive strike popularly came to be known as the "Begin Doctrine," which stated that Israel would not "permit an enemy to develop weapons of mass destruction against the people of Israel" and would use "all the means at [its] disposal" if necessary to do so. It is worth noting that the "Begin Doctrine" applied not only to nuclear weapons but to all "weapons of mass destruction." This presumably includes chemical and biological weapons as well. See the Israeli government statement published following the bombing, translated in FBIS-NEA, June 9, 1981, p.I-1.

[5]Senior defense officials and military officers opposing the strike included Deputy Defense Minister Mordechai Zippori, Director of Military Intelligence, Major General Yehoshua Sagi, Chief of the Mossad, Major General Yitzhak Hofi and Director of the Defense Ministry's National Security Unit, Major General Avraham Tamir.

disagreement in the government and military over the desirability of military action when the Osiraq raid was planned.

Finally, Israel can no longer be certain that it could destroy Iraq's nuclear facilities, which have reportedly been dispersed, hardened and concealed and may no longer be vulnerable to conventional air attack.[6] In addition, it would have to destroy or neutralize Iraq's retaliatory capability—its missiles, strike aircraft and chemical weapons stocks—to preclude a retaliatory counterstrike. However, it probably does not have the capability to do so since these forces have been protected against conventional attack.

IRAQ: A CREDIBLE RETALIATORY CAPABILITY

All major components of Iraq's strategic forces are protected by hardened facilities to ensure their survivability against conventional air attack and assure a credible retaliatory capability:

- Iraq's Al-Hussein and Al-Abbas missiles are kept in hardened bunkers and critical facilities at missile launch sites are hardened as well. These missiles provide an assured penetration capability against all existing defenses in the region.[7]

Shlomo Nakdimon, *Strike First* (New York: Pitman Publishing, 1987), pp.160-161,165-166.

[6]Ottaway, "Strike on Iraq," *The Washington Post*, p.A32.

[7]Israel is currently investigating active defensive measures intended to reduce the potential threat of missile attacks against civilian population centers. It is currently evaluating an interim Anti-Tactical Ballistic Missile (ATBM) defense which it could receive as early as 1991. An ATBM defense would cost about $100 million and would consist of two Patriot surface-to-air missile firing units (two launchers per firing unit), missiles (four missiles per launcher) and a tie-in to the United States Air Force's Defense Support Program early warning satellite system. The Patriot is, at best, however, an expensive stop-gap measure that could provide only a limited degree of protection to a small number of potential targets. In addition, Israel is pursuing the development of the Israel Aircraft Industries (IAI) Arrow ATBM. The Arrow is not expected to be deployed, however, for at least another five years. Melissa Healy,

• Part of Iraq's missile force is mounted on mobile towed launchers located in relatively secure, well protected rear areas and would be very difficult to locate and destroy.[8]

• Air bases can conduct operations under nuclear, biological and chemical warfare conditions and are equipped with hardened aircraft shelters that can withstand nuclear blast effects.[9]

• Chemical weapons stockpiles are dispersed at several sites and kept deep underground in reinforced concrete bunkers.[10]

Even if only a few Al-Hussein or Al-Abbas missiles survived an Israeli preventive strike, they could inflict heavy losses on Israel. Israel is a small, demographically compact and vulnerable country; nearly 60 percent of its population of 4,403,000 is located in the narrow coastal strip between Haifa and Ashdod.[11] Moreover, the tight-knit nature of Israeli society and a variety of historical and cultural factors make the country highly sensitive to casualties. This point was underscored by the Director General of Israel's Ministry of Defense, Major General (Res.) David Ivri, in a recent interview. When asked about Israel's ability to withstand missile and chemical strikes against civilian population centers, he responded:

> Are we as a state and as a people ready for this challenge and able to deal with it? In my opinion, no .

"New Anti-Missile System to Go to Israel, U.S. Says," *The Los Angeles Times*, March 9, 1990, pp.A1,A9.

[8]Gertz, "Baghdad Deploying Missiles," *The Washington Times*, pp.A1,A8; Gertz, "Iraqi Bases Capable," *The Washington Times*, p.A7.

