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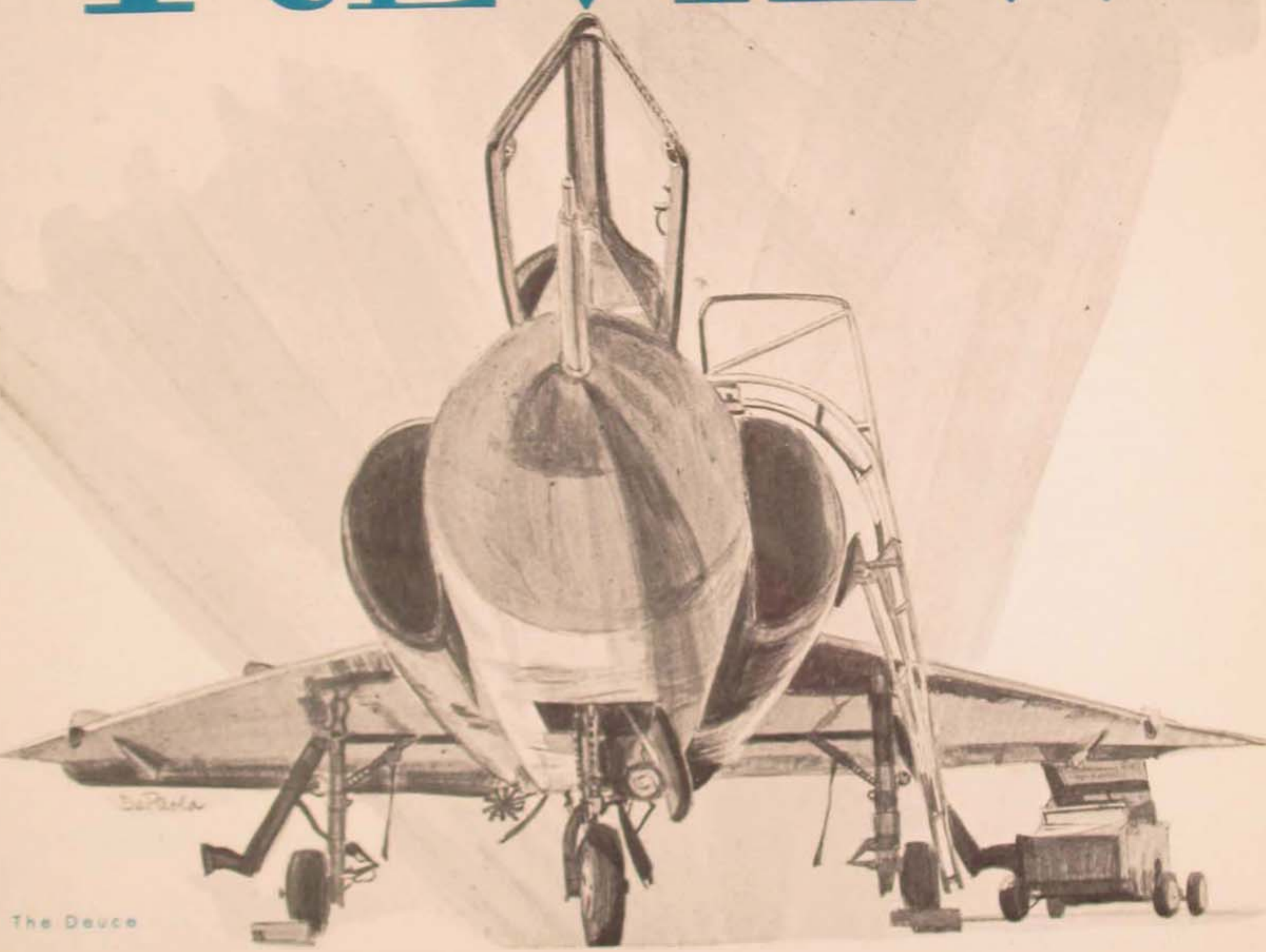

The Deuce

NUCLEAR FORCES AND THE FUTURE OF NATO . . . F-102 OPERATIONAL TRAINING . . . OVERKILL AND UNDERTHOUGHT

JULY-AUGUST 1964

UNITED STATES AIR FORCE

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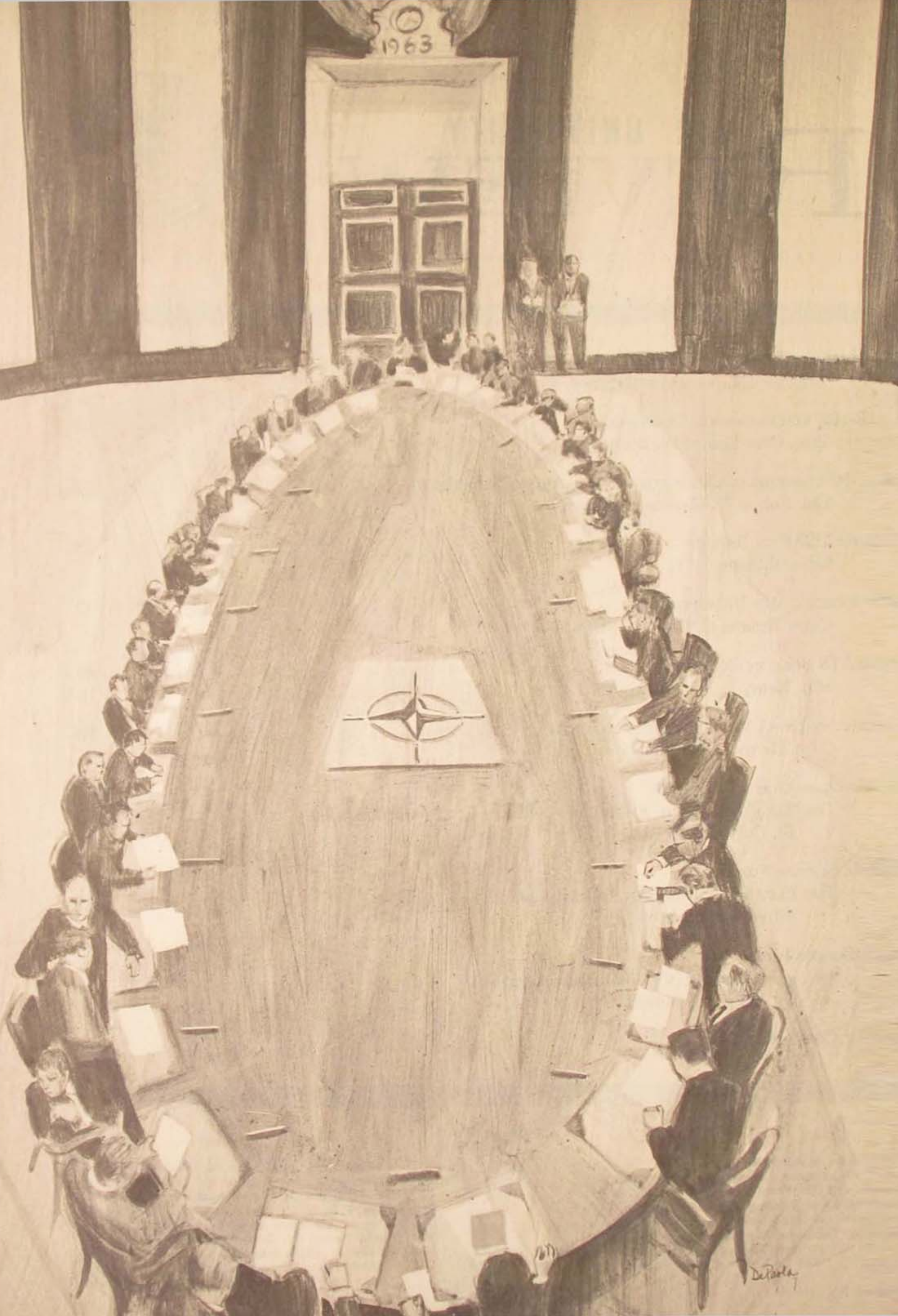
the cover

Operational units of the Air Defense Command now get combat-ready F-102 interceptor pilots through the highly professionalized training by the 4780th Air Defense Wing (Training) at Perrin Air Force Base, Texas. Brigadier General Robert W. Burns discusses this "Deuce" training, which relieves combat units of transition flying responsibility and enables them to concentrate on the business of air defense.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NUCLEAR FORCES AND THE FUTURE OF NATO

Brigadier General E. Vandevanter, Jr., USAF (Ret)

FOR MORE than a year now, strategists and policy makers have carried on a cross-Atlantic dialogue over the merits of the American proposal for a combined NATO multilateral nuclear force (MLF). Protagonists on both sides of the ocean continue to hold divided opinions as to what is at stake. Is the mixed-manned MLF a vital necessity to smooth relations with our European colleagues, or is it, as some have maintained, more apt to divide than unite the alliance? In either case, if the MLF should have to be scuttled because of lack of allied enthusiasm, what are the alternatives?

The area of maneuver for the strategic nuclear strike force issue is hemmed in on three sides by hard, seemingly immovable restrictions. First, France is by now bound and determined to have her own independent *force de frappe*. In retrospect, one can now guess that de Gaulle was almost certain to refuse the Nassau offer.* Even without de Gaulle, France could, and probably would, press its nuclear program to completion.

Second, a European community deterrent would have little purpose if its use were subject to a United States veto. Confidence in the American ability to provide active strategic deterrence is now waning because Europeans doubt that the United States would, in many cases, take action that might risk the devastation of America. This is no reflection on our bravery—or our integrity. Rather, Europeans regard their own suspicion as an acknowledgment of our propensity for making rational decisions in such matters. In any event, if Europeans think we may hesitate to come to their aid, their concern would not seem to be allayed by an arrangement that includes an American finger on the "safety catch."

But a third factor—fear of possible ungoverned German resurgence—generates demands for some type of control mechanism which would prevent unilateral national use of the component parts. Not only the Soviet and satellite nations would strenuously object to an independent, nuclear-armed West Germany; even neutrals and most of our allies would oppose such a course.* The Nassau formula of a

*Incidentally, some Americans still argue incorrectly that the French "turned down our offer of nuclear weapons." As far as is known, the Nassau proposal represented no change in the United States position regarding nuclear weapons sharing. According to the Nassau communiqué, the proposal involved "Polaris missiles (without warheads)." In the French view, this was like refusing to throw a life line to a tired swimmer but telling him you would have a scotch and soda ready if he made it ashore. The French needed warheads, not missiles, as de Gaulle emphasized in his reply.

*Most objectors are less emphatic in their opposition than the heir apparent to the role of British Prime Minister, Mr. Harold Wilson, Britain's Labour Party leader. He is reported to have said: "We are completely, utterly, and unequivocally opposed, now and in all circumstances, to any suggestion that Germany, West Germany or East Germany, directly or indirectly, should have a finger on the nuclear trigger. . . ." Laurence W. Martin, " 'Honest Brokers' in the Nuclear Muddle," *The Reporter*, Vol. 30, No. 1 (2 January 1964), p. 21.

NATO Conference, Ottawa, 22–24 May 1963 multinational Polaris armada, with each nation allowed to determine for itself the circumstances under which it could withdraw its contribution for independent national use, could not, in the opinion of allies and opponents alike, be applied to the German Federal Republic. The one course most likely to shatter NATO would be acquiescence in loose or ineffectual controls over West German nuclear armament.

Faced with these contradictions, what policy should the United States pursue? One course would be simply to let matters work themselves out. But this course, too, has its dangers, for, left to themselves, the energetic Germans might ultimately take matters into their own hands, either by repudiating their commitment not to manufacture nuclear weapons or by acquiring them from other sources. The MLF proposal was an attempt to head off unilateral German action by tying the Federal Republic into an unbreakable, mixed-nationality association with Britain and the Continental have-nots.

But Europeans have hardly waxed ecstatic over the American suggestion—in fact, some seem downright skeptical about its practical value.[1] They boggle at the cost to them of providing what would amount to only a tiny fraction of the U.S. unilateral nuclear delivery capacity. They note that the characteristics of the Polaris missile are such that the force would be configured for a "counter-cities" role. Yet the *surface* fleet proposed by the Americans would not ensure the degree of survivability against a pre-emptive enemy attack that a "counter-cities" force must possess in order to add stability to the strategic balance.

Overactive American sponsorship could generate hesitations among those who must participate, some of whom are naturally unenthusiastic and some of whom might drag their feet in familiar bargaining techniques. One should expect active opposition from the Scandinavian countries, and the southern Europeans have little wherewithal to back up their aspirations. Belgium, the Netherlands, and Italy appear to be going along reluctantly in order to exert some control over the Germans. As usual, the prime issue revolves around "who will pull the trigger" and "who will guard the safety catch." With so little enthusiasm for the project, deliberations over these complex procedures could be dragged out interminably.

Many have questioned the wisdom of the American policy. They wonder if a contrived community endeavor represents the only solution. Professor Henry Kissinger, for one, maintains there is a better alternative.[2] He favors a course of encouraging the French and British to form a European strategic force independent of the United States. Through the natural course of events he believes the most affluent European nation, Germany, would be drawn into this consortium, thus satisfying her yearning for strategic power. This proposal does not really come to grips with the matter of how to govern the German contribution. Could the British and French, having for years insisted on the sovereign right of nations to defend their own vital interests, reverse themselves by asking for restraints on Germany's employment of *its* component? Many observers feel that Kissinger vastly underrates the grass-roots opposition to such a semi-independent German nuclear rearmament.

Another pragmatist, Hans Morgenthau, takes a pessimistic attitude.[3] He predicts that a separate French national striking force would mean that "the alliance will for all practical purposes be dissolved." Since the *force de frappe* appears inevitable—or is already in existence, if we take the French word for it—the dissolution of NATO may soon be upon us. A logical question might therefore be, Is the alliance worth attempting to preserve under these conditions?

Originally, we are told, the North Atlantic Treaty was conceived solely as a means of guaranteeing a prostrate Europe that America would not leave it undefended against Soviet aggression. If this purpose is no longer served, what is the value of the coalition? Actually the very factors which have caused the loss of strategic significance seem to have increased the necessity for common defense. If America, with a reduced nuclear superiority and itself now vulnerable to attack, can no longer offer the same degree of protection through strategic deterrence, does it not become more important that the Continentals be able to provide a larger measure of their own defense?

The NATO association has demonstrably strengthened both the physical and psychological security posture of Europe. Without the backing of the other allies, it is hardly likely that, a few years back, little Norway—or, more recently, Greece—would have felt able to reject insolent Soviet demands. Without the alliance as a medium for consultation, negotiation, and reconciliation, it is doubtful that the Free World could present a common face to the Communist bloc on any matter. And finally, without the NATO military organization, the Europeans could hardly have accomplished the buildup to a formidable composite military force that has taken place in the past decade.

Beyond doubt, NATO is a valuable asset well worth striving to save. But NATO is only an alliance, an association of states which moves forward only when all members are interested in the same course of action. Each nation must view NATO's programs from the utilitarian standpoint of what policies would best further their own interests. What does the United States seek from the alliance?

Militarily, the answer to this question stems from two complementary functions: deterrence and defense. Some still see the alliance in the original context: as a manifestation of intent by all the allies to unite in opposition to aggression in Europe. Others place more emphasis on the role of welding the individual national potentials into the most capable fighting machine. But in either case there are important qualifications. Americans would reject any commitment so binding that it could take them into war without a decision on their part; nor would they accept any restriction which precluded their following a forceful, independent course in non-NATO areas like Cuba, Taiwan, and Africa.

Between deterrence and defense, as between the terms strategic and tactical, a useful distinction can be made if one does not carry it too far. For our purpose, it helps to consider one interrelation between these descriptive terms: strategic forces are deterrent because they dissuade the Soviets from going to war by the threat of devastation to the motherland; tactical forces are defensive because they would be used to stem a Soviet invasion. A slight oversimplification is allowable here, for the statement differentiates the two ways in which the threat of American strategic nuclear power could be lashed to the defense of Europe. The first way we have just discussed: through an independent European community or national strategic commands. The basic premise here assumes that the deterrent effect of even a small force will be magnified by Soviet and American fear that first use of the European force would trigger a worldwide general nuclear war.

The second linkage, somewhat more tenuous, would threaten the involvement of American strategic forces through escalation. Tactical nuclear weapons integrated into the NATO shield complete the potentially escalatory circuit.

Let us look more closely at this arrangement, for it may offer a partial solution to our dilemma. Much of the firepower would be delivered by American units assigned to or earmarked for NATO use, the rest by European tactical forces. Weapons for European army, navy, and air force troops of the NATO "shield" are stored and maintained by American teams at dispersed locations. In case of hostilities, when the release order is given, the Americans would turn over the nuclear weapons to the tactical troops, who would carry them to launching positions, mate them with delivery vehicles, and fire them as directed by NATO authorities.

Conceptually, the system has served a vital need, but in practice it has obvious drawbacks. It places a heavy drain on American manpower for technical and custodial personnel. Yet it does not give Europeans the feeling of ownership they would like to have. Naturally, some Continentals will always be reluctant to rely completely on weapons which are not under their sole jurisdiction to use as they see fit. Higher NATO commanders and staff planners have chafed in the past under U.S. legal restrictions which obstructed their access to essential information about how the warheads would act and how many were available where. The recent decisions to provide additional information may well alleviate this situation.

The system is not all bad, however. Indeed, some of the so-called weaknesses could also be considered advantages. Weapons are probably better guarded and cared for in the custodial sites than they would be if scattered throughout the tactical units. The storage teams function as valuable safeguards against unauthorized firing, since both the European tactical commander and the U.S. custodian must agree that the proper release order has been received.

Moreover, the system could be improved without change in the basic pattern. American legal restrictions (or our interpretation of them) could be eased. In this connection, one should note the reported search for electronic locking devices which would, if developed, make remote control procedures more effective.[1] Some of the provisions which have kept Europeans out of the planning and control functions are anachronisms left over from the days of atomic scarcity. The barriers have recently been lowered, but just how much is hard to say. Two of the measures agreed to in the spring of 1963 at the Ottawa meeting (namely, non-American representation in Omaha and a non-American deputy for nuclear matters at SHAPE) would have been meaningless under previous limitations.

Europeans would be pleased if certain weapons now in Europe could, without leaving U.S. physical custody, be fully committed to NATO. Such a pool would form the tactical equivalent of the warhead reservoir contemplated under the multilateral nuclear force. The United States would retain the same veto right as other nations, so that nuclear war could not be initiated without U.S. concurrence. But Europeans would receive an important psychological boost from the fact that the weapons were actually theirs to dispose of in a manner decided by the international network.

Hints of such an impending arrangement have been widely circulated. The Nassau communiqué spoke of an interim plan for "subscribing" nuclear delivery forces now in Europe to NATO. Since units in Europe are already "assigned" to NATO—heretofore the highest category of commitment—there must have been an intention to create a new order of dedication. To many observers, the new status could only mean a greater corporate sharing of weapons.

The United States should not feel obliged to subscribe *all* tactical weapons in Europe to NATO, for that would undercut one of the primary advantages of the present system. The weapons now located in, say, Italy or Germany are still American. If hostilities should deteriorate to a condition in which local troops and Americans were fighting side by side in a desperate situation, nuclear weapons would probably be used if both countries wanted to, regardless of the attitude of other NATO members. This feature is one of the reasons the Germans have been content with the present arrangements. The same feature would probably be lacking in a common strategic force, and the Germans have already tabled their objections to any voting system that would require unanimous consent of all members to engage the multilateral nuclear force.

Thus, those who want to be sure the weapons are readily available for use are relatively well satisfied with current tactical arrangements. At the same time, those who worry about impetuous use also feel that the NATO process interposes reasonable precautions against premature release.

THE OBVIOUS question then arises: Will the tactical arrangement with minor modifications (to make the command and control more truly international) satisfy the aspirations of responsible Germans and eliminate the need for a strategic command? Only time can tell. A few years ago the equipping of the *Bundeswehr* with tactical atomic weapons was the ultimate goal of only the most militant German rearmers and far beyond the desires of the moderates. Even Strauss stopped there. Chancellor Adenauer reluctantly swung over to the support of tactical weapons only after having sensed the opposition to large conventional armies.

German public and official opinion toward nuclear arms, originally characterized by passivity, has been growing more active with time. There is nothing at present, however, to suggest a widespread desire for strategic power. True, Bonn has been the staunchest European advocate of the MLF, which it seems to recognize as the best way to ease the Federal Republic into strategic activities. This attitude does not represent a self-generated campaign to insist on a strategic role; it is more a considered selection in response to the choices offered her.

Many observers feel that German concern is still directed primarily at the battlefield. Germans live with the constant knowledge that they, of all the allies in Central Europe, are most exposed. In spite of recent reassuring estimates of overall allied troop superiority, most Germans still believe that a European conventional war would be fought in Germany, with much of the country being overrun. Any apparent Western reluctance to use nuclear weapons from the outset might tempt the Soviets to bite off a piece of territory and then negotiate as to *how much* they should give back. Therefore, the prime German objective has been—and still is, in the eyes of many—to weave nuclear weapons inseparably into the forward defense at the Iron Curtain. This aim overshadows any incipient desire to engage in strategic deterrence.

Why then the American desire to deal primarily with strategic problems? At the Ottawa conference the other allies made plain their preference for improving the machinery for planning and control of *tactical* nuclear weapons. Many Americans, too, feel that the delicate issues of tactical control present the really critical problems. As limited wars become more likely, the chances for misuse of nuclear weapons multiply—more quickly with less rigorously controlled frontline weapons. Paradoxically, the vital issue of general nuclear war might hinge more importantly on how the Western allies handle battlefield and other tactical weapons than on how shrewdly they manipulate the threat of strategic attack.

Yet the American reticence to grasp the thorny problem of sharing tactical nuclear weapons is still consistent: it stems from the Administration's fundamental desire to *widen* the gap between conventional war and general nuclear war. In the Administration's view, frontline nuclear weapons in non-American hands are antithetic to that aim, for diffused control could shorten the fuse between a conventional spark and the combustion of a limited nuclear war—and limited nuclear war in Europe (if such a condition is possible) could easily escalate into full-scale war. Washington wants to "preserve the options," including the option to fight a large conventional campaign. Unhappily, an elaboration from one side of the water sometimes merely confirms previous suspicion on the other side. American proposals for conventional defense reinforce the anxiety that limited war means "limited to Germany." Bonn's arguments in favor of integrating nuclear weapons in troop units stationed near the frontier lead Administration strategists to fear that a minor conflict in Europe could flare inadvertently into a general-war nuclear holocaust.

Oddly enough, the present patchwork system seems to come as close to a workable compromise as any scheme yet suggested. As explained, it offers some advantages that a more clean-cut arrangement could not duplicate. In deciding to emphasize the tactical network in lieu of a separate European strategic deterrent, the United States would have several factors working in its favor.

First, the impetus would be coming from elsewhere. All Europeans, not even excluding the French, have an interest in tactical nuclear weapons. The British in particular, while not enamored of a hair-trigger nuclear response, favor an immediate emphasis on nuclear support for the shield, for in this endeavor they could make the greatest contribution at a time when they sorely need bargaining material.

Second, the modifications which would

make the system more attractive to Europeans in general, and to Germans in particular, are modest and politically feasible. They would depend mainly on changes in American attitude and some legal refinements. The latter process might be time consuming, but this does not necessarily represent a disadvantage.

On the debit side, one must admit that focusing on tactical issues might merely postpone a final reckoning with the Germans on the matter of strategic power. But the chances are more than negligible that the Germans will be permanently content with the close tactical tie to American strategic power. Even if the solution proves only temporary, a delay will probably be beneficial. All indications point to a willingness on the part of the Erhard government to approach matters of politico-military strategy with an open mind.

Advocates of the multilateral nuclear force have consistently opposed the mobile mid-range ballistic missile (MMRBM) for European forces as being militarily unnecessary. Yet this weapon could be integrated easily into the forces of Allied Command Europe without creating a fractional part of the political dilemmas involved in the MLF. The central problem is one of control. MMRBM's could be installed under the jurisdiction of the Supreme Allied Commander, Europe, whose command and control arrangements have so far provided the only workable formula. If such weapons can be supplied to German forces under conditions of control which satisfy the Germans but which do not unduly alarm the Soviets or the allies, could they not provide with less political friction the same firepower now contemplated for the surface missile ships of the MLF?

WORKING through the established framework, i.e., remodeling the tactical procedure and expanding the force, will tend to solidify NATO. Military officers of all nations want to have a voice in nuclear weapons planning. Non-American commanders want to be guaranteed that weapons will be available to them; they want to be assured that their influence will decide how these weapons are to be used. Arrangements for increasing the participation of the NATO staff and non-American commanders will add enormously to the solidarity and *esprit* of the international network.

I have argued that the multilateral nuclear force is not a *sine qua non* for sharing nuclear weapons in NATO. The mixed-manned surface fleet was a worthwhile gamble, one which would solve many a sensitive political issue if it could ever be brought safely into port. It may yet succeed in spite of its deficiencies. But the point is that we need not pin all our hopes on the MLF successfully negotiating the reefs ahead. The tactical nuclear apparatus also represents a useful vehicle for improving the sharing and control arrangements with our allies. Our course should be planned with enough flexibility to allow us to shift emphasis as the situation unfolds.

Washington, D.C.

Notes

1. Drew Middleton, "NATO Fleet Plan Is Opposed in Panel of European Union," *New York Times*, 5 December 1963, p. 1, col. 6.

2. Henry A. Kissinger, "NATO's Nuclear Dilemma," *The Reporter*, Vol. 28, No. 7 (28 March 1963), pp. 22-37.

3. Hans J. Morgenthau, "The Crisis in the Western Alliance," *Commentary*, Vol. 35, No. 3 (March 1963), pp. 185-190.

4. See Klaus Knorr, *A NATO Nuclear Force: The Problem of Management* (Princeton, New Jersey: Center of International Studies, 1963), p. 10.

F-102 OPERATIONAL TRAINING

Brigadier General Robert W. Burns

IN 1961 the ballistic missile threat became so urgent that Air Defense Command was compelled to place one third of its force on alert status. In assuming this posture, it became painfully apparent that tactical squadrons could no longer tolerate a significant percentage of non-combat-ready pilots. The work week for operationally ready pilots—consisting of alert duty as well as instructing pilots not operationally ready—was stretching into the 90-hour category. While under some conditions a 90-hour work week could be an acceptable way of life, the prospects as a matter of routine in "peacetime" were not likely to encourage long tenure among the officer personnel or many re-enlistments among the airmen.

Further, the lack of standardization in the transition and checkout processes among all the fighter-interceptor squadrons in the command made the concentration of combat-crew training at a central location appear not only desirable but the only feasible solution to the problem.

To this end Air Defense Command acquired Perrin Air Force Base, Texas, in mid-1962 from the Air Training Command, which had initiated F-102 pilot training there two years previously. The base, its 4780th Air Defense Wing (Training), and facilities were assigned to the 73d Air Division, headquartered at Tyndall AFB, Florida. The 73d, with its USAF Interceptor Weapons School and newly created F-101 and F-106 combat-crew training school, became Air Defense Command's "school-teaching division," responsible for all ADC interceptor pilot qualification.

Under Air Training Command the F-102 school at Perrin already had adequate academics and flying programs to accomplish the transition mission. Training, however, stopped at the checkout point, and new interceptor pilots sent to tactical squadrons required further mission-oriented training. This was the heart of the problem.

To the existing program, Air Defense Command added an intensive mission-oriented qualification training phase including academics and extensive flying training in ADC mission profiles. Using tactical squadron procedures as a foundation, the command instituted realistic training, conducted in an air defense environment by experienced F-102 instructor pilots.

The result of this expanded and standardized training program is an annual production of 120 new combat-ready F-102 interceptor pilots who require only a local area check ride at their new home base to be fully qualified to stand alert.

There are other products of the school, all aimed at filling the interceptor cockpits with qualified, operationally ready pilots. Some 50 "turnabout" and F-101 conversion pilots are graduated annually. These are qualified jet pilots retrained in the F-102 interceptor in an accelerated program. The school also provides some 50 F-101 "lead-in" pilots annually for the Voodoo interceptor school at Tyndall AFB.

Since successful training in an air defense environment requires a high degree of professional experience, Air Defense Command went to the field for the school's instructor force. Experience minimums call for 1000 hours' total time, of which 200 must be in the F-102. The present 100-man instructor force averages far above this level. The average instructor pilot possesses in excess of 650 hours of combat-qualified F-102 time and more than 7 years of rated, commissioned service with the U.S. Air Force. The combined weight of this experience adds considerable polish to the training program and ensures a maximum degree of professionalism and individual approach to the flying training given each student.

To ensure complete understanding of the F-102 training program, each instructor is required to take the basic "long course" on assignment to Perrin and annually take a refresher course, primarily in the academics phase. Most instructors also attend initial academics classes with assigned students to get the feel of the instructional pace and individual student problems.

The training, constantly under change to keep it current, is a precisely balanced combination of academics, simulator, and flying training. Each phase dovetails into the next to ensure continuity and standardization. Qualification training, constituting the final half of the training time, has built-in flexibility to allow addition of new material.

The so-called long course is the primary function of the school. This is a 26-week (108-day) combination of academics and flying, calling for 130 classroom hours and 146:30 flying hours (93 sorties). Flying training also includes an additional 293 ground hours in briefing, debriefing, and simulator.

The accompanying chart shows the training-day sequence and interlocking training phases.

The F-101 lead-in course parallels the long course through the 90th day, when students move to Tyndall AFB for F-101B interceptor training. The parallel exists again in the F-102 turnabout course, although the latter is of a shorter duration.

Students in the F-101 lead-in course are provided a minimum of 83 flying hours, 275:30 ground hours (simulator and briefing), and 113 academic hours. The cutoff point is at the qualification training phase.

The turnabout course, calling for 60:30 flying hours, 221:30 ground training hours, and 130 academic hours, totals 63 training days. It is designed to qualify rated pilots who have been previously qualified as interceptor pilots in single-place fighters as operationally ready F-102 pilots.

The F-101 conversion course of 36 training days qualifies operationally ready F-101B pilots as operationally ready F-102 pilots. Flying training includes 27 hours on 18 sorties, 106:30 ground hours, and 82 academic hours.

Early emphasis in all courses is on instrument procedures. Since the student inputs in the long course are all recent flying school graduates, this is a refresher in academics and an opportunity to log a considerable number of hours in the T-33 on mission flying and target flying.

Flying safety is stressed throughout the course, as are emergency procedures. Simulator rides often exceed the minimums, and in most cases students will log more than the minimum hours in flying training. Data link missions are flown, when possible, in time division data link (TDDL)-modified F-102 aircraft based at Perrin. Perrin operates a ground-controlled interception (GCI) facility for radar mission training.

Training Days	Morning Schedule	Afternoon Schedule
1–5	Pre-Interceptor (Classroom)	Pre-Interceptor (Classroom)
6–9	T-33 Flying (Instruments)	T-33 Flying (Instruments)
10–18	T-33 Flying	Link (Instruments)
19–22	T-33 Flying	F-102 Engineering (Basic Academics)
23–27	Simulator F-102	F-102 Engineering (Basic Academics)
28–36	Simulator F-102	T-33 Flying (Procedures-Target)
37–40	F-102 Transition (Flying)	(Open)
41–45	F-102 Transition (Flying)	(Open)
46–54	Basic Radar (Academics)	F-102 Transition (Flying)
55–63	Basic Radar (Flying)	Advanced Radar (Academics)
64–67	Simulator	Basic Radar (Flying)
68–72	ADC Indoctrination (Academics)	Basic Radar (Flying)
73–81	Basic Radar (Flying)	Basic Radar (Flying)
82–86	Qualification Training (Academics)	Advanced Radar (Flying)
87–90	Simulator F-102	Advanced Radar (Flying)
(Cutoff point for F-101 lead-in course)		
91–99	Alert Hangar Qualification Training	
100	Briefing/Tyndall AFB Deployment/Firing	
101–108	Qualification Training/Tactical Evaluation/ Graduation	

Probably the most unusual "final exam" in the command is the deployed flight firing mission to Tyndall AFB, some 800 miles to the east. Student and instructor aircrews posted to fire the mission brief and preflight on an alert status. After take-off, they fly to the Gulf of Mexico range offshore from Tyndall AFB, fire live air intercept missiles (AIM's) against the Ryan-built Q2C Firebee drone target, and recover at Tyndall. This training affords maximum realism in navigation, fuel management, GCI procedures, and recovery procedures. If all goes according to plan, the mission, flown generally on the 100th training day, terminates the same day at Perrin.

Air Defense Command's experience with a consolidated flying training program has proved its value in increased combat capability among ADC F-102 tactical units. Reactions throughout the command prove conclusively that combat-crew training at a central location is a feasible and most satisfactory solution to the ADC aircrew qualification problem.

The program's success in its present state can be attributed to three major factors:

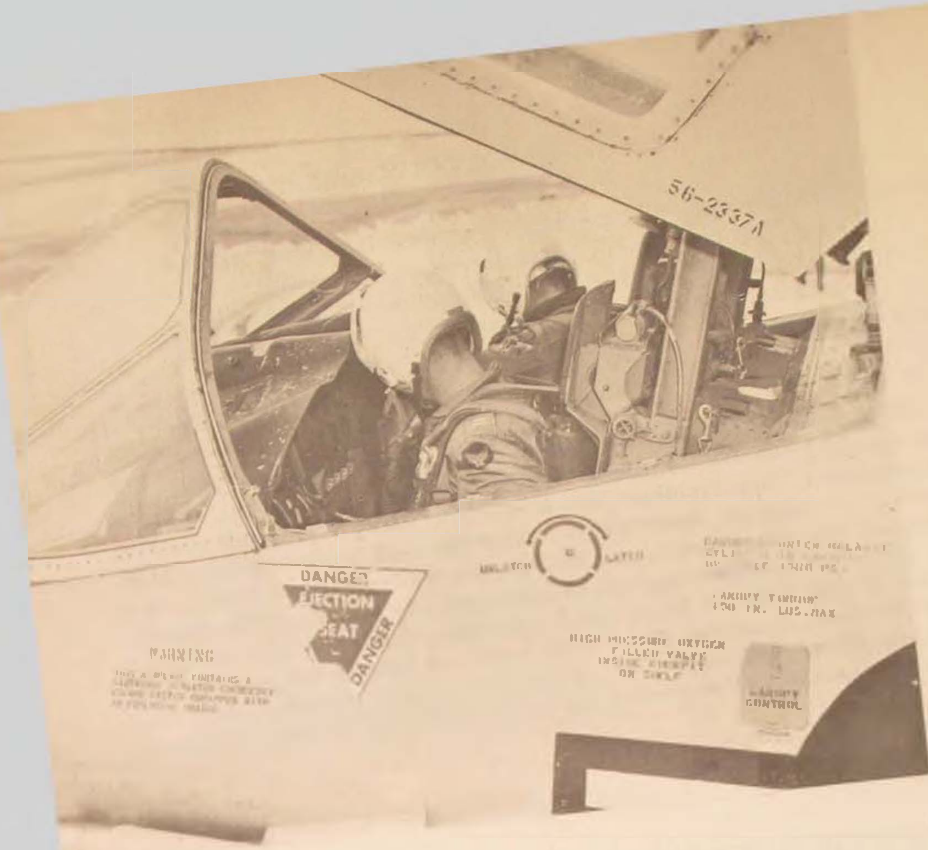
- A precise and balanced course of instruction oriented in an air defense environment
- A high degree of experience and mission-oriented ability in the instructor staff
- Strict adherence to standardization in transition and checkout processes.

