

Chapter One: Analyzing The Lessons of The Conflict

There is an inevitable arrogance in any effort to analyze the lessons of war. It is difficult enough to establish an accurate history of the facts available, much less interpret those facts in terms of lessons for the future. In many cases, key facts are missing, or are contradictory and uncertain in nature. Equally important, facts do not emerge instantly after a conflict. It has been more than four years since the end of the Gulf War, many memoirs and histories have appeared, and the Department of Defense has issued several reports on the lessons of the conflict. Nevertheless, much of the available data remain classified or are still in the process of analysis. Little has been written on the war from the Iraqi side, or by Arab members of the UN Coalition, and much of the history of coalition-building during the war is still classified. Even where repeated efforts have been made to create an accurate data base -- in areas like the estimation of the strength of Iraqi forces during various phases of the war -- experts disagree on many of the details.

Events, however, do not wait upon analysis, and decisions are never made on the basis of incontrovertible data or theories. The world is already evolving in response to the ways in which different nations interpret the lessons of the Gulf War, and in response to forces that indicate that many of these lessons may have to be adapted to meet the needs of very different conflicts. The conflicts in Somalia and Bosnia have exposed the limitations in the ability of the United Nations and the West to create a "new world order". At the same time, the emergence of a new threat from Iran, the survival of Saddam Hussein and relatively strong military forces in Iraq, the dramatic cuts taking place in western military forces, and the ongoing efforts to restructure the military forces of the southern Gulf, have created a clear need to learn as much from the Gulf War as possible.

This book attempts to deal with the problem of analyzing the lessons of the Gulf War by summarizing and examining the key lessons and issues, analyzing the history of the conflict and the character of the forces involved, and focusing on the lessons of the conflict in terms of specific aspects of the war. Individual chapters deal with the lessons of power projection, the differences between Iraqi and Coalition forces, command and control, intelligence, air battle, AirLand conflict, naval operations, and the missile war.

The strategic and tactical lessons of the war are analyzed in terms of their broad implications for the West and friendly states, which subsequently shapes the basic methodology used throughout the text. However, this book is not a history of the Gulf War. It does not examine the diplomatic history of the conflict in detail, attempt to analyze

the actions of individual commanders or policy makers, assess every weapons system that played an important role in the conflict, or examine the lessons of each battle.

It also is not intended as an exercise in revisionism, as a critique of US policy and actions in the Gulf War, or as a challenge to conventional wisdom where that wisdom is supported by the data available. The "bias" of the author is that the Gulf War was justified by Iraq's actions, and that most of the key policy decisions made before and during the conflict were correct. It is also that the lessons of the war must be viewed primarily in terms of how to best use force in the future to deter war, resist aggression, and support peace enforcement.

Sources and Methods

The fog of analysis can be at least as dense as the fog of war. War is one of the most complicated of all human activities, and one of the least predictable. Most of the activities that take place in a given conflict have to be adapted and implemented in ways that are unique to that conflict. No book can ever hope to integrate all of the information that becomes available, since a major conflict is too complex to be summarized in terms of a simple framework of analysis, and even the most dominant lessons and themes of a conflict are subject to constant qualification, particularly in cases where a given lesson is contradicted by at least some of the facts.

Reliance on Official Sources

This book approaches these problems by drawing on the work of others. The key sources used for most of the analysis are the range of studies that the US Government conducted after the war. These studies include analyses of the conflict by the Department of Defense, the US Army, Navy, and Air Force; individual studies of key issues and weapons effectiveness data; individual divisional or unit histories of US combat units; operational maps and charts used in the theater, and a wide range of other official briefing materials.

The following five works are of particular importance, since they serve as the most authoritative studies and data bases on the Gulf War to date:

- o Department of Defense, Conduct of the Persian Gulf War: Final Report (COW), Department of Defense, April, 1992. The final report has over 20 detailed separate annexes, covering data on virtually every aspect of the war. The interim report of July, 1991, and several early draft sections of the "final" report contains additional detail, overviews, and briefings. The total product is well in excess of 1,000 pages, including many separate data bases. The final report suffers somewhat from the fact that it was issued at a time when many key supporting studies, and

- reviews of data on Iraq forces, were not completed in time to be included in the analyses. A classified edition contains substantial additional detail.
- o Dr. Eliot A. Cohen, Director, Gulf War Air Power Survey (GWAPS), Washington, US Air Force/Government Printing Office, 1993. This study is a US Air Force examination of the history and lessons of the war. It is the product of a massive team effort consisting of five volumes, containing eight separate studies, a chronology, and a statistical data base. It totals over 2,000 pages, and is supported by a number of briefing aids, presentations, and a summary. While it emphasizes US Air Power, it is the most reliable data base on many other issues.
 - o Brigadier General Robert H. Scales, Director, Certain Victory: The United States Army in the Gulf War, Washington, Office of the Chief of Staff, US Army, 1993. This history of the war is the result of a major team effort conducted for the Chief of Staff of the US Army. It provides some of the best maps and battle descriptions, does not attempt to analyze the details of the war, or provide a detailed data base on the conflict, but does provide the best analysis to date of the US role in the land battle.¹
 - o The United States Navy in "Desert Shield "Desert Storm," Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991. This early summary of the Navy's analysis of lessons is somewhat limited by the fact that many data had not been declassified when it was written, and that only limited equipment effectiveness analysis was available. It does, however, provide an excellent overview of naval action during Desert Shield and Desert Storm, along with many useful tables, charts, and chronologies.²
 - o General A.M. Gray, Commandant of the Marine Corps, Preliminary Report on the Lessons Learned in Operation Desert Shield and Desert Storm, Washington, Headquarters US Marine Corps. This is an undated document which was submitted in response to Secretary of Defense letter of April 8, 1991, which includes a compilation of summary findings by the commandant and individual issue papers on key lessons of the war with many tables, charts, and maps attached. In addition, the USMC has issued a detailed series of volumes on each major aspect of the Marine Corps role in Desert Shield and Desert Storm. The volumes available for use in this study included Lt. Colonel Charles H. Cureton, US Marines in the Persian Gulf, 1990-1991: With the 1st Marine Division in Desert Shield and Desert Storm, Washington, History and Museums Division, Headquarters, USMC; Colonel J. Quilter II, US Marines in the Persian Gulf, 1990-1991: With the 1 Marine Expeditionary Force in Desert Shield and Desert Storm, Washington, History and

Museums Division, Headquarters, USMC; Lt. Colonel Dennis P. Mroczkowski, US Marines in the Persian Gulf, 1990-1991: With the 2D Marine Expeditionary Force in Desert Shield and Desert Storm, Washington, History and Museums Division, Headquarters, USMC.

These histories are supplemented by official war briefings, and a wide range of working materials from each US military service, coupled with supporting material from the Public Affairs Office of the Department of Defense, during and after the war, as well as a wide range of official material furnished to via the UN Coalition Joint Information Bureau in Riyadh.³

Such official histories and data bases have the inevitable bias that tend to justify the actions taken by the US Government and its component military services. At times, these biases interfere with the quality of analysis -- although largely in terms of the omission of contradictory interpretations and data. The author did, however, review part of the preparation of several of these histories, and is well aware of the quality of their data bases and the review process to which they were subjected. While some contradictions and uncertainties emerged, the US Government was able to collect a far more authoritative picture of the conduct and nature of the war than outside observers or analysts who could not draw on official sources.

As a counterbalance to such biases, this analysis draws upon the author's experience during the war. This included acting as a military analyst for ABC. It also draws on extensive interviews with Prince Khalid, the commander of the Saudi military forces, and with other senior Saudi commanders, and uses material provided by the Saudi Ministry of Defense and Aviation and by the British Royal United Services Institute and House of Commons. It draws on the memoirs of General Sir Peter de la Billiere, the report by the Defense Committee of the House of Commons on the lessons of the war, interviews, and a library of materials and background briefings, obtained from British senior officers and press liaison staffs in Saudi Arabia and Kuwait immediately after the war.⁴ It draws on several weeks of field research in Saudi Arabia, Bahrain, Kuwait, and southern Iraq. This field research involved numerous helicopter and land vehicle trips through the battlefield. It also draws on interviews with US, Saudi, British, French, Kuwaiti, and Egyptian officers.

Since many aspects of the war are already politically controversial, or involve clashes between personalities and force elements, most of the officers and officials interviewed on specific controversies did not want to become involved in such controversies on a personal level. This problem was handled either by not making reference to a particular interview and validating the analysis through other sources, or by drawing or footnoting interviews only in a context where corroborating evidence can be footnoted.

Extensive use is also made of a wide range of excellent studies by various journalists and academics, as well as the post-war memoirs issued by a range of senior commanders and officers who participated in Desert Storm and wrote about the conflict after the War. Further, this work draws on several years of work in collecting information and written materials from the Department of Defense, DIA, and CIA; Iraqi exiles; British and French experts; and experts and intelligence officials from Israel, Egypt, and Saudi Arabia.

Use is made of Iraqi official announcements and press articles before, during, and since the war. Most such material, however, is more useful to political scientists and historians, but not to military analysts. Most Iraqi sources to date are propaganda, and many exhibit ignorance or indifference to the most basic facts affecting the conflict.⁵

Another source of lessons consist of the ways various participants in the Gulf War have reacted to the war, and made changes in their forces. However, so many such changes are taking place -- many at a classified level -- that full reporting on such actions is often impossible or involves analysis of uncertain plans and programs. As a result, the analysis may sometimes give the impression that given nations or military services have not learned from the Gulf War. This simply is not the case, and the reader is urged to put the lessons in this book into the context of current developments in national defense systems, procurements, and military forces.