[9]"The Race to Armageddon," *Middle East Defense News*, April 2, 1990, p.4.

[10]Hersh, "Iraqis Made Use of a Nerve Gas," *The New York Times*, pp.A1,A6. According to this report, the U.S. and Israel had discussed, on at least one occasion, the possibility of a preventive strike against Iraqi chemical weapons production and storage facilities.

[11]*EIU, Country Profile 1988-89-Israel*, pp.7-8.

> . . Even if only a few missiles fell on Tel Aviv the country's morale or psychology would not be the same again.[12]

It can be safely assumed that Iraq's current inventory of Al-Hussein and Al-Abbas missiles could inflict severe punishment on Israeli civilian population centers. As an indication of their potential, during the War of the Cities Iraq fired about 190 Al-Hussein missiles armed with reduced-yield conventional warheads at Tehran and several other cities, killing more than 2,000, injuring 6,000 (for an average of about ten killed and thirty wounded per missile strike) and causing significant damage.[13] Although Israel's nation-wide network of bomb shelters would provide effective protection against attacks by conventionally armed missiles and help to reduce casualties, the physical and psychological effects of these attacks and their impact on Israeli morale would be significant.

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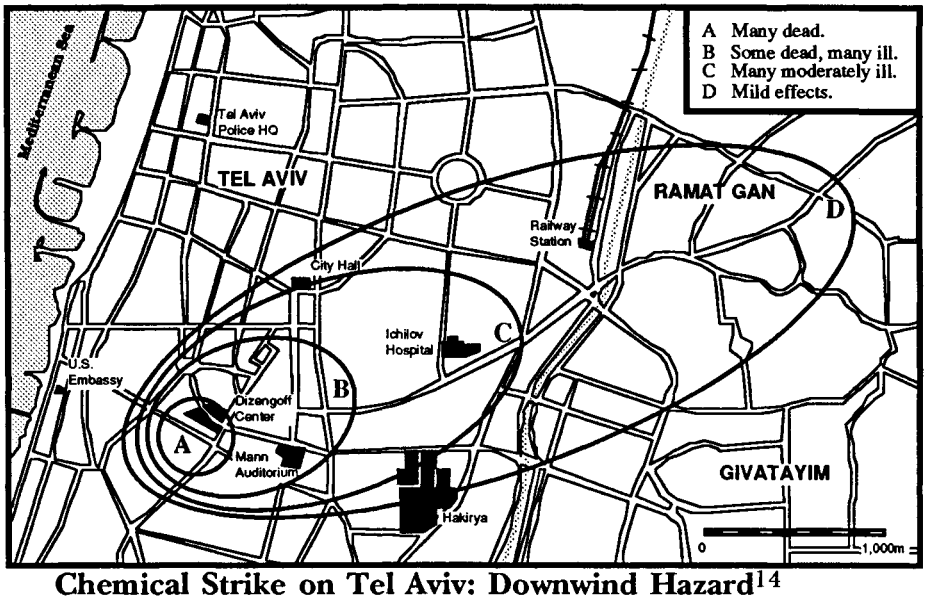
[12] *Yediot Aharonot*, April 29, 1990, translated in *Mideast Mirror*, April 30, 1990, p.7. Because of Israel's sensitivity to casualties, the threat posed by even conventionally-armed Egyptian SCUD-Bs during the 1973 war was sufficient to deter it from launching a strategic bombing campaign against Egypt in retaliation for the Egyptian launch of an AS-5 Kelt ASM against Tel Aviv during the first day of the war. By contrast, Syrian use of Frog-7 rockets against targets in northern Israel prompted a massive strategic bombing campaign of Syria, because it did not then possess SCUD-B missiles or any other credible means of retaliation. Schiff, *The Air Force*, p.171.

[13] Carus and Bermudez, Jr., "Al-Husayn Missile," *Jane's Soviet Intelligence Review*, p.244. Iranian casualties would probably have been higher if not for various civil defense measures. More than one quarter of Tehran's population of 10 million evacuated the city during this period, staying with relatives in cities not under attack or in a government-run evacuation camp with tents, electricity and medical facilities 10 km northwest of the city. Some wealthier residents stayed in large, reinforced-concrete luxury hotels, whose intermediate floors provided a degree of protection from roof or street-level missile strikes. Warren Richey, "Iranians Await Iraqi Attacks in Campgrounds and Luxury Hotels," *The Christian Science Monitor*, April 15, 1988, p.11.



