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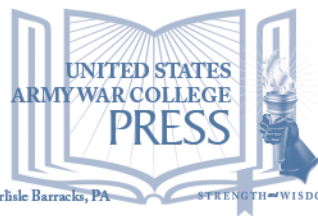Tami Davis Biddle Dr.

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AIR POWER AND WARFARE: A CENTURY OF THEORY AND HISTORY

Tami Davis Biddle

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Tami Davis Biddle

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FOREWORD

In this detailed but concise monograph, air power expert Tami Davis Biddle walks us through our century-long experience of air power as an instrument of warfare. Using the twin pillars of theory and history, she explains the expectations that were held for aircraft in war and then examines how those expectations played out in the actual realm of practice. This monograph, which focuses primarily on the most controversial aspect of air power, coercive bombing, takes a chronological approach that starts with World War I and comes all the way to the present day. By contrasting theory and practice, she identifies the overarching themes that have run through history and pinpoints those moments when the gaps between theory and practice have been largest. Her narrative mainly (but not exclusively) follows the experience of the U.S. Air Force. By the middle of World War II, the predecessor institution, the U.S. Army Air Forces, was investing more in aircraft than any other nation. The United States continued that pattern after the war, maintaining a large standing Air Force designed to deter threats to American interests, and to take a leading role in fighting the nation's wars.

Each decade brought new capabilities and new expectations. Americans embraced aviation technology and were at the forefront of its rapid development as an instrument of military power. Not infrequently, air power proponents expected more from it than it could deliver on its own. Not every war that the Americans fought after 1945 was suited to the dominant ways and means of American air power. The ability to coerce an enemy rests heavily on an accurate calculation of enemy will, and determination to sacrifice in order to hold or gain a stake. The tendency of Americans to
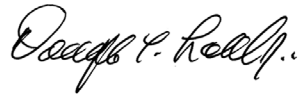
assume that they could successfully coerce—through numbers and power—has not always served them well. Biddle explains, however, those times when coercive air power has been effective in the last century and details the conditions undergirding that effectiveness. Moreover, she argues that early air theorist Giulio Douhet was right in one particular respect: the nation that wins and holds "command of the air" has an immense advantage in conventional warfighting. Biddle agrees with air theorist Robert Pape's argument that gaining air superiority is a sui generis function, distinct from the application of coercive air power, but that such superiority facilitates the subsequent use of coercive air power, and forms a crucial foundation for its success.

In trying to discern where expectations and outcomes were misaligned, and why, she hopes to help sharpen the critical thinking skills of strategists. She explains that successful coercion relies on highly detailed knowledge of the actor or actors one seeks to coerce. If those seeking to use aerial bombing for coercion use intelligence that lacks insight and nuance—or relies on mirror-imaging—then they will often find themselves facing bigger or thornier challenges than they expected. They will find, as well, that civilian populations are often more robust and resilient than air power theorists—and air forces generally—expect them to be, and that local coercive mechanisms can overwhelm more remote ones. Experience from the past tells us that war economies are usually less fragile and more adaptable than anticipated, and that, for a variety of reasons, air forces are rarely at liberty to carry out a bombing campaign in the way that they would prefer.

Biddle explains that gaining and holding air superiority over a battlespace became so much a part of the American style of warfighting that the U.S. military tended to assume it was a permanent fixture of the American way of war. However, this assumption, unfortunately, is no longer sound. Highly accurate and relatively inexpensive defensive systems have changed the game rather dramatically in recent years. The United States cannot be certain of air superiority in a wide range of scenarios now, even when facing adversaries that are not considered near-peer competitors. Addressing this situation and finding ways to maintain dominance in the air power realm will be high priority tasks for the U.S. Air Force in the years to come. In addition, its ability to make headway on this front will impact U.S. military effectiveness across the board.

Looking forward to the next 25-30 years, Biddle argues that air power—the way we think about it and what we expect of it—will go through a period of flux as the technology of the information age begins to take full effect. In some scenarios, our current knowledge and our legacy systems will retain their full utility; in others, they will retain only partial utility. As we move forward to environments increasingly characterized by anti-access/area denial (A2/AD), we will be forced to rethink many of our most fundamental assumptions,

and to develop new methods and platforms designed to deter potential adversaries, to protect our interests, and to prevail in the event of war.

DOUGLAS C. LOVELACE, JR.
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    U.S. Army War College Press

ABOUT THE AUTHOR

TAMI DAVIS BIDDLE is professor of history and national security strategy at the U.S. Army War College (USAWC), Carlisle, PA. She was chair of the USAWC Faculty Council from July 2014 to July 2016, and is currently the director of the USAWC's "Theory of War and Strategy" course. She was the 2011-2013 Hoyt S. Vandenberg chair of aerospace studies at the USAWC; the 2005-2007 George C. Marshall professor of military studies at the USAWC; and the 2001-2002 Harold K. Johnson visiting professor of military history at the U.S. Army's Military History Institute. Previously, she taught in the department of history at Duke University, where she was a core faculty member of the Duke University-University of North Carolina Joint Program in Military History. Her research focus has been warfare in the 20th century, in particular the history of air warfare. She has published articles and book chapters on civil-military relations, grand strategy, the law of war, and U.S. national security since World War II. Her book, *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas about Strategic Bombing, 1914-1945* (Princeton: Princeton University Press, 2002) was a Choice Outstanding Academic Title for 2002 and was added to the Chief of Air Staff's Reading List, Royal Air Force (RAF). She is currently writing *Taking Command: The United States at War, 1941-45* for Oxford University Press. Recently, she has written *Grand Strategy: What Students and Practitioners Need to Know* (Strategic Studies Institute, USAWC, 2015), and the chapter on Anglo-American strategic bombing for the first volume of the *Cambridge History of the Second World War* (2015). She is a recipient of the U.S. Army's Superior Civilian Service Award. She is a former trustee of the Society

for Military History; and she is a member of the Organization of American Historians, the RAF Historical Society, and the RAF Club (London). She received her Ph.D. in history from Yale, and has held fellowships from Harvard, the Social Science Research Council, and the Smithsonian Institution's National Air and Space Museum.

SUMMARY

In this monograph, Tami Davis Biddle analyzes the historical record of air power over the past 100 years. Her survey, designed for the student of strategy, is intended to provide both a concise introduction to the topic and a framework for thinking intelligently about air power, particularly aerial bombing. Her primary aim is to discern the distinction between what has been expected of air power by theorists and military institutions, and what it has produced in the crucible of war. Throughout this monograph, Biddle encourages students to focus primarily on the assumptions underpinning theories about what aerial bombing, in particular, might achieve, and why. Such assumptions are powerfully influenced by attitudes, ideas, capabilities, and fears prevailing at the moment when a given theory is articulated.

After their arrival on the scene in the early years of the 20th century, airplanes posed institutional challenges to all military organizations seeking to employ them. Immediate questions arose: How should they be used? Who should control them? How will they interact with other military instruments? None of the questions had simple or straightforward answers, and every military institution had to work out solutions tailored to its own needs. Early in World War I, it became obvious that airplanes were powerful military instruments offering important advantages to those who employed them well, and acute disadvantages to those who failed to do so. They immediately proved their worth in a wide range of activities, including reconnaissance, surveillance, communication, artillery spotting, ground attack, and short- and long-range bombardment. The value of airspace was immediately

evident, prompting the creation of "fighter" airplanes designed to protect one's airspace and deny it to one's enemies.

Aerial bombing was the most dramatic new innovation made possible by heavier-than-air flight, and the one bearing the highest burden of expectation. Both short- and long-range bombing received preliminary and inconclusive trials during World War I, and this fueled ongoing speculation and debate throughout the interwar years. World War II provided an extensive test of air power, and aerial bombing especially, but it did not resolve ongoing debates about the ability of bombers to win wars independently, as some claimed they might do.

Aerial bombing, Biddle argues, cannot control the ground. It is fundamentally a coercive activity in which an attacker seeks to structure the enemy's incentives—using threats and actions to shape and constrain the enemy's options, both perceived and real. It is an important and much-utilized military instrument for both deterrence and compellence. However, its ability to produce results varies, and students of strategy must understand the circumstances under which it is more or less likely to achieve particular results or political ends.

Biddle points to the assumptions embedded in theories of aerial bombing articulated before and during World War II, and assesses whether these assumptions eventually aligned with actual wartime experience. Relying principally on the extensive experience of the postwar U.S. Air Force, she undertakes similar analyses with respect to the many bombing campaigns that organization waged from the 1950s through to the present day. She explains and assesses the work of some of the more prominent air power theorists of

the recent past, including John Boyd and John Warden. In trying to discern where expectations and outcomes were misaligned, and why, she hopes to help sharpen the critical thinking skills of strategists.

She explains that successful coercion relies on highly detailed and nuanced knowledge of the actor or actors one seeks to coerce. Because of this, those seeking to use aerial bombing for coercion will often find themselves facing bigger or thornier challenges than they expected. They will find, as well, that: civilian populations are often more robust and resilient than air power theorists—and air forces generally—expect them to be; that local coercive mechanisms can overwhelm more remote ones; that war economies are usually less fragile and more adaptable than anticipated; and that, for a variety of reasons, air forces are rarely at liberty to carry out a bombing campaign in the way that they would prefer.

Looking forward to the next 25-30 years, Biddle argues that air power—the way we think about it and what we expect of it—will go through a period of flux, as the technology of the information age begins to take full effect. In some scenarios, our current knowledge and our legacy systems will retain their full utility; in others, they will retain only partial utility. Moreover, as we move forward to environments increasingly characterized by anti-access/area denial (A2/AD), we will be forced to rethink many of our most fundamental assumptions, and to develop new methods and platforms designed to deter potential adversaries, protect our interests, and to prevail in the event of war.

AIR POWER AND WARFARE: A CENTURY OF THEORY AND HISTORY

When political actors want to achieve aims and protect interests in the international system, they typically turn to diplomatic, informational, military, and economic tools. Among military planners, this set of tools is typically referred to as the "DIME." Within each subcategory, there are theories for how to maximize the utility of each instrument. As we evaluate any military subcategory, we must ask ourselves: What leverage does it offer those who employ it? What are its primary strengths and limitations? How does it interact with other instruments of power (both military and non-military)? Can it be used independently? What are the advantages and risks of doing so?

Military instruments typically stand in the background, reinforcing other tools and being called into play if those tools fail to achieve desired results. Land-power, sea power, and air power—with the recent addition of space and cyber power—all bring different types of leverage to the table. The strategist must understand them all, and must understand how they interoperate. The purpose of this monograph is to identify and analyze theories for the employment of air power. The focus here is principally—albeit not exclusively—on the experience of the United States. Since World War I, the United States has relied on aircraft extensively for purposes of both deterrence and warfighting. This national experience is wide-ranging and varied, and thus offers a good opportunity to test theory against reality.

If one is to understand air power—or any instrument of power—one must understand the assumptions that underpin the mechanism linking its use to

the achievement of a particular political end or goal. A theory is a basic hypothesis about causation: if we use X (air power), then we achieve Y (desired political aim). This formulation forces us to focus on the assumptions inherent in the linkage between X and Y. If, for instance, we make a claim about the utility of aerial bombing, we must understand what is at the heart of that claim—what is the mechanism linking the instrument of power to the achievement of a desired outcome? To argue—as U.S. planners did in World War II—that attacking ball bearing factories in Germany will undermine the German war effort, one must first be able to answer several fundamental questions, including: Are ball bearings central to the Germany war effort? Are they a scarce commodity, one not easily replaced? Then, just as importantly, one must ask: Is it tactically and operationally possible to attack ball bearing production and storage sites?

How aircraft might help achieve political aims, and who ought to employ aircraft for such purposes, developed into one of the most contentious and sustained military debates of the 20th century. Echoes of the struggle exist still, especially in budget battles within nations. At this point, we have more than 100 years of experience with air power as a military instrument, and this historical record has given us a strong sense of where theories have either aligned with or departed from expectations. The analysis is of particular significance at this moment in time, as changes in technology force us to rethink what we know and understand about the use of air power. Our existing knowledge (and legacy systems) will retain full utility in some scenarios and partial utility in others. By 2030, we are likely to see the beginnings of dramatic change. After that date, even our most fundamental

imperatives, like the need for air superiority in a battlespace, will require new thinking, new methods, and new means of execution as we face the spread of anti-access/area denial (A2/AD) environments. In the coming decades, aerial platforms are likely to become smaller, and manned aircraft are likely to be relied upon less and less frequently. If we can understand our past experience with nuance and skill, we will enter the future with a clearer perspective and more confidence.

