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FOCUS: Morale and Targeting

Air Strategy

Targeting for Effect

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AIRMEN HAVE ALWAYS believed that the airplane is an inherently strategic weapon. Airpower, operating in the third dimension, can bypass the tactical surface battle and operate directly against the centers of gravity (COG) of an enemy nation: the industrial, political, economic, and population loci that allow a country to function. However, airpower theorists have differed significantly over which specific targets should be struck or neutralized so as to achieve the greatest results. We must understand the various air-targeting strategies because they collectively define the boundaries of strategic-airpower thought, and they clarify the connection between the air weapon and its role in war. Moreover, understanding these concepts leads to a more balanced and flexible grasp of air strategy and the factors that go into its determination.

Psychologists tell us that the most traumatic event in one's life is birth. If so, the birth of airpower was doubly traumatic because it occurred in concert with World War I. That war smashed empires, spawned dictatorships, caused the deaths of at least 10 million people, and had a profound effect on the conduct of war. The loss of a generation of European men, as well as over one hundred thousand Americans, convinced military leaders that tactics and strategy had to be altered. Radical solutions, therefore, received greater consideration than would ordinarily have been the case. Airpower was one of those radical solutions.

When a country wishes to influence another, it has several instruments at its disposal—the military, economic, political, and psychological "levers of power." Depending on a country's objectives, it can employ these levers against another country. For example, if the objective is to express displeasure over a dictator in country A who oppresses his people, then country B may impose sanctions—use of the economic lever of power—in an attempt to modify his noxious behavior. Country B may also petition the United Nations to condemn the dictator and turn world opinion against him—use of the political and psychological levers of power. Obviously, as things become increasingly serious, the military lever becomes most prominent.

These levers of power are directed against an enemy's COGs, which can be the strengths of a country—perhaps the army or the industrial infrastructure—but they can also be a vulnerability. One must recognize this distinction. In attempting to bend an enemy to our will, attacking him at the strongest point is not always necessary or desirable; rather, we should hit him at his weakest point if that will cause collapse. Thus, a country's strength may be its navy, but its weakness may at the same time be dependence on sea-lanes that provide food and raw materials. In such an instance, a strategist may wish to avoid the enemy's strength while simultaneously attacking his weakness. This is analogous to the sit-

uation in World War I, when the German surface fleet remained in port in fear of the Royal Navy, while German submarines carried out a highly effective campaign against British merchant shipping. One can loosely group the generic COGs of a country into the categories of military forces, the economy, and the popular will (table 1). In sum, strategy consists of employing levers of power against the enemy's COGs.

Table 1

Levers of Power and Generic Centers of Gravity

Levers of Power	*Generic COGs*
• Military	• Forces
• Economic	• Economy
• Political	• Will
• Psychological	

Traditionally, armies have used the military lever of power to operate against an enemy's military forces (fig. 1). This was due, quite reasonably, to the fact that the other COGs within a country were protected and shielded by those military forces. As a consequence, war became a contest between armed forces; the losers in battle exposed their country's COGs to the victor. Usually, actual destruction or occupation was unnecessary: with the interior of the country exposed and vulnerable, the government sued for peace. Although land actions could also have an effect on the enemy's economy or will—depicted in figure 1 by the thinner arrows—such consequences were usually indirect and often unplanned. Small wonder that military theorists over time equated the enemy army with the main COG because when the army fell, so did resistance.[1] As noted, however, World War I demonstrated that such attritional contests had become far too bloody—for both sides—to serve as a rational instrument of policy. Soldiers sought a solution, but sailors and airmen took totally different approaches.

Sea warfare is fundamentally different from war on land. Navies have difficulty impacting

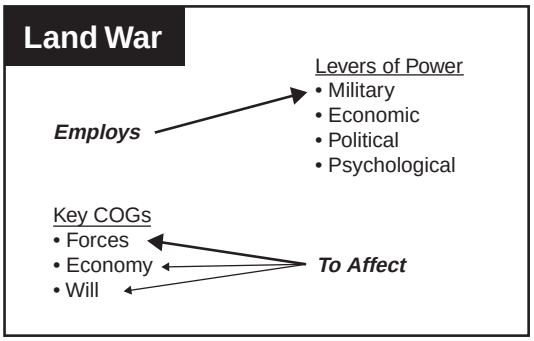


Figure 1. Land War

armies or events on the ground directly, so they have traditionally relied on a form of economic warfare—exemplified by blockades, embargoes, and commerce raiding—to achieve their war aims. Thus, although navies do indeed fight other navies, for the most part they use the economic and psychological levers of power against an enemy's economy and will (fig. 2). Blockade and commerce raiding deprive a country of the food and raw materials it needs to carry on the war effort. Over time, the people begin to suffer the effects of prolonged starvation, and their will to continue the war dissipates.

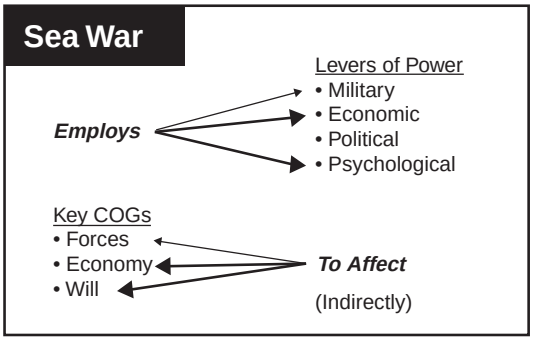


Figure 2. Sea War

Air war, in turn, is fundamentally different from both land and sea warfare. Airmen have always recognized that the airplane's ability to operate in the third dimension gives it the unique capability to strike all of an enemy's COGs. Moreover, although airpower operates

against the enemy's economy and will—as do navies—it does so *directly* (fig. 3). Navies block or sink ships at sea carrying raw materials to a smelting plant that turns those materials into steel, which is then transported to a factory that turns it into weapons. Aircraft can strike those factories and weapons directly. Indeed, an enemy's entire country becomes open to attack.