Chemical Strike on Tel Aviv: Downwind Hazard[14]

The effects of a strike by an Al-Hussein, Al-Abbas or similar missile armed with a chemical warhead on an Israeli civilian population center would be even more devastating. Casualty figures are difficult to predict, as they would depend upon a number of factors, including the altitude of the burst, air temperature, wind speed and direction, time of day and amount of advance warning.[15] A single missile strike against downtown Tel Aviv could kill hundreds of civilians and injure many thousands of others who would suffer various

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[14]Data on weapons effects derived from The International Institute for Strategic Studies, *The Military Balance: 1988-1989* (London: Brassey's, 1988), p.248.

[15]With an average population density of nearly 6,000 persons per square kilometer in the greater Tel Aviv area, up to 25,000 people could be in the downwind hazard area created by a chemical missile warhead. Only some of the persons within the downwind hazard area, however, would be exposed to lethal doses since uniform dispersion of the agent would probably be hindered by the effects of building, street and wind patterns on air movements at street and building level. State of Israel Central Bureau of Statistics, *Statistical Abstract of Israel: 1986* (Jerusalem, 1986), p.29.

immediate or delayed effects, including temporary or permanent incapacitation.[16]

However, with even minimal advance warning, civilians could implement simple countermeasures—donning protective masks and closing apartment doors, windows and air vents—that could greatly reduce casualties. Israel has recently taken steps to diminish the threat posed by chemical attacks by distributing protective masks and antidote kits to its civilian population, and by incorporating equipment familiarization, casualty treatment, evacuation and decontamination drills in civil defense exercises.[17] However, defense against chemical attacks on civilian population centers will remain a major problem, as no amount of peacetime training can adequately prepare civilians for an actual attack.

ISRAEL'S RETALIATORY DETERRENT

Lacking a viable preventive option, Israel has relied instead on its capacity for massive retaliation to deter the use of chemical weapons and missiles.[18] Defense Minister Yitzhak

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[16]These estimates are in general agreement with those of Israel's Chief Civil Defense Officer, Brigadier General Aharon Vardi. According to Vardi, " . . . [t]he launch of a single conventionally armed missile against a civilian population center would cause a relatively small number of casualties. This depends, of course, on the type of missile, the nature of the strike, the level of missile accuracy, defensive measures, etc. In the case of a salvo of missiles, losses will be higher. Estimates speak of several tens of casualties, depending on the circumstances. In the case of missiles armed with chemical warheads, the number of casualties will be higher and could reach several thousands." Yossi Melman, "Exclusive interview with Chief Civil Defense and Civil Guard Officer, Brigadier General Aharon Vardi," *Bit'aon Heyl HaAvir*, October 1988, p.24.

[17]Ariel Levite, "Israel Intensifying Preparations to Counter Chemical Attack," *Armed Forces Journal International*, May 1990, p.69.

[18]In a recent interview, Israeli Chief of Staff Lieutenant General Dan Shomron cited Israel's past success in deterring the use of chemical weapons as reason for believing this deterrence would work in the future: " . . . even in their past wars with us, the Arab countries possessed means of gas warfare. As far back as in 1967, Egypt possessed gas. Of course, in 1973, during the Yom Kippur war, the Arab countries possessed gas. Naturally, this was the case also during the Lebanon campaign. But they never used it, and there is a reason for this. This type

Rabin explained Israel's deterrent policy in an interview in July 1988:

> One of our fears is that the Arab world and its leaders might be deluded to believe that the lack of international reaction to the use of missiles and gases gives them some kind of legitimization to use them. They know they should not be deluded to believe that, because it is a whole different ball game when it comes to us. If they are, God forbid, they should know we will hit them back 100 times harder.[19]

Israel's undeclared nuclear and chemical capabilities and its impressive conventional capabilities constitute the foundation of its retaliatory deterrent. This includes F-15, F-16 and F-4 strike aircraft, and Jericho I, II and IIb missiles, capable of delivering nuclear, chemical and conventional payloads.[20]

Israel's 50 F-15, 75 F-16 and 125 F-4E aircraft are capable of striking targets throughout much of Iraq and its air force has demonstrated, on several occasions, an impressive long-range strike capability.[21] During the 1973 war, in retaliation for the

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of weapon invites [a] very harsh reaction." Israel Defense Forces Radio, translated in FBIS-NEA, March 10, 1988, p.37.