Methodology and Value Judgments

The basic methodology used throughout this book is to focus on key areas of analysis, to summarize the key data available, and then draw conclusions. The precise approach used varies by chapter. This sacrifices stylistic consistency, but it responds to the fact that the issues examined in each chapter are different in nature, as are the data available. (It seemed preferable to shape the process of analysis to fit the problem.) Similarly, some lessons are highlighted and others are left in context, depending on which approach seemed to best suit a given issue.

In many cases, footnotes highlight major uncertainties or alternative views. It is impossible, however, to provide a discussion of all of the issues and uncertainties affecting given judgments, or to draw any precise line between judgment and analysis. Further, no effort is made to discuss revisionist data and interpretations where these cannot be supported by substantial data, or to explain all of the historical reasons why data and judgments issued during or immediately after the war have been overtaken by events.

The level of detail provided in addressing a given lesson or issue varies according to its importance, the amount of available data, and the range of different views or interpretations. The reader should be aware that some issues and lessons could not be

covered, simply because of the complexity of the conflict. In fact, one of the key lessons of the Gulf War is just how complex a process modern war has become, how many uncertainties exist, and how many potential lessons can be drawn from a given conflict.

At the same time, facts are not always the issue. Many of the most important aspects of war cannot be quantified, or traced to some clear and orderly pattern of history. Many conclusions about the lessons of war must rely primarily on judgment and opinion. This is particularly true in terms of policy level issues. It is also true, however, of many aspects of strategy, tactics, and human factors, which raises the issue of value judgments.

Critique Versus Criticism

Any study of lessons necessarily focuses on the problems and weaknesses in military performance. As a result, such criticism must be kept in careful perspective. Perfect war is what policy makers, planners, and commanders strive for. Real war, however, achieves only a fraction of such performance.

This distinction between the perfect and the achievable is not a minor issue in writing a book on the lessons of war. Military literature is sometimes written as if the battlefield is a chess game that can be judged as if the players were grand masters with a perfect view of the board, with the time to deliberate every move, and with the ability to command pieces that always function according to the rules. None of these conditions apply to the changing chaos of war. The preparation of war, the conduct of war, and the termination of war will always involved countless and unavoidable mistakes and failures. There are no rules, and men, plans, and weapons will always function imperfectly. Accepting this reality is in no sense intended as a criticism of the men and women who fought in Desert Storm. .

In this context, it is important to point out that this study draws heavily on the self-criticism of commanders, and military services. Much of the analysis of the lessons in this book consists of putting such self-criticism in perspective, or illustrating the relationships between the self-criticism of different commanders and services. The reader who is unfamiliar with the fog of war, and whose knowledge of the Gulf War may often consist of media reports issued during and immediately after the war should carefully examine the footnotes in this text, and understand that few operations in government or military history have been examined with similar self-honesty.

The Gulf War as a General and as a Unique Case

It is important to keep the Gulf War in historical perspective. Military planners are often accused of planning for the next war by trying to re-fight the last, -- an accusation, which is often equally valid for military analysts. Any analysis of the lessons of The Gulf

War, however, must begin with the understanding that the Gulf War is likely to prove unique in many ways.

- o Unambiguous act of aggression involving major strategic interests:* Mobilizing and fighting Coalition warfare was greatly simplified by the fact that Iraq committed a blatant act of aggression, attacked a critical supplier of oil, and threatened to established hegemony over an area with nearly 66% of the world's oil reserves. Even so, the US Congress only narrowly voted to support President Bush's request for an authorization of force. Thus, it is unlikely that most regional contingencies will make coalition building as easy -- a fact already revealed by events in Bosnia and Somalia.
- o The impact of the end of the Cold War:* Russian support of the UN, and willingness to accept a US-led coalition force, is often seen as a paradigm for the future. However, it is unlikely that future aggressors will suddenly lose their ties to major regional or world powers, or that all of the major powers in the Security Council will be as willing to cooperate. It is more probable that states will restructure their regional and extra-regional ties and alliances over time, and/or that major power will divide of the nature of the action to be taken.
- o One side gave the other nearly half a year to prepare:* The UN Coalition had five and one-half months to deploy, adapt, and train its forces. This was critical to integrating tactics, technology, training, and sustainability necessary to build up heavy armored and mechanized formations, and to giving the Coalition the ability to control and sustain intense air operations. In contrast, Iraq showed little ability to take the initiative, and could not obtain reinforcement or resupply.
- o Iraq's reaction was largely passive and political:* Iraq did nothing militarily to try to limit the Coalition build-up. It took no action against Saudi ports, and military facilities during the time that the Coalition had only token forces. More importantly, it seemed to have discounted the risk of actual large scale conflict, and to assumed that a political solution would be found that would allow it to keep Kuwait. It failed to seriously study and assess the capabilities of Coalition forces, particularly in regards to advanced tactics and technology.
- o Power projection was simplified by unique host country facilities and capabilities:* The Coalition could use the advanced infrastructure provided by Gulf airports, sea ports, communications facilities, and lines of communication. The US, in particular, could take advantage of a largely interoperable and extremely advanced Saudi military infrastructure, including Saudi air bases, land-based air defenses, military cities, AC&W/C⁴I systems, supply dumps, military repair facilities and stocks of

- spare parts, and a Saudi military road net. This Saudi infrastructure compensated for many Coalition and US power projection problems.
- o Asymmetry in tactics:* The Coalition introduced highly sophisticated tactics designed to allow NATO to defeat a Warsaw Pact enemy with technological parity and numerically superior forces. Conversely, Iraq relied heavily on tactics designed to defeat Iranian forces, such as infantry attacks, which lacked meaningful air power and air defense, and moved relatively slowly.
 - o Asymmetry in the ability to use technology:* Iraq did not train its forces realistically. Its combat experience in adapting advanced technology to modern warfare was tailored to dealing with an Iranian enemy that had no resupply of modern technology, and relied heavily on mass infantry attacks by revolutionary forces. Iran also did not have the sophisticated command and control and sensor systems to integrate command and control activity at the levels necessary to match the Coalition operation in intensity or speed of reaction. One side was trained and organized to fight World War III, the other to fight World War I.
 - o Fighting a "blind" enemy:* The preparation for the war and combat took place under conditions where the Coalition had a monopoly of advanced theater intelligence, reconnaissance, and space-based systems, with photo (PHOTINT) and electronic intelligence (SIGINT), allowing the Coalition to accurately characterize Iraqi deployments, preparations, land movement, and conduct during the air war. Iraq lacked a human intelligence network in Saudi Arabia, and had tailored its tactical intelligence to deal with the much slower and land-oriented pace of Iranian operations during the Iran-Iraq War. Iraq also lacked sophisticated night-vision and long-range targeting systems for its armor and artillery. The Coalition intelligence and reconnaissance effort had many defects and weaknesses of its own, but it fought a "blind" enemy.
 - o Effective unity of command:* The US enjoyed extraordinary success in coalition building, and exercised a high degree of command authority. The Coalition did not attempt to create an independent or multinational command. Saudi Arabia accepted the role of junior partner, and Britain, France, and Egypt were willing to subordinate their forces to a high degree. In many ways, the US was able to unify of command within the theater. This was critical to allowing the US to exploit many of the capabilities of high technology battle management systems like the AWACS, and helped make the Coalition forces highly effective. Such conditions are more likely to be the exception than the rule.

- o Unique territorial conditions for the exploitation of technology:* Iraq chose to rely on largely static forces, using heavy armor and artillery deployed in open desert, which lacked effective air defenses outside the immediate area of Baghdad, and which could not defend against cruise missiles and stealth aircraft. These conditions made targeting exceptionally easy, and allowed the Coalition to use precision-guided weapons in ways that would not work against a more fluid enemy, one with better natural cover, and one fighting in urban and built-up areas. The exploitation of technology would also be far more difficult in low-level conflicts where the key forces engaged are guerrillas or infantry.
- o Iraqi failure to exploit unconventional warfare and weapons of mass destruction:* While Iraq did successfully use long range missiles, it did not successfully use terrorism, its unconventional warfare activities were limited to missile attacks, and it did not use weapons of mass destruction. These constraints may not apply to future conflicts.
- o Limited losses:* The fact that losses on both sides were far lower than the pre-war predictions of the US and Coalition planners, it does not mean that future wars will have equally low casualties. Coalition losses, both during Desert Shield and Desert Storm, seemed to have totaled less than 900, and combat losses were less than 400. This was far less than the range of estimates US and other military planners projected before the war. Similarly, Coalition air losses were far less than 0.5% per sortie, while a number of air planners expected 1% losses, or even the 2% losses used in some NATO planning scenarios. If Iraq had attempted to fight in Kuwait City, hold the coast, or fully commit its Republican Guards to the land campaign, the US predictions of serious Coalition losses would probably have been correct. The Gulf War is not a promise of "casualty free" war in the future.

These are important qualifications which should caution any reader that Santayana's warning that, "those who forget the past are condemned to repeat it" is a two-edged sword. Remembering the past is not a way of predicting the future.

At the same time, many aspects of the Gulf War are likely to be repeated in future conflicts. Many of the asymmetries between Coalition and Iraqi forces are likely to be typical of conflicts between Western and Third World nations, and involve large scale engagements between air and armored forces. The same has already been repeated in Bosnia and Somalia. Much of the Gulf War experience regarding the value of sanctions and embargoes, The "revolution in warfare" is likely to have a broad impact on the future of

war, broad future applications, and many tactical and technical lessons that follow seem likely to apply to future conflicts.