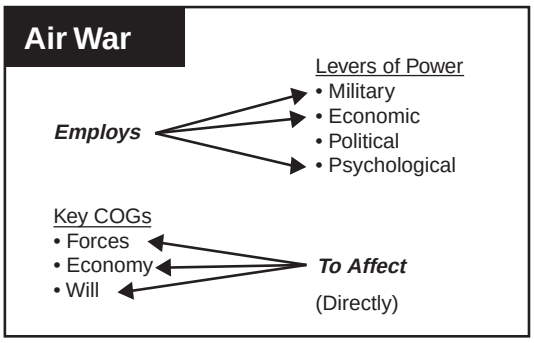


Figure 3. Air War

This, however, tends to complicate things for the air strategist. Obviously, airmen must become intimately familiar with the inner workings of an enemy nation. Knowing that a country depends on its railroads, canal system, political leaders, steel mills, electrical power grid, arable land, telephone system, chemical factories, and so forth is of limited practical value because not all of these targets can be attacked. Which COGs are the *most* important? Selecting the correct targets is the essence of air strategy. However, the fact that something can be targeted does not mean it is valuable, and a thing that is valuable is not necessarily targetable. Perceptive air planners realize that destruction of target sets does not automatically equate to victory; further, intangible factors such as religion, nationalism, and culture are no less important in holding a country together during war than are its physical attributes. The situation has become even more complex with the introduction of a host of "new targets" critical to the functioning of a modern state: fiber-optic networks, communications satellites, nuclear power plants, and the new electronic medium often referred to as "cyberspace," which plays an increasingly important role in all aspects of personal and professional life. How is a modern airman to sort it all out? A schematic representation of a modern country illustrates the problem and may also point to a solution (fig. 4).

The key to all war is the amorphous and largely unquantifiable factor known as the "national will." It occupies the central place in the schematic because it is the most crucial aspect of a country at war. At its most basic, war is psychological. Thus, in the broadest sense, national will is always the key COG—when "the country" decides the war is lost, then and only then is it truly lost. However, that really says very little. The obvious challenge for the strategist is to determine how to shatter or at least crack that collective will. Because it is an aggregate of so many different factors and because it has no physical form, attacking national will directly is seldom possible. Rather, one must target the manifestations of that will. In a general sense, those manifestations can be termed "military capability."

Military capability is the sum of the physical attributes of power: land, natural resources, population, money, industry, government, armed forces, transportation and communications networks, and so forth. When these things have been dissipated or destroyed—when there is no effective capability left with which to fight—then the national will either expires or becomes unimportant. Thus, in the schematic presented here, military capability is closely tied to national will. By the same token, because military capability is at the center of a nation's being and is the sum of a country's total physical power, it is extremely difficult to destroy entirely. The key lies in selectively piercing this hard shell of military capability in one or several places, thereby exposing the soft core. Through these openings, one can puncture, prod, shape, and influence the national will. In most cases, will collapses under such pressure before capability has been exhausted.[2]

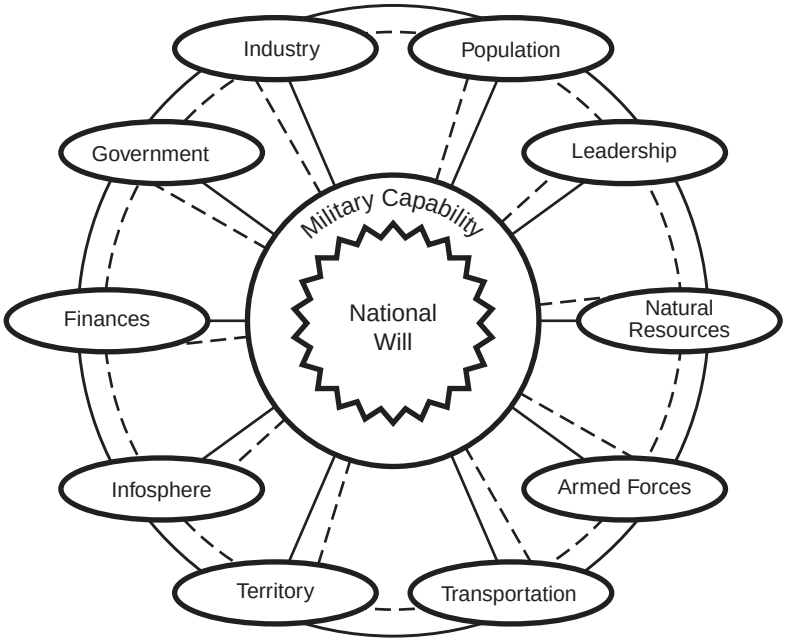
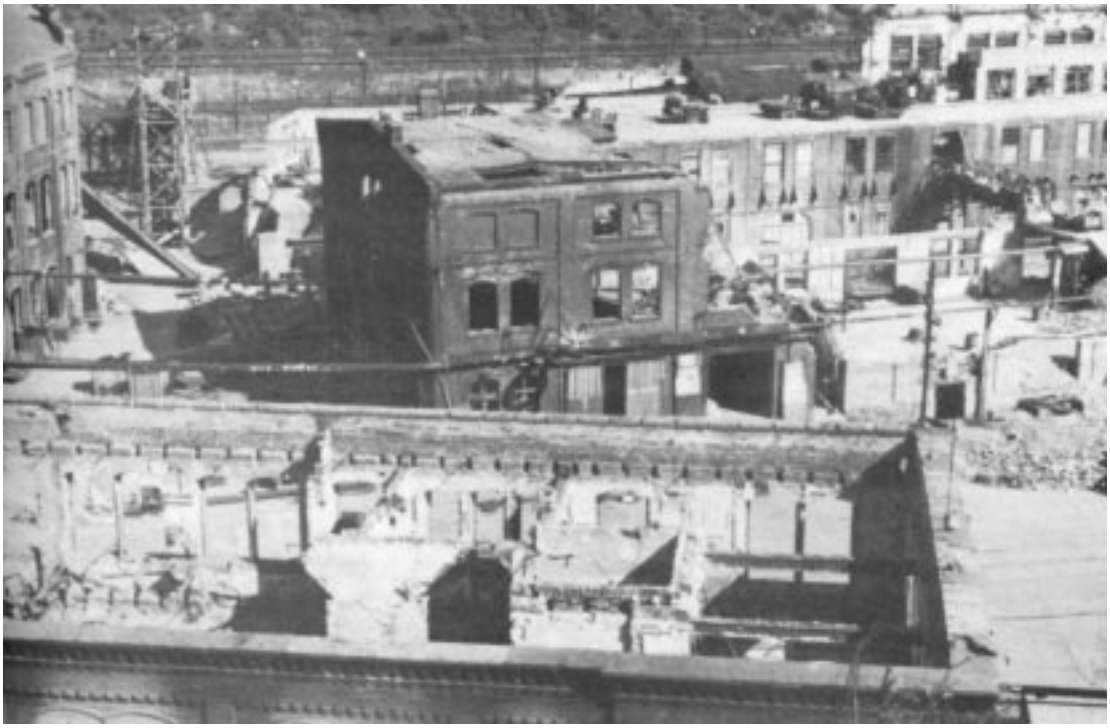