[19]Jerusalem Domestic Service, translated in FBIS-NEA, July 21, 1988, pp.28-29. Israeli leaders have also stated that they believe that under current conditions it is possible to deter Iraq. In a recent interview, Chief of Staff Lieutenant Dan Shomron stated that "I find it inconceivable that [Iraq] would freely use missiles or chemical weapons against Israel as they did against Iran and are doing against the Kurds, because they know that we have a powerful response capability." *Yediot Aharonot*, September 23, 1988, pp.6-7, translated in JPRS-NEA, December 6, 1988, p.36.

[20]Israel reportedly possesses between 100-200 nuclear weapons of various types as well as blister and nerve agent stocks. "Revealed: The Secrets of Israel's Nuclear Arsenal," *The Sunday Times*, October 5, 1986, pp.1-3; W. Seth Carus, "Chemical Weapons in the Middle East," Policy Focus Number Nine, The Washington Institute for Near East Policy, December 1988, p.3.

[21]Israel's long-range aerial strike capability will undergo additional improvements in the coming years. Of the 60 F-16C/D Block 40 aircraft to be delivered to Israel starting in 1991 as part of the Peace Marble III program, 20 will be optimized for long-range low-level night attack missions. Moreover, Israeli F-4Es have an enhanced ground attack

launch of Syrian FROG-7 rockets against civilian targets in northern Israel, Israel launched a wide-ranging strategic bombing campaign against Syria, hitting the general staff and air force headquarters in Damascus and economic and military targets throughout the country. In less than 100 sorties, the Israel Air Force succeeded in destroying about 50 percent of Syria's oil supplies and about 45 percent of Syria's electrical power generation capacity. In all, the bombing campaign is estimated to have caused Syria about $4.5 billion in losses.[22]

Israeli inventories include between 100-150 Jericho missiles. The Jericho is a mobile, solid-fuel missile, which has been produced in several variants that can be armed with nuclear, chemical and conventional high explosive warheads. The Jericho I, developed in the late 1960s, has a range of about 600 km, the Jericho II, developed in the late 1970s has a range of about 900 km and the Jericho IIb, developed in the late 1980s, has a range of about 1500 km. They are reportedly kept in hardened underground bunkers in southern Israel and are launched from mobile transporter-erector-launchers.[23]

Because of the distribution of Iraq's population and industrial infrastructure, Israeli retaliation could inflict significant damage on Iraq's economy, industrial

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capability under the Sledgehammer 2000 modernization program. Tim McGovern, *McDonnell F-4E Phantom II*, Aerofac Minigraph 20, 1987, p.7; Brian Wanstall, "Life After Lavi," *Interavia Aerospace Review*, July 1989, p.724.

[22]Schiff, *The Air Force*, p.173; Yahya Sadowski, "Patronage and the Ba'th: Corruption and Control in Contemporary Syria," *Arab Studies Quarterly*, Fall 1987, p.449.

[23]Arthur F. Manfredi, Jr. et al, "Ballistic Missile Proliferation Potential of Non-Major Military Powers: An Update," Congressional Research Service Report for Congress, August 6, 1987, pp.37-40; Carol Giacomo, "Group Says Document Proves Israel Has Nuclear, Chemical Arms," Reuters Information Services, Inc., November 14, 1989. Iraq claims to have successfully tested an ATBM, the FAW-1, with a 70 km range in November 1988. It has since deployed it on a limited basis, although there is some doubt as to whether it is in fact an operational system. "Iraqi Arms Production," *Middle East Defense News*, pp.7-8; Guy Willis, "Baghdad Show Reveals Iraqi Military-Industrial Capability," *International Defense Review*, June 1989, p.837.

infrastructure and population with a relatively small number of sorties or missile strikes against a number of select, high-value targets.

