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Air Power

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Introduction

As this volume appears, a single century has elapsed since armies and navies first began to experiment with the use of airplanes as implements of war. In the ensuing years, air power quickly became integral to the conduct of modern warfare, and sometimes its central element, particularly during the past several decades. Its use and effects are an increasingly important matter of study in international security scholarship, although it is fair to say that land and sea power, with their longer histories and somewhat greater stability of characteristics, remain more familiar to most scholarly observers.

Air power is a vast subject, comprising all the uses of aviation in the pursuit of nations' and other political actors' power and security interests (and the use of long-range missiles as well). Because of its focus on air power as an area of inquiry in international security studies, this essay does not aspire to provide a complete survey of air power history, to explore the many technological or sociological dimensions of air power, or to examine subjects such as the economic and cultural effects of air commerce. Nor does it give much attention to a number of primarily intra-military issues such as how best to organize and control a nation's air power, although these understandably loom quite large for airmen. Yet some of these considerations do impinge significantly upon understanding air power more narrowly as an instrument of national military power, as the following discussion will reflect. Finally, this essay concentrates almost entirely on conventional air power, because nuclear-armed air power is addressed separately in this volume.

The Evolution of Air Power

Air power emerged as an important element of military power virtually as soon as aviation itself existed, accelerated by the occurrence of World War I (although interest in the potential of air power materialized even earlier (Wells 1908; Mason 1994). Military applications for airplanes and airships quickly multiplied; by 1918 equipment and techniques had been developed to fly almost every type of aerial mission that would be important in later years, save for aerial refueling, which was not demonstrated until the

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1920s (Kennett 1990). The evolution of air power continued at a rapid pace over the following 90 years, driven by innovation in a wide range of relatively young sciences and technologies (including aerodynamics, metallurgy, propulsion, radio, photography, rocketry, and electronics), by policy choices that themselves created much of the demand for such technologies (Gray 2008), and by the often intense security concerns of the major powers.

This developmental history is central to the study of air power, and thus to security studies more generally. Just as land warfare underwent transformational changes that altered its nature and dynamics with the rise of mass armies and with mechanization, and sea power was fundamentally altered by the shift from sail to steam and other revolutions, air power has experienced a more rapid series of state changes that complicate efforts to generalize about its nature and its effects on modern warfare and international security. The development of air power theory has proceeded in parallel, with the distinctive twist that unlike Clausewitz, Jomini, Mahan, or Corbett, the most prominent classical air power theorists tended to focus their attention disproportionately on the use and implications of capabilities yet to be realized rather than on those that already existed.

Most of the intellectual leaders who cast the longest personal shadows over the air power landscape even today – including Douhet, Mitchell, Trenchard, Seversky, and Slessor (MacIsaac 1986; Meilinger 1997; 2003; Mets 1998) – emerged during the interwar years, when air power was still in its formative stages. In general they were both theorists and advocates of military aviation (and often of civilian aviation as well), engaged not only in seeking to understand air power but also in trying to generate interest and investment in it in spite of resource shortages and organizational resistance from powerful army and naval traditionalists. Outside of Great Britain, where the Royal Air Force (RAF) had been established in 1918, a central concern for many was promoting the creation of independent air forces.

It is thus far from surprising that they argued passionately and often aggressively for concentrating on missions in which air power would operate with relative independence, most notably long-range strategic bombing (Douhet 1942; Johnson 2003), and in the American case maritime defense as well (Mitchell 1925). “Command of the air” was a central concern, but in an era when underpowered fighter aircraft were often slower than bombers and were largely unassisted by early warning systems to direct them to their targets, the bomber initially reigned supreme as the tool for achieving it. Therefore emphasizing long-range bombing simultaneously served the bureaucratic interests of airmen seeking to establish their importance and autonomy (T. Biddle 2002) and appeared to offer the prospect that the next war could be won more quickly and decisively than the last through the innovative use of the new technology.

This focus on strategic bombing was not universal – J.C. Slessor (1936) argued insightfully for the importance of interdiction attacks against enemy armies – while air services such as the US Army Air Corps continued to invest significantly in attack aircraft for use on or near the land battlefield notwithstanding their enthusiasm for long-range bombing, and naval aviators concentrated on the potential for carrier-borne aircraft, seaplanes, and airships to dominate war at sea. Yet, based in large part on extrapolations from the fear and disruption caused by air raids in World War I, the expectation that in

future wars bombers would lay waste the cities and economies of their enemies was widespread, among the general public as well as military and civilian leaders, for example contributing greatly to Britain's already considerable averseness to war with Germany in the 1930s (Bialer 1980; T. Biddle 2002). As Harold Macmillan (1966:522) would later describe, "We thought of air warfare in 1938 rather as people think of nuclear warfare today."

Air power was born in the crucible of World War I, but came of age in the conflagration of World War II (Overy 1980 and 1995:101–33). In the former conflict, air power played small though important roles, preeminently by providing tactical reconnaissance and observation. In the latter, air forces ultimately comprising hundreds of thousands of far more capable aircraft were central to the conduct of the war on every front, both literal and figurative. Great effort was devoted to strategic bombing campaigns, particularly but not only against Britain, Germany, Italy, and Japan. By the end of the war almost every large German and Japanese city (and many smaller ones) had been devastated, with those killed by air attacks numbering on the order of a million (Elliot 1972). Britain became the first country to be subjected to strategic bombardment by cruise and ballistic missiles (the German V-1 and V-2). Aerial interdiction and close air support played a central role in the German blitzkrieg and in the subsequent Allied counteroffensives (Gunderson 1998); these were punctuated by spectacular though often costly airborne operations, while air transport became a ubiquitous and sometimes decisive component of military logistics. At sea, naval warfare was dominated by air power, as the aircraft carrier supplanted the battleship as the principal combatant and aircraft became key tools in antisubmarine warfare – in the Pacific, the war was above all a contest to seize and control bases for land-based air power. In each arena, the consequences of losing air superiority to the enemy were now potentially catastrophic.