Figure 4. The Notional Nation-State

The nodes surrounding the central core are the de facto COGs that can be targeted. As noted above, in the past the armed forces and the territory of the enemy were generally the foci of operations because they were the most accessible. Often, if the army were defeated or if a strategically located province were overrun, a negotiated settlement would follow. New capabilities offered new opportunities. The history of air strategy is a history of targeting—trying to discover which COG is the most important in a given place, time, and situation. Although air theorists might agree that airpower is intrinsically strategic, they have generally disagreed—vigorously—over which targets are most appropriate to achieve strategic objectives. What follows is a summary of the various strains of airpower targeting theory.

Gen Giulio Douhet believed that the population was the prime target for an air attack and that the average citizen, especially the urban dweller, would panic in the face of air assault.[3] Limited experience from World War I seemed to support that contention. Douhet, therefore, was convinced that dropping a mixture of incendiary, chemical, and high-explosive bombs on a country's major cities would cause such disruption and devastation that revolt and subsequent surrender were inevitable. Although his predictions regarding the fragility of a country's vital centers and the weakness of a population's resolve were to prove grossly in error during World War II, his basic premise has had an enduring appeal.

Fortunately, Douhet's American and British counterparts saw in airpower the hope of targeting things rather than people. Air doctrine in the United States and Britain during the interwar years focused on the enemy's industrial infrastructure, not his population. In this view, the modern state was dependent on mass production of military goods—ships, aircraft, trucks, artillery, ammunition, uniforms, and so forth. Moreover, essentials such as electrical power, steel, chemicals, and oil were also military targets and of great importance because they were the essential build-



Damage to a submarine-battery plant, Hagen, Germany. The Combined Bomber Offensive's support for the Battle of the Atlantic exemplified the challenges in priorities and targeting. Early on, submarine pens on the French coast were relatively easy targets, but Allied aircraft could damage these hardened structures only with bombs developed later in the war. The Strategic Bombing Survey found that damage done to the few factories supplying storage batteries and motor generators substantially reduced the supply of these critical components, affecting both submarine maintenance and new construction.

ing blocks for other manufactured military goods needed to sustain a war effort.

In America, the ideas of Brig Gen Billy Mitchell heavily influenced the Air Corps Tactical School, whose faculty refined a doctrine that sought industrial bottlenecks—those factories or functions that were integral to the effective operation of the entire system.[4] This "industrial web" concept envisioned an enemy country as an integrated and mutually supporting system but one that, like a house of cards, was susceptible to sudden destruction. If one attacked or neutralized the right bottleneck, the entire industrial edifice could come crashing down.[5] It was this doctrine that the Army Air Forces carried into World War II.

The Royal Air Force (RAF), led by Air Marshal Hugh Trenchard, took a slightly different approach. Trenchard himself had witnessed the extreme reaction by the population and its political leaders to the German air attacks on Britain in 1917 and 1918—after all, these attacks led to the creation of the RAF. He argued, as did Douhet, that the psychological effects of bombing outweighed the physical effects. Unlike the Italian general, Trenchard did not believe that attacking people directly was the correct strategy to produce psychological trauma.[6] Such a policy was morally and militarily questionable. Instead, he advocated something similar to the strategy of the Air Corps Tactical School: a country's industrial infrastructure was the appropriate target. He reasoned that the disruption of normal life—the loss of jobs, wages, services, transportation, and goods—would be so profound that people would demand peace. In short, whereas the Americans wished to bomb in-

dustry to destroy capability, Trenchard and the RAF sought to bomb industry so as to destroy the national will.

The massive and decisive use of airpower in [World War II] should have spawned an outburst of new thinking in the years that followed. Surprisingly and unfortunately, that was not the case.

Yet another RAF officer, Wing Commander John C. Slessor, grappled with the complexities of air theory between the wars.[7] He argued that the enemy army's lines of supply and communications were the key COG and that if the transportation system of the enemy were disrupted and neutralized, not only would the enemy army be unable to offer effective resistance but also the entire country would be paralyzed and vulnerable. This paralysis, in turn, would have a decisive effect on both the enemy nation's capability and its will. In essence, Slessor advocated strategic- and operational-level air interdiction. Significantly, the RAF pushed strongly for just such an air campaign against Germany in 1944. The "transportation plan," as it was called, indeed proved successful in assuring the success of the Normandy landings by severely restricting the flow of German reinforcements to the lodgment area. In addition, the wholesale destruction of the Germans' rail system in Western Europe had devastating effects on their entire war effort, as Slessor had predicted.