Baghdad, which is within range of Israeli aircraft, accounts for about 30 percent of Iraq's total population of 17,250,000, while three other major cities—Basra, Mosul and Kirkuk—account for another twenty percent. This degree of demographic concentration makes Iraq vulnerable to strategic bombing directed against its civilian population and the infrastructure which supports these cities.[24]

In addition, a large number of Iraq's senior politicians and military leaders are relatives or associates of President Saddam Hussein and come from his home village of Tikrit, northwest of Baghdad. Israel could strike a painful blow at the very foundation of the Iraqi regime by targeting Tikrit in retaliation for strikes against Israeli population centers.[25]

Moreover, the economy of Iraq is highly dependent on oil exports as a source of income and foreign exchange and Iraq's oil industry tends to be dependent on a relatively small number of major production, refining, distribution and storage facilities, all of which are highly vulnerable. Two oil refineries within striking range of Israeli aircraft—those at Daura and Baiji—account for over 65 percent of Iraq's total domestic refining output. In addition, approximately 30 percent of all Iraqi crude oil exports flow through the highly vulnerable oil pipeline that connects Basra to Saudi refineries and terminals at the Red Sea city of Yanbu, which is also within range of Israeli air and naval forces.[26]

Also, because of war damage to Iraq's Gulf port facilities and oil export terminals, it remains, to some extent, dependent on

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[24]*EIU, Country Profile 1989-90: Iraq*, p.6-7.

[25]For details concerning the predominance of the Tikritis, see Hanna Batatu, *The Old Social Classes and the Revolutionary Movements of Iraq* (Princeton: Princeton University Press, 1978), pp.1088-1093; Amazia Baram, "The Ruling Political Elite in Ba'thi Iraq, 1968-1986: The Changing Features of a Collective Profile," *International Journal of Middle East Studies*, November 1989, p.450.

[26]John Cranfield, "Planning for Reconstruction," *Petroleum Economist*, October 1988, p.326; *EIU, Country Profile 1989-90: Iraq*, pp.22-26; *Middle East Economic Digest*, January 26, 1990, pp.6-7,18.

the vulnerable Jordanian port of Aqaba as a transhipping point for dry cargo. Although Iraq's reliance on Aqaba has declined as its Gulf port terminals are repaired and brought back into service, Aqaba is likely to remain important to Iraq for some time to come.[27]

Nonetheless, the difficulties for Israel of conducting a sustained strategic bombing campaign against Iraq should not be understated. The prospect of long transits over hostile territory through alerted enemy air defenses in order to reach targets at distances close to the maximum combat radii of its aircraft entails substantial risks. In addition, Iraq's demonstrated ability to absorb massive casualties and damage to its industrial infrastructure raises the threshold of damage that Israel must be capable of inflicting to credibly deter the Iraqis.

Consequently, Israel might choose to retaliate against installations at Aqaba and Yanbu in Saudi Arabia and it might even be compelled to employ missiles and unconventional weapons against targets in Iraq. Thus, the requirements for massive retaliation could entail both the horizontal and vertical escalation of an initially limited conflict. Iraq has to consider that any potential conflict with Israel could lead to rapid escalation and produce casualty rates which no society could afford to sustain.

IMPLICATIONS OF THE NEW BALANCE OF DETERRENCE

Iraq's development of long-range strike systems capable of hitting targets in Israel and its acquisition of a credible retaliatory capability has transformed the nature of the Iraqi-Israeli relationship and paved the way for the emergence of a new balance of mutual deterrence between the two countries.

Iraq's development of a credible retaliatory capability makes it unlikely that Israel will again attempt a preventive strike to disrupt Iraq's nuclear weapons program or any of its other strategic weapons programs. An Israeli preventive strike

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[27]Over 90 percent of Aqaba's capacity is dedicated to the Iraqi transit trade. *Al-Ra'y*, August 5, 1989, p.25, translated in FBIS-NEA, August 11, 1989, p.27.

today would entail an unacceptably low likelihood of success and an unacceptably high risk of retaliation.[28]

Consequently, Israel will most likely rely largely on political and diplomatic efforts to block the transfer of technology and expertise to Iraq and covert action to disrupt and delay its strategic weapons programs. Experience has shown, however, that in the long run such efforts are generally unsuccessful. Iraq's eventual acquisition of a nuclear weapons production capability under the deterrent umbrella provided by its existing strategic capabilities might be inevitable.