Hq 73d Air Division

In classroom study at the F-102 school, the students get a general knowledge of the armament load their airplane will carry and of the MG-10 fire control system that controls the armament. Primary armament for the F-102A is the Falcon air intercept missile shown. The students learn its propulsion and guidance system during the basic radar instruction that precedes the flying-training phase. The school's academic program is individualized as much as possible to meet the needs of each student, and additional instruction in any phase of the training is always available.

Transition to Combat-Ready

The 73d Air Division is responsible for Air Defense Command's interceptor pilot qualification. It takes pilots graduated by Air Training Command, gives them transition training in the Interceptor Pilot Training School at Perrin AFB, Texas, and climaxes their training with live firing at drone targets over the Gulf range offshore from Tyndall AFB, Florida. The transition is to the delta-winged supersonic F-102 interceptor, backbone of the Air Defense Command's interceptor force since 1956. Capable of speeds in excess of 800 miles an hour, the F-102 Delta Dagger can fly combat at altitudes above 50,000 feet. It carries the Falcon radar- or heat-guided air intercept missile (AIM) in its closed armament bay. When pilots have mastered this interceptor and weapon, they are ready for combat alert status in the Air Defense Command.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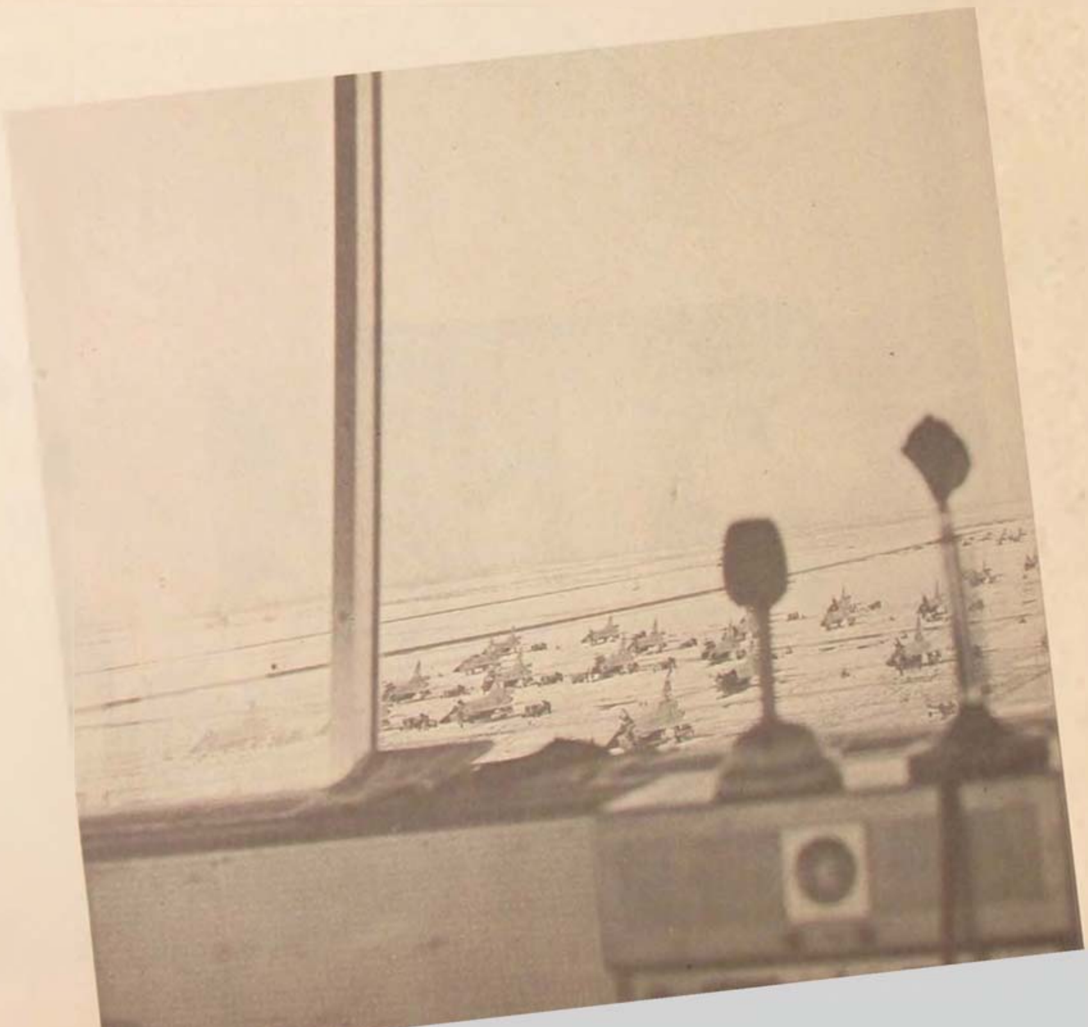

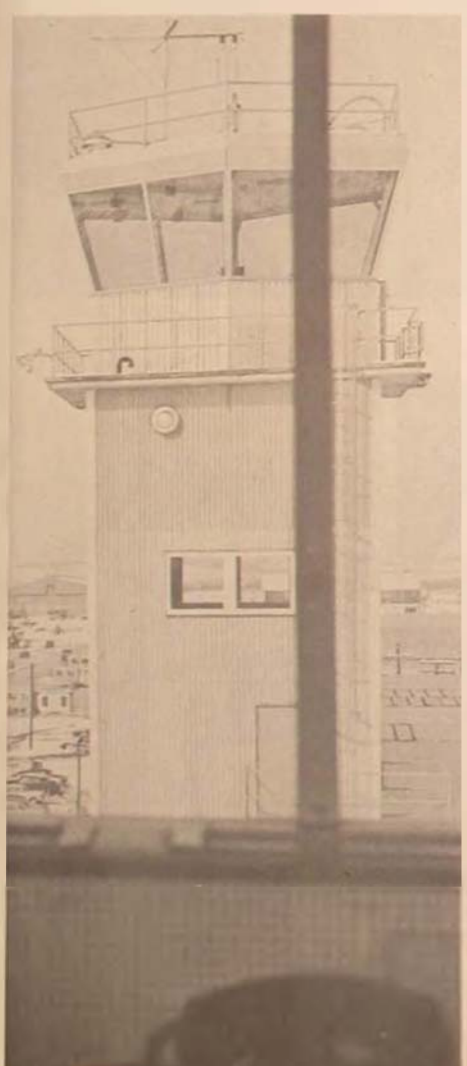

A student's initial exposure to the supersonic F-102 comes in the two-seat trainer, TF-102, used in early transition phases of flying training. Despite its bulging cockpit, it flies and shoots like its speedier single-place counterpart, which the student will take on after qualifying in the TF-102. The trainer is equipped with radar instrumentation, allowing the instructor to work firsthand with his student in radar intercept tactics, which are a basic part of the 26-week training program. . . . The command post of the 4780th Air Defense Wing (Training) is the nerve center of F-102 training activity. All flight operations are monitored round-the-clock by staff personnel representing the wing commander. The command post is much like those at ADC bases assigned to alert duty. . . . The snow-covered Texas countryside lies beyond the flight line and the F-102's poised to take student pilots aloft for training in the art of manned interceptor flying. These combat-ready aircraft have a secondary mission, to support the Nation's air defense system in time of emergency. From Perrin's old control tower the view takes in the new tower opened early in 1964.


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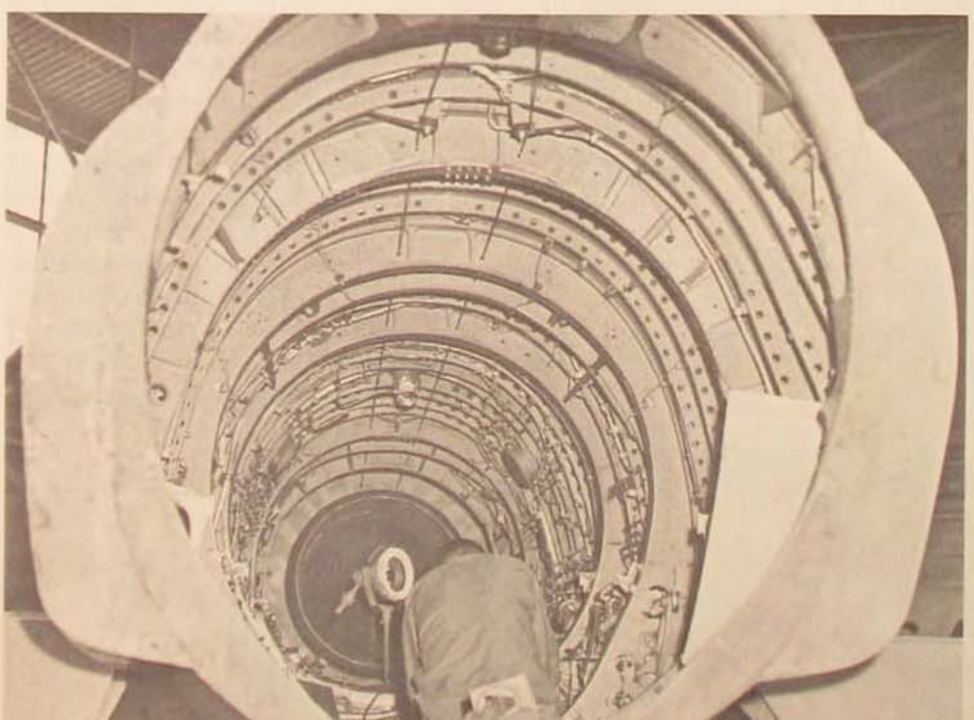
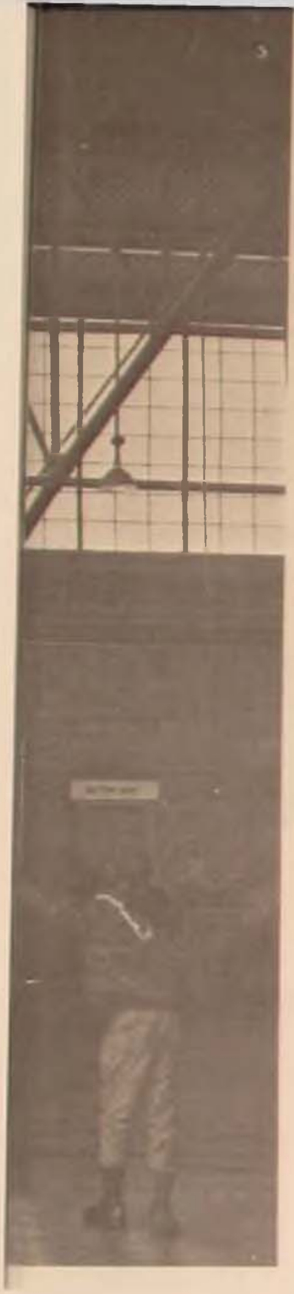
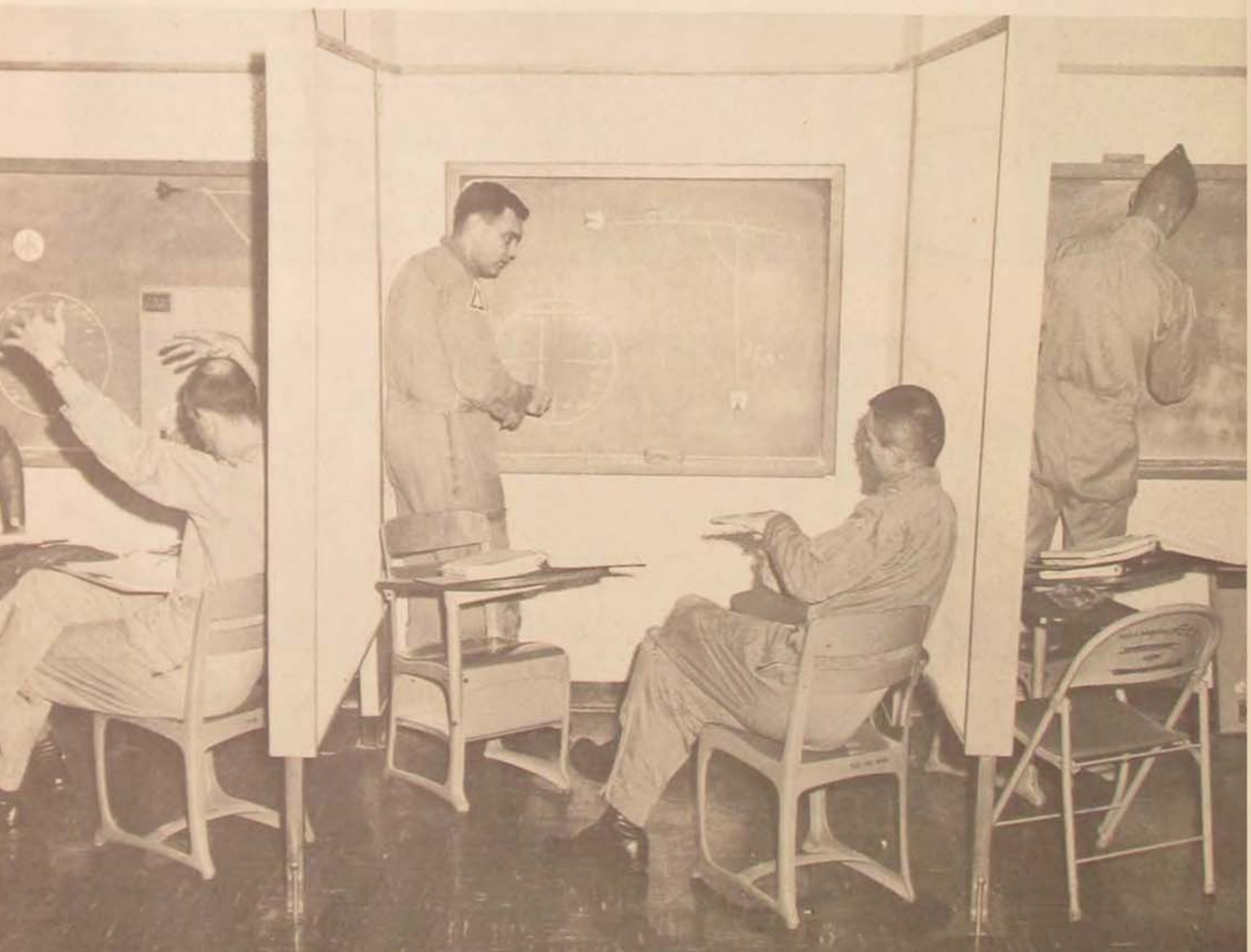


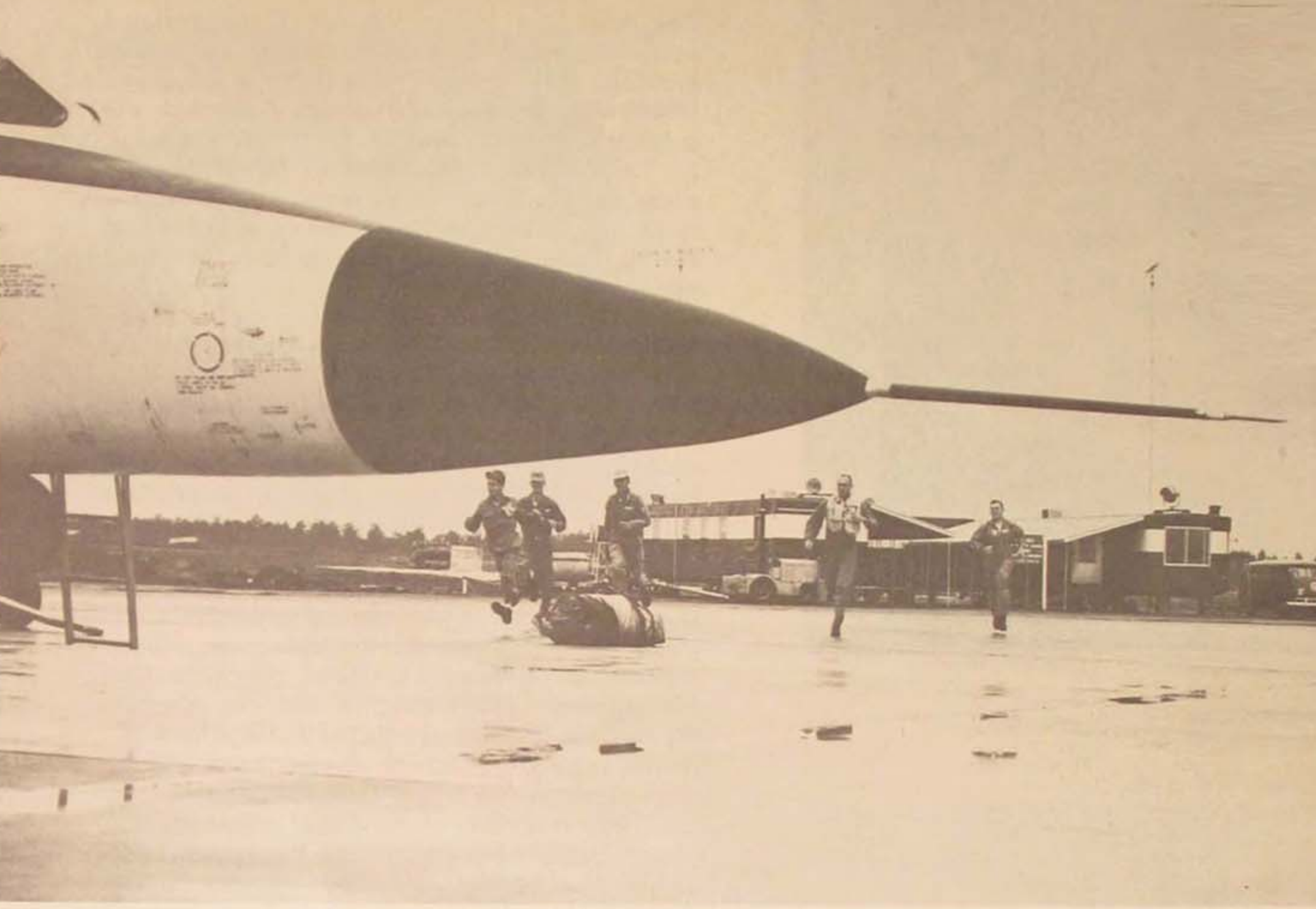


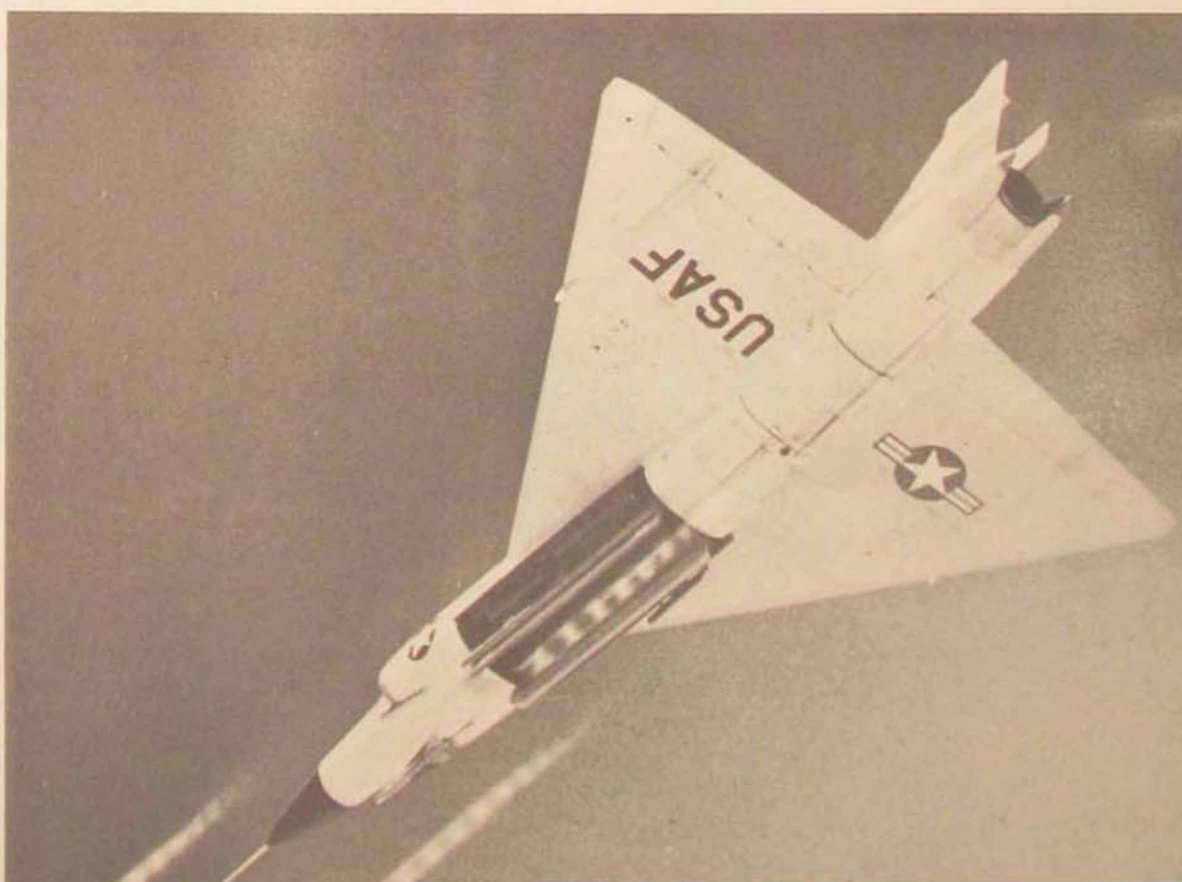
Like F-102's on air defense alert, those used to train new pilots require regular maintenance. At Perrin the heavy load of student and instructor missions necessitates precise scheduling to ensure adequate maintenance. In January a record eight inches of snow temporarily hampered maintenance and flying. . . . An F-102 fuselage gets a thorough checkout between training missions. Because of the number of sorties required to support the vast pilot training program, these interceptors are given meticulous care by aircrews and maintenance crews alike. Into the cavity goes a J-57 jet turbine engine. . . . The walkaround ritual, a must before every flight, is performed by the instructor pilot and student on a TF-102 preliminary to a transition training flight. A comprehensive knowledge of the aircraft, its systems and armament, and of Air Defense Command missions and procedures is required of a student before he is certified combat-ready and graduated from ADC's Interceptor Pilot Training School.


NOTAMS



The final stop before take-off is the personal equipment section. Parachute and survival equipment that have been fitted to the pilot are stored here, and technicians keep constant check on the condition of equipment to ensure its readiness. . . . Operations desk, source of information for every mission-bound pilot, is one of the busiest spots in the two student training squadrons at Perrin. Here instructors and students file flight plans as they get set for a training sortie. One hundred experienced F-102 pilots staff the two squadrons that have sole responsibility for the flying training of all new ADC interceptor pilots. The blackboard shows flight pairings, take-off and recovery times, tail numbers, and other pertinent data. . . . "Hand" flying is part of the postflight bull sessions. The instructor and the student get down to cases on the rights and wrongs of interceptor flying in the ADC manner. Individual attention by instructors to their assigned students ensures thorough knowledge of procedures and tactics of the manned interceptor air defense mission. Air Defense Command gets more than 120 qualified F-102 interceptor pilots annually from the training program conducted at the school. . . . In the postflight playback the instructor and his student watch the Signal Data Recorder, a magnetic tape recording of the actual radarscope display that the pilot saw during the mission. This unique machine not only shows whether the student got a hit or a miss but also enables the instructor to determine where any mistake was made, so that he can instruct the student accordingly. This is part of the individual attention that the more than 200 students per year receive during the flying training phase of ADC pilot training. The Signal Data Recorder replaces the sometimes-faulty gun camera film that was used in World War II.

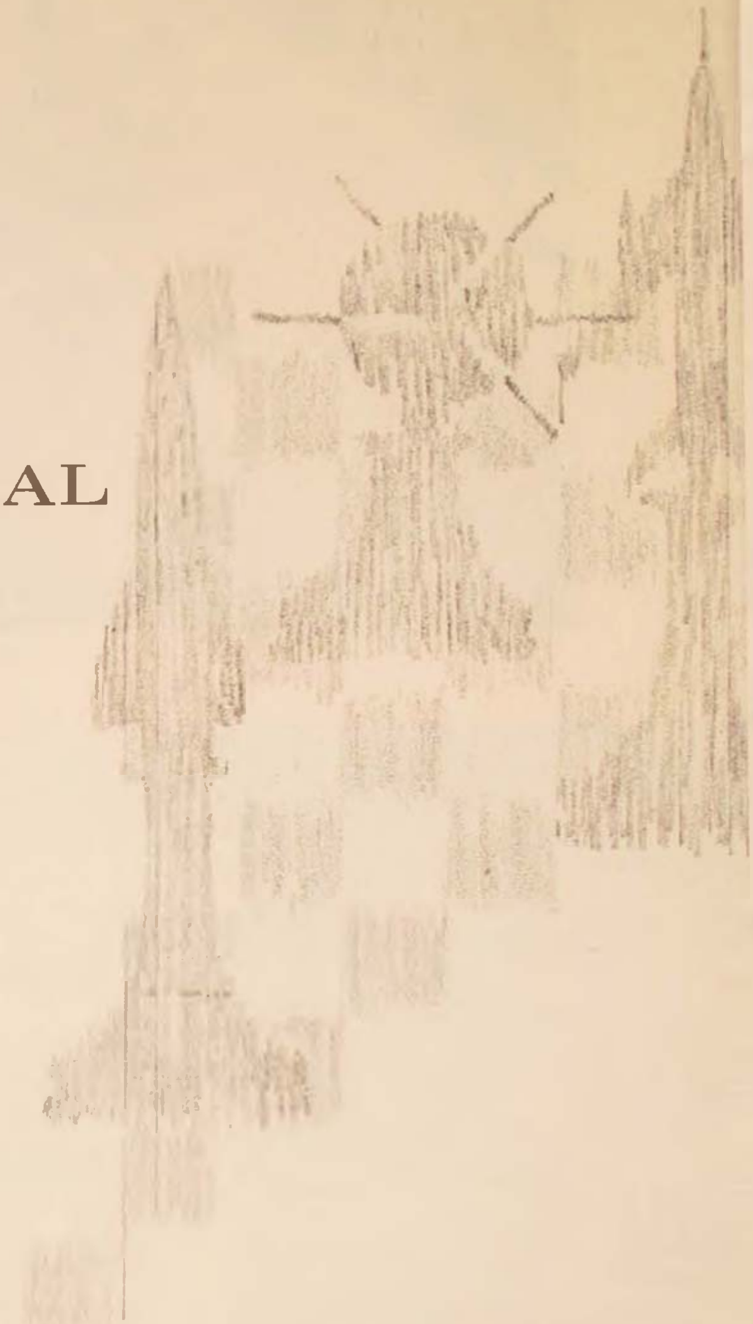



USAF

When the scramble horn blows, aircrews and maintenance crews sprint for their F-102's. In seconds the deadly interceptors are ready for flight. . . . The added power of the afterburner whips the delta wing skyward. Simulated combat-alert exercises give the student pilots realistic air defense experience. . . . Hypersonic Falcon missiles streak from the armament rails of an F-102 as a pilot goes through his final examination. After completion of the flying training at Perrin, students deploy to Tyndall AFB for this day of live firing. . . . Target of the Falcons is a simulated enemy, the Q2C jet-powered drone. Built by Ryan, this fast and versatile craft can be either air or ground launched. It flies a controlled "racetrack" course over the Gulf of Mexico range near Tyndall. The interceptors attack in ADC mission profile, and electronic systems score the success or failure of each missile fired.

Manual intercept controllers at the "Monday" radar site at Tyndall AFB electronically guide the student interceptions flown as the climax of the transition flight course of the 4780th Air Defense Wing (Training). Much of the success of a mission depends upon the ability of the controller and pilot to coordinate their information and instructions. Under these conditions the student fliers get realistic combat experience designed specifically to orient them to the Air Defense Command mission. . . . Like fighter base ramps almost anywhere, the Tyndall ramp packed with hardware is the first sight to greet the deployment flights from Perrin arriving for live firing. After successfully completing this firing, students fly back to Perrin for graduation to full combat-ready status in the Air Defense Command.

A PHILOSOPHICAL GUIDE FOR THE ARMCHAIR STRATEGIST



Colonel Robert N. Ginsburgh

WITH the increasing impact of military affairs on our daily lives since World War II, the discussion of military strategy has become a favorite parlor game. Since the rules of the game are not so well defined as those of the great American game of football, the armchair strategist is much less constrained than his close relative the Monday morning quarterback. Although excessive constraints on the armchair strategist are probably undesirable, the game of strategy would probably prove more interesting and worthwhile if several general rules were more regularly observed by the participants. As a start, it seems to me that the following seven rules could be quite useful.

• The first rule is that anyone can play. Although strategy in the narrow sense is simply the art of generalship, interest in military strategy is not limited to the generals or even to the military. Although the influence of the lay strategist has increased markedly in recent years, it was recognized long before World War I that wars were too important to be left to the military. The military player who tries to ignore this rule is likely to find himself playing a game of solitaire that has no relevance to the key problems of current military strategy. Similarly the lay strategist ought to recognize that the study and discussion of military strategy are also a proper concern of the military man, whose professional expertise extends beyond the mere implementation of strategy. It seems an overly ambitious project—and probably a futile one—to try to establish rules delineating the proper roles of the military and the civilian strategists. Nevertheless it seems worthwhile to observe that while the various aspects of national security are closely interrelated they are also roughly identifiable and to some extent separable into categories for expert consideration.

• The second rule is that the object of the game is to maximize our national interests. Observance of this rule requires first a general agreement on national interests, although it is not necessary to specify these interests in detail. The participants should also recognize that this rule involves a relative concept. Complete security can never be 100 per cent attainable. Furthermore the object is not simply maximizing security but also maximizing national interests. In some cases the maximization of national interests may not produce the maximum national security that could be achieved if military security were the only object. We must also never lose sight of what is really at stake. Although we talk in game terminology, we are not dealing in poker chips. At stake are the lives of our people, the health of our economy, and the existence of our country.

• The third rule is that the strategists should communicate with each other. The traditional ploy of the military man who limited his argument to an affirmation of his professional judgment has been generally discredited. Those who continue to rely on statements which begin "In my professional military judgment . . ." are bound to find themselves relegated to playing solitaire. On the other hand there has come into vogue another ploy that is equally unfair and unfruitful in encouraging intercommunication. This ploy, favored by some lay strategists, begins: "I have a study which proves . . . ." There is ample room for both military judgment and analytic study in problems of military strategy, and all participants would do well to become more familiar with the capabilities and limitations of each. As a start, the military professional should become better versed in the techniques of systems analysis. Actually the military services have given tremendous impetus to the development of techniques of systems analysis and opportunities for using it. They have also given substantial moral and financial support. Nevertheless there are many military professionals who have not been directly exposed to systems analysis in their normal assignments and who have no appreciation of the usefulness of this technique. Their attitudes may range from belligerency to skepticism based on ignorance of the process and antagonism toward the civilian analyst who has presumed to study military problems. Instead of hostility it would be more fruitful for the military strategist to learn more about the tools of analysis in order to apply them to his own studies and in cooperation with the civilian analyst.

On the other hand the systems analyst, whether civilian or military, should recognize the limitations of his tools and should not presume too much about the validity of the conclusions. Ultimately, the output of an analytic study can be no better than the input. While the input will involve many facts, it must necessarily also involve certain assumptions and opinions. The civilian analyst who refuses to listen to the professional military man ought to recognize that he is merely substituting his judgment for military judgment—which will not necessarily produce a more objective scientific study. This is not to say that the military assumptions should be accepted uncritically by the civilian analyst, but as a minimum one should take note of how the differences in assumptions will affect the outcome of the studies.

In addition to increasing professional military participation in the analytic approach, it seems that there is still a role for the more intuitive approach to strategy. By the intuitive approach I mean the intuitive application of the traditional principles of war to particular strategic problems. The greatest failing of this traditional approach to strategy is its highly subjective nature, varying according to differences in intuition and having no objective test of validity. Despite its shortcomings, some appreciation for historical examples can give a greater appreciation for the irrational factors of war and a feeling for the limits of objective analysis. It may also produce strategic hypotheses that can then be usefully subjected to the more rigorous tests of systems analysis.

• Rule four requires that the participants start with some appreciation of current strategy, friendly and enemy. The start is not always as easy as it might at first seem. National military strategy may not be explicitly stated. The responsible national military strategists may intentionally withhold public exposition of strategy because of their desire to keep the enemy—or even their friends—guessing. Perhaps equally important is the fact that the military strategy of great modern nations is not monolithic. Current military strategy, whether American or Soviet or other, seems to represent a compromise among the various preferred strategies of a variety of individual or institutional policy-makers. Thus strategy tends not to be completely consistent logically. Instead we find at any one time what Schelling has called various "strands of policy." The resulting national strategic consensus tends to represent some kind of a compromise which its supporters may advocate for a variety of different and sometimes conflicting reasons. It is helpful, therefore, in trying to synthesize current policy, to have an appreciation for the national strategic policy-making process and the relationship of the policy-formulating institutions and personalities.

• Rule five requires that the participants use the same time frame. It is neither fair nor productive to pit the friendly forces of today against the enemy forces of tomorrow or the friendly forces of tomorrow against the enemy forces of today. Similarly, strategic concepts must be in phase with weapon systems. A strategy for tomorrow is of little value without tomorrow's weapon systems and force levels to support or implement it. Participants should appreciate the factor of lead time, the time needed to translate an idea or a technological advance into operational hardware in the hands of organized military units. Lead time may also be a factor in the assimilation of strategic concepts as well as in the production of weapon systems. It takes time for the human mind to adjust to new situations and to develop methods for dealing with them. It may take even longer to gain general acceptance of these ideas, which is necessary if the military organizations are to exploit them effectively. Finally the strategist, as well as the tactician, must appreciate the interrelationship of time and distance. Reserves, for example, must be capable of being transported to the battle area in sufficient time to affect the outcome of the battle. This time concept is implicit in the old maxims: "Git thar fustest with the mostest" and "Bring superior forces to bear at the decisive point at the decisive *time*."

• Rule six is also concerned with the time factor: the future. Because strategy is concerned with future actions, it must deal in uncertainties. While the strategist must make some attempt to predict the future, he would do well to recognize the range of uncertainties involved. First he must recognize that his intelligence about the enemy's capabilities and intentions cannot be perfect. Even the enemy's knowledge of his own capabilities and intentions is undoubtedly not perfect. The strategist must also appreciate the fact that over a period of time there are various alternative actions open to his opponent as well as to himself. Furthermore he should realize that there is an interaction between himself and his opponent in the selection of alternatives. Not only do choices change, but over a period of time objectives and strategic thought patterns may also change.

The strategist, however, cannot afford to wait until the changes have been completed and the future has become the present. If he is to cope with future situations, he must make decisions on the basis of imperfect knowledge so that time will be available to him to create weapons and forces to deal with the expected future situation. General Marshall used to emphasize that WHEN to make a decision was frequently more important than what decision to make. Thus strategy must be predictive, but it must also be sufficiently dynamic and flexible to adjust to new situations as they evolve in unpredicted ways.