Significantly, most of the individuals and theorists mentioned thus far are from the pre–World War II era. In truth, the massive and decisive use of airpower in that war should have spawned an outburst of new thinking in the years that followed. Surprisingly and unfortunately, that was not the case. The atomic strikes on Japan had both a catalyzing and numbing effect on military leaders worldwide. The new weapon appeared to revolutionize warfare in ways that made all prior experience obsolete. As a consequence, a different group of theorists arose in an attempt to explain the use of military force in this new age. These theorists, however, were not from the military. Rather, a new breed of civilian academics with little or no experience in war emerged to define and articulate theories of nuclear war. Since no one had any experience with this type of war, civilian academics were seemingly as capable at devising a theory of nuclear air warfare as were uniformed professionals. The ideas they proposed—balance of terror, mutual assured destruction, strategic sufficiency, and the like—were elegant and reasoned. They served the West well throughout the cold war era. Regrettably, however, military airmen all too easily and quickly abandoned the intellectual field to the civilians. At the same time, the military accepted the premise that future wars would involve nuclear weapons. The result was that few airmen gave serious thought to the use of conventional airpower, especially at the strategic level.

The Vietnam War had many negative effects on both the United States and the military services. One positive aspect, however, was the growing realization that nuclear war between the two superpowers was an interesting intellectual exercise but hardly likely to occur—if only because we were so well prepared to wage it. At the same time, tactical airpower seemed not to be a war-winning weapon, as Vietnam amply demonstrated. Thus, while airpower had become polarized between people who thought only of nuclear holocaust and those who prepared to fight the tactical air battle, world conditions seemed to indicate that neither extreme offered useful and decisive results. The vast middle ground between those two poles had to be recaptured. The revitalization of strategic conventional thought began with an instructor at the Fighter Weapons School at Nellis AFB, Nevada—Col John Boyd.

Boyd was intrigued by the astounding success of the F-86 in air combat with the MiG-15 (a 10-to-one superiority) during the Korean War.[8] Upon reflection, he decided that the F-86's advantage largely resided in its hydraulically operated flight controls and all-flying

horizontal stabilizer that allowed it to transition from one aerial maneuver to another more rapidly than the MiG. Further thought revealed the broader implications of this theory. The key to victory was to act more quickly, both mentally and physically, than one's opponent. Boyd expressed this concept in a cyclical process he called the observe-orient-decide-act (OODA) loop (fig. 5). As soon as one side acted, it observed the consequences, and the loop began anew. The most important portion of the loop was the "orient" phase. Boyd speculated that the increasing complexities of the modern world necessitated an ability to take seemingly isolated facts and ideas from different disciplines and events, deconstruct them to their essential components, and then put them back together in new and unusual ways. He termed this process *destruction and creation*—a process that dominated the orient phase of his OODA loop.

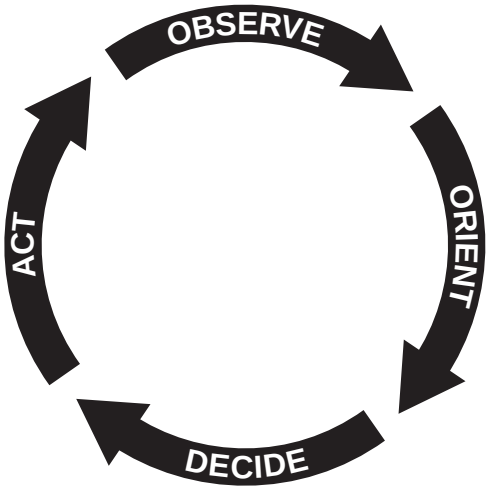


Figure 5. John Boyd's OODA Loop

The significance of Boyd's tactical air theories is that he later hypothesized that this continuously operating cycle was at play not only in an aerial dogfight but also at the higher levels of war. In tracing the history of war, Boyd saw victory consistently going to the side that could think more creatively—orient itself—and then act quickly on that insight. Although military historians tend to blanch at such a selective use of history, the thesis is interesting. Significantly, because of the emphasis on the orientation phase of the loop, in practical terms Boyd was calling for a strategy directed against the mind of the enemy leadership. Although posited by an airman, these theories encompassed far more than a blueprint for air operations. Warfare in general was governed by this process. Nonetheless, because of the OODA loop's emphasis on speed and the disorienting surprise it inflicts on the enemy, Boyd's theories seem especially applicable to airpower, which embodies these two qualities most fully.

Another airman has thought deeply on strategic airpower and has focused on enemy leadership as the key COG—Col John Warden. Like Boyd, a fighter pilot and combat veteran, Warden began a serious and sustained study of air warfare while he was a student at the National War College in 1986. The thesis he wrote that year was soon published and is still a standard text at Air University.[9] His subsequent assignment in the Pentagon put him in an ideal location when Saddam Hussein invaded Kuwait in April 1990. Putting his theories into practice, Warden designed an air campaign that called for strategic attacks against Iraq's COGs.[10] To illustrate his plan, he used a target consisting of five concentric rings with leadership at the bull's-eye—the most important as well as the most fragile COG—and armed forces as the outermost ring—the least important but also the most hardened element. Warden posited that the enemy leader was the key to resistance; killing or capturing him would incapacitate the entire country. It is apparent that both Boyd and Warden have turned away from the economic emphasis of previous airpower theorists. Instead, they focus on the enemy's leadership. However, whereas Boyd seeks to disrupt the *process* of the enemy's leadership, Warden wishes instead to disrupt its *form*. The epitome of such an air strategy was the Gulf War. Air strikes against the Iraqi communications network, road and rail sys-

tem, and electrical power grid made it extremely difficult, physically, for Saddam to control his military forces, but it also introduced enormous confusion and uncertainty into his decision-making process. This served to expand his OODA loop dramatically and slow its cycle time accordingly.

