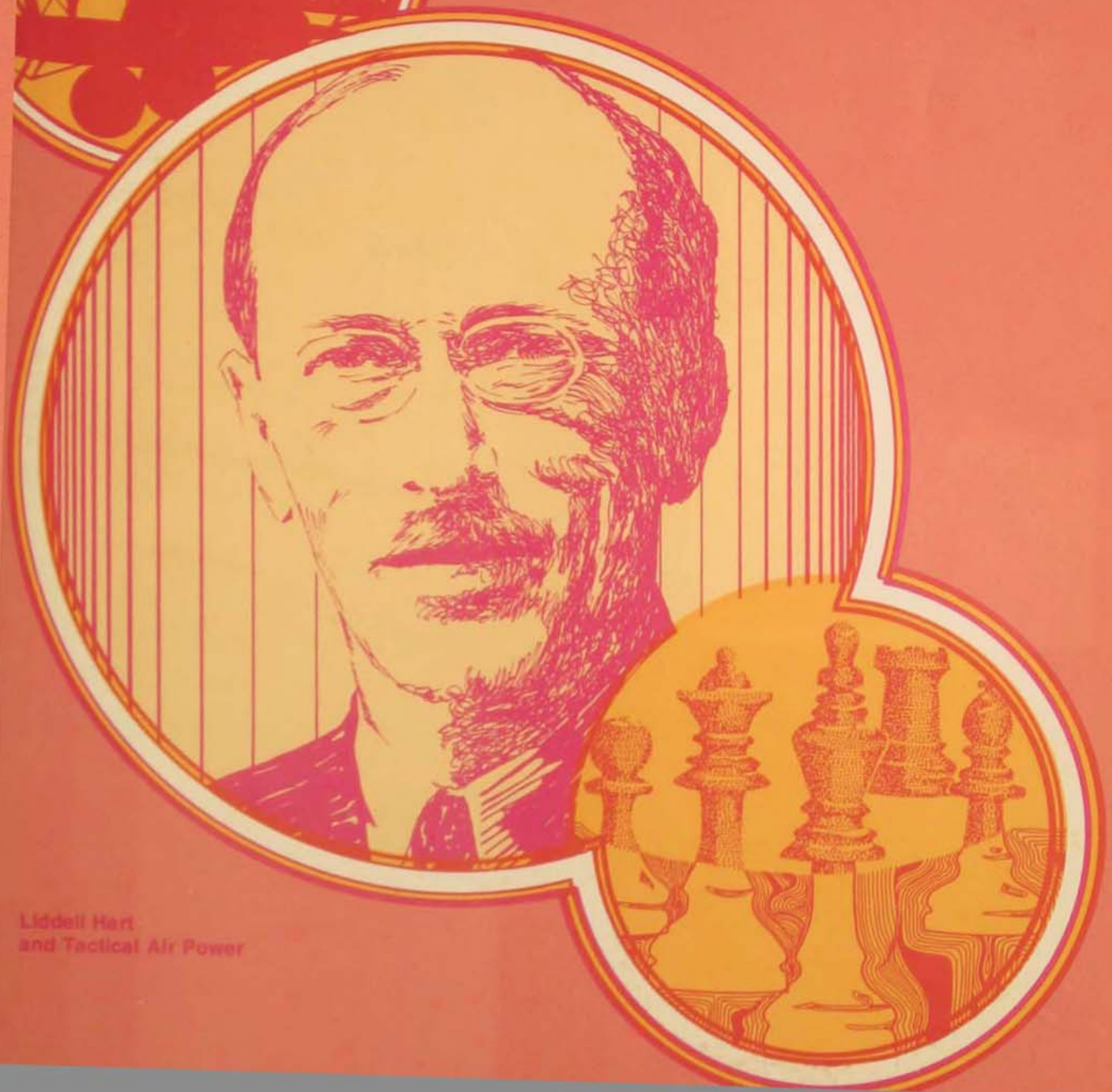
AIR UNIVERSITY
review

SEPTEMBER/OCTOBER 1975



Liddell Hart
and Tactical Air Power

UNITED STATES AIR FORCE
AIR UNIVERSITY
REVIEW

AIR UNIVERSITY
review
THE PROFESSIONAL JOURNAL OF THE UNITED STATES AIR FORCE

Address manuscripts to Editor, Air University Review Division, Bldg. 1211, Maxwell AFB, AL 36112. Printed by Government Printing Office. Address subscriptions to Superintendent of Documents, GPO, Washington DC 20402; yearly $11.60 domestic, $14.50 foreign; single copy $2.00. Air Force Recurring Publication 50-2.

Vol. XXVI No. 6 SEPTEMBER-OCTOBER 1975

the cover

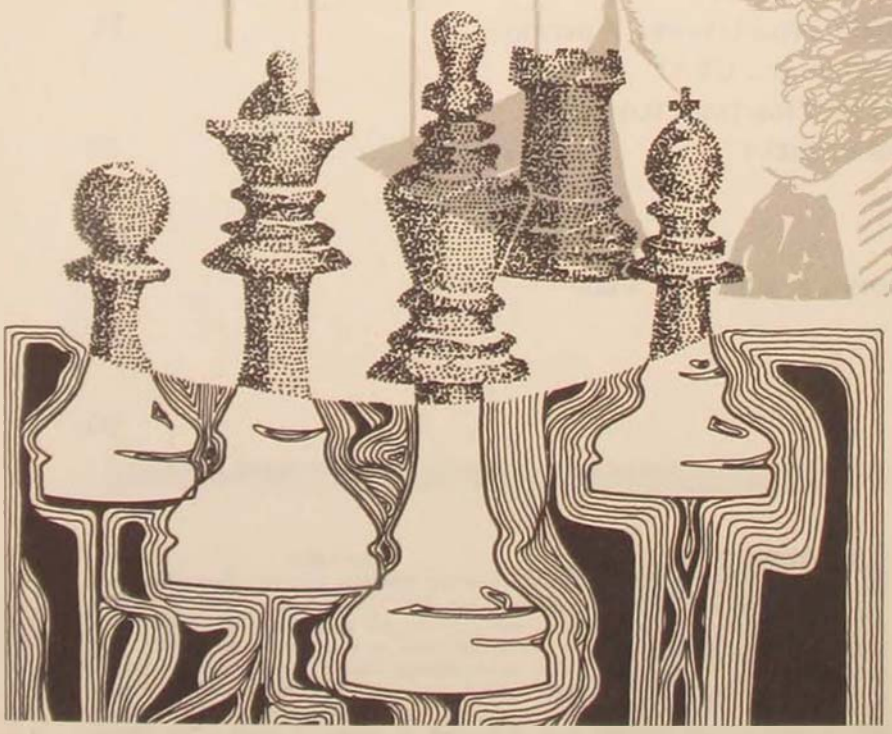
Legendary among twentieth century military historian-strategists has been Captain Sir Basil H. Liddell Hart, not only for his own voluminous writing but as mentor of many a younger military analyst. In much of his writing Liddell Hart emphasized ground warfare, with particular focus on the role of the tank, but Captain Michael O. Wheeler, in "The Employment of Tactical Air Power: A Study in the Theory of Strategy of Sir Basil H. Liddell Hart" concentrates on the British strategist's published thought, dating from the 1920s, on the tactical use of air power.

THE EMPLOYMENT OF TACTICAL AIR POWER

A Study in the Theory of Strategy of Sir Basil H. Liddell Hart

CAPTAIN MICHAEL O. WHEELER

FEW MEN in any age have employed the rhetoric of strategy so well as did the late Sir Basil Henry Liddell Hart. From his perspective as a former soldier with a rare sense of history and an even rarer access to the war ministries and the militaries of a score of nations, Liddell Hart over the course of half a century produced more than thirty major works on the history and theory of war.[1] His thought reveals a developing logic which many have taken to be the definitive statement of military strategy. Moreover, the logic of Liddell Hart's argument has not dated significantly since his death in 1970. As increased emphasis is placed today upon the



war-fighting capabilities of both general purpose and strategic forces, Liddell Hart's theory of strategy deserves renewed attention for the lessons that it yields.

This study will extract from the theory those reflections that relate to the employment of air power in general and of tactical air power in particular. Emphasis will be placed upon the strategy for employing ground attack tactical air power; in the development of Liddell Hart's views on this matter, tactics will be discussed to some extent, for, as he himself frequently observed, the border between strategy and tactics is never precisely defined. Before discussing the strategic dimensions of employing fighter/attack aircraft, however, it is necessary first to establish a framework of concepts emerging from the work of Liddell Hart.

The Evolution of Liddell Hart's Thought on Air Power

Liddell Hart was one of the most enthusiastic early proponents of air power. It can be seen from a close study of his work, however, that by the time he came to publish what is generally considered to be his most finished product (the second revised edition of *Strategy* of 1967), he had considerably muted his earlier enthusiasm for air as an instrument of military strategy. To fully appreciate the extent of this change, it is necessary first to consider some of his early views—views, one will note, which reflected the emerging nature of air warfare in World War I, in the sense that no distinction was then made between the strategic and tactical missions of aircraft.

A participant in the First World War, Liddell Hart was one of the foremost prophets of the early postwar period; he clearly grasped the significance of modern mechanized warfare, glimpses of which had emerged by narrow degrees in the latter part of that bloody conflict.[2] Although he is known to have become an outspoken advocate of the tank by 1921, his advocacy of fighter/attack aircraft is somewhat less well known. Part of the reason for this latter advocacy, one can conjecture, derives from his deep respect for the views of T. E. Lawrence, the famous Lawrence of Arabia, a man whom Liddell Hart took to be one of the few strategic geniuses of the twentieth century.[3] Lawrence's experience with a strategy combining attacks by his Arab irregulars with strikes by aircraft from the five Royal Air Force (RAF) squadrons in Allenby's campaign against the Turks in Palestine (1916 to 1918) had convinced Lawrence that "a combination of armoured cars and aircraft could [in the future] rule the desert."[4] Indeed, Lawrence's feeling for the future of air power, amounting almost to a religious vision for him, led to his enlistment in the RAF in 1922, for reasons which Liddell Hart summarizes:

> It may be near the truth to say that T. E. went into the Air Force for the same reason that some of the most thoughtful men of the Middle Ages went into a monastery. It was not a sudden decision, but had been his intention since the last year of the War. . . . His medieval forerunners went into a monastery not only in search of a refuge, but in support of a faith. T. E. had the same dual motive in entering his modern monastery. In his belief, the utilization of the air was "the one big thing left for our generation to do." Thus everyone "should either take to the air themselves or help it forward."[5]

Since Lawrence was one of Liddell Hart's few living heroes in 1921, since he and Lawrence frequently corresponded with one another, and since Lawrence's views on warfare increasingly focused on his vision of the decisive future of air

power, one can surmise that something of this vision would have rubbed off onto Liddell Hart. Regardless of the genesis of Liddell Hart's views, there is ample evidence that the potential of air power captured his imagination. He was to write (in 1923 and 1928, respectively):

> The tactical methods of the Mongol Army in the thirteenth century carry lessons of importance for present-day students of war . . . Aeroplanes would seem to have the same qualities [as the Mongol cavalry] in ever higher degree, and it may be that in the future they will prove the successors of the Mongol horsemen.[6]
>
> The wider role of mobility and offensive power lies in the air. And the air appears to be cast for the decisive role as the heirs of Alexander's "companion" cavalry.[7]

These comments are all the more striking when one considers the pre-eminent place in war's history that Liddell Hart assigns to a small group of military strategists, Alexander and Genghis Khan included. These comments are, moreover, quite representative of Liddell Hart's emerging views on the value of the airplane as an instrument of strategy, although the views were even then somewhat qualified. That qualification becomes clear when one considers his early assessment of the value of air:

> *Mobility:* "they have a tremendous superiority over all other arms"
>
> *Secrecy (for surprise and security):* "save in exceptional conditions, early warning of their approach is obtainable"
>
> *Co-operation:* "they share the advantage of the tank"
>
> *Security:* "they are, at present, most vulnerable save for the indirect security afforded by their mobility. . . . Here lies the joint in the aeroplane's harness"
>
> *Concentration (of hitting power):* "aircraft are difficult to assess"[8]

This evaluation can be further constrained to what Liddell Hart called "the three essential elements of warfare—hitting power, protection, and mobility."[9] The airplane is then seen by him to be strongest in terms of mobility, weakest in terms of protection (and survivability), and of uncertain value in terms of hitting power. That assessment, it will be argued later in this study, continued unabated in Liddell Hart's thought, through to the 1967 edition of *Strategy*. And the significance of such a fact lies in his failure to appreciate developments in technology sufficiently, which enhanced the survivability of the fighter/attack aircraft in hostile environments and increased the accuracy and magnitude of its firepower; these factors should have (but apparently had not) figured in Liddell Hart's final published position on the value of tactical air.

The wider role of mobility and offensive power lies in the air.

In the early 1920s, however, the unique mobility of the airplane was for Liddell Hart sufficiently impressive to justify his envisioning a virtually unlimited future for the impact of air power on strategy. Thus, he was to write in 1922:

> In view of the transcendent value of aircraft as a means of subduing the enemy will to resist, by striking at the moral objective, the question may well be asked: Is the air the sole medium of future warfare? That this will be the case ultimately we have no doubt, for the advantages of a weapon able to move in three dimensions over those tied to one plane of

movement are surely obvious to all but the mentally blind.[10]

It has been seen, then, that by the early- to mid-1920s Liddell Hart had arrived at a vision of the future of air power which was, to say the least, optimistic. The crucial stages in the evolution of his thought after the mid-1920s, however, did not prove to be so kind to air. To understand the reasons for that development, one must first explore the nature of his theory of strategy.

Liddell Hart's Theory of Strategy

The theory of strategy that Liddell Hart developed reflects his general approach to scholarship. It is broad in scope, articulate, brilliantly insightful, but (at least on first reading) unorganized and vague. To remedy this latter quality, it is helpful to supply an organized outline of Liddell Hart's theory before considering its application. Moreover, such an outline will facilitate a further discussion of his evolving views on air power, insofar as few central themes in his strategic theory were late products of his thought. All of the main ideas discussed here were already emerging in Liddell Hart's writings in the 1920s.

Three main themes form the backbone of the theory: (1) the nature of strategy itself; (2) the relationship of strategy to both grand strategy and tactics; and (3) the concept of the indirect approach. Since these themes are central to one's understanding Liddell Hart's thought, they will be discussed in detail before proceeding.

The first main theme, the nature of strategy, captured what Liddell Hart took also to be a first principle of human nature: namely, that the dimension in which wars are really won or lost is essentially a *psychological* dimension. Wars reflect conflicts that grow out of human relationships, and human relationships are but a manifestation of the influences which human beings exert, one upon the other. So far as a study of war is concerned, then, the central truth implied by this state of affairs is that "the real target in war is the mind of the enemy commander, not the bodies of his troops."[11]

This simple idea serves Liddell Hart as a springboard for a biting critique of the "pseudo-Clausewitzian" conception of strategy, which he took to be the prevailing wisdom of the military strategists of the First World War.[12] This "pseudo-Clausewitzian" view suggests that strategy can be reduced to the art of employing battles to gain the "objects of war" (shortly to be defined). The emphasis, indeed the single-minded concentration of this view, is placed upon closing with, engaging, and destroying the enemy in pitched battle, which is (as Liddell Hart interprets the "pseudo-Clausewitzian" view) taken to be the *logos* of the general's art.

It is important at this point not to misconstrue what Liddell Hart is saying. He is not denying the importance (frequently critical) of battle for winning wars, nor is he denying that one often gets at the mind of the enemy commander through the bodies of his troops. Instead, he is exploring the fatal attraction that the vision of pitched battle has had for many otherwise sober minds: an attraction which easily leads one to the view that the prime canon of strategic doctrine should be the destruction of the enemy's main forces on the battlefield. What Liddell Hart is arguing is that while engaging the enemy in battle may often be an option selected by strategy, it should not be allowed to become the option which dictates strategy. He thus concluded that "the true aim [of strategy] is not so much to seek battle as to seek a strategic situation so advanta-

geous that if it does not of itself produce the decision, its continuation by a battle is sure to achieve this." [13]

The tone of this conclusion is captured in the word "dislocation." The aim of strategy (and hence its defining nature) is to achieve a dislocation of the enemy, a situation that equates to psychological paralysis of the enemy's forces. This psychological paralysis can be expected to result in a decisive diminishing of the enemy's capacity to resist the application (or, indeed, even the threatened application) of force, and this—argued Liddell Hart—is the indispensable service that the military commander can offer his leaders, carrying out strategy in the service of the state.

One is led by this final view of strategy to consider the second main theme in the theory: namely, the relationship of strategy to both strategy in its more comprehensive form (grand strategy) and strategy in its operational application (tactics). It has already been suggested that strategy should aim at a dislocation of the enemy, a paralysis of his will to resist. This definition of strategy is, one must note, conceptually limited, in that it considers strategy in a vacuum—strategy solely in relation to itself. The complex web of possibilities open to the military strategist begins to be fully appreciated only when one considers strategy in a richer context, in the context of its relationships to both grand strategy and tactics.

Grand strategy is viewed by Liddell Hart as the consciously devised plan for combining all of the instruments of national policy (one of which is the military) to achieve national objectives. In this sense, then, grand strategy both sets the objectives and structures the proper mix of instruments (military, diplomatic, economic, and so forth) to achieve those objectives. Grand strategy can thus be viewed as "policy in execution" (Liddell Hart's phrase), and from the relationship of grand strategy to strategy arises his second definition of strategy as "the art of distributing and applying military means to fulfill the ends of policy." [14] It should be further noted that grand strategy has priority over strategy; hence policy should govern strategy, and not the reverse.

Similarly, Liddell Hart contends that tactics should not be allowed to dictate strategy. The tactical level can be viewed as the level at which strategy becomes operational. It follows from the logic of his argument that the aim of strategy at the border of tactics is to bring about battle under the most advantageous circumstances. If circumstances can be made so undeniably advantageous that the enemy perceives no chance of his winning, so much the better, he argues.

From this threefold relationship, then, emerges Liddell Hart's completed definition of strategy, delineating priorities and attributes in the following way:

(highest priority)

> **Strategy** in relation to grand strategy is the art of distributing and applying military means to fulfill the ends of policy, in the service of the state.
>
> **Strategy** in relation to itself is the art of achieving a situation so advantageous that if it does not of itself produce the decision, its continuation by battle is sure to achieve this.

(lowest priority)

> **Strategy** in relation to tactics is the art of bringing about the battle under the most advantageous circumstances possible.

Given this definition of strategy, one can then proceed to the final major theme in Liddell Hart's theory, what he calls the indirect approach. This phrase is the most difficult aspect of his theory to under-

stand, due to the ambiguity which surrounds it. The core meaning of the indirect approach is simply doing the unexpected, throwing the enemy off balance. In this sense, the indirect approach is a mere rephrasing of the classic principle of surprise. Liddell Hart himself notes this fact when he writes that "the strategy of indirect approach is, indeed, the highest and widest fulfillment of the principle of surprise."[15] The full meaning that he attaches to the indirect approach, however, is wider than mere surprise. From his comments, one can infer that the indirect approach involves three vital phases. First, the strategist should have as full an understanding of his enemy as possible—of his strengths and weaknesses—so as to identify the weakest points in the enemy's strategy, force structure, and operational doctrine. Second, the strategist should have an empathic, almost intuitive, turn of mind, which enables him to put himself in the place of the enemy. Only by identifying from the enemy's point of view what is perceived as expected can one begin to envision the possibilities for doing the unexpected. And third (and perhaps most important, since this is the most often ignored aspect of the indirect approach), the strategist should be keenly aware of the intricate relationships that exist among grand strategy, strategy, and tactics. The indirect approach cuts across all three categories; hence the strategist should insure to the best of his ability that pursuit of the indirect approach in one category does not subvert the achievement of ends necessitated by other categories, particularly those of higher priority.

Is the air
the sole medium
of future warfare?
That this
will be the case
ultimately
we have no doubt.

The indirect approach is most often manifested at the level of strategy in what Liddell Hart calls a "distracting" move preceding the "dislocating" move. The most frequent kinds of distracting moves in modern mechanized warfare normally involve an unexpected attack of a logistical nature: e.g., an attack on command and control facilities or on lines of communication. It is important, however, to avoid the mistake of identifying the indirect approach too closely to such moves, as some recent military writers have tended to do.[16] For the indirect approach offers strategic opportunities as varied as the complexity of the environment in which modern warfare occurs. That most strategies of indirect approach in this century have had a logistical motive does not entail that all strategies of indirect approach in the future be so limited.

Given, then, this notion of the indirect approach, Liddell Hart concludes that an understanding of strategy can profit from a study of history: "Throughout the ages, effective results in war have rarely been attained unless the approach has had such indirectness as to ensure the opponent's unreadiness to meet it."[17]

There are many other aspects of Liddell Hart's theory that could profitably be considered. The three major themes which have been discussed, however, form the conceptual framework within which the remaining minor themes are developed. Thus, this brief discussion can suffice for an examination of the next stage in the evolution of his view of air power: namely, his treatment of strategic bombardment.

Air Power's Falling from Favor in Liddell Hart's Thought

It is impossible to establish finally and authoritatively why a man changes his views, short of finding some explicit statement to that effect by the man himself.[18] Yet a change definitely did occur in Liddell Hart's views from the 1920s to the 1960s with respect to the value of air power as an instrument of strategy. It is important, for more than academic reasons, to reflect on why he changed his views. For, as will be argued, Liddell Hart's relative depreciation of the value of air power in his later thought results not from the logic of his theory but from a failure to apply that logic properly.

To establish this claim, one can begin by considering Liddell Hart's views on the strategic bomber offensives of the Second World War. He himself in the early twenties had begun exploring the possibility of massive air strikes against the industrial and political infrastructure of a country. He then wrote:

> But the air has introduced a third dimension into warfare, and with the advent of the airplane new and boundless possibilities are introduced. Hitherto war has been a gigantic game of draughts. Now it becomes a game of halma. Aircraft enable us to *jump over* the army which shields the enemy government, industry, and people, and so *strike direct and immediately at the seat of the opposing will and policy.*[19]

This statement reflects the outrage suffered by Liddell Hart's intellectual and moral sensitivities at the indecisive campaigns of the First World War. His emerging theory of strategy was to a certain extent a reflection of that outrage, and his incisive critiques of the casualty-intensive approaches which led to trench warfare chastised the lack of imagination which (in his view) had kept the Allied commanders from using the indirect approach. In this context, the airplane—with its ability to leap the trenches and strike directly at the protected heart of the enemy—seemed to offer the perfect innovation needed to adapt the indirect approach to twentieth century warfare. Thus, Liddell Hart was to write in one of his earliest histories of the First World War:

> The year 1915 witnessed the dawn of another new form of war which helped to drive home the new reality that the war of armies had become the war of peoples. From January onwards, Zeppelin raids began on the English coast and reached their peak in the late summer of 1916, to be succeeded by aeroplane raids. The difficulty of distinguishing from the air between military and civil objectives smoothed the path for a development which, beginning with excuses, ended in a frank avowal that in a war for existence the will of the enemy nation, not merely the bodies of their soldiers, is the inevitable target.[20]

Liddell Hart's views on tactical aviation's limited but suggestive successes in World War I tended to balance his views on offensive bombardment, at least through the early 1920s. The doctrinal debates in Great Britain and the United States on the proper employment of air power, however, were rapidly narrowing in favor of the long-range bomber offensive, to be strategically employed *independent* of ground forces.[21] Liddell Hart's emphases had largely followed suit.[22] The reasons for this are not hard to surmise. A sudden, massive, devastating strike at the enemy's industrial centers seemed to constitute the strategic ploy which could indirectly paralyze the enemy's will at the outset of a war, thus destroying his ability to resist, in a way consistent with the logic of Liddell Hart's theory. He had recognized this in 1930 in writing: "As the submarine was primarily an economic

weapon, so was the aeroplane primarily a psychological weapon."[23] Destruction of the enemy's will could thus offer a way to avoid the indecisive, bloody pattern of warfare set by the First World War.

Liddell Hart never went to the extremes that some of the advocates of air power tended toward, and thus he never argued for the *exclusive* use of air power in long-range bombardment, at the cost of the fighter pursuit, close air support, and interdiction missions. Moreover, he modified his early advocacy of industrial bombardment and by 1941 had come out in public in opposition to an air strategy based primarily on long-range bomber offensives. The reasons for this change in his view derive more from his strategic theory than from any moral concern, although the latter did play some part in his thought. His argument, quite simply, was that a strategy of long-range bombardment was ahead of the technology of the day. For the bombing strategy to succeed, it would have to accomplish the sudden and simultaneous delivery of massive firepower at a large number of points, so as to shock the enemy into surrender. Instead, the strategy that was adopted (constrained more by technology than by doctrine) involved a bombing campaign spread out over months, slowly rising in intensity. It amounted not so much to a decisive indirect approach as it did to an extended siege coupled with long-range interdiction. And concerning both siege and long-range interdiction, Liddell Hart's position is quite clear. With respect to the siege, he argued:

> Unless there is opportunity and favourable prospect for a quick surprise assault, a siege is the most uneconomic of all operations of war. When the enemy has still a field army capable of intervening, a siege is also the most dangerous—for until it is crowned by success the assailant is progressively weakening himself out of proportion to his enemy.[24]

And with respect to interdiction, he contended that the effects of such a campaign are inversely proportional to the distance between the targets interdicted and the front. The greater the distance, he argued, the slower are the effects of the interdiction on the campaign.

. . . in a war for existence the will of the enemy nation . . . is the inevitable target.

Thus, Liddell Hart was not so much arguing that the offensive bombing campaign would produce no *strategic* results as he was that it lacked the element of indirectness to produce *decisive* results. The siege was spread over time; the interdiction took time to be translated to effects on the battle. Even given these drawbacks, however, the bombing offensive might still have been strategically justified, for he recognized that "under the new conditions of warfare, the *cumulative* effect of partial success . . . may be greater than the effect of complete success at one point."[25] But the crucial factor that precluded its being realized was an incongruence of grand strategy with strategy. The aim of grand strategy, implicit throughout the war and explicit after the Casablanca Conference of 1943, was unconditional surrender, which ruled out the possibility of a negotiated settlement to the war. Thus, there was no practical way (according to Liddell Hart) for the weakening of the will of Germany's population to be translated into German policy. His

conclusion from this fact was the following:

> In a long-range war, such as a purely air war, it is inherently impossible for the people who suffer it to make an effective protest against continuing to suffer it. In that fact lay the fundamental weakness of the cross-Channel bombing match as a means of attaining our war aim. It was too much like pushing people into a steep-walled pit, telling them that you were going to pelt them with stones so long as they stayed there, while offering them no means of climbing out.[26]

Hence, while the essentially tactical successes of the long-range bombing offensives of World War II may have been real, their success as a strategy, according to Liddell Hart, was not realized. Moreover, by the time the technology had become available in the 1950s and 1960s to translate the timely shock of such offensives into an indirect strategy, strategic superiority was rapidly disappearing from the international scene. Liddell Hart had in fact anticipated many subsequent discussions of nuclear deterrence when he wrote in 1925:

> Moreover, though in Europe an air blow would be decisive, its achievement would probably depend on one side being superior in the air, either in numbers of aircraft or by the possession of some surprise device. Where air equality existed between the rival nations, and each was as industrially and politically vulnerable, it is possible that either would hesitate to employ the air attack for fear of instant retaliation.[27]

Dreams one is committed to die hard. Liddell Hart's intellectual youth had involved the construction of scenarios in which air power—in the form of bomber offensives—was seen to offer an instrument by which a strategy of indirect approach could be realized for modern mechanized war. That vision for him had died.[28] But there remain the successes of tactical aviation in World War II, and his views on some of those successes now deserve attention.

In the era immediately following World War II, Liddell Hart's respect for the potential of tactical air power remained high. With respect to this potential, he was to write in 1947:

> Although air power fell short of the decisiveness anticipated—except for its incidental use in conveying the atomic bomb—it wrought a greater change in warfare than any previous development had done. . . . While the air force did not supersede the older forces, it superimposed itself on them—and took the leading place, though not attaining sovereignty.[29]

However, air power was no longer viewed by Liddell Hart as a weapon to build one's strategy around, so much as it was valued for its tactical flexibility.[30] He spoke highly of the use of tactical air in close support of ground forces in North Africa and in Normandy, as he also did concerning the use of tactical air in various interdiction operations. But even the value of these roles had been further restricted in his views, by the time he published the revised edition of *Strategy*. There, he viewed air power as essentially a superartillery, to be molded to the roles it could play in support of mechanized ground forces.[31] The point is not that Liddell Hart had utterly failed to appreciate the value of the fighter/attack aircraft operating in conjunction with ground forces, for he did recognize the value of this role. It is simply that he no longer envisioned any truly independent role for air to play outside of supporting ground forces, to the extent that a strategy might fully exploit the use of air. Interdiction missions with their largely logistical motives remained a possibility, it is true, but one can infer from his comments that

even they had lost their aura of freshness and thus their element of surprise, making them unlikely candidates around which to devise a strategy of the indirect approach.

. . . air power
. . . wrought a
greater change in
warfare
than any
previous development
had done.

Liddell Hart, in short, seemed to have at worst rejected and at best understated the strategic flexibility of the modern fighter/attack aircraft. Thus, one might ask: Why did Liddell Hart underrate the potential of fighter/attack aircraft? How might fighter/attack aircraft be strategically employed in a manner consistent with his theory of the indirect approach?

Why Did Liddell Hart's Views Change?

As has already been noted, there will never be a definitive answer as to why Liddell Hart's views on air power in general and tactical air power in particular had changed. Indeed, the change may be more of degree than of substance, in that his early works were concerned more with the *future* of war (and hence tended to be speculative), while his latter works were concerned more with the *lessons* of war (and thus tended to dwell on the past). Even given this possibility, however, there are still sufficiently intriguing hints scattered throughout his writings to suggest at least nine fundamental reasons why Liddell Hart may have felt that tactical air power could not serve as a primary instrument around which to build a strategy. Those reasons, each of which is discussed at some point in his writings, are the following:

1. The fighter/attack aircraft lacks flexibility in the nature of the munitions to be delivered.
2. The fighter/attack aircraft lacks sufficiently precise accuracy in placing munitions on ground targets.
3. The fighter/attack aircraft lacks discrimination in placing munitions on ground targets.
4. The fighter/attack aircraft lacks surprise.
5. The fighter/attack aircraft lacks survivability in hostile defensive environments.
6. The fighter/attack aircraft lacks sufficient flexibility in combat operations.
7. The fighter/attack aircraft lacks an all-weather, day-and-night capability.
8. The use of fighter/attack aircraft for combat support engenders undue caution on the part of ground commanders.
9. The fighter/attack aircraft lacks the ability to capture or control territory or troops.

In assessing these views, one might initially note that the first seven relate to existing levels of technology, in that they reflect the three basic features of air power that Liddell Hart had discussed in the early 1920s: hitting power, protection, and mobility. He had then maintained that protection and firepower were the weakest aspects of the aerial weapon. There is sufficient cause to believe that he never changed from these early views.

Considering first the related issues of precision and discrimination in weapons delivery, one finds the following. Liddell Hart's basic concern in these issues was whether tactical air could reasonably be expected to hit a maneuvering target with

any reasonable accuracy while not simultaneously hitting friendly forces in the immediate combat vicinity. This concern surfaced at numerous points in his writings and with other factors led him to the following conclusions: "An air force is a super-guerrilla instrument. It has thus a natural tendency to lead, strategically, to attrition warfare—the gradualness of which carries an ever-extending devastation and damaging aftereffects." [32] This comment partly reflects his view that weapons delivered at high speed at small, often camouflaged, maneuvering targets, in the face of defensive ground fire, would necessarily be inaccurate, thus leading to the tendency to make up for this inaccuracy with massive increases in explosive firepower. Hence, discrimination between friendly and enemy forces would be sacrificed, and aircraft could not, therefore, be used in any truly *close* combat support role.