• Under rule seven are collected some miscellaneous suggestions for the play of the game. A good strategist will seek to preserve the maximum freedom of action to cope with the enemy while restricting the choices available to him. To achieve this objective one should devise a strategy that will take maximum advantage of national strengths, minimize the adverse effect of national weaknesses, and restrict the enemy's ability to do the same. Since strategy requires implementation to be effective, it must be explained—at least in its broad outlines—to those who will have to implement it. The exposition of strategic concepts should, however, avoid excessive sloganeering. Descriptive phrases are useful in exposition, but their repetitive use like advertising slogans is no substitute for strategic thinking.

Undoubtedly additional rules which strategists would find useful could be devised. These seven are merely suggested as a starting point for obtaining more useful discussions of strategy. As in any game, the need for additional rules would probably become obvious after further experience.

Council on Foreign Relations, Inc.

THE USAF IN BRITAIN

Kenneth Sams

PERHAPS nowhere in the world has a foreign operating environment been more congenial to peacetime Air Force operations than that in the British Isles. And in few places could there be less doubt about dependability in time of crisis. The United States Air Force has been operating from the British Isles for 20 of the last 22 years. In that period, which has included hot-war and cold-war conditions, practically every type of aircraft in the USAF inventory at one time or another has used a USAF base in Britain. Several politically sensitive weapon systems, such as the Thor missile and the RB-47, have been introduced. One of three stations of the Ballistic Missile Early Warning System (BMEWS) was welcomed by the British on their soil. Today the four tactical wings based in Britain are among the most efficient overseas, and the strategic rotational units, though being phased down, have for many years carried an extremely heavy deterrent role.

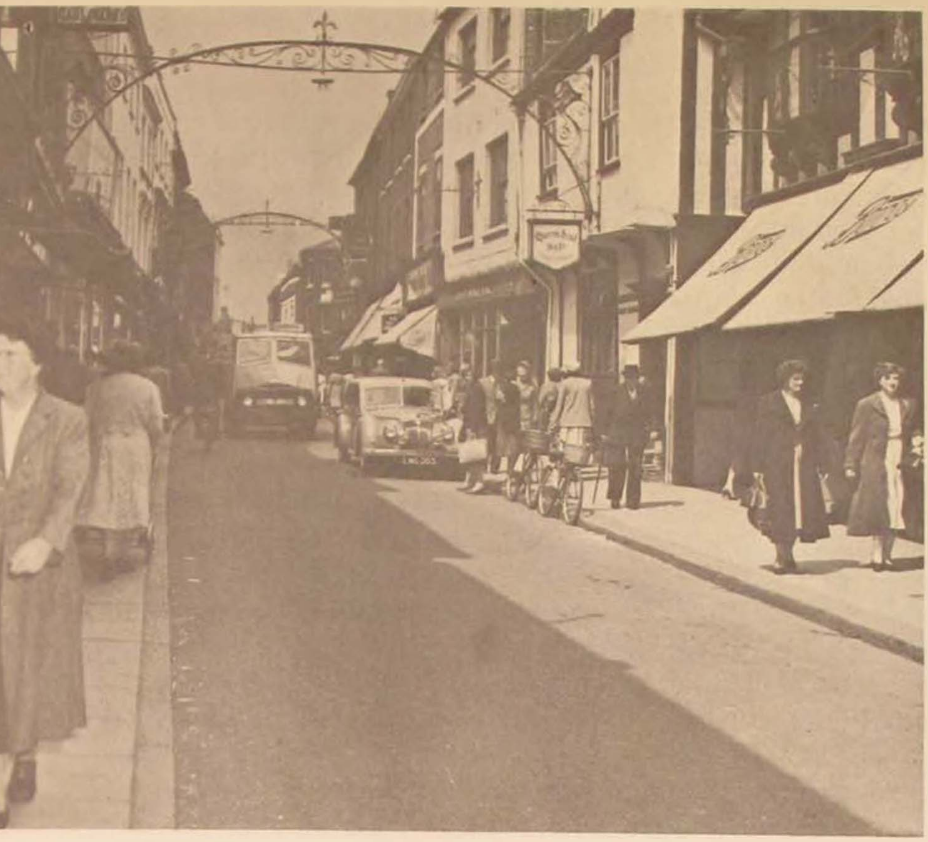
The acceptability of Americans and their air bases to the British people is as great as it ever was. The Air Force was invited to Britain informally in 1948 by a Labour prime minister, and it has stayed under four successive Conservative prime ministers. For the first four years of its presence, there was not even a written agreement. While political opposition has reached serious proportions at times, never has the opposition party formally questioned the value of the USAF presence. Debates on the USAF have frequently occurred in the House of Commons, but these usually centered on the problem of control and generally followed particular situations, such as the shooting down of the RB-47 in 1960 and the introduction of Thor missiles in 1958. Actually the blue-suited American has come to be accepted as almost a normal part of British life, and Americans in Britain know that they are really welcome. The best indication of this is the high degree of integration into the economy and social framework of the 65,000 American servicemen and their families in Britain. Some 75 per cent of them live off base, shopping in British stores, attending local churches, joining community clubs, and generally moving about almost as freely as they would in the States.

How has the Air Force managed to integrate itself so well into the British environment, and in what ways is this reflected in operational efficiency? Is there a value in the current relationship which might prove useful in later years when the world strategic pattern might have changed? These are questions worthy of study in terms of planning for the future utilization of overseas bases by the U.S. Air Force.

An important reason for the cooperative environment enjoyed by the USAF in Britain today is the reputation of the Air Force during World War II. Clearly etched in the minds of Englishmen today are memories of those unforgettable war years—crippled American bombers and fighters landing at East Anglia bases, early morning formations of B-24's taking off on bombing missions, care-free American airmen in Norwich, Cambridge, London. The unique camaraderie that only wartime can produce planted deep roots which nourish an excellent relationship today, a generation later.

To an air-minded British public it was the Royal Air Force and the U.S. Army Air Force with their devastating raids over Germany which brought the war to an end. Three years after the war, Britain, under conditions of severe austerity, had the understandable desire to put the thought of war behind her. Yet after trouble threatened in Berlin, Britain offered its RAF bases to the U.S. Air Force in July 1948. Those bases were already prepared for support of B-29's in just such an emergency, as the result of an informal and secret agreement reached in 1946 between Air Marshal Sir Arthur Tedder of the RAF and General Carl Spaatz. As far as U.S. military activity is concerned, Britain has been almost a second home for the USAF since 1948. Over 96 per cent of the total U.S. military strength in postwar Britain has been Air Force.

There are numerous other nonstrategic reasons why Britain has proved to be an ideal spot for USAF operations. The common language, history, legal system, and traditions of our people, the close industrial relationship which has brought many American commercial products into Britain, the sharing of nuclear



American airmen in Britain have moved into already-crowded communities such as King's Lynn, Norfolk, which is near the USAF installation at Sculthorpe.

responsibilities, and that special relationship which still exists in defense and foreign affairs —all these contribute to the easy integration of Americans and their bases into British life.

The long record of successful postwar operations from Britain is also partly due to the excellent reputation established by over half a million American servicemen and their families who have done postwar tours in Britain. As ordinary people from all strata of our society, they gave the British their first look at real American life, helping to break down the stereotyped image of Americans built up by American movies, popular fiction, affluent tourists and businessmen just passing through, and by the GI's of World War II. The relative ease with which these postwar servicemen fit into British life is perhaps best exemplified in the marriage rate of single airmen. Since 1948 an average of 3000 airmen a year have married British girls. American families in Britain do not live in "golden ghettos" but move about easily in British shops, theaters, restaurants, garages, barber shops, and pubs without the restraint evident in some other European countries. These American families have managed to create a good impression despite the fact that often they are living in crowded areas.

Anglo-American rapport is sustained by gestures like those of the USAF airmen at Lakenheath in aiding victims of the 1953 King's Lynn flood.

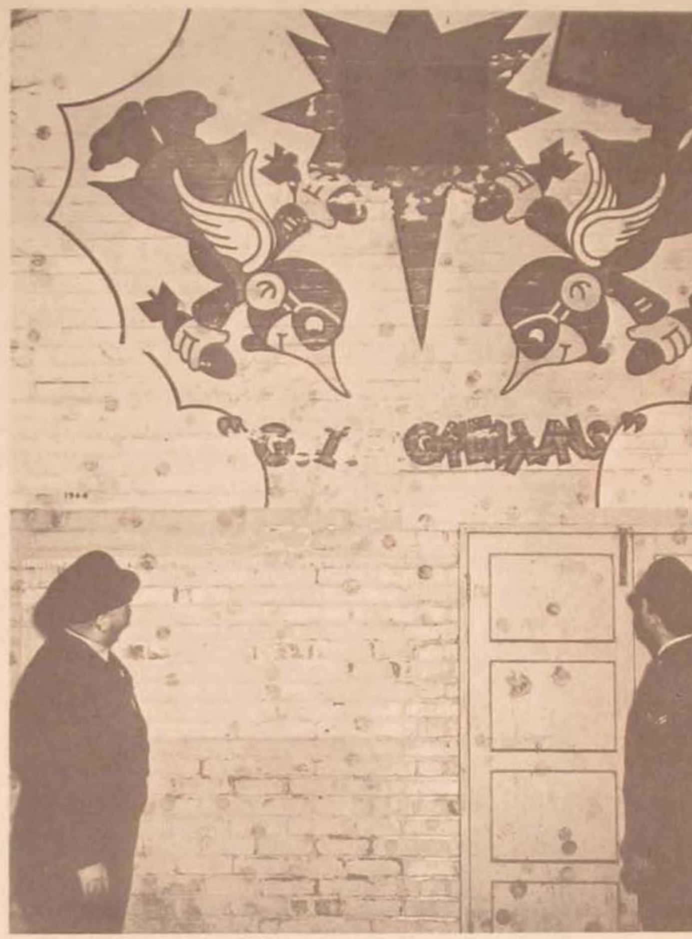
ALSO contributing to success of the USAF mission is the close operational relationship which has existed between the USAF and the RAF, two of the world's most sophisticated air forces. These two organizations have worked so closely together over the years that they have come to regard each other as more than allies. This special relationship probably applies more to the two air forces than to any other phase of defense.

The $300-million USAF network of bases in Britain was built jointly by the USAF and the Air Ministry, the British providing land and facilities free and paying part of the costs. Prior to 1951 the RAF made its own stations available for SAC bomber units rotating in and out every 90 days. When administration of these bases was turned over to the Americans in 1951, the British retained title to the installations, naming them RAF stations. To each base, even though it was taken over exclusively for American use, was assigned a Royal Air Force Liaison Officer, who also served as the RAF commander of the base. This proved to be a highly useful arrangement.

The Royal Air Force Liaison Officer, or RAFLO as he is commonly called, has a variety of functions, but they all boil down to the big job of fitting the American military operation into its English environment. The RAFLO, in a sense, provides the oil that lets the Air Force machinery run smoothly in Britain. As adviser to the U.S. base commander, he helps on such matters as customs clearances, RAF air traffic control procedures, compliance with British regulations on ammunition storage. At the same time he has close ties with all local British authorities, including government, service, and civilian people. Any time there is friction between the base and the local community, the RAFLO is on the spot to eliminate it. And it is the RAFLO at Third Air Force headquarters who is called upon to provide the answers to questions raised in the House of Commons about USAF operations. This he does in consultation with USAF officials.

There are many instances where this intercession by the RAFLO has proved valuable. When nuclear disarmament demonstrations occur outside USAF bases (and there have been quite a few in recent years), it is the RAFLO, not the USAF base commander, who meets the groups, and he meets them as RAF commander of the base. When an East Anglian farmer recently fired a shotgun into the air close to a USAF airman standing near a jet engine test stand because he objected to the noise, he was met at his home by the base RAFLO, who explained as tactfully as he could the serious implications of such an action. Complaints about aircraft noise and sonic boom are handled by the RAFLO, with the main objective of exonerating the USAF whenever possible. He moves tactfully into sensitive friction areas such as USAF security practices regarding British em-

Many a relic of the USAF "invasion" of Britain during World War II can still be seen at bases in the United Kingdom. Air Force folk art like "G.I. Gremlins" of 1944 vintage adorned numerous Nissen hut canteens.



As far back as 1951, USAF and RAF planes were practicing in-flight refueling together. Here a USAF KB-29 refuels three RAF Gloster Meteor fighters in flight. The British developed the "probe and drogue" system used by the USAF.

"City of Turlock," a Strategic Air Command B-52, lands at Brize Norton on a routine training mission to Britain. The United Kingdom has based B-47's primarily but has also been used by USAF B-36, B-52, and B-58 aircraft.

ployees. After several widely publicized cases where alert and armed USAF air police stopped British workers in security areas, the RAFLO, working with the base commander and the unions, devised a system satisfactory to both countries for allowing British workers access to sensitive areas with unarmed escorts.

More important in terms of operational effectiveness is the way in which the RAFLO arranges for a linking of USAF military activities with the British military activities. The RAFLO at Third Air Force headquarters, for example, as a member of the Third Air Force commander's staff, recently arranged for USAF fighters and reconnaissance planes to fly close support missions with British Army units maneuvering on Salisbury Plain. Although this was a radical departure from existing British Army/RAF training policy, USAF F-100's and F-101's in Britain were given a chance at valuable training for their conventional warfare mission. This type of exercise requires close coordination between the two services, including the use of USAF controllers on the ground with Army units. The RB-66's of the 10th Tactical Reconnaissance Wing also fly sorties against Royal Navy ships in British waters. In ground support exercises, the RB-66's take photos and fly them to their base, where they are picked up by British Army planes for use by field commanders.

The RAF wing commander at Third Air Force headquarters, Wing Commander Thomas Stafford, has done much to get USAF people together with their RAF counterparts. He has introduced USAF operations training officers, intelligence officers, and many other staff people to their RAF, Army, and Navy counterparts, usually during visits to British installations. He arranged for the Third Air Force commander to tour the headquarters and selected bases of the RAF's Bomber Command, Fighter Command, Transport Command, and Coastal Command and Royal Navy headquarters. This not only familiarizes USAF officers with the British military organization but allows them to make use of it in performance of the mission which the USAF and RAF have in common.

There are many other ways in which the British military establishment is placed at the disposal of the U.S. Air Force to make its operations more effective. Bombing and gunnery ranges manned by RAF personnel are made available for USAF units. A distress frequency service operated by the RAF helps USAF pilots when they need to get an immediate navigational fix. Air traffic control for SAC aircraft operating in the Oxfordshire area is provided by the Royal Air Force. The RAF provides air defense and air-sea rescue services for all USAF units based in Britain.

There have been numerous occasions when the RAF and USAF have jointly controlled the operation of certain weapon systems, notably the 60 Thor missiles until recently based in East Anglia. With the Thor operation, the RAF controlled the actual missile base while the USAF was responsible for the warheads. Successful tests were carried out in 1961 in which RAF tankers refueled USAF fighters and USAF tankers refueled RAF aircraft in mid-air. The giant BMEWS station in Yorkshire is jointly operated by the USAF and the RAF. The two services share the use of each other's installations. The RAF station at Northolt near Third Air Force headquarters in London, for example, is jointly used by the USAF and the RAF for administrative and support aircraft.

On several occasions the British have gone to great lengths to accommodate the USAF when it ran into difficulty. In 1959 when General de Gaulle refused to allow atomic weapons on his soil, the British agreed to accommodate two additional USAF tactical wings in the British Isles. Early this year after the French severely restricted low-level flying by USAF aircraft, arrangements were made through the RAFLO at Third Air Force headquarters to permit more of this type of flying in Britain.

THE CLOSE relationship between the two services is evident in many other ways. The Exchange Program run between the two services provides an excellent opportunity for the RAF and USAF to get to know each other better. A few years ago the present USAF commander at RAF Bentwaters was the commander of No. 1 Squadron, Royal Air Force, under the Exchange Program. USAF officers under this program hold actual command or staff positions in the RAF, and the same holds true for RAF officers assigned to the USAF. There are presently some 80 USAF people in RAF positions and 80 RAF people on assignment to the USAF. At least one USAF officer is enrolled at all times in the RAF staff colleges at Bracknell, Berkshire, and Andover, Hampshire. Presently there are six assigned to these courses, and one to the Joint Services Staff College at Latimer, Buckinghamshire.

Apart from the operational side, Britain as an operating base has certain advantages from a personnel standpoint. A highly efficient civil

Radomes of USAF's Ballistic Missile Early Warning System dominate the landscape of Fylingdales Moor, England. Their high-powered radar constantly scans northern approaches, to warn both the United Kingdom and the United States of attack.

service establishment is available to the USAF. At one time over 6000 United Kingdom civilians were working for the USAF, but this figure is down to about 3000 today. These U.K. civilians are extremely useful not only because they speak the same language but because of their high skills and training, their knowledge of the U.K. environment, and their excellent administrative abilities.

United States personnel working in the hospitable English environment enjoy a high state of morale which contributes toward an effective operational mission. The re-enlistment rate for USAF personnel in Britain is among the highest in the world, and the incident rate is among the lowest. Many USAF families are in Britain on their second tour by choice. There is practically none of the so-called "cultural shock" often experienced by Americans in other areas. The increasing prosperity of the country in recent years, coupled with the common language and similar way of life, makes it easy for Americans to adjust.

To make assimilation easier, the Air Ministry, at its own expense, has placed a Community Relations Officer on each major American base. These CRO's, usually girls in their 20's, help bring Americans into the life of the community. They get Americans into local clubs, arrange visits to British families, carry out tours for British groups on USAF bases, arrange Anglo-American social functions, and do everything possible to make Americans feel at home. The program is headed by a retired air marshal of the RAF.

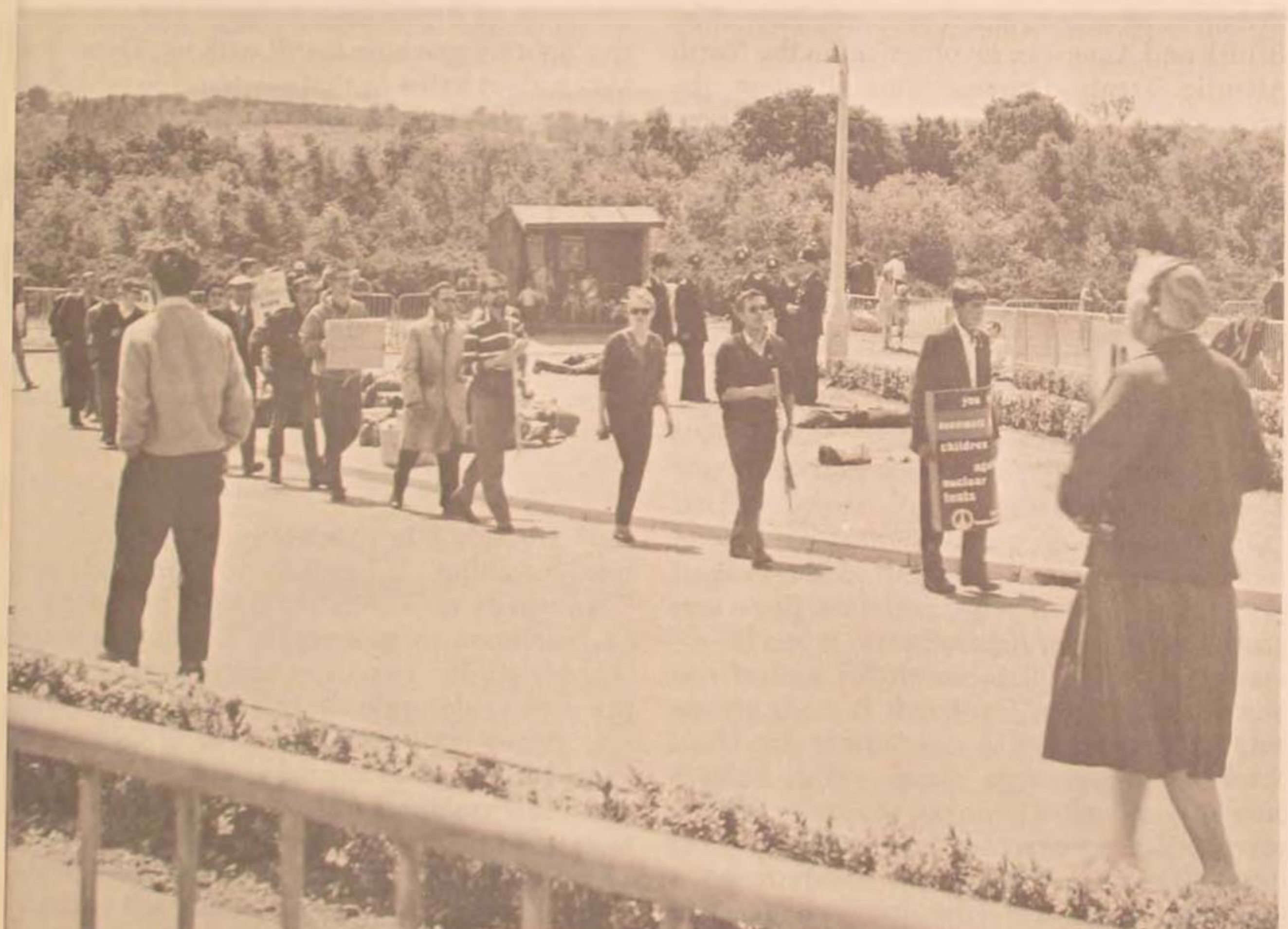
The Air Ministry, the Third Air Force, and the U.S. Embassy in London have been working closely together the past ten years to make Americans feel at home in Britain and to make their presence accepted. Every year the Ambassador personally presents awards to the USAF bases which have the best records in community relations.

Excellent communications and logistics support from British resources is available to the USAF. The British telephone and postal system, British railways, port facilities, pipelines, and many other elements of this highly industrialized country are at the service of the USAF. Britain's experience in aircraft production and its large numbers of skilled aircraft workers are used directly on a contract basis. When a major maintenance or modification project is required for USAF planes, British firms are sometimes contracted to do the job by sending maintenance teams to the base. In the old days this work was done by huge USAF overseas depots maintained at considerable expense.

What all this adds up to is the fact that the U.S. Air Force is more than just a foreign military force on British soil. It is a force closely linked operationally to the air force of one of the three atomic powers in the world today. It can draw upon the services of an efficient, up-to-date military organization with which it has strong and long-time links and which has developed along lines similar to those of the USAF. And USAF people quickly sense the hospitality of Britain to them as individuals and the understanding and sharing of their mission.

Today the British Isles may not be as important to USAF operations as they were during the critical years of the Korean War when a little-publicized USAF deployment was carried out. At that time there was a danger that Stalin might take advantage of U.S. involvement in the Far East to move against Western Europe. To preclude this, the USAF in 1950 placed about half of the effective strength of the Strategic Air Command on bases in Britain. It was these bombers, not the fledgling NATO and not the American military complex on the Continent, which have been credited with preventing a Soviet move. Sir Winston Churchill called attention to the role of these bombers on several occasions, and he also pointed out the great risks which Britain took by allowing their presence in his country.

"Ban the Bombers" demonstrations have been staged outside USAF bases, but they are generally ineffective and well controlled by British police.



This 1950 deployment was a real test of the unique Anglo-American partnership in air power, but this partnership was also put to the test on several other occasions in later years. The Indo-China crisis of 1954, when British and American policies were at odds, did not affect the presence of the USAF. Nor did the Suez crisis in 1956 and the nuclear disarmament campaign which reached its peak in 1961. In the big 1961 Campaign for Nuclear Disarmament march on USAF bases, the British Secretary of State for Air and the Chief of the Air Staff of the Royal Air Force personally took part in planning to meet the threat and were on hand at the USAF base at RAF Wethersfield when the demonstrators arrived. This was mainly to eliminate any doubt in the minds of USAF officials about the British Government's attitude toward the demonstrators. The demonstration was a failure, with only a few thousand marchers instead of the expected 50,000.

The present status of the USAF in Great Britain is, of course, based primarily on mutual British and American involvement in the North Atlantic Treaty Organization, although the presence of SAC bombers, the BMEWS station, and a Polaris submarine base indicate that much more is involved. The current commander of Third Air Force, Major General R. W. Puryear, and the SAC commander of the 7th Air Division, Major General Charles M. Eisenhart, command units which have been on alert "frontline" status since 1951. Their units enjoy a high morale and a high combat efficiency, largely because of long-time familiarity with the operational environment and the ability to use that cooperative environment to advantage.

If there is a military equivalent to that goodwill upon which industry places a monetary value, then the U.S. Air Force in Britain has something which goes beyond its immediate year-to-year needs. Certainly the political picture in Britain and the military situation in Europe have changed a lot since the USAF returned in 1948. The prosperous, booming Britain of today is a far cry from the austere, battle-damaged Britain of the late Forties. Still, the basic threat of Communism which welded the air forces of Britain and America into an effective fighting machine is still with us. There is a tremendous value in that relationship which is worth taking into account in planning for future military contingencies in Europe.

Hq Third Air Force

OVERKILL AND UNDERTHOUGHT

Captain Thomas C. Pinckney

IN THE last few months opposition to certain national security policies has appeared in a still fairly localized but particularly virulent form known as "overkill." Recently this argument has been the subject of comment by several senators, Secretary of Defense McNamara, General Taylor, General LeMay, and numerous members of the academic-scientific-strategic community. Thus it seems appropriate at this time to review the overkill position, consider its implications for national security, and arrive at some conclusions regarding its validity.[1]

the overkill argument

Dr. Seymour Melman of Columbia University defines overkill as ". . . military power sufficient to kill a population more than once."[2] Its fundamental supporting assumptions are that in any nuclear war cities will be the primary targets and that the objective of each antagonist will be to maximize total enemy casualties. The logic of these two premises leads the overkiller[3] to visualize a nuclear war as an uncontrolled spasm of politically pointless death and destruction which quite likely would destroy the human race or at best would leave the survivors, permanently mutilated by genetic injury, to scratch out a miserable and savage existence from the radioactive rubble of our civilization.

Several subsidiary propositions follow from these views. Since the overkiller believes that such a catastrophic outcome of any nuclear war is inevitable, he feels that logically our military planners will concentrate on producing larger and dirtier nuclear weapons in order to deter war more effectively. Likewise, since neither side could benefit from such a holocaust, the overkiller sees deterrence of total war as the only legitimate objective of strategic nuclear forces. For exactly the same reason, both sides—contemplating such assured catastrophe—*will* be deterred. In other words, deterrence will work because it must.[4]

If one accepts the above reasoning, certain conclusions follow naturally. Most important among these is that the United States should build only a minimum or finite deterrent.[5] One overkill author speaks approvingly of a force of "200 relatively secure missiles." Inseparable from this faith in finite deterrence is disdain for a counterforce strategy.[6] The overkill argument against counterforce is based upon several assertions regarding its infeasibility. Dr. Melman writes, "Counterforce has been made technically obsolete by the development by the Soviet Union of 'hard' missile locations and submarine carriers . . ."[7] and ". . . there is no basis for assuming the feasibility of constructing reliable defensive systems. . . ."[8]

Finally, the overkill argument is rounded out by four supposed characteristics of nuclear war, all of which are designed to help disprove the need for larger or modernized strategic nuclear forces. First, because present offensive forces are so effective against cities and defense impracticable, no such strategic improvement of our force is required. Second, thus the static nature of strategic military technology is implied. Third, the spasm characteristic and disastrous results of a total war supposedly obviate any requirement to provide either delivery systems or warheads for multiple strikes.[9] Lastly, they imply that an enemy first strike could not seriously degrade our retaliatory capability.[10]

cities as targets

Having reviewed the overkill position without comment, I shall now consider it in more detail. First, note the contention that cities will be nuclear targets, as reflected in the following quotations:

> Our military leaders do not assume that cities will not be attacked. Indeed, the whole rationale and the nature of nuclear war make it inevitable that cities *will* be attacked. . . .
>
> . . . Cities and populations will die in any case —in any massive nuclear attack—for this is the nature of the weapon. . . . Such is the ethos of the thermonuclear bomb. . . .[11]

Note the appealing simplicity of the assertion. Cities must be the targets because of some inherent characteristic of the nuclear weapon, something in its "nature," its "ethos." There appears to be only one grain of substance in these assertions: that since a single thermonuclear weapon *can* destroy an entire city, this option is now open to a belligerent whereas it never was previously.

Perhaps the strongest support for the overkillers' line of argument is the proximity of many military targets to cities. An important and difficult choice of alternatives faces an opponent wishing to execute a counterforce attack. If he strikes all American strategic military targets, U.S. leaders may not be able to discern any difference between his intended counterforce attack and a "devastation" blow against both military and population targets. Presumably, once his attack was detected, he would communicate his intentions to the President in an attempt to avoid misunderstanding and retaliation against his cities, but it is quite possible that in the confusion of the moment he would not be believed. To avoid consequent American countercity retaliation, the potential aggressor might elect a second alternative: to destroy all strategic military targets clearly separate from cities but ignore those close to population centers. However, the cost of allowing sanctuary to a significant portion of U.S. forces probably would rule out such a strategy. A third alternative might take the form of a compromise between the first two. That is, the enemy could target "overlapping" objectives with only one weapon (rather than the two or more usual for reliability) and with the smallest effective warheads. The great majority of such targets are air bases or other soft installations vulnerable to low overpressures. Therefore, with improved missile accuracy the attacker could destroy all aircraft on the ground with low-kiloton warheads and fallout-minimizing airbursts and rely on his slower but more accurate manned aircraft to crater the runways and so prevent the airfield's being used as a turnaround base.

Of course a state which feels itself the possible recipient of a nuclear attack can facilitate its enemy's choice of a strictly counterforce strategy by clearly separating its strategic—and preferably nonstrategic—military targets from cities. Assumedly this is a lengthy process, since such installations are far from cheap. Yet the rush of technology leads one to expect that even the normal replacement of obsolescent systems could make appreciable differences in the relatively short term, say five to ten years.

> The "counterforce" perspective has been rendered implausible by the development on the Soviet side of the same sort of "hard" missile

> locations and submarine carriers for missile launching as developed by the U.S. . . .[12]

This quotation at least makes a gesture toward supporting evidence, but it is interesting how the author selects for acknowledgment only those technological improvements which favor his argument and ignores those which weaken it. Hardening and submarine-launching platforms do make counterforce more difficult to achieve. Dispersal, more effective warning systems, improved active defenses, and any mobile systems at all—not only missile submarines—have like results. Yet is is quite a jump from such truisms to the statement that these developments have created conditions in which a counterforce strategy "has no military reality."

There are at least three developments which would tend to validate counterforce: a unilateral, highly effective active defense; reliable intelligence regarding enemy target locations; and greater missile accuracy. Although the first is perhaps most desirable, it is the least likely for the foreseeable future.[13] News media have reported that the Air Force has been orbiting observation satellites for some time and that their information is as precise as were the U-2's pictures.[14] Similarly, both superpowers are trying energetically to improve missile accuracy, and their efforts have been far from unsuccessful. A concrete illustration of the interaction of two of these factors, hardening and accuracy, may be helpful.[15] Assuming an accuracy of two nautical miles and an airburst, a 37-megaton warhead has a 50-per-cent probability of destroying a target hardened to withstand an overpressure of 100 pounds per square inch; with an accuracy of a quarter mile and airburst, 78 *kilo*tons are required against the same target. Changing terms of reference, assuming 3 psi overpressure is required to incapacitate a soft ICBM, with a 5-mt airburst we require an accuracy of only 9.06 nm. With the same-size warhead airburst but with the target hardened to 1000 psi, a .32-nm accuracy is necessary. Obviously, one development can offset another. Thus hardening a target from "soft" to 1000 psi can be countered by an increase in accuracy from 9.06 to .32 nm without increasing warhead size. The first comparison is more interesting, however, for it clarifies the potential of technology to lessen the dangers to a state's population and economy from a nuclear war. Against a 100-psi target, improved accuracy permitted a decrease in the warhead yield of 99.7 per cent. If such an improvement is applied across the board to an attack with an expected total yield of 50,000 megatons, the total yield necessary to accomplish the same counterforce target destruction with the same probability of success is reduced to 105 mt. The implications for maintaining control of the conflict and for survival are enormous.

The serious military student cannot arbitrarily choose those developments which suit him and his favorite strategy but ignore all the rest. He must consider conscientiously all developments (doctrinal and political as well as technological) and attempt to evaluate their impacts objectively. Attempting to do this, I conclude that the requirements for effective counterforce have become and will continue to become more stringent but that present and anticipated improvements in accuracy and observation meet these criteria. Dr. Lapp himself states that by 1965 missile accuracy will be "one mile or less."[16] Counterforce remains technically feasible. On the other hand, technically feasible does not mean perfect. Counterforce is not offered as a panacea for all strategic problems, and today probably the knottiest technical problem faced by counterforce advocates is antisubmarine warfare. Of course even this problem is not insurmountable. Improved sonar, hunter-killer submarines, nuclear-powered destroyers, satellite-facilitated communications, and the memory banks of special computers may offer significant improvements in ASW. In fact the United States is currently spending over $2 billion a year on ASW.[17]

morality and self-interest

Once cities are no longer considered the only appropriate targets for strategic nuclear weapons, serious questions arise regarding any targeting doctrine which seeks to maximize enemy civilian casualties. The generally accepted moral view in the West is that the use of force is legitimate only to counter an aggressive use of force against oneself. Even then two limitations act upon the defender's use of force: it must be proportionate to the need, and it must be directed against the immediate participants in the aggression. Granted, these moral considerations are Western, not Communist; but fortunately self-interest also cautions against indiscriminate countercity retaliation. Whether (1) a future general nuclear war has escalated from some more limited action to the point where one side or the other is faced with the choice between a large counterforce or countercity attack, or (2) the same choice is an outgrowth of limited strategic war,[18] or (3) someone is contemplating a premeditated surprise attack, it is most difficult to envision circumstances in which unrestrained countercity action would be desirable, either as an initial act or as a response.[19] Both the initiator and retaliator are interested primarily in their own people, economy, power, etc. Neither is interested merely in the unrestrained slaughter of the enemy population for revenge.[20] Of course, vengeance may be one motivation, but the survival of your own state demands that this motive be relegated to a secondary position at best.

Some assert that revenge is not the only motivation for attacking the enemy's cities. Perhaps his forces can be immobilized by such an attack. This is a conceivable though unlikely result. After all, the types of forces most dependent upon urban areas are a state's land armies and reserve units, which rely heavily upon transportation nets. Constantly alert strategic nuclear forces are highly independent of any support for at least several days, during which the issue of an unlimited general war would probably be decided. Therefore, countercity attacks to destroy war industries, à la World War II, seem irrelevant.