The Analysis of Strategic Lessons and Issues

While it may seem unusual to begin a book by summarizing its major conclusions, this seems to be the best way to give the reader an overview the key lessons and issues that are examined in the text, of setting the stage for more detailed analysis, and of looking beyond the constraints that would otherwise be imposed by a topical framework.

The analysis of strategic lessons and issues is a good example in point. It is tempting to draw broad conclusions based on the near term implications of a conflict, to engage in using the war as a historical excuse for special pleading in terms of a given set of policies or world view, and/or to interpret the war in terms of some form of historical determinism. Events in Bosnia and Somalia have already shown, however, that such efforts produce little more than speculation, and that it is not possible to make valid generalization about the post cold-war era based on a single conflict.

As a result, this analysis focuses on a more narrow interpretation of the strategic lessons of the conflict. Rather than treating the war as a indication of a major new trend in history or creating a new world order, it focuses on the following potential lessons and issues:

- o The problem of strategic intelligence.* The Gulf War reveals a need to create integrated intelligence efforts focused on potential threat and high risk countries, and to base strategic warning and deterrence more on capabilities relative to intentions. The US, other Western states, and the southern Gulf states failed to properly characterize Iraq's motives and actions before its invasion of Kuwait. Once Iraq acted, the US was forced to try to compensate for years of neglect in analyzing Iraq's capabilities. Other nations -- lacking satellites and sophisticated technical collection systems -- could contribute little to the Coalition effort.
- o Political versus military action.* The Gulf War provides important lessons regarding the potential value of UN Resolutions, sanctions, and embargo measures relative to the use of military force. The combination of UN actions during Desert Shield almost certainly played a major role in limiting Iraq's capabilities. At the same time, it is clear in retrospect that they would not have forced Iraq to leave Kuwait, and that they would not have protected the Kuwaitis still in Kuwait. Further, events since the war indicate that the measures would have inflicted considerable hardship on the Iraqi people without threatening the Iraqi leadership.⁶

- o A war between two military "cultures."* As the following chapters reveal, the strategic outcome of the war was shaped in many ways by the fact that the military capabilities and "culture" of the US and Iraq were so radically different in character. This difference in military "cultures" was reinforced by the fact that two key US allies -- Britain and France -- deployed forces, and organized and trained in ways that were similar to US forces. Further, the two dominant Arab states -- Saudi Arabia and Egypt -- had close ties to the US, and had achieved substantial interoperability with US forces. There are many cases where a close comparison of the differences between the military "cultures" of the US and Iraq, and Western and Third World forces, have broad strategic and tactical implications for the future.
- o The role of the "AirLand battle", "combined operations," and the "revolution in military affairs:"* A fine line separates strategy and tactics, and it can be argued that the US led the UN Coalition into the employment of a new "strategy" based on the integration of air and land forces, with a new emphasis on combined operations and combined arms, on striking deeper behind enemy forward combat positions, and on linking a wide range of new tactics to new technologies. It can also be argued, however, that calling this mix of different changes a new "strategy" disguises the nature of what really happened, and that behind any such strategic rubric lies a matrix of complex changes in tactics and technology, linked closely to equally important changes in human factors and readiness. In any case, both approaches differ largely in semantics. The reality is that the Gulf War marked a transition towards what can be called a "revolution in military affairs" that is the product of advances in a wide range of areas, and not of a few easily definable variables.
- o The importance of countervailing strategy.* The UN Coalition only made a limited attempt to exploit the weaknesses in Iraq's forces, and its inability to translate its strength in manpower, weapons, basing, and logistics into effective combat forces. One of the major lessons of the war, however, is that assessments of Iraqi strength that used orders of battle and numerical estimates of force strength as measures of effectiveness often sharply exaggerated the strength of a given side unless these were supported by an integrated concept of operations, suitable training, and professional forces. The Gulf War exposed weaknesses in Iraqi forces that are likely to be typical of third world forces, which indicates that a more deliberate effort to exploit these weaknesses may have a critical impact on future conflicts. At the same time, the Gulf War raises important questions about exploitable weaknesses in US and other western forces: These weaknesses include ability to take serious casualties, the timeliness of power projection capabilities, vulnerability

- to the use of weapons of mass destruction, limits in damage assessment capability, problems in dealing with lateral escalation, and uncertain ability to manage military victory in ways that is translated into an equal victory in achieving strategic objectives.
- o The importance of rapid power projection capabilities.* Future enemies are not likely to wait for the US and other states to deploy their power projection forces, and there is a clear need to develop better forms of strategic mobility, prepositioning, and interoperability. Iraq did not exploit the limits in Western capability to rapidly deploy power projection forces, but there is no question that several months elapsed before the US could deploy sufficient heavy land forces to ensure the forward defense of Saudi Arabia, and several more months elapsed before the US could deploy large enough land forces to liberate Kuwait.
 - o US structures for command and decision making.* The Gulf War provided a sharp contrast with many coalition elements of US and command structures in previous wars. It involved more unity of command, and a greater emphasis on combined operations. It showed that unity of command could be extremely effective in exploiting combined operations by all four US military services -- as well as allied forces -- when it could be coupled to fully interoperable communications, planning systems, and concepts of operations. Equally important, the Gulf War demonstrated that proper delegation of command authority by political leaders to military commanders, and by military commanders to commanders in the field, greatly improved Coalition military effectiveness relative to US operations in Vietnam, and Korea. The Gulf War indicated that the US may have found the proper politico-military interface between US civilian and military officials for joint strategic planning, and the proper political way of preserving coalition control of military operations without interfering in the effective conduct of such operations. At the same time, the Gulf War revealed that seemingly minor problems in interoperability could often place unexpectedly high costs in effectiveness which were increased by the higher tempo of operations.
 - o Coalition dependence on US command, control, communications, computers, intelligence, and battle management (C⁴I/BM) systems, and problems in making US C⁴I/BM systems capable of managing mid and high intensity combat.* C⁴I/BM has taken on a new strategic importance. No member of the UN Coalition other than the US was capable of effectively conducting large scale offensive air operations, or of managing the AirLand battle. This dependence on US systems and capabilities is an important lesson of the war. Yet, the US and its allies encountered grave problems

- in its pre-war planning, training, and equipment for command, control, communications, intelligence, and battle management (C⁴I/BM). These problems would have severely inhibited Coalition military operations if it had not had over five months to reorganize, although this still presented serious operational problems. There is a clear need to make C⁴I/BM regional and power projection capabilities combat ready in peacetime.
- o Readiness vs. Time:* One of the potential myths of Desert Storm is that its outcome was inevitable, not only in terms of victory but the efficiency with which that victory was won. Every chapter that follows provides substantial evidence, much in quantifiable form, that this was not the case. Saudi Arabia was vulnerable until at least mid-October. The US was the most combat ready power projection force deployed as part of the UN Coalition, but it had to still send the military equivalent of "Task Force Smith" to the Gulf in August, 1990. There is overwhelming material evidence that the US and its allies were unready to project a war fighting capability for high intensity combat at the time of Iraq's invasion and could not deploy, organize, and train such a capability for at least three months. Even in October, 1990, the Coalition almost certainly would have won a far more bloody victory if it had attempted to execute its original offensive plan, and was still deploying critical force elements for Desert Storm when the air campaign began. It is unlikely that any future enemy will make the mistake of granting a UN Coalition, or the West, five critical months in which to make up for a lack of war fighting capability, and the need to increase power projection capability and maintain war fighting readiness is one of the critical strategic lessons of the war.
 - o Conflict escalation and conflict control:* The Coalition took the decision to limit the scope of the war to military targets and the Iraqi infrastructure that directly supported the war. The value of its success in implementing efforts to limit collateral damage, and even damage to enemy troops, is one of the major lessons of the war. The need to contain the scope of future conflicts, and to prevent other powers from pursuing Iraq's path in trying to broaden the war, is a key lessons of the conflict.
 - o Conflict termination, limited war, and the ability of armed conflict to produce political and strategic change:* The Gulf War raises fundamental issues about the need to define clear goals for conflict termination in limited war. The decision to terminate the conflict, having won the initial goals set by the Coalition -- but having left Saddam Hussein in power -- is one of the most controversial aspects of the war. Viewed in historical context, the decision seems correct, but it still raises important

- questions about whether future major regional conflicts should be conducted without a clearer set of long term grand strategic goals.
- o Advantages and costs of coalition warfare.* The Gulf War provided important lessons in terms of what cooperative defense can and cannot accomplish, and the trade-offs between coalition and national military efforts. It demonstrated the current and potential advantages of coalition warfare. At the same time, it often demonstrated that coalition warfare has serious limits and risks in terms of the capability and effectiveness of allied forces. It also revealed major costs in terms of training, unity of command, support, and interoperability. One of the key lessons of the war is that the UN Coalition was successful in part because it was dominated by the US to an extraordinary degree, largely united in political purpose, with key national force components willing to subordinate themselves to a US led unity of command integrated with coherent US C⁴I/BM systems.
 - o Coalition building and future UN and international military action.* The Gulf War revealed many of the strengths and limitations of UN and international military action versus unilateral or nationally oriented uses of force. While some have seen the Gulf War as a paradigm for similar UN or cooperative security efforts, the unique character of the Gulf War indicates that it may be far more the exception than the rule, and that coalition building remains difficult and limited in scope.
 - o Arms control, and transfer of advanced weapons and weapons of mass destruction.* The Gulf War provided a brutal illustration of the fact that proliferation of advanced weapons leads to war. It is a valuable strategic lesson about the need to use arms control, and limits on arms sales and technology transfer, as a substitute for arms, to preserve regional security and stability.
 - o Reshaping forces and defense spending for major regional conflicts:* The Gulf War indicates that many of the changes in western military forces that had originally took place because of the Cold War will have great strategic value in major regional conflicts. These changes included the emphasis on immediate combat readiness, high quality professional forces, high technology forces, improved air mobility, maneuver oriented operations, night warfare, and many other changes. At the same time, the Gulf War provided many lessons about the need for further changes in the strategy, force posture, and defense efforts of US, other western, and friendly forces, to meet the needs of regional conflicts.
 - o Proliferation and counter-proliferation.* Iraq was not ready to use nuclear weapons and never employed chemical and biological weapons. Its conventionally armed long range missiles, while of political importance, were not highly lethal. At the

same time, no member of the Coalition was adequately prepared to fight in a nuclear, chemical, biological (NBC) environment, and the US-led effort to destroy Iraq's weapons of mass destruction and missiles not only failed in virtually every important respect, it failed in ways where the Coalition command could not understand how little damage it had done to Iraq. This failure to successfully attack Iraq's weapons of mass destruction is a clear warning for the future.