SOME KEY THEMES

Strategist Colin Gray has specified that range and reach, speed of passage (unrivaled except by ballistic missiles and spacecraft), freedom of choice in movement, and flexibility of concentration are the advantages of air power. While the movement of aircraft can be inhibited politically by rights to airspace, aircraft have fewer limitations on movement than armies and navies. Still, Gray observes, "the all-vector menace posed by an enemy in the air is somewhat alleviated by the fact that whatever his choices of routes, he has to arrive over or close to targets whose value is well-known."[1] Among the limitations of air power, Gray lists: gravity, expense, impact of weather, brevity of presence, and the inability to come to sustained grip with an enemy. Recently, remotely piloted aircraft (RPA)—also known as drones—have alleviated some of the problems associated with brevity of presence. In addition, ever-improving all-weather capabilities have enabled aircraft to fly in conditions that previously would have been prohibitive.[2] Speed, however, may in the future become less of an asset than it is now.

When implemented well, air power offers enormous advantages. Lord Tedder, who had commanded Allied air forces in World War II prior to the Normandy landing, explained:

> in order even to begin to wage war successfully, it is necessary to arrive at the situation in which the enemy air opposition is unable to interfere effectively with our own operations—that is what we mean by air superiority.[3]

Owning air superiority meant, for instance, that Allied troops could land successfully on D-day in 1944; it meant that South Korean and U.S. forces driven into the Pusan perimeter in 1950 would not be pushed into the sea. It meant that the United States and its allies could operate in the Gulf war (1991) and the Iraq war (2003) without much concern about the Iraqi Air Force. Holding on to control of its airspace in 1940 meant that Britain could continue to fight Germany in World War II, and the United States could station assets there once it joined the war.

Air superiority is necessary because airspace is valuable. From the moment airplanes made their first appearance, they proved to be potent military instruments. Right away, they enabled a view directly over and behind enemy lines. This allowed for the tracking of enemy movement, and the targeting of enemy assets. In modern expressions of this role, new air- and space-based platforms gather detailed intelligence and provide ongoing surveillance of enemy systems and behavior. Related to this, aircraft contribute to the communications realm; they have performed in this role using everything from early wireless sets to sophisticated radios, and from the airborne warning and control system (AWACS) to Link 16. Air- and space-based mechanisms are heavily relied on to provide timely,

vital intelligence, surveillance, and reconnaissance (ISR) to commanders.

Aircraft have been and will remain powerful tools in the joint fight. They bring crucially important assets to the table for the joint commander: the means for achieving air superiority, reconnaissance, communication, battlefield air attack, and interdiction. Air power supports naval power in winning and holding command of the sea, and helps crucially in protecting a nation's borders, coastlines, and airways. Air power can assist land and naval forces in **denying** an adversary's ability to successfully achieve its aims in battle.[4] (For instance, part of the role of contemporary North Atlantic Treaty Organization [NATO] forces is to threaten to deny Russia successful invasion of NATO-member states—and air forces have a key mission in this.) To contend with an enemy possessing air assets, one must have air assets too, including air defenses (over the battlefield and the homeland). An army without air power is desperately vulnerable on its "overhead flank" if it is fighting an enemy that possesses air power. Air lift and air mobility are crucial assets for any commander. Aircraft are essential tools in providing humanitarian aid in disaster zones, and in search and rescue missions of all types.

From the earliest days of aviation, airplanes also have engaged in the direct destruction of enemy assets and interdiction of enemy materiel at both short and long ranges. "Strategic bombing" is an umbrella term referring to the bombing of enemy assets far from the line of battle, usually on the enemy home front (industries, infrastructure, centers of communication, and the general population). Throughout its history, the utility of this form of air power has been hotly contested. Such bombing can take place as part of a larger

campaign (for example, the Anglo-American combined bomber offensive in Europe or the Gulf war air campaign), or it can be utilized on its own (as in NATO's 1999 war in the Balkans or limited, highly specific strikes on enemy assets). In recent years, modern air theorists have sought to impose forms of paralysis on an enemy; they focus less on destruction than on degrading normal processes of communicating and functioning.

The earliest advocates of long-range bombing expected that it would have a physical impact as well as a moral or psychological impact. However, air theorists have varied in their assumptions about what creates the linkage between bombing (as a threat or an act) and the attainment of a political aim. In his important book *Arms and Influence*, Nobel Prize-winning economist Thomas Schelling delineated two ways of using violence to achieve desired ends. If using brute force, an attacker imposes his will on an enemy without the need for cooperation. When a state lands an army on foreign shores, defeats the enemy military's services, and occupies the land, it is using brute force. There is no need for cooperation by the opponent. By contrast, coercion involves manipulating the behavior of an adversary by structuring its incentives (manipulating costs and benefits through threats and action). It requires cooperation from an opponent.[5]

Air and naval instruments of power are principally coercive, and thus require a particularly sophisticated understanding of the adversary, including their will, weak points, and resilience. Some air theorists have focused on threatening/imposing punishment on an enemy in order to achieve political aims; others have focused on destroying specific resources central to an enemy's war effort. Punishment, as a coercive

strategy, relies on the threat of (or imposition of) pain and loss, and the creation of social upheaval. These, in turn, create effects that push an actor to sue for terms or concede a stake. When it comes to strategies that threaten punishment, nuclear weapons are the ne plus ultra in this realm: no weapon has ever been able to threaten punishment like nuclear weapons can.[6]

Building on Schelling's work in his influential book *Bombing to Win* (1996), Robert Pape introduced four categories of coercive air strategies: punishment; risk (holding back on striking some valuable targets while making clear one may do so if there is no negotiation or concession); denial (weakening or smashing an enemy's military forces so that his security is degraded); and decapitation (striking an enemy's key leadership and telecommunications assets).[7] Pape imposed his theoretical taxonomy after the fact, and his categorization is by no means used or accepted by all those who write about air power. Few air power theorists have been sufficiently specific and articulate about how they link action and outcome, and thus historians are keen to avoid oversimplification or mischaracterization. However, the taxonomy Pape created is useful for the strategist: it highlights important assumptions embedded in theories of aerial bombing and offers a practical starting point for discussion and analysis.

Pape also argued that gaining and holding air superiority is not a separate (fifth) category of coercive air strategy. Instead, he insisted that air superiority is a prerequisite to the implementation of all of the other coercive air strategies, because "aircraft cannot systematically place bombs on any target set if air operations encounter strong opposition from enemy forces." And, in a comment that parallels Sir Julian Corbett's thinking on sea power, he added, "Air superiority

need not extend over the enemy's entire territory, but only over the target set the attacker intends to strike and the air corridors to it."[8]

Ever-improving technologies have supported increasingly sophisticated forms of precision strike. Bombing capability has advanced with evolving methods for target acquisition, penetration of enemy airspace, and self-protection. Twenty-first century bombers are light years ahead of their primitive World War I ancestors. Missiles and modern RPAs support highly precise strike options without placing a pilot in harm's way. Many forms of naval power, most especially cruise missiles, can be—and will be—used in coercive air campaigns from stand-off distances. However, naval and marine air assets will usually be employed in direct support of sea-oriented operations or ground and/or amphibious operations—and will be vital to their success. In the future, though, airspace will be guarded by increasingly sophisticated and precise defense platforms and networks, and this fact will pose challenges to even the most advanced offensive aerial platforms.

THE EARLY YEARS

For centuries before the Wright brothers' first flight in 1903, humans had tried to imagine all of the future roles that airplanes might play—as both military and non-military instruments. During World War I, aircraft underwent revolutionary, telescoped changes driven by the intensely competitive demands of the war. In 1914, warplanes were primitive machines held together by wire and twine; by 1918, large, sophisticated four-engine bombers had been developed and used. These new instruments had major institutional

and organizational ramifications for all modern military services—and the institutional transformation this entailed was far from painless. Prewar expectations tended to influence the interpretation of wartime experience. Since the interpretation of data and evidence is heavily conditioned by what people **expect** to see, observations are colored by social, cultural, and political influences. Prior to the outbreak of World War I, civilian writers typically held higher expectations for air warfare than military planners did. The latter were generally conservative, expecting an airplane's main or sole contribution to be reconnaissance. However, a minority—officers who came to hold formative roles in the development of air power and thus came to hold an institutional stake in the future of air warfare—emerged from the war with strong convictions and bold claims about the revolutionary impact of the airplane in war.

During World War I, airplanes proved their worth in a variety of realms. Indeed, nearly **every** modern mission of aircraft received at least a rudimentary trial between 1914 and 1918. As many had expected, airplanes proved to be extraordinary reconnaissance tools, revolutionizing the way that intelligence was gathered, and how the battlespace was monitored and utilized. Indeed, the obvious value of airspace created an instant need for instruments that could both seek it out (over enemy territory) and preserve it (over one's own territory). This led directly to the rise of fighter aircraft—and to their rapid development during the war. They have remained crucially important aerial assets ever since, with fighters and fighter tactics becoming increasingly sophisticated.

The relatively primitive state of communications technology in 1914 meant that air-to-ground and

air-to-air contact was limited, but it improved generally over the course of the war. Such communication increasingly allowed for artillery spotting and targeting. Battlefield air attack was a difficult and risky operation in World War I, but when done successfully, it brought impressive results. Tactics for the employment of aircraft over the battlefield were worked out in the same way that the tactics for modern combined arms were worked out between 1914 and 1918—through intensive trial and error. By the end of the war, a body of doctrine existed for all modern uses of aircraft.[9]

The World War I record of long-range ("strategic") bombardment was mixed. The hardware and tools needed to make it a viable proposition—including engines, airframes, navigation methods, and bomb development—were primitive at the outset of the war. By 1917, the Germans had twin- and four-engine bombers capable of waging attacks on Britain, but these were limited in number. By that time the British were developing a large bomber to be used over Berlin in 1919, but the war ended before it could be brought into service. The Italians also developed a large bomber during the course of the war.[10]

Not only was it difficult for the attacking bombers to reach their targets with their primitive navigation methods, but it was also difficult for them to bomb accurately. Moreover, limited numbers of planes put a ceiling on the damage that could be achieved through air attacks. However, by 1917 to 1918, several military institutions had theories and plans for long-range bombing. Some theoretically inclined planners in the Royal Naval Air Service (RNAS) and newly independent Royal Air Force (RAF), for instance, argued for sustained attacks on key targets in the German war

economy, including munitions, chemicals, and the steel industry. American observers were impressed by this focus on potential bottlenecks in the enemy war economy; indeed, they incorporated these ideas into their first plan for strategic bombing, compiled in 1917 but never implemented.[11] These ideas would take hold and develop in the 1930s as the "industrial fabric" theory (or "industrial web" theory) at the U.S. Air Corps Tactical School.

The impact that World War I's bombing had on an enemy's civilian morale was difficult to interpret, and observers tended to draw from it what they **expected** to see. Because long-range attacks were neither heavy nor sustained, they did not compel civilians to pressure their governments to sue for peace. What they did do, however—especially in the case of Britain—was to embolden civilians to demand better air defenses, and to call for retaliation against attackers. Nervous about civilian morale under air attack, many British elites assumed that these public demands were fueled by panic and terror. However, a close look at the primary sources indicates, instead, that the British public was indignant, not terrorized. Much prewar writing, influenced by racist and social Darwinist theories, anticipated that urban laborers, women, and Jews would be particularly vulnerable. This proved **not** to be the case, although many British elites who had been steeped in these ideas continued to look at events through narrow lenses influenced by social attitudes.[12]

For their part, the Germans were disappointed with the impact of long-range bombing. While they knew their effort had been limited in resources and scale, they realized, too, that they had not been able to seriously undermine the British war economy or reduce the British will to fight. However, the very fact

that long-range bombing had been a marginal effort compared to the vast ground war meant that the wartime experience was not the end of the story but rather the beginning. During the interwar years, those making bold claims for air power gained degrees of legitimacy for a variety of reasons. The war had indicated that technological advancement could take place in a highly telescoped way. Many observers thus concluded that the technological development of air power would be fast and relentless—and offensive capabilities would outstrip defensive ones. Moreover, many assumed that some of the most daunting weapons of the war, including chemicals and gas, would be teamed with air power.[13]

Air advocates argued that all modern states would have to embrace airplanes as essential tools of war and deterrence, insisting that those who failed to do so would put themselves at an enormous disadvantage in the ongoing competition among nations. Air power—long-range bombing especially—would restore offensive operations to the battlefield, and would offer the prospect of **directly** undermining the enemy's all-important "will to fight" by strikes on his homeland. One would be able to leap over the army and navy and go right to both resources and popular will. It is interesting to note here that offensive operations had not in fact disappeared from the battlefield. By 1917, armies had begun to work out the basics of modern combined arms, restoring the offensive on land. This was manifest in the German offensive of March 1918, and in the subsequent ground offensives led by the Americans in 1918. However, many writers, traumatized by the trench stalemate of 1914-1917, assumed that the offensive on land was largely dead. Another common misapprehension of interwar

theorists was that the German Army and Navy had not been defeated; instead, its population had lost the war due to war-weariness and defeatism.