Information warfare has become a growth industry. Seemingly, everyone in the world has or soon will have a fax machine, cellular telephone, powerful microcomputer, and access to the Internet. As a result, the accelerating pace of information exchange has become both a strength and a vulnerability for a modern country. Knowledge, presumably, is power. Whoever controls information flow has a tremendous advantage: "perfect information" for oneself and imposed ignorance, through either denial or corruption, for an enemy. To be sure, information—when broadly defined as intelligence, reconnaissance, and communications—is not new. However, the explosion in the volume and dissemination of such information—made possible by technology such as the microchip, fiber optics, and satellites—has given new intensity to an old concept. The ability to dominate information is often referred to as "infowar" and almost presumes a physical entity, sometimes called an infosphere, in which information resides or through which it is channeled. This infosphere is thus a potentially very important COG and one that has interesting implications for how future air warfare might be conducted.

Another "new" wrinkle in military theory stresses the cultural aspects of conflict. Although physical manifestations of power are the most discernible—the easiest to target and quantify—the cultural and social aspects of a society are also crucial. John Keegan, for example, has argued that the Clausewitzian model of war is flawed because it presumes conflict occurs between nation-states that are what we would call "rational actors" (i.e., they make decisions regarding peace and war based on a logical calculus grounded in policy). Keegan maintains that such factors explain only some motives for war; other societies are far more culturally based. He cites examples of Zulus in Africa, Siberian Cossacks, and Japanese samurai to demonstrate that some groups make war because it is traditional, a rite of passage to manhood, or a safety valve to release excess energy.[11] In such cultures, what Westerners would term the traditional causes of war and peace is largely irrelevant. The significance of this argument is not that small groups of isolated natives have in times past gone to war for reasons we would consider quaint. Rather, if these factors are present in some peoples, they are present in all peoples. In more modern societies, however, these cultural factors are subsumed or overshadowed by the more traditional political imperatives; they are not replaced by them. Thus, all people and countries do things or do not do things, based on a collection of reasons—some physical and some cultural or psychological. Military strategists must be aware that they are dealing with an enemy who is part rational and part irrational, and who is motivated by reasons of both policy and passion. When a modern country is dominated by a worldview that is seemingly completely alien from a Clausewitzian perspective, the problem for the air strategist becomes extremely complex.

Military strategists must be aware that they are dealing with an enemy who is part rational and part irrational, and who is motivated by reasons of both policy and passion.

One could argue, for example, that the passionate faith of Islamic fundamentalism effectively holds modern Iran together—not oil resources or the traditional political bonds of a Western country. Rather than the notion that the Iranian state uses religion as a tool of its policy, it would seem that radical Islam uses the state as a tool to achieve its religious goals. Air strategists have a difficult enough time attempting to predict effects and responses when they deal with a "similar

enemy"; dealing with a dissimilar enemy greatly magnifies the problem. Nonetheless, realizing the importance of such intangible factors as the enemy culture is crucial to military planners. The fact that something may not have a physical form does not mean it is not important—nor does it mean it is impervious to attack. In such instances, psychological-warfare operations—the use of propaganda, ruse, deception, disinformation, perhaps even the truth—can be decisive. In my schematic, these intangible but vital connections are represented by the dotted lines linking the physical COGs to each other and the national core (see fig. 4).

It is useful at this point to introduce some new terms used to describe air strategy. The object of war is to impose one's will on the enemy by destroying his will or capability to resist. An ongoing debate examines whether it is more desirable and feasible to focus on the enemy's will or his capability; consequently, military strategists and thinkers often fall into two categories. The first includes those who focus on seeking methods of confusing, deceiving, frightening, or otherwise influencing the mind of the enemy in the hope of shattering his *will* and thus causing surrender. The other school, more physical and direct, believes that if one attacks the enemy's military forces or industrial infrastructure, thus removing his *capability* to resist, then surrender must follow. Some people, especially those trained in the social sciences, have put new terms on these old concepts and now refer to *coercion* and *denial* strategies. Proponents of these two camps have engaged in vigorous debate over the past decade. In truth, it is virtually impossible to separate these two types of strategies in practice. If the point of attacking, say, an enemy's forces is to deny him the ability to fight, then it is highly likely that such an inability will also have a strong coercive effect on the enemy's will. Conversely, if an attack on the enemy's oil refineries is intended to break his will because it destroys something he values, then at the same time the value of the lost oil revenue will decrease his ability to fight. The issue, therefore, becomes one of emphasis.

To a great extent, the choice of strategy will be driven by objectives and by the nature of the war. In a total war, with surrender and subjugation of the enemy as the goal, destruction of the enemy's will *and* his capability will likely be necessary. Thus, in World War II the Allies conducted a war against both Germany's will and its capability—coercion and denial. Similarly, in the case of Iraq, both strategies were employed, albeit for different reasons: the coalition wanted to coerce Saddam into leaving Kuwait but also wanted to deny him the capability of remaining an offensive threat in the region thereafter. Other conflicts, such as that in Kosovo, are more problematic regarding the type of strategy employed. The North Atlantic Treaty Organization sought to coerce Serbia into stopping its ethnic cleansing in Kosovo. *Coercion* would ordinarily entail the attack of high-value targets in Serbia itself, but planners also employed a *denial* strategy by targeting Serbian military forces and infrastructure in Kosovo. Slobodan Milosevic surrendered, but was it the coercion or the denial targeting that brought him to that decision? We may never know. One must realize, however, that the choice of strategy will have a significant effect on the targets selected for air attack—power lines versus munitions factories versus rail yards versus artillery pieces. Our policy goals and the nature of the war will determine the most effective air strategy to employ.[12]

The task of the air strategist is to understand these various targeting theories and select one, or a combination of several, to make into a workable plan. One does this by first asking three fundamental questions: What is the goal? How much is it worth to achieve that goal? What is it worth to the enemy to prevent the opponent from achieving it? The air strategist must then devise a plan that involves transforming broad goals into specific military objectives, identifying the target sets that need to be affected (not necessarily destroyed) to attain those objectives, and then converting the whole into an operations order that can be implemented.[13] One can-

DOD photo (released).