Prewar theorists had foreseen many of these developments, at least to a degree. But some of their best-known prophecies went unfulfilled. Unescorted bombers typically suffered heavy losses by daylight when facing capable interceptors and air defense systems employing the revolutionary new technology of radar, and their ability to hit their targets accurately fell far short of prewar expectations that were often complacently based on experiments conducted under ideal conditions; early in the war, bombers flying at night often had trouble even finding the cities they were to attack, let alone specific targets within them. Strategic bombing campaigns were brutal contests of attrition, where the rule of thumb was that losses below 5 percent per mission were sustainable – yet even a 3 percent loss rate meant that a bomber crew's life expectancy was a mere 23 sorties. Losses were also heavy among fighter units, especially when conducting ground attack missions. The overall effect was something akin to trench warfare on the Western front in the Great War, with thousands of men going "over the top" into a hail of fire in each major bombing raid. By the end of the war, the RAF and the US Army Air Forces had each lost on the order of 40,000 airmen in the campaign against Germany.

Strategic bombing campaigns failed to produce the sort of rapid, decisive results originally envisioned by many of their proponents. Populations subjected to terror bombing did not rise up against their governments, demanding capitulation in order to stop the carnage as Douhet had predicted. The British and German war economies proved to be resilient under attack, the latter finally collapsing only late in the war when Allied

planners who had been overly influenced by the models of their own economies finally worked out which target sets truly represented its key vulnerabilities (Brodie 1959; Mierzejewski 1988). Yet ultimately economic collapse did come in both Germany and Japan, through the combined effects of bombing, blockade, losses on the battlefield, and Axis economic mismanagement (Bernstein 1995; Tooze 2007).

The end of World War II marked the beginning of the nuclear revolution. Air power was central to this development, being the delivery means for the "absolute weapon," and was itself transformed by it – although fear of Armageddon from the air was not entirely new (Quester 1986; Overy 1992). But as the air forces of the major powers embraced the nuclear mission, other technological developments were also altering the still-young art and science of air warfare, including jet propulsion, electronic warfare, and guided missiles of many types. Air power grew ever more capital-intensive and effective, with smaller numbers of aircraft exerting greater influence over larger areas. Major air raids against North Vietnam involved dozens of aircraft instead of the hundreds of earlier wars, and fighter-bombers and attack aircraft with one or two crewmen increasingly displaced bombers with larger crews in the strike role, breaking down forever the traditional association of conventional strategic bombing with heavy bombers and tactical air power with light bombers and fighters (Thompson 2000). Air mobility was also transformed, with the coming of jet transports making efficient transoceanic airlift possible, the decline of airborne operations, and the emergence of helicopters for tactical transport, especially in wars in the periphery.

Over the past 40 years these trends have been dramatically reinforced by the development of air-to-ground precision-guided munitions (PGMs), stealth aircraft, and new sensors and systems for air battle management, which became the centerpieces of air campaigns in Iraq, Serbia, and Afghanistan (Lambeth 2001; 2005; Davis 2002; Putney 2004). Although PGMs are best known for their utility in attacks against targets in urban areas such as Baghdad and Belgrade and against fixed military installations, their greatest effect has arguably been to increase the ability of aircraft to attack deployed military forces, whether moving, stationary, or entrenched, including at night and in unfavorable weather (Keaney and Cohen 1995) – provided that they can be detected and identified, and are not prohibitively intermingled with civilians. This has fundamentally altered the relationship between land and air power, creating opportunities for true "hammer-and-anvil" integration between air forces and armies (Johnson 2006), even in cases involving relatively small ground forces. It has also profoundly affected international politics, playing a large part in establishing the United States as the preponderant military power in the post–Cold War world.

For some 65 years the United States has been the world's leading aerial power, and today its preeminence is in many respects greater than ever following two decades of Russian air power decline and dramatic contractions in military investment by many Western states, most of which anticipate conducting high-intensity air campaigns only as part of a US-led coalition (Posen 2003; see also Seversky 1942). This is not merely, and arguably not even primarily, due to the quantity and quality of the US armed forces' combat aircraft and aircrew, but is also a function of years of massive, unrivaled US investment in "enabling" capabilities including airlift, aerial refueling, command and control, intelligence, surveillance and reconnaissance (ISR), communications, and basing

that make possible the sustained generation and coordination of large numbers of sorties, often over long ranges and far from the United States itself (Lambeth 2000).

However, challenges to the ubiquity and the supremacy of US air power are on the rise, as the air forces of China, India, and other rising powers develop, and as advanced surface-to-air weapons proliferate and counter-stealth sensors emerge. A less symmetrical challenge to the advantages possessed by established air powers is presented by increasingly sophisticated ballistic and cruise missiles. No longer merely blunt, inaccurate instruments for bombarding area targets, the modern incarnations of these weapons now imperil the security of air bases and aircraft carriers without requiring their owners to develop their own air forces to Western standards of capability. Meanwhile leading Western states are transforming their approaches to air power by coming to terms with, and gradually embracing, unmanned aerial vehicles (UAVs) (Ehrhard 2001). Although this process is still in its relatively early stages, it is raising new, fundamental questions – political and cultural as much as military – about the future shape of air power.