It is especially to the advantage of the weaker side[21] to restrict the war to counterforce in any situation where the anticipated destruction in both countries is neither total nor balanced at some lower level. If such melancholy symmetry is expected and if an unlimited general war does occur, it is equally advantageous to both participants to avoid countercity attacks. But otherwise, before the war the weaker side must rely on a *declaratory* policy of countercity deterrence, since it cannot hope to disarm the enemy. Nevertheless, once hostilities begin, the weaker side cannot afford to invite utter destruction by initiating a countercity exchange. Instead, it is faced with the unpleasant choice of surrendering immediately, of participating in a few strikes as evidence of its determination and then attempting to negotiate a settlement at an obvious disadvantage, or, finally, of beginning negotiations before the strategic nuclear exchange has begun. Yet this is not to imply that physical survival is the ultimate motive of either side. Our leaders are dedicated to the body of political, spiritual, and economic principles we refer to as the Judeo-Christian-democratic ethic, and Soviet leaders are presumably convinced of the benefits offered by Communism. On the other hand it must be recognized realistically that few governments have considered it their duty to allow the utter devastation of their people and territory when any alternative short of unconditional surrender was available, and the unconditional surrender of neither side is likely to be sought. If no or only a few small strikes have been exchanged, even the weaker state retains an ability to punish its enemy severely. The stronger will wish to decrease the chances of its antagonist becoming desperate enough to initiate countercity strikes by offering a real basis for negotiation rather than an ultimatum. The government which finds itself at a disadvantage may face the loss of an ally or satellite or may pay some form of reparations (rebuilding the enemy's damaged city or cities, donating a large sum to the United Nations), but surrender will probably not even be suggested.

The stronger side also finds it advantageous to strike counterforce rather than countercity. The stronger can hope virtually to disarm its opponent or at least to place a relatively low ceiling on the damage the weaker side can inflict. (Obviously the exact level cannot be specified because it will depend upon many variables unique to each situation, such as warning, intelligence, decision time, command and control arrangements, firing and launch times, active and passive defenses, etc.) Nevertheless neither side will resign itself to losing even its four or five largest cities unnecessarily and will probably sublimate its revenge instincts rather than ensure such a blow by provoking the opponent with countercity attacks. Thus the overkillers' vision of a nuclear Armageddon, while possible, is not the only form of nuclear war, not even the most likely.

Typically, the overkiller views strategic nuclear forces as having only the mission of deterring war, for he feels that no one can benefit from a nuclear war. Certainly no one anticipates that any state's immediate, post-nuclear-war standard of living would exceed or even equal its immediate prewar standard. In fact it would probably be considerably lower for some time. But an argument based on a prewar versus postwar comparison is largely irrelevant. While a potential aggressor is interested in the absolute prewar and postwar relationship, he is presumably much more concerned with the comparison of his postwar position and what he anticipates his position to be at some future time *if no nuclear war occurs*. Obviously, if he only considered the prewar versus postwar relationship, there would never be an intentionally initiated strategic nuclear war. On the other hand it is easy to posit situations in which one side might prefer the expected postwar world to the anticipated future non-nuclear-war world. For example, if the Soviet Union had undergone a series of sharp political, economic, and limited military reverses during which she had lost several of her satellites as well as the economic ability to maintain her side of the arms competition, her leaders might foresee the complete and inevitable failure of Communism in a future without general war. Therefore, they might decide to stake everything on a nuclear strike. Their pertinent calculation might well be between "no chance of success without war" and "a 10 per cent chance of success with war," rather than between "a standard of living of 137 in 1970 if no war" and "a standard of living of 89 in postwar 1970."

numbers of weapons

Although overkillers make a major point of the number of warheads and delivery systems the United States maintains, this question seems to be of only secondary importance to those issues already discussed. Yet insofar as the number of weapons is bound up with the question of counterforce or finite deterrence, it is important. It may be agreed in principle that for any chosen strategy, target list, set of enemy countermeasures, and weapons mix there exists a specific number of warheads beyond which no further expansion is required. Assumedly some production would always be necessary to replace warheads lost or ruined due to accidents, wastage, obsolescence, etc. However, we do not know how, when, or where a war might start, how it will progress, or what our options may be. Considering these formidable areas of uncertainty, our decision-makers would probably find it impossible to decide on the exact number of warheads needed, even theoretically.

On the other hand the overkillers go beyond obvious considerations based on tangible planning factors and make assertions regarding the deterrent or destabilizing impact of stockpiles. "And a build-up of an unlimited stockpile of nuclear weapons only tends to convince an enemy that he is in mortal danger and must strike first."[22] There is a certain, ostensible logic in this quotation if one ignores its unspoken assumption. The key word is "build-up." The implication is that if one side starts from a position of *inferiority* or *relative equality* and attempts to create, not of course an "unlimited" stockpile but rather one of definite, perhaps overwhelming, strategic superiority the enemy government may decide to pre-empt. But the United States is not today in a position of strategic inferiority or relative equality. On the contrary the United States enjoys a large, decisive strategic superiority. As a consequence, the Soviet Union cannot make a rational decision to pre-empt based on the relationship of strategic forces. William W. Kaufman's classic article, "The Requirements of Deterrence,"[23] discusses three aspects of credibility requisite to successful deterrence: capability, costs, and intentions. As noted above, the United States certainly has the capability to act, and our retaliation would inflict damage far beyond the range of any possible advantages which might accrue to the U.S.S.R. Therefore, it is only by discerning, or thinking he discerns, a weakness in our determination to use our forces that the enemy could launch a preventive or (falsely) preemptive attack.

One of the best ways to weaken the firmness of our intentions, in an opponent's estimation, is by proclaiming that a nuclear war is insane under any circumstances and would lead to the ultimate catastrophe. Such statements assumedly refer to a countercity war, for, as we have seen, that type of strategy maximizes damage to the vital fiber of the states involved. But there are circumstances in which the United States would participate in a nuclear war, even circumstances in which she might initiate a nuclear exchange. We are committed to protect Western Europe, and our political leaders have repeatedly affirmed our resolve to honor these commitments. Yet the point at issue is not what we know we will do. The relevant question is whether Soviet leaders believe we will act if provoked. It seems reasonable to presume that the more we proclaim an action irrational, the less convinced they become of our determination to so act.

civil defense

The question of civil defense produces mixed reactions in various members of the overkill school. Dr. Lapp states, "From the birth of the atomic bomb, I have been an advocate of civil defense." But Melman writes, "... the civil defense concept is technically faulty and is politically dangerous.... a major civil defense program announces an intention to strike first."[24] According to data presented in *Kill and Overkill*,[25] 30-psi shelters would protect anyone more than 5 miles from ground zero of a 100-megaton explosion, while every wooden house within 30 miles, and presumably the people in them, would be destroyed. Deriving the area of the circles prescribed by these two radii, 5 and 30 miles, we find that 30-psi shelters reduce the area of blast lethality from 2826 square miles to 78.5 square miles or by 97.23 per cent. Just why such effectiveness is "technically faulty" is somewhat difficult to understand.

Whether a large civil defense program signifies an intention to launch a first strike is debatable. To some extent the impression created depends upon the manner in which the program is implemented. If the United States suddenly began a $5-billion annual effort, the Soviet Union might well take alarm, but judging by the negative history of CD in this country, such a contingency is, at best, highly improbable. The most likely type of accelerated CD program, barring some major crisis, is in the range of $1 billion a year or less. An effort of this size would take so many years to provide adequate protection for the entire population —or even for only the most vulnerable portion —that the Soviet Union could hardly regard it as anything more than insurance against failure of deterrence, not as a sign of aggressive intent.

Another aspect of civil defense that is singled out for criticism is evacuation. The unstated assumption seems to be that in case of a surprise enemy attack, there would be no time for evacuation of metropolitan areas. But surely a "bolt-from-the-blue" attack, though possible, is only one way—and probably the least likely way—in which a nuclear war might begin. No state is apt to take such a momentous step without an overriding and immediate provocation. Much more probable is the escalation of some lesser conflict or initiation after a period of increasing tension. Either of these contexts would provide days, weeks, or possibly months in which evacuation and other measures might be carried out. If a total war occurred, prompt and proper actions during the preceding tension period might save millions of lives. Another and equally important aspect is that such preparations can also serve as an indication to the enemy of determination and of the degree of seriousness the Government attaches to the situation.[26] Simultaneously our vulnerability is reduced. Thereby such actions can serve to avoid the war. The difficult question remains: How provocative is evacuation? There is no definite answer, but my opinion is negative. Once again an enemy's interpretation of American actions may depend in large degree upon how they are conducted. A relatively slow evacuation program scheduled over several weeks, perhaps moving school children first, then the least essential workers and families, etc., would be less provocative than a total evacuation planned for completion in 24 hours. In any event, such cavalier dismissal of a potentially important program is, at best, unfortunate.

a matter of understanding

Overkill advocates repeatedly betray a lack of appreciation for even the most basic facts of international relations. For example, consider the following statement. "Winston Churchill, the early champion of deterrence, acknowledged that it could not guarantee peace." It is merely repeating a truism to point out that nothing can guarantee peace in a human society. Similarly, "the policy of deterrence . . . has generated an endless arms race and created increasingly dangerous forces of instability."[27] We might question whether this is an accurate interpretation or whether nuclear technology has merely transformed an arms race (made inevitable by an aggressive, militant Communism) from an entirely conventional to a partially nuclear sphere. Also, focusing the competition in the nuclear area may have a less undesirable impact on our economy and on our political institutions in the long run than a similarly prolonged conventional arms competition. The human and material resources devoted to a lengthy conventional arms competition promise to equal, if not exceed, those we are using in the present contest. Moveover the technical and educational skills acquired by the jet engine mechanic or missile maintenance technician are more assimilable into the civilian economy than are those of the infantryman or tank driver. Finally, a case can be made that nuclear weapons have brought about less instability than would have existed in a nonnuclear cold war. For example, if it were not for our nuclear capability, how much more aggressive might Communist China be?

A similar lack of understanding is evidenced when overkill advocates affirm, "Since World War II, the United States has spent more than $600 billion in quest of military security, yet it cannot be said that security has come any closer than before."[28] The author continues, "What was overlooked was that nuclear weapons introduced a new scale of weights and measures which demolished old doctrines and gave an entirely new aspect to defense." Both statements are true. Yet both give the impression that we *can* and *would* be more secure if only we had taken certain other actions, not specified but presumably some form of disarmament. The author ignores at least one thing. Not only have nuclear weapons "introduced a new scale of weights and measures" but so have delivery systems. In the Thirties and Forties, for instance, it was simply impossible for any state to attack our heartland. But today because of the march of technology we are and apparently will remain infinitely less secure than during the pre-ICBM, intercontinental-bomber era. From a somewhat more theoretical point of view, in a human society security is an ideal state impossible to attain. Security cannot be absolute. A state is not *either* secure *or* insecure. As long as any state exists with sufficient incentive and resources to compete with us, the U.S. will remain only relatively secure. Security must be measured with reference to many factors, among the most important of which is the military threat posed by intercontinentally delivered nuclear weapons. It is only in this complex context that numbers of weapons have significance. No thinking military man maintains that strength lies in simple numbers, but what many military men do suggest is that maintenance of a sufficient second-strike counterforce capability (which usually requires numbers of weapons considerably larger than those of the enemy) will provide a greater degree of security than any other presently suggested alternative strategy.

Neither do the overkillers exhibit a balanced appreciation of domestic affairs. One instance is exhibited in the unthinking automaticity they attribute to our decision-making.

> . . . Computers tell them that, under certain cir-

> cumstances, we could score a "win" in a nuclear war. Unhappily, the computer arrives at this result only because it has no feelings. . . . If Country A loses 30 million dead and 27 percent of its economy, whereas Country B has 90 million dead and 68 percent of its economy destroyed, the computer pronounces Country A the winner. One wonders how much consolation this would be to Country A.[29]

Anyone who has followed the Administration's handling of recent crises would never infer that the political decision-makers are abandoning their duties to computers. The passage suggests the U.S. would start a nuclear war if the computers forecast a "win," but the author ignores the salient point: If the other side brings about the war, either through a nuclear attack directly against the United States or by a massive attack in Western Europe, it is highly desirable to know how to limit the results to 30 million dead and 27 per cent of our economy destroyed in preference to 90 million dead and 68 per cent of our economy laid waste. Naturally either result would be an unprecedented catastrophe repugnant to any rational person, but such computerized war games are used to find means of *saving* the difference of 60 million lives and 41 per cent of our economy.

There seems also to be a misunderstanding of the willingness of states to attack in the face of superior power. According to Lapp:

> . . . because the advantage of the first strike is so great, the policy of deterrence through superior power is essentially self-defeating. The policy works to prevent war only when both sides are convinced that the other will never strike first. . . . as the race to outbid each other in deterrent power goes on, and as tension builds up, the temptation to try to avoid doom by striking the opponent first with a knockout blow becomes more and more compelling. . . .[30]

He fails to explain just how the U.S.S.R. with a force inferior on the order of three or four to one could possibly hope to strike "the opponent first with a knockout blow."[31] In fact, his conclusion only has validity when relative parity of strategic forces exists. Somewhat paradoxically, parity would be the result of the overkillers' preferred strategy, finite deterrence. Thus, the overkillers' own logic increases chances for the unlimited war they so wish to avoid.

the omniscient polemicist

Thus far where I have disagreed with the overkillers, the difference has been largely a matter of value judgments revolving around intangible considerations (for example, the future impact of technology). In such areas one feels his opponents' position to be in error but understandable. Unfortunately there is another, less appealing side to the overkillers' argument. In certitude of the correctness of their views they repeatedly betray a remarkable lack of perspective and imagination, a penchant for flat, unsupported polemics, and implicit claims of omniscience.

One of the cherished goals of the overkill camp is a great reduction in defense expenditures, and a favored means is to reduce outlay in military research and development. One author recommends a decrease from $7.2 billion to $200 million, a proposal which implies a basically static technology and no competition for technical military dominance. Another makes a mocking statement:

> For both offense and defense there remains the ultimate comic-strip weapon—"death rays." General Curtis E. LeMay, the Air Force Chief of Staff, has made known that the Air Force is not overlooking the possibility of "beam-directed energy weapons" which would "strike with the speed of light" and neutralize any missile.[32]

It seems bizarre for a contemporary scientist to ridicule a service chief for stating that his organization is investigating a promising new scientific application. Additionally, two of the same author's bases for considering an anti-ICBM defense impracticable are the brief time available for counteraction and the danger of the defender's suffering damage from the explosions of both defending missiles and intercepted warheads. It does seem worth investigating any new system, no matter how fantastic by current or past standards, which may overcome both these disadvantages.

Everyone interested in strategy is properly concerned with the allocation of our large but limited national resources. This overkill interest is not under question. What is being scrutinized is a set of argumentative techniques which proceeds from a simplistic view of extremely complex problems, goes on to imply incompetent perverseness on the part of any who disagree, and ends with implicit claims to omniscience. Unfortunately for the overkillers' own cause, such convictions lead them into using obviously fallacious supporting data. An outstanding example of this occurs in a passage intended to prove this increasingly adverse impact of defense expenditures upon the national economy: "The typewriter industry in the U.S. as recently as 1948 supplied virtually all U.S. requirements. It now only supplies 60% of the typewriters that are sold here each year. The remainder are imported, mainly from European factories."[33] All the quote really shows is that in 1948 U.S. manufacturers had a virtual monopoly of the domestic market as a result of World War II and that today they must meet vigorous competition. By omitting critical factors, the author attempts to draw the reader to invalid conclusions.

Another quotation illustrates a similar lack of perspective and imagination: "On the offensive side, destructive capability, having already gone far beyond the overkill mark, calls for no further improvement on military grounds."[34] This view ignores the highly desirable improvement of observation and accuracy capabilities previously discussed, improvement which, other considerations remaining equal, makes possible a tremendous decrease in the required size of warheads and consequent reduction in the number of noncombatants killed. Similarly it fails to consider the competitive nature of the strategic conflict. Third, it ignores the constant and continuing need for replacements to and modernization of our force. Finally, it implies that our nuclear forces can be brought to bear without significant enemy degradation of our effort. Yet in many possible circumstances we seem likely to have to absorb an enemy first strike.

The same author fails to consider vital aspects of the subject: "ICBM's compress the time scale of war to a point that allows no time for hesitation or deliberate thought and opens the door wide to global destruction."[35] First, this is an excellent argument for continuing a force of bombers as a vital portion of our deterrent force. Bombers may be flushed out of harm's way, allowing the President time to ascertain the exact nature of, say, the BMEWS targets before making a decision. Second, dispersal, hardening, mobility, and numbers tend to achieve the same end for the ICBM force (though perhaps not with the same degree of certainty). The more convinced the President is that our ability to retaliate in strength will survive regardless of enemy action, the more he can afford to wait until a provocation is absolutely unequivocal before responding with nuclear weapons. Third, the quoted passage seems to assume the impossibility of creating an invulnerable second-strike force. Yet such a force is exactly what the advocate of finite deterrence must have to make his strategy rational. Since overkillers propose finite deterrence, their argument appears somewhat inconsistent.

Not surprisingly, the overkiller is given to pejorative language. "We have no recourse but the hard one of untangling the skein in which we are all enmeshed—of finding a way out to rationality. For even in its own terms . . . the strategy of enforcing peace through terror is shot through with fallacies and contradictions."[36] Notice that the overkill argument is here equated with rationality, and the opposition with terror. Yet it is the overkillers themselves who prefer a strategy that bases its entire rationale upon an awesome threat to obliterate the enemy's centers of population. One might fairly ask whether this strategy, finite deterrence, or its primary competitor, counterforce, is more aptly termed a strategy of terror. Moreover we must distinguish between peace through terror and peace through strength. Peace through strength is the *raison d'être* of domestic police forces. Peace through strength is "fallacious and contradictory" only in a Utopian state where every member of society is trustworthy and of beneficent intent.

To rely on disarmament (as distinct from arms control) as a means to preserve peace is to surrender society into the hands of the unscrupulous, degenerate, and anarchistic.

The overkiller may retort that his concern lies exactly in the imperfect nature of mankind. Thus he sees American decision-makers and military officials no less fallible than those on the other side, and he foresees the temptation to use a counterforce capability if we build it. The rebuttal is obviously a matter of value judgment. It is as impossible to prove the overkillers' points "wrong" as it is for them to prove themselves "right." A countering argument could proceed along the following lines: (1) Although some individuals might be tempted to use nuclear forces illegitimately, the pressures of the American political and military selection system have the effect of eliminating those men given to impetuous decisions. (2) The overkillers' argument implies a moral symmetry between the two sides of the strategic conflict. In my judgment no such symmetry exists. The leaders of one bloc are schooled in the dictum that the end justifies the means. The West denies that this is so. (3) Vast efforts are being made to ensure that no individual can fire a nuclear weapon without authorization. And (4) in any event we cannot wish away the existence of nuclear military technology. We live in the age of the atom and must meet its problems realistically. Idealism is essential, for the idealist prevents the realist's becoming a cynic. But the realist keeps the idealist from becoming a corpse. Peace through strength is preferable to either anarchy through weakness or destruction through terror.

Regarding their pretense to omniscience, consider this unqualified statement: "It would take a high degree of self-control to 'absorb' the demolition of an American city without killing a Soviet city in return. And yet retaliation would certainly escalate into a general war."[37] No such certainty exists. Of course it is possible for retaliation to escalate into general war; but if we assume (1) that such retaliation were preceded by clear statements that our action was based only upon the necessity of a *quid pro quo* to deter a series of possible nonaccidental enemy accidents, and (2) that six hours, say, were allowed for the evacuation of a specified target city, it seems unlikely that the Soviet Union would misinterpret our one-city retaliation as the prelude to an all-out attack or would feel constrained to escalate the situation.

Such questionable argumentative techniques seem more calculated to convert than convince, to inspire than inform. They add little and detract much from the value of the overkill position.

The overkill argument is not convincing. It decries peace through terror and yet prefers to target noncombatant populations rather than the enemy's military forces. It posits a nonexistent moral symmetry between the leaders of the two sides and tries to reduce the uncertainty of war to a precise accounting of the number of required weapons. It vividly portrays the possible horrors of a nuclear war but makes almost no attempt to ameliorate them. Its preferred strategy would prove disastrous, by its own admission, if implemented. It repeatedly exhibits a lack of understanding of the basic facts and attitudes of international relations. In order to convince their readers, overkillers consistently underrate the advance of technology and its possibly positive impact upon counterforce feasibility. Given to polemics as much as to objective inquiry, the overkillers' argument is weakened by a remarkable choice of those facts which strengthen their argument and by a tendency to disparage the abilities and motivations of their opponents.

This article is designed to dispel the overkill implication of self-possessed omniscience. It is not primarily a case for counterforce, but many of the points are reverse sides of the same coin. Although some of the overkill arguments might be more valid if the United States were in a position of strategic nuclear inferiority or parity, such is not the case. We presently possess a gratifying degree of strategic advantage. The United States' security will be maximized by maintaining and refining that superiority while simultaneously improving our capabilities in the less-than-total portions of the conflict spectrum. It is particularly vital to concentrate on research and development as the source of our follow-on weapons, both offensive and defensive.

United States Air Force Academy

Notes

1. Space allows only a condensed presentation of the overkill position. In such a situation one leaves himself open to charges of partisan selectivity and quoting out of context. In an effort to avoid such failures I shall cite my sources frequently so that the reader with further questions may examine these authors' positions for himself.

2. Seymour Melman, "How Much Military Power Is Enough?" *A Strategy for American Security* (Lee Service, Inc., distributor, New York: 1963), p. 1.

3. For convenience I shall use the term "overkiller" as an abbreviation of the ungainly phrase, "person who believes that we presently possess an overkill capability."

4. Ralph E. Lapp, *Kill and Overkill* (New York: Basic Books, Inc., 1962), pp. 8, 64, 90, 97, 120, 140.

5. I use the differentiation between these terms specified by Herman Kahn in *On Thermonuclear War* (Princeton: Princeton University Press, 1960), pp. 8, 14-17. That is, minimum deterrence is the simple view that any state possessed of a "sufficient" number of thermonuclear weapons and means of delivery has an adequate deterrent force. The essential features of this strategic view are: that only a very few (for example, 50) weapons are enough; that no state would be willing to risk the loss of even a small number of its largest cities; and that therefore a stable balance of terror has been established. This view is epitomized in the statement, "Nuclear war is unthinkable." Although in vogue a few years ago, minimum deterrence has now been largely supplanted by the more sophisticated finite deterrence. The basic difference between minimum and finite deterrence is that the latter allows for credibility, making the use of one's deterrent appear believable. Thus although there is little or no unanimity, believers in finite deterrence typically see a requirement for forces larger than those felt necessary by advocates of minimum deterrence. Two hundred weapons delivered on target might be considered characteristic. But the phrase "delivered on target" includes several significant stipulations. First, one's deterrent must be a "second-strike" force; that is, it must be able to absorb and survive an enemy surprise attack. Such a capability may be achieved in various ways: increasing the size of your force, mobility, dispersal, hardening, concealment, early warning combined with quick reaction, and active defense. But this is only the first step.

Next the force must be able to penetrate enemy active defenses. Techniques helpful at this stage include decoys, electronic countermeasures, saturation, evasion, and multiple types of attacking vehicles, directions, and tactics. Each of these alternatives or any preferred combination imposes penalties in the form of costs and smaller sizes and numbers of warheads delivered. Certain of them also pose political requirements, for example, to obtain foreign bases or for support of certain other weapons (CW-BW) and unorthodox tactics (countercity targeting). Finally, the deterrent force must be able to destroy its targets. Required technical capabilities at this point include correct intelligence data, accurate delivery, adequate warhead size, sufficient numbers of weapons delivered, and, for fast-reacting targets, speed and coordination of attack. However, rapidly reacting targets are not a consideration in either minimum or finite deterrence, which in their "pure" versions only target cities, in the hope that the horror of the result will prevent occasion for their use ever arising.

6. The term "counterforce" is used in various ways by different authors. Kahn defines it as any means, offensive or defensive, active or passive, used to counter the enemy's use of force. (Kahn, p. 16n.) In a somewhat narrower use, counterforce is any strategy or application of military force against military force—at any level of the conflict spectrum. A third and perhaps the most common contemporary usage signifies a strategy for general nuclear war. In this sense a counterforce strategy assumes that the best deterrent is an acknowledged ability to strategically disarm a potential enemy. Secondary assumptions are that such a strategic force is technically and economically feasible. Moreover, counterforce believers maintain that it is possible by proper planning to ameliorate the impact of an unlimited general war to the extent that the United States could survive as a viable, powerful state and impose favorable (though probably not unconditional) peace terms upon the enemy.

There is a common misconception that counterforce advocates "want" a nuclear war. This is not true. Their position is that in spite of our best efforts such a war may occur (after all we no longer enjoy a monopoly of nuclear weapons) and that we must be prepared for this undesirable eventuality. They deny the minimum-finite deterrence position that deterrence is perfectible.

Perhaps the fundamental disagreement between the minimum-finite deterrence school on the one hand and the counterforce school on the other is that the former prefers to reduce the probability of nuclear devastation by strengthening prewar deterrence while the latter believes it possible and preferable to simultaneously strengthen prewar and intrawar deterrence *and* our war-fighting ability. This difference leads to the familiar dispute about targets (countercity vs. counterforce) and force structures (finite vs. superior).

7. Seymour Melman, "Military Power and Money," *Saturday Review*, 4 May 1963, p. 11. (Not again referred to)

8. Melman, *A Strategy for American Security*, p. 3. Also see Lapp, pp. 109-117.

9. Melman, p. 3.

10. For example, throughout his paper Melman's calculations posit losses of 30% or 50%. Yet it is common knowledge that only half of SAC's bombers are on ground alert. The non-alert half probably would be destroyed by an enemy surprise attack, and some of the alert force would be destroyed by enemy defenses. We are building our missile force to ride out an attack and can expect heavy losses here also.

11. Lapp, pp. 120, 140.

12. Melman, p. 3.

13. Yet promising developments appear possible even in this difficult field. See J. S. Butz, Jr., " 'Super' Guns for Misssile Defense," *Air Force and Space Digest*, November 1963, pp. 50-56.

14. "U.S. Intelligence: Is It Good Enough?" *U.S. News and World Report*, 9 September 1963, pp. 66-67.

15. Source of formulas for the following data is *The Effects of Nuclear Weapons*, AFP 136-1-3, prepared by the Department of Defense, published by the Atomic Energy Commission (Washington: USGPO, June 1957), pp. 107-111.

16. Lapp, p. 78. Even this statement is apparently pessimistic. As originally planned, the Atlas missile was to have a maximum range of 6325 miles, reliability of 50%, and an accuracy within 5 miles of the target. By November 1963 the Atlas had reached targets up to 9000 miles away; 70% of its developmental launches were successful (most failures occurred in early tests, so that present reliability is well above 70%); and average accuracy has been less than a mile. "Atlas Missile More Accurate than Required," *Denver Post*, 6 November 1963, p. 36, col. 1.

17. "Intensive ASW Research Effort," *Interavia*, XVIII, 3 (March 1963), p. 324. For discussions of the current U.S. ASW effort and future prospects, see *ibid.*, pp. 321-322, and Vice Admiral John W. Thach, "The ASW Navy of the Seventies," *U.S. Naval Institute Proceedings*, January 1963, pp. 57-65.

18. Either contingency seems much more likely than the "bolt from the blue" attack with which we have been so concerned for years. For a much more complete discussion of limited strategic war, see Klaus Knorr, ed., *Limited Strategic War* (New York: Frederick A. Praeger, 1962).

19. Some cities might also be vital military targets and consequently legitimate counterforce targets. Such military cities, however, would certainly be the exception and presumably would be limited to the most essential communication and nuclear weapon production centers. Because of the brief duration of this initial and decisive phase of such a war, the necessity to attack even such cities is open to serious question. If certain targets are considered vital (perhaps an ICBM plant), it would probably be wise purposely to restrict the warhead to the minimum size necessary.

20. It may be objected that a revenge-oriented retaliatory force is exactly what France is presently building. The answer may lie in the evolution of strategic thought which nuclear-armed states seem to undergo. The general line of development appears to be an initial fixation on the sheer power of the newly acquired weapons and a resultant emphasis on countercity deterrence. As weapons and delivery systems become more plentiful and larger (in efforts to perfect their deterrent capa-

bility), the strategic problem appears to be solved and attention turns to the major remaining area of difficulty, limited war. Theorists then stress the efficacy of smaller nuclear weapons against concentrated formations of the enemy's ground forces, and technical development responds in the lower end of weapons engineering. At about this point, though, it becomes evident that nuclear sauces apply equally to enemy geese and friendly ganders. Thereupon, continuing problems in both unlimited and limited areas of strategy are recognized, and more sophisticated conflict theories are developed to solve them.

21. By "weaker side" is meant the state suffering a significant numerical disadvantage in the weapons it can deliver on target. Assuming equal technologies and simultaneous launch (very doubtful assumptions), this is reflected before the war in relative numbers of weapons possessed. If one side has a highly effective active defense, it may have fewer offensive weapons but nevertheless be the strategically stronger state. It is impossible to specify how many deliverable weapons comprise enough of an advantage to qualify one country as the "stronger" without a detailed analysis of each specific situation suggested.

22. Lapp, p. 10.

23. William W. Kaufman, "The Requirements of Deterrence," *Military Policy and National Security* (Princeton: Princeton University Press, 1956), pp. 12-38.

24. Lapp, p. 121. Melman, p. 4.

25. Lapp, pp. 50-51.

26. For a discussion of bargaining techniques and international communication, see Thomas C. Schelling, *The Strategy of Conflict* (Cambridge: Harvard University Press, 1963), especially pp. 3-80. It is also published in paperback by Oxford University Press, New York, 1963.

27. Lapp, pp. 91-92.

28. *Ibid.*, p. 139.

29. *Ibid.*, pp. 95-96. For an interesting, unclassified discussion of several strategic war games, see Richard Fryklund, *100 Million Lives* (New York: The Macmillan Co., 1962).

30. Lapp, p. 107.

31. Alastair Buchan in *NATO in the 1960's* (rev. ed.; New York: Frederick A. Praeger, 1963), p. 177, estimates Western ICBM's in early 1963 at 450–500, Soviet at 75, and Western long-range bombers (over 5000-mile range) at 630, Soviet at 200.

32. Lapp, p. 117.

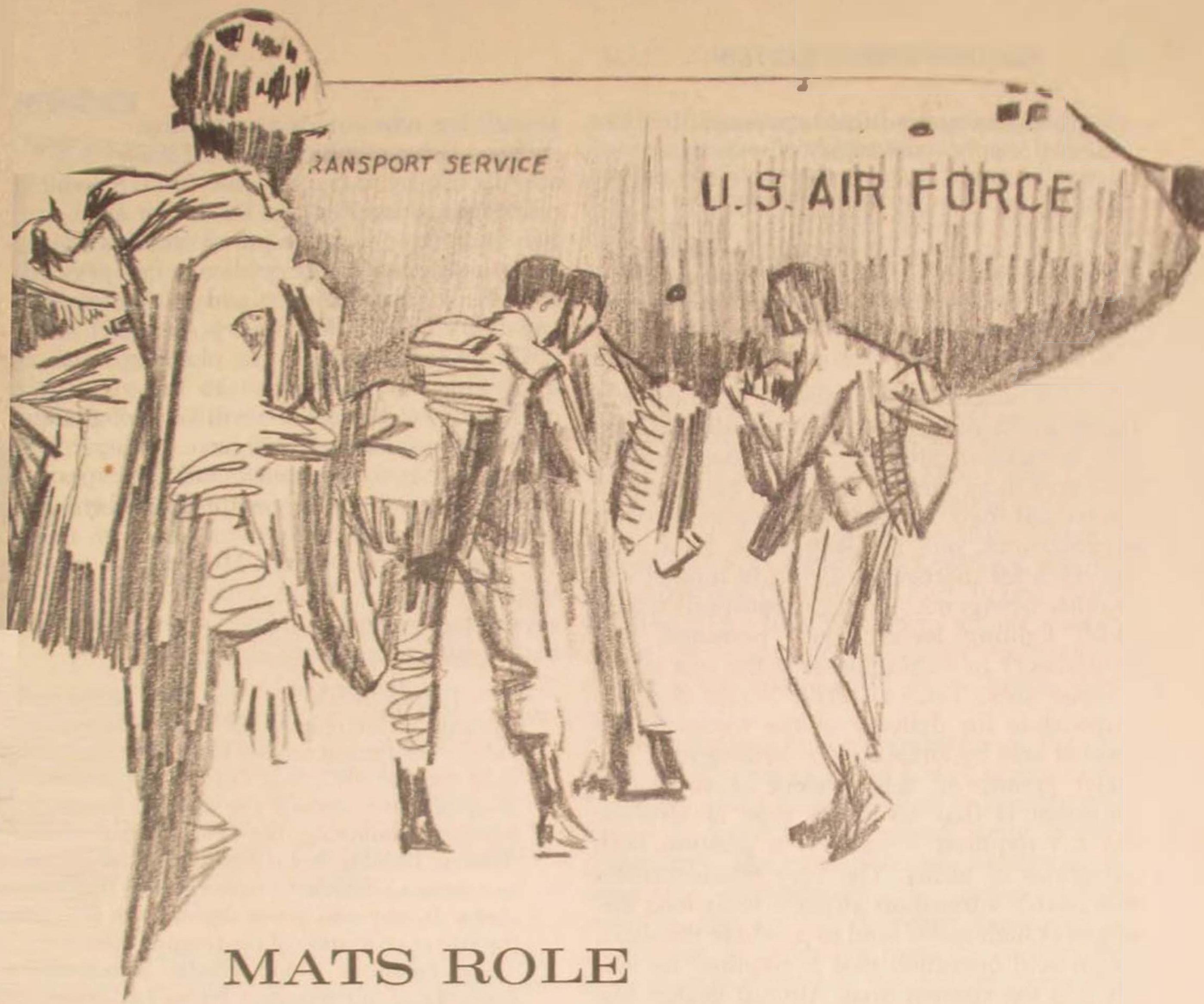
33. Melman, p. 5.

34. *Ibid.*, p. 3.

35. *Ibid.*, p. 78; also pp. 83, 133-34.

36. *Ibid.*, p. 22.

37. *Ibid.*, p. 132.



MATS ROLE IN COMBAT AIRLIFT

Major Henry L. Walker

THE Military Air Transport Service originated with consolidation of the Air Force's Air Transport Command and the Navy's Air Transport Service on 1 June 1948. MATS was placed under the command and direction of the Chief of Staff, United States Air Force. The purpose of the new organization was to bring components of the long-range airlift forces of the Air Force and the Navy together under a single command.

MATS was originally envisioned as a noncombatant airlift organization. The original MATS mission as directed by the Secretary of Defense in May 1948 clearly illustrates this point:

> MATS will be responsible for . . . the transportation by air of personnel (including the evacuation of sick and wounded), materiel, mail, strategic materials and other cargoes for all agencies of the National Military Establishment and as authorized for other government agencies of the United States. . . . The responsibility for air transportation for the National Military Establishment *does not include* responsibility for the tactical air transportation of

> airborne troops and their equipment, [or] the initial supply and resupply of units in forward combat areas. . . . MATS responsibilities will include participation in the development of "all weather" transport flight technique, but *will not include* responsibility for the operation or development of either transport type aircraft or procedures employed in the air transportation of airborne troops in tactical operations. . . . [Italics supplied.]

The noncombatant mission of MATS was based on the concept of military airlift divided into two broad categories: long range (strategic) and short range (tactical). This concept envisioned two distinct and separate airlift organizations, one for long-range airlift and the other for short-range airlift. In time of war or other emergency, strategic transports would airlift fighting forces (both personnel and equipment) to staging bases in the rear of the combat area. Tactical airlift would then be responsible for delivery of the forces to the combat area by airlanding or airdropping. The major premise of this concept of airlift employment is that no single type of airplane has the required versatility to perform both categories of airlift. The very characteristics that enable a transport airplane to fly long distances at high speed tend to preclude the short, rough-field operation that is required for airlift into the combat area. Aircraft design features which enable high-speed operation are not readily compatible with those required for airdropping at low speeds and low altitudes.