The Analysis Of The Tactical Lessons Of The Conflict

The tactical lessons of the Gulf War are somewhat easier to analyze in terms of specific aspects of the war than the strategic lessons, but many apply to more than one military service or aspect of military capability. The key lessons which are reflected throughout the analysis in this book include:

- o Tempo of operations: night combat and 24 hour day war:* The war involved a new intensity of combat on the Coalition side. The Coalition fought with forces and technology that could sustain combat at night, and in poor weather. It initiated and sustained sortie rates, and rates of armored movement and maneuver, far higher than those achieved in previous conflicts. While many of the tactics and technologies involved were in transition, or had major limitations, the Gulf War indicates that military forces can be reshaped to combine firepower, mobility, command and control, logistics and sustainability, and intelligence and targeting in ways that may create a revolution in conventional war.
- o Command, control, communication, computers, intelligence, battle management and targeting (C⁴I/BM/T) and "Space Warfare:"* The Gulf War involved the first successful integration of space-based intelligence and communications systems in theater warfare. At the same time the changes in C⁴I/BM involved much broader changes in the quality and integration communications, intelligence, battle management systems, targeting, and damage assessment capabilities at virtually every level of operations. While it is tempting to see these lessons in terms of "space warfare," it seems more accurate to say that the Gulf War was fought at an overall level of improvement in command capability and information that is likely to continue throughout the coming decade, and which seems as likely to change the future nature of war as the changes in the tempo of conflict. Desert Storm is only the avatar of the major changes C⁴I/BM/T is likely to make in future mid and high intensity combat.
- o Damage assessment and "friendly fire:"* The Gulf War exposed serious limitations in the capabilities of US and other coalition forces to deal with two aspects of the

- new tempo and intensity of conflict. Damage assessment capabilities lagged badly behind other advances in C⁴I/BM/T. In many critical cases, it was impossible to assess the effectiveness of given weapons and tactics; Similarly, the rapid pace of conflict made the problem of identifying friend from foe far more difficult, and led to an exceptionally high proportion of casualties from "friendly fire" as a percentage of total casualties. The need to correct these weaknesses is a critical lesson of the conflict.
- o Sustainability:* There is nothing new about the importance of logistics in warfare. The Gulf War did, however, demonstrate the critical importance of integrating the timely delivery of fuel, ammunition, and other supplies into advances in firepower, maneuver, and C⁴I/BM/T. Writings on war often talk about the need to balance maneuver, firepower, offense, and defense. One of the major lessons of the Gulf War is the need to establish a proper balance between maneuver, firepower, and sustainability in the broadest sense, including proper attention to readiness and human factors. The Gulf War also shows that sustainability can be restructured to allow a force to concentrate on fluid high intensity offensives in ways that sharply reduce the need use static defensive tactics.
 - o The importance of offensive air power in deciding the outcome of the conflict:* The Gulf War was not, and could not, have been won by offensive air power alone. It involved a unique combination of high technology offensive air power on the part of the UN Coalition, coupled with the ability to suppress Iraqi air defenses that were able to operate against a relatively static and exposed enemy. At the same time, the Gulf War demonstrated that offensive air tactics can be far more effective than in the past, and that the promise of precision guided weapons, improved sensors and battle management revealed in Vietnam and in the October War has become a reality.
 - o The importance of air superiority and suppression of enemy air defense capabilities:* The UN's early and decisive ability to win air superiority was as important in shaping the course of the conflict as the improvements in air offense. These improvements affected both the air and AirLand phases of the battle. It can be argued that they were as much the result of Iraqi weaknesses in operating its land and fighter air defenses as of Western tactical and technical excellence, but this asymmetry may be an important lesson for the future.
 - o Defenses versus offenses: penetrating the Iraqi line:* There is nothing new about the tactical lesson that a concentrated and mobile offensive can penetrate a highly defended static line, and then disrupt the enemy in ways where shock and maneuver

- become at least as important as attrition. This lesson is at least as old as Sun Tsu. It was demonstrated repeatedly during World War II, and is a key lesson of the Six Day and October Wars. At the same time, the Gulf War demonstrated that much of the speculation regarding probable Coalition casualties greatly exaggerated the risk of penetrating the Iraqi defensive line, and that other Third World countries may have serious problems in executing forward defense.
- o The changing pace and lethality of armored maneuver:* The final phase of the war demonstrated the ability of the AirLand battle to achieve decisive results against an enemy lacking air support, and the ability of modern armor, support vehicles, sensors, and battle management systems to engage with a speed, lethality, range, and speed of sustained maneuver that had never been achieved in previous combat.
 - o Deception and tactical surprise:* The history of war is a constant demonstration of the value of deception and surprise, and the cost of predictability. The Gulf War involved surprise at a number of levels. The members of the UN Coalition were surprised by Iraq's invasion of Kuwait, and unready to deal with the threat that it posed to Saudi Arabia. They were surprised by the survivability of Iraq's missiles and weapons of mass destruction, and failed to detect and/or properly analyze its use of decoys and deception. Iraq failed to understand that it faced imminent attack, it failed to understand US and UN resolve, it failed to anticipate the capabilities and impact of Coalition forces, and it failed to detect and counterattack two major deception efforts: movement of US forces to attack points to the West of most Iraqi defenses, and the use of amphibious and naval movements to pin Iraqi forces down on the coast. Such failures are common to warfare, whose outcome is often determined by a catalytic failure of one side to anticipate the intentions and capabilities of its opponent -- rather than by relative force, strength, or attrition. At the same time, the Gulf War demonstrated that such surprise is far easier to achieve when one side has an overwhelming advantage in intelligence and sensor coverage, and has integrated its tactics and technology. Such asymmetries between Western and third world forces are more likely to be the rule than the exception.
 - o Looking deep/striking deep/depth of operations:* Many of the US weapons systems and sensors necessary to strike deeply behind Iraqi lines were still in development at the time of the Gulf War. Nevertheless, the improved deep strike capabilities of systems like the F-117 stealth strike fighter, F-15 air defense and strike fighter, Joint Surveillance and Target Attack Radar System (JSTARS), AH-64 attack helicopter, M-1A2 tank, Multiple Launch Rocket System (MLRS), and many other systems indicate that fundamental changes in the depth of the battlefield are likely to occur

- in future operations, and that talking about the forward edge of the battle area as the principle zone of conflict may become steadily less realistic.
- o The limits of amphibious operations.* The Gulf War demonstrated the exceptional difficulty of conducting amphibious operations against forces equipped with shore defenses, mines, and anti-ship missiles. It indicates that US Marine Corps forces will need added air mobility to compensate for the limitations of landing craft, and added armor and firepower, or support by elements of the US Army, in future major regional contingencies.
 - o The tactical problems of proliferation:* One of the most important lessons of the Gulf War lies in the fact that conflicts can rapidly escalate to the use of long range missiles, and potential use of weapons of mass destruction. While Iraq did not use missiles or other delivery systems armed with biological and chemical weapons, it had the capacity to do so, and to force the UN Coalition to try of adapt its defenses and tactics to allow for such escalation. The Gulf War demonstrated that future regional conflicts must allow for the use of long range missiles, and for patterns of escalation that cannot be related simply to the battlefield, but that involve efforts to change the very character of conflict.

The Analysis Of The Technical Lessons Of The Conflict

The Gulf War involved as many changes in technology as it did in tactics, and it is often impossible to distinguish between the impact of given tactics and given technologies. In fact, it was the "fusion" of advances in tactics, technology, and human factors which proved decisive in giving the US and other Coalition forces many of their advantages.

The value of this "fusion" is perhaps the greatest single military lesson of the war. Dramatic as some individual new tactics, technologies, and training methods may have been, the outcome of the war cannot be explained in terms of some simple mix of factors, or decisive individual changes in military capability. The US forces that led the UN Coalition could probably have achieved nearly the same success without some of the innovations they introduced during the Gulf War because of the fusion of advances in tactics, technology, and human factors. It is unlikely that any advance in one of these areas could have compensated for a lack of advances in the others.

At the same time, technology was of critical importance. The analysis in the following chapters reviews the strengths and weakness of the major technologies used in the Gulf War, and attempts to assess the impact of given systems. There are three striking aspects of this examination, however, which must be kept in mind.