The limitations of using air in support of ground forces in close contact with the enemy were clearly expressed in this view. What Liddell Hart did not sufficiently anticipate, however, was the development of tactical delivery doctrine and a generation of guided bombs, allowing quantum leaps to be made in improving upon the accuracy of air-delivered munitions. Such munitions could indeed be limited in size and still provide the necessary accuracy and, given proper air-to-ground coordination, discrimination to facilitate the accomplishment of close air support missions.

Similar observations can be made concerning the other technology-related factors. Surprise, for instance, is facilitated by the speed with which an aircraft can be directed to a target, as well as by the ability to engage targets under adverse environmental conditions—once again, capabilities related to levels of technological advance. Flexibility (which Liddell Hart took to mean such things as combat radius and time over target) and, to a great extent, survivability are heavily influenced by the airplane's being tied to its airfields. Liddell Hart had observed in 1934 that "the large ground organization of a modern air force is its Achilles' heel." [33] Once again, however, technological advances (in shelters for aircraft, vertical or short takeoff capabilities, and so forth) can enhance flexibility and survivability, in ways which he did not apparently consider. And the same sort of argument can be raised concerning the capability of modern aircraft to survive in hostile defensive environments, given systems to suppress defenses.

The main observation of these comments, in short, is that the first seven reasons are expressions of circumstantial limitations, limitations which can be ameliorated to a considerably greater extent than Liddell Hart allowed for. There is nothing in the logic of his theory to suggest that any of the first seven reasons *necessarily* limits the ability of tactical air to function as an instrument that one could build a strategy around.

The eighth reason (the engendering of undue caution in ground commanders) is suggested in Liddell Hart's discussion of the Salerno Campaign in World War II. He contends that the German commanders at Salerno felt "that the Allied High Command's habit of limiting the scope of its strokes to the limits of constant air-cover had been the defender's solution, by simplifying the multiple problems of the defence." [34] This implies that an undue caution is engendered by depending on supporting air cover, thus foreclosing strategic options. Liddell Hart recognized the value of air cover, and he was not advocating the adoption of a strategy which threw ground forces into an environment dominated by enemy air. At the same

time, however, he recognized that military genius, in the sense of innovative strategy, often requires audacious action (a phrase he uses): "History shows that rather than resign himself to a direct approach, a Great Captain will take even the most hazardous indirect approach—if necessary, over mountains, deserts, or swamps, with only a fraction of his force, even cutting himself loose from his communications."[35] To this could now be added the phrase, "even cutting himself loose from his supporting air cover." It is surely no argument against tactical air power to suggest that reliance on air power can dull the capacity for audacious action. There is little reason to believe that any commander who could not be a Great Captain *with* supporting air cover would be likely to become one *without* such support. Audacity on the part of combat commanders is, in short, logically independent of the air power issue.

Finally, there is the argument that air power can control neither ground nor armies; hence (the conclusion is advanced) air power cannot be a primary instrument of strategy, in the sense that the doctrine supporting the achievement of one's objectives would necessarily consider the capability and force structure of one's fighter/attack aircraft. This thesis is suggested as follows:

> While air-mobility could achieve such direct strokes by an overhead form of indirect approach, tank-mobility might achieve them by indirect approach on the ground avoiding the "obstacle" of the opposing army. To illustrate the point by a board-game analogy with chess—air mobility introduced a knight's move, and tank-mobility a queen's move, into warfare. This analogy does not, of course, express their respective values. For an air force combined the vaulting power of the knight's move with the all-ways flexibility of the queen's move. *On the other hand, a mechanized ground force, though it lacked vaulting power, could remain in occupation of the "square" it gained.*[36]

The argument as stated may indeed turn out to be a straw man. There are other suggestive passages, however, which give the careful reader at least a small residue of doubt that Liddell Hart did violate his own views on physical control of territory, in the sense that he concluded that the lack of such a capability degraded the role of tactical air power. To draw such a conclusion ignores the coordinated aspect of modern combat doctrine, in which air, tank, and infantry can be deployed in a mutually supporting role. Moreover, even when employed by itself, tactical air power can play a crucial role in isolating the battlefield—itself a form of "control of territory."

. . . an air force combined the vaulting power of the knight's move with the all-ways flexibility of the queen's move.

It has not been the purpose of this essay to analyze exhaustively the thought of B. H. Liddell Hart. Instead, it has concentrated on revealing how modern tactical air power has features intimately consistent with the thrust of his strategic views. It is hoped that the value of these ideas will lie in the consequences that could follow from their adoption as premises, as, for instance, in the further refinement of a NATO strategy, using to the maximum the potential of tactical air.

United States Air Force Academy

Notes

1. The major works by B. H. Liddell Hart consulted in preparation of this study are the following: *Paris or the Future of War* (1925), *The Real War* (1930), *The British Way in Warfare* (1932), *T. E. Lawrence in Arabia and After* (1934), *Through the Fog of War* (1938), *Dynamic Defence* (1940), *The Current of War* (1941), *This Expanding War* (1942), *Thoughts on War* (1944), *The Revolution in Warfare* (1947), *The Tanks*, 2 volumes (1959), *The Liddell Hart Memoirs*, 2 volumes (1965, 1966), *Strategy*, 2nd Revised Edition (1967), *History of the First World War* (1970), *History of the Second World War* (1970). Of these works, the two judged to be most valuable for purposes of this study were *Thoughts on War* and *Strategy*.

2. For an authoritative discussion of Liddell Hart's role in the doctrinal birth of modern mechanized warfare, see "The Advocates of Mechanized Landpower," chapter five of Robin Higham's *The Military Intellectuals in Britain, 1918–39* (1966).

3. Liddell Hart's admiration for Lawrence was unqualified. He wrote: "Military history cannot dismiss him as merely a successful leader of irregulars. He is seen to be more than a guerrilla genius—rather does he appear a strategist of genius who had the vision to anticipate the guerrilla trend of civilized warfare that arises from the growing dependence of nations on industrial resources." *T. E. Lawrence*, p. 438.

4. *Ibid.*, p. 307.

5. *Ibid.*, pp. 414–15.

6. *Thoughts on War*, pp. 131–32.

7. *Ibid.*, pp. 28–29.

8. *The Current of War*, pp. 33–34.

9. *Paris*, p. 70.

10. *Ibid.*, pp. 53–54.

11. *Thoughts on War*, p. 48.

12. It is appropriate to speak of pseudo-Clausewitzian strategy, for although Liddell Hart criticizes Clausewitz's views on strategy at some points (for instance, chapter nineteen of *Strategy*), on other occasions he suggests that Clausewitz's insights were profound but misunderstood (see *Thoughts on War*, p. 33).

13. *Strategy*, p. 339.

14. *Ibid.*, p. 335.

15. *Thoughts on War*, p. 238.

16. "Lightning-war objectives ordinarily involve effecting a swift and locally powerful thrust through a suspected weak point in the enemy defenses to destroy control or logistical facilities in the rear. It is this tactic Liddell Hart calls the 'indirect approach.'" In Colonel Wesley W. Yale, General I. D. White, and General Hasso E. von Manteuffel, *Alternatives to Armageddon* (1970), p. 39.

17. *Strategy*, p. 25.

18. A careful study of Liddell Hart's writings does not reveal any explicit attempt at comparing his later views on air power with his earlier views.

19. *Paris*, pp. 36–37.

20. *The Real War*, pp. 80–81.

21. This study does not attempt to retrace the doctrinal debates of the 1920s and 1930s. To place Liddell Hart's views in perspective, however, a number of sources were consulted. For the development of air doctrine in Great Britain, see Robin Higham's *The Military Intellectuals in Britain*, *op. cit.*, and Air Marshal Sir Arthur Tedder's 1947 Lees Knowles Lectures (Cambridge University), published as *Air Power in War* (1947). For the development of air doctrine in America, see Raymond R. Fluegel's unpublished Ph. D. dissertation, *United States Air Power Doctrine: A Study of the Influence of William Mitchell and Giulio Douhet at the Air Corps Tactical School, 1921–1935* (University of Oklahoma, 1965) and the United States Air Force Historical Study Number 100, History of the Air Corps Tactical School, 1920–1940 (1955). See, also, Robin Higham's *Air Power: A Concise History* (1972) and Air Marshal Sir John Slessor's *Air Power and Armies* (1936).

22. Liddell Hart discusses his role in the British doctrinal debate in volume one of his *Memoirs*. The highlights of that role are as follows. An extensive review of existing military doctrine led him in 1925 to adopt a view favoring an independent use of air power. He first presented this view in an article entitled "The Napoleonic Fallacy: The Moral Objective in War," published in March 1925, where he argued in favor of long-range bomber offensives. He expanded this theme in his first major book, *Paris or the Future of War*, published in July 1925. This book had an immediate impact on the Chief of the Air Staff, Sir Hugh Trenchard, largely (the author believed) because it reinforced already established views. Sir Hugh saw that the book had wide circulation in the RAF and the new Staff College. Further, Sir Geoffrey Butler, Liddell Hart's former supervisor in history at Cambridge, had by then become Parliamentary Private Secretary to the Secretary of State for Air, Sir Samuel Hoare. It was through Sir Geoffrey that *Paris* came to Sir Samuel's attention.

23. *The Real War*, p. 313.

24. *Strategy*, p. 51.

25. *Ibid.*, p. 346.

26. *This Expanding War*, p. 262.

27. *Paris*, p. 55.

28. It would be interesting to speculate how Liddell Hart might have responded to the bombing offensives against Hanoi in December 1972, had he not died two years earlier.

29. *The Revolution in Warfare*, p. 29.

30. Liddell Hart had written in *The Revolution in Warfare:* "The inherent drawback to an air force as the prime means to victory is that while *tactically* it is the most rapid in operation and sudden in shock, *strategically* it is less fitted to produce a swiftly decisive effect."

31. Liddell Hart's comments on air power in *Strategy* invite three observations: (1) He gave considerably less space to air power in *Strategy* than in his previous works; (2) his discussion of air power was considerably more reserved in *Strategy* than it had previously been; and (3) he did not sustain any single discussion of air power in *Strategy*. The strongest statement concerning air power appears on page 359, where he wrote: "Air-power promised new scope for producing such paralysis of armed opposition—besides its capacity to evade opposition and strike at civil objectives in the enemy country." Unfortunately, he did not elaborate on this point.

32. *The Revolution in Warfare*, p. 26.

33. *Thoughts on War*, p. 54.

34. *History of the Second World War*, p. 474.

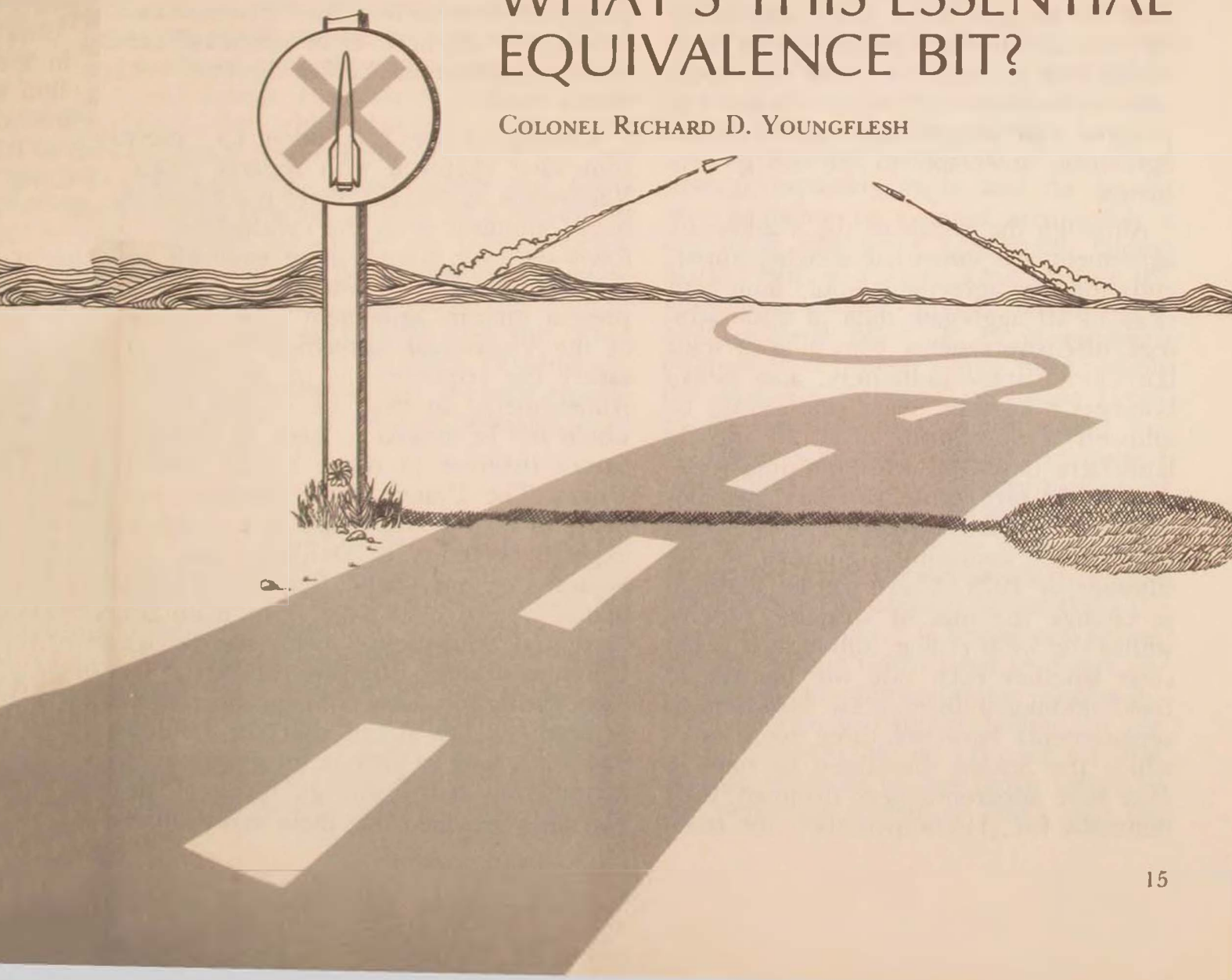
35. *Thoughts on War*, p. 64.

36. *Strategy*, pp. 358–59.

WHAT'S THIS ESSENTIAL EQUIVALENCE BIT?

COLONEL RICHARD D. YOUNGFLESH

ON 26 May 1972 in Moscow, the Secretary of the Communist Party of the Soviet Union, Leonid I. Brezhnev, and the President of the United States, Richard M. Nixon, signed two historic strategic arms limitation agreements constraining part of the strategic forces of the two signatories. The treaty limited antiballistic missile (ABM) systems, and the interim agreement on strategic offensive arms limited the number of intercontinental ballistic missle (ICBM) launchers and submarine-launched ballistic missile (SLBM) launchers. The interim agreement on strategic offensive arms, however, was a far less comprehensive agreement than was originally envisioned in the Strategic Arms Limitation Talks (SALT) by the United States.[1] Even during the final preparations of these documents, the United States did not feel comfortable with an "interim" and incomplete agreement limiting strategic offensive



weapons. As United States Ambassador, Gerard Smith stated on 9 May 1972 that if an agreement providing for more complete strategic offensive arms limitation were not achieved within five years, U.S. supreme interests could be jeopardized, and this could constitute a basis for withdrawal from the ABM treaty.[2]

From that historic day in Moscow in 1972 until the meeting between Secretary Brezhnev and President Gerald R. Ford in Vladivostok in the latter part of November 1974, the second phase of SALT had been distinguished only by the lack of progress in negotiating a more complete agreement on strategic offensive arms. With the apparent breakthrough at Vladivostok, however, it would seem that the basis for an agreement, which appears on the surface to be equitable, has been reached by the leaders of the two countries. It remains to be seen whether this progress can be translated into a formal agreement acceptable to the two governments.

Although the details of the Vladivostok agreement are somewhat sketchy, apparently the new agreement would limit both sides to an aggregate total of 2400 strategic offensive systems, consisting of ICBM launchers, SLBM launchers, and heavy bombers.[3] Further, each side would be allowed a maximum of 1320 missile launchers deployed with multiple independently targetable re-entry vehicles (MIRV's). The new agreement is to extend until 1985, assuming signature in the summer of 1975. There will be freedom to change the mix of strategic systems within the 2400 ceiling, although it is not clear whether each side will be free to build additional fixed ICBM launchers as replacements. However, three major issues which the Soviets attempted to raise in SALT have apparently been dropped: their demands for (1) compensation for modern ballistic missile submarines belonging to U.S. NATO allies, (2) the liquidation of U.S. ballistic missile submarine bases outside the U.S., and (3) an appropriate solution to the question of U.S. nuclear-capable systems deployed in third countries and on aircraft carriers in range of targets in the Soviet Union.[4]

There are many important details to be worked out before the agreement would be complete. For example, there may be several necessary collateral constraints to incorporate into the agreement in order to improve each side's confidence in the verification of MIRVed launcher limits. There will need to be an agreed definition of a heavy ICBM if that distinction is to be retained from the interim agreement. Appropriate destruction and dismantling procedures will have to be established to insure acceptable exercise of the freedom-to-mix option.

Although it may be prudent to remain somewhat skeptical with regard to the Vladivostok agreement, there is a basis for some optimism as to the conclusion of a follow-on SALT accord more equitable to the U.S. in terms of limitations than the present interim agreement. The outlines of the Vladivostok agreement appear to satisfy the requirements of the Jackson Amendment[5] in that the United States would not be limited to levels of strategic forces inferior to those of the Soviet Union. The United States, however, has made its goal in this phase of SALT more explicit. Secretary of Defense James R. Schlesinger has stated that the United States' objective in SALT is to maintain "essential equivalence" with the Soviet Union in strategic offensive capability.[6] In elaborating on this concept Secretary Schlesinger has stated that the United States is willing to tolerate the existence of asymmetries in the strategic forces of the two sides provided that these asymmetries

balance to provide essential equivalence in fact as well as in perception.[7]

It would appear that, in regard to the criteria that determine strategic capability, the principle of essential equivalence would require equality in those criteria whose attainment is practical and that, where equality is not practical, one side's advantage in one criterion must be balanced by the other side's advantage or advantages in comparable criteria, i.e., there must be balancing asymmetries. However, the term "essential equivalence" has been used to describe both the U.S. objective in SALT and the overall U.S. strategic objective. A new SALT agreement along the lines of the Vladivostok accord would limit those strategic systems that have the most influence on the strategic balance between the two countries. There are other strategic systems less central to the strategic equation than those to be limited but which also play a role in the strategic relationship between the two countries, e.g., aerial tankers and early-warning systems. A new SALT agreement may have no impact on these systems. Should there be two calculations of essential equivalence, one based on the terms of a new SALT agreement and the other based on overall strategic capabilities? More important, should essential equivalence be the U.S. strategic objective in or outside of SALT?

FIRST of all, the goal of essential equivalence in strategic offensive capability with a potential adversary does not have much appeal to a military man. In the event of hostilities, any sane military commander wants everything he can get going for him. It is difficult to imagine how a strategic conflict could be terminated in a way favorable to the U.S. when the initial strategic forces of the two sides are essentially equal and the U.S. would concede as a matter of national policy the advantage of the initiative. Some people may object that it is ridiculous to consider "winning" a strategic nuclear war—the levels of destruction on both sides could be so high that there would only be losers. The difficulty with this line of reasoning is that there is no indication that the Soviets subscribe to it. The Soviets may well believe that, with the deployment of their new generation of ICBM's and with other force improvements, they could gain strategic superiority over the United States even within a new SALT agreement. The Soviets may convince themselves that they could destroy so many of the U.S. offensive forces in an initial attack that any retaliatory strike would cause damage deemed acceptable to the Soviet Union. The Soviets might then decide it would be in their best interest to eliminate the United States as a major power.

It is not clear what level of improved strategic capability might lead the Soviets into believing they could accomplish a disarming first strike against the United States. Nor is it clear what impact the nuclear capabilities of other nations might have on Soviet planning. As other nations improve their nuclear forces, most notably the People's Republic of China (PRC), Soviet strategic calculations would undoubtedly take into account the nuclear capabilities and political aspirations of these other powers. In the case of the PRC, however, the Soviets have made massive deployments of theater nuclear-capable systems and conventional forces along the Sino-Soviet border.[8] It would not appear that the Soviets would need to divert any of their intercontinental-range nuclear delivery systems to Chinese targets. In any event, it would not be prudent for U.S. strategic planners to give much weight to any perceived inhibiting effect that the

Communist Chinese might exercise on Soviet actions.

Moreover, it would appear that essential equivalence in strategic capability with the Soviet Union is not a particularly desirable position politically. After World War II and until the late 1960s, the United States enjoyed a distinct superiority in strategic nuclear capability compared to that of the Soviet Union. Now that our nuclear superiority has eroded to a position of apparent parity, it is not clear what long-term impact this basic change in strategic relationships will have on international affairs. In any event, the United States is in a less confident military position vis-à-vis the Soviet Union now than we enjoyed until the late 1960s.

One thing is certain, however: although essential equivalence is not as desirable a strategic posture for the U.S. as superiority, it is infinitely preferable to inferiority.

The most basic question to answer with regard to essential equivalence is, Can our strategic offensive forces still accomplish their mission from such a position? The primary mission of our strategic offensive forces is to deter an attack on the United States. Our strategic offensive forces deter such an attack by retaining the ability to retaliate effectively regardless of how the Soviets or any other adversary might initiate hostilities. Against the threat of an all-out attack on the U.S., this capability to inflict unacceptable damage implies the targeting by our forces of the cities and industrial resources of the enemy—it is our "assured destruction" capability. Although Secretary Schlesinger has indicated by his requirement for a changed targeting strategy[9] that additional options and increased flexibility in strategic force applications are necessary to respond to other hostile initiatives, the ability to inflict unacceptable damage in retaliation remains an essential mission for our strategic forces.

During the tenure of Secretary of Defense Robert S. McNamara, unacceptable damage to the Soviet Union was quantitatively defined as the loss of 20 to 25 percent of the Soviet population and 50 percent of the Soviet industrial capacity.[10] Although it has not been publicly affirmed that these figures are still the U.S. criteria for unacceptable damage, there has been no official rejection of them by subsequent administrations.[11] Assuming that these figures still generally represent the current U.S. concept of what would constitute unacceptable damage, it may not be certain that a threat of inflicting this level of damage would be sufficient to deter the Soviet Union in all circumstances (which could be one reason for redefining the concept and looking at other options). More important, however, is the fact that as the strategic relationship between the United States and the Soviet Union has changed from a position of clear U.S. superiority to roughly one of equality, we should no longer be confident that the U.S. ability to deter a Soviet attack on the United States is independent of the amount of damage the U.S.S.R. could inflict on the U.S. Moreover, there is the possibility that these damage calculations may not be believed. In war, events have rarely correlated with plans, and in an endeavor as complex and as fraught with uncertainty as engaging in a strategic nuclear war, the results of a retaliatory strike could be much in doubt.

Whatever concern there may be about the military desirability of a strategic posture that restricts the United States to no more than rough equality with the Soviet Union, essential equivalence with the U.S.S.R. in strategic offensive capability is U.S. national policy.[12] The practical question, then, is not whether essential equivalence is a desirable goal but rather, Can we maintain essential equivalence with an

agreement along the lines of the Vladivostok accord?

There are many criteria of strategic capability that may be used to calculate essential equivalence, e.g., throw-weight/payload capability, prelaunch survivability, system reliability, accuracy, warhead numbers and yields, range and penetration capability. There are other, less quantifiable factors that directly affect the performance and therefore the effectiveness of strategic systems, e.g., state of crew training and morale, quality of the maintenance support, and efficiency of the supporting supply system. Although all these criteria influence the calculation of essential equivalence, few of them lend themselves to limitation in a formal agreement because such limitations could not be verified. Therefore, no verifiable SALT agreement, no matter how comprehensive it may be, could insure that essential equivalence would in fact be maintained even if both sides strictly observed the letter of the agreement. There will always be significant strategic system characteristics that cannot be constrained. If one side concentrated its development efforts on improving a system characteristic, upon which any limitations cannot be verified, e.g., ICBM accuracy, that side might achieve a decisive strategic advantage.

ACCORDINGLY, the new SALT agreement should not be approached as the panacea for all U.S. strategic problems. Although essential equivalence may be maintained with an agreement along the lines of the Vladivostok accord, major U.S. strategic programs will still be required. The question then becomes, What approach for formalizing essential equivalence in the next SALT agreement is most in the U.S. interest?

The options for handling essential equivalence vary from dealing grossly with one or two system characteristics to constraining or comparing as many characteristics as are feasible (and verifiable). The more characteristics are constrained, however, the less flexibility there is to respond to unforeseen developments or even foreseen threats. Secretary Schlesinger has identified the potential Soviet advantage in fixed ICBM throw-weight as an asymmetry of particular concern. This potential Soviet ICBM throw-weight advantage, combined with increased accuracy and MIRV's, could give the Soviets a major one-sided counterforce capability that would be impermissible.[13] Within the scope of the Vladivostok accord and its allowance of 1320 MIRVed launchers, it would appear that the Soviets could achieve this advantage if they chose to maximize the deployment of their new MIRVed ICBM's currently under development.

The actions the U.S. could take to offset this asymmetry militarily would be to improve the survivability of its existing ICBM force. This improvement could be accomplished by developing and deploying land-mobile and air-mobile ICBM's.

There are also political concerns. Secretary Schlesinger's emphasis on the perception of equality by the Soviet Union and third countries, as well as the reality of equality in a follow-on agreement, would require the U.S. to obtain a comparable counterforce capability. This U.S. capability can be improved through more-accurate and higher-yield warheads, but to attain a comparable capability would also require the U.S. to deploy a fixed land-based ICBM with a higher throw-weight. For the foreseeable future, only this type of system would possess the necessary yield/accuracy combination to provide the U.S. with a counterforce capability against hardened targets comparable to a Soviet force of its new generation of ICBM's.

The high levels of strategic systems and MIRVed launchers outlined in the Vladivostok accord lead to the conclusion that maintaining essential equivalence in the next SALT agreement should be approached in as simple a manner as possible and with minimal limitations on strategic system characteristics. In this context, the first objective should be to achieve a limit on the *total number* of strategic systems. As for other limitations that may be possible—the number of launchers for MIRVed missiles looms most important—these issues must be resolved on the basis of adequate verification.

This simple approach to essential equivalence would place boundaries on key aspects of the strategic arms competition and allow each side the flexibility to structure its forces as it deems necessary to support its critical security interests. It would also enable the U.S. to maintain a strong base from which to expand its strategic capabilities if it were determined that essential equivalence would no longer be a desirable posture and that strategic superiority should be reattained. The U.S. cannot accept the risk that would be inherent in unverifiable SALT constraints on weapon system technology. Avoiding an unrestrained strategic arms competition and reducing defense expenditures are admirable goals, but they are secondary to national security. SALT will probably continue indefinitely, even if a new agreement is reached in the summer of 1975. There will be other opportunities to attempt to negotiate lower strategic force levels and discover new verification techniques. Additional time is required for the United States to gain confidence in arms control as a method of maintaining national security. Measured steps are best.

University of Southern California

Notes

1. John Newhouse, *Cold Dawn—The Story of SALT* (New York: Holt, Rinehart and Winston, 1973). Chapter 5 of this book is a detailed account of the SALT I negotiations.

2. Message of Transmittal and the texts of the Treaty on the Limitation of Anti Ballistic Missile Systems and the Interim Agreement on Certain Measures with Respect to the Limitation of Strategic Offensive Arms, including an Associate Protocol, signed in Moscow on 26 May 1972 (Washington, D.C.: U.S. Government Printing Office, 1972), p. 13 (Unilateral Statement A), (hereafter cited as Message of Transmittal).

3. An apparently complete account of the results of the Vladivostok summit is contained in an article by Clarence A. Robinson, Jr., "SALT Proposals Facing Hurdles," *Aviation Week and Space Technology*, 9 December 1974, pp. 12–14.

4. Message of Transmittal, pp. 15–16. The Soviet demands for compensation for U.S. NATO allies' modern ballistic missile submarine bases outside the U.S. are contained in the Soviet unilateral statement of 17 May 1972. The Soviet concern about U.S. nuclear-capable systems in third countries within range of the Soviet Union has been identified in many sources. See, for example, John Newhouse, *Cold Dawn—The Story of SALT*, pp. 174–75.

5. Legislative History of the Jackson Amendment, 1972 (including the full record of Congressional debate on the ABM Treaty and the Interim Agreement on Offensive Weapons—3 August 1972 through 25 September 1972).

6. Remarks by Secretary of Defense James R. Schlesinger, Overseas Writers Association Luncheon, International Club, Washington, D.C., 10 January 1974. Mimeo transcript, OASD/DA.

7. Report of the Secretary of Defense James R. Schlesinger to the Congress on the FY 1975 defense budget and FY 1975–1979 Defense Program, 4 March 1974, p. 6 (hereafter cited as FY 75 DOD Report).

8. *The Military Balance 1973–1974*, The International Institute for Strategic Studies 1973, p. 6. This publication credits the Soviets with 45 army divisions deployed along the Sino-Soviet border.

9. FY 75 DOD Report, pp. 35–42.

10. Alain C. Enthoven and K. Wayne Smith, *How Much Is Enough?* (New York: Harper and Row, 1971), p. 175.

11. In an article published in the Fall 1974 edition of *ORBIS* entitled "Strategic Adaptability" by William R. Van Cleave and Roger W. Barnett, the authors discuss the genesis of the concept of assured destruction and go on to state that the U.S. " . . . may now prefer to judge the adequacy of the assured destruction capability with regard not so much to population fatalities and urban destruction as to objectives of greater political-military relevance to a war and its aftermath," p. 666.

12. FY 75 DOD Report, p. 43.

13. *Ibid.*, p. 6.