From an operational standpoint it is certainly desirable to have the capability to deliver forces across long distances directly into a combat area without the need for intermediate staging bases. The delivery of forces directly to the objective area is a major consideration in contingency planning. Obviously an airlift force with this capability has the flexibility to move large forces to an objective area if required for a show of force or other reasons.

changing airlift concepts

While it has been true in the past that no single aircraft could perform both missions, aircraft are now entering MATS' inventory that do have this capability. The C-130E, which is now in use by MATS, and the C-141A, which made its maiden flight in December 1963, are two aircraft with the required characteristics. Both have long range with a large payload plus the required airdrop and assault landing capability. The CX-4 heavy transport (described later) is now in the planning stage as a possible future addition to the versatility of the MATS airlift force. It will have long range with huge payloads. It will have the capability to airdrop both personnel and all types of equipment, and it will operate effectively from rudimentary airfields.

Secretary of Defense McNamara's recent testimony before House Armed Services Subcommittee further supports the contention that airlift concepts are changing.

> The distinction between troop carrier and strategic airlift operations based upon difference in equipment will no longer be significant once the C-130E's and C-141's are acquired. Both of these aircraft are suitable for either mission. Admittedly, the two missions require different training, but there does not seem to be any serious obstacle to cross-training the MATS crews. It may also prove desirable to increase the rate of utilization of the troop carrier forces. These measures would greatly increase the flexibility of our transport forces for both missions.
>
> Indeed, the C-141 may open up entirely new vistas in troop carrier operations. For example, it might prove to be entirely feasible to load troops and their equipment in the United States and fly them directly to the battle area overseas, instead of moving them by strategic airlift to an overseas assembly point and then loading them and their equipment on troop carriers. Thus, the line of demarcation between the strategic airlift mission and the troop carrier or assault mission may, in time, become less important.

General Joe W. Kelly, MATS Commander, in testimony before the House Armed Services Committee also punctuated the concept of airlift as an entity, not to be divided into strategic and tactical forces. General Kelly stated that the words *strategic* and *tactical* should not be used to describe airlift. Rather, terms such as deployment, employment, assault, and resupply are more descriptive of the role of airlift in combat.

Since the initial organization of MATS the trend has been toward more recognition of the capability of MATS to perform the entire spectrum of airlift including all phases of combat airlift. This trend has been strengthened by MATS acquisition of more modern aircraft which increase this capability.

Air Force Regulation 23-17, dated 9 July 1963, states the current organization and mission of MATS. The following excerpts from this regulation outline the present concept of the extent of MATS participation in combat airlift.

> *Over-all Mission:* The mission of MATS is to maintain, in a constant state of readiness, the military airlift system necessary to perform all airlift tasks under emergency conditions assigned by the Joint Chiefs of Staff in approved war plans and appropriate JCS and Air Force guidance documents. . . . To insure the ability to perform emergency airlift tasks, MATS will:
>
> (a) Train and equip its airlift forces in all airlift tasks, consistent with the capabilities of the aircraft assigned. Mobility and flexibility will be inherent in these forces.
>
> ° ° ° °
>
> (c) Develop detailed plans with appropriate agencies in support of approved JCS plans for deployment and employment airlift.
>
> (d) Participate in joint exercises and airborne training with the forces which MATS is required to support to insure capability to execute specific plans. . . .

The term *airlift* as used in the context above is defined as:

> The air movement of troops, cargo, special equipment, military impedimenta, passengers, patients, and mail in either a wartime or peacetime environment to and from areas requiring such airlift; includes the aerial delivery of troops, equipment, and supplies.

This mission statement is in marked contrast to the original charter given MATS.

MATS acquires combat airlift mission

MATS combat airlift role began in 1957. In that year two C-124 troop-carrier wings were transferred to MATS in a move to consolidate heavy transport aircraft under a single agency. These units were already qualified in formation flying and airdrop at the time of the transfer. An Air Force-directed study recommended that the requirement for these units to fly formation be dropped. The requirement to maintain proficiency in actual drops of personnel and equipment was retained, however. To provide adequate airborne training for the Army and drop training for the troop-carrier wings, they were allocated 1100 flying hours per month of joint airborne training time. The Army units involved were the 101st Airborne Division at Fort Campbell, Kentucky, and the 82d Airborne Division at Fort Bragg, North Carolina. This time was flown almost entirely at the convenience of the Army, the training of the MATS troop-carrier crews being a byproduct.

Subsequent to the acquisition of the two troop-carrier wings, MATS C-124 crews in air transport wings were required to become proficient in computed air release point (CARP) procedures. The CARP system is an attempt to determine scientifically the proper release point in the air for dropping personnel or equipment in order for them to land at the desired impact point on the ground. Such variables as parachute ballistics, wind velocity, aircraft velocity, rate of fall, and human delay factors are applied to solve for the exact CARP point. The air transport crews were trained in CARP procedures using miniature parachutes thrown from the aircraft by hand rather than dropping actual personnel and equipment. All procedures incident to an actual drop were followed to ensure maximum training. These crews were not required to fly formation.

Based on revised Department of Defense planning, the Air Force in 1962 directed MATS to qualify all its C-124 crews, both troop-carrier and air transport wings, in formation and airdrop. Qualification criteria were established and training was begun. Because of the urgency of the requirement and the magnitude of the training task, the airdrop requirements continued to be met, in the interim, by qualifying aircrews in CARP procedures using miniature parachutes. No actual drops were required. By the end of the year the training was completed. MATS made the first formation drop at Fort Campbell in September 1962, when 2100 paratroopers were dropped.

In the midst of the aircrew qualification program, the Cuban crisis erupted in October 1962. The scope of MATS involvement in this operation was tremendous. Missions included a series of airlifts of essential battle equipment, ammunition, and supplies to Florida. This was followed by a massive 48-hour airlift of battle-equipped Marines from the West Coast to Guantanamo. In addition, large numbers of dependents were evacuated to the U.S. mainland by air. Although the decision had been made earlier to qualify all C-124 crews in formation flying by September 1963, the Cuban situation demanded that the project be expedited. The formation training was given a high priority, and within a 20-day period 305 aircrews were qualified. Concurrently it became evident that special equipment required for dropping equipment from C-124's, which had been scheduled for delivery later in the year, was needed immediately. MATS had no alternative but to institute a self-help program to provide the aircraft with this vital equipment. The solution was to fabricate it from MATS resources. Mass-production methods were employed round the clock, and the equipment requirement was met within 20 days.

Applied Tactics Group

Headquarters MATS on 1 January 1963 formed the Applied Tactics Group. The charter of this provisional division required it to evaluate the current combat airlift status of MATS, establish the immediate requirements to improve MATS combat airlift capabilities, examine future requirements for equipment and techniques, and develop combat airlift doctrine. The Applied Tactics Group has worked closely with other divisions to develop a coherent program of combat airlift crew qualification and currency, equipment requirements, improved employment tactics, and integration of new equipment into the MATS force.

Several prime objectives were explicitly stated:

- To fully qualify all aircrews in units possessing aircraft with airdrop capability in all phases of combat airlift.
- To place greater emphasis on aircrew combat readiness, including actual drops of personnel and equipment for initial qualification and currency.
- To take other actions required to ensure that MATS is capable of performing all phases of combat airlift, limited only by inherent limitations of the equipment.

A program was established on 1 April 1963 to qualify all aircrews of units possessing aircraft with airdrop capability in all phases of airdrop, including actual drops. This program requires aircrews to maintain currency by making actual drops annually. A target date was set for qualifying the entire MATS force. To date, the program is essentially on schedule.

More stringent operational readiness inspection (ORI) criteria have been developed and approved by Hq USAF to better evaluate the combat readiness of MATS units. Actual airdrops are now required as part of readiness inspections.

MATS has changed the unit training standard (UTS) for C-124 and C-130E units to better align the training standards with the combat airlift mission. In addition to airdrop training required for C-124 and C-130 aircraft, the C-130 units are required to train for assault landing operations on improved and unimproved fields. At present assault operations are limited by lack of complete tests on the C-130E aircraft.

Joint Airborne Training Program

To enable MATS units to accomplish the additional training and currency requirements, an expanded joint airborne training program has been initiated at Fort Campbell and Fort Bragg. This program requires Eastern Transport Air Force (EASTAF) to provide three airplanes five days a week at Fort Bragg and

Western Transport Air Force (WESTAF) a like number at Campbell to qualify crews and maintain currency by flying formation and low-level navigation, making personnel drops, and making heavy-equipment drops for the Army. The 1100 hours' flying time allocated for joint airborne training is used for this program. The Transport Air Forces (TAF) rotate crews as required to ensure that maximum utilization is realized from this training program. It serves not only to train MATS crews but also to provide the airborne training required for the Army airborne units and to train MATS and TAC combat control teams which provide required support activities on the drop zones and landing zones.

Although the joint airborne training for the huge MATS airlift force requires a tremendous amount of support from the Army, the program is for the mutual benefit of both forces. The Army must also support the airdrop requirements for TAC in addition to those for MATS. The combined requirements of TAC and MATS exceed the training requirements of the Army. To provide the remainder of the training, MATS wings are taking action to provide unilateral airdrop training. For this purpose drop zones have been established at Camp Stewart, Georgia, Fort Lewis, Washington, and on Molokai Island in Hawaii. Although located on Army establishments, these drop zones are used for MATS training only. Both heavy equipment and miniature parachutes are dropped. Whereas the Army performs the parachute repacking for joint airborne training, the MATS aerial port squadrons perform this service for the unilateral training drops.

One of the MATS troop-carrier wings has an aerial port squadron which includes a combat control team and the capability for parachute repack and other functions required to support airdropping and airlanding. The other troop-carrier wing has only a combat control team. The MATS air transport wings have air terminal squadrons capable of performing air terminal functions such as cargo handling and aircraft loading and unloading. The air terminal squadrons have none of the capabilities required to support airdrop activities. To provide better support for combat airlift operations, MATS has recently taken action to provide an aerial port squadron in each MATS air transport wing. Thus ultimately these wings will be able to provide the necessary support for unilateral drop training, for all airdrops in which the Army is not involved (e.g., Operation Deep Freeze in the antarctic), and for other airdrop or airlanding operations that are conducted exclusively by the Air Force.

Project CLOSE LOOK

Throughout the entire history of airdropping, there have been serious limitations to accurate en route navigation, drop zone location and identification, and drop accuracy. Airdrop operations have been restricted to visual weather conditions. Some factors which limit capability are inadequate navigation equipment, poor communications equipment, unknown parachute ballistics, inability to determine drop zone winds, and cumbersome, inflexible tactics. Suitable drop scoring equipment has not been available to assess adequately the results of training or new techniques and procedures. Consequently troop-carrier effectiveness has not significantly increased since World War II. To overcome these deficiencies and to devise improved techniques, TAC initiated Project CLOSE LOOK, Phase I of which was actively pursued during January and February 1963. Phase I involved a comprehensive review of current tactics, techniques, and problems connected with troop-carrier and airborne operations. Revised tactics were devised and tested for use in airdrop under visual conditions, marginal visual conditions, and instrument conditions. Some of the recommendations from Phase I were that a revised type of formation involving low-level, in-trail flying replace conventional formation and that further development of equipment required for unlimited IFR airdrop be continued. Two MATS officers participated as full-time working members during the entire Phase I. Some of the actions taken by MATS to implement the recommendations of Phase I are discussed later. Subsequent phases of Project CLOSE LOOK will further investigate requirements for new equipment for a complete

IFR drop capability. MATS also furnished a five-man team of officers to Air Force Project NEW LIGHT, organized to provide the Air Force response to the Army Howze Board proposals. The group was tasked to design test plans to demonstrate that the Air Force, with its own aircraft, could give the Army airlift and tactical air power superior to what the Army could furnish itself with Army aircraft.

specialized training for staff officers

MATS has obtained quotas for key staff officers to receive Army parachutist training at Fort Benning, Georgia. This training will enable MATS to meet with the Army on more equal terms during conferences and in the field. It also gives MATS officers an opportunity to appreciate further the airdrop operations problems of the Army and to evaluate more effectively the quality of the service that the Air Force is providing. Twenty-two officers from MATS headquarters and the two transport air forces had successfully completed the program by 1 December 1963. Because of the tangible benefits already derived from this training, an expanded quota will be requested in the future.

Quotas have also been obtained for MATS staff officers to attend the Combat Operations Course of the USAF Air Ground Operations School. The school is located at Eglin AFB, Florida, and is operated by the Tactical Air Command. The Combat Operations Course is designed to train officers of the armed forces in jointly approved concepts, doctrines, techniques, and procedures for integrating the joint combat effort of the services. Subjects covered include close air support and joint airborne operations. The latter encompasses combat airlift. This school provides a medium for officers of the different services to meet face to face, thereby gaining a clearer understanding and appreciation for each other's problems.

standardization of airlift manuals

Since MATS is participating more in joint airborne activities, action is being taken to participate in the writing of manuals and other publications from which MATS had formerly been excluded. For example, a basic manual which is the "bible" of joint airborne operations is presently written jointly by U.S. Continental Army Command and Tactical Air Command. This manual, designated USCONARC Manual 110-101-1 and TAC Manual 55-2, provides operational procedures for joint airborne operations. MATS has recommended to Air Force that this manual be updated, standardized, and rewritten with Army, Navy/Marine, and Air Force participation and designated a triservice manual. This request is being staffed by Hq USAF, and informal information indicates the idea is being favorably received. Earlier in 1963 TAC Manual 50-2 was rewritten as an Air Force publication. This manual prescribes procedures for combat control team training and standardization. Since MATS has combat control teams, a MATS officer participated in the rewrite. MATS has several manuals, such as MATS Manuals 55-1 and 55-4, which relate to combat airlift matters that fall entirely within the purview of MATS.

airdrop competition

To stimulate further interest among MATS aircrews, an annual airdrop competition is held. This competition, popularly referred to by aircrews as the "CARP Rodeo," gathers together MATS aircrews from around the world. The objective is to select the MATS aircrew that best demonstrates the ability to perform the combat airlift mission. For scoring purposes an elaborate evaluating system has been devised. Each crew makes several actual airdrops of personnel and cargo. One or more referees accompany each flight. The final evaluation considers such factors as drop accuracy; starting, taxiing, taking off, and dropping on time; flying safety; crew coordination; general professionalism; and missions aborted for whatever reason. The competition is keen and considerable prestige goes to the winner. This program has generated so much interest that plans are under way to establish an Air Force-wide event in the future that will be open to all Air Force commands with an airdrop mission.

future of combat airlift

Considerable effort is currently being directed toward future requirements for the combat airlift mission. Included is the requirement for improved equipment and techniques of employment. Significant advances are now being made in improving techniques of employment, and such transport aircraft as the C-141A and CX-4 will revolutionize combat airlift.

C-141A. The Lockheed C-141A is a high-speed, long-range jet transport airplane. It is destined to become a workhorse of the MATS force. Designed within the current state of the art, it is an austere airplane, primarily for cargo-carrying but with a capacity of over 100 troops. It can carry a payload of 80,000 pounds over 3000 nautical miles and a payload of 33,000 pounds over 5000 nautical miles. It has complete airdrop capability and can operate from moderately short fields, requiring less than 2000 feet for landing ground run at maximum landing weight. The C-141A made its first flight 17 December 1963, and deliveries will begin in fiscal year 1965.

CX-4. Although the C-141A will provide a significant increase in the present MATS combat airlift capability, it does have limitations on the size cargo that can be carried. Large (outsize) cargo is now being airlifted by MATS C-133's and to some extent by C-124's. However, the C-133 fleet is aging and plagued with maintenance difficulties. The CX-4 heavy transport aircraft is proposed as replacement for the C-133. The CX-4 is not yet an approved program or a firm design, but most of the desired capabilities and characteristics have been defined by MATS. The CX-4 will be a tremendous airplane by any standards. Maximum gross weight will probably be between 500,000 and 700,000 pounds. Despite the huge size and capacity, it will be a surprisingly agile airplane, capable of operating from relatively small airfields. Additionally, the CX-4 will have all-weather airdrop capability for maximum flexibility. This airplane will offer such an increase in MATS airlift as to stagger the imagination.

all-weather drop capability

MATS airdrop capability is contingent on VFR weather conditions. Although conventional formations of transport aircraft have a limited ability to penetrate bands of weather, such formation flying is essentially a VFR proposition. Formations flown at low level to avoid enemy detection are completely dependent on VFR conditions. This places a severe limitation on the effectiveness of the airdrop mission by reducing flexibility. The planning and execution of a mission depend on VFR weather being forecast and realized. Therefore a pressing requirement exists to improve the flexibility of airdrop operations by the development of an all-weather airdrop capability. This requires new techniques and improved equipment, particularly electronic equipment. MATS has formally stated a requirement to fully equip the CX-4 for accurate all-weather airdrop capability.

IFR drop techniques and operational requirements

MATS is experimenting with improved airdrop techniques and is fostering development of the missing electronic equipment that experience reveals is necessary to airdrop under IFR conditions.

In-Trail Formation. A new technique for airdrop was developed in Project CLOSE LOOK for both VFR and IFR application. It involves an in-trail type of formation flown at high speed and low level over hostile territory. The in-trail formation can also be flown at high altitudes for fuel economy or other reasons. Spacing between aircraft (for C-130) is five seconds between each airplane of a three-plane element and thirty seconds between element leaders. Airspeed is 250 knots. This type of formation has almost as much maneuverability as a single aircraft. The low level permits operations under much lower weather conditions than permitted by the standard V formation. With the addition of the specialized electronics discussed later, it may be possible to fly the in-trail formation with extremely large numbers of aircraft under complete IFR conditions.

Pop-Up Maneuver. The in-trail formation can be flown as low as 300 feet or less over the terrain. The low-level portion is flown at high speed (250 knots). Minimum drop altitude is about 1000 feet, and maximum drop speed is

125–130 knots. A pop-up maneuver was developed to reduce airspeed while simultaneously climbing to drop altitude. At about five minutes from the drop zone all airplanes of a three-plane element climb rapidly to drop altitude while reducing airspeed to 125 knots. This increases the time between aircraft to 10 seconds although the distance between them remains the same. After the drop is completed the element descends to the lower altitude and increases airspeed for the return flight. Each succeeding element follows the same procedure. The result is a steady stream of airplanes over the drop zone at 10-second intervals. The pop-up maneuver used in conjunction with the in-trail formation enables VFR airdrops under less favorable weather conditions than is possible with conventional formations flown at higher altitudes.

These two techniques are still considered experimental, but tests to date are very encouraging. Both MATS and TAC are considering the latter technique as an alternate airdrop method. Ultimately it may completely replace the conventional formation. Although these new formation techniques lend themselves readily to IFR operation, improved electronics are required before this ultimate goal will be attained.

Station-Keeping System for IFR Drop. Three distinct navigation requirements must be met without visual reference to other aircraft or the ground before true IFR drop capability can become a reality. First, for flying formation under IFR conditions, a station-keeping capability is essential. IFR station keeping must provide the pilot, through electronic means, information on the location, speed, heading, and altitude of other aircraft in the formation. This information must be furnished to the pilot in a form which is readily usable with a minimum of interpretation. Ideally, it should give a pictorial display closely approximating what he would see under VFR conditions. It would also be desirable to have the option of automatic formation flying by coupling the station-keeping equipment directly to the automatic pilot. Several approaches to station keeping are currently being evaluated. The outlook for developing a satisfactory system is fairly good.

Terrain-Following Radar for IFR Drop. A second electronic equipment requirement for true IFR drop capability is for terrain-following radar. Terrain-following radar must enable a pilot to fly at 300 feet or lower under all weather conditions. As with the station-keeping equipment, the desired method of presentation is a pictorial display that duplicates what the pilot would see if he were flying VFR. To be effective for long low-level missions, terrain-following radar should have the capability of being coupled directly to the autopilot so that the airplane can automatically fly at a preselected altitude. Considerable development of terrain-following radar has taken place over the past few years. It is believed that the equipment required is within the state of the art.

Terminal Guidance System for IFR Drop. To complete the IFR drop package, a self-contained terminal guidance system is required. This means a system capable of navigating an airplane to within 100 yards of a predetermined geographical point without visual reference or any equipment outside the airplane. Navigation with this degree of accuracy is a fairly routine matter if adequate ground-based radio equipment is available. However, achieving such accuracy with only self-contained equipment constitutes a formidable task, probably the most difficult IFR drop requirement to satisfy. No equipment now in service has the required accuracy, but the outlook for its development is promising. Meanwhile, limited IFR drop can be realized by means of station-keeping, terrain-following, and the current navigation equipment augmented by prepositioned ground equipment for more precise navigation. By means of a Qualitative Operational Requirement (QOR) to Hq USAF, MATS has formally stated the requirement for station-keeping, terrain-following, and self-contained terminal navigational equipment for C-130's and C-141's. Provided Air Force validates the requirement and development is begun, true all-weather IFR drop should become a reality within the foreseeable future. Thus the planning and execution of airdrop activities in the future will be much less dependent on weather conditions. The effectiveness of airdrop as a combat tool will materially increase as a direct result of this increased flexibility.

changing role of MATS

The mission of MATS has been continually changing since the command was established in 1948. At first MATS was limited to a "military airline" type of operation, operating on a predominantly scheduled basis and with no combat role. Gradually the realization has dawned that this massive airlift force does have a significant capability for combat airlift. As new aircraft with increased flexibility have entered or been programed to enter the MATS inventory, this realization has crystallized, and positive action has been taken to exploit this capability.

For the past three years, and particularly for the past year, the trend has been away from a purely logistic mission for MATS to increased concentration on joint airborne training, air mobility exercises, and other combat airlift areas. Continuing emphasis is being placed not only on crew qualification and currency but on the development and perfection of improved employment techniques that will better enable MATS to perform the full spectrum of airlift, from loading troops at bases in the U.S. to delivery in the combat area.

A high priority is being given to the development of new equipment to permit even more flexibility of operation than is now possible. Included in the new equipment now being developed or planned is the C-141A, the CX-4 heavy transport, and the special electronics essential for all-weather formation and airdrop.

The present concept of providing greater air mobility for the Army in Air Force aircraft is putting increased emphasis on MATS combat airlift capability. This emphasis also projects MATS further into the overall Defense Department airlift mission, exploiting the full spectrum of MATS aircrew and aircraft capability.

Hq Military Air Transport Service

RETENTION – A VIEW FROM THE BOTTOM

Captain Henry D. Steele

SHORTLY after General LeMay became Air Force Chief of Staff, he wrote an article for *Air Force and Space Digest* which began:

> What is the Air Force's most critical need? Space Systems? More Missiles? Advanced manned weapon systems? All are high priority items, but there is one need that consistently outranks them in importance. And until machines can think creatively this will continue to head the list: PEOPLE.[1]

With this cue, our subject of discussion is people, specifically Air Force ROTC officers and why they are leaving the Air Force. Although there is a constant need for increased pay, better living conditions, and greater prestige, there is a continuing and more subtle problem area. Basically we already have the solution: the USAF Officer Career Motivation Program.

Admittedly, this program is not a panacea for the Air Force's retention ills, but its philosophy is an improvement over past efforts. At least it serves to make our young officers feel they belong, that someone is sincerely interested in their welfare and their careers. Why then is retention still a major problem? Because a majority of our officers do not appear to be sincerely interested in solving the retention problem. With all the visible emphasis on retention, this might seem to be an unjust accusation.

Let us then study the seed of this problem and follow its growth to the present, where it encounters the same difficulty—apathy.

in the beginning

After World War II and the Korean conflict, the Air Force found itself in somewhat the same situation as the old lady who lived in a shoe, with "so many children she didn't know what to do." The personnel glut was so great that eventually the Air Force, despite the many voluntary separations, had to resort to "riffing" the excess.[2] Further proof that retention was not a problem is found in the *Air University Periodical Index*. Not one article on retention appeared between 1949 and 1956 in any of the magazines listed. There is nothing in the alphabetical listing between "Rest Rooms" and "Retirement."

However, retention studies were under way. In 1949 Louis N. Ridenour warned that the personnel situation was "deteriorating" and that only "immediate and urgent" action would prevent the now infamous "hump and trough" effect.[3] Unfortunately his advice was ignored, and it was 1956 before any active attempt was made to stem the outgoing tide of young officers.

This attempt, the Officer Career Management Program (AFR 36-23), had little effect. It was similar to the previously tried and successful airman retention program, which distributed "kits" explaining the various benefits of an Air Force career. This modified program proved to be an ineffectual and halfhearted gesture unsuited for officers. Retention figures did not improve.

Less than 20 per cent of all rated AFROTC graduates eligible for separation in 1957 chose the Air Force as a career.[4] Yet those men were earning as much as or more than their civilian contemporaries. The nonrated picture was even grimmer, for retention of young nonrated AFROTC officers continued at a dismal 10 per cent.[5]

Hoping to discover the causes of poor retention, Headquarters USAF distributed questionnaires designed to find the answer. One predominant and disheartening reason appeared: money. This became the battle cry of military personnel planners in debates over the need for the Armed Forces Compensation Act of 1958 and the amount of raises needed. Eventually the bill passed and the services received their pay raise. Retention rose, sagged, and steadied at its previous level.

Realizing it could not hope to compete with industry on an income basis, the Air Force sought other career inducements. Housing, educational opportunities, prestige and responsibility, and retirement benefits became the focus of recruiting and retention campaigns. But retention still did not increase satisfactorily.

> [An] officer on his first tour of duty is confronted with negative career inducements. Early retirement, excessive emphasis on leave, oversold "fringe" benefits, and the standard line that the Air Force "way of life" must be accepted as it is are not inducements for a lifetime career. The professional person is alienated . . . until he is convinced by personal experience that he has the opportunity to make worthwhile and satisfying contributions.[6]

the present

As Major General H. G. Thorne, Jr., Director of Personnel Planning, DCS/P, USAF, pointed out to a House Subcommittee studying FY 63–64 appropriations, "increased pay, promotion, and proficiency pay aren't everything for officers."[7] He further stated that the personnel picture, although improved, is no cause for optimism or self-congratulation: Nonrated retention is up to 15 per cent and rated retention has jumped to 45 per cent. But he warned that these gains are misleading, for the Air Force forecasts a loss of "72% of all AFROTC graduates at their five-year service point."[8]

The prediction is even more ominous in view of the prospect of over 30,000 retirements in the next five years. The situation is further complicated by the termination of Officer Candidate School.

For 21 years OCS supplied the bulk of our officers. But present policies are aimed toward creating a college-educated officer corps through the academies, AFROTC, and Officer Training School. Since OCS has been discontinued, OTS becomes the principal commissioning source and hopefully will supply a career-motivated force of college-educated officers. However, the retainability of these officers is undetermined, for the first graduates are just now completing their commitments.

Retention of an OTS graduate is not a foregone conclusion as it was with the career-motivated, prior-service OCS product. Although there is no lag between commissioning and active duty for an OTS graduate, he is still the same type of person. He is a college graduate, just as his AFROTC brother is. He has been exposed to the same "antimilitary" environment, and he usually possesses a degree which can be as useful (if not more useful) in a nonmilitary career.

Thus our retention programs must be aimed at both groups, regardless of their commissioning source. Today's college graduates can expect to receive larger salaries as civilians, yet our Air Force scientists and engineers do not list this as a major reason for separation.

> The retention problem exists not for lack of study and recommendations, not for lack of the concepts of programs to correct known causes, but for lack of adequate and aggressive actions which effectively deal with the problem.[9]

one succeeds . . .

To counter the accusation that the Air Force was not sincerely concerned with the retention problem, General Bernard A. Schriever, Commander, Air Force Systems Command (then ARDC), created a dynamic "people-to-people" program aimed directly at young officers.[10] Junior officer councils, actively supported by General Schriever and his center and division commanders, encouraged young officers to identify irritants and suggest possible solutions. Those solutions which proved to be practical were adopted as quickly as possible, and those which did not lie within AFSC's power but warranted further study went on to higher levels with General Schriever's indorsement.[11]

From these steps officers within AFSC gained a new sense of responsibility and belonging. Nor was this new philosophy allowed to die of complacency. In late 1960 an ad hoc committee, composed of two junior officers from each base in the command, met in Washington. General Schriever directed them to identify the major irritants and suggest ways to improve retention. Besides higher pay, increased job opportunities, and promotions based on "quality rather than seniority," the committee stressed the need for more realistic and personal career counseling.[12]

As a result, General Schriever created the Personalized Officer Career Motivation Program. In his letter to commanders about this program, he said:

> Analysis of USAF-wide facts indicates the primary cause for loss of the junior officer is his concern about assignment and utilization. To counteract this loss, each commander and supervisor must utilize a more personalized approach to the management of young officers. It is suggested that a reading list of books on industrial relations, sociology, and executive training be furnished each supervisor.[13]

The people-to-people and personalized approaches, coupled with command interest and dynamic support, produced results. As of January 1963, AFSC's retention rate had risen from eleventh to eighth place among commands within the United States.[14]

. . . where others fail

Headquarters USAF recognized the value of these policies in 1961 and created an Air Force-wide program styled after AFSC's, the present USAF Officer Career Motivation Program (AFR 36-20). However, the program did not produce the desired results, as General Thorne pointed out in his testimony before the House subcommittee in 1963. The Air Force is still unable to retain the desired 51 per cent of its qualified young officers.

The failure is not in the philosophy of the program but in the attitudes of its administrators, the officer-managers. The ideas are sound, as AFSC demonstrated, but approach and support are not the same. Other commands viewed this program as a wearisome task or as squares to be filled on counseling reports. Such attitudes have plagued the Air Force since its first retention program.

In 1956 for example, 65 per cent of the lieutenants who had completed their required service had not received counseling or advice, prior to separation, on the advantages of an Air Force career.[15] By 1959 an Air Force survey showed that 52 per cent of the first lieutenants and 65 per cent of the second lieutenants had not been made aware of career management programs.[16]

Despite the emphasis on retention, commanders still failed to counsel young officers. In October 1961, 60 to 69 per cent of the lieutenants interviewed could not comment upon the effectiveness of the Air Force Career Management Program because 50 to 75 per cent of those with four years or less service had not seen or heard about it.[17] Yet at that time lieutenants listed counseling as the most significant factor that would motivate them toward an Air Force career.[18]

Obviously the report published in October 1961 did not fully reflect the effectiveness of a program initiated in March of the same year. To obtain more accurate data reflecting the use of this new program, in mid-1963 I conducted a survey of 100 officers at the Squadron Officer School who had less than six years' service. Because of the size and career intentions of the group, the survey dealt principally with the program's administration rather than its effectiveness.

why they failed

The first evidence produced by the survey was noncompliance with the regulation. Contrary to the stipulated requirement for annual counseling of both career and noncareer officers, over 50 per cent of those interviewed had not been counseled. Of the remainder, 26 per cent had been counseled once, and 23 per cent had been counseled twice.

Of those counseled, half stated that their counselor was indifferent, incompetent, or uninformed. The remainder reported that their counselor was sincere and competent. In other words, approximately 25 counseling sessions out of a possible 100 had the personal touch. It is interesting to note that AFSC had the best record among those interviewed.

But does the personal touch affect retention? Does the attitude of the counselor actually make a difference? For the answer let us turn to A. H. Maslow's theory of the five fundamental human needs:

1) Basic physiological needs (food, shelter, clothing, etc.)
2) Safety from external danger (attacks by man or beast)
3) Love, affection, and social activity (belonging and love needs)
4) Esteem and self-respect (What do my peers think of me?)
5) Self-realization (living up to one's capabilities).

Professor Keith Davis, in his book *Human Relations in Business*, applies Maslow's basic needs to the problems of contemporary life:

> Management sometimes has felt it could meet all human need satisfaction by providing wages and letting the employee then use the wages to acquire his own satisfactions. This "Economic Man" concept does not hold up when analyzed in terms of the five basic needs, because money is primarily useful in meeting only the first two of them.[19]

These five needs are the key to human motivation, and the first two are fairly well satisfied in American society. Yet from studying the previously mentioned surveys, we see that the human element is lacking and the need for a feeling of belonging, first among the remaining needs, has not been satisfied. Too often the human element in the management system is ignored, and it is assumed that people will continue to take care of themselves and work well without someone taking an interest in them.[20] Or as the report of the ARDC ad hoc committee put it, "apparently retention, while talked about, has not really been established as a goal by lower level leadership."

This attitude cannot continue if the Air Force wishes to motivate its best officers toward a service career, and the new career motivation program of 1961 specifically recognized this fact.

> The first five years of a young officer's career are the critical ones. During this period he is forming permanent impressions which will determine whether or not he will make the USAF a career. . . . The personal touch intended to make the officer feel at home and of some significance to the Air Force is the guiding principle in the new program.[21]

Here lies the difference between the increased retention rates of AFSC and the rest of the Air Force. All the other commands adopted this program, and all stressed the personal touch, the need to make the young officer feel that he belonged. For it is well known that young officers have been "influenced as much by the fact that someone was concerned about them as by the benefits they stood to gain."[22]

Yet Air Force retention rates have not shown a marked improvement since the inception of this program. We have failed to retain our young officers because of our own disinterest, not because our personnel policies do not stress interest in retention. Our efforts must be full-time and sincere, for as AFR 36-20 points out, "all career officers . . . are expected to contribute to the success of this program."[23] Last-minute efforts to convince a man to seek an Air Force career will not work.[24]

It is only by creating this feeling of proud belonging that we can interest a greater number of officers in a service career. We cannot motivate a man by simply publishing a regulation.

in the future

The solution to retention problems is simple, yet difficult. All career officers in the Air Force must demonstrate the same sincere interest in retaining young officers as did General Schriever and the officers of AFSC. Their personal support, from counseling to junior officer councils, would be required. This can be done within the existing regulation by the following methods:

(1) First, ensure compliance with the present regulation, especially in providing well-qualified, highly motivated career officers to administer the program. An "incompetent counselor" was a prevalent complaint among many of the officers interviewed.

(2) Providing continuous counseling is equally important. This should not be restricted to once or twice a year, nor should attempts to motivate officers be limited to noncareer as opposed to career officers. We must strive daily to create an atmosphere that will motivate young officers.

(3) Junior officer councils must receive the full support of their commanders. Commanders within AFSC are required to attend JOC meetings. Many officers from AFSC have stated that their commander's presence lends credence to the program and stimulates the members of the council. This is another complaint of many young officers. Some commanders either do not attend or else openly express their disbelief in the effectiveness of the council and refuse to support it. This atmosphere defeats the whole purpose of the council and hardly lends itself to creating a feeling that "someone is interested in us."

(4) Another failing is the lack of publicity for the JOC's. Such publicity might encourage active support of the council by the junior officers themselves. In many cases where the councils exist, no one knows what they are doing. A remedy for this situation is to publish a "JOC Newsletter" and distribute it to all junior officers. If full support is intended, then the cost of mimeographing a few hundred copies at each base would not be prohibitive.