In addition, while Israel's capacity for massive retaliation will probably deter Iraq from undertaking destabilizing initiatives which could result in a clash, Iraq's president has once before led Iraq into a protracted and costly war through miscalculation. As a result, there is a possibility that Iraq—overestimating its own capabilities or misjudging Israel's response—could take steps which undermine its uneasy deterrent relationship with Israel, such as:

- A clash—by accident or design—between Israeli and Iraqi aircraft over Jordan.

- Retaliation for an Israeli military operation elsewhere in the region in response to a request for assistance from another Arab state.

- The resumption of support for or encouragement of international terrorism.[29]

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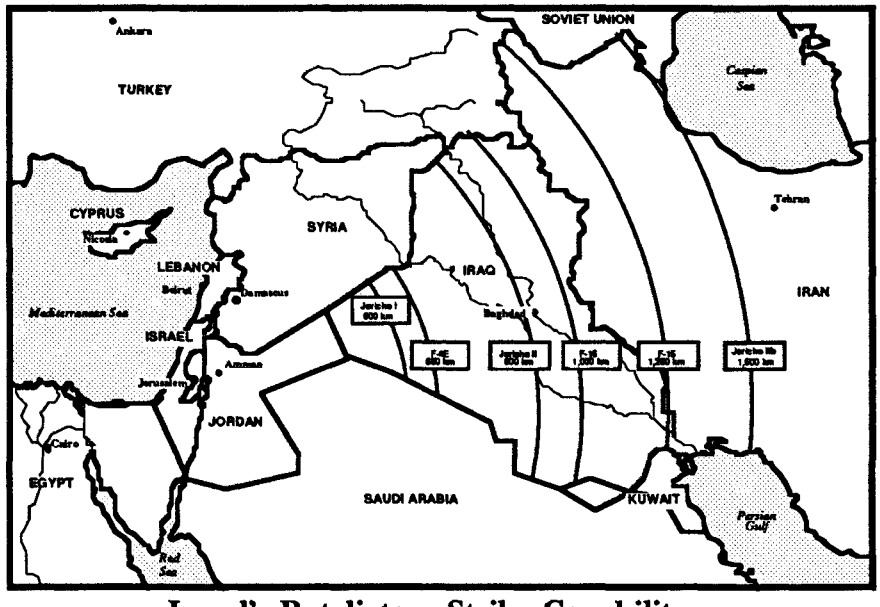
[28]David B. Ottaway, "Strike on Iraq," *The Washington Post*, p.A32; Uzi Mahanaimi, "This Time it is Going to be Hard to Bomb There," *Yediot Aharonot*, April 2, 1989, p.18, translated in FBIS-NEA, April 5, 1989, p.25.

[29]Deterred from taking direct action against Israel, Iraq might encourage terrorist surrogates to strike at Israel or Israeli interests in the hope that its role could be disguised. It is worth noting that Iraq provided financial and logistical support for the June 1982 Abu Nidal attack on Israeli Ambassador Shlomo Argov that provided the spark which led to the Israeli invasion of Lebanon. For details concerning Iraq's role in this operation, see Ze'ev Schiff and Ehud Yaari, *Israel's Lebanon War* (New York: Simon and Schuster, 1984), pp.97-100; Yonah Alexander and Joshua Sinai, *Terrorism: The PLO Connection* (New York: Crane Russak, 1989), pp.70-71.

Moreover, the limited nature of past contacts between Iraq and Israel means that both sides lack a clear understanding of each other's vital interests and intentions. Mechanisms for regulating conflict between the two countries like the various tacit understandings that regulate relations between Israel, Syria and Jordan, have never been developed. For all these reasons, there is a heightened potential for miscalculation between Israel and Iraq.