REFORGER

More than Just an Airlift

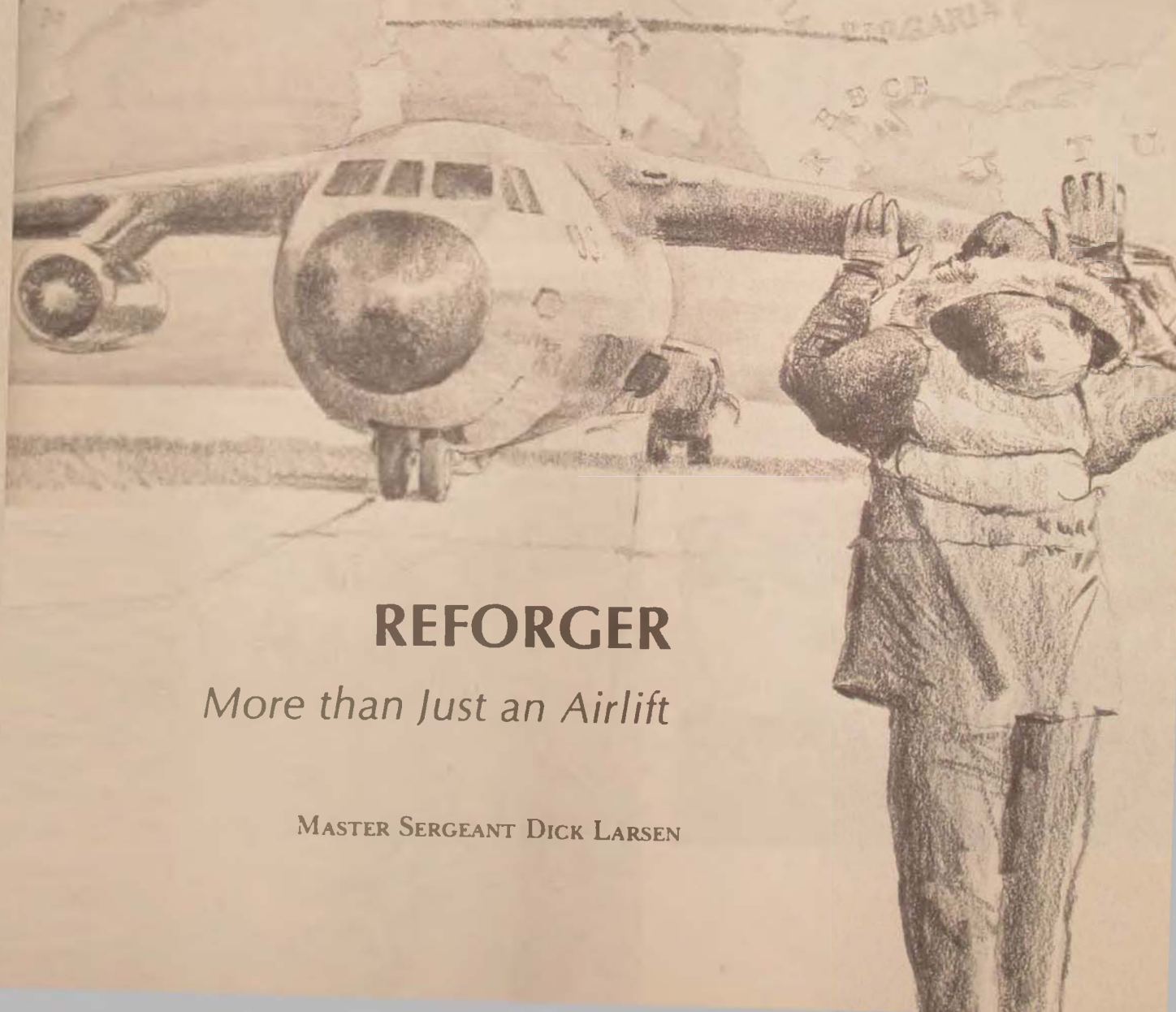
MASTER SERGEANT DICK LARSEN

EVERY year the U.S. Air Force cooperates with the U.S. Army for the massive airlift of American dual-based forces from the United States to forward bases in Europe. The annual exercise is called Reforger, an acronym for "*Re*deployment of *forces* to *Ger*many." It is a complex logistical operation involving Military Airlift Command aircrews, who shuttle between the United States and air bases in Germany.

Reforger 1974, the sixth such airlift operation, is being hailed by officials as the most successful to date. More than 12,000 men and 1261 tons of equipment were flown from bases in the U.S. to Ramstein, Rhein-Main, and Echterdingen airfields in Germany.

Once in Germany, the soldiers, from two brigades of the 1st Armored Division, joined with Canadian, German, and Europe-based American Army units for a field training exercise called "Certain Pledge." During the 11-day exercise, the combined force of more than 40,000 men practiced the role they would fill should the Warsaw Pact launch an attack against the West.

The intent of this article is not to detail the success of Reforger 1974 but rather to point out that military men often become so involved with the means that the ends may become lost amid an impressive welter of statistics. If we judge Reforger simply by how many men, how much equipment, how fast the transportation, or



A C-141 Starlifter parks on flight line at Ramstein Air Base, Germany, during Reforger 74. Military Airlift Command provides the quick troop movement capability that is vital to the U.S. dual-basing concept. . . . U.S. soldiers unload from C-5 Galaxy at Rhein-Main AB, Germany, during deployment phase. . . . Dual-based troops arrive from U.S. by C-141.

how many sorties, the critical principle upon which Reforger is based becomes hazy.

Instead, we must evaluate Reforger from a strategical or political viewpoint. Reforger then symbolizes far more than just the regular practice of modern tools of war. Reforger is, in the final analysis, one of the cornerstones of the North Atlantic Treaty Organization's philosophy of flexible deterrence.

From a NATO point of view, the Reforger exercise yields military dividends that are rather hard to calculate but whose implications are profound.

To begin with, the orthodox military considerations of Reforger create an operational nightmare for the Soviet/Warsaw Pact planner who might be charged with calculating the necessary force levels for an invasion of Central Region territory.

NATO commanders are confident that their in-place defensive forces cannot be overcome without extensive Warsaw Pact buildup behind the demarcation line but in close proximity to it. Such a strengthening of Eastern assault forces would automatically sound a warning bell to NATO intelligence sources. The time required for the Warsaw Pact to bolster its force levels would then yield the vital warning period in which the West can use the proven flexibility of Reforger-perfected aerial reinforcement to beef up NATO's on-the-spot forces quickly.

The heart of the problem confronting a potential enemy planner is the complex "Reforger factor." Although the factor is multifaceted, the mechanics of the problem can be reduced to basic mathematics.

Most strategists have concluded that an aggressor must possess an overall force advantage of 3 to 1 if he is to have a reasonable chance of winning a conflict. A brief comparison of unit strength between American and Warsaw Pact ground units illuminates the essential importance of the Reforger factor in enemy military calculations.[1]

A Soviet armored division, for example, is listed as 9000 men and 335 tanks. The American armored equivalent, however, consists of 15,400 men and 351 tanks. Each U.S. division is formed from three brigades, each totaling approximately 5000 men and 117 tanks.

On the basis of the 3 to 1 overall force advantage required, it becomes apparent that for every armored brigade deployed from the U.S. to forward positions in Europe, the Soviet Union must allocate an additional $1^2/_3$ armored divisions. For every full U.S. armored division brought to Europe, the enemy must counter with an additional five full armored divisions.

The deployment of all three U.S. divisions earmarked as reserve for U.S. Army Europe would require a 15-division force in enemy planning. This would be a mammoth logistical task, even considering the shorter lines of communication enjoyed by the Warsaw Pact.

Additionally, the enemy strategist must now try to establish predetermined objectives for his assault forces without knowing for certain what kind of resistance they will face or even where the defensive force reserve will be employed. He must also try to fix time requirements based on a series of unknowns: how many combat troops will be deployed and what kind (infantry, armor, or airborne), where will they be used, how quickly will they be ready for battle, and whether they will be offensive or defensive in nature, to name just a few.

Other important considerations also have a bearing, not the least of which is the three-brigade ready-reaction force of the British Army that is dual-based in England. This force can be moved to the Continent and ready for action in a

matter of days. Nor does this take into account the reserve forces of other Central Region nations.

One other spectre must lurk in the minds of their planners: the American forces that may be deployed are as strong in an offensive role as they are on defense. That poses the critical question of flank protection for assault forces and the possibility of counterattack by NATO forces. This offensive implication of American forces that might be rushed to Europe is a major roadblock to an effective invasion plan based on a headlong Russian plunge to the West with its resultant weak flanks.

Calculations such as 3 to 1 overall force advantage, number of brigades available for deployment, reinforcement times, etc., are, of course, abstract figures that can be viewed only as a beginning point for discussion. It is a military reality, however, that planning demands a concrete starting point from which all other factors flow. The Reforger factor robs the enemy of certain vital information, such as knowing how many, how fast, and where the reserves will flow into Europe to man forward defensive positions. This uncertainty alone is a vital element in the deterrent effectiveness of the Atlantic Alliance.

Pact planners faced with the Reforger factor must therefore carefully consider their alternatives. If they are to crank into their data the potential reserves that can be funneled quickly from the United States to Europe, they will be faced with two logical choices: (1) they can assign very limited objectives to forward forces presently in place, or (2) they can go for a massive overkill capability in the assault force to take into account the possibility of

Reforger in West Germany

M-60 tanks of 2d Armored Division from Fort Hood, Texas, move along autobahn between Kaiserlautern and Mannheim. . . . An armored command vehicle rolls through a German town during Reforger exercises.

strong American reserve forces being deployed from the U.S.

Limiting the campaign objectives is not an appealing choice because the aggressor would risk the chance of a general war to achieve gains that would not be worth the possible consequences. Furthermore, a campaign of limited objectives carried out by Warsaw Pact forces now in forward positions along the demarcation line—estimated to be some 56 divisions—would most certainly be stopped cold by NATO forces presently in place. A cardinal rule of military operations is to concentrate one's force at the point of attack. Concentration, however, takes time and gives warning to the defender. If we assume that the Warsaw Pact would therefore launch a surprise attack without force concentration, it would of necessity be conducted piecemeal along the entire front. That would be a suicidal form of military strategy, and you can be sure they know it.

A massive overkill conducted by huge Warsaw Pact forces is a scheme that well suits Soviet military operational characteristics. What makes such a stratagem unlikely is that the massing of huge forces would be like a road map to their intentions—something the West could hardly overlook.

In addition, enormous troop marshaling areas would present lucrative targets for counterattack by the West.

In short, no matter which alternative the Pact planner considers, the Reforger factor sends him back to square one: no logical chance of certain success that would warrant the risks involved. Take away the Reforger factor and you have removed one of the basic building blocks to the credibility of the NATO defensive deterrent.

Reforger must also be examined in regard to its psychological value in Central Region defensive strategy. The fact that American dual-based forces are returned annually to Europe is vital in reinforcing the credibility of NATO's deterrent in the minds of the Warsaw Pact.

Reforger in the field

A track-mounted Vulcan air defense system follows a USAF F-4 Phantom during field training exercises of Reforger 74. . . . An M-60 tank maintains a defensive position in the field.

Donald Atwell Zoll, writing in *Strategic Review*, defined a special need that is filled by Reforger: "Another object of strategy," he wrote, "is to provide an explicit military demonstration of the political resolution of the national will. Collective security arrangements require the occasional 'combat' demonstration on the part of such a collective alliance system." [2]

The success of any defensive alliance based on deterrence is inescapably linked with its own credibility. Modern military strategy demands believability by the other side if that strategy is to be effective. Reforger demonstrates in practical, easy-to-understand terms that the credibility of NATO's flexible response is not limited to

decisions that will be made on some future battlefield. The annual Reforger operation sounds a clear warning to the East that nations of the West will not tolerate aggression; that NATO's military capabilities are as strong in time of détente as in time of crisis.

General Michael S. Davison, former commander of U.S. Army Europe, pointed out the psychological necessity of Reforger when he stated: "Without exercising the capability annually, it will erode not only in terms of the Army's expertise, but also in the minds of our . . . potential enemies."[3]

The Vicomte de Turenne wrote that strategy is the art of influencing the enemy so that he will change his mind and leave the battlefield. Reforger serves this axiom by helping to persuade the Warsaw Pact not to come in the first place.

The political aspects of Reforger are also crucial in helping NATO to maintain its deterrent against Soviet aggression. Yet the political implications of the Reforger exercise are perhaps the least recognized.

General of the Army Douglas MacArthur was fond of telling his staff officers that "preparedness is the key to success and victory." In this regard the Reforger exercise fills a political requirement that transcends the physical act of transporting troops and equipment to Europe for annual maneuvers.

One of the basic weak spots in the dual-basing philosophy is the speed with which political decisions are made actually to begin the redeployment. This time factor is crucial in times of real tension. It is a question that goes directly to the core of how effective the dual-basing concept will be if it ever needs to be put to the acid test.

Defense Minister Georg Leber of West Germany defined the political aspects of the problem: "If, in times of tension, American troops had to be redeployed to Europe, this would confront the U.S. government with a difficult political decision between the possibilities of failing to move up the necessary reinforcements in time, or of escalating a critical situation by early action." [4]

It is not difficult to tell when something is too late; however, how does one judge when something is too early?

The failure to exploit quickly the Allied landings at Anzio during the Italian campaign of World War II points out how opportunity can be lost by waiting. At the other extreme, the Canadian debacle at Dieppe in August 1942 paints a vivid picture of the results of "too early."

The judgment that will have to be exercised if and when East and West stand on the brink of armed confrontation is purely political in nature; the military consequences that will ride on the decisions made are critical in the extreme. For example, what would have been the Soviet reaction if American dual-based forces had been rushed to Europe during the 1968 Russian occupation of Czechoslovakia? The West could have justified such a move as prudent military precaution. Would the Soviets have taken the action in the same spirit? Or would they have concluded that the West was preparing for a quick pre-emptive attack while Soviet forces were busy in the streets of Prague?

It may seem remote in this age of détente, jet plane diplomacy, and Washington-Moscow hot lines that the Soviet Union could ever make such a tragic mistake. Yet history is filled with wars that were fought because of errors in judgment.

There is always the chance, slight though it may be, that the East could misjudge our purpose if dual-based forces were suddenly returned to Europe during an international crisis. Given the historical Russian mistrust of Western intentions, it becomes impossible to rule out completely the chance of a Soviet overreaction. Far too often we fail to perceive an action through the eyes of those toward whom the action is directed.

The "too early" consideration is especially critical should events in the East give the appearance that a Western move might be made to aid a Russian satellite country—Yugoslavia, for example—at a moment when the Soviets were in the process of enforcing their political grasp on that country, as in Hungary or Poland (1956) or Czechoslovakia (1968).

Reforger directly attacks this time element problem in the dual-basing deployment strategy. By practicing the movement of forces to Europe each year, political leaders and military planners in the United States can develop realistic parameters within which the political decision-making process can operate.

For an American president and his advisers to form logical thresholds for decisions with which they may be faced, they must know how long it will take the dual-based forces to get into their European positions. Once the parameters are established, the diplomats have room for maneuver.

Once the last critical deployment threshold is reached, the political leaders will know that it is time to stop talking and start rattling the dual-based sword. It is, ultimately, the military power of a nation that prevents war when efforts at the diplomatic level have failed. We live in an age of negotiation and rational approach to problems between conflicting national ideologies.

The importance of negotiation as an alternative to constant military confrontation was clearly identified in the Nixon Doctrine by its approach to the realities of the nuclear age. As former President Richard M. Nixon explained his view of international relations:

> The classic concept of balance of power included continual maneuvering for marginal advantages over others. In the nuclear era this is both unrealistic and dangerous. It is unrealistic because when both sides possess such enormous power, small additional increments cannot be translated into tangible advantage or even usable political strength. And it is dangerous because attempts to seek tactical gains might lead to a confrontation which could be catastrophic.[5]

Mr. Nixon qualified this philosophy by reminding that détente does not imply that military capability is no longer necessary. "They require vigilance and firmness and exertion," he said. "Nothing would be more dangerous than to assume prematurely that dangers have disappeared."[6]

The benefits of a new foreign policy must be balanced against the requirements to support that policy. If the United States is to move away from the traditional "balance of power" philosophy in foreign affairs, then new methods of employing our military capability must come to the forefront. In addition, the United States incurs a special responsibility to its allies: it must put credibility in its commitment.

One highly visible method of reconfirming our commitment to the NATO Alliance is by the annual redeployment of dual-based forces to Europe. Those C-5A Galaxy and C-141 Starlifter transports carry far more than men and equipment when they make that long journey across the Atlantic. They are bringing to Europe a symbolic reminder that our pledge to help maintain a free and sovereign Europe is as strong today as it was in 1949 when the NATO partnership was formed. The fact that American forces return each year helps strengthen in the eyes of Europeans, and confirm in the eyes of the world, that the U.S. commitment to its allies remains unaltered.

Besides this result of Reforger, the practice gained by air transport personnel and Army combat forces sharpens the skills needed to make dual-basing a flexible tool in the hands of the political leaders of the United States. Should a crisis arise, they, in consultation with their European allies, can use Reforger to the degree necessary under the circumstances: a single battalion might be deployed in one instance to halt a crisis, while a full division might be the last step before full mobilization were declared.

Military capability has always played a vital role in the foreign policy of the United States. From the gunboat diplomacy of the late nineteenth century to the Cuban confrontation of the 1960s, it has been the military potential of the United States that has put muscle into its foreign policy. Reforger serves the same need but in a more flexible, less brutal manner. Its means are as much implied as demonstrated, but its significance to détente is critical in this age of nuclear overkill potential.

Hq Allied Forces Central Europe

Notes

1. Unit strength comparisons are based on data found in "The Military Balance 1973–1974," published by the International Institute for Strategic Studies, London, p.80.
2. Donald Atwell Zoll, "New Aspects of Strategy," *Strategy Review*, Fall 1973, p. 43.
3. As quoted by David Minthorn, "Reforger '74 Maneuvers Not Satisfying Strategist," *New Orleans Times-Picayune*, October 31, 1974.
4. Georg Leber, "Defence Is Definitely a Two-Way Street," *Transatlantic Crisis: Europe & America in the '70s*, p. 105.
5. Richard Nixon, "U.S.Foreign Policy for the 1970s: Shaping a Durable Peace," a report to Congress, May 3, 1973.
6. *Ibid.*

IMPROVING THE GROUND SURVIVABILITY OF IN-THEATER TACAIR

Lieutenant Colonel Thomas C. Blake, Jr.

INHERENTLY, aircraft are easier to destroy on the ground than in flight, yet ground survivability has not always been a major cause for concern.

During World War I, neither side had the munitions or aerial delivery capability to pose a serious threat to the other's air bases. Furthermore, the concepts and doctrine for employing those fledgling air forces had not developed an effective means for attacking any kind of ground target.

In World War II, the Axis powers did not sustain a concentrated effort long enough to inflict crucial damage to home bases of the Allies' aircraft. Initially this was due largely to fallacies in Axis strategy. Later in the war, when the Axis powers might have sought to correct their mistake, the Allies had gained air superiority. This air superiority allowed the Allies to operate from their "sanctuary" bases with relatively little concern for ground survivability.

After World War II and into the 1950s, there still was little perceived threat to the ground survivability of U.S. theater air forces. In Korea and later in Vietnam, U.S. air forces never suffered a heavy attack by enemy air. In Europe, Soviet Pact tactical aircraft had limited range and payload and were largely air-defense oriented, Soviet strategic air was intended for a different kind of target.

Development of the first family of relatively unsophisticated medium-range ballistic missiles (MRBM) marked the beginning of today's ground survivability dilemma. Later, when the Soviets acquired intermediate-range ballistic missiles (IRBM), they were able for the first time to threaten North Atlantic Treaty Organization (NATO) air bases throughout West Europe and the United Kingdom. It was not only the direct MRBM/IRBM threat that caused concern but also the influence that this had on the employment of Soviet aircraft. As the Soviet operational missile forces grew in quantity and quality and were able to assume more of the strategic targets, the manned bombers they replaced became more available for tactical targets. The Soviets began shifting from an almost totally defense-oriented tactical air system toward one that possessed a respectable offensive capability.

In 1961 the Soviets, having long been aware of NATO's capability to attack their air bases, began to build hardened aircraft shelters. To understand better the overall implications of all these developments, in 1964 the Secretary of Defense directed the Air Force to establish a working group to study and analyze the subject of "Theater Air Base Vulnerability." This "TAB VEE Working Group," as it became known, published an initial report in 1965. Major findings concerning passive defense measures included the statement that tactical aircraft and other mission-essential resources should be dispersed (either widely separated on the same facility or formed into small groups and located at operating sites other than main bases), concealed, and sheltered.[1]

While the U.S. was negotiating with other NATO nations to determine how much should be spent to carry out the recommendations of the TAB VEE Working Group and who should pay the cost, events occurred in the Middle East that dramatically illustrated the need for ac-

tion. Early on 5 June 1967 at the outset of the Six Day War, the Israeli Air Force caught the bulk of the Egyptian Air Force vulnerable on the ground at a number of air bases and virtually demolished it. This demonstration of the need to protect aircraft on the ground spurred the Soviets to intensify their program for sheltering aircraft and hardening facilities. NATO countries continued for several years to lag in taking these steps, although more recently significant progress has been made in this direction (but less than the U.S. recommends).

trends for the future

A number of developments and trends indicate a new context for tactical air forces (TACAIR) ground survivability in the future. This new concept may affect the relative emphasis placed on the findings and alternatives (dispersal, concealment, sheltering) of the TAB VEE study.

An existing trend that promises to continue is NATO's increasing dependence on its tactical air power. NATO depends heavily upon tactical air power to help offset the significant disparity in the amount of its military resources that are organized and in-place readily available for combat vis-à-vis the Pact countries.[2] Moreover, if it appeared that NATO TACAIR could be held down or significantly disrupted, much of its weight in deterrence would be removed. Therefore, tactics which either hold down aircraft or destroy TACAIR resources (including sheltered aircraft) would tend to be more effective against NATO than against the Pact nations, whose powerful land army likely could accomplish its objectives in a neutralized air environment.

For several reasons it appears likely that the Pact forces could attack air bases more productively than could NATO: (1) There are fewer NATO air bases to be attacked and destroyed or held down, and the Pact force has an increasing numerical superiority in tactical assets. (2) Compared to NATO, more of the Pact's air forces can operate from sod surfaces without depending on prepared runways, making NATO's forces more vulnerable to runway denial tactics. (3) As aggressors, the Pact forces can strike at a time most opportune to them and possibly achieve a favorable element of surprise. (4) Geography favors the Pact commanders in that they can position and disperse their strategic reserve of general-purpose air forces over a vast heartland area.[3] Also, the Soviets' task would be simplified if their advancing armies were able to engulf NATO airfields.

In particular, the advent of precision guided munitions (PGM) adds new dimensions to the problem of defending airfields. In the Six Day War of 1967, the Israelis employed "concrete dibbers," new-type lightweight bombs with special shaped-charge conventional warheads, to crater Arab runways and make them unusable.[4] (Since then, Martin Marietta Aerospace Corporation has developed an improved lightweight penetrator that will pierce a foot thickness of steel-reinforced concrete and cause runway damage much more difficult to repair than simple cratering.) Similar weapons delivered with precise guidance techniques could be used to penetrate existing shelters and destroy the aircraft inside. This problem will grow as the standoff delivery capability of precision guided munitions improves. Because of their high speed and small size, PGM launched from standoff ranges will probably be more difficult to detect and intercept than penetrating aircraft. The U.S. is directing much technological effort toward increasing the accuracy of PGM as well as the standoff range from which they can be employed. It is reasonable to assume

that the Soviets also will pursue this objective.

In addition to PGM threats from manned aircraft, technological advances in drone or remotely piloted vehicles (RPV) could lead to the development of an air base attack system. Conceivably, drone/RPV could counter intense point defenses by employing standoff PGM or by penetrating and taking losses that might be unacceptable for manned aircraft.

Standoff weapons such as air-to-surface (cruise), surface-to-surface, short- or intermediate-range ballistic missiles might be used in lieu of manned aircraft or RPV for air base attack. Various types of rockets, artillery, and mortars also would be effective, particularly against unsheltered aircraft or unhardened air base facilities.[5]

Although this article is concerned primarily with the threat to air bases from conventional weapons, it must be noted that a tactical nuclear threat also has existed for some time and continues to be considered credible. The Soviets might risk employing tactical nuclear warheads in a limited, "surgical" application, particularly against counterforce targets such as runways, if they felt that (1) this was the best way to achieve their objectives and that (2) NATO might match this escalatory step but would go no further toward general nuclear war.[6]

Together these factors serve to make the future TACAIR ground survivability problem in NATO increasingly more severe than when it first was addressed ten years ago in the TAB VEE study.

future problems of air base survivability

Fundamentally, an air base has become a vulnerable array of separate but interdependent targets. The capabilities of modern offensive air power threaten all three interdependent elements of an air base: (1) the aircraft; (2) the runway; and (3) the mission-essential resources, such as the logistical support and services infrastructure composed of personnel, facilities, equipment, and supplies. These elements are separate but mutually dependent—like the links of a chain. First, the aircraft must be survivable while on the ground. Second, the aircraft must be able to get airborne to perform their mission during or after attack. To do this, TACAIR must be able to use its runways or become independent of them. Third, the logistics infrastructure must survive to sustain future air operations. TACAIR will be only as strong as the weakest of the three links.

In the future, each one of these elements or links will become more difficult to protect so long as air bases continue to be relatively confined and in close proximity to conspicuous runways. The presence of a runway alerts the enemy that aircraft can be expected to base in that vicinity and serves as a readily identifiable focal point for his reconnaissance, surveillance, intelligence gathering, and subsequent targeting efforts. A determined and resourceful enemy could pinpoint the locations of individual shelters and support facilities around such a landmark. New sensors, platforms, and methods for detecting and attacking targets at night and in adverse weather will continue to evolve.

It should be expected that, as aircraft and the logistical infrastructure continue to be more effectively concealed and hardened, runways will become much more attractive targets. As this happens, surely new munitions will evolve that can cause damage very difficult to repair. Furthermore, as the Israelis showed in 1967, repairs can be prevented or greatly hampered by the use of antipersonnel munitions equipped with devices that allow randomly timed, delayed detonation. This

ordnance is small and can be dispensed at intervals to blanket an airstrip.

Of course, assuming that repair resources were still intact and the work was not effectively hampered by continual enemy harassment tactics (or residual nuclear radioactivity), airfield out-of-commission time from runway damage can be fairly short. Even so, a runway out of commission for only a limited period, if at a crucial time, could be catastrophic in a short war—as shown by the repeatedly successful Israeli tactics against the Arabs. Studies show that disrupting an opponent's sortie rate, even without destroying aircraft (which could be destroyed at leisure if the runway were unusable), can greatly influence the outcome of an air operation. This is because such actions effectively alter the power balance of the opposing air assets.[7]

alternatives for ground survivability

It is beyond the scope of this article to address the active defense measures that might be taken to enhance TACAIR ground survivability. Any active system for defending air bases against *all* air threats must integrate capabilities to cope with surface-to-surface, cruise, or ballistic missiles, as well as with manned aircraft and drone/RPV, perhaps employing standoff PGM. Of the many active means for defending against a powerful, aggressive air attack, each has limitations, and it is not apparent that any one or combination is completely reliable or feasible. Some enemy weapons will get through. Insofar as U.S. TACAIR is vulnerable on the ground and can be crippled by a relatively small air attack employing advanced weaponry, additional survivability measures must be taken beyond active air defense.

There are many ways that passive means can be used to enhance the survivability of parked aircraft and their ancillary facilities as the capability of the weapons used against them increases.

One course of action would be to continue sheltering aircraft and further hardening the logistics infrastructure. (Runways are already hard, and it would be difficult to increase their hardness significantly.) This alternative will provide only short-term respites until succeeding advances in weapons technology can again make aircraft shelters vulnerable and overcome the hardening of base facilities. Eventually, a point will be reached where it becomes too costly to pursue further this single alternative.

Another passive measure is to introduce concealment and mobility on an air base. Aircraft can be concealed or moved to different areas on the base. Facilities and storage areas can be camouflaged. (Again, runways would not be amenable to this alternative.) However, studies indicate that it may be a worthwhile tactic to attack occupied airfields, even if bombs have to be dropped by use of random area techniques. Should shelters be concealed or proliferated, it probably still would be worthwhile to attack them because the attacker knows the shelters are concentrated in a relatively small area and many or all can be found (if necessary) and destroyed with shelter-bursting munitions.

Proliferation of major air bases could increase the effectiveness of active area defenses and could complicate the Pact's targeting problems by allowing aircraft to be employed from a larger number of operating sites located throughout the defended area. This would make it more difficult and costly for enemy air to penetrate and effectively conduct air base attacks. Also, if more bases are available than are needed at any one time, vacant ones would serve as decoys to confuse and dilute the enemy's offensive efforts. A

major obstacle to proliferating air bases in West Europe lies in the difficulty of acquiring adequate real estate to meet the requirements. Even if most of the base facilities were put underground (to enable use of the surface in other ways), the land requirements for runways and taxiways would be prohibitive in many areas. Also, to man and maintain a large number of bases suitable for the present force would be more costly than current basing concepts. Where construction of new runways and facilities is necessary, it would be still more expensive.

By acquisition of more aircraft capable of short takeoff and landing (STOL), the runway construction and maintenance portion of the cost for airfield proliferation could be reduced somewhat. If these STOL aircraft could operate from sod strips, runway costs would be still less, and more potential sites would be available for basing TACAIR. The Soviets employ this technique extensively. But, while the amount of land required for STOL runways is less than that required for conventional operations, acquisition of real estate in West Europe for new STOL airfields would remain a major problem. Furthermore, although a sod strip is less conspicuous than a runway, so long as aircraft must be parked in that vicinity and a logistics infrastructure clustered nearby, the base would provide a lucrative, relatively vulnerable target.

Many of the real estate costs and political obstacles to proliferating main bases could be circumvented through the acquisition of "zero launch and recovery" TACAIR forces. One way to do this would be by modifying the present force. However, zero launch techniques, such as catapults and auxiliary propulsion units, were tested on conventional takeoff and landing (CTOL) aircraft in the early 1950s and rejected as not feasible. Even had the tests been successful, such a system would not have been fully beneficial because there was no provision for zero recovery. A comprehensive technological assessment and cost analysis would be needed to determine the feasibility of "adding on" a zero launch and recovery capability to present and oncoming CTOL aircraft. On the surface it appears complex and costly to modify manned aircraft for this purpose.

Another way—one that may have more merit—is to acquire vertical or short takeoff and landing (V/STOL) aircraft, which have an *integral* zero takeoff and recovery capability. The Air Force has considered V/STOL for many years but for several reasons has never opted to acquire such an operational capability. Historically, a major drawback to V/STOL systems has been that they were expensive to develop, fly, and maintain. This is still true, but now there are ways in which the impact of the cost barriers to V/STOL exploitation could be mitigated. Another factor that reduced V/STOL utility and desirability was the severe constraint on its fuel and payload capacity imposed by the gross weight limitations for vertical operations. The advent of precision guided munitions helps alleviate the small payload factor because PGM are relatively small and light, and not as many are required to equal the lethality of comparable unguided bombs against a wide range of targets. As the standoff capability of PGM increases, there will be opportunity for even more range/endurance/payload trade-off.

However, a capability to land and take off vertically would not be a panacea in itself. Even if no runways existed to serve as landmarks and targets, main bases would continue to be lucrative, relatively vulnerable targets as long as their complement of aircraft and other mission-essen-

tial resources were clustered in a rather confined area.

A survey of the potential for hardening, concealment, mobility, and proliferation reveals that, under current basing concepts, no single passive defense alternative appears particularly promising. Nor do any of the alternatives seem promising in combination, for neither hardening, concealment, nor mobility appears to have great utility so long as aircraft and facilities must be located at only a few main bases and in the near vicinity of a runway. Thus, proliferation of major bases, even without runways, does not provide a totally acceptable solution.

A more innovative and comprehensive approach to the problem of TACAIR ground survivability appears to be necessary. If TACAIR could operate independent of centralized major bases and runways and if aircraft and logistics infrastructure could be dispersed much more than is now possible, those passive measures already outlined could become mutually reinforcing. Dispersal of TACAIR resources into numerous small, inconspicuous targets can strengthen all links of the chain more than any other passive technique. Mobility, concealment, proliferation, and hardening would all become more effective when combined with dispersal techniques. At the same time, dispersal tends to increase the overall effectiveness of the active defense system against attack by manned aircraft. Furthermore, it is equally good for both conventional and nuclear survivability.

A big question to be answered is how to provide major maintenance and repair and other logistical support to numerous widely dispersed operating sites. A lack of innovative logistics concepts has been the undoing of several previous proposals for V/STOL systems and TACAIR dispersal. New basing concepts are needed to suggest both feasible and substantial improvements, and it would seem that such concepts should focus on the pivotal liabilities imposed on dispersability by dependence on runways. As these liabilities are lessened or eliminated, new ground survivability avenues can open up. New concepts, therefore, should be oriented toward wider dispersal after becoming independent of runways. The complete independence from runways provided by V/STOL systems offers the ultimate potential for airfield dispersal and—when combined with other active and passive defense measures—for survival.