Air Power Theory

In spite of these large and relatively frequent changes in their subject, air power theorists have devoted much attention to identifying essential, enduring properties that characterize air power and distinguish it from other forms of military power. Moving beyond the commonplace enumeration of basic attributes such as "speed," several features of air power loomed large for the early theorists and remain fundamental today when considering its possible shapes in the future, two of which are especially salient.

The first is the ability of air power to bypass the enemy's army and navy, and terrain that would impede or prevent the movement of land or naval forces. This not only gives air power unique ability to act across a wide area, but also allows it to strike at targets deep in hostile territory without first achieving success on the surface battlefield. It is easy to overstate the extent of this freedom of action, and air power advocates have often done so. Weather and darkness, the "terrain" of the atmosphere, constrain air operations even today, although these limits have eroded dramatically over the years. Moreover, although aircraft can fly above armies, penetrating enemy air defenses has almost never been a simple matter except when facing grossly inferior opponents – hence the preeminent importance airmen tend to place on achieving air superiority as a precondition for military operations. Yet there are important differences between air and land warfare in this respect: although it is not true that "the bomber will always get through," it is usually the case that some bombers will do so, if they are willing to suffer losses. Even effective air defenses tend to be permeable compared to front lines on conventional land battlefields, where successful attacks usually result either in driving the enemy back en masse or shattering them.

To conclude that air power is "inherently strategic" because it can attack targets other than an enemy's armed forces in the field is not very illuminating, as Colin Gray notes (2008), because all forms of military power have strategic effects. Nevertheless, the fluidity and flexibility with which air power can be employed and the long ranges over

which it can operate, along with the fact that it does not occupy terrain as surface forces do, make the dynamics of air power employment tactically and strategically distinctive. This more than any other factor lies behind the argument that the proper use of air power requires those commanding it to possess a degree of "air-mindedness" not typically found in military leaders accustomed to fighting symmetrical battles within confined sectors of a terrestrial front line (Meilinger 1995).

The second property, related to the first, is the ability of air power to mass quickly at a selected time and place. This potential for concentrated effort persuaded early theorists that air power was far more effective when used offensively than when used defensively, since a defender would be spread thin, unable to meet an attacker with concentrated forces of its own. The advent of radar-based air defense systems altered this imbalance, and over subsequent decades the relative capabilities of offense and defense in air warfare have swung back and forth with the appearance and proliferation of surface-to-air missiles (SAMs), airborne early warning aircraft, stealth, and other innovations. With the coming of PGMs, the importance of the ability to concentrate force in a single location was displaced by the value of being able to coordinate the actions of aircraft over a broad area, as "parallel attack" became a watchword (Warden 1989).

Throughout these evolutions, belief in the proposition that "air power is inherently offensive" to a greater degree than other forms of military power has remained strong among airmen, if not always universal. This conviction has many roots, including the need for aircraft to act offensively at the individual level in order to destroy their foes or their targets, and the absence of protective terrain in the air making a central tenet of Clausewitz's dictum that defense is the stronger form of warfare inapplicable to air combat, as well as the attacker's ability to concentrate air power at selected places and times. At the higher levels of war the picture is less clear, however, with the Battle of Britain serving as the evergreen example (but far from the only one) of a defender successfully exploiting the advantages of the defense in air warfare.

More central to the study of international security is the question, often conflated with the preceding one, of whether air power facilitates offense as a whole – whether investment in air power tends to make aggression and conquest easier to a greater degree than it protects against them – and of whether it encourages aggression as a result. Air power can certainly be a potent offensive instrument, and during the interwar years longer-range aircraft and bombers in particular were prominently cited as likely tools of aggression whose restriction or elimination would help avert war (Meilinger 2003:104–28). Moreover, like their terrestrial counterparts (Van Evera 1999) airmen do tend to favor offensive doctrines, a preference that in some cases has escalated into an aerial "cult of the offensive," suppressing rational analysis and decision making and contributing to dangerously unrealistic planning (Carter 1998). Yet at the strategic level air power has often favored the defense, a pattern that began in World War I, where the massive defensive power of artillery was multiplied by aerial observation, and reconnaissance aircraft revealed enemy forces massing for attacks in time for defenders to shift forces to meet them. In subsequent conflicts aerial reconnaissance and attack have been central to strategic defensive victories from the Battle of the Atlantic to the defeat of the 1972 Easter Offensive, and made offense more difficult in venues as diverse as the Falklands and the European central front during the Cold War. Airlift, too, has

strengthened defense and deterrence, in cases ranging from the Berlin Airlift to 1990's Operation Desert Shield, while air power's most profound defensive effect has arguably occurred in the arena of nuclear deterrence.

Two other less strictly military characteristics of air power, especially modern air power, deserve note as well. One is that air power has become a particularly attractive policy tool for the leaders of the United States (and a number of other nations) to wield, the "instrument of choice" when there is reason to use military force against an adversary if centralized control of its employment or minimizing friendly casualties appears to be important – as is almost always the case (Cohen 1994). With the advent of reliable PGMs and with US enemies in the post–Cold War era mostly being much weaker states with limited ability to defend themselves effectively against sophisticated air strikes, attacks (and deterrent signaling) by aircraft or cruise missiles offer the promise of inflicting damage that can be carefully calibrated, limited in its collateral harm to those not being targeted, and delivered quickly and with minimal risk of losses. In practice, of course, these promises are not always fulfilled, and the political effects of using any type of force often differ from what was intended. Yet air power's political appeal remains, and not without good reason, relative to other available forms of military force.