Israel's Retaliatory Strike Capability

APPENDIX

SELECTED STATEMENTS BY IRAQI PRESIDENT SADDAM HUSSEIN CONCERNING IRAQ'S DOCTRINE OF DETERRENCE AND RETALIATION:

". . . [W]e want to assert and warn that any attempt by the Zionist entity to strike against our scientific and military installations will be confronted with a precise reaction, using the means available to us according to the legitimate right to self-defense."

Speech by President Saddam Hussein on January 5, 1990 marking the 69th anniversary of the establishment of the Iraqi Army, translated in FBIS-NEA, January 5, 1990, p.16.

"[I]f an Arab, wherever he may be from the east to the west, is exposed to a foreign aggression, and this Arab permits us to defend his rights against a foreign occupier or usurper, it is our duty to do that . . . A foreigner must not attack the Arab homeland . . . If an aggression is committed against an Arab and that Arab seeks our assistance from afar, we will not fail to come to his assistance.

"[The United States and England] will be deluded if they imagine that they can give Israel a cover in order to come and

strike at some industrial metalworks. By God, we will make fire eat up half of Israel if it tried against Iraq.

"Everyone must know his limits. Thanks be to God, we know our limits and we will not attack anyone. Neither will we . . . forget our . . . national and pan-Arab responsibilities."

Speech by President Saddam Hussein on April 1, 1990, translated by FBIS-NEA, April 3, 1990, pp.32-33,35.

"I said: If Israel strikes, we will strike back. I repeat now . . . that if Israel strikes, we will strike back. I believe this is a fair stand. A stand known in advance . . . helps peace, and not otherwise. For if Israel realizes it will be struck, it might refrain from striking . . . I also have said: If Israel uses atomic bombs, we will strike at it with the binary chemical weapon . . . We have given instructions to the commanders of the air bases and the missile formations that once they hear Israel has hit any place in Iraq with the atomic bomb, they will load the chemical weapon with as much as will reach Israel and direct it at its territory. For we might be in Baghdad holding a meeting with the command when the atomic bomb falls on us. So, to make the military order clear to the air and missile bases' commanders, we have told them if they do not receive an order from higher authority and a city is struck by an atomic bomb, they will point toward Israel any weapons capable of reaching it."

Text of President Saddam Hussein's remarks during a meeting with a U.S. Senate delegation on April 12, 1990, translated in FBIS-NEA, April 17, 1990, p 7.

"They want to strike the missiles we have deployed. Yes, it is true we have deployed these missiles and they are directed west, not east; that is the direction of Israel. If they strike one missile base, what will that mean? Is it the only base we have built? Our missiles are mobile . . . We can launch missiles every hour and from different places.

"The time when they stepped on the toes of the Arab nation without anyone telling them not to—by force of action, not words—is now over; it is a thing of the past. If anyone

imagines he can build his glory on the rubble of the Arabs, he is mistaken.

"Just as Israel imagines it can cross countries to come and strike at Iraq, we also will cross countries and strike at Israel . . . Our missiles can reach Israel, and our planes also can reach Israel . . . I have explained to you the capabilities Iraq possesses so you will find no Iraqi excuses when they fail to reply forcefully to the aggressors.

"If the Israelis strike us once, we will not answer them just once and remain silent. No. If they strike us, we will continue to strike until the remotest capability in the Arab nation is mobilized, to give the Arab nation its chance to mobilize its capabilities."

Speech by Saddam Hussein to the Central Council of the International Confederation of Arab Trade Unions, on April 18, 1990, translated in FBIS-NEA, April 19, 1990, pp.23-25.

"In the event of an Israeli attack, the Arabs must guard against a short-lived response. This is because Israeli force is based on the strategy of attacking major targets in the shortest period of time possible and with a minimum of losses to its military, economic and manpower resources. And since the resources of the Arab nation cannot be quickly mobilized for reasons related to the spread of the Arab homeland, and given that we are 21 countries, among other reasons, it would not be possible for us to deploy our resources in the right places at short notice. Therefore, it behooves us to declare clearly that if Israel attacks and strikes, we will strike powerfully. If it uses weapons of mass destruction against our nation, we will use against it the weapons of mass destruction in our possession."

Speech by Saddam Hussein at the opening of the extraordinary Arab summit conference in Baghdad, May 28, 1990, translated in FBIS-NEA, May 29, 1990, p. 5.

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