GIULIO DOUHET

Perhaps the most outspoken and assertive initial advocate for air power was the Italian, Giulio Douhet. Born into a military family, Douhet first became an artillery officer. Prior to the start of World War I, he commanded the Italian Army's aviation section. During the war, he recommended breaking the land war stalemate with Austria by using a 500-plane bomber force. Because his proposal also contained a sharp critique of Italian military leaders, he was court-martialed, but he was recalled to service in 1918 to head the Italian Central Aeronautical Bureau.[14] His 1921 book, *The Command of the Air,* painted a graphic vision of societal collapse in the face of air attack. Indeed, it was the futurist drama he conveyed, rather than the analytical rigor of his ideas that gave Douhet a lasting place in the canon of air warfare.[15] A poet, painter, playwright, and amateur novelist, Douhet brought to bear on his work "the intense modernist fascination with the latest advances in science and technology . . . prevalent in prewar Italian protofascist avant-garde culture."[16]

Both British and American airmen had developed indigenous theories of air warfare **before** Douhet published, but *The Command of the Air* was cited widely—especially in the 1930s after it had been widely translated—and used to support apocalyptic visions of air warfare. Douhet's vision stressed the offensive; indeed, he referred to aircraft as the offensive weapon par excellence: "Nothing man can do on the surface of the earth can interfere with a plane in flight. . . . All

the influences which have conditioned and characterized warfare from the beginning are powerless to affect aerial action." He stressed that "the battlefield will be limited only by the boundaries of the nation, and all of their citizens will become combatants since all of them will be exposed to the aerial offensives of the enemy."[17]

Douhet also largely dismissed the potential of ground defenses. As Phillip Meilinger has noted, "Douhet sarcastically concluded that ground fire might down some aircraft, much like muskets shot in the air might occasionally hit a swallow, but it was not a serious deterrent to air attack."[18] Once an air force had fought for and won command of the air, it would be free to exploit the situation "with forces capable of defeating the material and moral resistance of the enemy."[19] Such bombing forces, he believed, would be so effective as to force an enemy government to sue for terms.

Much of the power of Douhet's vision came from his linkage of airplanes and chemical warfare. During World War I, gas weapons had evoked a sense of dread in the public mind. Douhet asked, "How could a country go on living and working under this constant threat, oppressed by the nightmare of imminent destruction and death?" He was impressed by the possibilities of attack against those of "least moral resistance," such as factory workers.[20] His vision was one of technological determinism:

> The brutal but inescapable conclusion we must draw is this: in the face of the technical developments of aviation today, in case of war the strongest army we can deploy . . . and the strongest navy we can dispose . . . will provide no effective defense against determined efforts . . . to bomb our cities.[21]

The one virtue of this bombing, he explained, was that at least wars would now be shorter: civilians would not endure for long the privations imposed on them by air.

Douhet was not systematic or analytical about targeting, but he cast a wide net that included industry, transport, infrastructure, communication, and seats of government. He believed that a violent offensive waged relentlessly against a range of important targets, using explosive, incendiary, and gas bombs, would do the most to destroy the enemy's will.[22] His writing put great emphasis on coercion by punishment. However, Douhet's perspective was narrow; he saw only the evidence that supported his view. As historian Michael Sherry has pointed out, his ideas rested on crude extrapolation, and, like many other interwar prophets of air power, he failed to see how it "might evolve unpredictably, strengthening the defense as well as the offense, creating its own futile charges and bloody stalemates."[23]

SIR HUGH TRENCHARD

Hugh Montague Trenchard served as a field commander for the British Army's Royal Flying Corps during World War I. He would ultimately become known as the "Father of the RAF," although this was ironic, since he initially opposed the creation of a separate air service in Britain. RAF independence, finalized in 1918, resulted largely from public demands for better air defense, and for retaliation following German air attacks on Britain. Trenchard was called on to be the first head of a British long-range bombardment force in 1918; however, he received few airplanes and had little ability to implement any kind of

systematic bombardment of Germany. It was clear to him, though, that the British Government and public expected to see results; he thus felt a need to justify the use of resources given to him, even if meager. He argued expediently both during and after the war that the **psychological** effect of bombardment was much greater than the physical effect.[24]

Named post-World War I Chief of the RAF, Trenchard became a convert to and defender of an independent air force. After the war, the British Army and the Royal Navy sought to regain control of their air arms. To head this off, Trenchard sought a rationale for independence. He argued that an attacking air force would be in a position to undermine an enemy's will to fight by placing pressure directly on the enemy population. Attacks on enemy "vital centers" would cause the enemy population to call for better air defenses, as the British had done in World War I. The heavier and more persistent these offensive attacks, the more the enemy would be driven on to the defensive by popular cries for protection. The enemy's increasing defensive effort would place it on a slippery slope from which it would not be able to recover.

Many of Trenchard's ideas were articulated in the May 1928 memorandum on: "The War Object of an Air Force." He argued for attacking enemy materiel, undermining enemy will, and disrupting enemy communications. He combined ideas about attacking enemy military assets and communications (forms of denial) with ideas about undermining enemy will. He argued:

> I would state definitely that in the view of the Air Staff the object to be sought by air action will be to paralyse from the very outset the enemy's productive centres of munitions

of war of every sort and to stop all communication and transportation.[25]

He believed that the "moral effect" (psychological effect) of air attacks to be "very great."[26] The idea of "paralyzing" an enemy would be echoed, later on, by air power theorists in the United States.

Trenchard saw great value in the ability of aircraft to "pass over the enemy navies and armies, and penetrate the air defenses and attack direct the centres of production, transportation and communication from which the enemy war effort is maintained."[27] He believed that each belligerent would "set out to attack direct those objectives which he considers most vital to the enemy. Each will penetrate the defenses of the other to a certain degree."[28] Once this has taken place:

> The stronger side, by developing the more powerful offensive, will provoke in his weaker enemy increasingly insistent calls for the protective employment of aircraft. In this way he will throw the enemy on to the defensive and it will be in this manner that air superiority will be obtained, and not by direct destruction of air forces.[29]

Like Douhet, Trenchard felt there was no question about whether bombers would appear in the next war:

> Whatever we may wish or hope, [he argued] . . . , there is not the slightest doubt that in the next war both sides will send their aircraft out without scruple to bomb those objectives which they consider the most suitable.[30]

The only answer was preparation and an offensive spirit. Trenchard also argued that his air force could make key contributions to the policing of parts of the British Empire that were otherwise difficult to govern. He advocated using air power coercively—threatening and using bombardment against those peoples

who resisted British domination. Some modern writers have drawn interesting parallels between British "air control" policies and contemporary use of RPAs by the United States.

BILLY MITCHELL

William L. "Billy" Mitchell, son of a wealthy Wisconsin senator, enlisted as a private in the U.S. Army during the Spanish American War and later gained a commission. He served successfully in the Signal Corps and began taking flying lessons at the age of 38. Mitchell went to France in 1917 and helped pave the way for an American air contribution to the war. A tireless and flamboyant leader, he rose quickly to Brigadier General, commanding all American air units in France. Despite his rapid rise, he alienated many with his aggressive, arrogant style, which continued after the war. He feuded with the Army, and his aerial attacks on stationary battleships in 1921 and 1923 placed him in the midst of a passionate fight with the Navy. His harsh criticism of the crash of the Navy dirigible *Shenandoah*, which, he argued, had resulted from "an almost treasonable administration of the national defense," ultimately led to his court-martial and ouster from the Army.[31]

Mitchell devoted the rest of his career to making a public case for air power and an independent U.S. Air Force. More an advocate and enthusiast than a true theorist, Mitchell was tireless in his quest for aerial resources, and for "air-mindedness" among the American people. Mitchell's style is apparent in his 1925 book, *Winged Defense: The Development and Possibilities of Modern Air Power—Economic and Military*.

His arguments are similar in style to those of Alfred Thayer Mahan. He wrote:

> The air-going people actually form a separate class. They are more different from landsmen than are landsmen from seamen. At the present time, the air-going people in the national services are not accorded the position nor the rank to which the importance of their duties entitles them.[32]

He added, "The world stands on the threshold of the 'aeronautical era.' During this epoch the destinies of all people will be controlled through the air."[33]

Like Douhet, he downplayed ground-based air defenses:

> The only defense against aircraft [he argued] is by hitting the enemy first, just as far away from home as possible. The idea of defending the country against air attack by machine guns or anti-aircraft cannon from the ground is absolutely incapable of being carried out.[34]

He was prescient in foreseeing that air superiority would have to be won through a battle between air forces: "Great contests for air control will be the rule in the future. Once supremacy of the air has been established, airplanes can fly over a hostile country at will."[35]

He added:

> How can a hostile air force be forced to fight, it may be asked, if they do not desire to leave the ground? The air strategist answers: 'By finding a location of such importance to the enemy that he must defend it against a bombardment attack by airplanes'.[36]

Here again he was prescient, sensing that enemy fighters might in some instances have to be lured into the

air. Like Douhet, he believed that aircraft would make wars more intense, and thus shorter in duration:

> The menace [of air power] will be so great that either a state will hesitate to go to war, or, having engaged in war, will make the contest much sharper, more decisive, and more quickly finished. This will result in a diminished loss of life and treasure and will thus be a distinct benefit to civilization.[37]

With respect to the details of targeting, Mitchell's vision was—like Douhet's and Trenchard's—rather all-encompassing: "Air forces will attack centers of production of all kinds, means of transportation, agricultural areas, ports and shipping; not so much the people themselves."[38] However, he was inconsistent: at times, he prioritized denial and decapitation (of communications); at other times, he appeared to emphasize punishment.

Douhet, Trenchard, and Mitchell were revolutionary in their thinking: their work reflected an unbounded enthusiasm for air power and an impatience with those who took a more evolutionary and integrated approach to warfighting. Douhet and Mitchell insisted on a battle for air superiority. All three theorists expected that civilian populations would hold up poorly in the face of bombing, and expected that the threat of bombing might deter wars or shorten them.

THE INTERWAR ERA

Douhet, Trenchard, and Mitchell were all influenced by the circumstances in which they found themselves. Their central assumption about the inherently offensive nature of air power relied on a selective interpretation of the evidence from World War I.

In general, they believed that airplanes would only grow more capable in the future by flying faster and higher, and it would thus be harder to defend against them. They were also impressed by the vastness of the sky; this physical fact, they believed, would give a permanent advantage to the attacker. In the 1920s, bombers developed more quickly than fighters did. However, the momentum began to shift in the 1930s, as fighter development began to catch up. Moreover, the advent of radar changed the air defense equation significantly.[39]

Air defense later took many forms and proved much more robust than the early theorists had predicted. During World War II, for instance, the Germans in particular would develop highly effective anti-aircraft (flak) guns that could reach and destroy bombers flying at high altitude—and disrupt the flight paths of many others. In terms of passive defenses, the Germans would build decoy factories and towns.[40] They also managed to disperse a great deal of their industry and to place some of it underground.

Nearly all industrialized nations took an interest in air power and long-range bombardment. However, not all nations developed the latter. The way in which air power was integrated into a state's military organization was influenced greatly by geography and geopolitics. States with enemies on their borders including Germany, Russia, and France could not afford to stray too far from an army-centric military organization and priorities. The English Channel was a moat protecting Britain; there was no desire among British elites to maintain expensive and potentially disruptive large standing armies. British interest in strategic bombing was thus in line with British defense policy more generally. However, during the interwar years, the RAF

did not back up theory with rigorous analysis of past experience, or equally rigorous analysis of assumptions about the **mechanisms** linking air power to political outcomes.

The French, the leading aviation power in World War I, never entirely recovered from the devastating effects of that war. Economic and political problems, as well as overall war-weariness, kept France from regaining any semblance of the position it held up to 1917-1918. Russia, wracked by civil war and then devastated by the paranoid politics of Joseph Stalin, recovered only just in time to save itself with Allied help from Hitler. The Russians would develop highly capable air power during World War II, but it remained largely, albeit not entirely, tied to the Red Army. Although the Treaty of Versailles had prevented Germany from having an interwar air force, the Germans continued to take an interest in aviation and long-range bombing—and they retained active glider clubs. The development of advanced, long-range bombers lagged in Germany for a variety of reasons under Hitler. Nevertheless, the Luftwaffe (Hitler's aerial warfare branch) developed highly effective methods of coordinating tactical aviation and maneuver warfare on the ground. Indeed, this cooperation was the heart of what the West called "Blitzkrieg" early in World War II. It facilitated the unprecedented speed with which Hitler moved westward to the English Channel in 1940, and made clear that no modern army would be able to achieve maximum power in the future without sophisticated aviation.[41]

The American people, despite taking an interest in the aggressive salesmanship of Billy Mitchell, did not feel the need to create an independent air service before World War II. The United States was largely

defensive in its military posture, and most serving officers who wrote about air warfare were obliged to do so within careful boundaries. Nonetheless, the organization that was first called the "U.S. Army Air Service," then the "Air Corps," and later the "Army Air Forces," gained increasing autonomy during the interwar years. Ideas about bombing an enemy war economy were articulated in the documents and lectures of the Air Service, and later the Air Corps School system.