The other feature, which often goes unremarked, can have subtle but far-reaching effects in both policy and scholarship. This is, for want of a better term, the virtual nature of air power. It is relatively difficult to represent air power on a map: an air unit will be based somewhere tangible, but instead of occupying and exerting its influence in a well-defined sector whose boundaries can easily be drawn, its potential effects exist in a probability field of multiple range rings, which often encompasses a considerable portion of the theater. Moreover, to the extent that air power is particularly well suited to producing indirect effects, often remote from the point of its application, these may be less predictable than those of land forces, and will usually take forms that are less easily measured than is the movement of the front line on a terrestrial battlefield. As a result, it is hardly surprising, for example, that academic analyses of the strategic situation in Cold War Europe only occasionally considered air power with the depth of attention typically given to surface forces (Epstein 1984; Posen 1991). In the political arena, the virtual nature of air power is also a function of limited opportunities for vicarious contact with it – reporters are often embedded in army units and on ships but rarely in cockpits or air operations centers, while realistic portrayals of modern air power in movies and television are rare indeed. All of these factors help to contribute to impressions about air power among both leaders and general populations that often either over- or under-estimate its capabilities significantly.

Coercion and Strategic Air Power

Of all debates in the theory and application of air power, far and away the most prominent, particularly for those not in uniform, have related to how air power can most effectively be used to coerce an enemy. Most of the principal classical air power theorists agreed that strategic bombing was the best answer: by striking directly at the enemy's centers of national power, air forces could bring about victory relatively quickly,

reducing or eliminating the need first to defeat the adversary's surface forces, but this is not the only way in which air power can be used to coerce.

Like war itself, strategic bombing is usually coercive: that is, it seeks (generally in concert with other forms of attack) to cause the adversary to comply with compellent or deterrent demands rather than simply to destroy its ability to resist or misbehave altogether (Schelling 1966). Victory may ultimately require such destruction if coercion fails, but most conflicts end before the losing side has been completely deprived of its ability to fight. Yet strategic and coercive air attack are not entirely congruent. Other forms of air power, such as reconnaissance, airlift, and close air support on the battlefield or interdiction behind it, can also help to alter an adversary's behavior. Conversely, strategic attack is sometimes employed in conflicts where outright destruction of the enemy is indeed the goal, such as in the invasions of Afghanistan in 2001 and Iraq in 2003, or in limited attacks with objectives other than coercion of the target, such as the 1981 Osirak raid.

Objectives, Coercive Mechanisms, and Targeting

It is common for coercive air power prescriptions to be characterized according to their recommended targets – fairly in some cases and less so in others. Douhet advocated attacking population centers, the theorists of the US Army's interwar Air Corps Tactical School (ACTS) promoted bombing industry and infrastructure, Slessor made the case for attacking armies, Gulf War strategist John Warden (1994) favored concentrating on leadership targets, and so on. Important though it is, however, target selection is not – or at least should not be – the basis for air strategy, but rather the final step in its development (Pape 1996). The strategy-making process ideally begins with selecting the objectives ultimately to be achieved (and those to be avoided), followed by identifying or designing the coercive mechanism, the cause-and-effect sequence of events expected to lead to the desired outcome (Ehrhard 1995). This in turn should dictate the choice of targets, based on expectations about how the coercive mechanism can best be set in motion.

Drawing on classical deterrence theory, Robert Pape's *Bombing to Win* (1996; see also Mueller 1998) partitions air strategies into punishment and denial categories, based on their coercive mechanisms. Punishment strategies, including Douhet's and the dominant strains of the ACTS "industrial web" strategy, but also more gradual approaches that emphasize signaling (Schelling 1966) work by imposing costs on the enemy – and creating fear of further punishment to come – of sufficient magnitude to outweigh the value of defying the coercer's demands. The nature of the costs depends on the strategy: many coercive campaigns have revolved around causing suffering among civilian populations, but harm or peril to anything that is valued by enemy decision makers or those with influence over them can be a punitive coercive lever.

Denial strategies, in contrast, are more Clausewitzian. They seek to coerce by making resistance appear futile rather than painful, causing the enemy to anticipate defeat and thus to concede now because the only alternative is conceding later on terms that might be even worse. Denial does depend on the threat or infliction of costs as well – to make

surrendering sooner preferable to surrendering later – but typically this is an intrinsic result of the denial effort. The target sets for denial strategies usually focus on enemy military capabilities, either the armed forces themselves or the industrial production and other systems that sustain them, but in theory anything that gives the enemy reason to hope for eventual victory might serve as the focal point for action. One of the great virtues of a denial strategy is that since making the enemy's defeat apparently inevitable is usually well served by making it actually inevitable, a denial strategy that fails to coerce may nevertheless lay the foundation for a brute force victory; punishment strategies, on the other hand, more often involve attacks that are not optimized for weakening the enemy militarily.