Even without V/STOL, the application of innovative basing and logistics concepts should allow a gradual shift in emphasis from hardening toward dispersal to enhance TACAIR survivability. This also could make TACAIR more mobile and responsive and further add to its flexibility.[8]

USAF future directions

In general, it appears that the Air Force would be well advised to commence new directions for TACAIR ground survivability in a combat theater. The following Air Force actions and future directions appear appropriate for the short term (next five years), mid term (subsequent five years), and long term (10–15 years after the mid 1980s).

Short-Term Directions:

- Begin spreading out the logistics infrastructure on existing bases, employing optimum hardening and concealment.
- Continue the aircraft sheltering and concealment program, with emphasis on greater individual separation where possible.
- Place greater emphasis on emer-

gency operating capability to cope with runway damage or destruction of portions of the logistics infrastructure.

- Initiate more intensive advanced research and development for TACAIR v/STOL capabilities.
- Begin developing advanced basing and logistics concepts and capabilities for highly dispersed operations.

Mid-Term Directions:

- Begin de-emphasis of further shelter construction at main operating bases.
- Where feasible, implement permanent or emergency dispersal plans to operate TACAIR from more air bases, emphasizing overall mobility and relocation capability as well as survivability.
- Employ airfields with unprepared runways or STOL-only runways where this will add to dispersal without excess operational or resource cost.
- Continue developing concepts, procedures, and hardware for dispersal, concealment, hardening, and mobility of TACAIR operating locations and logistics. Emphasize v/STOL developments.

Long-Term Directions:

- Continue efforts to achieve greater dispersal, concealment, hardening, and overall mobility of TACAIR resources in-theater.
- Where feasible, implement v/STOL operations employing a highly dispersed and flexible structure of operating locations without runways.

Of course, passive measures should be combined with active counterair techniques such as air base attack and air-to-air and surface-to-air intercept. Future passive measures should ensure that the air base's essential elements all have roughly equal survivability, without any weak links.

Air War College

Notes

1. Over the years, this program has been referred to as the Theater Air Base Vulnerability Program (TAB VEE), SACEUR's Airfield Physical Protection Program, NATO Airfield Survivability Measures (ASM), and the Aircraft Shelter Program. Current Air Staff actions dealing with this program use the standardized title "Improved Airfield Survivability Measures." Although hardened aircraft shelters for tactical fighters represent a large portion of the Air Force program, many other active and passive airfield survivability measures are included, such as dispersal, hardened operational facilities, point air defense, airfield security, and reduced vulnerability of strategic airlift. (Source: Input from DCS/Plans & Operations to the *Daily Staff Digest, Headquarters USAF*, No. 58, Monday, 25 March 1974, p. 2.)

2. Report of Secretary of Defense James R. Schlesinger to the Congress on the FY 1975 Defense Budget and FY 1975–1979 Defense Program, 4 March 1974, pp. 87, 88.

3. "The Military Balance 1974/75," A Publication of The International Institute for Strategic Studies," London. *Air Force Magazine*, December 1974, pp. 41–104. Also see FY 1975 *Annual Defense Report*, p. 143.

4. Robert R. Rodwell, "Three Hours—and Six Days," *Air Force Magazine*, October 1967, p. 58.

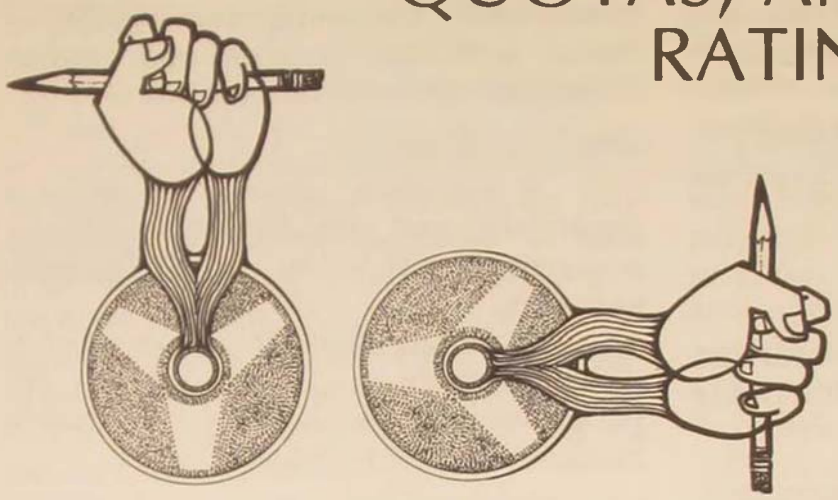
5. Air base defense against sabotage or enemy ground forces, as shown by experiences in Vietnam, continues to be important. This problem is separate from that of defending against attack by air weapons and, although beyond the scope of this article, must be considered in the total context of the ground survivability problem. Some of the alternatives discussed herein for enhancing survivability against air attack also may offer a measure of protection against the ground threat.

6. John M. Collins, *Defense Trends in the United States 1952–1973*, Congressional Research Service Study 74-103SS, Library of Congress, May 14, 1974, pp. 24, 25.

7. William B. Ammon, Jr., Study Director, *Barbarossa II*, Orlando Division, Martin Marietta Aerospace Corporation, Orlando, Florida.

8. To provide these TACAIR characteristics, it would appear that in the combat theater tactical combat aircraft must be stationed reasonably proximate in distance and time to the areas in which they will operate. For this reason, the ground survivability alternative of stationing all TACAIR combat resources far to the rear of the expected areas of operations (e.g., in the United Kingdom or possibly even in the CONUS for NATO operations) was not discussed. It is true that this alternative might permit the U.S. to exploit its superiority in aircraft range, in-flight refueling techniques, and standoff technology so as to attain great range and mobility from bases outside the combat zone. However, such a concept would have major disadvantages. For example, assuming that Pact aircraft or missiles possess or could possess equivalent ranges in-theater, any TACAIR stationed in the U.K. would continue to suffer the same survivability problems described under trends for the future. Basing procedures would tend to be more centralized and rigid, thereby reducing basing mobility and flexibility and making it more difficult for TACAIR to deploy to and provide a continual presence in distant overseas areas. Except when aircraft actually are patrolling over a given area, TACAIR's responsiveness would be severely curtailed. The concept may warrant further study, but essentially it is alien to this article's basic subject—ground survivability of TACAIR stationed in-theater.

OER INFLATION, QUOTAS, AND RATING-THE-RATER



LIEUTENANT COLONEL WALTER T. BROWN, JR.

THE implementation of the new Air Force Officer Effectiveness Report (OER) system has stimulated renewed interest in the problem of personnel evaluation systems. This article discusses a little-publicized but possible method for enhancing personnel evaluations. This capability would also provide two new options for eliminating OER inflation as well as additional management tools for senior managers. The new methodology resulted from a recent research project at the Air Force Academy. Ten years of Air Force OER data (2.2 million OER's written between 1960 and 1969) were used in demonstrating its feasibility. The capability can be extended to officer and enlisted personnel of all services, to the Civil Service, and to industry.

A quantity called a "Tag" has been devised that quite accurately describes an officer's OER history. It has been computed for almost 200,000 past and present Air Force officers.* A new term, "rating-the-rater," is also coming into use. It refers to a computer capability for tracking each rater and adjusting for his inflationary tendencies. Each officer's Tag incorporates, among other things, a correction for the inflationary tendencies of each of his raters. Later the discussion will show how the rating-the-rater concept can eliminate OER inflation without resorting to the quotas of the new OER system. These terms, "Tag" and "rating-the-rater,"** will now be described along with some of their possible uses.

What is the Tag?

Officers must be evaluated. However, any-

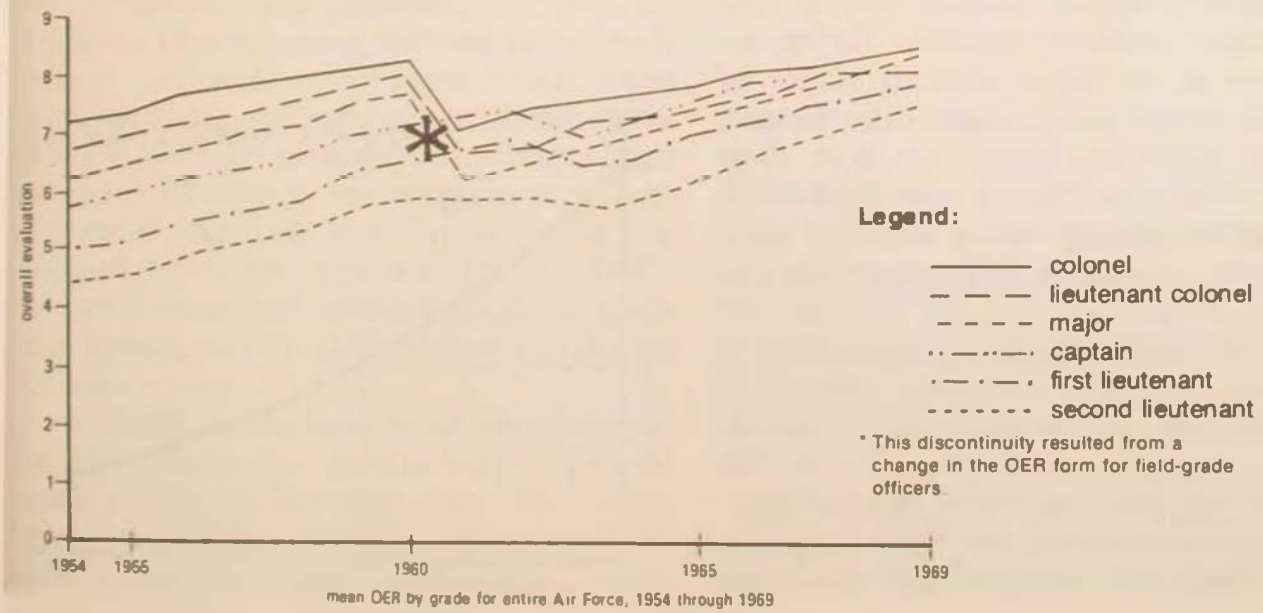
* The Tag is a numerical measure of each officer's past performance. It is not in any way connected with an officer's promotion file or any other file on an officer. The 200,000 Tags that have been produced for the 1960–1969 data base are used only for research purposes.

** The term "rating-the-rater" was first mentioned to the author by Lieutenant General Marshall S. Carter, USA (Retired), in a private conversation. He firmly believed that "OER inflation will never be licked until the rater is rated."

one evaluating OER's knows that they contain many possibilities for error. Several of the most significant errors will be identified in this article, along with an explanation of how they can be corrected. As the reader may have guessed, these errors are primarily a result of the OER inflation in past years. It will soon be apparent that the errors in old OER's are so serious that they can no longer be ignored. But to eliminate them requires such a tremendous number of computations and such a vast amount of comparative data that a computer must be employed. Once the computer has stripped out these errors, a quantity (or number) remains that presents a very good relative picture of an officer's OER history. This quantity is called a "Tag."

Let us begin with a brief overview of some of the considerations that should be weighed in evaluating an OER file. The evaluator, of course, should recognize that some raters are tougher than others. Ideally, all easy and tough raters should be identified, along with the degree to which they are easy or tough. One should also consider the year an OER was written, since there has been an upward trend in ratings over the past two decades. The grade of the ratee is also important because typically the more senior officer receives higher ratings. (See Figure 1.) The period of supervision on each OER deserves special attention, since some ratees are frequently and intentionally shifted from one rater to another to build up a large number of "max" ratings on the top of their file. We must be careful not to overemphasize (or weight) the older evaluations at the bottom of the file; attitudes and performance frequently change with time. However, inflation has pushed more recent OER's up against the ceiling, and consequently newer OER's may provide less differentiation and therefore deserve less weight than one might expect. Finally, an ideal measure of an officer's OER history should consider the ratee's command. It is well known throughout the Air Force that at certain times some commands established an unwritten policy

Figure 1. Inflation trends by grade and year



mean OER by grade for entire Air Force, 1954 through 1969

of inflating their ratings. Therefore, an adjustment should be made for the inflationary biases of a command at the time a rating was given. These frequently overlooked difficulties are directly addressed and corrected by the Tag concept. Let's now look more specifically at how this is done.

How is the Tag constructed?

As one can see, an accurate assessment of a rating requires a broad perspective. Consider now what is required to interpret properly an overall evaluation of 8 of a maximum possible of 9 points. Figure 1 shows that such a rating in 1967 would have been above average for lieutenants, captains, and majors. However, it would have been slightly below average for lieutenant colonels and colonels. Knowing only this, we would have to conclude that any captain, for example, who received this rating in 1967 was above average. But to determine just how far above average would require some measure of the extent to which the ratings for captains varied in that year. It is unreasonable to expect the evaluator of an officer's promotion file to do the required arithmetic, but with the aid of a computer it is easy.

Consider another problem facing an evaluater as he flips through stacks of OER's. In recent years, many officers have received maximum ratings on both their overall evaluation, 9, and their promotion potential, 4. Distinguishing between these 9s and 4s is difficult. The most obvious way to break the ties is to *score* all quantitative information on both sides of the form: overall evaluation, promotion potential, and the ten or so rating factors on the front of the form. To do this properly requires not only time and patience but also consistency. This is again a task in which the computer can be a valuable aid.

Another problem an evaluator must resolve is the significance (or weight) that should be assigned to each OER. Certainly a report covering a 360-day period of supervision should be given greater weight than one covering only 90 days. With a little thought one can see that each OER should be weighted in proportion to the length of the period of supervision.

The next question about weighting concerns the weights that old OER's should have relative to the most recent OER. The author's study of the problem has shown that, other things being equal, the older a rating is, the less weight it should receive. In other words, the weight might be represented by a ski-slope type of curve similar to the one shown in Figure 2. The difficulty arises in deciding which one of the thousands of curves of that general shape should be used. Here is how the "best" curve was selected.

An officer was picked at random, and the front and back of all the OER's he received were scored (with appropriate adjustments for inflation trends shown in Figure 1). His most recent OER score was covered, and no one was allowed to look at it. Then a weighted average of all his other OER's was calculated, based on the

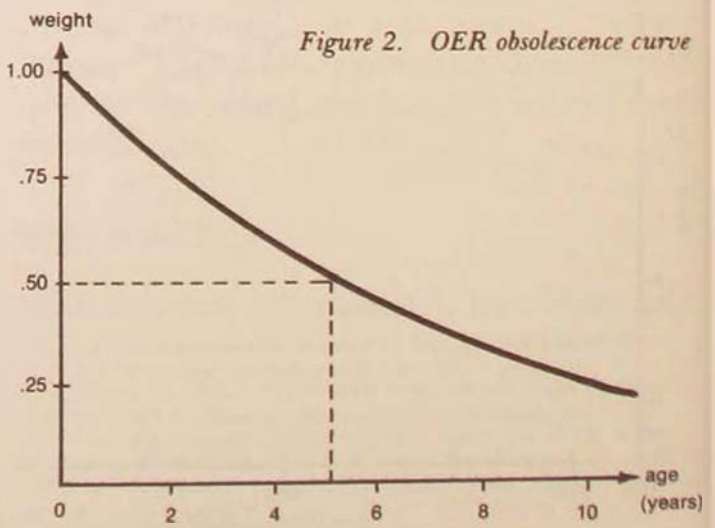


Figure 2. OER obsolescence curve

first of thousands of possible weighting curves. This process was repeated for each of the other weighting curves. The question was then asked, How much did each weighted average deviate from the most recent score—the one that was covered up? The magnitude of these misses was calculated, each miss being associated with the particular curve involved. The whole process was repeated by selecting another officer and scoring all of his OER's. Again, the amount by which each curve's weighted average missed "predicting" the most recent OER was calculated. These results were added to the previous misses. After looking at tens of thousands of officers, one curve was found that had fewer total miss points than all others. This curve is the one shown in Figure 2. As the dashed lines indicate, an OER loses about half its predicting value every five years.

A final problem confronting the evaluator of an OER file is to adjust for two types of inflationary bias—rater bias and command bias. To begin, we need to rate-the-rater. Is the rater, relatively speaking, easy or hard, and to what degree? We cannot simply assume that a rater who gave high ratings is inflationary. Perhaps he had better ratees. This possibility can only be resolved by examining the OER file of each officer he rated, to see how others rated him, and this will prompt a similar question: Were each of these other raters hard or easy? Obviously, the problem of rating-the-rater expands rapidly. It turns out that all raters and ratees in the Air Force must be examined simultaneously to assess the inflationary or deflationary tendencies of each rater.

A similar technique must also be used to determine the inflationary biases of each command for each year. For example, SAC-1964 and TAC-1968 (and all other command-year combinations) would be analogous to raters. By comparing how these "raters" evaluated the same officers, one can compensate for each command's bias in past years.*

To summarize, all [X]s on the front and back of every Air Force OER are scored. The score for each OER is then compared (normalized) with all other ratings given in that same year to officers of the same grade. Next, the inflationary tendencies of each rater and each command-year are determined, and adjustments are made in each OER's normalized score. These adjusted scores are finally weighted in proportion to their period of supervision and the measure of each OER's currency as shown in Figure 2. The weighted average of each officer's adjusted OER's is his Tag.

The job of rating-the-rater and rating-the-command is quite large and exceeds the capability of most first- and second-generation computers.** Fortunately, the necessary OER data have been kept on computer tape by the Human Resources Laboratory since 1960. With these data and the Air Force Academy's third-generation Burroughs 6700 computer, the job (including the other corrections needed to produce the book of 200,000 Tags) required only several hours of computer time.***

How accurate is the Tag?

The reader has probably thought of ways in which an incorrect Tag might be

* Although the Tags currently do not reflect the command-year inflationary bias, future calculations could easily incorporate this adjustment.

**For the benefit of the reader who recalls his first course in high school algebra, this task is roughly equivalent to solving 300,000 simultaneous linear equations. An industrious high school student with a well-sharpened pencil would require over a billion billion years to solve such a problem. Probably he would make a mistake before the first day was over.

***I wish to acknowledge the invaluable assistance of Lieutenant Colonel Douglas Johnson during the final programming phase of this project. The initial program for solving this problem would have required 10,000 hours of computer time. Reprogramming efforts eventually reduced the time to 20 hours, after which Colonel Johnson was able to reduce it further to 2–3 hours.

produced. The most obvious of these is rater inconsistency. It is possible for a rater to change from an inflationary to a deflationary tendency, or vice versa. If that should happen, the computer would classify the rater as being somewhere between the two extremes. Unless the fluctuations from one extreme to the other are considerable, the error caused by such a change should be small. Unfortunately, this sort of inconsistency produces errors in most rating systems.

A second area of concern, and one in which individuals will probably differ, is the scoring weights to be assigned to the various blocks on the OER form. Admittedly, changing the weights will produce a different Tag. However, a sensitivity study I conducted showed that reasonable but differing weighting schemes had only a minor effect on groupings of Tags. Since individuals disagree on the desired weights for the different blocks on the OER form, a decision must ultimately be made at the Air Force policy-making level. In short, the different blocks on the OER form can be weighted to reflect the significance that the Air Force wishes them to reflect.

A frequent question concerning the Tags is, "How well do they predict the results of promotion boards?" This question, however, reflects two possible misconceptions that require comment:

(1) *The Tag is not intended to be a promotion-predicting device.* Nor is it proposed that the Tag be given to promotion boards. The Tag, which contains adjustment for certain systematic errors, is only a relative measure of an officer's OER history. Its uses will be discussed shortly.

(2) *Promotions are not based strictly upon OER's.* A promotion board must consider many other factors, such as the needs of the service, breadth of military experience, educational background, and skills. In addition, subjective judgments will always be required in making promotion decisions. Nevertheless, past promotion board results are one means of validating the Tag concept. Keeping this in mind, let us look at the relationships between the Tags (past performance) and promotability.

The Tags that have been calculated were current as of 1 July 1969 and therefore were used (after the fact) to "predict" the subsequent year's O-4 through O-7 promotion board results. It was found that by using only the Tag (and ignoring job categories, education, combat experience, etc.) over 85 percent of all promotions and passovers would have been correctly "predicted." While such a high "batting average" does not necessarily confirm the accuracy of the Tags, it does support the reasonableness of the Tag concept.

potential use of the Tags

Initially the Tags of Air Force officers were calculated so that the Air Force Military Personnel Center could determine how abilities were distributed among the different commands. The results were displayed by command for all grades in each of ten years. Significant differences between commands were noted. The first possible use therefore is as a feedback device for the assignment people. It would provide a comparison of the current assignment policy with the actual distribution of officer abilities throughout the Air Force. In this way subsequent assignments could bring the distribution more nearly in line with policy.

The second potential use, related to the first, is to give senior Air Force commanders (including the Air Force Chief of Staff) improved visibility of how abilities are distributed within their respective organizations. Some commanders would un-

doubtedly find that their headquarters had absorbed too much of the organization's talent. Other commanders would find certain subordinate units relatively low in officer quality—low enough that excessive passovers and loss of morale and effectiveness could be expected unless personnel changes occurred. With this tool, some important personnel problems could be anticipated and circumvented.

Cost-effectiveness studies involving personnel offer another fruitful area for using Tags. As many realize, often the most difficult part of a cost-effectiveness study is determining a meaningful measure of effectiveness. This is especially difficult when the study concerns military personnel. The Tag is in many cases an appropriate measure—a measure of officer performance.

For example, a recent study examined the job performance of officers from various commissioning sources—ROTC, Air Force Academy, and Officer Training School—in each of three skill areas—pilot, navigator, and nonrated. The effectiveness data, together with the "procurement" costs for an officer of a given skill from each commissioning source, will be of value to certain decision-makers. Other studies could address the cost effectiveness of various professional military education programs and military-sponsored civilian education (both in the humanities and the sciences). The Tags can also be of value in establishing appropriate criteria for selections to various training and education programs.

A fourth possible use of the Tags is related to the new OER system. Under the new system no reviewer may exceed the quota of 22 percent top ratings, 28 percent middle ratings, and 50 percent bottom ratings, regardless of the quality of the officers being rated. In view of the unequal distribution of abilities as indicated by the distribution of Tags among the various commands, this quota system produces inequities. Furthermore, most officers tend to believe that their organization has above-average officers, and consequently they feel that the new system discriminates against them. This problem could be overcome by using the Tags to *tailor* a quota to fit the group of officers currently being rated under each reviewer. An organization having officers with above-average performance records would then be given a better-than-average quota.

As an example, consider a rating cycle in which a reviewer of ten majors on the Air Staff is given the *standard quota* of two top, three middle, and five bottom ratings. Had a *tailored quota* been given in this hypothetical situation, it might have allowed five top, three middle, and two bottom ratings. Such a tailored quota system would make the rating system more equitable. Notice that the tailored quota does not dictate who should receive the top OER's. It would offer each person in the group being rated a chance to receive a top rating—the better his group's past record of performance, the more top ratings. Stated another way, a ratee would have the same chance of receiving any specific rating, regardless of whether he is competing with high- or low-quality officers.

For over a decade the academic grading system at the Air Force Academy has been based on this principle; courses having above-average students (based on college board tests or prior academic records) are allowed to give a higher proportion of top grades. As a result, problems associated with inflated academic grades, which are frequently found at other colleges and universities, have been practically eliminated at the Academy.

It is worth noting that none of these

uses involve *individual* Tags, only the *aggregating* of many Tags. Thus slight random errors that might exist in individual Tags tend to average out when aggregated. There is justifiable concern about basing any significant personnel decision on a single Tag. Therefore, access to the Tag should be restricted. It may be necessary to modify the computer program so that only aggregates are printed, never individual Tags.

One of the more controversial questions concerning uses of individual Tags is whether to show an officer his own Tag. Strong arguments exist on both sides of this issue. Those supporting such an action ask, Since every officer has access to his OER file, why not give him the best possible picture of his OER history? Another supporting argument is that each officer must make major career decisions, and he deserves the best possible information for making those decisions. Besides, the recently amended Freedom of Information Act and the Privacy Act of 1974 would probably authorize officers to see their Tags.

Those who oppose allowing an officer to see his Tag argue that a rater or reviewer might be influenced if the Tag of someone he was rating became known to him. Others feel that if individual Tags existed, they might "leak" to people such as assignment officers. The assignment officer, as a result of time pressure or a tendency to be overly influenced by a number, might base an assignment primarily on the Tag instead of the "whole man." Certainly indiscriminate use of and excessive confidence in *individual* Tags can be dangerous.*

* Another controversial area involves giving individual Tags to selection boards. Although this might smack of *Brave New World* to some, it would not be nearly as mechanistic as the Weighted Airman Promotion System (WAPS), which has been generally well received by Air Force enlisted personnel. The reader may want to consider the many pros and cons involved.

another role for rating-the-rater

Some readers may have observed that, by rating-the-rater, inflation could be brought under control without requiring a quota system. Each rater would have a personal stake in not inflating his ratings, since his inflationary bias would always be known and an adjustment of the rating would be made accordingly. Consider the rater who always gave maximum ratings to a typical cross section of officers. His ratings, if adjusted, would all become average ratings. Since the rater would thereby forfeit his opportunity to advance the better officers and retard the worst, there would be some motivation for raters to distinguish between them. If a rater did so, it would not matter which end of the rating scale he used, high or low.* The fear that most officers have of working for a hard rater would also be overcome, since such a rater's deflationary tendency could be identified and corrected automatically.

In 1968 the Army adopted a new OER form containing an innovation designed to stop inflation (see Figure 3). Raters and indorsers were to compare the ratee with all other "comparable" officers they were currently rating. In the example shown in Figure 3, the rater considered the officer the fifth best of the eight officers performing similar functions under him.

Unfortunately, this system eventually broke down because (1) raters frequently (or conveniently) concluded that no other officers were comparable and (2) machinery did not exist for policing the system. Eventually instructions were given to disregard this portion of the form. Rating-the-rater would overcome these problems. The computer, in effect, would fill out this portion of the form, and lapses of memory (or cheating) could not occur.

* Unusual rating patterns could be easily detected by the computer, and, where appropriate, corrective counseling of the rater could be initiated.

PART XII - OVER-ALL VALUE TO THE SERVICE *(Read paragraph 4-3j, AR 623-105)*

a. OFFICERS OF THIS GRADE PERFORMING SIMILAR FUNCTIONS I CURRENTLY RATE OR INDORSE		TOTAL	PLACEMENT OF OFFICERS *(Enter * in appropriate group)*					RANKING WITHIN OVER-ALL GROUP
			BOTTOM 5TH	FOURTH	MIDDLE	SECOND	TOP	
	RATER	8	0	1	2	2*	3	5
	INDORSER	19	1	2	9*	3	4	11

Figure 3. Army OER form, 1968

Furthermore, if a rater had better-than-average officers, the rating-the-rater system would automatically take that into consideration. The Army system did not.

quota vs. rating-the-rater

The two methods for controlling inflation, rating-the-rater and quota systems (either a standard quota as in the new OER system or a tailored quota) can be compared in several ways. Both pose their own unique set of problems, yet both avoid the far greater problems associated with inflation.

Quotas. The primary requirement of quota systems is that many officers must be rated simultaneously. This "pooling" of a large number of ratees is required to insure (1) that at least one officer in each pool has an opportunity to receive a top rating and (2) that the distribution of abilities being rated will have a greater chance, statistically speaking, of matching the distribution of ratings allowed by the quota. Therefore, to achieve the necessary pool size requires (1) that reviewers (as opposed to raters or additional raters) give the rating that is controlled* by the quota and (2) that the controlled rating for all officers in a given grade be given at the same time each year. In other words, there must be rating cycles. Let's now look at the consequences of these two corollary requirements.

The costs of having reviewers give the controlled ratings are high. Reviewers, who are typically colonels and generals, must be involved in the time-consuming process of making these hard decisions. One estimate is that about ten reviewer man-years will be spent each year in policing this system. Even others must become involved at the reviewer and command level. Since reviewers often have little firsthand knowledge of the ratees, advisory boards are frequently established to recommend specific ratings. In other cases meetings are held among intermediate supervisors to determine who will receive the high and low ratings. Some commands, through internal restructuring of jobs, have even established administrative positions for the purpose of maintaining statistics for the new OER system.

Some ratees feel that several inequities exist, not the least of which is that their organization deserves a higher quota. Reviewers are sometimes geographically separated from some of their ratees while their other ratees work directly for them in the headquarters. In other instances, the reviewer, who may not know the ratee by sight, must frequently overrule the rater's opinion in order to meet his quota. Consequently, ratees become concerned, and the rater sees his supervisory position being somewhat weakened.

Rating cycles, the second corollary requirement of quota systems, produce high peak workloads and other administrative problems. Officers who have worked up

* Quite obviously the controlled rating will carry greater significance in the eyes of promotion boards simply because it must fit the quota and cannot be inflated.

to eight months under their rater can avoid a controlled rating for this time period if their rating official is changed four months or more before their annual rating. Other officers who must depart their organization within four months of their annual rating often feel that their interests suffer, since they are not present while the hard rating decisions are being made. These perceived inequities are the price one must pay to achieve the large "pool" of ratees that quota systems require.

Rating-the-Rater. Now let's look more closely at how rating-the-rater can work as a control system and the problems associated with it. There are several means for achieving this control. The most obvious is that inflators, including commands, raters, and intermediate organizations, can be identified with a high degree of confidence. (The reader will recall from the discussions involving the Tag that the calculation of a rater's inflationary tendency compensates for the average quality of the officers under the rater.) This awareness would provide the top leadership in the Air Force with information which, if acted upon in any of several ways, could assist in licking inflation. Another means of control would be to place in each promotion file a summary sheet of the rating histories of each officer's raters since the control system began. There could be an accurate and up-to-date entry, similiar to that shown in Figure 3, for each OER in the file.* Additionally, there could be an index describing the aggregate quality of the officers under each rater or even a score for each OER that contained an adjustment for OER bias. In this way differences in quality throughout the Air Force could be recognized.

Rating-the-rater as a control system has its problems, too. Obviously the job could not be done without a computer. But computers, in general, are not trusted by the officer force. Many months of testing would be required in order to assure promotion boards that the rating histories of raters and the aggregate quality of those whom they have rated were accurate. There would also have to be a significant effort to educate the officer force as to what mechanisms were at work to insure that they were being treated fairly. Finally, several technicians would be needed to maintain the computer software and distribute the computer outputs.

Both quotas and rating-the-rater will control inflation. The latter technique would require a thorough explanation to the officer force and use of some computer-generated data in a highly sensitive and personal area—promotions. On the other hand, with rating-the-rater as the control to prevent inflation, the *rater* would give the controlled rating, and he would do so *whenever* a rating was appropriate. Quotas and rating cycles would be unnecessary. Inequities associated with standard quotas would disappear.

A NEW CAPABILITY has been developed. *Raters and commands can be tracked to determine their inflationary biases.* Past OER's can be adjusted for these biases and the inflationary creep of each officer grade. What remains after the adjusted OER's are properly weighted is a Tag describing an officer's OER history. Two hundred thousand such Tags have been produced for research purposes. Similar results could be developed for enlisted and civilian personnel.

Tags can be used in many studies where some quantitative measure of officer performance is required. Tags can also be aggregated to show senior com-

* Of course, the ratee should also receive a copy of this summary sheet.

manders how their officer quality is distributed. People, like money, are resources and must be wisely allocated by the commander to best achieve his mission.

By aggregating Tags at the reviewer level (tailoring quotas), we would create a rational and equitable basis for OER quotas.

On the other hand, rating-the-rater can provide the control to eliminate inflation. *A quota system would not then be needed.* Raters (as opposed to reviewers) would once again be allowed to determine ratings; expensive overhead costs associated with quota systems would be eliminated; and the inequities and administrative problems associated with rating cycles for each grade would be removed. Officers would not feel that the system works against them merely because they are in an outstanding organization.

Several years ago it could truly be said that the job of rating-the-rater was prohibitively large. Recent advances in computer technology now make it possible.