In 1926, an unsung air theorist, William C. Sherman, put forward an early version of what became, in the 1930s, the U.S. "industrial fabric" theory of bombing. Sherman wrote:

> Industry consists . . . of a complex system of interlocking factories, each of which makes only its allotted part of the whole. . . . Accordingly, in the majority of industries it is necessary to destroy certain elements of the industry only, in order to cripple the whole. . . . On the declaration of war, these key plants should be made the object of a systematic bombardment . . . until they have been sufficiently crippled.[42]

This approach was distinct from what either Trenchard or Douhet had argued. It did not rely on an uprising from the population, or the enemy being (in Trenchard's words) "thrown on to the defensive." It assumed that a war economy would collapse if **key elements** of it were destroyed by aerial bombing. Sherman's theory, developed further by his colleagues in the 1930s, looked to the interdependence of modern economies, and sought specific structural weaknesses within them. By identifying and eliminating key nodes in an enemy's war economy, bombers might deny that enemy the means with which to fight an industrial war.[43]

Despite possessing a theory of bombing and developing the tools that might be used to implement it—the B-17 bomber and Sperry and Norden bombsights—the interwar Air Corps was officially prevented from thinking in terms of offensive action. Even as Hitler made his aims increasingly clear in the 1930s, the American people had no wish to be pulled into another European war. However, by the late 1930s, as President Franklin D. Roosevelt began to increase military budgets, he gave special attention to the Air Corps. He believed, initially, that air power might help deter a war. Later, he envisioned the United States as the "arsenal of democracy" but not a belligerent itself, and he imagined that the United States might provide its future allies with advanced tools with which to fight Hitler and Nazism. As the war approached, American aviators received more autonomy, but not full independence from the U.S. Army.

Perhaps it should be no surprise that both Britain and the United States were drawn toward long-range bombing in the 1930s. Both nations, blessed with geographical good fortune, had eschewed large standing armies in favor of sea power. They followed a similar pattern with respect to airplanes and air power. Their inclination to substitute advanced technology for manpower was only reinforced by memories of the dreadful casualties of the long-stalemated ground battles of World War I. Decision-makers in both states felt that if a war had to be fought, it might be possible to fight a quicker and perhaps even cleaner war through the air.

WORLD WAR II: A TEST OF THEORY

When World War II began, the 1940 Battle of France revealed that neither the French nor the British had paid enough attention to air-ground cooperation on the battlefield. Fortunately, the RAF had not neglected air defense, even if Trenchard and his colleagues had given rhetorical prominence to the offensive qualities of long-range bombing. This fact enabled the British to prevail in their quest to maintain control over their own airspace during the 1940 Battle of Britain. Victory in this vital battle meant that Britain remained in the fight and could serve as a key staging area for a continuing war against Hitler.

As the war progressed, the Germans, like the British, constructed formidable defenses centered on radar. However, if radar hindered the Germans in the Battle of Britain, it would hinder British bombers in their attempts to attack Germany. The British began their bomber war with strikes on German oil and communication targets. This was not only to stay within a general ethical framework but also because many in the RAF thought such attacks would be the most effective and efficient. The British discovered early in the war that they could not bomb in daylight without prohibitive losses; thus, they shifted increasingly to night bombing. The RAF knew that such raids would suffer from inaccuracy, but they did not fully appreciate the degradation until the summer of 1941 when a thorough photoreconnaissance analysis revealed that only about 1 in 5 bombers were getting within **five miles** of their targets. In February 1942, the British formalized what had become obvious: since cities were the only targets that Bomber Command could reliably find and hit, British bombers would attack German

cities, particularly those areas with dense populations of industrial workers.[44]

This was an expedient strategy, undertaken at a moment when aerial bombing was the only way that Britain could strike back at Hitler. It was intended not only to strike the enemy but also to bolster home front morale. Sir Arthur Harris, who took over as head of Bomber Command in 1942, believed in city bombing; he felt that the Germans valued their cities and that cities were the main engines of modern war. He believed that bombardment, combining elements of punishment and denial (destruction of crucial industrial output), would sooner or later force the Germans to sue for terms. He believed that in the battle between the destruction Bomber Command could impose on Germany, and the attrition Germany could impose on Bomber Command, he and his force would win out. The theory of victory here was distinct from others we have seen. Interestingly, Harris was more committed to city bombing than others in the RAF, and this dispute would later become a factor in the prosecution of the war.[45]

In the autumn of 1942, when the Americans were just getting their war effort organized, Winston Churchill invited them to join the nighttime bombing effort. They declined. They were convinced that by flying in groups of high-altitude, self-defending bombers, they could defend themselves adequately and find their way to specific industrial targets, undermining the German war economy, and dealing a fatal blow to the Luftwaffe.[46] However, the Americans too suffered high attrition, particularly when they began to attack targets deep in German territory in 1943. The losses eventually prompted the Americans to change course. By bringing large numbers of long-range fighters

equipped with droppable, self-sealing fuel tanks to the theater, and flying raids on targets the Germans felt compelled to defend, the Americans provoked aerial battles of attrition with the Luftwaffe. This counter-force battle for air supremacy over Europe paralleled Mitchell's thinking. Eventually, this offensive—waged by a vast and growing American force—overwhelmed the Germans' ability to train pilots, provoking a down-ward spiral from which they ultimately could not recover.[47]

In Europe, the Americans initially tried to limit themselves to industrial targets. However, the weather was frequently too cloudy for bombsights to be used effectively. Late in 1943, the Chief of the U.S. Army Air Forces ordered that Americans would bomb through overcast skies rather than not bomb at all when the weather was poor. Like the British, the Americans adopted this approach as an expedient measure. This meant, however, that the Americans substantially diverged from the "industrial web" theory a great deal of the time. Their willingness to add incendiary bombs to their ordnance mix also indicated a drift from their original conception for long-range bombing. They inaccurately bombed through clouds in bad weather and used bombsights against specific industrial and military targets when the weather was decent. During poor weather in the winter of 1944-1945, 42 percent of U.S. 8th Air Force bombs fell more than five miles from their target.[48]

Similarly, cloud cover and jet stream winds pre-vented successful bombing of Japanese industry in the Pacific theater, which the Americans attempted to implement in 1944. By early 1945, the Ameri-cans—feeling an urgent need to make progress in the war—abandoned this effort and turned to low-level

incendiary attacks on Japanese cities. Over 60 such attacks were waged, the most devastating on March 9-10, 1945, when well over 100,000 Japanese died in a single attack on Tokyo, which was more than would die at Hiroshima. As in Europe, the Americans tried to do industrial targeting whenever conditions made it feasible. The conventional bombing of Japan continued right up until the Japanese surrender in mid-August, with some raids taking place in between, and even after, the two atomic attacks.[49]

What all air forces discovered in World War II was that long-range bombardment is **much** more difficult and demanding to prosecute than the interwar theorists had predicted. Air defense methods proved to be formidable and effective; by no means did the bomber "always get through" as so many had assumed it would. Moreover, finding and hitting targets reliably—especially in bad weather—was anything but a simple process. The enemy could thwart determined efforts through deception, stockpiling of materials, substitution, dispersion, and other means.

Throughout World War II, Allied tactical aviation was an incredibly powerful asset. Indeed, its utility simply **cannot be overstated**. After a bumpy start, talented aviators like Arthur Tedder and Arthur "Maori" Coningham of Britain, and Pete Quesada of the United States, raised tactical air power to a high art; they leveraged an Anglo-American asset in a way that gave immense advantages to their national fighting forces, protecting the overhead flank. This put heavy stress on German infantry, reconnaissance, and armored units that otherwise would have operated with far more freedom of action. Air superiority facilitated Allied reconnaissance and communication on the battlefields of Europe, as well as battlefield strike and interdiction.

On the Eastern Front, the Russians learned to cope with German Blitzkrieg methods by developing their own strong tactical aviation to support their fighting forces on land.[50]

At sea, the development of aircraft carriers and their complement of potent instruments including strike aircraft transformed and revolutionized naval warfare, and gave navies a new form of coercive leverage and new instruments for work at the tactical and operational levels. The impact was seen most fully in the unfolding of the U.S.-Japanese war in the Pacific, and was made known to the world shortly after the dramatic battle of Midway in 1942.[51]

Both the RAF and the U.S. Army Air Forces were learning institutions, and they were able to continue to prosecute their offensives even as they adapted to the conditions they had failed to anticipate. By 1944, the British were able to hit specific industrial targets under the right conditions. In addition, the insistent American determination to defeat the Luftwaffe proved immensely important and consequential. This campaign gave the Anglo-Americans air superiority in Europe—and the attainment of air superiority made the D-day landings feasible. D-day ensured that the Anglo-Americans would have a say in the European settlement coming out of the war. Air superiority and continued bombing of enemy infrastructure greatly aided the progress of Anglo-American armies. In the last phases of the European war, aerial bombing of oil and railway targets had an immense impact on the ability of the Wehrmacht (armed forces of Nazi Germany) to prosecute a war of maneuver. German factories needed coal, but a devastated railway meant coal could not get to where it was needed. In addition, Germany's dwindling oil supply meant that its tanks

and aircraft could not move and its pilots could not train.[52]

During World War II, civilian populations proved to be much less fragile and much more robust than the interwar theorists had predicted. British civilians during the Blitzkrieg and German civilians during the long years of Anglo-American air attacks found ways to adjust to life under fire.[53] In addition, the effect of local, immediate coercion (for instance, the Gestapo, or secret police of Nazi Germany) could overwhelm the effect of more remote coercive mechanisms like enemy bombers. Finally, culture could play a role too. In Japan, the strong commitment to the Emperor, who held religious status in Japanese society, made it difficult for citizens to turn their anger or desperation toward the overthrow of the existing government.

The shift to an emphasis on city bombing by the British—and a partial shift to city bombing by the Americans in Europe and a full shift in Japan in 1945—raised major, legitimate ethical questions that are still debated today. Strategic bombing had been embraced in hopes of finding a method of warfighting that would avoid the horror of trench warfare. However, it brought its own kind of horrors. The air campaigns grew more intense as the war continued. The large and devastating bombing of late 1945 in Europe, for instance, took place in the wake of the V-weapon (Vergeltungswaffen, or retaliatory weapons—V-1, V-2, and V-3) attacks on Britain, the shock of the Battle of the Bulge, and the fear of German jet fighters and Schoerkel submarines (which some feared might launch V-weapons against U.S. soil). Unfortunately, the interwar theorists' assumption that air war would be too terrible to be endured for long did not prove to be the case. The moral ramifications of long-range

bombardment in both World War II theaters cannot be sidestepped.

Because the strategic bombing of World War II did not have the impact that the interwar theorists had predicted, many postwar analysts concluded that it had failed to live up to its promise and had contributed only marginally to victory. Nevertheless, these critiques deserve scrutiny. In any analysis, the first issue to consider is whether a different expenditure of resources would have been likely or even possible. Neither Britain nor the United States was comfortable with large standing armies; they both had bitter memories of World War I and were anxious to avoid that experience again. It is unlikely either would have eschewed the promise of air power (alongside sea power) in favor of a strategy that relied principally on armies.

Even if bombing in Europe was imprecise and highly imperfect, it still served to place an important ceiling on the expansion of the German war economy—an effect that was crucial at key moments during the war. Bomber Command's 1943 campaign against the Ruhr prevented German munitions czar Albert Speer from carrying out a vast expansion of German production that year—an expansion that would have greatly benefited the Germans on the Eastern Front.[54] Heavy American attacks on the Luftwaffe facilitated the Normandy invasion. Prior to D-day, the bombardment by Allied bombers greatly disrupted the French transport network and kept the Germans from waging optimal maneuver warfare after the Allied Normandy landing. Air Marshal Sir Arthur Tedder, Eisenhower's deputy commander, recognized the crucial nature of the Allied air attacks on the German rail net, and he understood how they interacted with attacks on

German synthetic oil in the last stages of the war. Air power—both strategic and tactical—made immense contributions to victory.

The debates that had begun in the interwar years were not resolved during World War II, indeed, in many respects, they intensified. One passionate air advocate of this era was Alexander de Seversky. In his 1942 book, *Victory Through Air Power*, he wrote:

> The most significant single fact about the war now in progress is the emergence of aviation as the paramount and decisive factor in warmaking. . . . All experts agree that air power will play an ever more decisive part in determining the power balance among the nations of the earth.[55]

Long-standing debate has taken place on whether or not the atomic attacks on Japan were necessary for victory in that theater. Some have held that naval blockade plus short-range bombing, along with the threat of a Soviet ground offensive, would have been enough to bring Japan to terms. Others have argued that the shock of the atomic attacks pushed the Japanese to surrender. Of course, there is no simple answer—and any attempt to address the issue must consider both the timing of victory, the casualties the Americans would have been willing to accept, and the fear and heightened emotions of the period of 1944-1945. Another relevant issue pertains to the vague wording of the Potsdam Declaration, issued to the Japanese as an ultimatum in July 1945. Historian Richard Frank has made a compelling argument that the effects of war, including sea blockade and conventional and atomic bombing, created fears in the minds of civilian leaders of a popular uprising. If Frank was right, then the fears that were created by the heavy

punishment of the Japanese people at the end of a long war, which had escalated steadily since Pearl Harbor, had an impact on Hirohito and many of those in his circle.[56] Japanese surrender came, however, only after immense pressure on the civilian population, and ghastly losses.