Pape argues that while denial strategies do not always produce coercive success even when they are militarily effective, punishment strategies always fail to coerce. Although the empirical basis for the latter, categorical conclusion is far from conclusive (Mueller 1998), the logic of the argument is straightforward: when the coercive stakes are very high, such as catastrophic defeat or loss of territory, the suffering conventional bombing can produce is insufficient to outweigh the incentives for fighting on if victory (or in some cases merely improved surrender terms) still appears to be within reach. Even if punishment strategies are not always doomed to fail under such circumstances, their track record is certainly poor in the canonical cases Pape examines in detail. Germany fought on to the bitter end in spite of several years of devastating urban bombing. The razing of Japan's cities was even more complete – Douhet could hardly have dreamed of worse destruction – but conventional punishment did not end the Pacific War (though the relative impact of the atomic bombs upon the Japanese surrender decision is still hotly debated). Nor were punitive attacks coercively effective when applied bluntly in Korea (Crane 2000) or with exquisite deliberation against North Vietnam (Thies 1980; Clodfelter 1989), although they did play a more significant role in Italy's decision to surrender than is often recognized (P. Smith 1998). In 1999, however, punishment achieved a career best performance in the Kosovo War, apparently playing a central role in catalyzing Serbia's capitulation, alongside denial threats of an eventual NATO ground invasion (Byman and Waxman 2000; Hosmer 2001a), even rehabilitating for many the concept of gradual escalation as a coercive template, long out of favor following the overdetermined failure of Operation Rolling Thunder in Vietnam.

In addition to punishment, Pape declares that denial strategies based on bombing war production do not work, nor do decapitation or "strategic paralysis" strategies, such as those inspired by the theories of Warden (1989) and John Boyd (Osinga 2006). He concludes therefore that strategic bombing as a whole is ineffective, and advises that air power investment should concentrate on providing capabilities for interdiction, close air support, and other missions to defeat enemy military forces. Attacks against enemy leaders have indeed failed with remarkable frequency to produce their desired results (Hosmer 2001b), while strategic paralysis has proved to be an elusive goal – and one that in some cases, such as the 2003 invasion of Iraq, might have been counterproductive in any event (Hosmer 2007). The situation is murkier with respect to denial campaigns against war industry – for example, Pape's claim that this was ineffective in the German case depends on classifying the destruction of the German petroleum industry as something other than strategic attack because its principal effect was to cripple German

tactical and operational mobility, and he does not address the possibility that the ultimate collapse of the German war machine could have been achieved earlier if different targeting choices had been made. However, it is true that bombing enemy military production will be irrelevant to denial except in prolonged conflicts against states that are consuming their war materiel and cannot import more of it. In the end, however, whether strategic bombing can be decisive is less important than whether particular types of strategies are likely to succeed or fail, particularly since the aircraft and weapons used for strategic attack today are in many respects not fundamentally different from those needed for other types of air campaigns.

Embedded Theories in Air Strategy

Although Pape's assertion that "strategic bombing does not work" is overwrought, it is certainly true that strategic air attack has often failed to deliver the results promised by its proponents. In some cases this has been due to tactical or operational failures, in others to a lack of coherent strategy to guide the effort. Often, however, the problem has derived largely from strategies' faulty theoretical underpinnings – attributable in more than a few cases to strategists and campaign planners having insufficient expertise in the social sciences needed to complement their mastery of the military art. Three bodies of theory figure centrally in many of the most prominent approaches to air strategy and targeting.

The *psychological effects* of air attack have loomed large for strategists since the earliest days of strategic bombing when, based on limited experience in World War I, it was widely expected that large-scale bombing could terrorize populations on a massive scale. Both the prospect and the reality of air attack have indeed been terrifying. Yet images of Guernica, Rotterdam, and Israel under *Scud* bombardment mingle with those of doughty civilians soldiering on unfazed in the face of bombing in London, Valetta, or Chongqing. The first systematic efforts to analyze bombing's psychological effects came at the end of World War II, particularly in the US Strategic Bombing Survey (USSBS) (Janis 1951; MacIsaac 1976). These showed a considerable degree of resilience in British, German, and Japanese civilians, although bombing did indeed lower morale, especially when coupled with a sense of futility or defenselessness, and produced other psychological effects, particularly among those most directly exposed to it.

Counter-intuitively, and contrary to early expectations, the morale of military forces under air attack has often proved to be more fragile than that of civilian populations at home instead of the reverse, although the degree of fragility varies markedly from one case to another (Lambert 1995; Hosmer 1996). A number of factors contribute to this pattern, ranging from the greater isolation and physical deprivation often suffered by troops in the field to the fact that civilians frequently have no plausible alternative to muddling through, lacking opportunities to desert or surrender. This remains a subject where much additional research is needed, especially regarding the psychological effects on combatants and civilians of the presence and use of air power in irregular warfare.

The *economic effects* of strategic bombing have also often been less decisive than anticipated, mostly for reasons that apply similarly to blockades and other forms of

economic warfare. The effects of damage to industrial and other productive sectors or infrastructural systems can frequently be offset by substitution, conservation, repair, and other workarounds, provided that the target has sufficient time, technical and economic expertise, and political will to adapt (Olson 1962; 1963; Griffith 1992). However, the potential for such adaptation varies greatly from one sector to another, making accurate and sophisticated understanding of an enemy economy central to successful economic attack. The archetypical example of this challenge is the Allied bombing of German war industry: due in part to overestimating the similarities between the German and US economies (in the case of the ACTS theorists), attacks against German industry initially concentrated on very resilient economic sectors (and were also hampered by difficulties in inflicting the intended degree of damage against their targets). Eventually planners shifted their focus to the transportation system and petroleum and synthetic fuels industry, which were already stretched to the limit by the demands of the war, and brought about a collapse of Germany's war production while crippling the operations of its air and mechanized forces (Mierzejewski 1988).