Poststrike photograph used in bomb damage assessment of the Novi Sad Petroleum Refinery, Serbia. The photo was part of a press briefing on NATO's Operation Allied Force held in the Pentagon on 3 May 1999.

not overemphasize the importance of clearly linking the targets chosen and the objectives sought. What specifically does one expect the enemy to do if his power grid is bombed? If the overall objective is to force the enemy to halt an invasion, then how will striking the power grid—or munitions factory or armored divisions or intelligence headquarters—contribute towards achieving that goal? In other words, destroying or neutralizing a target does not mean that one is any closer to attaining one's goals. The intellectual process of linking ends and means is a crucial, yet too often overlooked, requirement for the air strategist.

Perhaps one of the most important factors to remember in this entire discussion of COGs is that society is a living organism which reacts to a myriad of internal and external stimuli. Indeed, all the COGs in the schematic are connected to each other to illustrate that an attack on one usually will have an impact on all the rest. Hence, striking industry will affect the overall military capability of a country, which will also affect the national will. In turn, the will may crack, or, more likely, the leaders will send a signal to direct more people and resources to rebuild the damaged industries. The organism will react to counter the threat. In short (and this is crucial to note) this schematic depicts a living entity—precisely what a country is—that can act and react to various stimuli. And it can do so in ways that are not necessarily predictable: it can move, shift, alter its appearance, defend itself, panic, and/or steel itself.

Indeed, organisms develop scar tissue after they have been injured, sometimes making subsequent injury less severe. As a result, the second attack, to some extent, hits an organism different from the one first attacked. Correspondingly, the results may also be different. Thus, the tendency to view an enemy country as an inanimate, two-dimensional model is extremely dangerous because it assumes a static, laboratory condition that is far from the case. Imposing rationality on an enemy society via computer simulations and models is foolhardy. War can never be completely rational—no more so than the people who wage it.

One should also understand that the COGs of one country are not necessarily those of another. In the case of Japan during World War II, for example, sea-lanes were vital because so many of its required raw materials came from the Asian mainland or the East Indies. However, sea-lanes were not vital to Nazi Germany. Because Hitler controlled most of Europe, he was largely self-sufficient in raw materials and barely affected by the Allied blockade. Similarly, an autocratic country like Nazi Germany may be more dependent on the personality and power of the leader than is a democracy with a clearly established line of succession in the event of the leader's death.

Moreover, not only are COGs often different between countries, but they may change over time within the same country. During the Battle of Britain, for example, the RAF was perilously short of pilots and aircraft. Had the Luftwaffe continued to attack RAF airfields in the fall of 1940, this key British COG may have cracked. The following year, however, the RAF was no longer in such dire straits because planes and pilots were far more plentiful. By that point, however, the key British COG had moved into the Atlantic. German U-boats were sinking British shipping at an alarming pace, and serious concern existed as to whether or not Britain could long endure. Significantly, this key COG also changed when the United States entered the war, and the massive infusion of shipping capacity alleviated the British plight.

If one agrees that an enemy country is a living organism composed of multiple COGs that act and react with one another and the outside world, then several conclusions follow. First, airpower is an especially effective weapon for affecting those COGs. Most of the vital centers noted above are physical and can be directly targeted. Indeed, because they are for the most part immobile and thus vulnerable—a power grid, railroad network, or factory complex, for example—they are often especially susceptible to the effects of airpower. Other types of military force cannot generally act against such targets directly and are limited to operations against fielded forces.[14] Of course, airpower can attack those forces as well and can do so quite effectively. Reasons for turning to airpower in the post–World War I era when anticipating war against an industrial opponent include the desire to avoid bloodshed, the interdependence of modern economies, the perceived vulnerability of strategic COGs, and airpower's ability to affect them at relatively low risk. It is important to note that the number of such reasons has tended to increase over the decades. To be sure, the intangible aspects of a country—its culture, religion, and tradition—will be difficult to influence, but that is the case when one uses all military forces, not just airpower.

Determining the key target or group of targets within a country requires careful and accurate measurement of the effects of strategic air attacks. This analysis is essential to ensure that the results are what were expected so that one can make adjustments for future operations. This is not a minor consideration. Air intelligence is a relatively new phenomenon. Although information-gathering agencies have existed for centuries, the types of intelligence they sought ran to two extremes. On the one hand, they looked for diplomatic insights to determine potential adversaries' foreign policy, strength of the government, alliance commitments, or soundness of the economy. On the other hand, they also wished to ascertain military information, such as the size of the enemy army and navy, route of march, adequacy of supplies, and rate of fire of the artillery. Although tactical infor-

mation is also necessary for the air battle—the strength, disposition, and capability of the enemy air force and air defense network—strategic air warfare demands a totally new type of intelligence. Detailed economic and industrial information is also now required. Because aircraft can strike military, economic, and governmental centers deep within enemy territory, one must know the precise location and function of such targets. Air warfare requires a detailed understanding of the electrical power grid, rail and road network, iron and steel industry, communications network, and a host of other such items. This type of military intelligence differs fundamentally from that of previous eras. As a result, during World War II new bureaucracies arose, composed of economists, industrialists, and engineers whose main function was to study the makeup and vulnerabilities of an enemy state.[15] Today, these intelligence agencies form a major portion of the military, and their products are vital to the formulation of a viable air campaign plan.

At the same time, air leaders quickly realized in World War II that understanding how an economic or industrial system *failed* was just as important as knowing how it operated. They needed a way to measure the effects of air attacks on a complex, interconnected, and multilayered system—an extremely difficult task because it requires analyses of complicated networks. For example, it is relatively easy to determine the amount of physical damage an air attack causes to a railroad marshaling yard—the number of buildings or railcars destroyed, tracks torn up, and so forth. It is more difficult to measure the effect such damage will have on an entire rail network, given the redundancy of such systems, the availability of repair teams, and the ability to route traffic through other yards. It is more difficult still to judge what effect the shortage of materials *not* moved by the destroyed trains will have on the economy as a whole. One finds an illustration of this problem and its complexity in the work of one historian who has examined the records of the German railroad bureau in World War II. His analysis revealed that the destruction and disruption of German rail traffic severely curtailed the movement of coal, the primary fuel for most industrial production and power generation, throughout the Reich. Therefore, the shortage of coal caused by the disruption of the rail system had a major effect on the production of steel, resulting in the decreased output of tanks, ships, and heavy artillery.[16] Thus, air strikes against seemingly unrelated targets deep in Germany reduced the overall military capability of the German armed forces. Clearly, such analysis requires intimate familiarity with the enemy's economy as well as keen analytical skills. These are not the only problems.