- o First, many of the technologies employed in Desert Storm were transitional in the sense that far more advanced systems and capabilities were nearly at production readiness, or could not be fully exploited because related technologies were not ready, or fully integrated into the force structure. In broad terms, Desert Storm is not a measure of the impact that technology can play in achieving a revolution in military affairs. It is rather an indication of the technological progress that will change war fighting capabilities even more strikingly over the next decade.
- o Second, many of the available data on the Gulf War deal with the thing and not the man. One of the striking aspects of the Gulf War data is how often a weapons system is described in technical terms, or in terms of the estimated battle damage it inflicted without an explicit effort to analyze the impact of tactics, sustainability, or human factors. In contrast, descriptions of combat during the War repeatedly demonstrate the need to integrate tactics, training, and technology, and emphasize reliability, reparability, and sustainability.
- o Third, the Gulf War involved an extraordinary degree of near simultaneous interaction between different force elements and technology. Any discussion of air power, for example, presents the problem of trying to weigh the relative importance of the different elements of air power that were synergistically interacting at any given time. This problem becomes even more complex during the AirLand battle where joint operations affected virtually every battle or clash. Many technologies emerge as consistently important, but the more one asks the question of precisely how any given technology influenced the battle, the more the Gulf War becomes a lesson in the value of synergy and synchronicity, rather than in the value of any one weapon or technology.

There are significant data problems in any unclassified attempt to discuss the technical lessons of the Gulf War. The initial reporting after the war, and even in studies more than a year after the war, often made uncritical use of force strength and battle damage assessment data. The more detailed studies that have followed have often revealed much lower levels of effectiveness. Even these studies, however sometimes ignore the level of modification that took place before Desert Storm, and the amount of additional maintenance and technical support required. Military technology still had a massive impact on the outcome of fighting but few systems appear as effective now as they did right after the war.

Another major problem occurs in the way that some data on performance are reported. Reporting on some systems is often made out of context -- particularly on new systems with high procurement priority, or which achieve a high political profile. It is often

difficult to trace the impact of related systems and less publicized systems, and it become clear that many effectiveness data were gathered without a serious effort to determine whether other systems should be credited with the same contribution or killing effects. There are clear indication of service bias and program-related politics in some of the data.

As the following chapters illustrate, these problems in analyzing the impact of given weapons and technologies are compounded by the fact the reliable data on battle damage are not available, and the seeming precision of some widely circulated data is sometimes little more than statistical or quantitative nonsense. This problem is clearly recognized in the later official studies of the Gulf War but there often is no way to correct the problems in the data developed during or shortly after the War.

These problems are compounded by a tendency -- particularly in official studies of the land battle -- to confuse terms like "destroy," with inflicting "damage", and to talk about the defeat of Iraqi combat units in terms of the largest combat unit involved, rather than the specific brigade, regiment, battalion, or task force actually engaged.

This presents problems because given weapons technologies are sometimes credited as having had a major impact in "destroying" an Iraqi division when they only affected elements of a regiment or smaller size force. Further, much of the surviving force succeeded in fleeing to Iraq. This problem, in objectively describing the outcome of battles, is particularly serious in the case of reporting by the US Army, and is a flaw in otherwise excellent historical reporting.

Much of the performance of given technologies and weapons systems remains classified. The praise or criticism given systems in the open literature might well be put in a very different perspective by such data. Special problems occur in a number of cases like the Tomahawk and Patriot because the impact and lethality of given weapons tends to be exaggerated in the publicity issued during periods of combat, and in the materials made public immediately after a war, while the gradual discovery of data that provides a more balanced perspective are often treated as classified material.

If the "fog of war" is invariably followed by the "fog of analysis", the importance of the technology of war is also hidden by the "fog of after action reports." It is an open question as to which does most to obscure reality. The most that an independent analyst can do, in many cases, is to try to put the available data into perspective, examine the relevant controversies, and draw lessons accordingly. There are, however, a number of cases where the Gulf War clearly involved advances in technology that are changing the nature of war, and it is interesting to note that in each case, the advances were not the product of a single weapons system, but rather of the integration of a range of systems into an overall operational concept.

o Advanced training technology. Many of the Western ground, air, and naval forces employed in Desert Storm were trained using simulators and electronic battlefields, firing ranges, and air-to-air combat ranges that provided far more realistic combat training than had previously been possible.

o Space technology: The Gulf War was the first war to be fought using modern space systems for intelligence and targeting. While satellite intelligence was used to some degree in the fighting in Vietnam, Lebanon, Grenada, and Panama, the nature of the technology then available, the fact the enemy was largely infantry and often dispersed in small numbers, and the type of conflict precluded near real time use of space assets.

Although crude or ineffective use was sometimes made of such systems, and major problems occurred in making use of space-based intelligence assets to support theater and tactical commanders, the relative advantages and disadvantages of spaced-based systems are critical lessons of the conflict.

The key space systems employed included classified multi-spectral imagery, electronic intelligence, and communications intelligence satellites, and a wide range of unclassified systems like the Global Positioning System (GPS) navigation satellites, the Defense Meteorological Satellite Program (DMSP) weather forecasting satellites, the NOAA Television and Infrared Observation Satellites (TIROS) and the US land satellite (LANDSAT) for multi-spectral imagery, the Defense Support Program (DSP) missile detection satellites, the Defense Satellite Communication System (DSCS), and US Navy Ultra-high frequency Satellite Communications System (USCS). The only other allied space-based asset used during the Gulf War was the French Satellite Probatoire d'Observation de la Terre (SPOT), a relatively low resolution multi-spectral imagery system.⁷

o Reconnaissance, intelligence, and targeting technology: The Coalition's advantage in theater reconnaissance, intelligence, and targeting assets was probably even more critical than its advantage in space-based assets. The Coalition enjoyed a near monopoly in many aspects of such capabilities because of the poor organization and technology base of Iraqi forces, and the fact that the Coalition enjoyed a degree of air superiority that denied Iraq the ability to carry out most forms of reconnaissance over Coalition territory (Iraqi use of remotely piloted vehicles (RPVs) being a partial exception).

The mix of Coalition systems included advanced intelligence aircraft like the TR-1 and U-2, electronic reconnaissance and SLAR systems like the RC-135,

reconnaissance fighters like the RF-4C/E and scout helicopters, the targeting systems on strike aircraft, the long range targeting capability of the Joint Surveillance and Target Attack Radar System (JSTARS), the use of RPVs, and the maritime reconnaissance capability of the E-3A and E-2C. It also included superior battlefield systems ranging from better intelligence communications and processing systems to superior counter-battery radars and communications intelligence equipment. Coupled with the Coalition's advantages in night and all-weather combat systems, the Coalition often fought an Iraqi opponent that was "blind" by comparison.

o Long range strike systems. The Coalition enjoyed a wide range of advantages in long range strike systems. These included the first successful use of sea and bomber-launched cruise missiles, the upgraded conventional capabilities of the B-52G and F-111 bombers, the survivable precision strike capability of the F-117 stealth bomber, experimental sea-launched systems like the US Navy stand-off land attack missile (SLAM), and experimental long range targeting systems like the Joint Surveillance and Target Attack Radar System (JSTARS). These advantages in long range strike systems were further enhanced by superior targeting and battle management capabilities, by the diversity of different assets available to Coalition commanders, and by the availability of supporting sophisticated strike systems with less range like the MLRS, ATACMS, F-15E, and Tornado.

o Advances in air offense technology. The Coalition enjoyed the same advantages in using sophisticated targeting sensors and battle management systems that it did in using long range strike system, with the advantage that it could some times re-target aircraft on a near real time basis and use superior endurance and refueling capability to keep aircraft over target areas and attack on a target of opportunity basis. The Coalition enjoyed an advantage in areas weapons like cluster bombs and hard target kill weapons. The most advanced Coalition strike aircraft, such as the F-15E, Tornado, and A-6E had far better sensors and weapons management systems than the aircraft employed in previous wars, and were far more capable of all-weather and stand-off combat. At the same time, the use of "next generation" all-weather navigation and targeting systems like LANTIRN provided new capabilities that are likely to make air power much more effective in future wars. The same is true of the avionics and munitions that are improving the ability to deliver weapons like the laser-guided bombs and air-to-surface missiles.

- o Beyond visual range, close air to air combat, and air superiority technology:* The radars, avionics, and air-to-air missiles of Coalition aircraft like the F-16C, F-14, F-16, and F-18 offered the Coalition a decisive advantage in air-to-air combat at beyond visual ranges, which was compounded by the support of the E-3A AWACS and E-2C airborne warning and air control systems. The Coalition also had superior avionics and air-to-air missiles for close-in encounters or dogfights, although the Coalition was generally able to exploit its range advance using radar guided missiles. These advantages were further compounded by far superior training and overall air-battle management capability.
- o Stealth, electronic warfare, and active and passive countermeasures:* While the use of the F-117 Stealth aircraft to penetrate Iraqi defenses was perhaps the most dramatic use of new technology, the Coalition had a major advantage in electronic warfare, IR counter-measures, and radar countermeasures. These advantages include the ability to use the E-3A, EP-3E, and RC-135 to find safer penetration corridors, and "jamming" aircraft like the EF-111 and EA-6B. They included superior self-protection pods and on-board avionics for many Coalition aircraft and helicopters, as well as ship-based defense systems against anti-ship missiles.
- o Air defenses and anti-tactical ballistic missiles and counter-measure capabilities:* Iraq had large numbers of older heavy Soviet surface-to-air missile systems, short range French and Soviet surface-to-air missile systems, and anti-aircraft guns. The Coalition was able to defeat these systems by a combination of superior intelligence and targeting, electronic warfare, direct attack, anti-radiation missile, stealth, stand-off attack, and active and passive counter-measures, aided by the freedom of action provided by air superiority. At the same time, the US Patriot system, in spite of some limitations, was able to provide both excellent air defense coverage and limited anti-tactical ballistic missile (ATBM) defense. While the benefits of this ATBM capability were sometimes more important psychologically than the actuality of destroying incoming warheads, the Patriot played an important role in boosting morale, and safeguarding Israel from entering the conflict.
- o Attack helicopters - close air support aircraft:* The UN's advantage in longer range air strike systems was matched by its advantage in employing true attack helicopters like the AH-64 and AH-1S, sophisticated multi-role helicopters like the Lynx, and dedicated close-air support aircraft like the A-10, plus aircraft like the Jaguar, and AV-8B. These systems gave the Coalition superior battlefield mobility, strike capability, and the advantage of assets that could support

commanders on a near-real time basis, while Iraq's extensive holdings of short range air defense missiles, and anti-aircraft guns were surprisingly ineffective.