Closely related to its psychological effects are the *political effects* of air attack, which are central to many coercive theories. These are particularly salient, and often troublesome, in several types of punitive strategy. The first is strategies that seek to trigger popular uprisings or military coups against enemy governments, which has proved to be exceptionally difficult. This was the most fundamental failing in Douhet's strategic theory, for example: based on the experience of collapsing states late in the Great War, he prophesied that populations terrorized by bombing would rise up against their governments and demand peace at any price. This did not occur in subsequent wars, less because of insufficient terror or misery than because its victims responded with defiance or resignation, lacking either the interest or the capacity to alter their leaders' behavior by force. Weakening a regime with powerful internal enemies can facilitate revolt, but it is notable that the post–Gulf War uprisings against Saddam Hussein's government did not occur in areas where air strikes attacked leadership and internal security targets (Pape 1996). Conversely, applying even great pressure against a government to take actions for which it lacks the capacity, as in the case of Israeli punitive attacks against Lebanon in 2006 to encourage opposition to Hezbollah, should hardly be expected to succeed (Arkin 2007).

A related mechanism, based on a very different model of domestic politics, underlay the ACTS's more American civics-based coercion theory: the expectation that suffering among the population (anticipated in that case from the collapse of modern industrial economies) would lead governments to capitulate in order to protect their citizens, either out of genuine concern or fear of electoral rebuke. By and large this also failed to occur during World War II, as nationalism, often reinforced by repression, carried the day, while there is little basis for the popular myth that the connection between the B-52 raids on Hanoi in late 1972 and the subsequent Paris peace settlement was due to North Vietnamese fears of urban annihilation. Yet leaders do hold and act upon such concerns, which can be quite powerful. The Combined Bomber Offensive and the V-1 and V-2 attacks against England led German and British leaders respectively to divert large amounts of military capability from vital battlefronts to protect their populations – or in some cases simply to give the impression of such protection – and the

massive yet largely ineffective "*Scud* Hunt" of the Gulf War was analogous in many ways (Treadway 1997). Whether or not they were a necessary catalyst for Japanese capitulation in 1945, the atomic bombings of Hiroshima and Nagasaki apparently did contribute to rousing the Emperor to intervene and demand that his government make peace, though he managed to resist any such impulse through five preceding months of bombing that was more apocalyptic than any seen before or since.

An additional source of potential strategic failure on the political dimension lies in the interactive nature of coercion: in most crises and conflicts there is a two-way coercive competition, though the enemy's goal may be no more than to cause attacks against it to stop (Byman and Waxman 2002). The coercer not only needs to convince the opponent to concede, but must do so before the counter-coercion effort can succeed. Thus in the Vietnam War, US aerial denial and punishment efforts ultimately foundered not only because of their intrinsic shortcomings, but because North Vietnam proved to be the more effective at convincing its adversary that the costs of the war were prohibitively high and the prospects for ultimate success were poor.

A final issue in the coercive use of air power, as in all coercion, concerns the overriding importance of considering what is at stake. Experiences such as the US intervention in Vietnam have led some observers to assert that the side that has the greater interest in coercive success will consistent prevail in such contests; this is of course incorrect, for while it is certainly harder to coerce someone to make a large sacrifice than a smaller one, for both punishment and denial it is the relationship between coercive pressures and the severity of demands that matters, not the absolute scale of the demands. For example, the success of the 1995 NATO air campaign in Bosnia had a great deal to do with the fact that by the time the Bosnian Serbs capitulated to what would become the Dayton Peace Accords, Croatian and Bosnian government attacks had already deprived them of nearly all the territory they were being asked to relinquish (Owen 1999).

Conversely, analysts of air power who consider only conflicts where national survival or something comparable was at stake for the coercee, as in a number of marquee cases such as the World Wars and Vietnam, risk overgeneralization when applying their conclusions to the use of air power in pursuit of more limited goals. This is a critical consideration, because air power's potential for applying force with relatively little cost and risk to the attacker tends to make it a very attractive military instrument in such limited-liability conflicts, ranging from punitive strikes on a small or large scale (for example, the US bombing of Libya in 1986) to the imposition of "no-fly" zones and other shows of force (Tubbs 1997). Pape's argument that conventional bombing cannot inflict sufficient damage to change enemy behavior does not hold in such cases. On the other hand, it is all too easy to underestimate the obstacles to successful punitive coercion when the stakes appear to be low – conceding to even mild demands in the face of enemy bombing tends to be psychologically and politically difficult, and strategists who fail to recognize this should expect frequent disappointment.

Air Power in Counterinsurgency

With most analyses of air power focusing on its employment in conventional (or nuclear) warfare, consideration of the uses of air power in "small wars" has traditionally been a peripheral niche in air power scholarship – and in the broader study of counterinsurgency (COIN) and irregular warfare. However, this pattern has lately shifted in response to the prolonged and often frustrating involvement of US and Allied forces in conducting COIN in Iraq and Afghanistan.

Although often drawing relatively limited attention, fixed- and rotary-wing air power has figured prominently in many irregular conflicts over the past century (Flintham 1990; Corum and Johnson 2003). Canonical examples include interwar British colonial "air policing," colonial and post-colonial COIN by France in Indo-China and Algeria, Britain in Malaya and Borneo, and the United States in Southeast Asia, and more recent insurgent and guerrilla wars in Angola, El Salvador, and Colombia. Historical documentation of many of these cases, including very significant ones such as the US Marines' employment of aviation in their interwar campaigns and Soviet use of air power in Afghanistan in the 1980s, remains conspicuously sparse (Westermann 1997; Corum and Johnson 2003:11–50). More recently this empirical record has been further expanded by substantial uses of air power against insurgents from Chechnya to Somalia to Sri Lanka as well as in post–9/11 Afghanistan and Iraq.