And so, to the other great computer conquests let us proceed to add that long-time vexation of the military: the Officer Effectiveness Report.

United States Air Force Academy

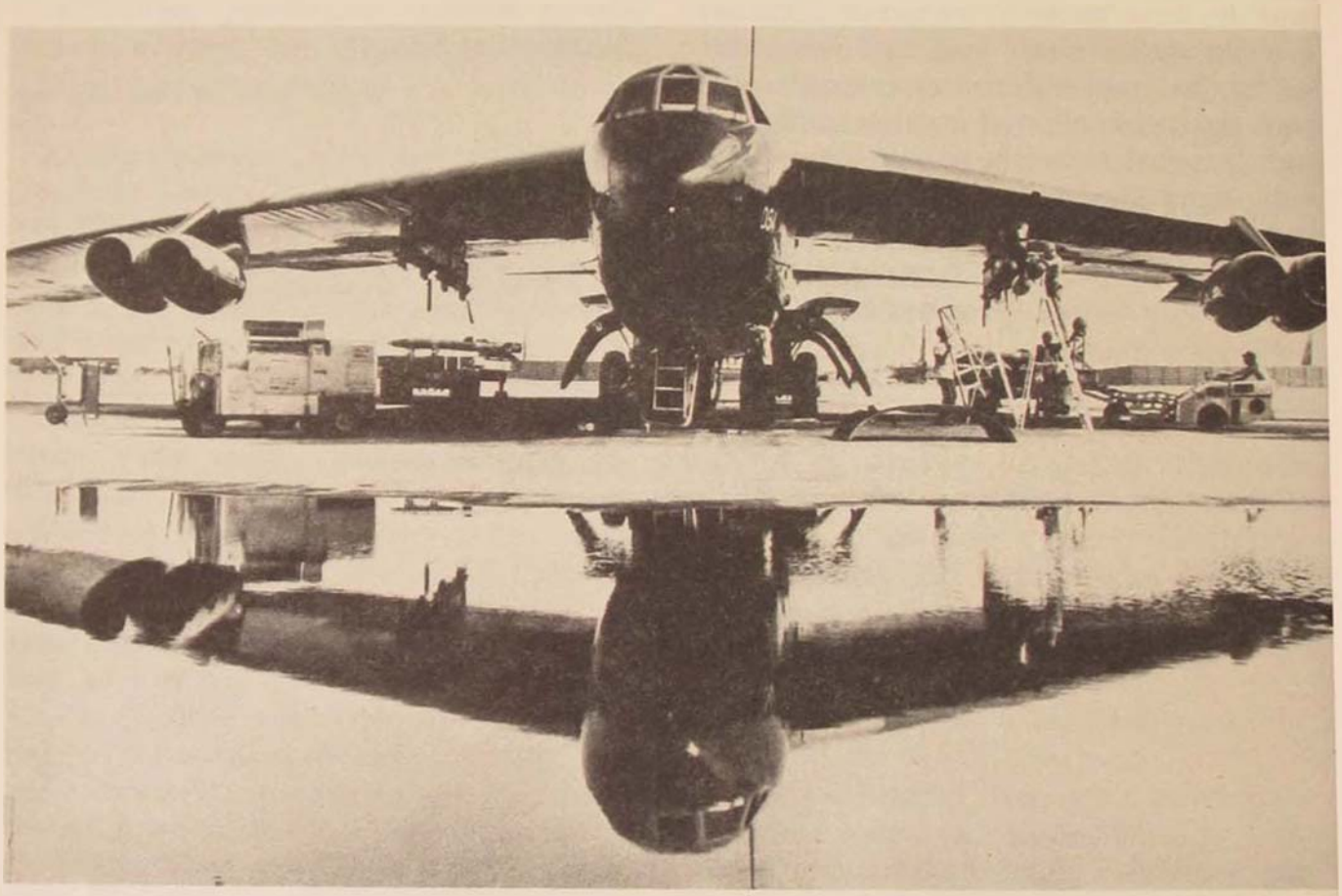
Editor's note:

Readers are invited to raise questions or comment on this article, either directly to Colonel Brown at the Department of Mathematical Sciences, United States Air Force Academy, Colorado, 80840 (AUTOVON: 259-4470), or to the Military Personnel Center, Randolph Air Force Base, Texas, 78148.

still going strong

the B-52 in its third decade

William G. Holder



SOMETHING was in the air! The mammoth flight ramp at Andersen Air Force Base, Guam, was abuzz with activity. Ground crews sweated over their giant Stratoforts, checking every nut and bolt. Bombs were loaded internally into the B-52s' massive bomb bays on preloaded bomb racks. It was December 1972, and the B-52 (affectionately called Buff for "*B*ig *U*gly *F*at *F*ellow") was going to face its toughest challenge ever: Linebacker II was on!

The flight crews heard the news three hours before takeoff on that first day. "Gentlemen, we are going to strike targets in the Hanoi-Haiphong area. . . ." Weather: "It's bad." Enemy defenses: "Tough." Order of battle:

"Max effort." The B-52s had for years conducted precision bombing over South Vietnam, basically unhindered, but this would be the first maximum effort "up north." The crews knew it would be tough going.

The B-52s pounded North Vietnam for eleven days, during which time more than a thousand surface-to-air missiles (SAM's) were launched against the fleet. Many times the missiles came up in salvos of two and four. And when the SAM's were through, the MIG's were waiting. For those bloody and heroic eleven days the skies over North Vietnam were alive with bursting SAM's, flashing rockets, and, sometimes, falling, burning airplanes, a goodly number of which were giant B-52 Stratoforts.

But the giant Stratoforts did the job! And with the termination of Linebacker II, the Southeast Asia (SEA) conflict ground to a stand-down. The B-52 had proven in Vietnam what the B-17 and B-29 had in World War II: that the devastation with conventional ordnance can be the winning hand for stopping hostilities. The giant B-52, with its 108 iron bombs, was indeed a devastating weapon.

B-52s take off from Andersen AFB, Guam, on 13-hour mission to North Vietnam and return, as part of Linebacker II operations during December 1972.

One of Linebacker's B-52s awaits installation of its drag chute before resuming its missions. . . . An RB-52B, the reconnaissance version of the Stratofortress, receives the flying boom of a KC-97 Boeing tanker for in-flight refueling, to extend its flying range.

But the bird was, in effect, playing a role for which she had never been cast. Conceived in the time of nuclear weapon infancy and the climate of the cold war, the B-52 had been envisioned as a high-altitude carrier of nuclear destruction. Its conversion to an iron-bomb hauler is but one of the many transitions this versatile aircraft has experienced during its long lifetime.

genealogy

The B-52's genealogical roots go deep. As early as 1945, the Army Air Corps discussed the possibilities and characteristics for new postwar bombers. By November of that year, definite characteristics for a high-speed, high-altitude, long-range bomber had been formulated. The requirements called for a plane capable of "carrying ten thousand pounds of bombs for 5,000 miles while operating at a speed of 300 mph at 35,000 feet."

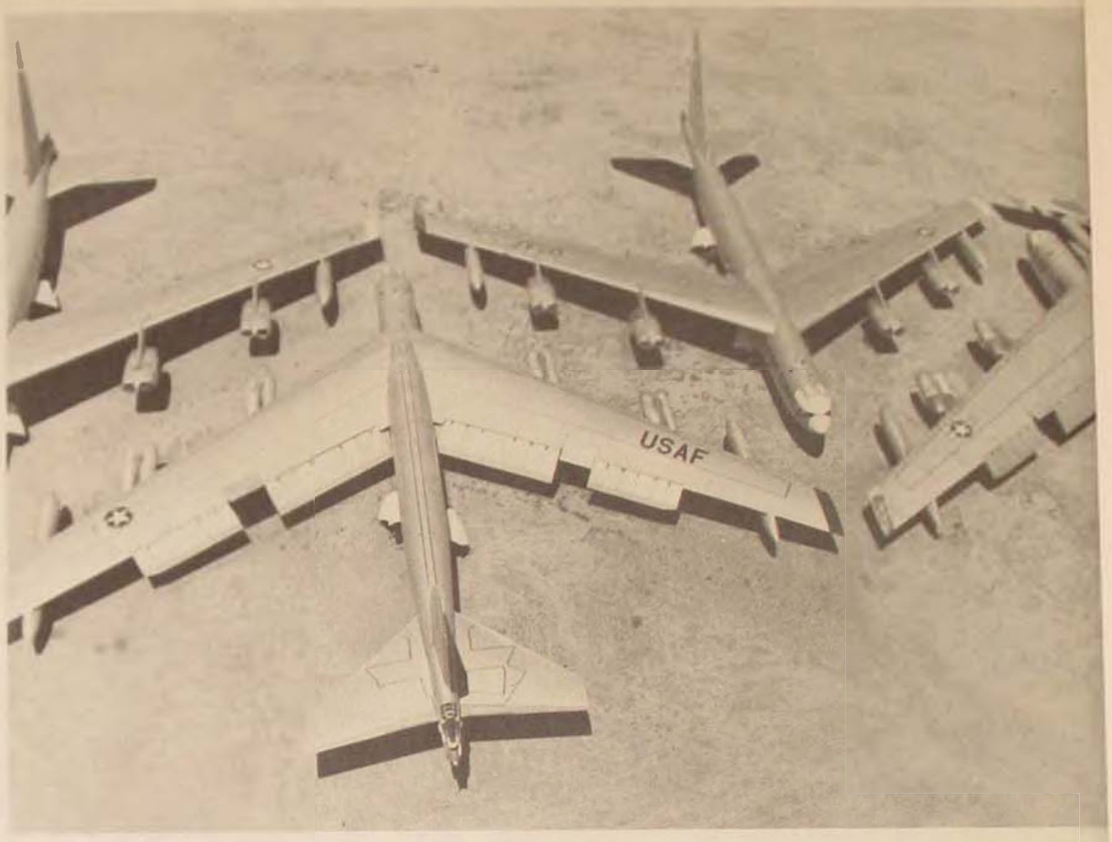
Boeing submitted a straight-wing design, Model 462, for a six-engined design weighing 360,000 pounds with a 3110-mile radius and a 410-mph cruising speed and bearing a marked similarity to the B-29. Then, during discussions of new medium bombers, Boeing presented Design Study 464, which outlined a four-engine aircraft with a gross weight of 230,000 pounds and a 400-mph cruising speed. In 1946 plans were formulated for a four-engine aircraft capable of carrying nuclear weapons, a 12,000-mile range, and a 400-mph cruising speed. With the technique of in-flight refueling being developed, the planners' attention then turned to an aircraft with greater speed capability. An improved model evolved from Boeing drawing boards as the Model 464-29 and featured a 20-degree sweep in the wings along with a more sharply tapered wing. Grossing out at about 400,000 pounds, Boeing engineers calculated a maximum speed of almost 450 mph. Several other turboprop models were considered, including the Model 464-35, which promised

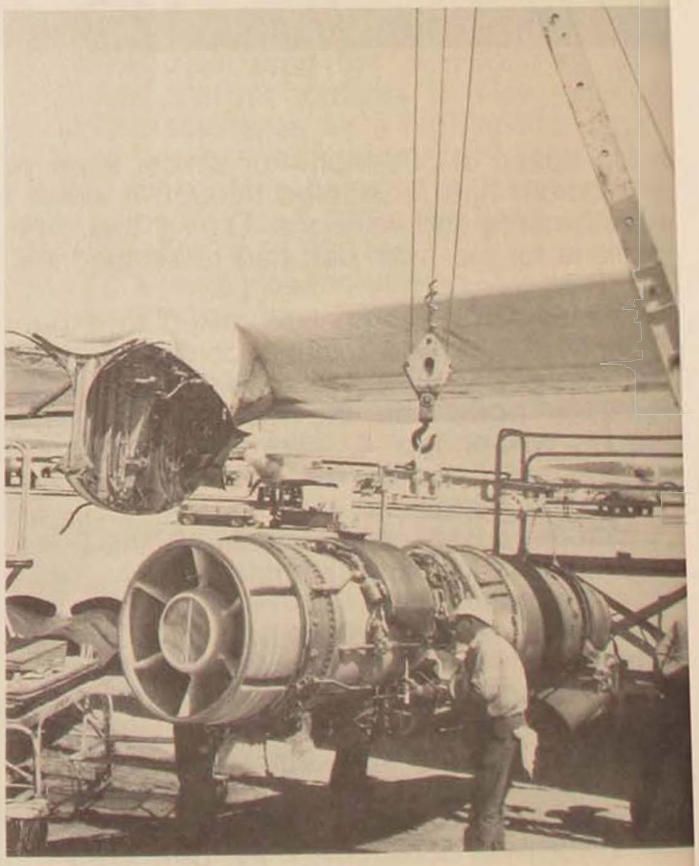
a top speed of 500 mph. For almost three years the XB-52 bomber had floundered through a series of changing requirements and revisions. During that time period, the airplane for the most part had resembled the B-17, B-29, and B-50 forerunners.

In May 1948 Boeing was asked to expand its performance studies and include configuration studies using pure jet power. So the 464-40 model was born, incorporating jet power with the Westinghouse J40 jet engines. Models 464-46 and -47 were further refinements of the -40 design, with consideration of using the new Pratt & Whitney J57 engine.

With the advent of Model 464-49, the Boeing engineers had come up with an aircraft that was finally starting to look like today's B-52. The new design incorporated eight J57 turbojets, possessed additional fuel capacity, and carried only one turret instead of the previous two. It didn't take the Air Force long to decide that this was indeed the aircraft it had been looking for. The XB-52 would be an eight-jet, swept-wing creation.

During the evolutionary process to the -49 model and the slightly refined Model 464-201, upon which the XB-52 prototype was constructed, the development faced major





Early models of the B-52 rest in retirement at Davis-Monthan AFB, Arizona. Wheels, engines, and guns are removed from aircraft stored at the Military Aircraft Storage and Disposition Center (MASDC) to support operational requirements worldwide. . . . A B-52 engine from MASDC is restored to operational readiness.

problems. It was time for the jet age, but the old prop-powered, straight-wing school still had deep roots, and many rejected the change.

The five or so years of B-52 definition had seen a tremendous evolutionary process take place. In fact, it could well be described as a transition from the straight-wing technology of World War II to the swept-wing jet era. Through the evolutionary process the gross weight remained nearly constant at about 400,000 pounds, but the speed capability increased from 382 knots (Model 462) to 490 knots on the final configuration.

The Air Force knew it really had something with its new super bomber, and a tight cloak of secrecy covered its development. The new aircraft was covered with concealing tarps much like those on new-model cars. Extensive modifications had to be made on the XB-52 before it was ready for flight, which did not occur till 2 October 1952. This delay allowed the second prototype, the so-called YB-52, to make the first flights.

models

For eleven years the B-52 production lines hummed. Some 742 Stratofortresses were produced, of which 275 were built at the Boeing-Seattle facility. But the bulk of the production program was produced at the giant Boeing-Wichita plant, including all the later models (a total of 467 B-52s). In all, some seven different major models evolved from the Boeing drawing boards.

The B-52A, of which three were constructed, maintained a basic similarity to the previous prototypes. The basic difference evolved from the addition of a four-foot longer nose contour and elimination of the B-47 type of bubble canopy. The initial B-52A rolled out of the Seattle plant on 18 March 1954 and made its first flight test on 5 August 1954. These first three A-model Stratoforts would never see operational service with Strategic Air Command (SAC) but later served basic test functions.

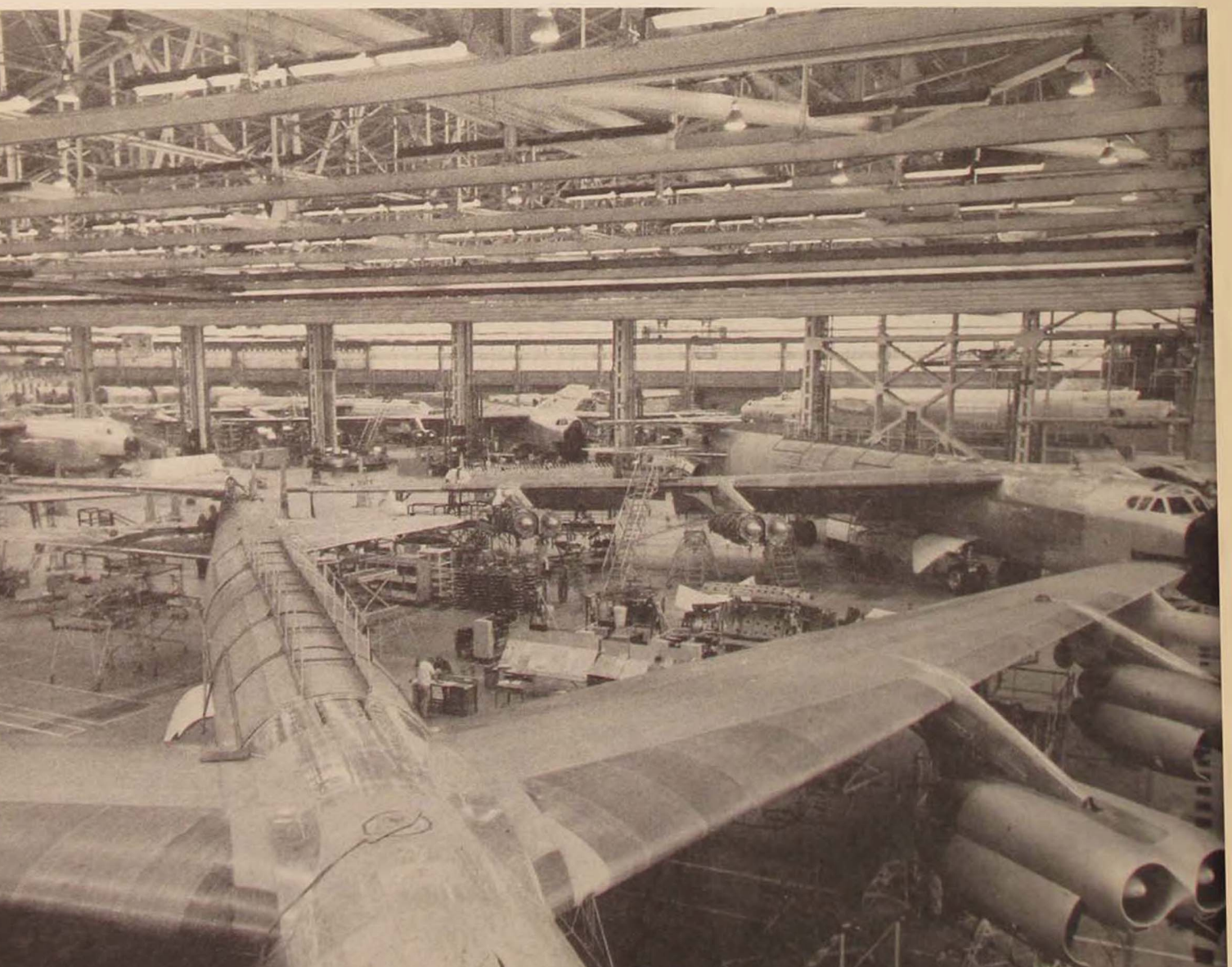
On 25 January 1955, the first B-52B took to the air from Seattle. The B model would be the first Stratofort to be delivered to SAC, to the 93d Bomb Wing. The B variant incorporated several changes, including the MA-6A bombing navigation system. RB-52B was the designation given to some 52Bs that incorporated a reconnaissance capability, but only 27 of these were built. The B-52B was the version that set the first of many significant B-52 range and endurance records.

The first flight of the B-52C—the last pure Seattle-produced Stratofort—was on 9 March 1956. The B-52C incorporated larger underwing drop tanks and an increased gross weight of 450,000 pounds. Actually the B-52C was a product of the evolutionary process and could have been called essentially an improved B-52B. Thirty-five were constructed.

With the advent of the D model, Boeing began B-52 production at Wichita, although of the 170 B-52Ds that were produced, 101 were built at Seattle. With the exception of the later G and H models, the D model was the most numerous model built, the first B-52D test flight occurring on 28 September 1956.

Exactly 100 B-52E aircraft were built, with Wichita assuming production leadership by producing 58 of them. The first B-52E flight took place at Seattle on 3 October 1957, with the first Wichita-manufactured aircraft flight taking place some two weeks later. The B-52E was the first B-52 to carry the Hound Dog missile and the first to incorporate improved bombing, navigation, and electronics systems.

The last Seattle-produced B-52 was the F model, giving Seattle a total Stratofort production output of 275 aircraft. The B-52F incorporated so-called "hard-drive" alternators, which were connected to the port unit of each pair of turbojet power plants.



One hundred ninety-three B-52Gs rolled off the Wichita production line, the first on 27 October 1958. The G variant incorporated extensive changes, with a redesigned wing containing internal fuel tanks. The fuel capacity was increased to 46,000 gallons. A significant tactical change had the gunner positioned forward in the pressurized forward portion of the aircraft. The B-52G also achieved 25 percent greater range, increased climb performance, and greater over-target altitude. But the most noticeable outward change was the shortening of the vertical fin, a change that would also be carried through to the final H version.

The B-52H would be the last of the Stratofort breed, with Wichita production (September 1960 to October 1962) turning out 102 of the model. The B-52H was a significant improvement over the earlier models, with the equipping of P&W TF-33 turbofans. The advanced power plants gave the B-52H a 10 to 15 percent increase in range. The power boost, improved low-altitude capabili-

B-52 production scene at Boeing-Wichita . . . A B-52H flies over the Air Force Flight Test Center, Edwards AFB, California. Rogers Dry Lake, the huge natural landing field, stretches beyond the regular landing strips.

ties, and the substitution of the 6000-rounds-per-minute six-barrel Gatling gun made the H version a much-improved aircraft.

Although the B-52H was the last model to be produced, during the mid-1970s another (the so-called B-52I) was considered as a possible future B-52 model. However, the B-52I was not a new airframe production program but rather an extensive modification of the B-52G/H fleet. The modification would incorporate new, more-powerful engines and new electronics technology. Boeing estimates ranged from $7 to $12 million per airplane for the "upgrading." At the time of this writing (early 1975), no firm decision had been made as to whether the modification would be made.

modifications

In an operational career of some two decades by 1974, the B-52 has maintained its role as SAC's front-line strategic bomber. Perhaps the main reasons the Stratofortress can claim such longevity are the Air Force's and Boeing's extensive modification programs. Historically, maintenance and modification of B-52s have rested with the Oklahoma City Air Logistics Center at Tinker AFB and the San Antonio Air Logistics Center at Kelly AFB.

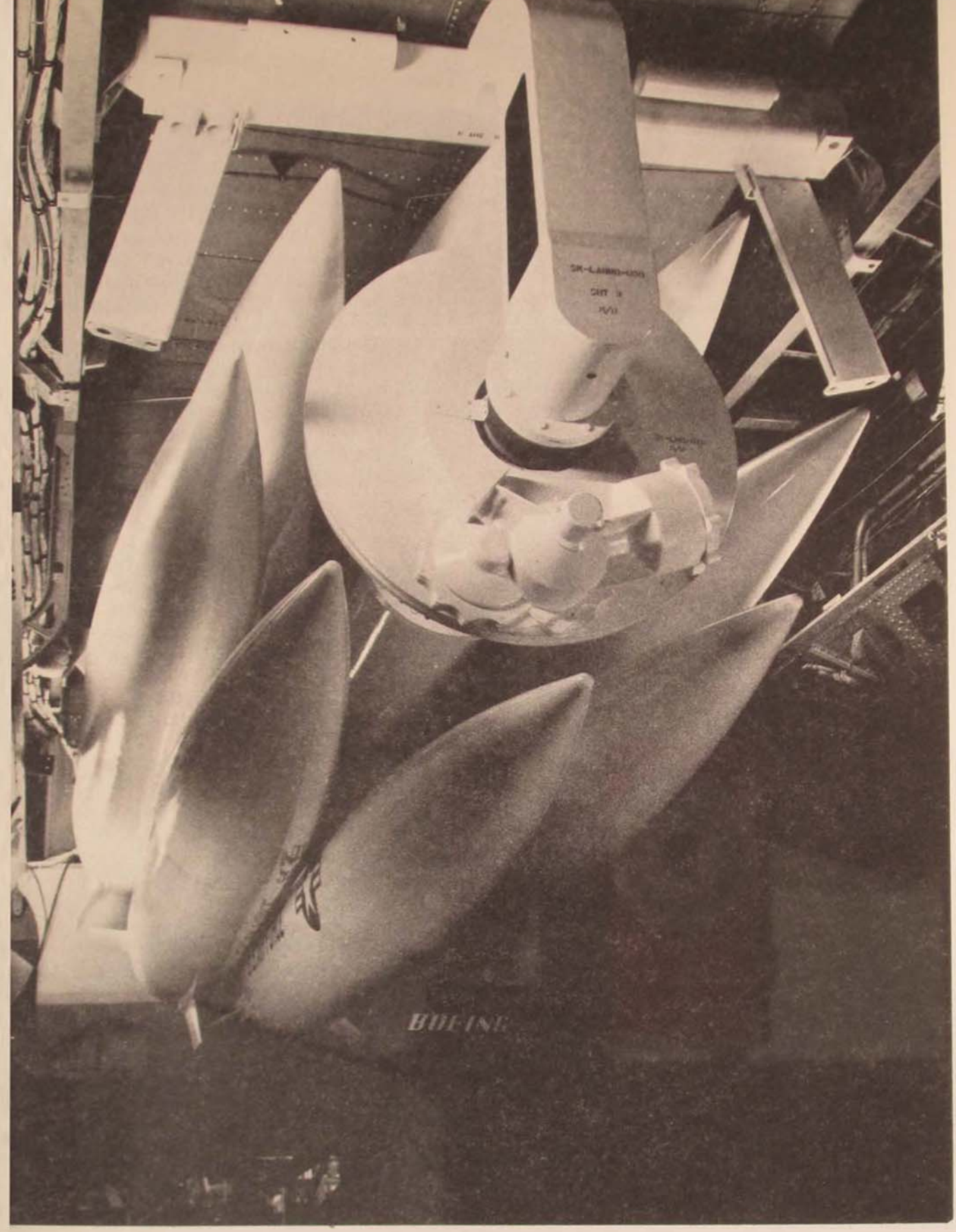
One of the largest B-52 modifications, the "Mod 1000" low-level capability, was one of the largest single modifications initiated on any weapon system by the U.S. Air Force in the 1960s. It equipped certain models of the B-52 to perform high-speed, low-level penetration flights with an air-to-surface missile profile while still maintaining its high-altitude capability.

Providing the Stratofortress with adequate structural integrity became a problem of great magnitude in the 1960s as the bomber approached the end of its structural life span. Engineering changes to beef up structural weaknesses were developed to guard against further deterioration and fatigue. As a result, the life of the B-52 was extended to meet continued operational commitments.

Another large modification effort was the B-52 quick-start package. This modification installed cartridge/pneumatic starters on all eight engines on B-52G/H aircraft, which allowed the simultaneous starting of all engines. The program, which began in 1974, is scheduled for completion in 1976, and 273 aircraft are to be modified.

many jobs—master of all

Versatility and flexibility are but two of the superlatives that can be applied to the B-52. The plane's longevity has seen it serve in many capacities other than that for which it was initially conceived. Designed to perform a high-altitude nuclear-deterrence function, the Stratofort has performed a multitude of functions for which it was not



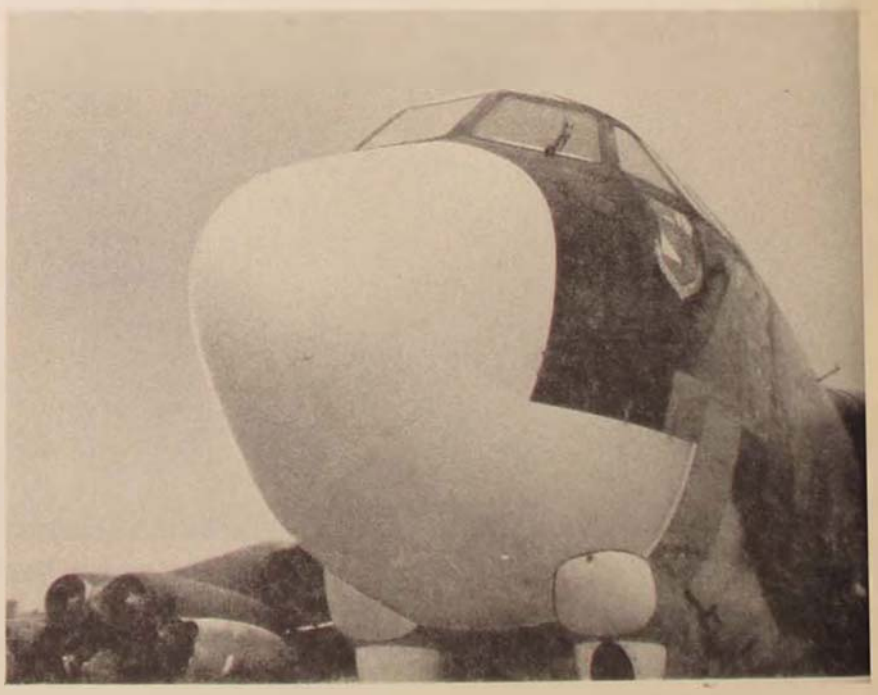
Eight short-range attack missiles (SRAM) can be released by the rotary rapid-launch equipment in the B-52 to attack targets separately, from high or low altitude, ahead, behind, or to the side of the aircraft when flying at subsonic or supersonic speeds. Boeing designed and developed SRAM for the Aeronautical Systems Division of Air Force Systems Command.

designed, including carrying ballistic and cruise missiles, air-breathing decoy missiles, and conventional iron bombs. And in addition to the tactical implications of the B-52, a small number of B-52s have performed important functions in aeronautical and space research programs.

The B-52 was designed from the outset as a delivery system for nuclear weapons. It has retained this capability. But a host of new weapon innovations has been added, and there could be additional new weapons before the last Stratofort is retired.

This B-52 missile capability was best typified by the AGM-28B jet-powered Hound Dog missiles that the Stratofort has carried in pairs since 1960. The Hound Dogs are carried on wing-mounted pylons between the fuselage and inboard engines. The missiles extend the operational reach of the B-52 by more than 500 miles and permit one bomber to knock out targets hundreds of miles apart.

In February 1960 the Air Force approved development of a long-range ballistic missile that could be launched against ground targets from high-flying jet bombers—a weapon more sophisticated, with more accuracy and range (1150 miles), than any previous air-to-surface missile. The missile was called the Skybolt (GAM-87A), and the carrying bombers were to be the B-52H and RAF Vulcan jet bombers. Each Stratofort was to carry four Skybolts, two under each wing on inverted T pylons. However, the program was canceled, and the B-52Hs were adapted to carry the Hound Dog.