If John Keegan is correct in his assertion that social and cultural factors play a far greater role in war than has hitherto been acknowledged, then the problem of analysis becomes even greater. This difficulty becomes compounded if one considers that a country may strike a particular target not because of the effect it expects to produce on the enemy but for the effect on its own domestic population. Gen Jimmy Doolittle's raid that sent 16 bombers against targets in Tokyo in April 1942 not only influenced the Japanese leaders or the Japanese economy but also bolstered American morale after a series of defeats. Similarly, one may carry out attacks to influence a third country. Some people would argue, for example, that we dropped the atomic bombs on Hiroshima and Nagasaki not to compel Japanese surrender but to send a political message to the Soviet Union—as an act of deterrence for the future.[17] Similarly, did the air strike on Libya in 1986 in response to the terrorist bombing in Berlin have an equally deterring effect on Syria? In short, we must remember that warfare consists of living organisms fighting other living organisms while still other living organisms look on and are affected. Actions in war, therefore, have effects on both participants and nonparticipants, and those effects may be both intended and unintended. If such complex and layered motives are indeed at play, the problems of analysis are enormous. It thus becomes necessary for intelligence organizations to focus on making a second

leap—from an understanding of industrial and economic processes to cultural and psychological ones. This will not be easy.

Until it becomes possible to accurately and predictably measure and quantify such macrolevel effects, airmen will always be at a disadvantage, compared to their surface counterparts. For centuries one has traditionally measured victory or defeat on land in terms of armies destroyed, soldiers slain, and territory captured. Such standards are both quantifiable and widely recognized. One must remember, however, that just as the absence of hard statistics does not necessarily mean a theory is wrong, so does their presence not necessarily confirm that a theory or policy is correct. Americans seem to have a cultural penchant for measuring things, especially in war—bomb tonnage, sortie rates, body counts, tank kills—and this can beguile one into thinking that the mere presence of numbers implies either accuracy or success. If one is measuring the wrong things, however, the statistics are worse than meaningless.

In summary, it has become apparent over the past six decades that airpower is playing an increasingly important role in warfare. Surface-force commanders realize that their operations are extremely difficult, if not impossible, without the extensive employment of airpower. Indeed, our Navy has built most of its force structure (the carrier battle groups) around airpower; the Marine Corps has organized its air-ground task forces around airpower; and the Army's five thousand helicopters constitute the largest air arm in the world. Few people question the ability of airpower to be decisive at the tactical and operational levels of war. The issue of its effectiveness at the strategic level of war, however, is a different matter. Airmen have claimed since the first decade of flight that warfare has been forever changed because of their new weapon. Without denying the dominance of airpower on the battlefield, they argue for its preeminence at the strategic level as well. Their arguments for this contention have relied upon their various targeting philosophies. The question as to which strategic targets should have priority in an air campaign is surprisingly complex, and the answer is not at all self-evident. As a result, a variety of air theories has sprung up, each with its own logic and evidence.

The statement "flexibility is the key to airpower" has become an aphorism. That is just as true in the theoretical sense as in the operational. We now need airmen conversant and well grounded in all aspects of warfare, including the theoretical. Only then will they be able to select the employment concept best suited to the situation at hand. Flexibility is also the key to air strategy. Ultimately, air-targeting strategy is an art, not a science. Unfortunately, it is an incredibly complex art. This article has sought to better arm air strategists with an appropriate array of questions so that they can make better decisions in peace and war. □

Notes

1. Hence, Clausewitz's dictum that "destruction of the enemy forces is the overriding principle of war, and, so far as a positive object is concerned, the principal way to achieve our objective." Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1976), 258.

2. An exception was Nazi Germany. Not until the German air force, army, and navy were largely destroyed; the economy was in shambles; and Soviet troops had actually entered Berlin did Hitler's successor sue for peace. Given the state of the Reich at that point, his official surrender was almost irrelevant.

3. Douhet's primary work was titled "Command of the Air," first published in 1921, with a revised edition appearing in 1927. In 1942 this essay was combined with three other of his major works, translated by Dino Ferrari, and published as *Command of the Air* (New York: Coward-McCann). In 1983 the Air Force History Office reprinted his translation with a new introduction. For analyses of Douhet's theories, see Bernard Brodie, *Strategy in the Missile Age* (Princeton: Princeton University Press, 1959); and Col Phillip S. Meilinger, "Giulio Douhet and the Origins of Airpower Theory," in *The Paths of Heaven: The Evolution of Airpower Theory* (Maxwell AFB, Ala.: Air University Press, 1997), 1–40.

4. See Lt Col Peter R. Faber, "Interwar US Army Aviation and the Air Corps Tactical School: Incubators of American Airpower," in *Paths of Heaven*, 183–238.

5. The origins of the industrial-web theory can be found as early as the mid-1920s. Maj William C. Sherman, an instructor at the Air Corps Tactical School, wrote, "In the majority of industries, it is necessary to destroy certain elements of the industry only, in order to cripple the whole. These elements may be called key plants." *Air Warfare* (New York: Ronald Press Co., 1926), 218. For the developments of the 1930s, see the account by one of the

participants, Maj Gen Don Wilson, "Origins of a Theory of Air Strategy," *Aerospace Historian* 18 (Spring 1971): 19–25.

6. For an analysis of Trenchard's theories, see Col Phillip S. Meilinger, "Trenchard, Slessor, and Royal Air Force Doctrine before World War II," in *Paths of Heaven*, 41–78.