In World War II, Britain's Bomber Command and the American bomber forces employed a mix of denial through strategic interdiction of key elements of the German war economy and punishment. Experience proved that the denial efforts were more effective than the punishment efforts. The latter did not have prompt effects because civilians proved resilient and able to resist, avoid, and counter the effects of even very heavy bombing. In the end, strategic and tactical aviation were able to work together—and with other military instruments of power—to create formidable synergies. These, combined with Russian success on the Eastern Front, were more than the Germans could handle. In the Far East, successful U.S. naval war and interdiction, combined with the effects of bombing from both long-range forces and bombers flying from carriers, proved to be more than the Japanese could endure.

THE COLD WAR AND THE KOREAN WAR

After World War II, bomber aircraft able to carry nuclear weapons allowed the Americans to hold enemy assets at risk from long distance. While the U.S. Air Force would have won its autonomy after the war anyway, the postwar emphasis on the nuclear mission guaranteed it and brought considerable resources to the new Strategic Air Command (SAC). Under the fiscally conservative Eisenhower administration, the

SAC offered the United States an inexpensive way of balancing against the large army maintained by the postwar Soviet Union. From the 1950s to the 1980s, the U.S. Air Force was a SAC-dominated institution; its focus was geared toward maintaining a robust deterrent force that would head off a nuclear conflict between the superpowers. Indeed, SAC's motto was "Peace is our Profession." When the Americans possessed only a small number of nuclear weapons, SAC targeting focused on Soviet cities. Once the nuclear arsenal grew, targeting shifted to Soviet industry—but the bombs were large and devastating, and collateral casualties among civilians would have been very high as a result.[57]

The two Asian wars fought by the Americans during the Cold War in Korea and Vietnam were frustrating for practitioners of long-range bombardment, not least because the fear of escalation with Russia and China kept constraints on targets American air forces could strike. In Korea, training for atomic missions went forward, but authorities withheld permission for their use.[58] The use of bombers did not translate into steady progress toward victory, and as time passed, American B-29 bombers became increasingly vulnerable to North Korean air defenses.[59] The politics of limited war ensured that enemy supply sources in China and Russia remained off the target lists, and North Korea itself contained only limited indigenous industry; the industrial fabric theory was thus a poor fit to the conditions of the war. SAC commander General Curtis LeMay would later say about the war, "We never did hit a strategic target."[60] Moreover, like the Japanese, the North Koreans proved able to endure heavy punishment.

After only a few months of war, U.S. bombers had destroyed all of the industrial targets in North Korea.[61] After the Chinese entered the war in late 1950, constraints on U.S. targeting were loosened and the U.S. Air Force firebombed Pyongyang. However, the North Koreans held out. The spring of 1951 brought very high tension as General MacArthur pressed for a widening of the war, and nine nuclear cores were released by the Atomic Energy Commission and flown to Guam, where they could be mated with bomb casings.[62] In 1952, further attacks on Pyongyang, on smaller towns and cities, and on North Korean hydroelectric plants failed to break the war's stalemate. The attacks on power plants were made mainly by fighter bombers; by late June 1952, this campaign had cut off 90 percent of North Korea's electrical power generation.[63] Some of these attacks were designed explicitly to "punish the enemy with air power," although the Americans tried at the same time to retain the language of "military" targets, as they did not wish to cause a complete break during the war from the norms prohibiting the direct targeting of cities and civilians.[64]

The escalating bombardment campaign culminated in the spring of 1953 with the breaching of dikes that led to the flooding of portions of the Korean rice crop. The armistice that followed shortly thereafter (in July 1953) was interpreted by some to mean that this final form of aerial punishment had worked. However, by that time, many other factors including the death of Stalin were bearing in significant ways on the peace process, and thus, it is difficult to tease out the precise events and effects that led to a settlement. After he won the Presidency in November 1952, retired General Dwight Eisenhower—who had promised during his campaign to end the Korean war—made indirect

threats of nuclear war against North Korea. While historians disagree on the precise nature and impact of these threats—what they entailed and how they were conveyed—Robert Pape has argued that signals sent to the Chinese, which had indicated the U.S. willingness to further escalate the level of violence in the war, along with Eisenhower's threats, influenced the thinking of the North Koreans and their allies.[65]

As historian Conrad Crane has argued, the Korean war brought terrible devastation and death to the peninsula. He points out that, "By the end of the war, most North Koreans were living in hidden villages or caves, and eighteen of their twenty-two major cities had been more than 50 percent obliterated." He adds, importantly, "One of the primary motivations for the contemporary North Korean nuclear and missile programs is to deter the United States from ever doing that to their homeland again."[66] Robert Pape has argued that the Korean war precipitated China's independent nuclear program.[67]

As in World War II, skillful use of battlefield-oriented aviation was an irreplaceable asset to the Americans, saving the early war effort in 1950, and aiding the conventional denial campaign that:

> compelled the Communists to concede the future presence of U.S. troops in South Korea as well as the movement of the inter-Korean boundary from the Thirty-eighth Parallel to the military frontline somewhat north of the parallel.[68]

Similar to World War II, American bombing in the Korean war relied on combinations of denial, punishment, and risk strategies. As the war dragged on, and as the Americans faced setbacks, initial constraints fell away and targeting expanded. Strong tactical aviation

provided invaluable help to United Nations forces on the ground, without which they could not have survived and sustained themselves.

Once the Korean war ended, the U.S. Air Force reverted to its priority focus: SAC preparation for possible war with the Soviet Union. The U.S. Air Force was able to maintain that focus for just over a decade, prior to the outbreak of the war in Vietnam, during what were probably the most intense and dangerous years of the Cold War, to include 1962—the year of the Cuban Missile Crisis.

THE WAR IN VIETNAM

When President Lyndon B. Johnson and his advisors increased the U.S. commitment to South Vietnam in 1964-1965, they hoped that air power might facilitate a relatively quick and painless campaign that would not drain resources from domestic programs, including Johnson's "Great Society" program. As had been the case in the Korean war, Americans did not want an escalation that would include either China or the Soviet Union, so political constraints were again placed on targeting and timing. The Johnson administration hoped that bombing carefully selected targets would demonstrate U.S. resolve; convince North Vietnam that supporting the insurgency in the South would be too costly; bolster morale in the South; erode the morale of Viet Cong cadres; and generally intimidate the leadership of the insurgency, thereby convincing them that they could not win.[69]

In April 1964, the U.S. Joint Chiefs of Staff had compiled a list of 94 bombing targets in North Vietnam. The Air Force wished to attack these immediately to impose psychological shock as well as physical

damage. The Johnson administration, however, would choose a more graduated approach. After Viet Cong guerillas struck a U.S. military instillation in Pleiku in February of 1965, American policymakers implemented Operation ROLLING THUNDER, an aerial bombing campaign designed to keep North Vietnam from moving men and supplies into the south, and to persuade Hanoi to accept a peace settlement preserving an independent, noncommunist South Vietnam. If the goals of ROLLING THUNDER were clear, the strategy of coercion to be used was a matter of debate. As Robert Pape had pointed out, the campaign ultimately included, at different times, elements of risk, punishment, and denial strategies.[70]

In August 1965, Secretary of Defense Robert McNamara rejected the Joint Chiefs of Staff recommendation for attacks on North Vietnam's strategic oil facilities and electric power plants. The administration believed that by undertaking limited bombing that would hold more valuable targets at risk, it could signal the prospect of unacceptable escalation and prompt the North Vietnamese to rethink their objectives. However, the administration entered into this belief over-optimistically, and without a full understanding of Vietnamese motivation and determination to liberate their nation from outside influences and unite it. The Johnson administration also believed that the North Vietnamese would be able to read clearly the signals sent by this pattern of bombing.[71]

The Hanoi government began to disperse the nation's limited industry and erect passive and active air defenses, and supplies and workers from the Soviet Union and China aided these efforts. In light of this, the Joint Chiefs of Staff called for an expanded bombing program late in 1965. Ultimately, the Johnson

administration expanded the air campaign in 1966 and 1967: in June 1966, North Vietnam's oil storage facilities were bombed for the first time; in May 1967, Hanoi's main power station was attacked. North Vietnamese assets once held at risk were now targets.[72]

Unsurprisingly, the Air Force chafed at the early restrictions that had been placed on the campaign. The Joint Chiefs of Staff target list grew from 94 targets to 242 targets shortly after ROLLING THUNDER began, and the latter number changed little through the rest of the campaign. In 1965, 158 of these targets were destroyed (nearly all of them were military targets below the 20th parallel); in 1966, 22 more were destroyed. The President released nearly all of the remaining targets for attack in 1967, and by December, almost all of North Vietnam's industrial war capacity had been destroyed.[73]

During the war, the U.S. Air Force dropped some 6,162,000 tons of bombs—more tonnage than had been dropped by the Allied Powers in all of World War II. Many in the U.S. Air Force came to believe that the constraints and gradual escalation had prevented aerial bombing from achieving success. The fundamental problem, however, was that the North Vietnamese and Viet Cong were determined to achieve a unified Vietnam free of outside influence—and were willing to accept immense levels of pain to achieve this.[74] The Americans might have been able to better understand this determination and foresee its consequences had they looked more closely at the French experience in Vietnam.[75]

When the North Vietnamese and Viet Cong were fighting a guerrilla war, insurgents required few supplies, and could often move what they needed through territory that was off limits to the bombers. They could

fight the war at their own pace, backing off when their losses became unendurable, and recommencing when they had recovered. The slow pace—and the inability of the Americans to build an effective government in South Vietnam—eroded American public support for the war. Structural factors, including the economy and geography of Vietnam, helped insulate the North Vietnamese and Viet Cong against the effects of interdiction and coercive air power generally. Finally, even if an earlier all-out air assault had convinced North Vietnam to stop supporting the Viet Cong insurgency, this is no guarantee that the Viet Cong would not have continued the war on their own, and at their own pace.[76]

In 1972, Operation LINEBACKER, an air campaign designed to halt Hanoi's spring ground offensive, largely achieved its purpose and appeared to put a settlement in reach. By this time, the North Vietnamese and Viet Cong were fighting conventionally and were far more vulnerable to superior air power than they had been previously in the guerilla war phase. Negotiations on a settlement went forward, but then North Vietnamese negotiators stalled late in the day, prompting Operation LINEBACKER II, an 11-day campaign from December 18 to 29, to bring enemy negotiators back to the table to sign a final accord. LINEBACKER II concentrated on military assets in and around Hanoi. On December 29, communist leaders indicated a willingness to resume serious negotiations. Some observers argued later that a LINEBACKER-style campaign executed at the outset of the war would have brought victory. However, this perspective overlooked the crucial differences between 1965 and 1972. The success of the LINEBACKER I campaign was facilitated by the fact that Hanoi had shifted to a conventional war

strategy. Moreover, by 1972 and certainly when LINE-BACKER II commenced, the Hanoi leadership already had achieved most of its political goals, and was prepared to sign an accord that would put its ultimate aims within easy grasp.[77]

An important insight here is simply that all military campaigns take place in a political context that will impose political constraints. For a variety of reasons, including the just war constraint of proportionality, the Johnson administration was not prepared to wage an all-out air assault in 1965. As the U.S. Air Force fought in the Cold War campaigns in Asia, it reconfigured and reconstituted itself to meet the immediate needs—and constraints—of those campaigns. However, on occasion, this led to episodes of profound institutional discomfort. Another important insight is that if one is going to rely on a coercive strategy meant to change enemy behavior, then one must intimately understand the enemy one faces. This requires sophisticated intelligence and astute analysis of such questions as: What is the enemy seeking? How much pain is the enemy willing to endure to achieve its goal? Is it structured to endure long-term pain? Can it manipulate the pace of the campaign and thus raise the price of victory for its adversary?