Given such a list of conflicts, the image of air power that often springs most readily to mind is its use in the strike role, with a variety of airplanes, helicopters, and UAVs conducting attacks against insurgents, suspected insurgents, or their supporters (Scales 1994). Indeed, aerial firepower can be critical to counterinsurgency, particularly since COIN often involves relatively light ground forces conducting dispersed operations where artillery or other heavy fire support may be unavailable in the event of ambush or other emergency. The potential for air power working together with small special operations units and allied local forces to become a formidable force on the battlefield was demonstrated recently both before and after the fall of the Taliban in Afghanistan; the extent to which this "Afghan model" may usefully be applied in future conflicts is a subject of great current interest (S. Biddle 2005/06). The presence of aircraft can also play an important role in COIN even when no attacks are actually launched, by deterring insurgents from moving or massing. However, it is often, even typically the case that air power's so-called "non-kinetic" roles of airlift and intelligence, surveillance, and reconnaissance (ISR) have even greater impact in COIN, where success hinges heavily on the insurgents' ability to be elusive and avoid combat under unfavorable conditions, and on the government's capacity to extend its reach and authority into remote areas (Owen and Mueller 2007).

In all of these roles, air power tends to operate in support of land forces (and of civilian governance) to a greater degree in COIN than in conventional military operations. This is an inevitable consequence of the nature of COIN. Insurgencies, unless they are extremely weak, must ultimately be defeated on the political battlefield, and even military success against them hinges to a great degree on the sympathies and the behavior of the populations among whom they operate. Making progress in these areas requires a degree of direct, sustained contact between the counterinsurgents and the

populace that simply cannot be achieved from stand-off ranges (Vick et al. 2006). However, the natural centrality of surface forces in COIN does not mean that air power should be considered peripheral in such conflicts, and what roles it can usefully play in COIN beyond providing support to ground forces is the subject of a nascent debate. Recent essays by Charles Dunlap (2008a, 2008b), for example, argue that because local troops tend to be better suited than foreign forces for fighting insurgencies, being able to deploy large US ground forces should not be the focus of American efforts to prepare for future COIN efforts. Perhaps more significantly, Dunlap warns against overemphasizing increasingly remote historical experience when assessing the potential utility of air power in future counterinsurgencies (2008b). Given the dramatic changes that have occurred in aerial ISR and strike capabilities in the past generation, the possibility of developing approaches to counterinsurgency in which air power is more strategically and operationally influential should not be dismissed lightly.

Casualties, Morality, and Law in Air Warfare

<p>Of all the elements of military power, it is in the consideration and use of air power that issues relating to the legal use of force are most prominent. This is not because air power is uniquely prone to harm noncombatants – naval blockades and economic sanctions have killed far more civilians than aerial attack, to say nothing of the direct and indirect destruction wrought by land warfare (Elliot 1972; Meilinger 1993) – but because, as the early theorists emphasized, it is uniquely capable of attacking an enemy nation without first defeating its armed forces. Moreover, when bombing does kill civilians or destroy non-military structures it is often starkly visible, especially in conflicts where such events are not so commonplace as to be taken for granted, which tends to set aerial attack apart from policy instruments such as blockades that injure and kill in a more diffuse, actuarial manner.

The two fundamental principles of international law that govern the use of air power (and other force), embodied in the Hague Conventions, are discrimination and proportionality (Parks 1990). Discrimination categorically proscribes deliberately attacking noncombatants and other classes of protected targets, regardless of the potential utility of doing so (it also requires states and military forces not to violate this protected status, such as by using civilians to shield military installations). Proportionality requires that no attack may be conducted unless its expected military benefit is greater than the collateral harm to noncombatants that is anticipated in the course of carrying it out, and mandates that risk to civilians must be minimized insofar as doing so is possible without increasing the risk to the attacker or compromising the mission's prospects for success. This last provision thus places more stringent demands on armed forces whose weapons and sensors make it possible for them to use force precisely than those less well equipped.

These requirements are of course much simpler to describe than they are to implement, especially when assessing proportionality calls for weighing the relative importance of benefits and costs that are at once uncertain, difficult or impossible to quantify, and radically different in nature. The application of law to the use of air power

is further complicated by changes in the underlying moral concerns that the law of armed conflict only partially reflects. Shifting beliefs about what uses of force are acceptable derive from many sources – a general trend of rising expectations that war should not be barbaric, increasing technological possibilities for precision in targeting and limited weapon effects, and the waxing and waning of the desperation that particularly in wartime causes governments and peoples to embrace behavior that they might have eschewed under other circumstances (Downes 2008).

Although Douhet famously argued that carpet bombing cities with incendiaries and gas would make war more humane by shortening it and averting the horrors of prolonged industrial wars of attrition, most of the early architects and advocates of air power argued that bombing could and should concentrate on precisely attacking an enemy's war industry rather than its citizens. In World War II these visions were largely unfulfilled. As precision bombing proved to be more difficult and less effective than expected, indiscriminate attacks became commonplace, not only in Axis air attacks in Europe and Asia and in the nocturnal area bombing of Germany by the RAF and Japan by US B-29s, but often also in raids that were nominally directed at specific industrial and transportation targets (Parks 1995). Whether these air campaigns were morally justifiable remains a subject of debate to this day (Garrett 1993) – Michael Walzer, for example, argues (2000:251–86) that the principle of "supreme emergency" made the British bombing of German civilians legitimate in the early years of the war but not later – and its echoes resonated through Cold War debates about the morality of nuclear deterrent threats.