Some recommendations for improvement of the existing regulation:

• Command support of JOC's needs to be increased. Currently, base commanders have the prerogative of stopping council recommendations at their level. To avoid this, all JOC recommendations should be sent forward, with the commander's comments to follow.

Admittedly, JOC's all too often concern themselves with such minor irritants as club dues and showing dependent ID cards at the commissary. To avoid annoying higher echelons with these complaints, councils should be hand-picked and consist of the brightest young officers available. A dull, plodding council is just as ineffective as an incompetent counselor.

• To avoid improper and incompetent counseling, yearly refresher courses in human relations should be established for all officers in supervisory positions. These courses would not only stress the personal touch but also emphasize motivating highly qualified young officers, rather than merely trying to retain any officer.

• A second means of creating an atmosphere of belonging would be the establishment of a "Big Brother Program." This would be an expansion of the present sponsor program for new arrivals on a base. It is not intended to create a 1984 "big brother is watching you" climate, but rather a "big brother is interested in you" atmosphere.

This program would be designed especially for the second lieutenant entering active duty. The "big brother" should be an outstanding lieutenant or captain, preferably from the same office or section as the "shavetail." There should be no set time when this man is no longer concerned with the welfare of his protégé. There is a mistaken tendency to assume that, once settled in, the young officer no longer requires advice and counsel. Neither is it true that an academy or OTS graduate is more knowledgeable than the AFROTC entry and therefore does not require as much help. Thus the career "big brother" can offer constructive criticism, help the young officer with his minor problems, and above all encourage and motivate him.

• A final solution to providing the personal touch is the creation of a base-level career guidance officer. His primary duty would be to answer questions on assignments, career progression, and Air Force personnel policies. He should also have the responsibility of dealing with all malassigned officers and the authority to recommend transfers after 18 months for those officers seriously affected by malassignment. He would work directly under the DCS/P at the base to which he is assigned.

If manpower restrictions prohibit this, I suggest the establishment of a career guidance office at major command level to provide the same service. However, this alternate solution does not allow for the same personal touch provided by a base-level career guidance officer.

IN RETROSPECT, this study of retention, some of its faults, and some possible solutions offers no radical departure from any known fact or existing retention program. The problem lurks in what might be the hardest area to correct, our own attitude.

Important as pay, housing, and education are to increased retention, we are still faced with the subtle necessity of making a man feel he is needed and wanted. Our efforts to satisfy this inner need are the weakest part of career motivation.

The human factor is the most unreliable of all the elements in the USAF Officer Career Motivation Program. Until we shake our apathy, not only will we, the officers responsible, appear to be paying lip service to all retention programs, but so will the United States Air Force.

The Air Force cannot direct its officers to be sincere and interested any more than it can order a man to be happy. The success of our retention efforts must come from within, stimulated by the strong support of commanders and supervisors at every level.

Officer Training School

Notes

1. Gen. Curtis E. LeMay, "Our First Priority: People," *Air Force and Space Digest*, September 1961, p. 44.
2. Maj. Donald E. Harrawood, lecture, "Personnel Problems—Current and Projected," to Class 63-B, Squadron Officer School, 7 June 1963.
3. ARDC, Report of Ad Hoc Committee on AFROTC Lieutenants (Washington, D.C., 1960), p. 3.
4. Dr. Eli S. Flyer and Dr. Abraham Carp, "The Officer Retention Dilemma," *Air University Quarterly Review*, IX, 2 (Spring 1957), 61.
5. "Big Hangar," *Air Force Times*, 20 December 1958, p. 8.
6. ARDC, Report of Ad Hoc Committee, p. 7.
7. House of Representatives, Hearings before a Subcommittee on Appropriations, FY 1963-64, p. 273.
8. *Ibid.*, p. 288.
9. ARDC, Report of Ad Hoc Committee, p. 3.
10. *Ibid.*, p. 12.
11. "Lieutenants Tell ARDC How to Boost Retention," *Air Force Times*, 12 November 1960, p. 1.
12. ARDC, Report of Ad Hoc Committee, p. 91.
13. AFSCM 36-1, *Personalized Officer Career Motivation Program* (Washington, D.C.: Air Force Systems Command, 31 August 1962), p. 8.
14. "World Wide Career Motivation Congress Meets, Demands Refused," *Air Force Times*, 12 January 1963, p. 18.
15. Air Force Survey, *Analysis of the Career Plans and Attitudes of Non-Career Reserve Officers Derived from 100% Survey* (Washington, D.C.: Department of the Air Force, 29 November 1956), p. 13.
16. Air Force Personnel Report, *Characteristics and Attitudes from Sample Surveys*, IV (Washington, D.C.: Headquarters, Comptroller of the Air Force, October 1959), 35.
17. *Ibid.*, VI (October 1961), 21.
18. *Ibid.*
19. Keith Davis, *Human Relations in Business* (New York: McGraw-Hill Book Co., 1950), p. 39.
20. Flyer and Carp, p. 2.
21. *TIG Brief*, "Motivation Today—A Quality Air Force Tomorrow" (Washington, D.C.: 17 March 1961), p. 4.
22. "Full-Time Retention," *Air Force Times*, 20 May 1961, p. 12.
23. AFR 36-20, *Officer Career Motivation Program* (Washington, D.C.: Department of the Air Force, 6 March 1961), p. 1.
24. *Air Force Personnel News Letter*, "People Make the Difference in Retention, Too" (Washington, D.C.: Department of the Air Force, August-September 1958), p. 9.

Air Operations in Viet Nam

THE AIR FORCE CIVIL ENGINEER'S ROLE IN COUNTERINSURGENCY

Lieutenant Colonel Francis E. Torr

IN A Special Air Warfare situation the civil engineer is involved with all the usual engineering problems—weather, material availability, manpower, and the ever present problem of obtaining funds. Added to these are transportation to the site and working under constant or threatened harassment by insurgent forces.

Using Southeast Asia, more specifically the Republic of Viet Nam, as a locale for describing the Air Force civil engineer's role in counterinsurgency, one of the primary factors is the weather and its accompanying effects. The climate of South Viet Nam breaks down roughly into two seasons: the hot rainy season and the hot dry season, each lasting approximately six months. Construction work on airfields is generally limited to the dry season, for during the rainy season most flatland areas become seas of viscous mud. Stateside construction methods could overcome many of the wet-season construction problems, but often these methods require extremely costly and complex equipment that is not available to local construction organizations. The terrain features of Viet Nam run the gamut from the rice paddies of the delta country to the rugged, densely tree-covered upland mountains reaching altitudes of over 8000 feet. Construction problems in the mountainous areas revolve around accessibility, availability of skilled labor, and the ever present threat of ambush or surprise attack.

airfields

Airfield sites that meet minimum standard design criteria are difficult to find. There are very few large, flat areas in the mountain territory which allow construction of runways of adequate length with unobstructed approaches. Airfield construc-

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Airfields

At Can Tho Airfield, the plowed and windrowed subgrade of the parking apron dries prior to regrading, as the work of runway rehabilitation progresses in the background.

Pierced steel planking is moved by fork lift and loaded into a C-123 at Da Nang Air Base, South Viet Nam. It will be flown to Aloui and assembled for an auxiliary airstrip.

The heavy Vietnamese rainfall creates drainage problems. A ditch inside the earthen dike at Soc Trang Airfield carries the water to pump at far end, which empties it over the dike.

Buildings

In December 1961, when it was decided to send USAF personnel to South Viet Nam, civil engineering specialists were rushed from Clark Air Base, Philippines, to arrange for needed accommodations. Facilities had to be constructed immediately at Tan Son Nhut AB near Saigon and at bases in Bien Hoa, Da Nang, Pleiku, and Nha Trang. At first tents were set up (like those at Da Nang AB above) to house incoming Air Force personnel. Later the Civil Engineering Directorate arranged for construction of needed operational facilities, improved billets, roads, recreational facilities, mess halls, and water and electrical distribution systems. Among the most important construction projects, from a personnel viewpoint, were the semipermanent quarters for airmen at Tan Son Nhut (below), Da Nang, and Bien Hoa, along with mess halls, base exchanges, and recreational facilities. Construction, as shown, is usually done by Vietnamese contractors and labor, under supervision of engineering personnel of the 2d Air Division.

Vietnamese workers complete the brick understructure of a masonry barracks.

The finishing touches. Roads and walkways will follow.

One of many rows of barracks at Bien Hoa Air Base. The Bien Hoa huts, unlike the masonry quarters at Tan Son Nhut, are built of prefabricated steel sections.

tion in the low, flat Mekong-Bassac River delta area presents a different problem. The delta area is covered by very soft, silty clay, hundreds of feet deep in some areas. Upon becoming saturated during the rainy season, this material becomes an unmanageable, plastic mass, with practically no bearing quality whatsoever.

With the weather and terrain factors and their effects in mind, the stage is set for planning the construction of a typical Special Air Warfare airfield. In the Republic of Viet Nam the types of aircraft that must be accommodated are the T-28, C-123, A-1H, B-26, and L-19A, plus other service types whose weight and flight characteristics fall within the criteria of the aircraft mentioned. First, to provide a fully operational, all-weather field for Special Air Warfare missions, a runway at least 6000 feet long is required. This runway must have a designed load capacity of 25,000 pounds on a single wheel having a constant tire contact area of 100 square inches in a tricycle gear configuration.

In Viet Nam the civil engineer's problem of siting needed airfields had, for the most part, been done for him. Airfields constructed by the Japanese and the French during their occupancy still existed. Complete rehabilitation, enlargement, and additions, however, were generally needed before these airfields could support the mission requirements of Special Air Warfare operations.

The rehabilitation was no easy task. Pierced steel planking, the standby of World War II, was pressed into service to provide a surface over the old laterite* paved runways, which were slowly sinking into the delta mud or being washed away by the torrential rains in the mountains. But this provided only stopgap relief, as the bearing quality of the subsurface material was reduced to practically nothing during the rainy season. At one such field, Can Tho, a planned maintenance program of regrading and compacting the subsurface material has been put into effect. This program involves taking up a portion of the runway pierced steel planking as soon as the dry season starts and plowing up the subgrade material. This material is then wind-rowed for drying. After drying out the material is graded and compacted, and the straightened runway planking is then relaid. This method leaves a portion of the runway available for minimum operation during the entire maintenance period. The rehabilitated runway barely lasts through the rainy season, after which the process must be repeated.

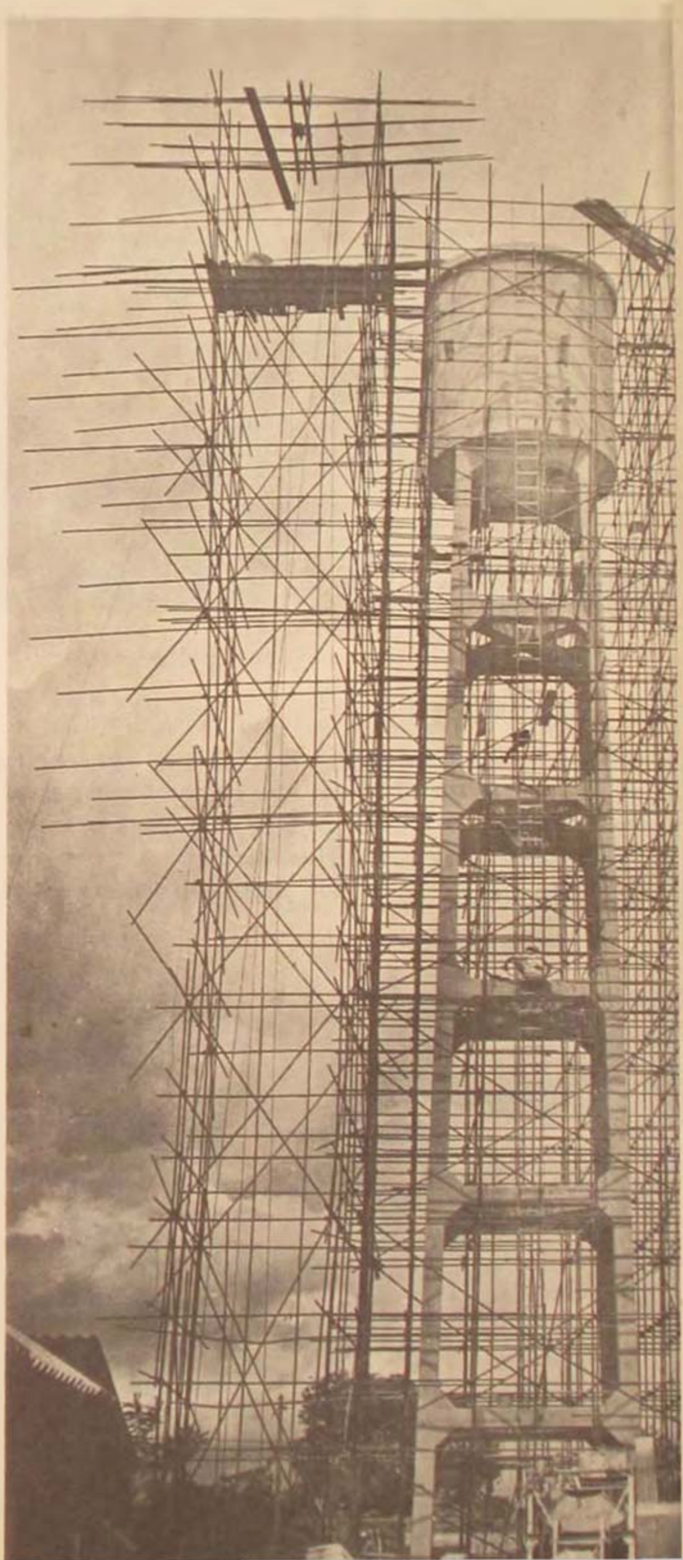
At another airfield, Soc Trang, a dike was constructed around the airfield to keep out the surface water of the delta area. Immediately inside this dike a large ditch was dug. This ditch slopes toward opposite ends of the airfield so that one half of the surface water run-off from the airfield is carried to each end. Two large diesel-powered pumps empty the water from these points over the dike, thus draining the airfield area and minimizing infiltration of water into the runway, taxiway, and apron base courses. The native laterite material was used to fill the voids in the crushed rock subsurface, and a double-penetration asphalt surface was applied. This surface has held up through one rainy season reasonably well.

Many safety features enjoyed by pilots flying out of Stateside bases do not exist at Vietnamese airfields, mainly because crushed rock and laterite are unavailable at the sites. The construction materials that did find their way into the delta area had to be barged in or trucked overland. The meager highway system with its hundreds of bridges provides excellent opportunities for insurgent ambush. For these reasons present airfield layouts are limited in length, lateral clearance, and parking facilities. If more airfields are to be constructed in the delta area, the engineers contemplate hydraulic dredging of river-bottom sand. The sand will be pumped to the nearby shore and dried. Then it will be spread like a thick blanket over the silty clay site of the airfield. After this blanket settles, it will provide the stability required for the construction of an asphalt-surfaced runway, taxiway, and apron system. Gradual settling of airfields constructed by these methods is expected. Thus, planned maintenance will have to be performed at least once every two years to "lift" the airfield above the water table. Preliminary cost estimates for the construction of such an airfield average about $4.5 million. This amount

*A soil-type material produced by weathering or decay of underlying rock. This material is developed through a process known as laterization, which occurs in tropical areas due to high temperatures and high moisture conditions. The resultant material, which is a lumpy, crusty substance, has a high content of iron oxide and hydroxide of aluminum and a low proportion of silica. It is an easy material to work with and when applied, bladed, watered, and rolled provides a hard, stable surface with good bearing quality.

Roadways

Before the spring of 1963 the roadway between the Joint Operations Center and hangars at Tan Son Nhut Air Base was frequently a precarious mixture of mud and gravel. Since then the road has been effectively black-topped, though the methods used were sometimes rather primitive. The roadbed was prepared mainly by hand labor—picks, shovels, etc.—and the tar used for final surfacing was melted down in barrels over open fires.



Water Supply

A new water well was drilled in 1962 to supply the Air Force cantonment or permanent quarters area at Tan Son Nhut Air Base, Saigon. The water in this region is soft, has little mineral content, and is potable without treatment. Drilling to a depth of 115 feet required five days, and the job was completed in 25 days by the Vietnamese branch of a U.S. corporation. With erection of the water tower, water can now be piped under pressure.

will provide only the minimum runway, taxiway, and apron and does not include the structures necessary for aircraft maintenance, operations, or personnel billeting.

buildings

In providing the support facilities for a Special Air Warfare airfield, the engineer's problems are not overly complex in the construction of buildings. Wood for flooring and framing is available locally, and corrugated asbestos roofing in easy-to-handle 3x5-foot sheets is readily available to all parts of Viet Nam. Since there is no extremely cold weather, wooden buildings with louvered sides provide the shelter required. Vietnamese workers can erect them. Because they were rapidly constructed to replace tents at Bien Hoa Airfield, this type of structure became known as the "Bien Hoa hut." Larger, more permanent facilities are generally provided through the Military Assistance Programs. These more complex structures are designed and constructed by a Navy Construction Agency, with guidance for functional design provided by USAF counterparts of the Vietnamese using agency. Owing to the large buildup necessary to support other service missions at airfield sites, considerable coordination must be accomplished by the Air Force civil engineer to preclude siting conflicts and duplication of effort and to provide for maximum use of available real estate.

water and waste disposal

Potable water in Viet Nam is obtained from wells. Frequently in the delta area, wells must be drilled to a depth of 500 feet before a desirable stratum is reached. At a cost of roughly $15,000 each, wells are considered a more economical means of obtaining water than processing the polluted, muddy river water. In the up-country areas, solid rock must be penetrated before a water-bearing stratum is encountered. These problems of providing potable water do not appear to be difficult to overcome until it is realized that modern well-drilling machinery is practically nonexistent in Viet Nam.

Sanitary disposal of waste matter is accomplished by means of septic tanks with leaching fields. The clay soil, upon reaching saturation, prevents further leaching of effluent from septic tanks; therefore, when the ground areas become saturated during the rainy season, surface overflowing of septic systems becomes a major problem.

electricity

The production of electricity is one of the most serious single problems with which the Air Force civil engineer must contend. Only at large installations, such as Tan Son Nhut near Saigon, is commercial power available in quantity. Moreover the available power not only is unreliable but is 50- rather than 60-cycle alternating current. Most of the electronic equipment designed to provide the needed communications for the Tactical Air Control System for Special Air Warfare operates on 60-cycle a-c. Power for this equipment and for isolated navigational aids and innumerable other Air Force facilities must be generated by means of portable gasoline or diesel-powered generators. Generators ranging from 3.5 to 150 kw output in 8 configurations, manufactured by over 20 different firms, found their way to Viet Nam to satisfy the USAF's increasing demand for electricity. These machines, designed for use as "emergency" generators to provide short-term power while the prime source of power is being repaired, were pressed into service as primary sources of power.

The high-speed engines in Air Force portable generating equipment have a short life-span and dependability factor, which is acceptable if their normal usage is to be for periods of short duration. When these units are called upon to operate continually from one oil change until the next, a high breakdown rate is experienced. Since so many makes and models are involved, a supply of parts for needed repairs is hard to come by. An extremely tight control over generator usage and maintenance must be effected if any appreciable dependability is to be obtained. In order that a highly mobile, packaged generator can provide a maximum output, electrical control is accomplished by sophisticated internal systems. The high skill level required to troubleshoot these systems is not usually found among power-production specialists within the AFSC 543X0 career field. The continued successful use of this type of unit requires an improved parts supply system and higher-level training of power-production specialists.

needed improvements

The problems mentioned, while presenting a constant challenge to the Special Air Warfare engineer, can by no means be allowed to occupy his full time. Programing, budgeting, and acquiring manpower must still be accomplished in accordance with peacetime methods. In a fast-moving situation, in which the engineer in counterinsurgency often finds himself, these methods will not suffice. Spontaneous requirements must be met instantly with construction authority, funds, materiel, and manning in order to stay ahead of the enemy in a counterinsurgency situation.

Several studies are in the process of being evaluated at various levels of authority which have as their purpose increasing the effectiveness of civil engineer support. One of these studies recommends the organizing and equipping of special civil engineer squadrons. These squadrons, especially trained to be self-sufficient in a Special Air Warfare situation, would have complete packaged equipment to erect prefabricated buildings of sizes and shapes predetermined to fit the requirement. Equipment would include portable generators and sufficient tools and supplies to operate and maintain them. Upon exhaustion of certain prepackaged materiel, replacement packages could be provided from the nearest hard-core base to keep the squadron fully equipped for its mission.

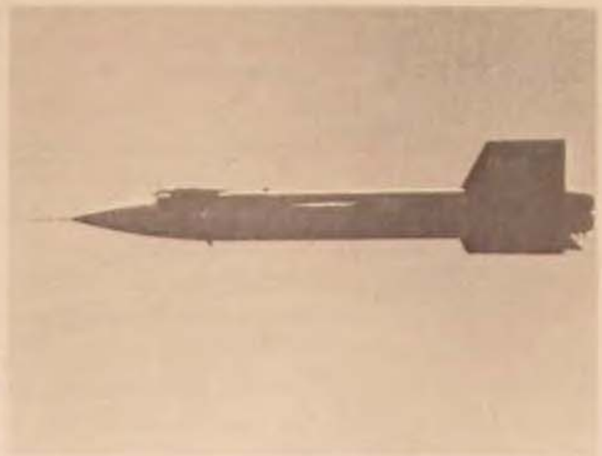
Another study recommends that all design capability be centralized in one industrial area in the Special Air Warfare locale. Required items could then be designed in accordance with materials available. Local national contract forces could be assembled and deployed to the various sites to perform the construction. This method would replace the present system of providing civil engineering capability individually to each deployed organization. The present method is considered by some to divide the total engineering capability available in the overall area below the point of maximum efficiency. Peacetime methods of providing construction funds for a Special Air Warfare operation through annual programing add an obstacle for the Air Force COIN engineer. In many instances the need for support construction is immediate. If standard items of construction could be predesigned for the geographical area concerned, package funding to cover the cost of planned numbers of facilities could be accomplished for budget purposes.* Upon receipt of the budget authorizations and funds, the engineer could continue throughout the year to provide required support without reprograming, reducing scope to keep within funds available for a specific project, or compromising design standards to stay within dollar authorization levels.

It is hoped that this presentation of the problems in the civil engineering role has provided thought-provoking suggestions which may lead to improvement in the capability to support Special Air Warfare.

Hq 2d Air Division

*We already have a book of in-country standard designs, and when these are not used, site adaptation of design from other bases is used. There is very little special design now being used in Viet Nam.

The Science Frontier



THE PAST SEVEN YEARS IN AERODYNAMICS

ALFRED C. DRAPER

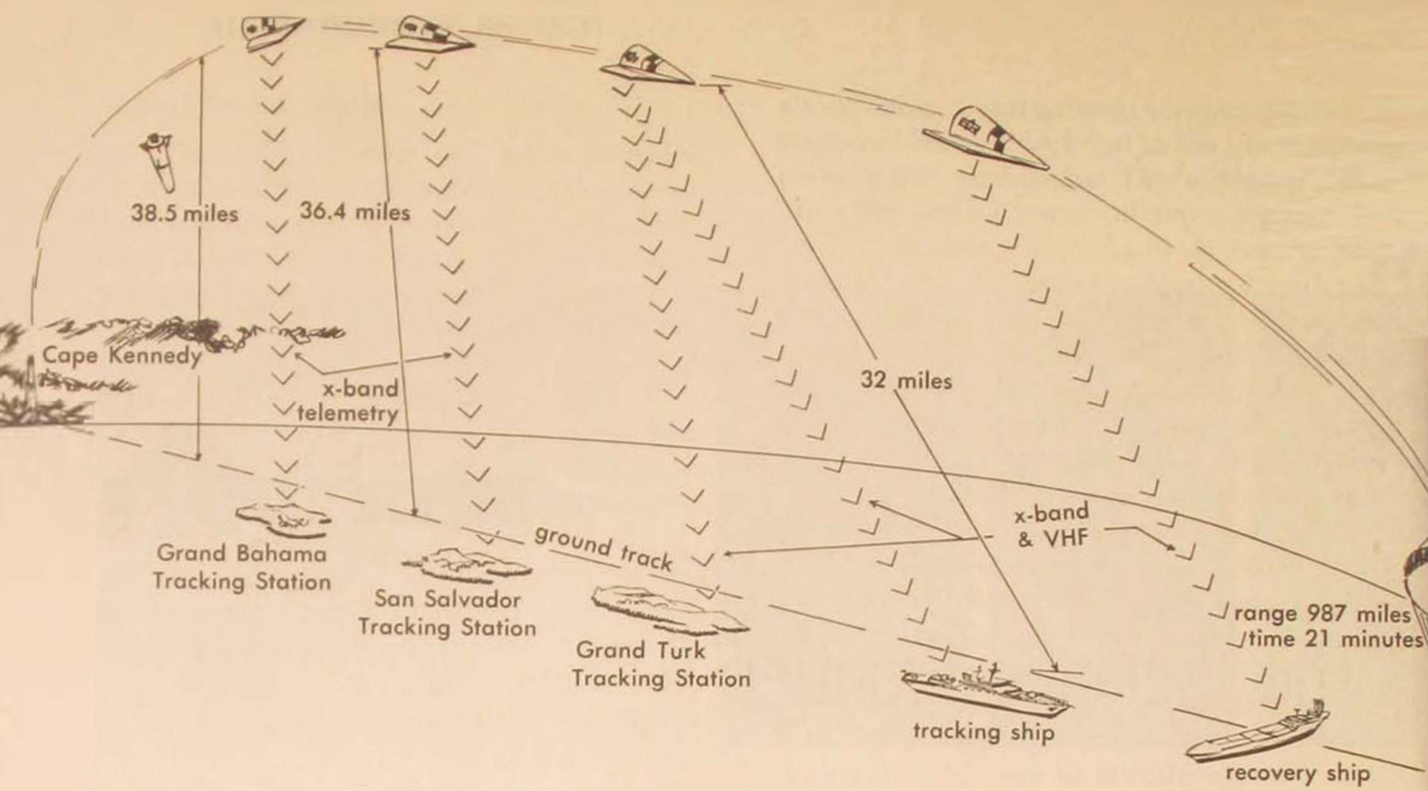
AT APPROXIMATELY 0439 EST on 18 September 1963 the world's first lifting entry vehicle, ASSET, was successfully launched into clear 76° weather from the Atlantic Missile Range. Some 21 minutes later and 1000 nautical miles down range when the vehicle touched down into the ocean north of the Virgin Islands, lifting gliding flight for re-entry became a reality rather than just a concept. In retrospect, it is interesting to note that seven years ago, in the spring of 1957, Walter T. Bonney, then of the National Advisory Committee for Aeronautics, wrote an article for the *Air University Quarterly Review* entitled "The Shape of Aerodynamics."* In it he proved to be extraordinarily perceptive and prophetic. The clarity of hindsight also shows that Bonney was in fact somewhat conservative though in his forecast of the expectations for high-speed flight, since we are now at the threshold of manned re-entry into the earth's atmosphere at velocities 40 times that of sound. The Apollo program, with its supporting unmanned technologies, should demonstrate such flight within the next three years.

Let us take up where Bonney left off and review our progress from the standpoint of theoretical development, facility simulation, and actual flight achievement. The field of aerodynamics during the past seven years has seen some highly significant accomplishments and breakthroughs, generally encompassing the entire velocity spectrum from very low to hyperbolic* speeds. There have been some rather excellent contributions in the lower speed regimes of flight, particularly with the use of such techniques as laminar flow control (LFC) by suction, which has shown substantial improvements in the lift-to-drag characteristics and consequently in the range capability of future aircraft. The objective here, of course, is to maintain a laminar boundary layer** rather than per-

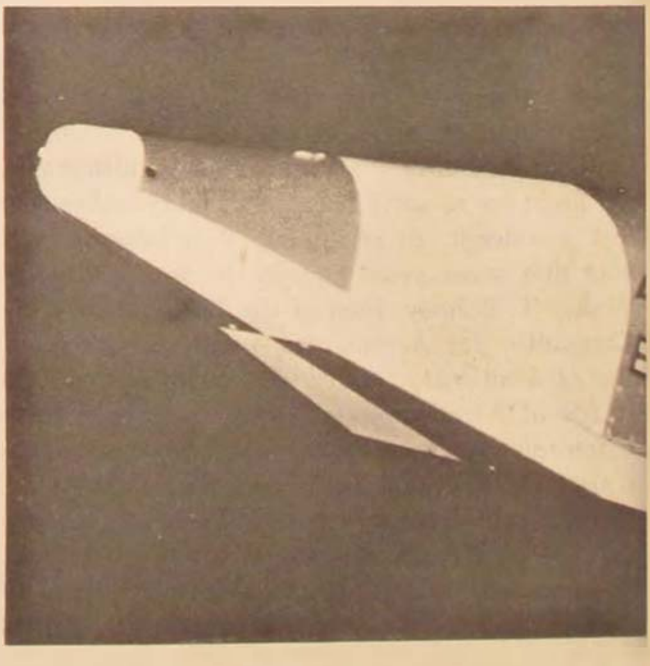
*Vol. IX, No. 2 (Spring 1957), 48-60.

*Velocities in excess of the parabolic or escape velocity, i.e., greater than 36,000 fps.

**A thin layer close to the body where friction plays an essential part.



ASSET (for Aerothermodynamic-Elastic Structur Systems Environmental Tests), first lifting entr vehicle, was successfully fired and tested along th Atlantic Missile Range on 18 September 196



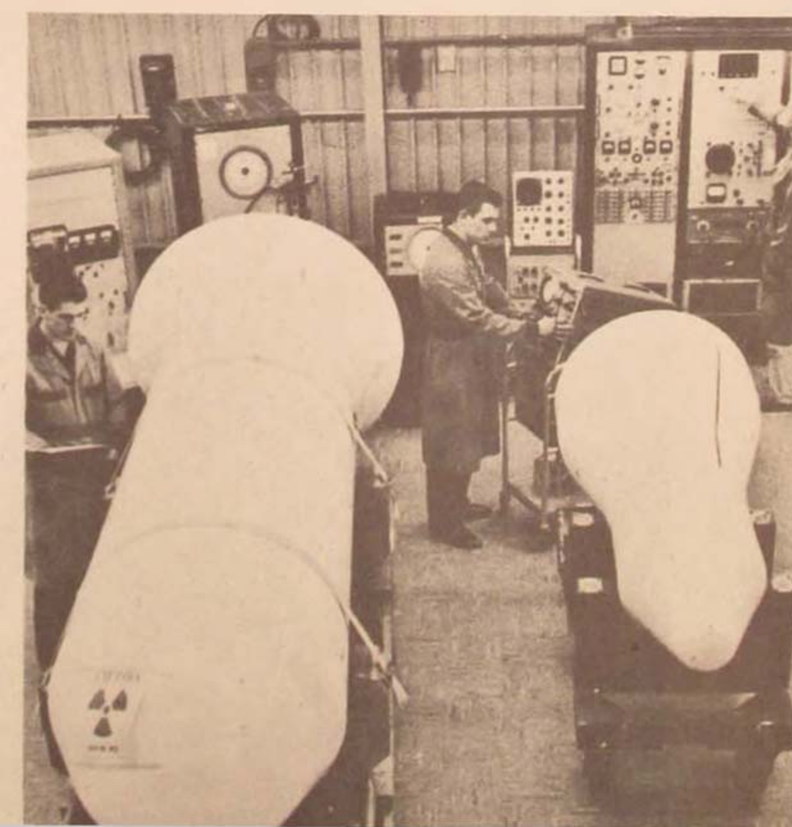
mit transition to turbulent flow with the accompanying rise in drag. The LFC suction is applied through a series of carefully configured slots in the wing. The use of variable-sweep wings for aircraft has also proved to be not only an attractive but also an equitable solution between the supersonic cruise constraints and low-speed landing constraints. With the wings extended, we obtain low wing loadings, span loadings, and improved aerodynamic characteristics, thereby increasing the low-speed efficiency of the aircraft. With the wings folded back, a substantial increase in the supersonic efficiency can occur.

Yet probably the greatest technological advances have occurred relative to problems associated with high-speed flight. We have in mind here the subdisciplines of hypersonic aerodynamics and aerothermodynamics. The reason for this trend is that the largest knowledge voids existed in these areas, thus spurring our scientists and engineers into obtaining at least design solutions. It also might be observed that, since so little was known, any accomplishment necessarily attracts attention. Bonney recognized the importance of the newly emergent discipline of aerothermodynamics, and indeed its criticality has become paramount since it has been, in essence, the criterion which has most seriously challenged man in his conquest of higher flight velocities.

The basic work in these new disciplines began to receive impetus in mid-1957, initially concentrating largely on manned and unmanned ballistic re-entry. A considerable effort was directed toward delineation of aerodynamic configuration for such purposes as the Mercury program and various weapon delivery concepts. Relative to the latter objective, initially most work centered around the H. Julian Allen blunted nose concept as a heat sink,* but subsequent advances in ablative thermal protection schemes essentially permitted an advanced generation of lower-drag vehicles. In late 1958 a definite change was made in an effort to solve the problems associated with first-generation lifting re-entry glides of the ASSET and Dyna-Soar types. These two vehicular concepts were limited to re-entry from close-proximity or low-energy orbits with initial velocities in the order of the circular orbital velocity, i.e., 25,600 fps. A comprehensive series of analytical and experimental efforts was pursued through 1960 to define the aerodynamic, aerothermodynamic, and performance characteristics of these types of configurations, with particular emphasis on the lifting body or wingless type during the later portions of this time period.

*The use of high-pressure drag coefficients by employing blunt shapes to dissipate a large fraction of the heat.