THE IDEAS OF JOHN BOYD

One of the most influential thinkers to come to the surface in these years was John Boyd, a fighter pilot who flew F-86 Sabre jets in the famous "MiG Alley" during the Korean war. Boyd was not, and did not consider himself to be, an air power theorist per se. His work was both more narrow and, on the other hand, more expansive. Boyd captured the insights of

his pilot experience in the intellectual work he called the "energy-maneuverability theory," which continues to guide the training of fighter pilots to this day. He placed an emphasis on maneuver over speed, the ability to make rapid changes in altitude, and good visibility to foster situational awareness. All this was pivotal in the design of a generation of American fighters, including the F-15, F-16, and F-18, and Boyd should be credited for his direct influence on these aircraft.[78]

After retiring from the military, Boyd expanded his work. He had an eclectic and wide-ranging intellectual appetite, and was deeply influenced by a number of trends that became dominant between the 1960s and 1990s, including cybernetics, systems theory, complexity theory, and chaos theory. He was also interested in cognitive science and quantum mechanics, and was influenced by the work of Kuhn, Popper, Heisenberg, and the neo-Darwinists.[79]

Writing and speaking in the 1970s, when the Cold War seemed to have ossified strategic thinking, Boyd brought an emphasis to the work of Sun Tzu, and facilitated the rediscovery of operational art—in part through a focus on the concept of Blitzkrieg, the sophisticated use of combined arms the Germans employed at the outset of World War II. A member of the "military reform" movement that gained energy as a reaction to what seemed like a bureaucratic, attritional war in Vietnam, Boyd sought to resurrect the idea of the adaptive, creative warrior.[80] He eschewed the concept of attrition and focused instead on imposing paralysis through maneuver. The guiding idea in his work was that competitive human interaction—warfare, specifically—is a struggle between complex, adaptive systems. His work would influence the

thinking and the vocabulary of all of the U.S. armed services, but in the long run, would take particular hold in the U.S. Air Force and the Marine Corps.[81]

A 1976 essay, "Destruction and Creation," was his opening step in the development of a longer intellectual exercise, documented in an unpublished series of briefings called "A Discourse on Winning and Losing." In these, Boyd sought to capture the cognitive processes crucial to prevailing in a highly unpredictable and competitive world. This involved:

> reaching across many perspectives: pulling each and every one apart (analysis), all the while intuitively looking for those parts of the disassembled perspectives which naturally interconnect with one another to form a higher order, more general elaboration (synthesis) of what is taking place.[82]

The longest of the presentations (193 slides), called "Patterns of Conflict," has been described by one scholar as the "intellectual heart" of Boyd's work. It brought together his ideas about winning and losing in a competitive world filled with uncertainty and introduced the intellectual construct for which he is best known: the observe, orient, decide, and act (OODA) loop.[83]

Anxious to move away from what he thought of as reductionist and linear thinking, Boyd promoted a theory of maneuver that was principally psychological; it aimed to "break the spirit and will of the enemy command by creating surprising and dangerous operational or strategic situations."[84] If conflict and uncertainty are unavoidable features of human society, then one must rely on adaptability as the key to survival. Drawing on both Clausewitz and Sun Tzu, Boyd looked for ways that a combatant might reduce his

own friction while simultaneously increasing the enemy's. The OODA loop attempted to address human behavior at the individual and organizational levels. The adversary that was moving through the cycle more rapidly and efficiently would prevail, by forcing its enemy's reactions to be increasingly ill-suited to the prevailing situation. Often over-simplified by others, the OODA loop was, in Boyd's rendering, a complex construct that required layers of sophisticated inputs and ongoing feedback mechanisms.[85]

Boyd emphasized stretching beyond one's own self-oriented and self-limiting cognitive frames. By increasing friction for the enemy, one can get inside his OODA loop and stay there. Attrition warfare, he believed, under-utilizes the mental and moral domains. By contrast, maneuver, broadly conceived — to include surprise, shock, deception, and ambiguity — breaks an adversary's cohesion and sows disorder and panic. The goal is to "unstructure" the enemy's system into "confusion and disorder by causing him to under- or over-react."[86]

Boyd did not perceive potential enemies as either static or fragile; indeed, he believed that an enemy would constantly seek out its **own** ways to **impose** shock and disorder. The key was to get ahead of the enemy, in part through good training, trust, a strong moral foundation, and intellectual creativity, and stay there by applying continuous and escalating pressure. Boyd dismissed single-answer solutions and ready prescription. There was, he believed, no recipe or template for getting inside the adversary's decision cycle. It is specific to the circumstance, and must be arrived at through insight, intuition, clarity of thought, and the self-awareness that comes from wisdom and experience.[87]

Boyd did not provide targeting prescriptions. However, many of his general ideas worked their way into the thinking and doctrine of the U.S. Air Force and other air forces and manifested themselves in the way the U.S. Air Force fought in Iraq in 1991 and 2003, and in Afghanistan.[88] Direct influences of Boyd's work are visible in the U.S. Air Force's Basic Doctrine of 2003:

> The 'American way of war' has long been described as warfare based on either a strategy of annihilation or of attrition and focused on engaging the enemy in close combat to achieve a decisive battle. Air and space power, if properly focused, offers our national leadership alternatives to the annihilation and attrition options. . . . It is possible to directly affect adversary sources of strength and will to fight by creating shock and destroying enemy cohesion without close combat. While such attacks may not totally eliminate the need to directly engage the adversary's fielded military forces, it can shape those engagements so they will be fought at the time and place of our choosing under conditions more likely to lead to decisive outcomes with minimized risk to friendly forces.[89]

AFTER THE COLD WAR

The Persian Gulf war of 1991 saw the implementation of an air campaign that had multiple goals and multiple theoretical underpinnings. However, part of it bore the imprimatur of Colonel John A. Warden, U.S. Air Force, who had been in charge of the Deputy Directorate for Warfighting Concepts in the Air Staff Directorate of Plans, and who had become particularly interested in the prospects of targeting enemy leadership.

The air campaign in the Kuwaiti theater of operations had three primary objectives: suppression of Iraqi air defenses; preparation of the battlefield for

coalition ground attack; and support of the ground attack.[90] The strategic air campaign over Iraq was designed to support the war aim by directly pressuring and degrading Saddam's regime on a number of levels. In 1988, Warden had circulated a paper articulating a targeting theory based on five principal categories, envisioned as five concentric rings (like rings in a bull's eye) that increase in value as they approach the center. The focal point—his designated "center of gravity"—was enemy leadership. Just outside of that, in the position of second priority, were the enemy state's energy sources, advanced research facilities, and key war-supporting industries. In the third ring was enemy infrastructure, such as transportation systems. The fourth ring was comprised of the enemy's population, and the fifth ring designated the enemy's fielded military forces.[91] Warden was focused mainly on disrupting leadership and decapitating the state.

Warden's book, *The Air Campaign*, begun when he was a student at the National Defense University, argued that air power allows for strikes against the full spectrum of enemy capabilities, with leadership first and foremost. The "five rings" model was an extension of the operational concepts he had first explored in his book. In an essay he published in 1992 called "Employing Air Power in the 21st Century," he wrote:

> The command structure . . . is the only element of the enemy . . . that can make concessions. In fact, wars through history have been fought to change (or change the mind of) the command structure—to overthrow the prince literally or figuratively or to induce the command structure to make concessions.

He added:

> When command communications suffer extreme damage . . . the leadership has great difficulty in directing war

efforts. In the case of an unpopular regime, the lack of communications not only inhibits the bolstering of national morale but also facilitates rebellion on the part of dissident elements.[92]

The plan that Warden and his staff developed for the Gulf war, "Instant Thunder," won theater commander General Norman Schwarzkopf, Jr.'s endorsement, and Warden went to Riyadh, Saudi Arabia to brief Lieutenant General Charles A. Horner, U.S. Air Force. Uneasy with the plan's failure to consider fully the offensive capabilities of the Iraqi Army, Horner modified it, changed its name, and appropriated several members of Warden's staff to comprise a secret "Central Air Forces Special Planning Group," nicknamed the "Black Hole."

Even though the aircraft coming into the theater comprised the vast majority of the U.S. Air Force's precision delivery capability at the time, the force was not ideally suited to the task Warden had set for it. Technological evolution throughout the Vietnam war had yielded some promising results in highly precise, guided-bomb technology, but the Air Force had been leisurely in its attempts to acquire it.[93] Still, the U.S. Air Force had the capacity to employ air-delivered, precision-guided munitions with hard target-penetrating capability, and this would become a centerpiece of its war effort. Robert Pape had observed that the capacity for high accuracy "encouraged strategic bombing advocates to propose the first systematic decapitation campaign in air history."[94] One can thus identify multiple theories of coercive air power at work in the Gulf war. Along with a more traditional denial campaign, Warden's "Instant Thunder" plan hoped to isolate, and possibly kill or overthrow Saddam Hussein. The

Saddam Hussein regime itself—the leader and the structure under him—was the primary target.[95]

The Black Hole planners, led by Lieutenant Colonel David Deptula, updated the air war plan right through the opening hours of the war on January 17, 1991; they emphasized simultaneous attacks on target sets that would have overlapping and linking effects. Rather than attacking targets in a sequential, prioritized order, coalition air forces were able to carry out simultaneous counter-air, interdiction, close air support, and strategic missions into Iraq. By mid-February, coalition bombers had struck the Iraqi Ministry of Defense, the Baghdad Conference Center, the Military Intelligence Headquarters, and television and press buildings. As the month went on, strategic attacks targeted airfields, nuclear and chemical sites, communication facilities, and mobile Scud missile launchers.

Attacks on Iraqi communication targets surely had a corrosive effect on the speed and efficiency with which Saddam could conduct his war. However, fiber-optic nets were more redundant and elusive than the Black Hole had anticipated, and in some cases, Saddam could resort to runners to carry messages. The precise military and political impact of raids on leadership and communication targets—the focus of Warden's theory—has been difficult to discern with certainty, and are thus contested. As historian Richard Davis concluded, "little solid data is available to connect the bombing of leadership or command and control facilities with specific consequences."[96]

Strikes on Iraqi oil production sites led to the collapse of refinery capacity by the end of the war. However, the short duration of the war meant Iraq was able to rely on stored supplies for military operations. Pressure on the Iraqi population due to strikes on the

electrical grid and other fuel sources may have contributed to the postwar uprisings by the Kurds and the Shiites. However, it did not appear to lead to a weakening of the Sunni commitment to Saddam's regime, not least because of the deep fears the Sunnis held of losing power to groups it had badly mistreated in the past.[97]

The 5 months between the invasion of Kuwait and the commencement of Operation DESERT STORM gave Saddam time to further disperse and hide his weapons of mass destruction capability—a set of resources already dispersed in reaction to the Israeli strike in 1981. The targets proved to be elusive, and postwar inspections revealed that target planners—who had operated with limited and outdated intelligence—had missed many facilities.

The coalition achieved its main aims, including the withdrawal of all Iraqi forces from Kuwait, the right of the United Nations to install peacekeepers on the border, and the right to inspect and eliminate any weapons of mass destruction in Iraq. Pape has argued that the denial campaign "generated powerful coercive pressure on Iraq to withdraw from Kuwait."[98] Through a variety of means, air power crippled Iraq's military strategy for holding Kuwait. Many analysts have noted that the pressure on exposed ground troops led to their demoralization; indeed, between 20 and 40 percent of Iraqi frontline troops had deserted before the ground offensive commenced.[99] However, Pape was critical of the decapitation campaign, which he believes did not attain its objectives. "Instant Thunder," he wrote, "failed to kill, overthrow, or isolate Saddam or his regime."[100] Saddam was hard to track and find, and his communications were thicker and more resilient than the Americans had anticipated.

Moreover, the air campaign did not manage to set up the conditions for a coup against Saddam's regime.[101]

The speed and apparent ease of the Gulf war victory prompted many commentators to proclaim that a "Revolution in Military Affairs" had occurred based on the sophisticated technology employed by American forces. Indeed, the one-sided outcome had resulted from the **interaction** of American proficiency and Iraqi incompetence. Poor skills and training ensured that the coalition's modern military toolkit and operational proficiency punished the Iraqi Army disproportionately.[102]

Warden continued to refine his ideas after the war. He followed in the tradition of the early theorists in a number of ways. Like Mitchell and Douhet, he placed a strong emphasis on winning command of the air. One of Warden's protégés, Lieutenant Colonel (later Lieutenant General) David Deptula, would become particularly influential in the U.S. Air Force. He would highlight the idea of parallel warfare reflecting a principle of electrical circuit design that "was based on achieving specific effects, not absolute destruction of target lists."[103] His approach focused on facilitating simultaneous attacks on leadership targets; key essentials, such as oil and electricity; and communications and fielded military forces. Using echoes of Boyd, Deptula saw parallel warfare as part of the post-Gulf war Revolution in Military Affairs that could offer alternatives to the "attrition" and "annihilation" strategies of older styles of warfare. The specific effects that Deptula highlighted were the new objects of war, achievable through "effects-based operations."[104] He argued that:

> The strategies of annihilation and attrition rely on sequential, individual target destruction as the ultimate

method of success and measure of progress—generally measured in terms of forces applied, or input. Using effects-based operations, the determinant of success is **effective control of systems that the enemy relies upon** to exert influence—output [emphasis added].[105]

BY AIR POWER ALONE?