o Long range artillery and rockets: The Iraqi army had a theoretical range advantage in the fact that most of its artillery could fire longer ranges than the weapons held by its Coalition counterparts. For example, Iraq possessed nearly 500 Austrian GHN-45, PRC copies of the GHN-45, and South African G-5 155mm weapons with ranges up to 30 kilometers (19 miles) with standard shells, and 39 kilometers (24 miles) with the based bleed shells designed by Dr. Gerald Bull.⁸ However, the Coalition enjoyed an overwhelming advantage in beyond visual range targeting capability, limited artillery mobility, and organizational and technical capability to rapidly allocate and switch targets and fire. Many of its artillery rounds were ICM or "improved conventional munitions" rounds, and the US had the Copperhead guided artillery projectile. The US also had the multiple launch rocket system (MLRS) which fire rockets with nominal ranges of 32 kilometers (20 miles) to 45 kilometers (28.1 miles), and which could deliver bomblets, anti-tank mines, and terminally guided submunitions over areas as large as 1,000 X 5,000 meters.⁹ The MLRS was far more lethal than the Soviet-made rocket launchers in Iraqi hands which lacked accuracy and lethality, and were comparatively easy to target. Further, the superior combined operations capability of Coalition forces allowed them to use bombers, attack fighters and attack helicopters as alternatives to artillery in both the fire support and counter-battery roles.

o Tank fire control and thermal sights: The US M-1 and British Challenger tanks exhibited problems in desert operations that required extensive modification before the war. At the same time, they provided a major advantage in firepower because of superior fire control systems and sights. The use of thermal sights and superior gun stabilization proved to be of particular advantage in spotting Iraqi tanks long before they usually detected Coalition tanks, and in achieving very rapid kill rates at long ranges. Superior night vision and thermal sights also allowed some Coalition forces to make excellent use of long range anti-tank guided missiles like TOW and HOT.

o Improved armor and armored mobility: Coalition tanks and other armored vehicles did not always have a decisive technical advantage over the Soviet supplied systems in Iraqi hands. In general, however, the US and British army forces had the advantages of superior armored protection and mobility, coupled with superior fire-fighting, internal protection systems, and ease of operation, or

ergonomics. The full advantages of superior armor were not tested in the Gulf War because the air campaign and Coalition air superiority sharply limited Iraqi armored capabilities, and because Iraq's armored forces did not approach the US and British professionalism and training levels. Nevertheless, the Coalition was able to exploit the advantages of superior firepower and mobility, and protection played an important role in reducing Coalition losses.

- o Secure and flexible communications:* The Gulf War scarcely eliminated communications problems. These were especially severe in tactical land operations and they also affected many aspects of air and other operations. At the same time, the communications systems of Coalition forces were generally far superior to those of Iraq, particularly in terms of speed of reaction, reliability, flexibility, handling of secure data, and integration of intelligence and operational data.
- o Precision guided munitions:* The Gulf War introduced precision guided munitions, which were "smarter", more lethal, easier to operate, and more reliable than in previous conflicts. Such systems also were better integrated into C⁴I/BM/T systems and launch platforms. At virtually every level of operations, this gave the Coalition forces a striking advance which was compounded by superior tactics and training. While the Coalition did not always enjoy a "stand-off" range advantage in technical terms, it often obtained one in operational terms by a combination of superior technology, training, tactics, battle management, and ergonomics.
- o Anti-armor weapons:* While the anti-tank guided weapons in Iraqi and Coalition hands had roughly equivalent ranges and lethality, Coalition systems like the TOW, HOT, and Milan were generally much easier to guide, target, and better integrate into combat vehicles. As has been noted earlier, the Coalition also enjoyed a major advantage in battle management, in locating its fire units, and in long range sights and night vision devices. While it is not clear that it had a major impact on combat, the M-1, M-1A2, and the Challenger tanks, it enjoyed an advantage in anti-tank round lethality over the best rounds available to Iraq.
- o Night vision and all weather vision and navigation systems:* The Coalition employed a wide range of night vision and all-weather systems. These played a critical role in air attack operations, and in allowing US and British armored forces to "own the night" and engage Iraqi ground forces at long ranges. This greatly improved the shock effect of US and British armor, the tempo and range of operations and maneuver, and killing effects.

- o Naval combat systems:* The Gulf War did not test many aspects of naval technology. The Coalition did, however, have a major advantage in naval surveillance and targeting, mine warfare and attack helicopters, anti-ship missile and anti-ship missile defense systems, amphibious warfare, and naval gunfire. Its only major weakness was in its naval mine detection and mine sweeping capabilities.
- o Combat engineering and logistic support systems:* The Coalition was able to take advantage of a number of improved engineering, tank recovery, improved trucks and trailers, and special logistic support systems to relocate its ground forces, cross Iraq's defensive barriers, and sustain its armored advance. While these systems may lack glamour, they played a critical role in achieving a low cost breakthrough and in increasing the UN's rate of advance.
- o Maintainability:* Much of the equipment employed in Desert Storm was designed to provide more reliability, ease of maintenance, and sustain operation and reparability than in previous conflicts. These design features did not always succeed, and extensive modifications were sometimes required during the five and one-half months before Desert Storm to bring equipment to combat readiness. Nevertheless, the cumulative impact of improved maintainability played a role in allowing the Coalition to increase and then sustain the tempo of operations.

This is a striking list of Coalition advantages over Iraq, compounded in virtually every case by superior organization and battle management, adaptation and innovation, employment tactics, training, and readiness. The Coalition's advantages were not based on a few new high technology systems, but on an integrated mix of technologies affecting every aspect of combined operations and combined arms. It is, important, however, to note that the combination of Iraq's relatively passive approach to warfare, and the superior tempo of Coalition operations, gave the Coalition the ability to concentrate its technological advantages in ways where it could fully exploit their advantages. The UN Coalition also had sufficient forces to allow it to attack in a way that reduced concern about Iraqi attacks on those Coalition forces which lacked advanced weapons and technological capabilities.

The Analysis Of Human Factors

Differences in human factors were critical in shaping the ability of Coalition forces to conduct the offensives in the air and AirLand battle phases of the war. For example, the US forces that fought the Gulf War were manned, trained, and led in fundamentally different ways from the US forces formerly deployed in Vietnam. They were largely career regulars rather than conscripts, and actives and reservists alike were volunteers with better

educational backgrounds, training, and selection for promotion than any previous US force. They had unified leadership and they were led from the front. They not only had far more realistic training in simulated combat, but training that exploited advances in communications, firepower, and maneuver in new ways.

The difficulty from the analytic viewpoint is that the impact of these human factors cannot be separated from the impact of tactics and technology. Many of the reports on the importance of given training methods, career service, leadership, and other aspects of human factors are also often anecdotal. It is certainly possible to create complex analytic models to try to assess the importance of such training, but making a model complex does not make it more valid, and much of the importance of human factors during the Gulf War is ultimately a matter of judgment which cannot be independently validated. As a result, it is easy to underestimate the importance of human factors, and to focus on other aspects of the lessons of war.

The fact remains, however, that the Gulf War teaches several key lessons regarding human factors:

- o The importance of ideas and action:* The ability to innovate and react is a function of training, organization, and readiness as well as innate human talent. One of the critical differences between the UN Coalition forces and those of Iraq - particularly at the high command level -- was that the commanders organizing and commanding the Coalition forces clearly recognized that technology and training alone cannot radically change the tempo of warfare, exploit maneuver, and substitute shock for attrition. They deliberately chose strategies and a series of tactics that stressed military leadership to its limits as a means of putting further stress on a relatively passive, over-centralized, and rigid Iraqi command system. The advantage of continuing innovation, and coupling new ideas to rapid action, is one of the major lessons of the Gulf War, and one that is as important as any mix of changes in tactics and technology.
- o The importance of leadership:* The US and most of its allies fought the Gulf War with forces that stressed the demanding selection of leaders at all levels of combat, that selected leaders on the basis of promotion for merit, that allowed for independence of action, and that were structured so that officers led from the front rather than the rear. The lesson of leadership is an old one, but it is still a fundamental lesson of the Gulf War.
- o The importance of career regulars and NCOs:* The Western portion of the UN Coalition forces consisted largely of career regulars, although a substantial portion of US support forces were reservists. US, British, and French forces also had large

numbers of highly experienced non-commissioned officers who often performed tasks normally allocated to officers in the Iraqi and most third world armies. These regulars and NCOs played a crucial role in allowing the Coalition forces to use new technologies and tactics, and sustain a new tempo of combat. They gave Western forces a critical advantage in human factors over Iraq -0- which had a more rigid command hierarchy and lacked experienced and highly trained NCOs, and which relied on junior officers as a substitute for well-trained career NCOs, thereby forging a gap between officers and enlisted personnel.