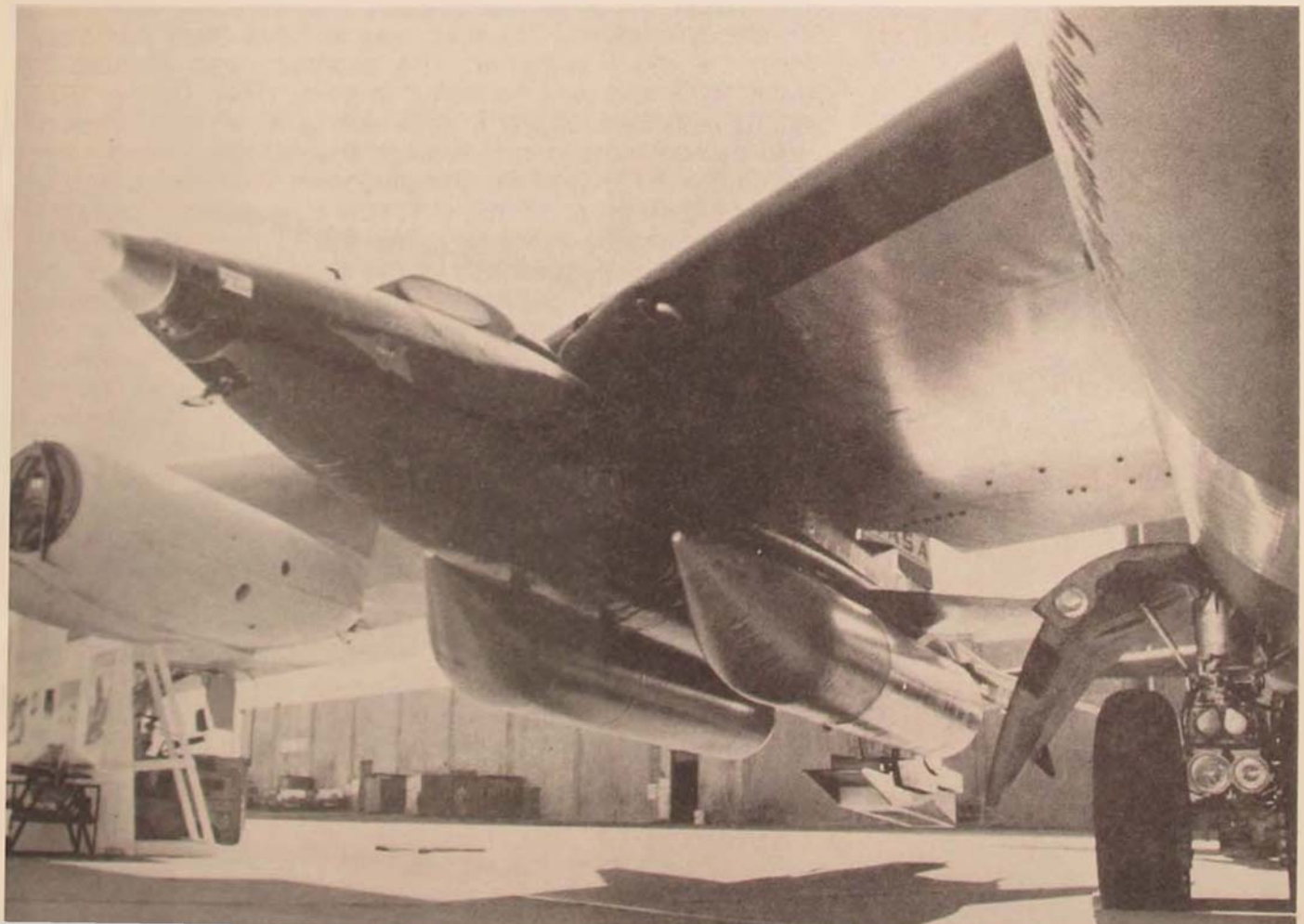


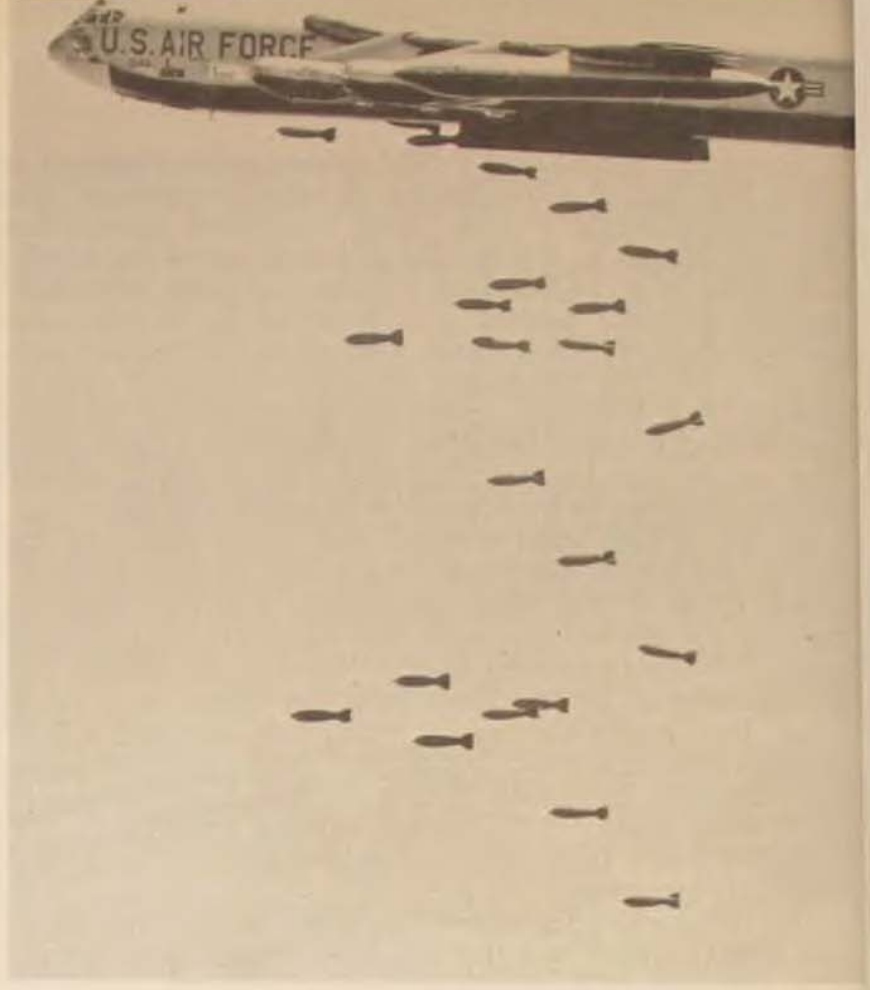
The modified radome of the B-52 incorporates the Electro-optical Viewing System (EVS), Forward Looking Infrared (FLIR), and Steerable Television (STV). . . . The B-52 acts as "mother ship" to an X-15, probably best known of the X family of high-performance research vehicles carried by the B-52 to flight altitude for release.

Some 281 B-52G and B-52H models were modified to carry the next of a succession of weapon systems. The short-range attack missile (SRAM AGM-69A) provided a new dimension to the B-52's offensive strike capability. The SRAM is a 14-foot-long missile weighing only 2230 pounds. Inertially guided, it is powered by a two-pulse, solid-propellant rocket motor and carries a nuclear warhead. It can be retargeted aboard the aircraft prior to launch. The B-52 can carry up to 20 SRAM's on wing pylons and a rotary launcher installed in the bomb bay. The missile can be launched singly or in salvo, demonstrating a variety of trajectories in different directions.

As the B-52s aged through the 1960s and into the 1970s, significant electronic improvements were incorporated. One of the most significant countermeasures carried for some time was the ADM-20 Quail decoy missile. The jet-powered decoys were to be dropped in an operational environment from the Stratofort's bomb bays. The Quail's electronics would then simulate a B-52 to enemy radarscopes. Additional decoy/diversion gear was carried by some B-52s in the form of chaff-dispensing pods. In the wing-mounted pods, 2.75-inch rockets actually push chaff outward in front of the aircraft for radar deception.

The *S*ubsonic *C*ruise *A*rmed *D*ecoy (SCAD) was to be the replacement for the Quail but with one added





Bombs away. A B-52 Stratofortress drops its cargo of bombs on a Viet Cong stronghold southeast of Saigon, August 1966.

dimension: the SCAD was to carry a warhead in addition to its decoy mission. The SCAD was to have been launched from the SRAM launcher. The program was initiated in June 1972 and was canceled in early 1974. During 1974 an air-launched cruise missile with a diversional mission was being considered to replace the canceled SCAD.

During 1973, with the installation of the Electro-optical Viewing System (EVS), the B-52G/H's penetration capabilities were greatly increased. The EVS kit was designed to increase the effectiveness of the G and H models of the Stratofortress by providing the crew with an improved flight-hazard avoidance capability that enables the airplanes to fly at low level in a "closed curtain" environment. It also allows the crew to assess strike target damage and avoid low-level terrain features. The Electro-optical Viewing System consists of two steerable sensors: one a low-light-level TV camera and the other an infrared unit. They are mounted in turrets under the nose of the B-52. Looking forward and downward, they transmit a picture of the terrain in TV display form to the cockpit and navigator stations.

But with increasing American involvement in Vietnam during the 1960s, the massive capability of the B-52 as an iron-bomb hauler was exploited. On 18 June 1965, modified B-52s started carrying out high-altitude missions against targets in South Vietnam. Modifications on the

Stratoforts by Boeing had increased conventional bombing capabilities by as much as 57 percent on some of the models.

Modification of the bomb bay permitted loading of up to 84 bombs in the 500-pound class, or 42 750-pounders. An additional 24 750-pounders could be carried on external racks under the wings. B-52s so equipped were able to carry a total bomb load of about 60,000 pounds—an increase of 31,750 pounds over the 28,250-pound normal payload.

But not all of the modifications to the B-52 have been for tactical or strategic reasons. It has served as a test-bed aircraft for many programs. One well-known B-52 application is as "mother ship" carrier for a number of the famous X family of high-performance craft. The B-52 continues to be used in this research role. The manned rocket-powered X-15 was probably the best known of the B-52 "riders." More recently, the so-called NB-52 has been used to carry the X-24 family of hypersonic research vehicles. This job could carry well into the late 1970s.

During 1973 an NB-52E participated in a test program to produce superstable aircraft of the future. The Stratofort was equipped with a series of forward canards. The Control Configured Vehicle (CCV) program demonstrated that the speed of future aircraft need not be limited to avoid flutter or structural bending. Two other B-52s served as test beds for large new jet engines. The TF39 (engine for the Lockheed C-5A) and the JT9D (engine for the Boeing 747) were flight-tested on the normal inboard engine pylons.

combat role

In 1965 the Stratofort was called on again, and this time it was for real. From 18 June 1965 to 27 January 1973, B-52s flew conventional bombing missions almost daily against Communist forces in Vietnam. Crews operating from U-Tapao, Thailand, and Andersen AFB, Guam, flew B-52s, each carrying up to 60,000 pounds of bombs, to perform strategic bombing, close air support, and interdiction missions. B-52 strikes continued against military targets in Laos until 17 April 1973 and in support of friendly forces in Cambodia until 15 August 1973.

During its wide-ranging operations in South Vietnam, the B-52s were used to deliver huge tonnages of bombs in precision high-altitude strikes against hidden enemy concentrations. Usually flying in three-plane cells, the B-52s helped clear paths for tactical ground operations against targets where individual aiming points were often well hidden. The target types included supply zones, area headquarters, and troop concentrations.

B-52s played an important part in the now-famous Khe Sanh operation. Early in 1968, 6000 marines and South Vietnamese rangers were surrounded at the airstrip by 20,000 North Vietnamese troops. While tactical fighters

B–52 memorial display at Tinker Air Force Base, Oklahoma

harassed the enemy, the B-52s dropped up to 1400 tons of ordnance daily, with devastating results. The effectiveness of the B-52 response was intensified by the arrival of a three-plane cell every 90 minutes around the clock. During the Khe Sanh operations, the Stratoforts produced some 2600 sorties, delivering over 75,000 tons of ordnance. The "nuclear" bomber had demonstrated with conventional ordnance the effectiveness of World War II strategic bombing.

But the biggest operation for the B-52s came in December 1972, Operation Linebacker II. The mission was "up north," and the challenge was probably the toughest the old bird would ever face. The strikes were against military targets in the Hanoi and Haiphong area of North Vietnam. It was hoped that the Linebacker II operation would bring an end to American involvement in Vietnam.

(A little-known fact is that this was not the first time the B-52s had ventured north. During the previous April, 17 B-52s went to Haiphong, and all aircraft returned safely.)

B-52s had previously been under SAM attack in southern operations, but the attacks had been few and scattered. Linebacker II provided a massive SAM challenge to the B-52, along with the menace of fighters, for the first time. As it worked out, there were no Stratofort losses to MIG's although some 32 came up to contest the B-52s.

The raids were carried out during eleven fateful days, from 18 through 29 December 1972. The Stratoforts (B-52Ds and B-52Gs), with their day/night, all-weather capability, struck their targets throughout the night hours, leaving the daylight hours to tactical aircraft, when visual bombing could be accomplished.

Linebacker II was a highly coordinated, precision operation. The Navy provided support for the B-52s over Haiphong, since there were carriers located close off the coast. The Air Force provided the tactical air support over Hanoi in the form of fighter escorts and electronic countermeasures (ECM) aircraft. The B-52s also used chaff and ECM to confuse the enemy defenses.

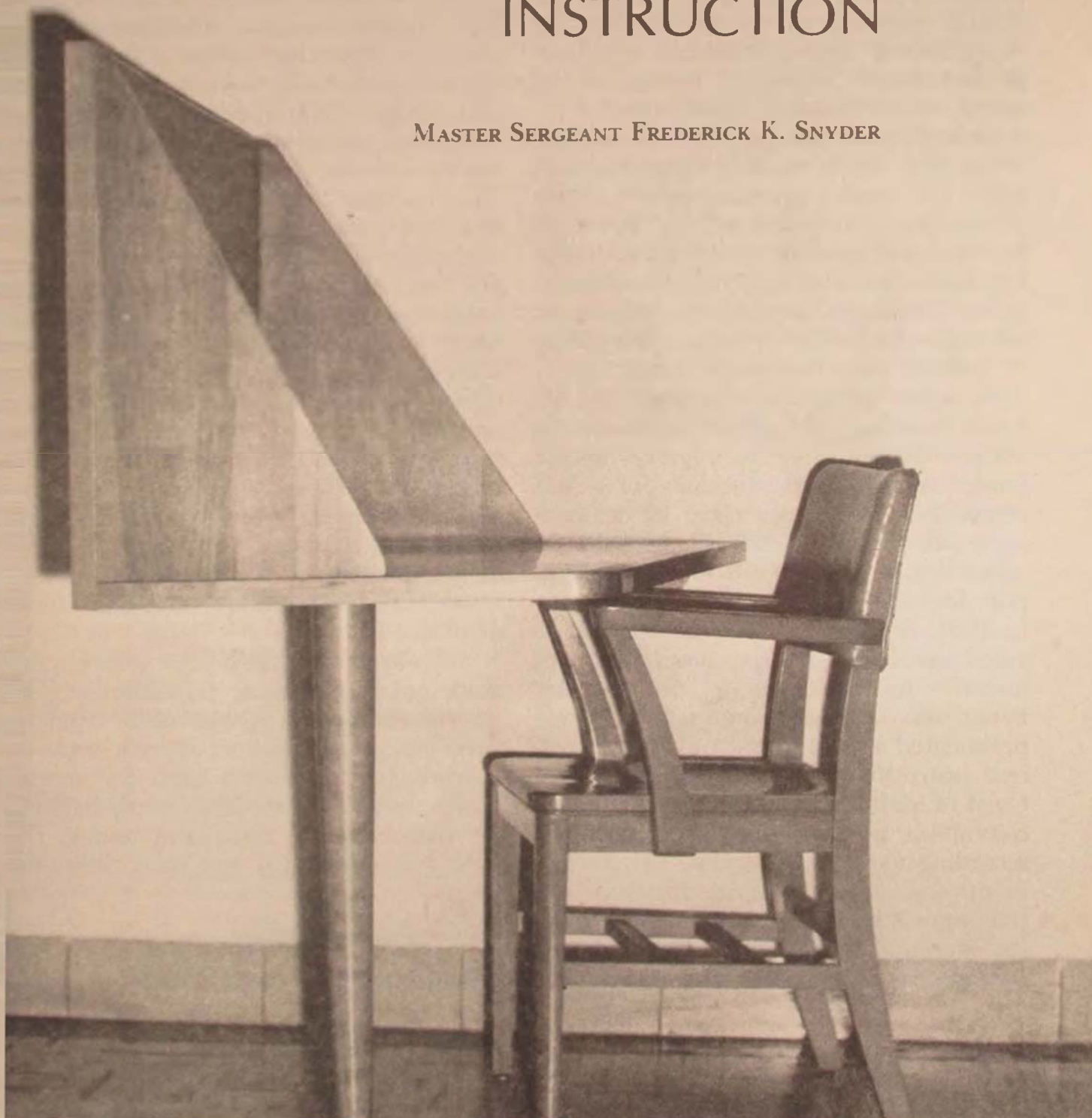
But the cost was not cheap. Fifteen of the giant Stratoforts were lost, ten in North Vietnamese territory. Nine other "Forts" were damaged, two heavily, but all of these made it back safely. The cost had been high, but not as high as the three percent that had been estimated. Losses amounted to only two percent—15 aircraft on about 700 sorties. The cost was still high—very high—but the B-52s got the job done.

As the future of the Stratofortress is examined, the continued use of the B-52 is projected well into the 1980s. Even though its design roots go back to the 1940s, the aircraft has kept current with the new technology of the 1960s and 1970s.

Foreign Technology Division, AFSC

AN INTRODUCTION TO INDIVIDUALIZED INSTRUCTION

MASTER SERGEANT FREDERICK K. SNYDER



FAILURE to provide for individual differences among students is perhaps the greatest single source of inefficiency in education."[1] With the advent of new communication technology in the 1960s, the long-desired goal of individualized instruction, which provides for the differences among students, is capable of being reached.[2] A 1972 study by the Air Force Human Resources Laboratory of 38 existing individualized instruction programs found not only a 25 to 44 percent reduction in training time but also a significant improvement in graduate performance.[3] These are motivations to change to individualized instruction.

As with most changes, one of the first things that needs to be changed is attitude. The most important attitude is that of the instructors who will do the work involved and then present the new training methods to the students. The attitude of the instructors' supervisors also matters because each instructor responds to what he feels his supervisor really wants.

A major permanent change in Air Force training procedures requires an attitude change at the very top of the Air Force. At this level the Air Force has responded to the leadership of its managers. Presidents Kennedy and Johnson asked and received from Congress support for educational technology research. In 1965, Secretary of Defense McNamara asked the services to recommend ways to improve military training. For the Air Force, Air Training Command (ATC) experimented with and evaluated individualized instruction.[4] In 1970 the Air Force Chief of Staff established this policy for all commands: new training will be organized according to the Instructional System Development (ISD) method and existing training will be selectively converted to the ISD concept.[5] AFM 50-2, *Instructional System Development,* implements this policy. ATC conducts several courses on ISD. The intent of this article is to explore the major facets of individualized instruction. To explore individualized instruction, it helps to have before us a picture of current conventional training procedures. With knowledge of today's training behavior, we can interpose new learning theory, and training quality can be improved.

A typical class is a group of students, individually different in their abilities and interests, who sit listening to an instructor lecture about a subject. The students take whatever notes they desire. If the instructor uses the chalkboard or other teaching aids, he uses them rather sparingly. When he directs attention to a displayed item, his hand stays there only a short time. The students are relying mostly on their sense of hearing to take in new information. When a student realizes he missed a key point, he asks for a repeat explanation. The whole class stops its progress while one student gets his needed facts. This routine is interrupted only infrequently with a test to measure student progress formally. Little effort is made to reteach identified weak areas; there is no time for that in a conventional class. The result is that only a few students get high grades, most students have gaps in their understanding of the subject with less than desirable retention, and some students fail.

My analysis of this picture puts importance on these factors: (1) differences in student abilities, (2) sparse use of training aids, (3) great reliance on one sense—hearing, (4) a student's need for repeat explanations, (5) a student's needs holding the class back, (6) infrequent testing, (7) little reteaching, (8) less than desirable results.

redefining student aptitude

Aptitude tests are often considered to be

measurements of prior achievements.[6] Aptitude test scores are used to predict which students should succeed or fail in training. Students with low aptitude scores are usually denied certain training, and the Air Force loses when needed jobs go unfulfilled for lack of qualified people. A student's aptitude score for a particular subject predicts the level to which he could learn the subject in a given period of time.

The fixed part of the definition of student aptitude is *in a given period of time*; the variable part is *the level of learning*. The definition can be restated to read: student aptitude is the time required to learn a subject to a given level.[7] Fixing the level of achievement and letting time vary implies that practically every student can succeed when given enough time.

The time needed, which is predicted by the student's learning rate (aptitude), is determined by: (1) the quality of his instruction, (2) the quality of his instructional materials, and (3) his ability to understand the instructions and materials.[8]

When time is allowed to vary and the quality of instruction is improved, then a majority of students, up to 95 percent, can achieve the required level of performance.[9] Three key actions make up individualized instruction: (1) clearly state what each student is expected to learn and to what level, (2) help each student when and where he has learning difficulties, (3) give each student sufficient time to learn.[10]

Proficiency in applying modern instructional technology to implement these actions requires increased instructor training equivalent to at least a college course of three semester hours.[11] Therefore this article is limited to an overview of individualized instruction.

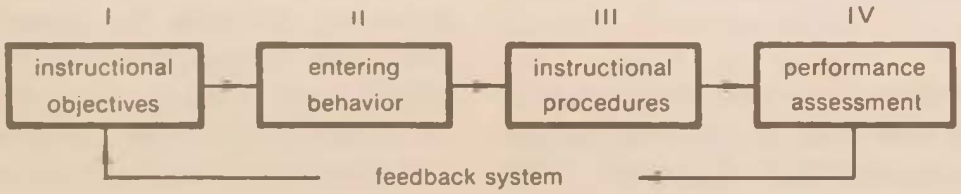
an individualized instructional model

The cycle of individualized instruction may be illustrated by the accompanying instructional model. In block I the objectives are clearly stated. In block II each student's entering behavior (current ability) is determined by diagnostic testing. If he has met any of the objectives stated in block I, the training for these objectives is eliminated from his schedule. Objectives minus entering behavior equal the training requirements for the individual student. Training for this reduced set of objectives is prescribed in block III, where the student interacts with the instructional system in ways that help him reach his objectives. In block IV the student is involved in frequent performance testing, the results of which feed back to block I objectives, showing what objectives have been mastered and what objectives remain for further learning. Individualized instruction is a continuous cycle of diagnosis, prescription, and evaluation until the student has mastered all stated objectives.

instructional system development

Before this instructional model can be

Glaser's instructional model with feedback system[12]



employed, much preliminary work must be done. Clearly stated objectives must be written; diagnostic tests must be formulated; instructional procedures that help the individual student must be developed; and performance evaluations must be prepared. The work involved is more than one instructor should be expected to handle. It may take as much as 250 hours to produce a 15-minute lesson.[13] This expenditure of effort has produced a more proficient group of graduates in less time compared to conventional training systems. There are eight steps for developing an instructional system:[14]

(1) Write a set of Task Analyses

(2) Write a set of Objectives based on the Task Analyses

(3) Write tests that fully measure each Objective

(4) Decide what available instructional media will best help the students reach the objectives

(5) Use the Task Analyses to develop the information it contains into the format required by the chosen media

(6) Edit for obvious shortcomings

(7) Validate this developed instructional system by trying it on a small group of students; make necessary improvements

(8) Implement this individualized instructional program for all students and continue to improve as necessary.[15]

These steps require diligent and skillful preparation by the instructor staff. The traditional role of the teacher has been to find ways to explain subjects to his students. With individualized instruction, the instructor will find this role an even greater challenge.

task analysis

The instructional system development process indicates that a training system must be more precisely organized. This precision starts with the task analysis. The task analysis, a detailed outline of behavior that comprises a task,[16] is prepared in a two-column format for easy visual reference (refer to Appendix A). The task analysis states the behaviors, skills, and knowledges in a logical sequence that makes up the task. Each left column entry becomes a teaching step with a teaching step appraisal, which is student activity that constitutes the feedback mechanism. Right column entries are the skills and knowledges that must be learned in order to perform the student activity. The student masters each teaching step by learning the accompanying skills and knowledges and by performing the teaching step appraisal. With mastery of the teaching steps, the student is prepared for the overall objective of the task. This task objective is called a criterion objective with its associated criterion test.

When each task is broken down into such detail, appropriate objectives (criterion and teaching step appraisals) can be written without any objective being overlooked. Tests to measure objective achievement can be written with the same confidence that nothing important is left out. Finally, the detailed task analysis serves as the outline for those instructors who select and prepare appropriate instructional media, again insuring that nothing is omitted.

behavioral objectives

Behavioral objectives clearly state what each student is expected to learn and to what level. Schools have long had objectives, but they have been too general and vague to provide the direction thought necessary.[17] Objectives must be stated specifically and in such a way that a student's attainment of each objective is measurable.

A measurable objective consists of a

statement of performance, condition, and standards.[18] Let's examine a simple objective: The student will be able to read. This objective states a performance, but it is too general and vague. If the student is 16 and can read the word "cat," he has met the stated objective. Clearly we must add some standard of acceptable performance. A better objective is: the student will read 250 words per minute with 80 percent comprehension. This objective fails when more than one instructor is responsible for different students' achieving the objective. Compare three students: one is tested for achievement using a college chemistry text, a second is measured with a chapter of John Steinbeck's *The Grapes of Wrath*, while the third student is given a copy of a third grade reader. The degree of difference has been expanded to show that some condition must be stated.

In any instructional system where there are many students and instructors, there will be honest misinterpretations of what goals must be reached and how to train to reach the goals. Explicitly stated objectives will minimize these honest errors that cause either student failures or a waste of time.

If we decide that the student must learn to read at a common adult level, we could so state our objective: the student will read a chapter of Steinbeck's *The Grapes of Wrath* at 250 words per minute with 80 percent comprehension. This is a behavioral objective because it states a specific performance with certain conditions to a measurable standard. An individualized instructional system rests on a set of clearly defined objectives.

Should the student be made aware of his objectives before he begins his training? Definitely, yes. Concrete objectives not only control the thrust of the instructional system but also direct each student's activity. When a student has clear objectives before him, he can more easily focus his energy on achieving these goals. Learning should be the business of acquiring skills and knowledges that are necessary for later use. This is especially true when the training has a direct job relation and when costs are involved.

performance testing

To help students when and where they have learning difficulties, we must have some way to identify their needs. We can identify each student's needs by examining his performance with a test. This diagnostic test differs from the usual connotation of tests (formal grading) because the purpose is solely to identify the student's needs.[19] Once these needs are known, both the student and the instructor realize what the student must learn to achieve the objectives. When the student can succeed on the diagnostic test, there is no need for training in that subject. The test, of course, must be written in such a way as to measure completely the established explicit objective.

A criterion objective and its performance test state and measure the student's acceptable achievement of a task. The task analysis breaks down each criterion objective into smaller units called teaching steps. Tests are developed for each teaching step. These teaching step appraisals and criterion tests are perhaps the single most important component in individualized instruction.[20] From the instructor's point of view, the tests measure student progress and identify student problems. From the student's view, these tests are activity through which he is able to increase and internalize his learning by doing something with the training just received.[21] Opportunities to use new skills and knowledge immediately tend to in-

crease retention. Performance testing confirms student progress or points to the need for correction.

For example, both Mel and Jim must reach the same criterion objective which has three teaching steps. Jim masters steps one and two but has difficulty with step three. He needs some kind of assistance to overcome his difficulty. Mel, who had problems on steps one and two, receives the help he needs and finds step three within his ability because he mastered the first steps. Mel may be ready for the criterion test in thirty minutes while it takes Jim an hour. The important point is that both Mel and Jim have mastered the criterion objective by overcoming their individual learning difficulties. The teaching step appraisals have been used to find these problems and allow for individual correction. Neither Jim nor Mel has slowed the other down while overcoming his particular problems.

The most effective way discovered so far to find each individual's strengths and weaknesses is through the use of performance tests.[22] Instructional systems that use behavioral objectives and performance tests to diagnose progress and allow for immediate correction of problems are said to be efficient and effective. The instructional system is effective because each student can actually perform to explicit objectives, and it is efficient because each student has received only that training necessary for him to achieve the objectives. Each student is neither undertrained nor overtrained. Undertraining is avoided because each student must reach all objectives. Overtraining is avoided because training in an area stops once the criterion objective is met.

instructional media

Explicit behavioral objectives focus the entire training effort. Frequent diagnostic testing shows when and where students are experiencing learning difficulties. But how does one instructor have time to help each student and give each student sufficient time to learn? The answer is through the use of instructional multimedia.

Media are the means of communication. In conventional training, the instructor and the textbook are the predominant media. In individualized instruction, the information to be learned is presented by a much wider variety of media. While slides and tape recordings appear most often, "media" actually refers to anything that presents information to the student (see Appendix B). The use of multimedia affords the instructor time to help each student whenever that student experiences a problem.

To make intelligent decisions concerning the use of media, instructors must have sufficient knowledge of existing media and the principles of media utilization. Instructional media are expensive; the cost must be measured against media effectiveness in teaching. Cost-effective media should be chosen objectively rather than on the basis of personal preference. Supervisors of training systems should have their instructors complete one or more courses in media and audiovisual instruction.[23] Without such training, most instructors have only personal bias on which to recommend the purchase of expensive hardware. Without such training, instructors who develop the software will do so without sufficient knowledge of the techniques for effective production.

During the past ten years, media technology and techniques have been expanded so rapidly that few instructors are aware of the impact on their efforts to train their students. Having the media and accepting their value is one thing;

knowing how to use them effectively is something that requires additional instructor training.

Some of the advantages of using instructional media for the teacher include the following:

(a) Using instructional media to present the teaching segment of the teaching-learning activity (TLA) frees the instructor from lecturing on the same subject class after class. Instructors can suffer from boredom, too, and it is understandable that there are days when the instructor just does not put forth his best effort. Once the media have been developed into top-quality tools, the instructor can be confident that all the material is well presented every time.

(b) With the various teaching media, the teacher is no longer the sole source of information in the class.[24] The teacher has time for communicating with each student in ways that establish rapport and a spirit of cooperation. There is little time to do this in conventional training because the teacher is occupied presenting the lesson. Increased cooperation and communication between the teacher and the individual student can create a learning environment in which the student feels he is important and has a stake in the system. When the student sees himself as really belonging, his ability to learn is improved.[25]

(c) Besides motivating the student, the instructor works with each individual, searching for student understanding. Students who can explain what they are learning actually learn that subject better. In conventional training, not every student has the chance to explain what he is getting out of his learning. If the student can explain his new knowledge, he has confidence in it; if the student finds he is confused, he realizes he needs to recycle his learning effort to get a better grasp of the subject.

(d) The instructor should determine the student's reaction to instructional media. There will be media presentations that, from the student's point of view, are difficult to understand. Perhaps the student can suggest what he feels is a better way to present the material. If the instructor remains aloof from the student, his chances of finding out what to improve will be reduced.

For the student, use of instructional media has certain advantages, also:

(a) The student acquires instruction through the multiple sensory approach. In conventional systems, the student depends greatly on his sense of hearing to absorb lecture materials. How many of us feel we learn our best through the use of one sense only—hearing? With instructional media, the student is receiving information through several of his senses at the same time or at closely timed intervals. The training is more intense, and the student is more involved. Better and faster learning occurs when a combination of senses is employed. The greater the number of senses taking data in, the higher the learning retention is likely to be.[26]

(b) While the instructional media intensify student involvement, the need for repeat explanations still remains. The student simply resets the media to the appropriate place, and he has the explanation as many times as he needs without slowing the progress of the rest of the class. A good instructional system will have alternate presentations available for students who develop a mental block with certain media.

Within one decade the role of the media has changed from that of a supplement to a primary source of instruction.[27] The major burden for presenting the material in class is delegated to a system of instructional media. The student interacts with this selected variety of media with the

personal guidance and help from the instructor that he could not get in conventional classes.

expected results

Individualized instruction, based on the principles described in this article, has been used worldwide at all levels of education and in a variety of subjects. There are some problems in interpreting the results of the past seven years of experience; however, it seems reasonable to state the following:

(a) Two to three times as many students using individualized instruction have achieved A and B grades as compared to students studying the same subjects in conventional ways. The number of failures with individualized instruction also has been reduced.[28]

(b) Although time is a flexible factor, the total time in training has been reduced. Reductions of 25 to 44 percent have been reported in military, industrial, and academic training programs.[29] This time savings translates into a financial savings that compensates for the initial investment in expensive media and increased instructor training.