The year 1945 did not mark the end of terror bombing by any means – it would reappear prominently in Korea, Afghanistan in the 1980s, the "War of the Cities" in the Iran–Iraq War, and the *Scud* missile attacks of the Gulf War, among other cases. However, over the next 50 years, a profound shift occurred, at least in the West, as the ability of conventional air power to strike with precision improved, and expectations that it should and would be used with discrimination grew accordingly – and sometimes far more rapidly. The US-led air campaigns of the 1990s inflicted civilian casualties in numbers that were remarkably low by historical standards, but drew attention to the potential for bombing to cause much larger numbers of fatalities indirectly, particularly through damage to infrastructure such as electrical power generation and water treatment systems that are essential to maintenance of public health, and also for certain weapons, notably poorly made cluster bombs, to cause disproportionately large numbers of casualties in populated areas (Human Rights Watch 2000; 2005).

During and after these conflicts it has become clear that humanitarian considerations in the use of air power now extend well beyond the obligations imposed by the Hague Conventions, although to what degree is very much an open subject of debate. Indirect and long-term consequences of the use of force cannot easily be neglected, while the sorts of harm to civilians to be avoided also appear to be expanding well beyond the relatively narrow bounds of death or physical injury. It is striking that this general shift toward increased concern with minimizing collateral damage broadly defined has occurred among airmen and military leaders as much as, and perhaps more than, in the civilian world: for example, strenuous efforts to avoid civilian casualties in the 1995 Bosnian air campaign were initiated by planners without being directed by their

national governments, while US use of force in the air-centric campaign in Afghanistan following the 9/11 attacks showed none of the "gloves off" relaxation of humanitarian restraint that many observers expected, and that certainly would have been tolerated (and quite possibly welcomed) by domestic audiences. Yet as subsequent COIN campaigns have demonstrated, the nature of a conflict can lead to inflicting considerable noncombatant casualties even when firepower is provided by forces with great capacity for precision (Human Rights Watch 2008).

Air and Space Power

Some readers will find this essay's neglect of space power to be surprising. The question of whether air and space power constitute one subject or two is a longstanding matter of debate, primarily among those with an interest in whether military activities in the two realms ought to be managed by the same services or agencies or divided among separate ones (Lambeth 2003). Setting aside questions of organizational efficiencies and economies of scale, the argument that air and space are best understood as two parts of a single aerospace whole has traditionally hinged on two elements. The first is that they form a "seamless continuum" so separating them is literally unnatural. This is relatively easy to dismiss. Although air and space do of course blend together at their interface, a large gulf separates the two for practical purposes, a zone on the order of 100 kilometers deep with too little atmosphere to sustain aerial flight yet too low an altitude for a satellite to orbit (M. Smith 2002:36–43).

The second is functional: that air and space technology and operations have far more profound commonalities than differences. This is often bolstered by analogical arguments that the evolution of space power is following the patterns of air power's development, from a focus on observation and reconnaissance to the use of force within and from the realm, although the proffered analogies between the historical developmental of air and space power hold little water when scrutinized seriously (Mueller 2003; Sheldon 2009). Certainly air and space flight do involve many of the same engineering elements, and there is a relatively unified aerospace industry. Moreover, wielding air power and space power both depend on three-dimensional perspectives with wide fields of view. However, the most fundamental operational and strategic characteristics of air power are almost wholly absent in the space arena. Air power's great strength lies in its ability to shift and concentrate effort with great freedom, but because the paths of orbiting satellites are predictable and exceptionally difficult to change, space power excels at providing the persistence on station that air power lacks, and in distributing its effects globally. In addition, because of the location and nature of satellites, space systems are primarily useful for the collection and transmission of information, beside which the limited potential for useful space-based weapons pales by comparison (Preston et al. 2002; Spacy 2004); aircraft can be invaluable for surveillance and reconnaissance as well, but the vast majority of air power investment focuses on combat and transport missions. Moreover, although air and space superiority are analogous in many ways, such basic concepts as offense and defense have very different

meanings in the two arenas because of the divergence between the territorial nature of air space and the global indivisibility of non-geosynchronous orbital space.

In the aggregate, the merits of treating space power as a domain of national security theory and policy separate from those of land, sea, and air power are compelling. Space power stands to grow considerably in importance in coming years, yet is an area where useful existing theory is far from abundant (Sheldon 2009). The United States will increasingly have to wrestle with weighty arguments both for and against the establishment of an independent space force, while the increasing centrality of space systems to terrestrial military operations, and the expanding activities of states such as China and India in the national security space arena, should raise the profile of space power to the point that the next edition of this compendium will almost certainly feature an article devoted to reviewing it.

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RAAF Air Power Development Centre. At http://airpower.airforce.gov.au/Contents/Publications/18/Publications.aspx, accessed May 28, 2009. The Royal Australian Air Force's internal research institute has for many years published a variety of noteworthy air power-related studies by its staff and fellows.

Air Power Australia Analyses. At www.ausairpower.net/apa-analyses.html, accessed May 28, 2009. Air Power Australia is a private think tank that engages energetically in debates about air power, especially regarding the future of the RAAF, with which it often disagrees. *APA Analyses* is its online journal, focusing on recent technological and policy developments.

The RAND Corporation. At www.rand.org/pubs/, accessed May 28, 2009. First established shortly after World War II as an independent, non-partisan think tank to study air power issues for the USAF, RAND has subsequently expanded its scope to many areas of defense and public policy but continues to be the leading civilian center of air power studies and analysis. All of its unclassified publications are available to the public on its website.

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