- o The value of simulation and realistic combat training:* The revolutionary changes in air and land combat training developed in the West produced the first peacetime force in history that was ready to accept the stress of combat, trained to react realistically in combat situations, able to make proper use of tactics and technology, and able to operate as an integrated force at the major combat unit level, and in combined operations and combined arms combat. Much of the American writing on the Gulf War correctly stresses the advantage provided by advanced simulation and training of the kind used by US forces. The advantages of such training are a critical lesson of the war, and it is important to note that they may often have been as important in determining military effectiveness as the impact of a given tactic and technology.
- o The advantage of readiness:* The Western forces in the UN Coalition -- particularly the US forces -- had the advantage that they were not garrison forces in the classic peacetime sense of the term. They were funded and supported at a high degree of combat readiness at virtually every level, and they had time during Desert Shield to correct many of the detailed problems in their readiness to fight desert warfare. This high degree of initial readiness, and the ability to adapt to the needs of a specific contingency over a period of months played a critical role in shaping the influence of human factors, and the outcome of the war.
- o The importance of morale and motivation:* Morale and motivation are intangibles, but the Gulf War provides further evidence that they are critically important. The Coalition forces had consistently better morale and motivation -- even during the initial attack period when many expected to take much higher casualties than actually occurred. Iraq's authoritarian government could not provide similar motivation, and proved unable to deal with the shock of the Coalition air and AirLand offensives. Large scale Iraqi desertions took place during the air campaign and much of the Iraqi army disintegrated as an organized force during the AirLand campaign.

One additional lesson that emerged out of the research for this analysis -- which cannot be validated except anecdotally -- is that the interdependence between tactics and technology, and the continuing effort to exploit all of the potential capabilities of military forces, constantly stressed the key forces in the air and AirLand campaign to the limit of their human capability. Much of the equipment deployed in US, other Western, and Saudi forces, was designed to ease the burden on the operator, reduce fatigue, and simplify the tasks involved in combat. Instead, these advances were used to demand more from the operator.

Almost without exception, technology did not meet the goal of unencumbering the military personnel, operating the equipment, due to the burden placed on them by combat. As a result, weapons and support systems often required exceptional human expertise, commitment, and endurance. The Gulf War shows that there is a natural synergy between tactics, technology, and human factors, and effective military leaders will exploit every new advance to the limit. As a result, virtually every advance in ergonomics was exploited to ask military personnel to do more, do it faster, and do it in more complex ways.

This stress occurred whether the issue was flying and sustaining higher sortie rates, conducting faster armored maneuvers over longer periods of time, targeting and firing at longer ranges, or increasing the speed of logistic support. Wars may occur in which one side is so superior that it can rely on tactics and technology without a matching improvement in manpower, and without stressing human factors to their limit. Such wars, however, are unlikely to involve significant levels of conflict, and the idea that technology can reduce the stress of combat or the need for manpower quality and readiness is almost certain to be a myth. While there is no way to prove such a conclusion, one very real lesson of the Gulf War is that new tactics and technology simply result in altering the pattern of human stress to achieve a new intensity and tempo of combat.

The Analysis Of Major Areas Of Controversy

No matter how well a war is documented during or after the conflict, it leaves many major areas of uncertainty. Some of these uncertainties are the result of a lack of adequate data and analytic methodology. Some are the product of legitimate debates over the meaning of the events that took place, and how they should be interpreted. In some cases, the resulting controversies can be resolved as better information becomes available. In many cases, the resulting controversies simply cannot be resolved, but analysis can highlight the data involved, and the nature of the debate.

The key areas of major controversy touched upon in various chapters of this book include:

- o Strategic surprise.* Whether the US and its allies should have anticipated the risk of Iraq's effort to seize Kuwait and taken more effective diplomatic and military efforts to prevent it.
- o The size of Iraqi forces and Iraqi losses to air attack and the AirLand battle.* US government studies have progressively reduced both wartime estimates of the size of the Iraqi forces, at the time the war began, and after the impact of the air campaign and AirLand battle had destroyed given amounts of Iraqi major combat equipment. This still, however, are uncertainties as to the size of the Iraqi forces in the KTO, at the onset of Desert Storm.
- o The inability to totally envelop and cutoff Iraqi forces in the KTO from retreat:* The question remains whether a different strategy and battle plan, or a more rapid advance by VII Corps, XVIII Corps, and JFC-North could have achieved a far more decisive victory.
- o Termination of the war:* The decision to terminate the war before the physical destruction of many of the Iraqi forces in the Kuwaiti Theater of Operations (KTO), without expanding the objective of the war to overthrow Saddam and the Ba'ath elite, and avoid any support of the uprisings in the south and north.
- o Technology and analytic models for damage assessment:* As has been noted earlier, the war exposed major limits in battle damage assessment capability. Experts disagree, however, on the nature and seriousness of many of these limitations.
- o The role of less sophisticated attack aircraft.* Immediately after the war, there was a tendency to praise all aircraft equally, and some of the analyses of Western aircraft tended to credit all types with high levels of performance. Later studies have raised serious questions about the value of attack aircraft that cannot support advanced delivery of precision munitions, provide high range-payload capability, and provide the advanced navigation, self defense, and attack avionics and systems needed for outstanding all-weather and day-night performance, and the ability to fly both extremely demanding attack profiles, and the ability to strike effectively at ranges beyond the kill capability of most short range air defense systems (SHORADS).
- o The effectiveness of the A-10 and close support aircraft:* There is no question that close support systems like the A-10 and AH-64 played a significant role in the war. A debate has arisen, however, about just how effective such systems were, the limits placed on their operations during given periods of the conflict, and the

extent to which their operational capability is likely to be typical of close air support (CAS) operations in the future.

- o Attacking Iraqi lines of supply and communication:* During the war, and in many of the studies conducted soon thereafter, it was assumed that Coalition air power played a major role in cutting Iraqi lines of communication and reducing the flow of supply. The success of such efforts is an important test of the changing effectiveness of air power. The evidence that has become available since the war raises questions about just how effective this aspect of the air campaign really was.
- o Impact of static defenses and mine warfare:* Experts have long debated the relative value of static defenses and mine warfare. Many experts estimated that Iraq's defenses would pose a major challenge before the fighting began, and that they would produce high levels of Coalition casualties. In practice, they did not. There are, however, important uncertainties as to whether this was because of inherent limitations in such defenses or because of poor Iraqi execution and use of such defenses.
- o The role of light forces in major regional contingencies:* It is difficult to generalize about the Gulf War, since it involved large numbers of heavy divisions and armored forces that may not be typical of future combat. Nevertheless, the US and Britain found that they were forced to deploy heavy armored forces, and that the US was compelled to significantly increase the heavy weapons strength of Marine Corps units, and attempt to improve the anti-armor capability of the light US Army forces that it deployed during Desert Shield. The war raises important questions about the adequacy of "light" ground forces in future regional contingencies.
- o The effectiveness of reserve forces:* US deployments to the Gulf raised serious questions about the ability of reserve combat units to rapidly deploy in a form that allows them to play a major role in mid and high intensity combat. The US concluded after the war that major changes were necessary, but little agreement was achieved on the precise nature and effectiveness of such changes. The capabilities and proper role of reserve forces is one of the major controversies of the war.
- o "Friendly fire" and the identification of friend and foe (IFF):* There is a broad consensus that the Gulf War revealed a need to improve the ability to distinguish friend from foe, both in armored combat and AirLand operations. At the same time, the question of what level of improvement is really needed remains valid.

There is a trade-off between casualties from friendly fire because of the increase tempo and intensity of operations, and much more significant reductions in casualties from enemy fire. Improved IFF systems that inhibit operations may well increase overall losses, and costly investments in IFF systems may preclude investment in other force improvements which have a more important impact on reducing net casualties.

- o Artillery range.* Before the war, many analysts pointed out that the Iraqis had a potential advantage in artillery range. In practice, they had little time and/or ability to exploit this advantage. The Gulf War raises important questions about the potential advantage of range, and the proper mix of range, rates of fire, lethality, targeting capability, and damage assessment.
- o The decision of the US to ignore Iraqi casualties and body counts:* As has been touched on earlier, the US made the political decision not to estimate and report on Iraqi killed and wounded, which effected all Coalition reporting on the subject. This decision has led to controversies over both the size of Iraqi casualties, and the political and military implications of deliberately avoiding any effort to accurately estimate enemy losses.
- o The size of Iraqi casualties:* Radical differences exist in estimates of the number of Iraqi killed and wounded in combat, and over the implications of such losses for the conduct of future wars.
- o The ability to limit collateral damage.:* The debate over the number of Iraqi killed, wounded, and missing is accompanied by a debate over the impact of the war in wounding and killing Iraqi civilians, the indirect impact of the war in causing hardship to Iraqi civilians, and the proper nature of limits on collateral damage.
- o The potential effectiveness of chemical and biological weapons and defenses:* Iraq did not make use of chemical weapons, if it made any use of such weapons. It did not employ biological weapons. The threat of using such weapons did, however, raise serious questions about the effectiveness of such weapons in hitting civilian and military targets; about the ability to detect the use of such weapons and provide adequate protection, antidotes, and treatment, about the proper role of active defense, and about the proper nature of deterrence and retaliation.
- o Success of the Patriot as a tactical ballistic missile defense system:* Reporting during the war credited the Patriot with a success in intercepting Iraqi Scud missiles that disguised many of the limitations of the system, problems in way it was employed, and the ability of the system to destroy missile warheads when it scored an intercept.