(c) Students really enjoy individualized instruction because they no longer are passive participants. Their active involvement in doing things with newly acquired skills and knowledge during the learning process has caused them to express greater interest and more positive attitudes toward their training. Success and enjoyment of learning instill confidence in their ability to learn, which can carry over to other endeavors.[30] If these student benefits are important to the reader, he has a good portion of the attitude necessary to be a part of an individualized instructional system.

INDIVIDUALIZED instruction is student-centered and not teacher-centered as in conventional systems. It is student-centered because it focuses all activity on the needs of each student in his efforts to achieve predetermined specific objectives. It responds to individual student abilities in three ways: (1) multiple sensory approach to teaching; (2) increased student activity, which helps him internalize his training; and (3) sufficient time to overcome his weaknesses.

Although the emphasis is on the student, the teacher's role has not become outmoded. Rather, the teacher finds his role even more demanding. Individual learning activity must be prescribed for each student according to his recent progress and remaining goals. The teacher becomes more professional and assumes the role of learning guide and consultant. The teaching staff is responsible for the creative development and effective use of the instructional media. The individual teacher manages the learning process of diagnosis, prescription, and evaluation.

The individual student's training is intensified by the multisensory approach, and his activity is intensified by responding to frequent teaching step appraisals and criterion tests. The student is doing more than he did in conventional systems. Experience is the best teacher, and student activity is the experience by which he learns.

Individualized instruction is attained through the Instructional System Development process. Using *Webster's New World Dictionary*, we describe the process: "To cause to become better" (*develop*) "the orderly way" (*system*) of "giving the facts of the matter" (*instruction*). More simply stated, "It is a better way to teach."

Citrus Heights, California

Notes

1. B. F. Skinner, *The Technology of Teaching* (Appleton-Century-Crofts, 1968), p. 242.
2. James H. Block, *Mastery Learning, Theory and Practice* (San Francisco: Holt, Rinehart and Winston, 1971), p. 4. The Winnetka Plan (1922) by Carleton Washburne and another approach by Henry C. Morrison (1926) at the University of Chicago's Laboratory School fell into disuse primarily because of lack of technology to sustain a successful strategy.
3. Hq MAC/DOTO, *Introduction to Individualized Training*, USAF ISD-Q-4-003 (1974), an audiovisual production.
4. *Air University Review* (September-October 1968) featured the "Air Training Command: Providing for the Future." In that issue, Lt. Col. Vernon J. Elslager's "Toward Individualized Instruction" (p. 10) and John P. Murphy's "Behaviorally Oriented Instruction in ATC" (p. 21) describe ATC's pioneering work in ISD. Now, seven years later, the major principles of ISD are intact with only a few changes in terminology, i.e., Instructional System Development has replaced the term Systems Approach to Training (SAT). Since 1970, ISD has been spreading throughout the major air commands.
5. L. F. Miller, Major General, Hq USAF letter, subject: USAF Policy on the Systems Approach to Training (SAT), dated 13 November 1970.
6. John B. Carroll, "Problem of Measurement Related to the Concept of Learning for Mastery," *Educational Horizons*, 48, No. 3 (1970), pp. 71–80.
7. John B. Carroll, "A Model of School Learning," *Teachers College Record*, 64 (May 1963), pp. 723–33.
8. James H. Block, "Teachers, Teaching, and Mastery Learning," *Today's Education* (November-December 1973), pp. 30–36 (hereafter cited as "Teachers").
9. *Ibid.*
10. *Ibid.*
11. One Air Force course equal to at least three semester hours is ATC Course 3AZR75100, Instructional System Materials Development. Two college texts are Brown, Lewis, and Harcleroad, *AV Instruction, Technology, Media and Methods* (San Francisco: McGraw-Hill, 1973) and Wittich and Schuller, *Instructional Technology, Its Nature and Use* (San Francisco: Harper and Row, 1973).
12. Richard Hersch and Stuart Cohen, "Beyond Behavioral Objectives: Individualizing Learning," *Elementary School Journal*, November 1972, p. 102.
13. Hq MAC/DOTO, USAF ISD-Q-4-003.
14. USAF ATC Course 3AZR75100, Instructional System Materials Development (1973), p. 402.
15. AFM 50-2, *Instructional System Development* (December 1970), pp. 5–21.
16. USAF ATC Course 3AZR75100.
17. Sherman Frey, "Behavioral Objectives: Attitudes of Teachers," *The Clearing House*, 48 (April 1974).
18. Robert F. Mager, *Preparing Instructional Objectives* (Palo Alto, CA: Fearon, 1962).
19. AFM 50-2, p. 1-1.
20. Block, "Teachers," pp. 31-33.
21. USAF ATC Course 3AZR75100, p. 202.
22. Wittich and Schuller, p. xiv.
23. AFM 50-2, p. 6-3. See also note 11.
24. *Ibid.*, 6-3.
25. Block, "Teachers," p. 36.
26. Rita and Kenneth Dunn, *Practical Approaches to Individualizing Instruction* (West Nyack, N.Y.: Parker, 1972), p. 99.
27. *Ibid.*, p. 62.
28. Block, "Teachers," p. 34.
29. Hq MAC/DOTO, USAF-ISD-Q-4-003.
30. Block, "Teachers," p. 34.

Appendix A

A Sample Task Analysis

Performance:	Obtain, validate and plot a time difference reading from the EC-121 LORAN C System
Conditions:	AN/ARN-92(v)-2, Local Area Navigation Charts and Log, pencil, dividers, and Weems plotter
Standards:	The plot must be within 3NM of actual EC-121 position.

Teaching Steps	Skills and Knowledges
1. Identify the purpose, theory of operation and location of components and controls of the LORAN C.	1a Purpose of the LORAN C 1) Micro-miniature receiver indicator 2) Converts an analog system to a digital system. 3) Inserts time difference into a memory mode, holds it there, and continues to update it with more current time difference data.
Notes: *1. PCS statement controls the Criterion Objective and Test.* *2. Each Teaching Step will have a Teaching Step Appraisal.* *3. A Teaching Step is measurable student activity.* *4. Right column entries are skills, knowledges and supporting teaching points for each Teaching Step.* *5. Students do not see or use the Task Analysis. The instructor who selects the media and writes the subject explanation uses the Task Analysis as his outline.*	1b Theory of Operation 1) Operates on the principle of Group Repetition Rate (GRR), or a burst of eight pulses. 2) Five basic rates are used. a) The distance of the Master and Slaves determines the rate. b) The rates are: *1* SS 100,000ms *2* SL 80,000ms *3* SH 60,000ms *4* S 50,000ms *5* L 40,000ms
2. Obtain, validate and plot a time difference reading for the LORAN C.	2a Obtain a time difference reading 1) Presetting is accomplished IAW 552 GPMan 55-1, Vol. II. To expedite search phase, preset a value of 1,000 to 2,000ms below actual aircraft position. 2) Warm-up is 15 minutes after power switch is placed in STBY.

Source: Format from USAF ATC Course 3AZR75100 (July 1973), p. 159.
Data: USAF ADC Course ADC12100T, Navigator.

APPENDIX B

Instructional Media

Individualized instruction was not possible until technological advances made possible a wide variety of media. Too often when we think of media, only two or three examples come to mind, and we tend to think that that is all there is to media. We also forget the many experiences and learning options that should be considered when individualizing instruction.

The lists in this appendix may convince the reader of the magnitude of choices and combinations confronting the teaching staff as they select and

develop their instructional system. The quality of training can suffer, and certainly time, money, and effort can be wasted when media are overlooked, or the wrong media are purchased, or the instructors lack knowledge in how to blend the media into the student's learning activity.

I recommend that instructors pursue their personal training in the field of audiovisual instruction. Training supervisors should consider taking steps to have their instructors attend audiovisual courses at organization expense. This financial investment will pay off in the development of an efficient and effective training program.

Experiences leading to learning

Thinking
Discussing, conferring, speaking, reporting
Reading (words, pictures, symbols)
Writing, editing
Listening
Graphing, charting, mapping
Demonstrating, showing
Experimenting, researching
Problem solving
Collecting
Observing, watching
Traveling
Exchanging
Recording
Interviewing
Outlining, taking notes
Constructing, creating
Drawing, painting, lettering
Photographing
Displaying, exhibiting
Videotaping
Dramatizing
Singing, dancing
Imagining, visualizing
Organizing, summarizing
Computing
Judging, evaluating
Working

Individualized learning options

Read textbooks
Read nonfiction books
Read pamphlets
View transparencies
Listen to records
View filmstrips
Study periodicals
Watch instructional television programs
Work on self-instructional kits
Give oral reports
Study charts
Study maps
Take self-administered tests
Interview resource personnel
Participate in small group discussions
Use the amplified telephone
Study reference books
Refer to fiction books
Listen to tape recordings
Study pictures
Study programmed instructional materials
Study models or objectives
View 35mm slides
View microscopic slides
Write reports
Produce learning materials
View graphs
View films
Participate in student teaching conferences
Conduct experiments
Play educational games

Facilities for learning

Lecture halls
Classrooms
  Divisible
  Undivided
Independent study areas
Discussion rooms
Laboratories
Shops
Theaters
Studios
Libraries
Resource centers
Electronic learning centers
Playing fields
Community resources
Home study centers

Equipment for learning

Record players, tape recorders, radios
Slide and filmstrip projectors and viewers
Overhead projectors
Motion picture projectors and viewers
Television receivers
Videotape recorders, players, viewers
Teaching machines
Computer terminals and print image producers
Electronic laboratories: Audio/video/access and interaction devices
Telephones with or without other media accessories
Microimage systems—microfilm, microcard, microfiche
Copying equipment and duplicators
Cameras, still and motion

Media for learning

Textbooks
Supplementary books
Reference books, encyclopedias
Magazines, newspapers
Documents, clippings
Duplicated materials
Programmed materials
Motion picture films
Television programs
Radio programs
Recordings (tape and disc)
Flat pictures
Drawings and paintings
Slides and transparencies
Filmstrips
Microfilms, microcards
Stereographs
Maps, globes
Graphs, charts, diagrams
Posters
Cartoons
Puppets
Models, mockups
Collections, specimens
Flannel-board materials
Magnetic-board materials
Chalkboard materials
Construction materials
Drawing materials
Display materials
Multimedia materials

Source: *AF Instructional Technology Media and Methods*, Chapter 1.

In My Opinion

AN EFFECTIVE WRITING FORMULA FOR UNSURE WRITERS

LIEUTENANT COLONEL ROBERT H. EMMONS, JR.

IF YOU are the kind of guy who gets a lump in the pit of your stomach every time the boss assigns you a writing task, then this article is for you. Its purpose is to provide some techniques, both psychological and practical, to help unsure Air Force writers overcome some of the more common obstacles to effective writing.

"We have nothing to fear but fear itself"

The first obstacle is, strangely enough, you. A change in attitude is the first step in becoming a successful writer. It is a proven fact that you aren't going to do a good job as long as you think you can't. But it is also a proven fact, particularly in writing skills, that it is never too late to develop your innate abilities. Now, don't start making excuses! I've heard them all and made up a few myself. If you think about it, you will recognize that you have developed your language skills to a pretty high degree already. Linguists estimate that the average college sophomore has a vocabulary of over 200,000 words.[1] You have been putting words together into meaningful arrangements, both oral and written, most of your life. You've also spent a great deal of time interpreting word arrangements, i.e., listening and reading. "Yes," you say, "that's true, and so has everyone else to one degree or another. But does that make me a writer?" No, it doesn't. No one is going to become a writer until he decides to develop his innate abilities into useful skills. So, overcoming the first obstacle requires a decision on your part. That might be an easy decision to make since your boss expects you to be a writer.

The second hurdle to get over is pride of authorship. This is a high hurdle, which, for most people, has been reinforced over and over again since a seventh grade teacher put the red pencil to their first theme. Unfortunately, most of us took those constructive (although not always very tactful) critiques the wrong way. I know just how you felt. I too saw "red" every time a teacher or boss had the unmitigated gall to correct my peerless prose. The result of these unseemly deprecations upon what I then considered inviolate was that I developed an uncommon aversion to writing anything more profound than a grocery list. It didn't take me very long to get into a vicious cycle: no matter what I wrote, someone criticized it, so I wrote less and less, exactly the opposite of what I should have been doing.

Writing is a learned skill or craft that requires constant practice for improvement. Although it took a long time, I finally realized that writing was like business: "The customer is always right." If he doesn't like what you are selling, then you've got to improve the product until he does like it. Getting over the second major obstacle, then, requires changing your attitude toward your reader. You are the seller and he is the buyer. There is no way you can force him to buy your product; you've got to make him want to buy. Look at it this way—the parts he didn't mark are the parts he bought, and the parts he did mark up at least give you a clue to what he didn't like. Once you know what a customer doesn't like, you can fix it up so he will want to buy. Knowing what a customer likes or dislikes is half the battle.

This brings up another point that seems almost too elementary to mention but is tied closely with knowing what your reader likes. As you've probably found out, every boss you've had wants it done a little differently. Usually by the time one or the other of you is reassigned, you've got a general idea of what he likes. Then you have to start all over with a new boss. Terrible waste of time, isn't it? Rudolph

Flesch, noted author of *A New Guide to Better Writing* and *Why Johnny Can't Read*, says that most peoples' writing is an unconscious imitation of what they read.[2] Put this fact to work for you. Start right now by making a copy of every draft your boss has corrected for you. Study them carefully, especially those he is going to sign because most bosses are not about to put their signature on anything that isn't the way they like it. Generally, after two or three corrected drafts, you'll be an expert on what your boss likes. Compare these drafts with things he has written personally. You now have a gold mine of information on the communicative likes and dislikes of your boss.

Before you begin to write another letter, background paper, or position paper, go back and review what you have learned from your collection of corrected drafts. There are two reasons for this review: first, you are exercising your power to discern what your boss wants—sort of tuning in to his wavelength before you transmit. Second, you are unconsciously sharpening your ability to analyze writing. Both actions help you get ready to write and reduce the anxieties associated with writing. The next portion of this article will show you a way to organize your thoughts without a lot of extra writing.

"Up the organization"

How do you get organized to write? All the experts agree that you must get your thoughts organized before you start to write, but few tell you how. My purpose is to give you a technique that will show you how to get organized and avoid the agonizing mental gymnastics of trying to put scores of unrelated ideas into a logical order. It will also save you a severe case of writer's cramp by eliminating the need for several written iterations before you get your ideas in a logical sequence. I will introduce this organizing technique by using the outline I developed for this article. I'll take it step by step, in sequence, explaining as I go along.

The first step is the task itself: you have to have a reason for writing. Whether your task is a background paper assigned by your boss, a letter to your insurance company, or an article for publication, you must decide what you want the paper to accomplish. Notice I said, "what *you* want the *paper* to accomplish." It is important—part of that change of attitude—to realize that the only thing the reader has in front of him is the written word. The "word" must stand on its own merit and must appeal to the reader enough to make him want to finish the paper and comply with your wishes. Therefore, the words are only as strong as the reason that supports them. That is a pretty tough order, but it can be done.

Start by taking a clean piece of paper and writing in big, bold letters at the top exactly what you would like your paper to do for whom. My paper reads:

Objective: To provide some practical techniques to help unsure Air Force writers overcome some of the more common obstacles to effective writing.

The second step in the process of organizing to write is compiling ideas. *Guide for Air Force Writing* calls this the brainstorming step.[3] In essence, it is brainstorming, or the free-wheeling gathering of ideas. Unfortunately, this is the point where the experts usually drop you. They expect you to be able to dream up the ideas, eliminate the irrelevant, and put what is left in logical order. Poof! Magically you have a model outline! The next statement they make, ordinarily, is that poor organization can often be traced to a

poor outline. How right they are! But how can you develop an outline that is a help instead of a hindrance?

Take the piece of paper on which you wrote your objective and draw a line down the center. Left of the line write in sentence form everything you can think of about your topic. Don't try to evaluate your ideas, and don't modify ideas you have already jotted down. If a modification comes to you as you are thinking, write it down also, but don't change the original idea. You'll find that one idea suggests another; usually, you'll wind up with chains of related ideas. When you have exhausted your memory bank, number the sentences consecutively. My brainstorming page for this article looked like pages 78 and 79.

As you can see, my brainstorming produced 48 loosely connected ideas on the same subject. No need to worry about comprehensiveness though, for this is not the stage to refine ideas. The important thing to keep in mind is that if you have taken the time to list that many ideas about one subject, you certainly have sufficient material to write a complete paper. Limiting your subject will be more of a problem than searching for more ideas. Now you must sort out your ideas and develop a plan or outline to write from.

An outline—what is it? An outline is your blueprint for a paper. Just like the blueprints for a building, your blueprint has got to be drawn so clearly and logically that anyone could build a paper from it. In fact, if you develop your outline with the thought that someone else might be writing the paper from it, you're more apt to insure that it is structurally sound. With that mental set established, let's step through the outline development process.

My next step was to review my objective statement. What did I say I wanted to do? I wanted to "provide practical techniques to overcome common obstacles." From my list, then, what were the most common obstacles? Judging from my own writing struggles, I felt that number 19, a change in attitude; 1, getting organized to write; 41, developing a usable outline; and 33, knowing how to rewrite effectively were the more common obstacles. I considered items 2, 8, 11, and 21 but decided to eliminate them because I felt they were not as important as the ones I had selected. If I had been writing a longer article, I would probably have included them.

Again referring to the objective statement, I started selecting those items that were related to or that expanded the main points. These were subsumed under the main points as befitted their priority and abstraction level.

The outline as it stands now was the result of several iterations, any one of which would have consumed an inordinate amount of time had I written out each one separately. Changes, however, required only a few minutes to rearrange the numbers. What the experts say is true: "Poor organization can usually be traced to a poor outline." Yet I suspect that most poor outlines are the result of being faced with a seemingly overwhelming task.

In the past, I would have accepted my first try at outlining, thinking I would be able to correct it while I was composing. I was naïve; not once was I ever able to salvage a leaky outline while writing the paper. This failure could be compared with trying to build a house without a set of blueprints—structural weaknesses are inevitable.

Plan Your Work

There is another step in the organizing

OBJECTIVE: TO PROVIDE SOME PRACTICAL TECHNIQUES TO HELP UNSURE AIR FORCE WRITERS OVERCOME SOME OF THE MOST COMMON OBSTACLES TO EFFECTIVE WRITING.

1. How to get organized to write?
2. How do you start writing?
3. Don't try to proofread your own writing -- find a helper.
4. Don't let your momentum wane; press on!
5. To start, type the word "the" at the top of the page!
6. Outlining: one method I've found helpful.
7. You've got to have a blueprint to build a house; you also need a plan for writing.
8. How can I improve my spelling?
9. Find your recurring errors.
10. Make up mnemonics to remember the right way to spell your recurring errors.
11. How can I avoid comma faults?
12. How can I recognize a comma fault?
13. Use the framework method to build a paper.

INTRO: 35
PURPOSE: from objective statement
METHOD: 40
MOTIVATION: 18

BODY:

1st MAIN POINT:
19
48
32 36
37 38

2nd MAIN POINT:
1 6
14 7
15,16 13
41

3rd MAIN POINT:
41
42
44, 43

4th MAIN POINT:
31 33
34 45
46
47
3, 24
25
27, 28
29, 30
26

ENDING:
SUMMARY: 19, 1, 41, 31
CONCLUSIONS: Effective writing can be accomplished via a formula.

14. Make an objective statement.
15. Decide who your readers will be.
16. What reaction do you want from your readers?
17. What tools do you need in your writing kit?
18. How can you learn to write for your boss?
19. A change in attitude is the first step to becoming a successful writer.
20. Most points are never made because of inadequate support.
21. How can I integrate support references into my outline?
22. Put code numbers on reference cards.
23. Get a helper to determine understanding.
24. Ask only for lack of understanding, not for correction of copy.
25. Have your helper mark fuzzy passages.
26. You determine why they were fuzzy.
27. Was he ignorant of the subject?
28. Did he get the wrong connotation?
29. Did he get bored?

REMOTIVATION: You too can become an effective writer.

30. Regardless why, it is your fault, Writer!

31. Revising and Rewriting

32. You need to change your attitude towards readers and towards writers -- you.

33. How to re-write effectively.

34. How to revise effectively.

35. I feel an identification with guys who are frightened by writing; hence the reason for this article.

36. A writer needs to develop confidence.

37. How can I reduce my pride of authorship?

38. How can I overcome anxieties associated with writing?

39. What do you do after you've written your first draft?

40. I've tried to fill in the gaps left in the writing instructions.

41. From a sentence outline, build a framework and fill in the holes.

42. Framework = outline = topic sentences.

43. Don't waste time trying to perfect each sentence. Keep moving. Refine on your rewrite. Take it one step at a time; it is the shortest way in the long run.

44. One paragraph equals one idea.

45. Rewrite or cut-n-paste?

46. Take the CUE

47. Coherence, Unity, Emphasis are necessary characteristics of good writing.

48. You've got to want to become an effective writer.

process that I feel is important at this point, although some authorities suggest waiting until you have written the body of your paper. That step is planning your introduction and ending. Planning these two important parts helps you maintain coherence and unity in the paper. Adding these vital parts to your plan also helps overcome the mental hesitation associated with writing the first sentence.

For the basic structure, I have divided my outline into three major parts: introduction, body, and ending. The specific elements of the introduction are the purpose, method, and motivation. I have applied pertinent sentence numbers to these as I did to the main points in the body. The summary, conclusion, and remotivation sections of the ending were handled the same way. Now I had a complete plan, or blueprint, and one from which I could work.

In writing there is a great deal to be said for the trite but true motto: "Plan your work, and work your plan." In this section you have planned your work, and the next section will deal with working your plan, or filling in the empty spaces of the framework.

Work Your Plan

There is a strange phenomenon about writing that can cause people to sit transfixed before a blank sheet of paper for hours. It is often accompanied by ever increasing degrees of panic—especially if your deadline is rapidly approaching. Even the most notable authors admit to occasional dry periods, especially when beginning a new piece. Most of them have devices for getting started. One starts by writing the word "the," then adding another word, and another, until his momentum has built up and the creative juices start flowing.[4] Another begins by describing something he can see on his desk or out the window. These exercises are devised just to get started, and most of them are largely unproductive. In the workaday world of the Air Force, we can't afford the luxury of leisurely warm-up exercises. Fortunately we don't have to rely on devices or gimmicks to begin writing if we've produced a workable outline. We can start by merely writing down the sentence we selected as the opener in our outline. There are, however, a couple of rules to keep in mind when working your plan.

The first rule is simply to work your plan without deviation. Since this is the first cut, you will be further ahead to write as you've planned rather than try to refine as you compose. It is tempting, of course, to try to say exactly what you mean the first time, but unless you are a literary genius, it is generally a waste of time.

Revising is a mandatory step in the writing process, and it is unproductive to mix the composing step with the revising step. I call this grasshopper progress—lots of movement, but getting nowhere—it's all up and down. We shall consider revising in the next section, but for now suffice it to say that filling up pages from the product of your plan is paramount. Once you have overcome your inertia, keep on writing.

The second rule is to use applicable outline sentences as paragraph topic sentences and limit your paragraphs to that single idea. Stick to your plan like epoxy glue because deviations will be irrelevant and slow you up. You'll be surprised how much of your writing task is already done if you follow your plan and limit each paragraph to one idea. Nothing is quite like the feeling you get when page after page of coherent copy begins to roll out of your typewriter.

If you have followed these two rules—

work your plan as you've planned it and limit each paragraph to one idea—you'll find that you have a completed draft, rough though it may be, in no time. Now you have something you can really develop. One final tip about composing that will be invaluable during the next phase is to type your copy, triple-spaced. It will save you untold aggravation.

R and R Time

"R and R" doesn't mean "Rest and Recreation" when you are talking about writing. On the contrary, it means labor and hard work, but here is where your labors "literally" bear fruit. R and R means revise and rewrite—the most vital step in writing. Noted author Bergen Evans underlines the importance of revising by stating:

> Revision is important to a writer because it is really a part of the writing process. Many pieces are unsatisfactory not because they are badly conceived but because their possibilities aren't realized. A thing must not merely be said. It must be said effectively.[5]

Rarely does one say it effectively the first time.

Revising could also be classed as the most traumatic part of writing because no one likes someone taking liberties with his peerless prose. But remember that second obstacle to writing: reduce your pride of authorship and please the customer. No one but you knows how many times you have rewritten a particular passage; those other people only see the finished product. It stands or falls on its own merit—not on how much labor went into it.

The question is, How do you revise effectively? What yardstick can you use to see if each sentence, paragraph, or section measures up? Gordon Carroll, director of the Famous Writers School, suggests you ask yourself three questions as you revise:

1. Can this be stated more simply?
2. Can this be stated more aptly?
3. Does this have to be stated at all?[6]

These three measurements are fine for the first cut. They eliminate much of the rambling and muddy prose that we all have a tendency toward. In short, they add snap to your writing. The U.S. Army Command and General Staff College calls it the ABC's of writing: accuracy, brevity, and clarity. Either or both yardsticks make your copy more succinct, but succinctness isn't the only essential characteristic of military writing.

Everything in military writing, like military operations, should be pointed toward accomplishing the mission. Your writing mission was spelled out in your objective statement, and you should keep it constantly in mind while revising. Measuring your copy against your objective is imperative, but without more precise dimensions it tends to make you write telegraphically. The telegraphic style can become pretty boring, as anyone who has ever read a two- or three-page TWIX can testify. My solution to this obstacle is to take the "CUE."

CUE is an acronym for coherence, unity, and emphasis. Let me define these three dimensions, and I think you'll see how they apply to measuring your copy against your objective. CUE makes your writing more readable, and in the final analysis readability has a lot to do with selling your ideas because the reader becomes your ally instead of your adversary.

Coherence is a sticking together, as in cohesion, of all parts of a piece of writing. The dictionary further defines coherence as the quality of being logically integrated, consistent, and intelligible or congruent. The most common way of achieving coherence is by using connectives or word bridges to prepare the

reader's path and lead him smoothly to your next point. The *Guide for Air Force Writing* (AFP 13-2) calls these word bridges transitions.[7] Transitions may be mere words or phrases, or they can be sentences or paragraphs. Transitions keep your writing from becoming jumpy or jerky. Whatever their length, they tie the various aspects of your main theme together.

Unity is the core dimension of all writing but especially of two specialized forms of writing—short stories and military writing. In both forms, time and space are precious commodities. Since "unity" is defined as singleness of purpose or consistency of theme, it behooves the military writer to insure that everything he writes contributes to achieving his objective. Much of the progress toward unity was made while developing the outline, but a conscientious writer will go through his copy, carefully eliminating anything that causes his reader to detour. Digression is the mortal enemy of unity, and it is the writer's enemy, too. Nothing irritates a busy reader more than discovering he has been led into a "cul-de-sac of irrelevancy." It is especially dangerous when the busy reader has eagles or stars on his shoulders.

Creating unity in writing is analogous to weeding your garden. If a plant doesn't contribute to the harvest or the beauty, pull it out. You've got to be absolutely ruthless in cutting out the irrelevant or unnecessary.

The final dimension to CUE is emphasis. Where you were cutting to create unity, you are usually adding to achieve emphasis. Emphasis is the stressing or illuminating of the important parts of a piece. Without emphasis, writing would be monotonous and dull, just an endless string of uninteresting facts. The writer has many ways of achieving emphasis. Technically, emphasis can be achieved in seven legitimate ways:

1. By using mechanical means, e.g., capitalization (CAPS), underlining, heavy (boldface) type, or *italics*. These means are often overused.

2. By making a flat statement, usually in the form of an opinion. This is analogous to the pitcher's change-up.

3. By an isolated paragraph. This method is often used in combination with indention and boldface type.

4. By repetition, or the old trick: "Tell 'em what you're going to tell 'em, tell 'em, and tell 'em what you told 'em."

5. By proportion, or giving one section fuller treatment than another.

6. By style. Zesty phrases and zingy words are examples of emphasis by style.

7. By position—the strongest positions of any piece of writing are at the beginning or at the end. And of these two positions, that which is remembered longest is at the END.

You will note that I referred to the seven ways above as "legitimate" means of emphasis. There are, unfortunately, other ways to emphasize that are not recommended but that are too often found in writing. They include exaggeration, innuendo, half truths, and even bald-faced lies. Needless to say, these emphases have absolutely no place in any writing.

Of the legitimate seven, emphasis by proportion, by style, and by position are the most effective.

Emphasis by repetition is also effective, so I will use it to emphasize the importance of revising. Take the CUE and revise, revise, revise. As Gordon Carroll has said, "Revision is the healthiest act of writing."[8]

Up to this point, you have done everything alone. Now it is time to hire a helper. The hardest obstacle to get over in writing is recognizing that what you have

written may not be understandable to others. That old demon, pride of authorship, is back again. That is why you need a helper. You need someone who will tell you honestly what parts of your writing he doesn't understand. Essentially, you need someone on whom to try out your writing—sort of a "practice customer." Whom you get and what you pay are personal problems, but there are a couple of tips that, if followed, will keep your helper on the payroll. The first is to ask him only whether or not he understands what you wrote. Don't ask him to correct your copy, just ask him to mark those passages that are fuzzy. The second tip is: don't argue! Your helper is doing exactly what you asked him to do, and if he didn't understand because he was ignorant of the subject, or he got the wrong connotation, or he just plain got bored, it isn't his fault. It is *your* fault, Writer! You must determine why he didn't understand, or you won't be able to correct your mistakes.

Summary

What I've tried to give you is a structured formula for turning out acceptable and effective writing in your job as a member of the Air Force. The first factor in the formula was a change of attitude. You must get rid of the notion that effective writing is an artistic gift. Effective writing is a skill or craft that can be learned. And, once learned, it can be improved through practice.

Another attitude you must get rid of is pride of authorship. Nobody knows or cares how much blood, sweat, and tears went into a piece of writing. All the customer wants is a message he understands and finds pleasure in reading. It is amazing how many writers can rationalize away the need to make their readers comfortable, and yet they complain bitterly about dry, dull prose.

The next hurdle in writing is getting organized. This is a thinking process, and the quality of the finished product seems to be directly proportional to the quality of thinking that went into the process. Most Air Force members are good logical thinkers, but trying to keep the myriad of details straight literally boggles the mind, usually resulting in a less-than-sparkling finished product. A workable plan is needed. The plan or outline was developed by first deciding what your objective was. Next came the brainstorming step where all ideas were uninhibitedly written down in sentence form and numbered consecutively. Once the ideas were down on paper, the next step was to organize them into a number-coded outline.

Your number-coded sentence outline had by then become a workable topic-sentence framework; therefore, the composition step was little more than filling in the open spaces. The time-saving tip to speed composition was to keep moving rather than try to refine your copy into finished work.

The finishing touches were reserved for the revision step of writing. Here you polished your work, using as many applications of "CUE" as were necessary to bring out the sparkle. CUE, you'll remember, stands for *c*oherence, *u*nity, and *e*mphasis. Finally, you ran your product through your quality control section, a helper who was to inspect it for "rough" spots. Again, you had to revise, revise, and rewrite.

Conclusions

Writing is hard work. Anyone who has put pen to paper will attest to that, but hard work hasn't yet been added to the list of the top ten killing diseases. However, the worry and anxiety associated with writing have taken their toll. Hopefully, this article will help to reduce your

anxiety about writing by giving you a simple formula to follow.

There is a tremendous amount of information about writing that hasn't been included here, but then it wasn't my intention to repeat what the experts have said. My hope was to supplement what you already knew about writing with some rules that will make the job a little bit easier. "Keep on writing."