In 1999, NATO went to war in what ended up being an air-only operation trying to halt Serbian mistreatment of the population in the then-province of Kosovo. Ethnic Serbs formed a small part—about 10 percent—of the population of the province, which consisted mainly of Albanian Muslims. The failure to bring the opposed parties together at the Rambouillet conference in early 1999 led to a NATO decision to try to coerce the Serbs into accepting terms. The Clinton administration expected Serbian President Slobodan Milosevic to cave in under air strikes in a few days, but he did not. Muslims poured out of the province and into refugee camps in neighboring states. Air strikes, waged from high altitude to minimize the risk to NATO pilots, could not halt events on the ground, and the strikes seemed only to unify the defiant Serbs behind Milosevic. NATO was cautious in all regards, and there was considerable anxiety about whether the alliance would hang together. Initially, President Clinton would not agree to the use of ground troops. In May, an increasingly alarmed NATO took advantage of improving weather to intensify the bombing—attacking rail lines and bridges in Kosovo and Serbia and, on May 24th, destroying the transformer yards of the Yugoslav power grid. The latter had widespread effects, including the undermining of the nation's banking system.[106]

Significantly, NATO also began to discuss the use of ground troops. This put the Russians—old allies of the Serbs—in a particularly awkward situation since they had no intention of ending up in a shooting war with NATO at that time. Pressure from the Russians surely helped convince Milosevic that he had to accept NATO terms. The bombing ceased in June, and the United States and NATO sent a force of 60,000 troops (Kosovo Force) into Kosovo. Milosevic, who in the meantime had been indicted as a war criminal by the International Criminal Tribunal, was ousted from power in the autumn of 2000.[107]

The air war over Kosovo rekindled the debate about whether airplanes can win wars on their own. Clearly, air strikes had not been able to halt the ethnic cleansing; indeed, they hastened it. However, the relationship between the intensification of NATO strikes in May and the acceptance of terms by Milosevic in June suggested that the strikes on Serbia proper had an important role in the outcome. The war was brought to a conclusion before any ground forces were introduced, and thus, it was hard to take this victory away from air forces. RAND analyst Benjamin Lambeth stated appropriately, "We may never know for sure what mix of pressures and inducements ultimately led Milosevic to admit defeat."[108]

The very fact that NATO managed to sustain a 78-day campaign that—Milosevic believed—might have continued indefinitely must have convinced the Serb leader that his opponents were committed to the cause. Another RAND analyst, Stephen Hosmer, argued that Milosevic and others in his circle seemed to fear that there might be no limit to the level of destruction NATO might be willing to impose; that indeed NATO, led by the United States and Britain, might

continue escalating to the point of "carpet bombing" Serbia.[109] As much political wrangling and tension as there was in NATO, the members of the alliance held together in a campaign that grew more intense over time. Clear evidence that NATO was preparing to authorize the use of ground troops was an unmistakable sign of this commitment. Not only did it spur the Russians to pressure Milosevic, but also it signaled to the Serb leader that his political and personal fortunes were more at risk from a continuation of the war than from a cessation of it. A direct clash between NATO and Serbian ground troops would have been a nightmare for the Russians on multiple levels. The way the campaign played out revealed that Milosevic had miscalculated virtually every important strategic issue of the war.[110] In this instance, coercive air power, backed by a threat of ground war, achieved NATO's aim. Nevertheless, the campaign had been difficult to wage, not least because of the conflicting imperatives and constraints of alliance partners.

INTO THE 21ST CENTURY

Although the decade of the 1990s was tumultuous, the first decade of the new millennium would prove to be even more so. The U.S. Air Force had important roles to play in the wars fought in both Afghanistan and Iraq, and in the stabilization efforts that continued in their aftermath.

U.S. Air Force Basic Doctrine (November 2003) echoed elements of Warden and Deptula:

> Air and space forces, through their inherent speed, range, and flexibility, can respond to national requirements by delivering precise military power to create effects where and when needed. . . . Strategic attack is defined

as offensive action conducted by command authorities aimed at generating effects that most directly achieve our national security objectives by affecting the adversary's leadership, conflict-sustaining resources, and strategy. . . . As a concept, strategic attack builds on the idea that it is possible to directly affect an adversary's sources of strength and will to fight without first having to engage and defeat their military forces.[111]

The wars in Afghanistan and Iraq, while resting heavily on the efforts of the U.S. Army and Marines, nonetheless saw air power applied in a range of ways. In the first phases of Operation ENDURING FREE-DOM, the United States teamed its special operations forces, who were equipped with advanced data links and sensors, with friendly indigenous fighters to evict the Taliban regime. As Frans P. B. Osinga observed, "A network of sensors and communications systems glued together combat aircraft, dispersed air bases, command centers, and special forces."[112] During the brief major combat phase of the Iraq war in 2003, air power was able to continue to press the offensive when weather conditions halted the ground troops, paving the way for swift entry into Baghdad.

Air assets continued to provide crucial support to ground troops even as the conduct of the two wars changed over time. Sometimes, doctrinal differences between services and lack of joint exercises slowed and complicated the wartime integration of ground and air, but all parties revealed a commitment to adaptation and real-time learning.[113] In a recent analysis and critique of air power theory, Colonel Jeffrey Smith, Commandant of the U.S. Air Force's School of Advanced Air and Space Studies, argued that with the emergence of the counterinsurgency campaigns, the U.S. Air Force had to re-engage with theory and

operations that had been, since Vietnam, underappreciated and secondary:

> Daily operations now required tactical airlift, special operations, ISR, close air support, and tightly integrated action with ground forces.[114]

He argued that in the new situation, the demand for ISR became "insatiable," and the need for RPA pilots—"once a dreaded and often considered career-ending path—became phenomenally important."[115]

In counterinsurgency operations, the use of air strikes independent of ground operations can be tricky and, at times, counterproductive. A misguided bomb that kills civilians can quickly alienate the population, undermining the strategic purpose of the campaign. Insurgent forces that control the pace of the war can use cover and concealment to avoid air strikes much of the time. In addition, they will intermingle with civilians in urban areas or use human shields to protect themselves from the superior air power wielded by their opponents. All of these factors put very real constraints on the use of air power. However, they do not rule out the use of air power in counterinsurgency campaigns. If used carefully and sparingly, independent air strikes can be invaluable in attacking highly specific targets. Moreover, with the precision capabilities now available—particularly through remotely piloted vehicles (RPVs), which are often referred to as RPAs—such strikes can target particular individuals who may be instrumental in the planning and implementation of terrorist activity. However, caution, care, and intentionality are required. As Major Jason Brown wrote in 2007:

when operational-level commanders can 'watch' insurgents in real time by means of ISR feeds, they tend to fall back to the tactical level, thus reinforcing the 'we must do something now' mentality. This reactive approach can quickly devolve into a game of 'whack a mole,' which can cause commanders to neglect other important lines of operation and lose focus on the strategic end state.[116]

To avoid this, he insisted, "commanders and planners must integrate the use of airpower for dynamic targeting into the operational design of a counterinsurgency campaign."[117]

Inter- and intra-theater transport of personnel and equipment is always a critical mission for air power in counterinsurgency. In addition, the first decade of the 21st century surely called attention to the expanding need for ISR resources and platforms. Finally, air forces can offer invaluable assistance to newly developing indigenous air forces opposing insurgents. Well into the foreseeable future, the U.S. Air Force is likely to continue its role in advising, training, and equipping partner air forces.[118]

LIBYA

The decision by NATO in early 2011 to support the rebel forces opposing Libyan dictator Colonel Muammar Gaddafi highlighted the political appeal of reaching for the air power instrument to solve political problems. However, it has also raised to the surface many of the issues and complications associated with the strictly independent use of air power in conflict. Even though Gaddafi was wielding state power, his forces adopted many of the tactics associated with insurgents. He manipulated the pace of the war to erode the will of his enemies; used cover and

concealment to take his forces out of reach of superior air power; and resorted to commingling in cities and using human shields to deter NATO air strikes. As defense analyst Stephen Biddle wrote in a *Washington Post* editorial:

> Locals with existential stakes often prove more stubborn than distant Americans expect, and even high-tech firepower has serious limitations against low-tech but determined enemies who control the people on the ground through close-up violence.[119]

He added:

> Especially when the multilateral action is based on protecting civilians, rather than defeating one side, a dictator willing to mix ruthless fighters with innocent noncombatants poses serious challenges to limited applications of precision air power. The result could easily be a drawn-out, grinding stalemate.[120]

REMOTELY PILOTED AIRCRAFT: ISSUES AND QUESTIONS

From the end of the George W. Bush administration, and continuing through the Obama administration, U.S. policymakers expanded the use of RPAs for the targeted killing of those considered threats to U.S. security. This tool was used initially in very limited circumstances to target high-ranking al-Qaeda officials. However, over time it became a means, as Professor Rosa Brooks explained, "to go after an ever-lengthening list of bad actors, many of whom appear to have only tenuous links to al Qaeda and the 9/11 attacks, and many of whom arguably pose no imminent threat to the United States."[121] This warning came in Brooks'

testimony before the Senate Armed Services Committee in the spring of 2013.

The benefits and costs of using RPAs for targeted killing is a topic policymakers and planners must consider carefully. RPAs have an inherent appeal: they seem to allow a leader the opportunity to strike in ways that are relatively precise in comparison to other military tools, and that pose no immediate risk to military personnel. The work is carried out quietly and off the front pages of newspapers. This means that it has little **immediate** political cost. Thus, the strikes can have the appeal of a silver bullet—a low-cost, almost magical way to dispatch enemies. However, dangers lurk in this seductive appeal. One first-order question is simply about due process of law. The target of an RPA strike has no opportunity to face the charges against them or argue a case before a court. Who ought to have the authority to be judge, jury, and executioner (all three) in these cases? Using RPAs for the targeted killing of enemies concentrates vast power in a few hands—and this sets up a situation that can be quite readily abused if it is not overseen and monitored for compliance with domestic and international law. There is also a concern about mission creep. How high on the enemy leadership chain need one be to qualify for an RPA strike? What evidence must that person reveal of intent to do harm? How imminent and clear must that threat be?

Many critics of RPAs during the Obama years saw their use as evidence of American high-handedness and arrogance—evidence that Americans do not feel themselves to be bound by any rules or constraints in their international behavior. They perceived an American President using RPAs rather like a self-proclaimed Zeus, hurling thunderbolts from the sky.

However, there is also another concern. Most analysts agree that terrorist threats die a natural death over time. The harsh methods of the terrorist are so alienating that those who wield them are ultimately rejected by local populations. The danger with RPA strikes is that because they arouse deep resentment, especially when unintended civilian casualties occur, they may prolong the life of terrorist movements that otherwise would die out on their own.

Brooks argued:

> Drone [RPA] strikes enable a 'short-term fix' approach to counterterrorism, one that relies excessively on eliminating specific individuals deemed to be a threat, without much discussion of whether this strategy is likely to produce long-term security gains.[122]

She added:

> At the moment, there is little evidence that U.S. drone [RPA] policy—or individual drone [RPA] strikes—result from a comprehensive assessment of strategic costs and benefits, as opposed to a shortsighted determination to strike targets of opportunity, regardless of long-term impact.[123]

This critique could apply to any air-based platform used in a similar way. Undertaking the kind of comprehensive assessment that Brooks calls for is the role of the strategist.

THE ONGOING DEVELOPMENT OF THEORY

Leaders of contemporary air forces are aware of the range of missions they may be called upon to fulfill in the future. They know they must ensure that their personnel possesses not only a wide-ranging skill set but also detailed operational knowledge. In addition to

working with service partners and international part-
ners to leverage strengths and create synergies, the
U.S. Air Force will continue to develop capabilities in
realms where it leads the world, including aerospace
and intelligence technologies. Intelligence, which is
central to effective targeting, always will be a core ele-
ment of air power; intelligence partnered with preci-
sion capability enables an air force to take on specific,
high-priority missions, some of which may develop
on short notice, and in crisis situations.[124]

David Deptula has explained that new technol-
ogy is changing the way aircraft operate in combat.
Modern platforms—RPAs and advanced ISR and
strike aircraft—can now perform multiple roles,
enabling "compression of the 'find-fix-finish' equation
in both time and space." This, he adds, "greatly com-
presses the time required for successful closing of the
'observe, orient, decide, and act' loop."[125] Similarly,
U.S. Air Force Basic Doctrine (2015) states:

> The proper application of a coordinated force across
> multiple domains can produce effects that exceed the
> contributions of forces employed individually. . . . the
> objective is the precise, coordinated application of the
> various elements of airpower and surface power to bring
> disproportionate pressure on enemy leaders to comply
> with our national will . . . or to cause functional defeat of
> the enemy forces.[126]

The doctrinal statement here also reveals that the U.S.
Air Force has become, over time, more comfortable
in the joint arena. Now secure in its independence, it
does not feel so compelled to constantly reiterate the
primacy of independent action.