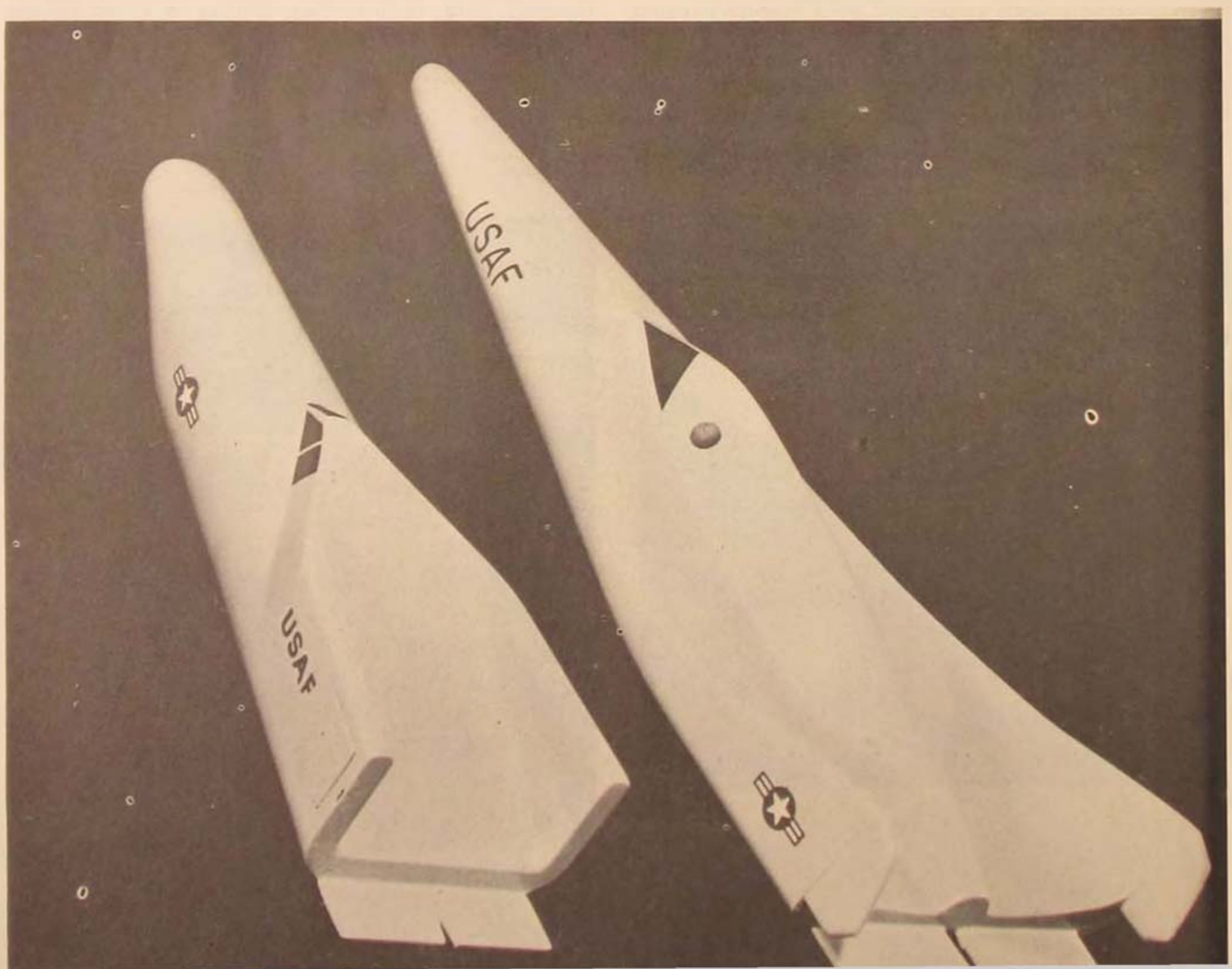
These lifting body configurations appeared particularly attractive at high velocities, for they generated essentially equivalent aerodynamic efficiencies with a superior volume of payload capability. In addition these "flying bath tubs," as some call them, offered significant growth potential for even higher re-entry velocities where the winged glider was essentially limited to circular orbital speeds. Consequently in 1961 a natural evolution was made to these lifting bodies for re-entry at superorbital velocities (around 36,000 fps) such as those which would occur during re-entry from high-energy orbital or lunar return missions. Various classes of these lifting bodies were analytically and experimentally evaluated

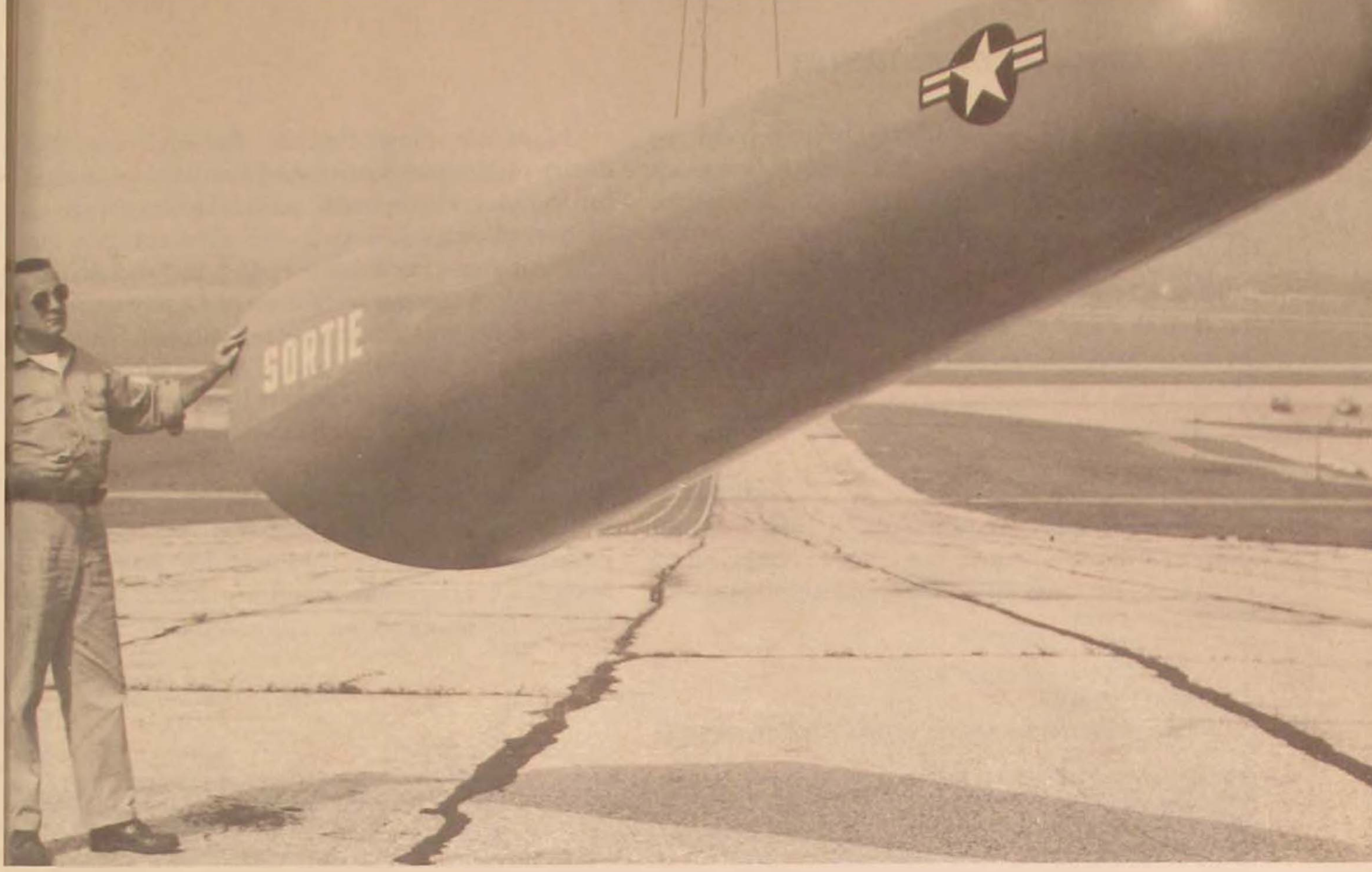


Advanced-generation ballistic re-entry vehicles through velocities of approximately 33,000 fps. Although this large concentration of effort has been directed toward the lifting type of configuration, considerable work has also been focused on ballistic shapes for superorbital or high-energy re-entry as evidenced by the NASA Project Fire, the first of which was launched in April of this year. This is a ballistic configuration which will enter the earth's atmosphere at approximately 37,000 fps and measure the heat experienced at such velocities. The heat problem is particularly severe when the vehicle travels at superorbital speeds, for, in addition to the normal convective or aerodynamic heating, a new phenomenon occurs which has been termed radiative heating. The shock layer surrounding a vehicle emits a high radiant energy flux at these re-entry speeds, and this radiant flux may equal or exceed the convective heating in magnitude. It is readily obvious that the lessons learned from such programs as Fire will be of immeasurable value in the more vital national prestige efforts like Apollo.

During the latter part of 1962, again a marked change in emphasis occurred in the technology, particular attention being directed toward the high-volume air-breathing hypervelocity configuration. This trend, we believe, is particularly noteworthy, for not too many years ago it was rather pessimistically assumed that the air-breathing vehicle had fairly well reached its limit for high-speed flight, around mach 4, and that the rocket would probably be the primary propulsion mode for future high-speed flight vehicles. Recent advances in high-speed induction systems, for both subsonic and supersonic combustion applications, have, however, encouraged optimism as to the extension of air-breathing systems. There have been even more drastic changes in the technology since 1962,

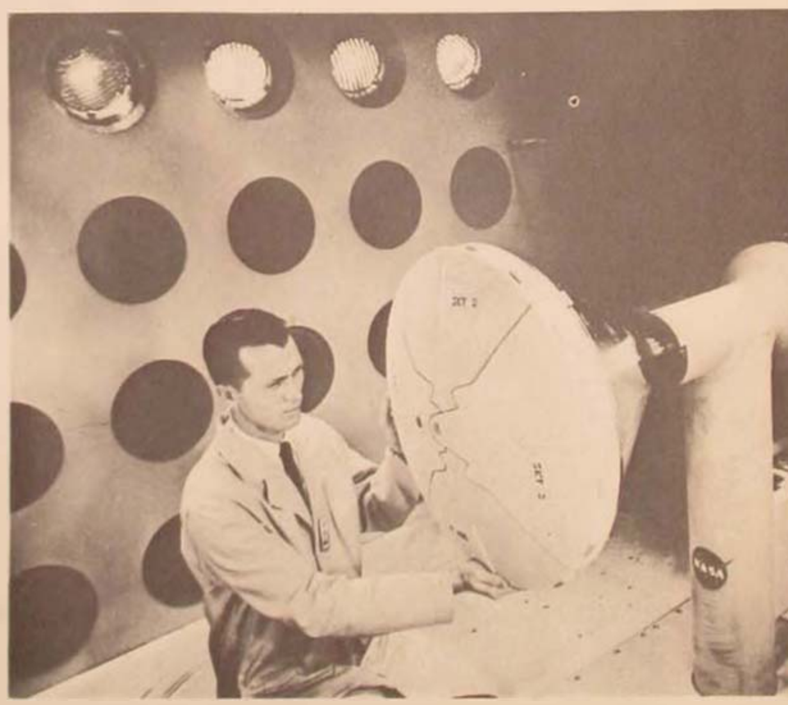
Typical lifting body and winged glider tested through mach number 20





The Sortie, a lifting superorbital entry vehicle studied by USAF

A Fire vehicle mounted in the Langley thermal structure tunnel



which will be discussed later. The one point we would like to make clear is that the last few years have been among the most fruitful in the entire chronology of aerodynamics, rivaled only by the advances made during the years of World War II. Recent aerodynamic achievement then can best be seen through an appraisal of the developments in aerodynamic theory, facilities, and flight through these years.

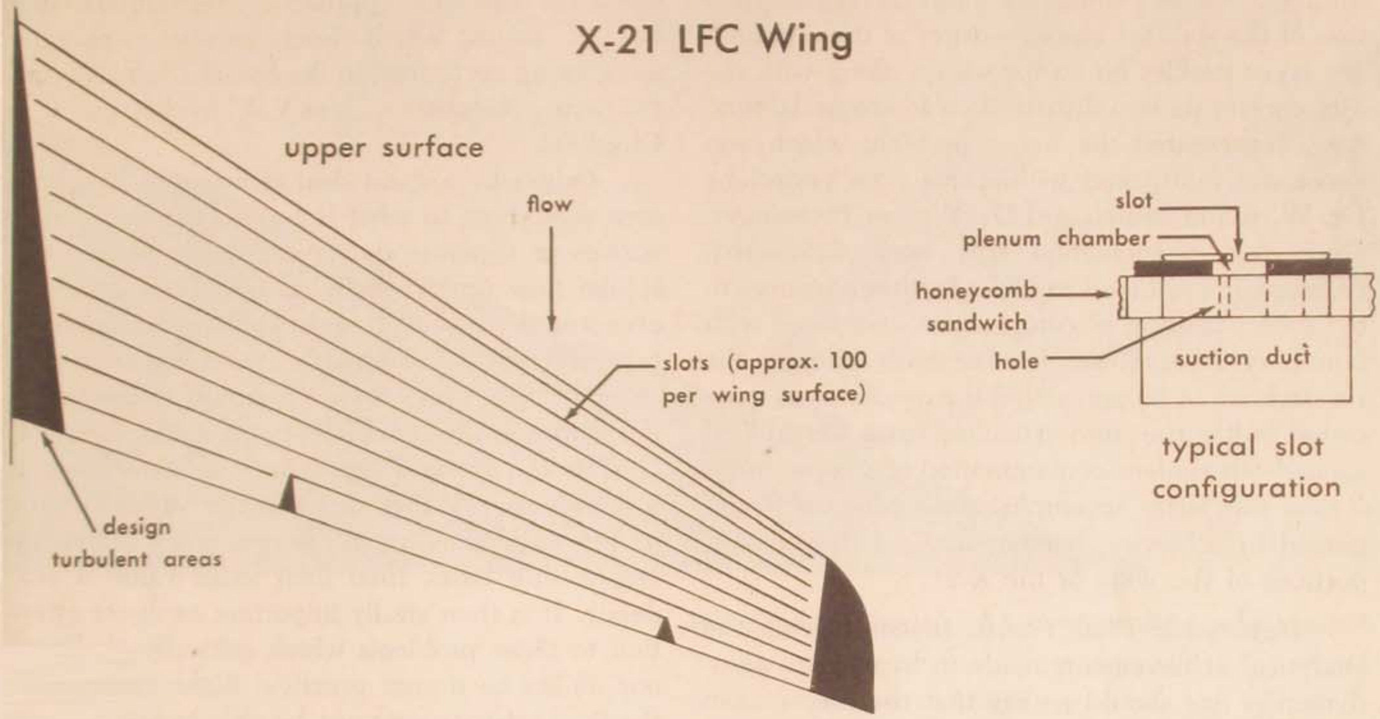
theoretical developments

The primary developments in analytical understanding have been in the areas of laminar flow control, hypersonic flow fields, and aerothermodynamics.

Laminar Flow Control. Research into the theory of laminar flow control has been pioneered by the Air Force, with particular emphasis on suction through fine spanwise slots cut into aircraft surfaces. Such laminarizing techniques that do not cause severe weight or cost increases offer potential for significant gains in aircraft range for fixed aircraft weight or reductions in gross weight for fixed mission requirements by comparison with turbulent designs. No other means of aircraft drag reduction offers such large potential payoffs. The theory for two-dimensional flows and straight wings had been well established, but the three-dimensional transition problem for flow over a sweptback wing represented a practical case that had to be attacked for application to advanced

X-21, laminar flow control demonstration aircraft

high-speed aircraft. Robert T. Jones and others had attacked the separation problem but not the transition problem. The physical phenomenon involved here is the actual artificial stabilization of the disturbances in the laminar portion of the boundary layer so that they do not amplify and become unstable, thereby causing transition with the onset of turbulence. The boundary layer itself is sensitive to many influences, such as the roughness of the wing surfaces, waves in the surface, pressure gradients, and acoustical effects. All these factors can trigger transition to the turbulent case.



X-21 laminar flow control (LFC) wing. In August 1960 the Laminar Flow Control Aircraft Demonstration Program was initiated. The objectives of this program are to demonstrate achievement of laminar flow at aircraft cruise conditions and to determine operating characteristics and manufacturing and operational data in a form directly usable in the design of future laminar flow aircraft. Two WB-66 aircraft have been modified, incorporating an LFC suction system on a completely redesigned 30° swept wing. Thin slots have been cut into the wing surface, and turbines suck the low-energy boundary layer air through the slots and ducting system into suction compressors and then exhaust it rearward. On swept wings boundary layer transition is caused primarily by the inherent instabilities in the cross flow due to spanwise pressure differences, rather than by those instabilities which develop in the boundary layer streamwise flow. Boundary layer suction reduces the cross flow within the boundary layer and increases the stability limit Reynolds number of the cross flow in such a manner that transition is delayed or prevented. Maintenance of a laminar boundary layer can reduce wing friction drag by 80 per cent. These aicraft are presently being flight-tested at Edwards AFB.

Perhaps one of the primary factors in determining whether the boundary layer will remain stable in the laminar sense is the Reynolds number.* On straight wings the Reynolds number is considered with a characteristic length parallel to the flow. But as mentioned previously, the most significant case is that of the swept wing, where another critical Reynolds number which significantly affects the stability of the boundary layer was determined to be the cross-flow Reynolds number.** Vastly improved methods for computation of the stability characteristics of these boundary layer profiles on swept wings, along with the appropriate suction distributions to ensure laminar flow, represented the major problem which was successfully attacked within this time period by Dr. W. Byron Brown and Dr. Werner Pfenninger. Once this phenomenon had been delineated, Pfenninger continued to make further advances in the understanding of complexities associated with boundary layer flow. He essentially capped the research when he postulated the mechanisms associated with the understanding and control of spanwise turbulent contamination of swept wings. It was this latter accomplishment which was employed in achieving laminar flow on the inboard portions of the wing of the X-21.

Hypersonic Flow Fields. In considering the analytical achievements made in hypersonic aerodynamics one should realize that the theoretician has worked in close cooperation with the experimentalist in defining the nature of hypersonic flow as we know it today. Until quite recently ground facilities were generally lacking to simulate the hypervelocity environment adequately. Consequently it quite often fell to the theoretician to lead the way in postulating the mechanisms for hypersonic, high-temperature flight. We have, as do all scientific disciplines, our outstanding theoreticians—such men as Van Dyke, Cheng, Vaglio-Lauren, and Gibson—but some of the outstanding work in developing practical techniques for day-by-day application has been accomplished by lesser-known members of the aerodynamic community working on actual flight-test hardware.

*Reynolds number is an important dimensionless similarity parameter for viscous or boundary layer flows and is defined as the product of the density, velocity, and characteristic length divided by the coefficient of viscosity.

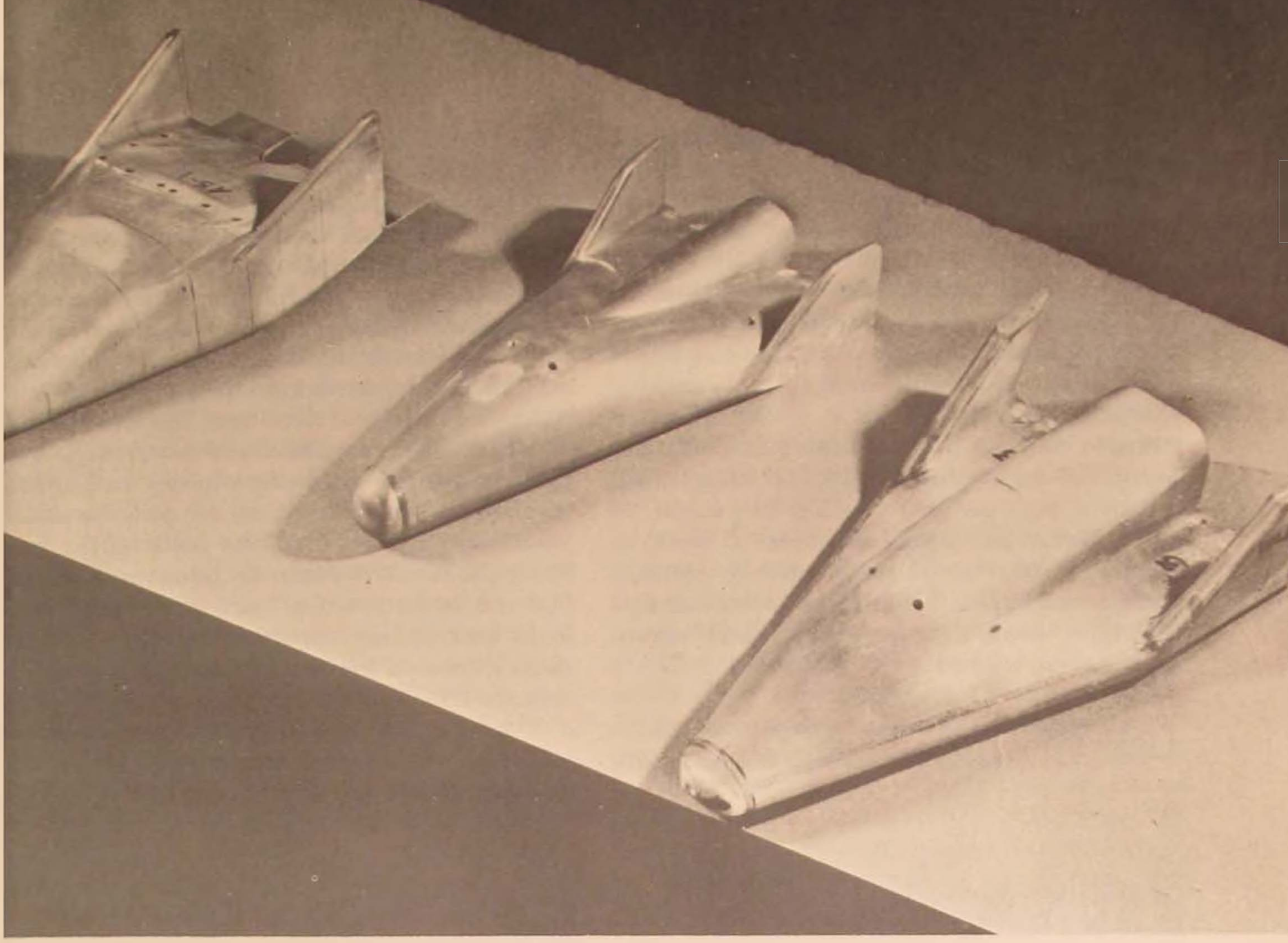
**Based on a local velocity component parallel to the wing's leading edge.

It is perhaps interesting to note that the aerodynamicist has also not played national favorites in selecting his base-line tools for developing the hypersonic prediction schemes. The work of Sir Isaac Newton has proved particularly helpful, and the various postulates outlined in the *Principia Mathematica* have been expanded in many directions and combinations to give us useful design approximations for estimating the aerodynamic characteristics of hypervelocity vehicles. In the quest for alternate approaches, techniques have been developed which closely parallel in part the work being performed in the Soviet Union by contemporary scientists such as V. V. Sychev and P. I. Chushkin.

Originally a great deal of attention and concern was given to what is termed rarefied gasdynamics or superaerodynamics,* such as free molecular flow problems. It has now been generally accepted that although such problems undoubtedly exist, they can be reasonably considered as second-ordered in that they do not normally influence the design of advanced vehicles to a significant extent. Despite the classical significance of many theoretical endeavors, if they do not materially contribute to the understanding of design problems on an engineering basis, then their main value is academic. It is then vitally important to direct attention to those problems which critically challenge our ability to design practical flight vehicles. In the final analysis we must be able to analyze and predict their performance if we are ever truly to understand the complexities and potentialities associated with high-speed flight.

Along these lines an especially comprehensive effort has been devoted to developing a broad base of scientific knowledge for understanding the vast and complex flow phenomena associated with hypersonic entry or sustained flight vehicles. Many detailed programs conducted by both USAF and NASA have significantly contributed to defining the problems of orbital and superorbital re-entry. The ASSET project—and the Dyna-Soar even in cancellation—have made excellent contributions in advancing the state of the art in aerodynamic/aerothermodynamic disciplines. The data obtained from ASSET will materially add to the overall technology on hypersonic aerodynamics, since it ob-

*Simply the aerodynamics at very high altitudes, where the molecular nature of the gas, rather than the gas only as a continuum, must be considered.



Wind-tunnel models of hypervelocity configurations

tains data over the entire velocity range from subsonic to near orbital speeds.

Although there has been a substantial advancement in the simulation capability of ground test facilities in the past three years, there is still a critical requirement to increase the velocity range from 16,000 to 36,000 fps. (More will be said of this in the next section.) Experimental investigations have been made to verify the theoretical and analytical prediction methods and to assist in the development of empirical relationships to predict the aerodynamic and stability characteristics of hypersonic configurations for the mach number range 0 to 22. Methods have been developed for estimating pressure distributions, local flow properties, skin friction drag, and aerodynamic forces and moments on simple geometries. These techniques are currently used in the design of hypervelocity configurations.

Many of these techniques, although admittedly not always completely theoretically rigorous, have proved to be quite satisfactory at hypersonic speeds. The various Newtonian approximations and modifications, as well as patched techniques* such as those developed by Creager, are used with a fairly high degree of confidence for configurations with simple geometries, especially when combined with skin friction predictions such as those based on Professor Ernst Eckert's reference methods.** But in order to understand more completely the flow phenomenon at hypersonic speeds over ad-

*Combining various theories into one prediction technique. M. O. Creager of NASA combines Newtonian, viscous, and blast wave or violent explosion solutions.

**Employed for calculating skin friction effects.

vanced vehicles, the USAF has pioneered, through the Research and Technology Division, research in "exact" dimensional flow field programs based upon the method of characteristics* and for real gas flows.**

The initial work obviously did not include the viscous or boundary layer effects, but recent analytical breakthroughs have enabled coupling of these viscous effects in terms of three-dimensional attached boundary layers. It is particularly interesting to note that this was made possible largely because of the previously discussed basic boundary layer work performed by Dr. Pfenninger. In other words, this significant piece of work by Pfenninger has, through the intuition of our engineers, found application to both the laminar flow control problem and the hypersonic "exact" viscous characteristic methods.

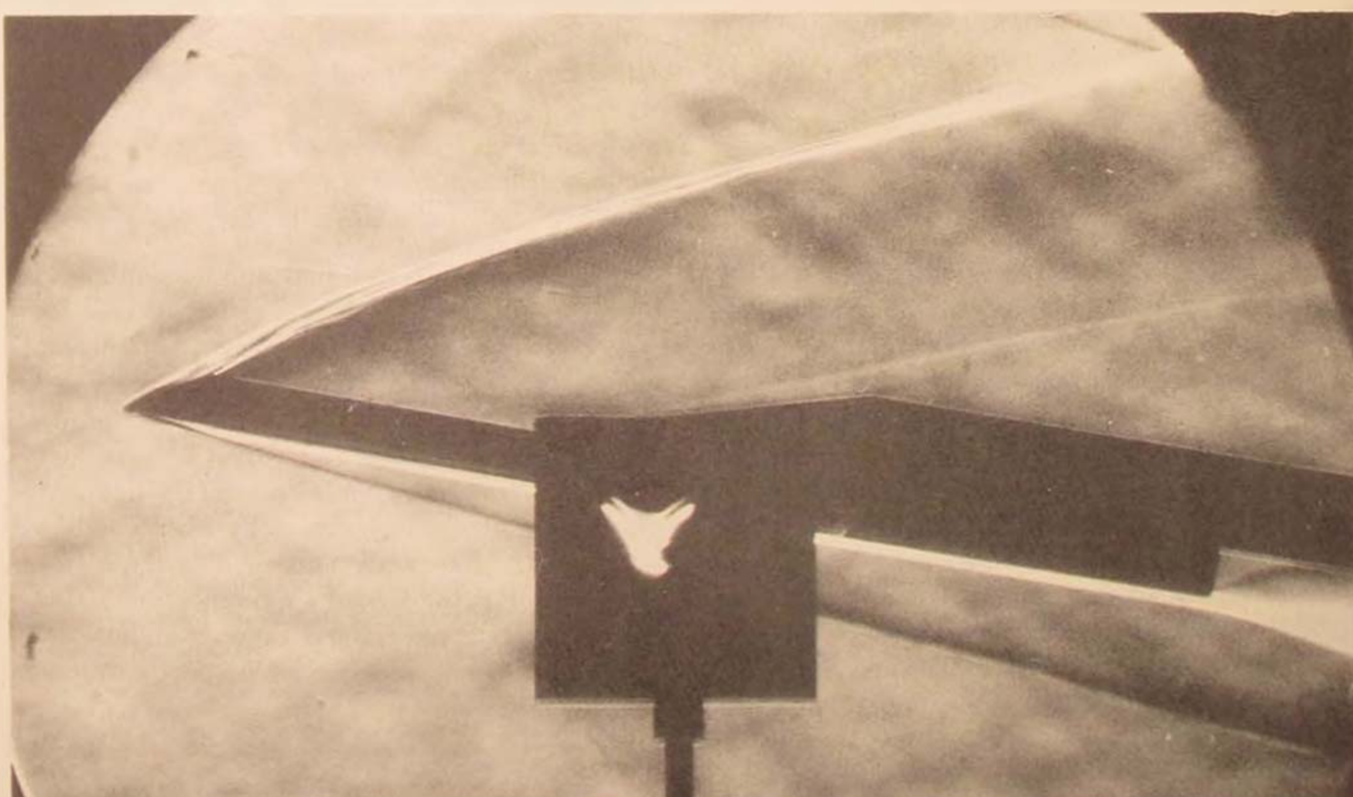
*A method for exact stepwise numerical calculation in supersonic flows.

**Considers effects which are neglected in ideal-fluid theory.

A particularly large emphasis has been devoted to formulating the design criteria for hypersonic re-entry configurations. Generalized families of both winged and nonwinged lifting body configurations have been subjected to critical analyses. Tests have been conducted from low subsonic to hypervelocity speeds to define the aerodynamic, performance, stability, control, and landing characteristics of simple configurations in both Government and industrial facilities. The problem of boundary layer transition and interacting flow fields, which are now being critically analyzed to determine their influence on the design and delineation of flow regimes from continuum to free molecular flow, is continuously being reviewed and updated as information from ground and free-flight tests becomes available, to ensure that no major effects in the technology have been overlooked.

Additional work in hypersonic aerodynamics has been concerned with extending the state of the

Shock-wave formations at mach number 21 over a hypervelocity configuration at an angle of attack. These tests were performed in Cornell Aeronautical Laboratory's 48-inch shock tunnel. Direct measurements were made of the hypersonic skin friction.



art to sustained hypersonic flight and superorbital lifting re-entry. This requires extensive investigation of the local flow field properties, complex geometries, boundary layer transition, and nonequilibrium flow effects. The very strong influence of viscous drag on aerodynamic performance has been vividly illustrated both analytically and empirically. Programs are being conducted to measure skin friction drag directly through mach number 20 and through large angles of attack. This represents a significant advancement, since until recently data were limited to mach numbers below 8. These data will greatly assist in the design of high-performance vehicles. Investigations are being conducted for the high mach numbers on hypervelocity air-breathing configurations with various interfering geometries, and comprehensive analyses are being made of the associated high-speed inlets on induction systems for both subsonic and supersonic combustion applications. These inlet-airframe configurations are thus being studied to determine the most favorable location of the inlet on the configuration with respect to aerodynamic, performance, and stability characteristics as well as to the total integrated systems.

As mentioned earlier, a considerable amount of work has been directed toward the aerodynamic and stability problems for lifting re-entry at superorbital speeds. A number of candidate configurations have been analyzed throughout the entire range of mach numbers, and tests have been conducted at velocities as high as 33,000 fps.

Aerothermodynamics. The most significant contributions, however, have been made in the field of aerothermodynamics. The rate of heat transferred from a boundary layer to the surface has become significant only with the flight of high-supersonic aircraft and critical with the advent of ballistic vehicles and true hypersonic flight. The design of hypervelocity re-entry or sustained flight vehicles is vitally dependent upon the heat transfer rates and temperatures which occur at critical points on the vehicle.

Two modes of re-entry are of primary interest: the ballistic or high path angle re-entry, and the lifting or gliding vehicle.

In the ballistic re-entry, the heating rate is intense (thousands of Btu/ft^2 sec) for a short period of time (tens of seconds), and the re-entry path angle is relatively large. In this type of vehicle the heat is either absorbed by the heat capacity of a thick shielding material such as copper or beryllium or is dissipated by ablation of a surface coating. In the latter case the kinetic energy of the vehicle is absorbed by the latent heat during the change of phase which occurs when the surface material is vaporized and carried away by the airstream or charred as in the case of the newer ablators.

The re-entry of the lifting or gliding type of vehicle involves much less severe heating rates than for the ballistic type (tens of Btu/ft^2 sec), but the total heat transfer quantity can actually be greater because of the extremely long period of time in re-entry flight (tens of minutes). In this case the re-entry path angle is relatively small compared with the ballistic mode angle, and normally radiation-cooled structures are used, although recently ablation techniques have been investigated for practical application. In the radiation application, since the vehicle is exposed to high heating for such long periods, a steady state is reached in which the incoming aerodynamic convective heating equals the outgoing radiation, resulting in an equilibrium temperature of the surface. This temperature is maintained below the limit of the surface material (approximately 3500°F) by carefully designing the vehicle shape and designating flight paths that will avoid the critical heating regions. These problems associated with lifting entry have received considerable attention because of their complexity, and we shall review some of the principal accomplishments.

Present winged-type configurations are relatively simple shapes with swept surfaces and blunt leading edges and noses, while the lifting body vehicles are also normally simple shapes. These noncomplex geometries facilitate analysis of the heating of this class of vehicles. It must be realized that as research programs improve the capability of high-temperature structural materials and cooling techniques, more sophisticated designs will evolve which require more detailed analyses—in fact they are beginning to appear now.

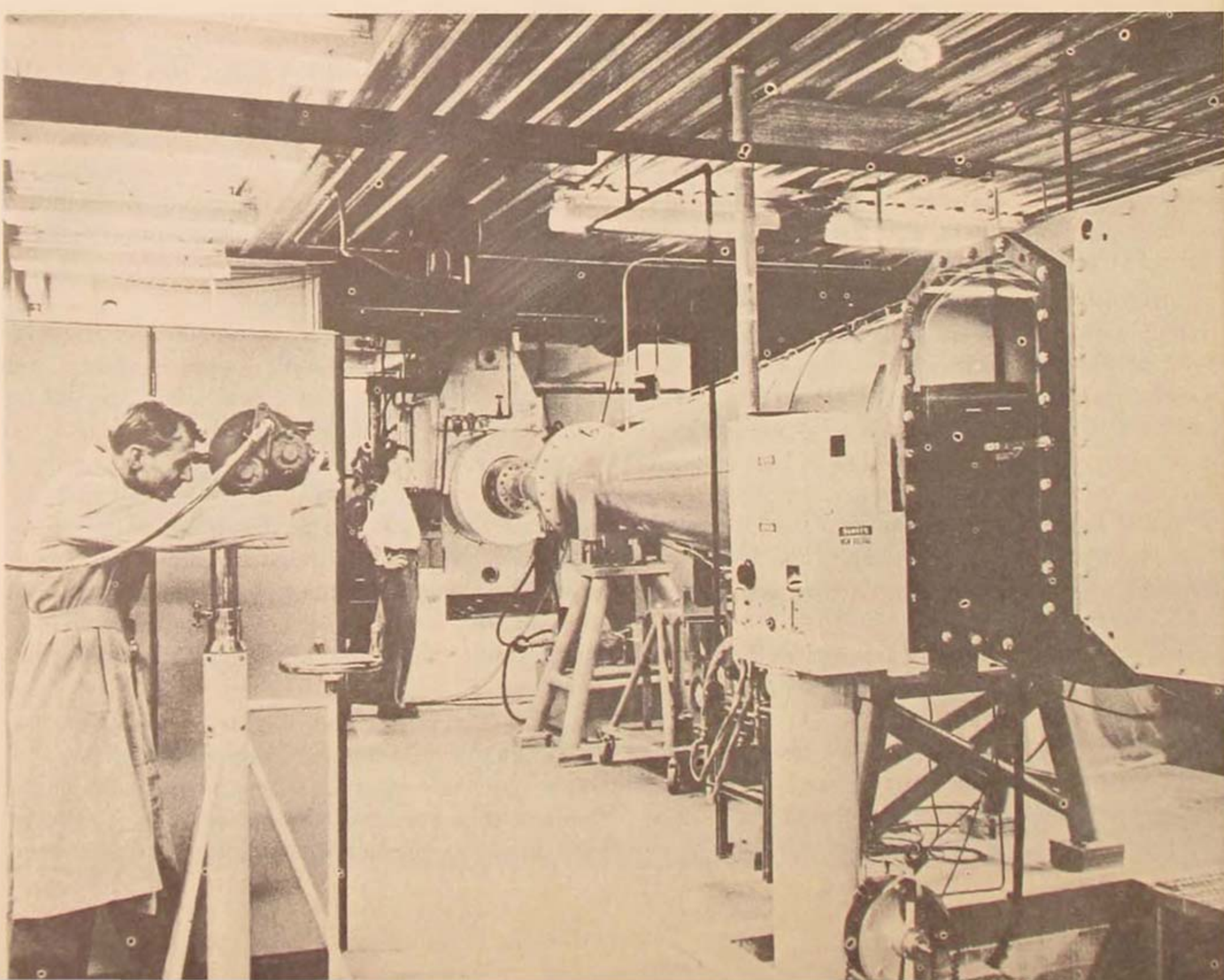
To determine the degree of aerodynamic heating, the environment through which the vehicle will pass must be known; hence the flight path or trajectory must be determined. A number of different prediction techniques have been formulated in the last few years, generally based upon the work of James Fay and Frederick Riddell and the reference theories pioneered by Eckert.