- o Problems in targeting and destroying mobile Scud missiles.* Even during the war, Coalition analysts were well aware that the Coalition air offensive had had only a limited impact in directly destroying Iraqi missile launchers, and in reducing Iraq's capability to launch long range missiles. Analysis since the war has produced even lower estimates of damage and raised major questions regarding the effectiveness of such efforts.
- o The impact of the war in creating expectations that future conflicts will produce equally decisive outcomes with equally limited casualties:* The extraordinary scale and speed of the UN's victory has created a debate over the possible impact that the Coalition victory may have in leading to false expectations about the cost and risks of future war, and unrealistic demands for "loss-free combat".

Analysis and the Problem of Uncertainty

There are broader uncertainties that go beyond individual issues. No one who writes on the lessons of war can ever be authoritative or definitive. It is impossible to address every controversy or uncertainty affecting the lessons of the Gulf War, and this book generally ignores the more extreme revisionist debates over the war, and efforts at interpreting the conflict in terms of various conspiracy theories. The analysis does, however, examine the range of different views and data available on each of the major issues and controversies that have been discussed previously. The footnotes list the range of open sources used in analyzing a given controversy, although a few issues have had to be addressed using unattributable interviews and background briefings.

The quality of data is a major problem. Many key studies of the war remain classified, as does a great deal of data on the strength of the forces on each side, casualties and losses, weapons effectiveness, intelligence, and many other issues. At the same time, the Gulf War has produced a great deal of information, much of which is quantified or appears to be highly precise, and almost all of which is contradicted by other sources -- or is even self-contradictory. Preference is given in most cases to the data bases released by the US Government in its official studies after the war. This material is used extensively throughout this analysis, and is often reflected in the form of tables, charts, and chronologies. The reader should be aware, however, that much of the precision even in this data is illusory. It is also difficult to verify much of the quantitative data available, since many key terms are not fully defined, or they differ from service to service, or country to country. The use of statistics must also be kept in careful perspective. Although the author literally examined many different tables and statistical summaries, the statistic and quantitative data on force strengths, weapons numbers, weapons performance, and weapons

effects often uncertain, and includes many estimates and some guesswork. Much of the available information is far less reliable than the original source indicates, and some data have been generated in ways designed to prove a given point or support a given form of advocacy.

The reader should regard the tables and statistics presented in this work as broad indications of the probable level of strength and activity. It is also important for the reader to understand that some of the statistics and data points, provided in various places in the text, are contradictory -- though not to the extent they alter a major judgment. The analysis deliberately preserve the figures provided in original sources to keep the data consistent within a given table or section in the text, rather than tries to impose study-wide consistency where eliminating contradictions in the data would make it impossible to track figures against the original source or have to be guesswork. At the same time, some tables and statistics have been altered to reflect the fact that later analysis corrected given facts or data, or to reflect a range of uncertainty that was not provided in the original material.

Geography is also a problem. Many sources use place names haphazardly, and different sources often use different spellings for the same place. The use of a place name can mean at, near, or somewhere in the general vicinity of the place, or it can simply be wrong. Some sources make the problem worse by finding new and more inventive ways to transliterate Arabic into English. While an effort is made to standardize the spelling of place names, no claim is made to use the "right" spelling. Further, the author's use of a relational data base to link some portions of the text to given sources make it impossible to fully standardize spellings without presenting major problems in updating the analysis. This may be a minor inconvenience to the reader, but it was unavoidable in structuring the analytic effort.

Times and dates also present problems. The historical data available on US, British, French, and Saudi force movements generally seem correct -- although there are problems because of a lack of standard time and date groups in a few cases. The official histories prepared by the US Department of Defense, and the US Army and Air Force seem particularly accurate. Even in these cases, however, uncertainties often arise because of the difficulty in characterizing the strength, actions, and intentions of Iraqi forces, as well as a tendency to ignore, or understate the respective roles of allied forces, and other services.

Descriptions of combat often have to be based on impressionistic sources. Detailed histories of specific battles often present the problem that national and major UN Coalition commanders focus on the activities directly under their supervision. Unit or major combat command histories often ignore the impact of other units, the overall shape of the battle, and the role of other services. Eyewitness accounts are often based on a limited knowledge

of the battle, both in terms of the overall interaction of events and the actual nature of the forces engaged in the battle being observed. The history of war is inherently impressionistic, particularly at the tactical and technological levels -- where the confusion and shock of combat can lead those involved to draw broad conclusions based on limited experience and data.

Two areas present special problems that affect much of the analysis. Battle damage assessment was a major problem throughout the war, and many of the experts involved reached very different conclusions. This has been disguised by the fact that the US prepared and issued virtually all of the unclassified data involved, and by the fact that some of the debates over such data have never been resolved, while others have been kept classified. As is discussed in Chapter Five, this has led to a situation where much of the basic data on the damage to Iraqi forces are uncertain or contradictory -- often with contradictory data emerging in the same document.

In some cases, such as air-to-air combat, it is possible to obtain highly accurate statistics. In other cases, the data are highly impressionistic or depend a great deal on the personal judgment of those involved. As has been the case in previous wars, air crews directly involved in delivering air munitions and soldiers directly involved in land combat had no way to make accurate or detailed assessments of the effect of many of their weapons or actions. Reconnaissance, satellite photography, and interviews of enemy prisoners often produce ambiguous data.

One of the major lessons of the war is, in fact, that as much effort needs to be given to provide accurate and near real time data on weapons effectiveness and battle damages, as is given to command, control, communications, computers, and intelligence (C⁴I), battle management (BM), and targeting (T). As was the case during World War II, Korea, and Vietnam, the failure to provide such data -- and the natural competition to claim success -- often proved to be a serious problem in allocating forces and using them effectively.

The assessment killed and wounded is also a major problem. In the case of Iraq, the Iraqi government deliberately chose to propagandize losses of both Iraqi military and Iraqi civilians, while the US chose to depersonalize the war by deliberately avoiding efforts to determine the number of Iraqis killed and wounded during given points of the war, or after its conclusion. This effort to avoid the "body counts" of Vietnam probably had propaganda value, but it also makes it almost impossible to distinguish the shock effects of firepower and maneuver, from the killing effects. It also makes it extremely difficult to determine the true level of resistance Coalition forces encountered, and the effects of the air and AirLand campaigns in causing desertions and disruption of Iraqi forces. These problems are compounded by the fact that many of the Arab states in the UN Coalition did not provide

detailed reports of casualties and losses, and the US took an inordinately long time to come to grips with the problem of friendly fire.

The lesson involved is more arguable than the lesson regarding battle damage assessment, but it seems likely that depersonalizing the conflict proved more costly than any propaganda advantages were worth. It created major problems in understanding the true strength of Iraqi forces and their probable resistance at any given point in time, it made it impossible to assess the killing effect of weapons on human beings, and it gave the reporting on the war an artificial sterility that often made it seem as if things -- not people were being destroyed. This helped trigger debates over the war about massive Iraqi casualties that almost certainly did not take place, it created a climate of false expectations in regard to future wars, and it left the US military with an inadequate emphasis on casualty assessment and characterization -- although in many wars, the number of enemy killed and wound may be the critical measure of effectiveness -- not damage to weapons or territory occupied.

Every effort has been made to deal with these issues, and to identify the impact and importance of uncertainty. The discussion of potential lessons attempts to summarize the range of data available to support a given lesson, and the major uncertainties involved. Where it is impossible to draw clear conclusions about lessons, a detailed description is provided of the uncertainties shaping the controversies involved. The reader should be aware, however, that any effort to discuss all of the uncertainties affecting major issues in the Gulf War would be endless, and often involve speculation about classified data and methods. As a result, it is desirable to remember Einstein's warning about simplification and false precision: that "mathematics are most precise when they are least real."

¹ Another US Army history of the war should be available by the time this book is published. see Frank N. Schubert and Thera L. Kraus, The Whirlwind War: The US Army in Operations Desert Shield and Desert Storm, Washington, US Army Center of Military History, 1994.

² A much more detailed study has been performed by the Center for Naval Analysis, but the results are classified and could not be used in this study.

³ Some of the US Navy and US Marine Corps histories available to the author were interim documents, not final histories. Several were provided in draft form. The primary official US Navy history used was Office of the Chief of Naval Operations, The United States Navy in "Desert Shield, "Desert Storm, Washington, US Navy, May 15, 1991.

⁴ These sources include General Sir Peter de la Billiere, Storm Command, London, Harper Collins, 1992; and House of Commons, Defense Committee, Preliminary Lessons of Operation Granby, Tenth Report, London, HMSO, July 17, 1991.

⁵ For a fuller analysis of Iraq's motives and actions, the reader is referred to Dr. Amatzia Baram's work in "Calculation and Miscalculation in Baghdad," in Alex Danchev and Dan Kehone, ed., International Perspectives on the Gulf Conflict, 1990-1991, Oxford, St. Martin's Press, 1994, pp. 23-57; and Amatzia Baram and Barry Rubin, Iraq's Road to War, New York, St. Martin's Press, 1993.

⁶ For a detailed analysis of the impact of sanctions and embargoes since the war, see Anthony H. Cordesman, Iran and Iraq: The Threat from the Northern Gulf, Boulder, Westview, 1994.

⁷ Cohen, Dr. Eliot A, Director, Gulf War Air Power Survey, Volume V, Washington, US. Air Force/Government Printing Office, 1993, pp. 126-127.

⁸ Graham Smith, Weapons of the Gulf War, Salamander, London, 1991, pp. 74-76.

⁹ Graham Smith, Weapons of the Gulf War, Salamander, London, 1991, pp. 106-107.