Leaders of contemporary air forces know that they
must do the difficult intellectual work necessary to con-
tinually update and refine the theories that underpin

their doctrine and actions. Air power can hit value targets and force targets; some targets, like leadership, are both value **and** force targets. Precision capability has enhanced the ability of air forces to hit both types, yet precision capability does not preclude occasional errors, which can be quite costly to the strategic aims of a campaign. Nor is precision capability a silver bullet, allowing a magical route to the solution of a complex political problem. In order to blunt the effects of precision, many adversaries will be prepared to intermingle their forces with civilians, exploit social media methods, and remain highly dispersed.

Recent experience has indicated that strong norms remain in place around the idea of discrimination; air forces that disregard it do so at the risk of losing domestic and international support. Trends in the modern world mean that infrastructure, rather than being state-owned, may be an international asset. Thus, hitting an industrial site or power generation facility may impact our allies nearly as much as it impacts our adversaries.[127]

The idea of creating paralysis by cutting off or shutting down an adversary's communications is challenged by global cell networks, hardened communication lines, and space-based communication. In addition, aircraft speed may not be the asset it once was. As Colonel Smith put it, "Given new detection capabilities, advanced radar and targeting systems, and global communications systems that work in nanoseconds, traditional aircraft speed may provide little in terms of advantage."[128]

Coercive air campaigns must be designed very carefully. If they underestimate or misread the enemy, they will fail. One must know the enemy one is dealing with and the kind of war one is fighting. Campaigns

that depend upon gradual escalation and signaling are particularly tricky since they rest on a very sophisticated understanding of enemy motives, strengths, weaknesses, aspirations, and fears. The signals sent must be understood clearly by the recipient, and the recipient must be willing and able to comply with them. In these campaigns in particular, there is a high risk of miscommunication. In many situations, a low-tech but determined enemy can be a formidable foe.

No planner can assume that they will be given freedom to launch the kind of all-out offensive that usually seems instinctive to those in the military. Constraints on the use of force (in some form) are very likely to infringe on the air planner's dream of an all-out, paralyzing offensive right from the start. Proportionality remains an important norm for jus in bello. Punishment campaigns do not have a strong track record; human beings tend to be both adaptable and resilient. Beyond that, enemy political leaders can often find ways to push pain on to the population, and then manage the reaction through more direct, coercive mechanisms, like secret police. Moreover, punishment campaigns that appear indiscriminate often will be viewed harshly by a domestic audience, allies, and the global community. Popular uprisings and coups are more difficult to instigate than air theorists have tended to assume. Even if a state or political actor is decapitated, it does not guarantee improvement in the political situation; indeed, the situation may become worse, or at least harder to control.

Elements of the "industrial fabric" theory continue to influence air power operations. Various theorists operating under this broad umbrella have sought to find key node targets that would quickly degrade or eliminate an enemy's ability to fight effectively. This

theory is immensely appealing, not least because it promises efficiency, but its inherent seductive qualities must be understood. As the Anglo-Americans found out in World War II, an enemy can find ways around bottlenecks, especially if resources can be obtained from occupied territories, allies, or those willing to break sanctions. The modern effects-based operations tradition has links back to the "industrial fabric" idea. Warden's special emphasis on leadership and communication is another attempt to find a key card in a house of cards—a way of producing a big impact from a highly specific target set. Warden and Boyd both hoped to evoke in an enemy a kind of system "paralysis" that is not without parallel to Douhet and Trenchard's violent, all-out air offensive. The details, though, are different. Precision capability would allow for the takedown of very specific enemy assets. Whether this act would actually create "paralysis" depends on many factors, all of which must be accounted for in high-quality staff work. Contemporary air theorists often seek a strategy that "focuses on ending wars rather than fighting them." John Andreas Olson elaborates: "A leadership-oriented systemic approach identifies and targets centers of gravity, critical vulnerabilities, and key linkages rather than focusing on engaging through a denial strategy fixated on military forces." He adds, "Disrupting an opponent's decision-making calculus renders the opponent increasingly deaf, dumb, and blind to proactive and constructive actions."[129]

Many air theorists are of the belief that non-lethal mechanisms will become increasingly important tools in the arsenal of air warfare. However, even in this scenario, one cannot assume that the enemy will respond as the theorist or planner expects. Adversaries—as

John Boyd pointed out—are adaptive; they will seek and find ways to resist coercion of all kinds. Finally, air power on its own does not allow one to control the politics or the narrative on the ground in the aftermath of paralysis. One can rely on indigenous allies for this, but their goals and incentives are rarely the same as one's own—as the United States discovered, to its discomfort, in both Afghanistan and Iraq.

Those who work in the contemporary aerospace realm realize that we are moving quickly toward a complicated moment in time. Charting a course through the current information revolution means accepting the fact that the ideas, mechanisms, methods, and platforms we have relied on for 100 years are going to be in flux and transition for the foreseeable future. The way we use air power—and indeed the air power we can use—will vary with the situation we face. In some scenarios, traditional ideas and legacy platforms will continue to have full value; in other scenarios, they will have partial value; and in still other scenarios, they will have almost no value at all. Today, "the increase in detection capabilities, especially ground-to-air weapons systems, is advancing exponentially in terms of both competency and low-cost production."[130] It will be increasingly difficult for objects—particularly those in the air—to operate undetected. Furthermore, detection means they can be targeted by increasingly precise and reliable defensive systems. As one author has explained:

> Given this inversely proportional relationship between detection technology and antidetection technology, any strategy that relies on current and traditional physical access using significant systems (traditional aircraft) in the future will likely be disappointing.[131]

This fact will have important implications on all air forces in the future; the required shift in thinking may seem particularly drastic for the U.S. Air Force, which has been able to work in permissive air environments for the previous 2 decades, and has been able to win air superiority consistently since World War II. Some analysts believe that we may have to rethink traditional notions of air superiority: "no country will be capable of gaining and maintaining air superiority due to future advance detection and targeting technologies." Others disagree. Brigadier General Alex Grynkewich, assigned to examine ways the U.S. Air Force might be able to maintain the capacity for gaining and maintaining air superiority, bluntly stated: "Air superiority is not an optional capability. Without it, you lose."[132]

Thus, we will see another offense-defense struggle and, like previous iterations, it will see spirals of measures and countermeasures. Grynkewich and his team recognized that simply upgrading existing systems would not suffice. They discovered as well that the issue was not just one of penetrating and persisting in enemy airspace to create effects; it was, rather, one of serving "as a key node in what was emerging as a new, conceptual multi-domain battle network."[133] Going forward, the U.S. Air Force is counting on the stealth capabilities of future aircraft, including the B-21; small, hard-to-track RPAs capable of ISR and attack; and advanced cyber- and space-based technologies. It will seek to go above and below defensive technologies, relying on space, cyberspace, and low altitude. Enemy anti-satellite and cyberspace capabilities may be threatened "left of launch." New systems will be required to operate over long distances, and will often be dispersed; they will need robust logistical

support. In addition, they will need to have the capacity to recover and regenerate combat power following enemy attack.[134]

In the future, A2/AD assets will be owned increasingly by modern powers, and this will change the operating environment for aircraft in important ways. While recognizing that prediction is imperfect, Stephen Biddle and Ivan Oelrich argue that A2/AD assets, which are likely to be owned by the United States and China by 2040, will erode U.S. command of the global commons, and will create a situation characterized not by Chinese hegemony over the Western Pacific but by:

> a more differentiated pattern of control, with a U.S. sphere of influence around allied landmasses, a Chinese sphere of influence over the Chinese mainland, and contested battlespace covering much of the South and East China Seas, wherein neither power enjoys wartime freedom of surface or air movement.[135]

They point out as well that the ever-increasing range and reduced cost of precision-guided missiles is giving many states a coercive strategic bombardment tool capable of striking a wide array of fixed targets, including power plants, industries, and cities.[136]

The changing environment will pose serious challenges to air forces worldwide, forcing them to invest in sustained analysis, research, doctrinal development, and the adroit acquisition of, and adaptation to, new technologies. All of this will be complicated by the need to interweave these assets and capabilities with those operating in the cyberspace and space realms. Indeed, the speed and magnitude of change in this environment is likely to place on analysts and planners the kinds of demands not seen since the rapidly

transforming warfighting environment experienced during World War I.

AEROSPACE POWER

Colin Gray has written:

> The conflation of air and space into aerospace has the authority of three and a half decades and points, accurately enough, to the leading role of the air force in developing, acquiring, launching, and maintaining space systems.[137]

As early as 1959, U.S. Air Force Chief of Staff Thomas D. White explained, "air and space comprise a single continuous operational field in which the Air Force must continue to function."[138] Of course, only spacecraft can operate in the vacuum of space, so one must be careful with White's assertion of a "continuous operational field," which was an early claim to a domain. Gray argued that space systems are force multipliers for ground-based systems, and this is undoubtedly true: today, armies, navies, and air forces depend heavily on assets located in space, including space-based weather systems and global positioning systems (GPS).[139] This interdependence and synergy between earth and space—the latter including both low earth orbit and geosynchronous orbit—will only develop further over time. It is therefore in the interest of the services to protect those assets, particularly in times of conflict. However, even though nations have been operating in space for decades, there is much that remains to be worked out regarding legal definitions, acceptable activities, and rites of passage. Trying to draw close parallels to either airspace law or law of the sea is problematic since neither is an ideal fit—although some precedents are useful.

After the Soviet launch of Sputnik in 1957, concern that space would be weaponized led to a declaration that it ought to be reserved for peaceful purposes. However, the inherent advantages of this approach, sometimes referred to as the "sanctuary school," have been buffeted by the pressure of technology. In light of this, new models have been proposed; one that seems to be gaining ground, at least in U.S. debates, is the "control school." Control school advocates argue:

> there are space lanes of communications that must be controlled if a war is to be won in the terrestrial theaters." They argue further "the capability to deter war is enhanced by the ability to control space and that, in future wars, space control will be co-equal with air and sea control.[140]

Philip Swarts has written:

> Any conflict between the U.S. and an adversary is highly likely to include a space component in the future. Whether it's trying to knock out communications, disrupt GPS, or destroy missile warning systems, the U.S. and other nations will try to find ways to eliminate each other's satellites and space assets.[141]

Biddle and Oelrich have argued that in a high-stakes confrontation with China, the United States cannot assume that its satellites will survive. Rather than trying to reconstitute space assets in wartime, the U.S. Air Force should keep in mind that:

> surveillance, target acquisition, and guidance can all be provided by airborne platforms that can be made independent of fixed bases; communications can be provided by airborne relays and links, and navigation can be accomplished via natural celestial or terrestrial reference points.[142]

Contemporary discussions of the future environment make it clear that space, an immensely valuable domain, is almost certain to be contested, just as air was 100 years ago. It is therefore essential for contemporary students of strategy to gain a fundamental grasp of these discussions and debates, and to understand the ways in which they are likely to affect future wars, and to evolve over time.[143]

ENDNOTES

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4. Robert A. Pape, *Bombing to Win: Air Power and Coercion in War*, Ithaca, NY: Cornell University Press, 1996, p. 15.

5. Thomas C. Schelling, *Arms and Influence*, New Haven, CT: Yale University Press, 1967.

6. Ibid. Schelling made this point often in his work on coercion.

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8. Ibid., p. 58.

9. Tami Davis Biddle, "Learning in Real Time: The Development and Implementation of Air Power in the First World War," in Sebastian Cox and Peter Gray, eds., *Air Power History: Turning Points from Kitty Hawk to Kosovo*, London, UK: Frank Cass Publishers, 2002, pp. 3-20.

10. Ibid. See also Tami Davis Biddle, *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas About Strategic Bombing, 1914-1945,* Princeton, NJ: Princeton University Press, 2002, pp. 25-68.

11. George K. Williams, "The Shank of the Drill: Americans and Strategical Aviation in the Great War," *Journal of Strategic Studies*, Vol. 19, No. 3, September 1996, pp. 381-431.

12. Biddle, *Rhetoric and Reality in Air Warfare*, pp. 11-35.

13. Ibid., pp. 34-35, 69-110, 147-153.

14. Editor's introduction to Giulio Douhet, *The Command of the Air*, Washington, DC: Office of Air Force History, 1983 (reprint of New York: Coward-McCann, 1942 edition), pp. xii-xiii.

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17. Douhet, pp. 9-10.

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20. He asserted, "when the working personnel of a factory sees one of its machine shops destroyed, even with a minimum loss of life, it quickly breaks up and the plant ceases to function." See Douhet, pp. 22-23.

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22. Douhet, p. 20.

23. Michael S. Sherry, *The Rise of American Air Power: The Creation of Armageddon,* New Haven, CT: Yale University Press, 1987, p. 27.

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31. See Phillip S. Meilinger, *Airmen and Air Theory,* Maxwell Air Force Base, Montgomery, AL: Air University Press, 1997, pp. 7-9; Mark Clodfelter, "Molding Airpower Convictions: Development and Legacy of William Mitchell's Strategic Thought," in Meilinger, ed., *The Paths of Heaven*, pp. 79-114.

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36. Ibid., p. 436.

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