Murphy Dome AFS, Alaska

Notes

1. Norman Lewis, *Word Power Made Easy* (New York: Pocket Books, 1971), p. 3.
2. Rudolph Flesch, A. H. Lass, *A New Guide to Better Writing* (New York: Popular Library, 1963), p. 160.
3. *Guide for Air Force Writing*, Air Force Pamphlet 13-2, Washington, D.C., 1973, p. 63.
4. *Principles of Good Writing* (Westport, Connecticut: Famous Writers School, Inc., 1960), p. 38.
5. *Ibid.*, p. 194.
6. *Ibid.*, p. 195.
7. *Guide for Air Force Writing*, pp. 125–27.
8. *Principles of Good Writing*, p. 232.

Acknowledgment

Credit for the handy outlining technique for getting organized to write goes to a former Air Command and Staff College student, Major J. William Rice.

A SPECIAL BREED OF CAT

The Fighter Pilot in Systems Acquisition Management

MAJOR LEE LILLY

BECOMING a "Victim" of the rated supplement can be a rude shock to an aggressive young fighter pilot. Yet in today's Air Force a rated supplement tour may be the norm. Most ambitious officers already realize that simply being a "good stick" is not enough to assure progression to the top; they therefore accept staff and rated supplement tours as a necessity. Most pilots, however, try not to venture too far from flying, thereby glutting the market for those challenging and rewarding staff jobs in operations. The flying gate system probably will make rated supplement tours more common as more pilots must serve some time in the supplement so that others may return to meet flying gates. Therefore, I would like to make some observations from my own tour in the rated supplement.

I served in the Air Force Systems Command (AFSC) as a project manager for a subsystem on the F-15 aircraft. This tour made me aware of the immense satisfaction available from such assignments and the vital importance of the operational viewpoint to the working level of the acquisition process. However, my earlier experience in the Tactical Air Command as an F-4 pilot taught me that few fighter pilots seek jobs outside the operations area. This view has been reinforced by discussions with fighter pilots attending the Air Command and Staff College. Most of the students who are not returning to flying assignments are seek-

ing assignments at TAC or USAF headquarters. The lack of fighter pilots in AFSC creates a problem for the Air Force and and for the Tactical Air Command in that the rated positions involved in the development of tactical weapon systems are not being filled by currently qualified fighter pilots, and many of the positions are not even filled by fighter pilots. By writing this article I hope to convince fellow fighter pilots of the need for, and the advantages of, their service in the development of the weapon systems we will be using in the near future.

The Air Force has not overlooked the need for operational experience in weapon systems development. The equipment requirement itself comes from the operational command in the form of a Requirement for Operational Capability (ROC). The ROC, however, gives only broad performance requirements and rightly leaves the method of meeting those requirements to the development engineers. There is also extensive coordination between the TAC Requirements Division and the Air Force Systems Command and between the Requirements Division at Hq USAF and AFSC during concept formulation. Additionally, a TAC liaison office is located at the Aeronautical Systems Division of AFSC for the purpose of continued coordination. All these efforts are expended to assist in communicating operational requirements to AFSC working-level managers and to keep TAC advised of the nature of the systems under development. Unfortunately, there are inherent limitations to the effectiveness of these provisions for cross-feed. The different backgrounds, experience, and points of view of user and developer inevitably lead to lack of communication and to misunderstanding. These provisions do not make operational information immediately available to the project manager or engineer who must make the day-to-day decisions required during the course of the development. The number and complexity of projects that must be monitored limit the degree to which the TAC liaison officers can understand every action taken on each, and it is not only the big decisions that may affect operational use.

An example serves to illustrate how an operationally experienced project manager can avoid mistakes that may be made by someone else who is an equally good manager but has no operational experience. In this case, a warning device was under development for an aircraft. The performance requirement was stated in terms of minimum acceptable range. The nonoperationally oriented engineer insured that system specifications were written in such a manner that detection capability was at least the minimum stated in all areas of coverage. As the equipment began taking form, the detection capability met minimum range requirements even in the edges of coverage and exceeded minimum requirements many times over in most regions of coverage. The operational monitors and advisers were not close enough to the actual situation to realize that the system would detect threats at extremely long ranges but would not display the specific range. It was not until a pilot was assigned to the project that it became known that there was a problem. From his experience he knew that threats detected at long ranges but not distinguishable from close threats were equivalent to false alarms and would unduly distract the pilot. Fortunately, this problem was discovered before the system went into production, but this is not always assured. The problem developed because the operational personnel who submitted the requirement for a minimum range did not realize that from an antenna design viewpoint they were driv-

ing peak detection range to unacceptable limits. The technical experts, who very early in the design phase understood what the detection range would be, did not realize the operational implications.

This example illustrates only one manner in which operational experience at the working level can eliminate a potentially large problem before costs become excessive. In a more complex weapon system, such as an aircraft, there are many more opportunities for such errors to occur. The importance of the physical interface between various components of a system is obvious. The interface between the user and developer is no less important to the success of a weapon system and is perhaps even more difficult to achieve. As noted earlier, good communication is difficult at best between operational personnel and systems developers. This problem of communication is exacerbated by a lack of complete trust among the parties. TAC personnel see a legitimate need and realize that the opportunity for new equipment to meet that need comes infrequently. They therefore want to get the most performance possible in a given development and are impatient with anyone they perceive as reluctant to comply with their stated requirements. On the other hand, the AFSC personnel are faced with very real budget restrictions and sometimes with just as real state-of-the-art limitations. There is a natural conflict between TAC users and AFSC developers about where to draw the line on specifications for a given project. TAC requirements become suspect as possible "pie in the sky" desires, and AFSC is suspected of foot-dragging. The fighter pilot serving in AFSC is in a unique position to understand both sides of the situation and communicate with both sides, while receiving a reasonable amount of trust from both.

Systems acquisition needs the fighter pilot; but does the fighter pilot need systems acquisition? Although it cannot be denied that better weapon systems are in the pilot's interest, let's look a little closer to home to see why a Sierra Hotel fighter jock should seek a job in Systems Command. Of all the complaints I have heard in nearly twelve years' service, by far the most common has been lack of real responsibility. However, I did not hear that complaint very many times in the systems acquisition career field. Cost is a convenient measurement of project size and is some indication of the degree of responsibility. Even small projects are measured in hundreds of thousands of dollars, and a minor avionics system can amount to millions in the development phase alone. If you should be so fortunate as to play a major role in an airframe development, the responsibility can be staggering at today's development costs. You do not have to be a general officer to play such a major role, either. For example, the airframe project manager for the F-15 was a lieutenant colonel position.

The real satisfaction, however, is not calibrated according to budget size. It comes from working on an important and difficult management job and from working with professionally dedicated people who accept you as a professional. You work with such people on both the Air Force and the industry side of the defense business. There is something about working on the development of equipment destined to enter the inventory—and which you may use one day in combat—that creates tremendous awareness of its relevance. There is a great incentive to make sure that you do everything in your power to develop the best equipment possible. Much satisfaction is gained as you see the results of your efforts taking form. As a project manager, you would coordinate all activities related to your

project. You would require the efforts of people from many disciplines; but you yourself would be responsible for the successful completion of the project. The project manager monitors the progress of the civilian contractor by frequent visits and review of status reports. You will find that the Air Force has many personnel widely recognized as experts in their specialty. You will also find that the Air Force keeps both responsibility and authority vested at a much lower level and in younger personnel than does industry. As the Air Force officer directly responsible for a project, you will gain a feeling of accomplishment from working on an equal level with such experts and high-level industry officials.

A discussion of any rated supplement tour is not complete without mentioning the flying gates requirements. It is my opinion that the gate system should not deter anyone from seeking career-broadening assignments. I believe that more officers can expect to enter the rated supplement in the future whether they wish to or not. By the same token, fewer officers should become stuck in the rated supplement. The gate system requires that officers return to flying if they have not met gate requirements. Thus, to assure return to flying assignments, one should enter the rated supplement prior to meeting the second gate requirement. Since more officers will probably serve in the supplement so that all may meet flying requirements, it behooves each individual to seek out an assignment satisfactory to his career plans.

Perhaps a brief word is in order about a final advantage of AFSC duty as a rated supplement tour: that is, from the aspect of promotion opportunity. A review of promotion board statistics quickly confirms that AFSC personnel more than hold their own in promotions (see accompanying tabulation). As a normal rule, officer effectiveness reports will be reviewed by a general officer. The level of responsibility and type of management experience involved in most acquisition management jobs should stand out as a high point in most officers' records.

Promotion List Analysis

Career Field	Percentage of Promotees on FY75 Major List	Percentage of Promotees on FY76 Lt Col List
System Program Management	86%	52%
Scientific & Development Eng.	65%	41%
Lawyers	79%	—
Commanders/ Directors	75%	50%
Comptrollers	68%	46%
International Politico-Military Affairs	67%	76%
Bandsmen	67%	—
Operations	61%	31%
Security Police	47%	—
Communications-Electronics	—	30%
Civil Engineer	—	38%
Personnel Resource Managers	—	33%
Logistics	—	31%
Computer Technology	—	46%
Intelligence	—	26%
Information	—	24%
Rated	70%	34%
Nonrated	53%	33%

Source: This information was summarized from two articles in *Air Force Times:* "3087 Named for Hike to Major" in the 15 January 1975 issue (page 20), and "2043 Win LC; List Analyzed" in the 9 April 1975 issue (page 4).

The need for operational experience of all types is recognized by AFSC, and many positions are designated as requiring rated experience. This article was written because of the failure of fighter pilots to realize the attractiveness of these jobs. The satisfaction and experience to be gained from such assignments should place them in high demand. For those interested,

here are some of the requirements for the jobs.

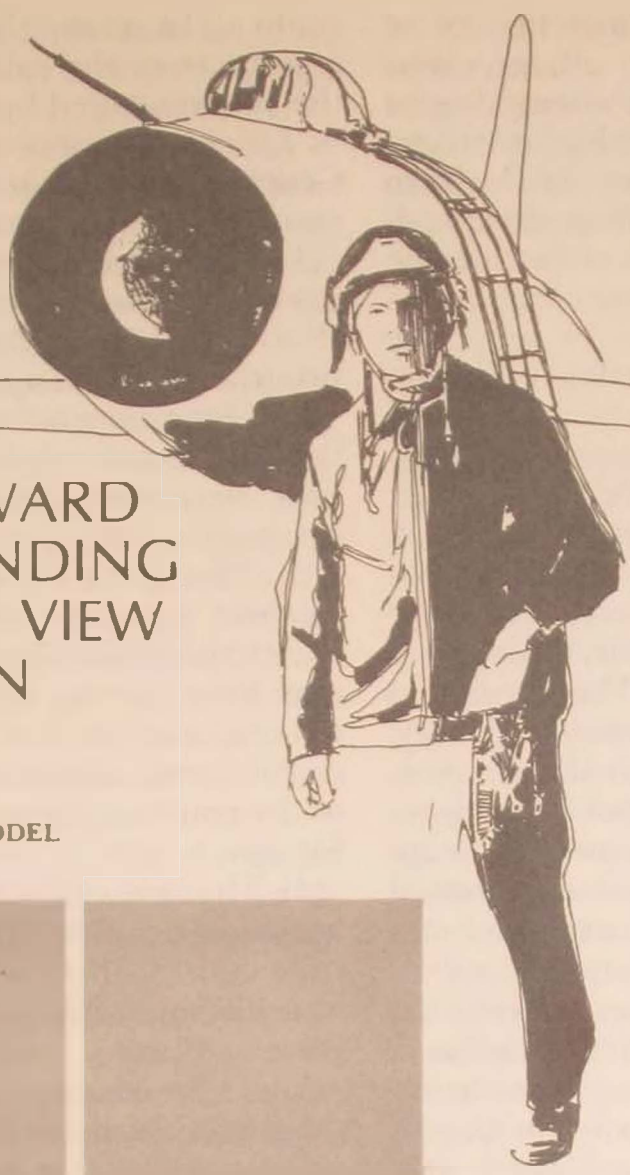
An educational background suitable to the type of position sought is, of course, desirable. Engineers of many types are needed. Operations experience is applicable to many engineering positions. Training in management or business administration would be helpful in the management positions. It is not necessary to be an expert in systems management techniques, however, unless you wish to work on the program control staff. The management positions most needing operational experience are in project management and in test and deployment management. Attendance at one of the System Program Management Schools en route to the assignment is highly desirable because later attendance is difficult. Lack of formal management education should not be allowed to deter you from seeking a position in systems acquisition management, because experience is the best teacher. You should not be frightened by the lack of experience in systems management but should keep it in mind and realize your need to listen to those around you who have more experience with the unique pitfalls in such work. At first, your primary qualifications will be your operational experience and the innate abilities that you must have if you are to be successful in being selected for AFSC duty. As you become more experienced, you will be more comfortable in your new role.

I have pointed out the need for fighter pilots in AFSC to provide a readily available input of operational experience. They are needed to insure that the weapon systems being developed will meet operational needs in such a way as to be fully compatible with the conditions under which they will be used. Everyone who has flown F-4s from the early models to the latest is well aware of the many changes that have been required in the area of cockpit layout. These changes were not the result of advances in the state of the art but were required because in the original designing the operational use by the pilot was not kept in mind. Careful application of operational experience, such as has been applied in the F-15 program, can prevent the recurrence of such problems. This requires that highly qualified fighter pilots be willing to serve in positions of responsibility during equipment development.

Before I am accused of being overly impressed with the importance of fighter pilots, let me add that other pilots are just as important to their equipment developments, as in fact are all the other people in operational disciplines, including the maintainers and suppliers.

Not only is it important for operations personnel to seek development assignments but such an assignment can be highly rewarding for the individual in terms of satisfaction and experience for later use as an operational manager or commander. Thus, the Air Force will profit from better weapon systems and better managers, and the individual will be better qualified to manage or command as the result of his opportunity to practice management in a very difficult arena.

Air Command and Staff College



A STEP TOWARD UNDERSTANDING THE SOVIET VIEW OF MODERN WARFARE

MAJOR CARL W. REDDEL

Books and Ideas

AN old anecdote, used by George F. Kennan to illustrate the problem between the United States and the Soviet Union of mutually assessing intentions, goals, and actions shortly after the founding of the Soviet state, emphasizes the changes which have taken place in the reciprocal appreciation of the two countries. The story, as Kennan related it, dealt with

> . . . two cross-eyed men who bumped into each other on the street in Philadelphia. The one said: "Why in hell don't you look where you're going?" To which the other replied: "Why in hell don't you go where you are looking?"[1]

In the early and subsequent history of the Soviet state, both countries spent much time posturing and attempting to communicate with each other in irrelevancies. Since then they both have learned to evaluate capabilities more realistically and avoid at least some of the "cross-eyed" confusion over intentions and appearances.

Over the years, the reality of Soviet power has stimulated an increasing willingness in the U.S. to assess the intentions and purposes of the Soviets in their own terms. The translation of the book reviewed here is evidence of an American desire to deal with some of the raw evidence of what makes the Soviet military function effectively.† The translation of the book has an interesting duality. The purpose of the original version is pedagogical: to inform Soviet officers about important changes in modern weaponry. The English translation provided by the United States Air Force also has a pedagogical purpose, a general goal of all the volumes in the series selected for translation: to acquaint American officers with the Soviet perception of their common military profession, an aim that is probably misleading in its apparent simplicity.[2]

How successful is the original Russian volume in achieving its purpose of informing Soviet officers about important changes in modern weaponry? For the Westerner, perhaps the best means available of assessing this success is the degree of correspondence between the Soviet perception and the Western sense of reality. In sum, the following views emerge from the collective authorship of the volume edited by Colonel General N. A. Lomov, previously a professor at the General Staff Academy and currently a consultant to the Institute of the U.S.A.

(1) The fundamental basis for dramatic changes in the Soviet armed forces since World War II is the scientific-technical progress of the country in general.

(2) Technically culminating for the military in nuclear weapons, these changes have necessarily brought a host of accompanying developments in their wake.

(3) The possible unrestricted use of nuclear weapons in modern warfare erases the distinction between front and rear lines, raising new problems in civil defense and for the total political, economic, and administrative organization of the country during and in preparation for war.

(4) The use of strategic nuclear forces makes it possible to achieve direct strategic results, thereby emphasizing speed in achieving military goals in the shortest period of time.

(5) These changes and accompanying requirements necessitate a revised organizational structure in the armed forces and the modernization of equipment at all levels of command.

(6) The effect of all these developments is to increase the significance of the factor of surprise and emphasize the urgency of maintaining a high degree of combat readiness.

The authors of the volume describe the overall impact on Soviet military affairs

---

† **N. A. Lomov, editor, *Scientific-Technical Progress and the Revolution in Military Affairs*, translated and published under the auspices of the United States Air Force (Washington: Government Printing Office, 1974, $2.25). Originally published as *Nauchnotekhnicheskii progress i revoliutsiia v voennom dele* by the Military Publishing House of the Ministry of Defense of the U.S.S.R. in the spring of 1973.**

as "revolutionary," a term used by Western analysts more than a decade ago for the changes they witnessed from afar.

On the whole, the Soviet perception of the technical dimensions of modern warfare exhibited in this volume appears strikingly accurate. For example, Chapter II, "Characteristics of New Means for Waging War," by Major General I. I. Anureyev, and Chapter III, "Conventional Weapons and Prospects of Their Development," by Major General M. I. Cherednichenko, are excellent specimens of straightforward narrative designed to help produce an officer informed in the technical problems of modern warfare. For the Soviet military professional, ideological discussion and extraneous issues clearly have no place in the description of the performance characteristics of a weapon system or its employment. This is not to suggest, however, that the Soviet authors consider ideology extraneous or irrelevant in forming a realistic perception of modern warfare.

Setting the correct ideological viewpoint on the subject is certainly part of the book's purpose, but such discussion does not interfere with the technical sections and appears in isolation or is kept to appropriate chapters. This does not justify the distortions that appear in the book. The statement that "all science in the capitalist world has become militarized" (p. 29) probably is as ridiculous to some Soviet officers as it is to the Western reader. Such as extreme view suggests the Soviet author may be transferring the experience of the politicization of scientific institutions in his own country to the Western world. The historical selectivity exercised in portraying the Soviet Union's role at the end of World War II and in the description of the development of nuclear weapons is also offensive to the Western reader in its inaccuracies. (pp. 34–35) The limited and selective nature of this historical information explains the possible willingness of some Soviet officers to accept a distorted view of the role and motivation of the Soviet Union in military and political affairs. Nonetheless, the overall effect of the volume is to provide reasonably accurate information on the nature of modern warfare. Marxism-Leninism certainly has not interfered with the ability to depict accurately the weapons and conditions of modern warfare for the Soviet officer. Indeed, the American officer might usefully read some of the chapters, especially Chapters II and III, for the same purpose.

Apart from the negative virtue of not serving as a fatally distorting prism for the technical realities of modern warfare, does the ideology provide any unique or valuable insights about the problems of modern warfare? Can an American officer, moreover, develop insight about the Soviet viewpoint through reading the translation provided by the Air Force? Undoubtedly he can, but the success of his effort depends partially on an awareness of some of the difficulties he faces. The largely nonideological training of the American officer, at least in a formal sense, may make it difficult for him to take seriously the frequently turgid prose of Soviet ideological discussions. This attitude could undermine the attempt to understand the Soviet viewpoint. To underestimate those we do not like is axiomatic; even more probable is the likelihood of underestimating what we do not understand and do not like. Disliking ideologies antithetical to our own is easy enough, but misunderstanding them is inexcusable. The core of what is unique about the perception of the Soviet officer will not be found in his description of weaponry. The truly dis-

tinctive element is ideological. But fighting one's way through a seemingly useless discussion of the application of the dialectic to a given military problem is useful only if one believes it useful to understand the probable mode of a Soviet officer's reasoning.

What is the significance of the ideological component for the thinking of the Soviet officer? To recall Kennan's anecdote: Are the Soviets going where they are looking? Are they looking, ideologically, where they are going? To be sure, both the Soviet and the American officer can be highly professional without ideological training. Especially from the American viewpoint, the less ideological the officer's makeup, the better he may be professionally. Nonetheless, ideology is an ever present component for both American and Soviet officers, whatever its relative significance. It should not be dismissed lightly in any event when viewing the Soviet officer. Rather, it may be valuable to recall that for the Soviet officer Marxism-Leninism may be not only a political philosophy and a world view but also a dynamic and flexible critique, which should provide useful insights on professional problems when mastered. This oft-repeated premise is stated in the conclusion: "Marxist-Leninist teachings create a scientific basis for correctly understanding social phenomena, and for analyzing the patterns of war, the methods of waging it and the trends in the development of military affairs." (p. 275)

Perhaps one of the most important points of emphasis in Marxist-Leninist ideology concerning modern warfare is the relationship between the "masses" and war. Simply, as the author states: "Wars are waged by people." (p. 187) The key factor for Soviet victory in a potential conflict is not economics, weaponry, or military theory. Rather, "Man has always been and remains the decisive force of war." (p. 188) This belief leads to the conclusion that "war is a process which is inseparably intertwined with all aspects of social life." (p. 224) In keeping with this belief, questions of civil defense, paramilitary training, and the concept of total mobilization of a society in all its facets and dimensions receive a high priority in the Soviet Union, an understandable development in the light of Marxist-Leninist ideology. In turn, the lack of priority given to these considerations in the United States, a country that shares with the Soviet Union a similar sense of urgency and immediacy for the problems of modern warfare, is also explainable from an ideological viewpoint. If Marxism-Leninism suggests a valuable approach to the relationship between society in all its aspects and modern warfare, a weakness is the single-factor emphasis on the significance of the economic underpinnings of a society. According to the Soviet view, "In modern bourgeois society, there is no main objective basis for ideological unity of the nation, that is, a unity of the fundamental economic interests of the basic classes and social groups." (p. 196) This single-factor approach holds as much promise for error as Hitler's reliance on race in misunderstanding the capacity of mongrelized Americans for unified political and military action in World War II.

Because of the similar nature of the problems of modern warfare for both the United States and the Soviet Union, reading the Soviet views occasionally produces the sensation of looking into a mirror that accurately reflects some features of American experience and distorts others. The "revolution" in military affairs described by the Soviet authors has increased the similarity of the mili-

tary problems of both countries as modern industrial states. In spite of all the differences between the two societies, the Soviet Union has been following a path of historical experience along which countries of the West have already traveled, the path of modernization. This means that the Soviet Union is destined to experience some of the same problems and successes as the United States, whatever the differences may be in the distribution of economic burdens and social benefits for the members of each society. Moreover, the general technological leadership of the United States has forced the Soviet Union to accept standards of success determined by American achievements, an experience that is not unique to the Soviet period of Russian history. Russia has been reacting directly to Western achievements in military technology since before its defeat in the Crimean War. To some degree, the society of revolutionary Communism is guiding its progress down the road of historical development by what it sees in the rear-view mirror of capitalist American experience.

Many of the problems of directing and managing the new weaponry accruing to the Soviet armed forces as a result of the "revolution" in military affairs have been experienced by Western military forces. The masses of data and complex problems now accompanying Soviet military developments also occurred in the West, where the use of computers and systems analysis set achievements and standards not yet fully duplicated by Soviet computer technology and cybernetics. The Soviet authors are correct in suggesting that the problems of the Soviet military are part of developmental difficulties facing all of Soviet society in its continuing modernization.

Just as the problems of direction and control for the increasingly complex Soviet economy have become more difficult, so the requirements placed upon the Soviet commander have grown. Old systems of communication and data management no longer suffice. The quantitative dimensions of the problem have grown to such an extent that the situation has changed qualitatively for the worse. Like many Americans, many Soviets believe that problems created by technology can be solved by technology. Lenin, early in the history of the Soviet state, expressed the belief that Bolshevik direction of Russian society, plus the development of electricity, would hasten the arrival of Communism. Today's hope is in computer technology and automation. Seen as the means of solving many production and distribution bottlenecks in the country, computers are viewed as essential for development of the most efficient and effective military performance: "In other words, a good staff armed with an automated control system is the most advanced troop control body which can be imagined today." (p. 179) The potential effectiveness of the Soviet commander is therefore viewed as partially contingent upon his technological resources.

However, the most important determinant of the Soviet commander's effectiveness on the battlefield of modern warfare is not the efficient use of technical control devices. Recalling the Soviet view of man as the decisive force in war, ideological factors remain foremost in the Soviet view of modern nuclear warfare. Despite the "revolution" in military affairs resulting from the overall progress of the Soviet Union, the most important revolution in determining the elements peculiar to the Soviet viewpoint remains the Bolshevik political revolution of 1917 and its accompanying ideology, not the rev-

olution of scientific-technical progress. Moreover, the latter developments increase rather than decrease the ideological role of the Soviet commander, especially for the political indoctrination of his subordinates:

> The role of ideological stimuli has increased in the conduct of a soldier, since without aware [conscious] loyalty to duty and a readiness to fight in the name of the just goals and interests of one's people, one can scarcely expect that selfless risk and even self-immolation which are required in modern combat. (p. 204)

The Soviet military commander is only part, however, of the mobilization of the entire society, for "in the event of a war, there emerges a particularly crucial problem of providing ideological unity of the entire people, their solidarity, monolithicness, or in other terms, the problem of the united will necessary for mobilizing all the forces of the people." (p. 195)

AN UNDERSTANDING of the Soviet view of modern warfare is incomplete without an investigation of its ideological dimensions. This volume translated by the Air Force is a useful contribution to that end, and its sponsors should be congratulated on the value of their efforts for the understanding of a potential enemy by the officer corps at large. Knowledge of weaponry and technological capability is insufficient for understanding the Soviets' broader purpose and motivation. We expect them to grasp some of our larger purposes as a society, apart from sheer military capability. We need to attempt no less in understanding them.

United States Air Force Academy

Notes

1. *Russia and the West under Lenin and Stalin* (New York), p. 16.
2. For a review of the first two volumes in the series translated under the auspices of the United States Air Force, see Dr. Kenneth R. Whiting, "Some Sense and Some Nonsense: Two Soviet Books on War, the Army, and Strategy," *Air University Review*, XXVI, 2 (January-February 1975), 83–91.

The Contributors

CAPTAIN MICHAEL O. WHEELER (USAFA; Ph.D., University of Arizona) is an Associate Professor, Department of Political Science and Philosophy, United States Air Force Academy. He has served as an intelligence officer, Hq Tactical Air Command, and in Thailand. Other assignments were with the Directorate of Plans on the Air Staff and with the Bureau of Politico-Military Affairs, State Department. Captain Wheeler is a graduate of Squadron Officer School, Air Command and Staff College, and Industrial College of the Armed Forces.

COLONEL RICHARD D. YOUNGFLESH (USMA; M.S., Air Force Institute of Technology) was USAF Research Associate at the School of International Relations, University of Southern California, until his recent assignment to the 4000th Aerospace Applications Group (SAC), Offutt AFB. He served on the Joint Staff, J-5, as a military staff assistant at Strategic Arms Limitation Talks and on the Air Staff in Plans. He is a command pilot and flew C-123s in Vietnam. Colonel Youngflesh is a graduate of Armed Forces Staff College.

MASTER SERGEANT DICK LARSEN is a writer for the Public Information Office, Hq Allied Forces Central Europe, Brunssum, The Netherlands. He served five years as a photographer and had assignments in England, Vietnam, and the United States. In Vietnam as journalist and combat historian, he was named best combat historian in Vietnam for two consecutive quarters. He is author of more than 20 magazine articles in *Air University Review, Army, Airman, British Army Review, Air Force Magazine*, etc.

LIEUTENANT COLONEL THOMAS C. BLAKE, JR. (M.B.A., George Washington University) is assigned to the Directorate, Development Plans, Hq AFSC. A tactical aircraft pilot with some 1000 combat hours, he has had overseas assignments in Japan and Europe and two voluntary tours in Southeast Asia. Other assignments have been at Hq TAC and at Hq USAF. Colonel Blake is a graduate of Squadron Officer School, Air Command and Staff College, and Air War College.

LIEUTENANT COLONEL WALTER T. BROWN, JR. (USMA; Ph.D., Massachusetts Institute of Technology) is a Tenure Associate Professor of Mathematics, U.S. Air Force Academy. Previous assignments have been as Director of the Army's Benet Research, Development, and Engineering Laboratories; with the 25th Infantry Division, Vietnam; White Sands Missile Range, New Mexico; 82d Airborne Division; and Ranger School. Colonel Brown is a graduate of Army Command and General Staff College and a distinguished graduate of Air War College.

WILLIAM G. HOLDER (B.S.A.E., Purdue University) is an intelligence engineer with the Foreign Technology Division, AFSC. He has worked with the Boeing Company on the Bomarc B and the Saturn V. As a lieutenant in the U.S. Army, he served three years as an air defense guided missile instructor. Mr. Holder is the author of numerous technical and historical articles and books, including *Saturn V–The Moon Rocket* (1969) and *Boeing B-52: The Stratofortress* (1975).

MASTER SERGEANT FREDERICK K. SNYDER is an Instructor Radar Supervisor, 552d Airborne Early Warning and Control Group (ADC), McClellan AFB, California, where he applies Instructional System Development (ISD) principles to training EC-121 radar operators. He has more than 3800 hours in the EC-121, including 130 combat missions in Southeast Asia, and tours at ground radar sites in Iceland and the Philippines. Sergeant Snyder is a distinguished graduate of ADC's NCO Academy.

MAJOR RELVA L. LILLY (USAFA; M.S., University of Southern California) is Chief, Target Management Branch, Joint Operations Staff (J-3), United States Support Activities Group, Thailand. He spent six years as a pilot, aircraft commander, and instructor pilot in the F-4, including tours in SEA and USAFE. Entering the rated supplement in Air Force Systems Command, he was project manager for the F-15 Electronic Warfare Warning Set and advanced countermeasures concepts. Major Lilly is a graduate of USAF Fighter Weapons School and Air Command and Staff College.

LIEUTENANT COLONEL ROBERT H. EMMONS, JR. (M.S., Troy State University) is Commander, 744 Aircraft Control and Warning Squadron (AAC), APO Seattle 98750. He recently completed an assignment as Deputy Director of Curriculum, Air Command and Staff College. He has served primarily in air defense or tactical air control operations, on the ADC Operational Readiness Inspection team, the NATO staff, and as an adviser to the Vietnamese, Italian, and German air forces. Colonel Emmons is a graduate of Squadron Officer School, Air Command and Staff College, and Air War College.

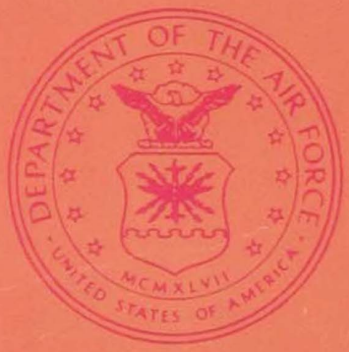
MAJOR CARL W. REDDEL (Ph.D., Indiana University) is Associate Professor of History, United Seates Air Force Academy. He served with the 2d Mobile Communications Group in Europe and participated in the CHECO (history) program in Southeast Asia. Currently he is at Moscow State University, U.S.S.R., performing research under the sponsorship of the International Research and Exchanges Board (IREX).

AWARD

The Air University Review Awards Committee has selected "Some Myths about the Strategic Balance" by Mrs. Amoretta M. Hoeber as the outstanding article in the July-August 1975 issue of *Air University Review*.

ATTENTION

Air University Review is published to stimulate professional thought concerning aerospace doctrines, strategy, tactics, and related techniques. Its contents reflect the opinions of its authors or the investigations and conclusions of its editors and are not to be construed as carrying any official sanction of the Department of the Air Force or of Air University. Informed contributions are welcomed.



UNITED STATES AIR FORCE AIR UNIVERSITY REVIEW