7. Slessor's ideas have not yet been adequately explored. For his excellent memoirs, see *The Central Blue: Recollections and Reflections* (London: Cassell, 1956). His most impressive theoretical work is *Air Power and Armies* (London: Oxford University Press, 1936).

8. John Boyd never published his theories, but the best description and evaluation of them is by Lt Col David S. Fadok, "John Boyd and John Warden: Airpower's Quest for Strategic Paralysis," in *Paths of Heaven*, 357–98.

9. Col John A. Warden III's *The Air Campaign: Planning for Combat* (Washington: Pergamon-Brassey's, 1989) has had a major impact on Air Force thinking, even though its calls for strategic airpower are relatively modest. Indeed, it is illuminating that Warden's book today elicits little controversy; the ideas he proposed then have become accepted wisdom. Warden's ideas took a sizable leap with the experience of the Gulf War.

10. For a readable and illuminating account of air campaign planning in Desert Storm, see Col Richard T. Reynolds, *Heart of the Storm: The Genesis of the Air Campaign against Iraq* (Maxwell AFB, Ala.: Air University Press, 1995).

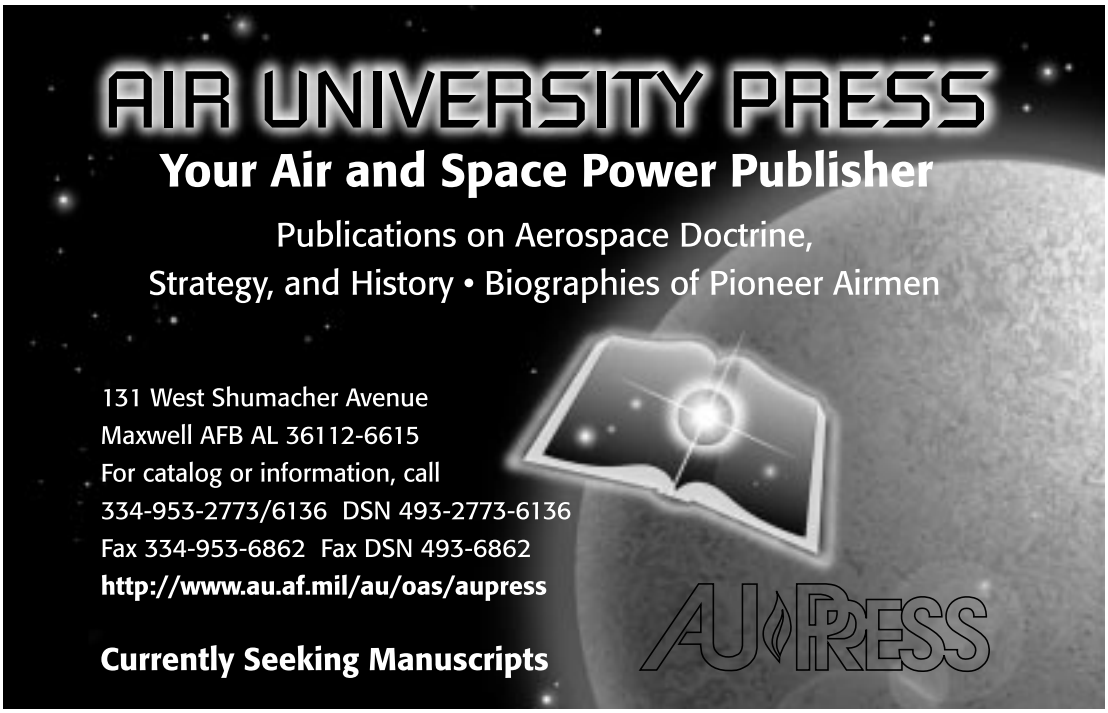
11. See John Keegan, *A History of Warfare* (New York: Knopf, 1993). For an excellent analysis of how cultural factors apply to air warfare, see Lt Col Pat Pentland, "Center of Gravity Analysis and Chaos Theory: Or How Societies Form, Function and Fail" (Maxwell AFB, Ala.: Air War College, 1993); and Paul M. Belbutowski, "Strategic Implications of Cultures in Conflict," *Parameters* 26 (Spring 1996): 32–42.

12. For good discussions, see Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca, N.Y.: Cornell University Press, 1996); and Michael Clarke, "Air Power, Force and Coercion," in *The Dynamics of Air Power*, ed. Andrew Lambert and Arthur C. Williamson (Bracknell: Royal Air Force Staff College, 1996).

13. For excellent discussions of this process, see Lt Col Maris McCrabb, "Air Campaign Planning," *Airpower Journal* 7, no. 2 (Summer 1993): 11–22; and David E. Thaler and David A. Shlapak, *Perspectives on Theater Air Campaign Planning* (Santa Monica, Calif.: RAND, 1995).

14. Actually, airmen do believe in the decisiveness of the counterforce battle—the one for air superiority. Without air superiority—gained by destroying or neutralizing the enemy's air force and ground defenses—all other military operations on land, at sea, and in the air will be extremely difficult.

15. A study of these economic warriors has yet to be written, but for the views of two participants, see (for the Americans) W. W. Rostow, *Pre-Invasion Bombing Strategy: General Eisenhower's Decision of March 25, 1944* (Austin: University of Texas Press, 1981); and (for the British) Baron Solly Zuckerman, *From Apes to Warlords: The Autobiography (1904–1946) of Solly Zuckerman* (London: Hamilton, 1978).

16. See Alfred C. Mierzejewski, *The Collapse of the German War Economy, 1944–1945: Allied Air Power and the German National Railway* (Chapel Hill: University of North Carolina Press, 1988).

17. For an excellent discussion of these ideas, see Maj Thomas P. Ehrhard, "Explaining the SAAS Airpower Analysis Framework" (master's thesis, School of Advanced Airpower Studies, Maxwell AFB, Ala., 1995).