The stagnation region usually experiences the highest rate on any hypersonic vehicle. Of the many available methods for predicting laminar stagnation point heating rates, perhaps the approximate method developed by Lester Lees of the University of California has proved most useful. It closely parallels the more exact methods of Fay and Riddell and greatly facilitates calculations. Techniques have also been developed for the distributions in this region.

Leading-edge heating is the next most important problem area to be considered. This analysis must necessarily deal with the effects of angle of attack. Analysis of the region aft of the leading edge also must follow, and this region is generally treated as a flat plate. Methods have been developed for both laminar and turbulent flow. The reference methods are quite useful for these problems.

Specifically, prediction techniques are available to evaluate the heating and flow fields about simple shapes such as spheres, cones, cylinders, etc., and, as well, the interaction effects due to the resultant configuration synthesis so long as secondary shock systems are not formed. Secondary shock systems such as those occurring from fins or control surfaces may be grossly evaluated, or at least their effects may be bounded. Passive cooling (surface reradiation), as indicated earlier, may be provided for in the design. However, active cooling, such as transpiration or film ejection, of critical areas has been only superficially reviewed. Calculations are presently based on real gas flows. The effects of chemical nonequilibrium have not been reduced to engineering application, though

Arnold Engineering Development Center's 50-inch Hotshot hypervelocity facility



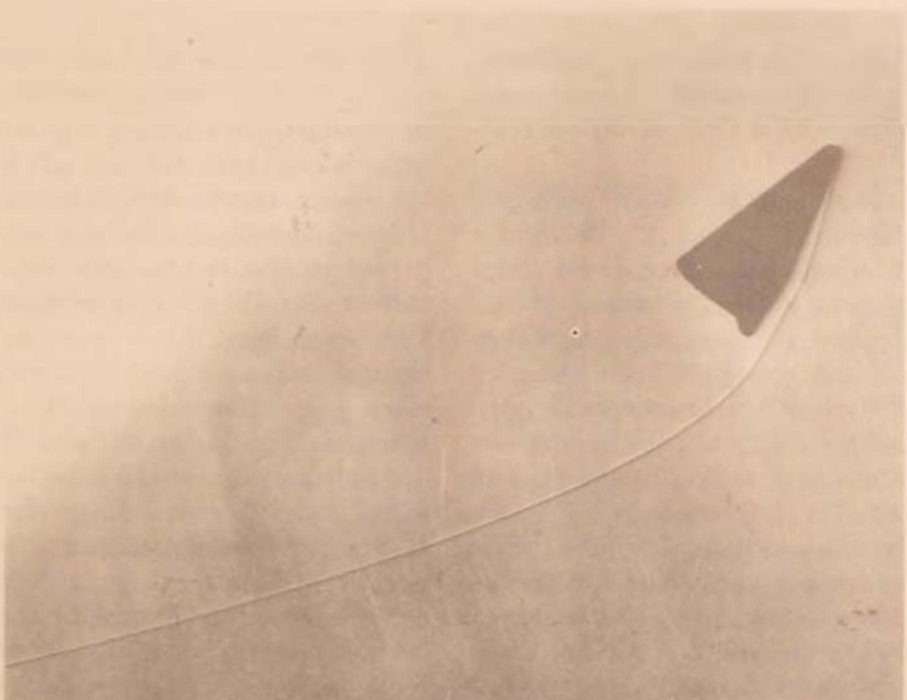
nonequilibrium effects for orbital entry are not considered to be adverse to the design.

Superorbital entry vehicles that are more sophisticated than the Apollo (e.g., lifting configurations) may be constructed, but such designs are based only on the present gross knowledge of the flow fields and heating. These problems are in the stage of active investigation, and competency will increase rapidly in the next several years. Work relative to the previously discussed radiative heating by such researchers as Lees and Benneth Kival has proved most useful, but because of facility limitations only a small percentage of the phenomena can be simulated. This situation is hampering present studies in the superorbital area.

facility simulation

The use of relatively small-scale experimental facilities to simulate full-scale flow phenomena about aircraft has been of considerable importance since the inception of the science of aerodynamics. These facilities have been used both for the experimental verification of analytical theory and, as well, to give the engineer an insight into complex flow mechanisms for which direct analysis is not possible. The goal of the experimental facility, then, is to duplicate the induced flow conditions found in free flight. This goal is seldom achieved, however, and today, with the rapid advances in vehicle speeds, direct duplication of all quantities is not yet possible. This failure to simulate fully the flight environment results from our incomplete understanding of the interrelationships of flow variables and has led to the design of "partial simulation" facilities.

The most important quantities to be achieved in the simulation of aerodynamic data are the local Reynolds number on the body, the total energy



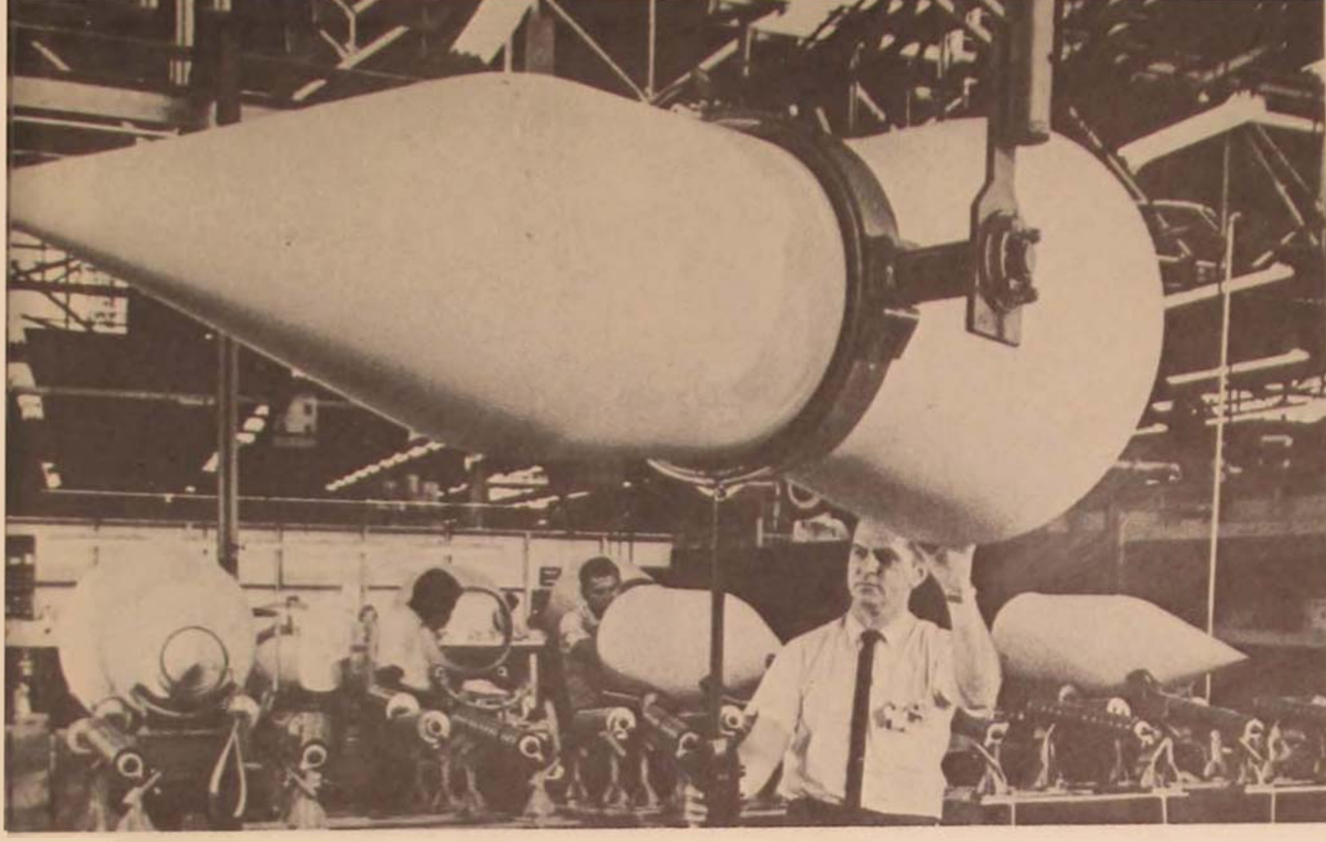
Winged glider at mach number 8 in aeroballistic range

X-15's established both speed and altitude records in 1962.

of the flow, and the mach number of the stream. Our efforts are generally directed toward accomplishing these achievements through various techniques.

Basically there are only two facility concepts: (1) continuous flow facilities and (2) the impulse type of facility which directs a short-duration test slug of gas past a model for a matter of several milliseconds by means of a controlled explosion. Both these facility concepts have been perfected to the point that they will yield acceptable aerodynamic data, and the merits of one concept over the other are resolved according to the type of test to be conducted and the economy of operation. Most continuous facilities today heat the air only sufficiently to avoid air liquefaction in the test section, but few attempt to achieve proper enthalpy* simulation. A variety of air heaters is used, according to the temperature requirements. For temperatures less than 2000° the electric resistance heater is commonly used. Examples are tunnels A, B, and C at the Arnold Engineering Development Center. For temperatures up to 4500° the pebble-bed heater concept is used. In this concept the refractory pebbles (either alumina or zirconia) are heated by a propane/oxygen mixture, and then the test gas is blown through the heater to absorb the heat energy. For still higher temperatures, the electric arc heater is employed to heat the test gas. This arc facility can correctly simulate the temperatures reached during hypersonic flight; however, gas chemical difficulties are apparent in the use of the arc tunnels when proper Reynolds number simulation is attempted. "Shock tunnels" and "Hotshot tunnels" are names given to the impulse facilities. These use either cold or heated light gas drivers or, as in the Hotshot, use an electric arc to heat the test gas directly in a confined region. The principal difficulty in the development of these facilities has been in the instrumentation, which must be capable of millisecond response. Now that such instrumentation has been developed, many detailed measurements may be made in these facilities. Pressures, forces, heat transfer, direct skin friction measurements, and the actual sampling of gas constituents in the flow field are some of the

*Sum of the pressure and the internal energies.



An advanced high W/C_DA ballistic re-entry vehicle

measurements that have become available to the experimentalist in these facilities.

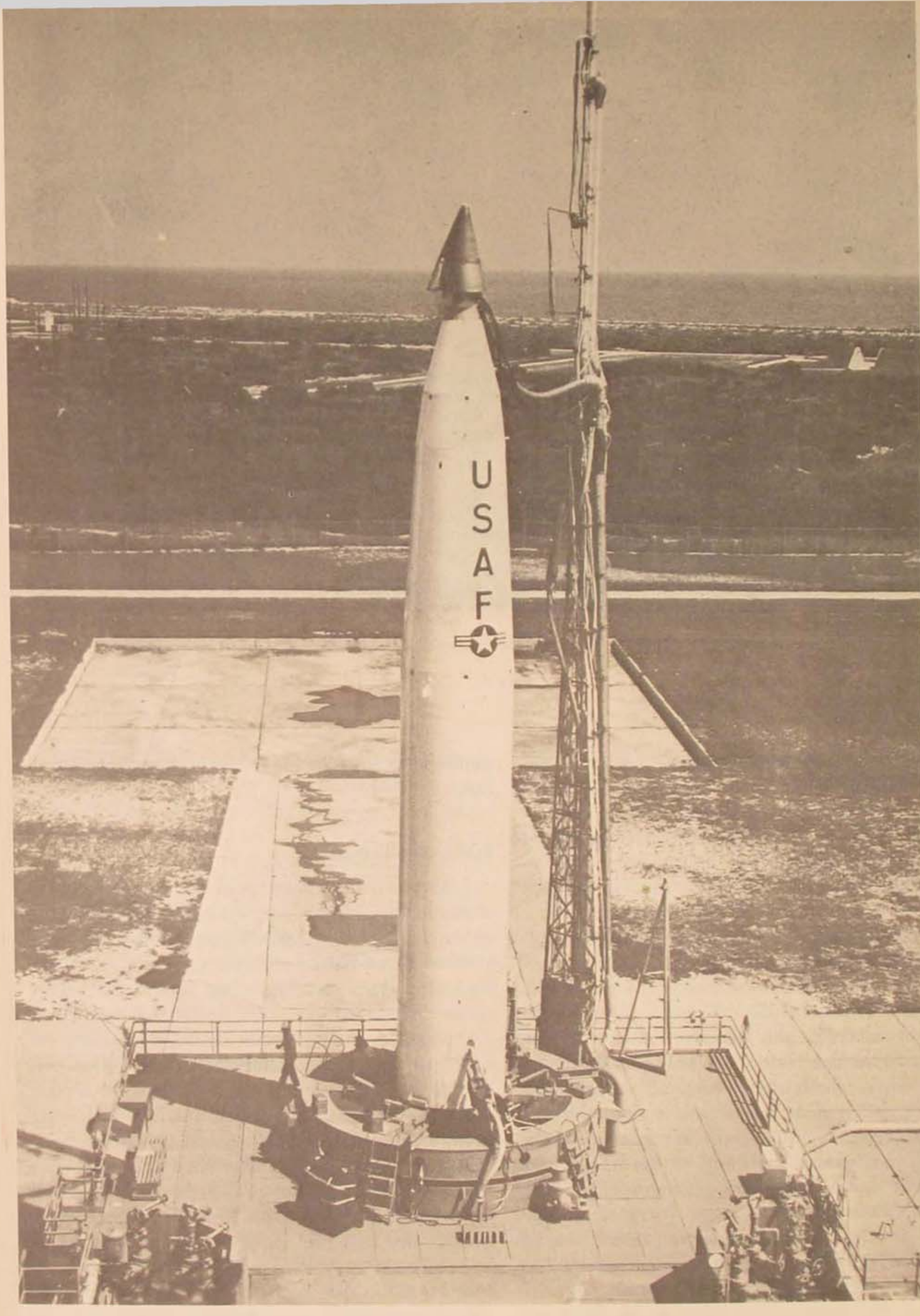
A final class of simulation devices is concerned with nonconventional methods of obtaining hypersonic velocities. These facilities include the use of ballistic ranges where the models are projected through a quiescent gas; the coupling of a ballistic range with a shock tunnel to achieve still higher velocities, around 43,000 fps; and the new class of facility schemes which employ a linear accelerator in place of the conventional supersonic nozzle to accelerate the gas. The first two modes suffer from the lack of accurate local measurements on the model under study, since all model-borne instrumentation must be telemetered to the observer. These facilities at present generate data through the optical "tracking" of the model and surveys of the shock layer by photographic means.

The linear accelerator, or "magneto-gasdynamic" acceleration technique, requires a source of high-temperature, partially ionized gas for the accleration technique to operate on, and no facility using this concept has been constructed for useful aerodynamic testing. However, this technique holds promise for future high-speed simulation.

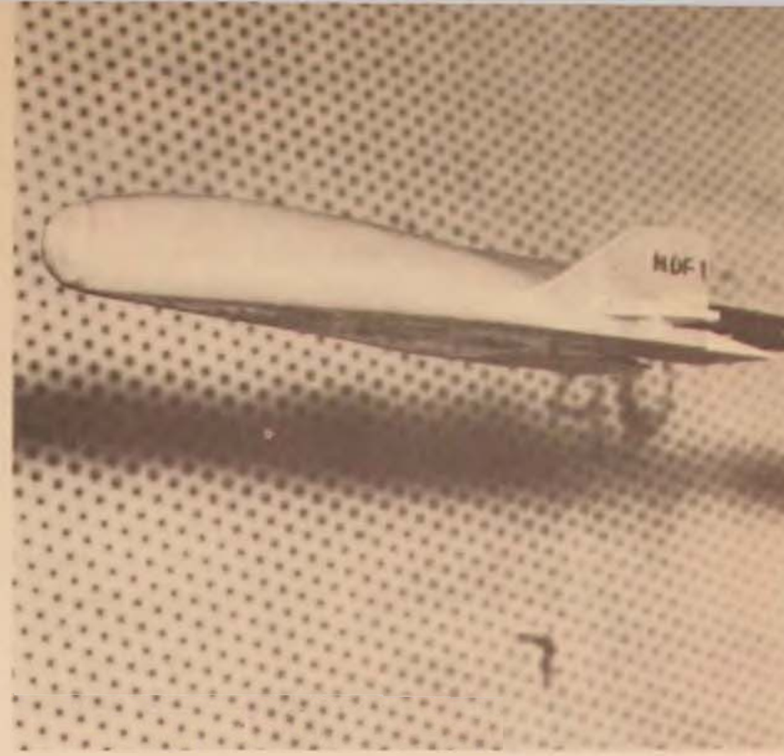
flight achievements

We have discussed some of the accomplishments in the fields of aerodynamics and aerothermodynamics, but there still remains the question as to what has been demonstrated by actual flight, for when all is said and done this is the prime reason for all such research in the flight sciences.

In reviewing the achievements since 1957 we have quite a task, for coincidentally on 4 October in that year the world's first man-made object ever to orbit the earth was successfully launched. In his 1957 article Bonney suggested that the X-15 would be considerably faster than the X-2. This was indeed the case, for on 17 September 1959 the first powered flight of the X-15 was made, and during June and July 1962 it climaxed its numerous achievements with a speed record of 6020 fps and an altitude record of 314,750 feet. Within this same time period, considerable advances were being made with sustained flight aircraft, led by



ASSET, mounted on a Thor booster at Cape Kennedy



Re-entry configuration with dual design approach showing contoured upper surface

the century-series airplanes, which established high-speed flight on a fairly routine basis. This trend has to date culminated in flights of the A-11, as recently announced by the President. The USAF simultaneously was developing a whole new technology focused on nose cone development for ICBM applications, and we have been privileged to see outstanding aerothermodynamic accomplishments in the area of unmanned ballistic re-entry vehicle technology.

This area of the technology produced many firsts. During 1958 the first data capsule was successfully returned and retrieved under the Mark 2 program for demonstration of a heat sink technique. In the spring of 1958 the first ballistic vehicle, the RVX-1, was successfully recovered, having tested various ablation concepts. Success followed success, and during the summer of the next year the first high W/C_DA* ablating entry vehicle was recovered down range. These accomplishments were essentially centered on improved weapon delivery concepts, but it was an outgrowth of these ballistic investigations that enabled the USAF to recover the first Discoverer from orbit during August 1960. The history of the Discoverer program is generally well known, and many of these data capsules have been retrieved, thereby contributing to the store of knowledge now associated with the aerodynamics of re-entry. Paralleling this work was the National Aeronautics and Space Administration's development of the manned technology associated with the Mercury program. Of course here we saw the unmanned programs such as "Big Joe" to test the heat-protection schemes, but the major achievement of the period was undoubtedly the first manned suborbital Mercury flight by Commander Alan B. Shepard, Jr., on 5 May 1961. This was surpassed only by the first manned orbital flight of an American, Lt. Col. John H. Glenn, Jr., on 20 February 1962. It is interesting to note that the Mercury configuration very closely resembles a shape tested by the USAF in 1958.

During the time period from 1957 to 1960, the prime concentration was undoubtedly focused upon exploiting this ballistic entry technology because of the national sense of urgency toward developing an operational ICBM. Even during this surge of what might be termed pure drag vehicles, however, a moderate amount of work was progressing relative to lifting entry vehicles. In February 1959 from Pad 10 at the Cape an aeroballistic vehicle glided successfully down the Atlantic Missile Range. This vehicle, the Alpha-

*Defined as the ballistic coefficient, using weight, drag coefficient, and area.

Draco, was the product of a relatively austere program, but it graphically demonstrated the capability of a body to generate lift and to perform a controlled gliding flight. This entire concept is now being actively studied for advanced applications, along with very advanced generations of ballistic re-entry vehicles.

The major activities associated with lifting gliding flight were concentrated about the Air Force's ASSET and recently canceled Dyna-Soar programs. The basic work on the ASSET program was initiated during 1960 and, as previously mentioned, resulted in a completely successful flight of the first aerodynamic/aerothermodynamic test vehicle on 18 September 1963. The significance of this flight should be clearly understood, for in essence it has established an entirely new era of lifting, maneuvering flight.

Another flight achievement which contributed to the technology and base of knowledge associated with sophisticated flight vehicles was the first successful launching from a B-52 of an air-launched ballistic vehicle down range from the Cape just prior to the cancellation of the program early in 1963. This, to a limited degree, demonstrated the coupling of two reasonably complicated systems at least from the standpoint of the launching phase, which can be aerodynamically critical as to separation and pull-up problems.

An especially appropriate way to perform the final assessment of our flight achievements is against the backdrop of booster technology, for it was the success of this particular endeavor that enabled these subsequent advances in ballistic, lifting, and space vehicles. This chronology of booster system development is particularly noteworthy, for it was just seven years ago, in 1957, that our first real successes with the Jupiter, Thor, and Atlas systems were experienced. Within two years the first of the Titan series was launched, and on 1 February 1961 the Minuteman also became a reality. Thus our knowledge of the stability and control of such systems was significantly increased.

prognosis

When any prognosis or forecasting of a technology is attempted, it is necessary not only to consider the specific technical items but also to be aware of the nontechnical wind shifts and factors which the aerospace sciences must face as a whole, for it is these latter influences which are subject to the more abrupt change. These factors can significantly alter not only the plans and predictions but also the growth of current concepts within the next decade. With this reminder that any prognosis is at best nothing more than a conjecture, an effort will now be made to forecast logical extensions in the technology.

Perhaps one of the more likely aircraft advances to expect is the supersonic commercial transport. If this vehicle does not employ variable geometry for its wings, then certainly either the F-111 or a comparable system will. In any event considerable work will have been directed toward the sonic boom problem as it relates to the supersonic transport. Specifically, efforts will have been made to configure the aircraft so as to minimize the ground overpressure. This overpressure is primarily a function of atmospheric variables and aircraft volume and weight, flight path, and configuration. By giving careful consideration to the volume and lift effects, supersonic aircraft most likely will be designed with improved overpressure levels. If positive results are obtained from the current efforts in laminar flow control, then we also can expect to see long-range aircraft taking full advantage of this technology. Also, as planned, the X-15 will be augmented to 8000 fps.

There most certainly will be a demonstration program in lifting and maneuvering re-entry, most probably employing a vehicle with a moderate lift-to-drag ratio and the capability of performing a conventional horizontal landing. The concept which appears most likely for initial tests would be a vehicle whose lower surface and leading-edge geometries are designed for the hypersonic constraints but whose upper surface is deliberately contoured for low-speed aerodynamic efficiency. In other words, a dual design approach. It is felt that eventually this lifting vehicle will be upgraded to very-high-performance systems with hypersonic lift-to-drag ratios in the order of 3.5, thereby guaranteeing an arbitrary recall capability from any orbital condition. As a result our knowledge of the total hypersonic viscous problem, including skin friction, will be greatly enlarged.

Superorbitally, aside from the Apollo and Fire programs, we can expect a demonstration of lifting entry with unmanned vehicles at velocities near 36,000 fps, since both NASA and the USAF have quite actively investigated the problems associated with this vehicular technology. We can anticipate that our knowledge of both the mechanisms and magnitudes of the heating problems will increase immeasurably. In postulating the expectations for advanced weapon delivery concepts, we might indicate that highly maneuverable vehicles will eventually be used and that, despite the tenacious problems involved, considerable progress will be made in anti-ICBM technology. The aerodynamic and performance techniques for evaluating such a vehicle obviously must be upgraded.

Finally, we might suggest, with a reasonable degree of confidence, the development of a high-volume air-breathing cruise vehicle at a mach number perhaps as high as 10. It is also not implausible to suggest that such a vehicle might eventually perform a dual role not only as a hypersonic cruise vehicle but also as an orbital launch platform or recoverable booster. In addressing ourselves to this question of a recoverable booster, however, we can anticipate formidable problems, for it is not an easy task to define either the configuration or the propulsion mode. Perhaps the initial concepts may be merely rockets with lifting and control surfaces to negotiate a noncatastrophic return, but eventually as more knowledge is obtained it is felt that these vehicles most probably will take full advantage of the dividends associated with air-breathing flight and in this way great advances will be made in understanding the complexities of hypersonic inlet technology with particular emphasis on boundary layer and real gas phenomena.

BONNEY, in 1957, demonstrated an uncanny ability to predict the course of aerodynamics. It will be interesting to note in 1971 whether this author will have demonstrated equal perception in forecasting the shape of aerodynamic technology. In the language of a profession considerably senior to aerodynamics, "That's a tough act to follow!"

Air Force Flight Dynamics Laboratory

Books and Ideas

AN ARMY HISTORIAN'S "RECONSIDERATION"

Dr. Robert F. Futrell

"If YOU will only let experience be your teacher," General Orvil A. Anderson once observed, "you can have any damn lesson you want."[1] The experience of World War II was so broad that it can be mustered to support almost any conclusion that appears appropriate. By way of example, statements of operational experience made by such high-ranking commanders as Generals Omar Bradley and George Patton were gravely cited in 1946 as proof that the Army had a continuing requirement for horse cavalry.[2] The very volume of the writings on World War II makes it difficult to determine exact lessons of consequence to the future. The task of synthesizing and refining this vast body of historical source material has not yet been adequately accomplished.

In a series of lectures delivered at Memphis State University in October 1962 and now published in a small volume,[*] Dr. Kent Roberts Greenfield has sought to draw upon his experience as the dean of Army historians and provide a synthesis and interpretation of American strategy in World War II. Dr. Greenfield has good qualifications for this task. Called to military service from academic life as Chairman of the Department of History at Johns Hopkins University, Colonel Greenfield served as wartime Chief, Historical Section, Army Ground Forces. After the war he served in civilian status as Chief Historian, Office of Chief of Military History, Department of the Army, until his retirement in 1958. In his present volume of lectures, Greenfield acknowledges heavy reliance upon the work of his former colleagues, whom he directed in the preparation of the many-volume (99 were originally planned but not all have been published) history of the *U.S. Army in World War II*.

On a lecture platform, many historians have

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[*]Kent Roberts Greenfield, *American Strategy in World War II, A Reconsideration* (Baltimore: The Johns Hopkins Press, 1963, $4.50), viii and 145 pp.

been known to shade cold historical fact for the sake of stimulating the thought of their listeners. There is undoubtedly some tendency to "provoke the audience" in Greenfield's four Memphis State lectures, but for the most part he is content to report history as he believes that it was. His first lecture concerns the major strategic decisions of World War II and the relationship of Anglo-American political objectives and military strategy. His conclusion here is not very startling: "Military considerations consistently prevailed." (p. 23) In his second lecture, Greenfield determines that differences in American and British ideas of military strategy were less sharp than many have believed and that the differences were always successfully resolved. More "revisionist" than the other lectures, Greenfield's third lecture argues that on at least 22 occasions President Franklin D. Roosevelt made major strategic decisions against the advice of or over the protests of his military advisers. Except for the case of China, where Roosevelt's policies are said to have ended in "dismal failure," Greenfield asserts that Roosevelt's strategic decisions made "military sense" and in fact gave "shape" to the Anglo-American strategy that defeated the Axis in Europe and Japan in the Far East. Greenfield passes over Roosevelt's decision for "unconditional surrender" very lightly: his thought is that this policy was a natural outgrowth of the type of total defeat that the Allies had already pledged themselves to inflict on the enemy, and he says that it was "never vigorously opposed or even seriously debated" during the war. This, of course, is a vast oversimplification of a rather complex subject. Greenfield's portrayal of Roosevelt as a great military leader parallels the recent revisionist writings that have attempted to show that President Lincoln rather than his military commanders was the chief architect of the Federal military victory in the American Civil War.

In his fourth lecture, entitled "Air Power and Strategy," Greenfield prefaces himself with the observation: "It has been difficult, especially in the United States, to be objective about the role of air power in World War II. . . . Objectivity was difficult for the young and ambitious leaders of the American air forces. It was equally difficult even for historical observers like myself, who were identified during the war with one of the established services." (p. 85) This admission appears appropriate, for in earlier writings and lectures Greenfield at times left his objectivity concerning air power somewhat in doubt. In lectures delivered in 1953 and published under the title *The Historian and the Army*, for example, Greenfield stated that the Army and Air Force had been effective partners at levels of coequality, but he charged that at working levels this had not been true:

> The air and ground forces of the Army of the United States did not develop an effective air-ground battle team in World War II. The Marines did, in cooperation with naval aviation and their own. The Army Air Forces were too much preoccupied with other interests and goals: with strategic bombing; with freedom from entangling alliances, in order to protect the precious flexibility of their forces and permit shifting them quickly; with independence of any control but their own, except at theater level. Close-in support of the ground forces was one of their missions, but the one given lowest priority. It was impossible to interest them seriously in developing the equipment, techniques or skills needed for genuine teamwork in ground combat.[3]

Greenfield based this sweeping indictment upon a historical monograph, *Army Ground Forces and the Air-Ground Battle Team*, which he had written earlier after research in the record files of Headquarters Army Ground Forces, an agency that, by most reports, was almost entirely lacking in sympathy for independent air power ideas and objectives.

In the lecture at hand on "Air Power and Strategy" Greenfield has happily lifted his sights and broadened the scope of his investigation. In regard to overall air power, Greenfield now concludes: "It cannot reasonably be maintained that air power was the decisive, in the sense of being the major factor, in the defeat of Germany and Japan. But that by its application in a new combination with land and sea power, and in overwhelming force, it became a primary factor in the defeat of both is incontestable." (p. 86) Even though he is willing to admit that Allied air power became a "primary factor" in the Axis defeat, Greenfield apparently still wonders whether the Allied emphasis (especially the American emphasis) on air power was wise. He records that in initial War Department planning in the summer of 1940, the U.S. Victory Program called for a ground army of 215 divisions and an air force of 84 groups. By the winter of 1942–43, however, the U.S. Army had changed its force plans to include 89 divisions and 273 air force groups. As Greenfield sees it, the American Army was reshaped to include "a long-reaching, heavy, and powerful air fist, and a comparatively small though compact ground fist."

> This in turn [Greenfield continues] reacted on the ultimate strategy of the coalition. In the spring of 1945, though in victorious pursuit of the Germans, the Americans could not deploy enough ground combat strength in Europe to adopt without grave risk Mr. Churchill's proposals for resolute opposition to the oncoming Russians, even had Mr. Roosevelt been convinced of the wisdom of taking an open stand against them. In Asia, if we had had more divisions to deploy in 1944–45, we might not have felt it necessary to invoke the active support of Russian arms to pin down the Japanese army in Manchuria. For the same reason we lacked the means, during those years, to contain or effectively oppose Mao Tse-tung's Communists in China. (pp. 6-7)

Greenfield is apparently arguing that American force goals failed to provide a "flexible response" to the full spectrum of the strategic problems of World War II. His readers should, of course, know that many of these "strategic problems" were not completely recognized in the war period.

Professor Greenfield's discussion of air-ground cooperation in "Air Power and Strategy" is much more sympathetic than were his remarks in 1953. After telling the rather dismal story of the failure of U.S. air-ground systems in North Africa early in 1943, Greenfield now notes that cooperation improved markedly in Italy and underwent such a "transfiguration" in Europe that General Eisenhower's Chief of Staff, Lt. Gen. Walter Bedell Smith, could state in March 1945 that "the tactical coordination of air and ground forces has become an instrument of precision timing." Greenfield believes, however, that this improvement was not the result of "organizational changes and high-level definitions of doctrine." Through the good work of such Air Force leaders as Generals Gordon P. Saville and Elwood R. ("Pete") Quesada, improvements in air-ground cooperation grew up "in the field." Equally effective cooperation matured in the Pacific, where Generals Douglas MacArthur and George Kenney "combined to produce a most cordial and effective air-ground partnership." (pp. 107-111) Although Greenfield notes that the services learned to work together in combat, he observes that the "new practices would have worked sooner and better if the troops had been trained beforehand." (p. 110) He does not explain how troops could have been trained in tactics and techniques that were learned "in the field" before they went into the field.

Just as he believes that tactical air commanders learned from their association with the ground commanders, Greenfield also observes that, ironically, "much of the most effective work in the strategic bombing of Germany was done while the air forces were co-operating with the ground forces." (p. 118) He asserts that the strategic air commanders "reluctantly accepted" the need to bomb Germany's transportation systems only because of General Eisenhower's orders; in the end, however, these transportation attacks unhinged Germany's economy. At the same time, Greenfield points out that the ground advance in France wrecked the enemy's air-warning net and facilitated the deadly effectiveness of the final bomber assaults. The strategic bombing of Japan became effective only after sea-air-ground offensives brought the B-29's within range of the Japanese home islands and naval blockade had strangled Japan's shipping and war economy. In World War II the Allied air forces were thus clearly unable to attain "the dream and ultimate goal of air war" which Greenfield conceives to be "to produce surrender by air power with only incidental help from other forces." Stated once again, Greenfield concludes: "The defeat, then, both of Germany and Japan, was inflicted by a combined team of Allied ground-sea-and-air forces." (p. 120)

In final analysis, an Air Force reader may well wonder what the historical "reconsideration" may have been in this essay on "Air Power and Strategy." Most of the substantive ideas presented here have been previously presented in the official Air Force history, *The Army Air Forces in World War II.*[3] Certainly Dr. Greenfield appears to have "reconsidered" the rather harsh portrayal that he made of the Air Force in his 1953 lectures, but he still manifests little sympathy for air power as a predominant weapon. Writing in 1948 of the campaigns against Germany and Japan, General Carl A. Spaatz observed: "No useful purpose would be served now by refighting these wars as the airman might have wished to fight them."[5] This admonition doubtless still holds good, but Dr. Greenfield has opened the door and it may be worthwhile to take another look at the role of strategic air power in World War II.

Because the last war saw the weapons of all services employed in profusion," General Spaatz suggested in 1948, "one may argue the exact degree of contribution made by strategic bombing to the final decision." As Spaatz saw the matter, independent strategic air power never received an adequate test in World War II since "the war against Germany was fundamentally an infantry war supported by air power, much as the war against Japan was fundamentally a naval war supported by air."[6] The fact that the Allied war effort would be directed by a surface strategy, which in the end would make it impossible to say whether a strategic air strategy might not have been successful, was definitely not the fault of American air leaders and probably not of the British war commanders.

Meeting in Washington in the first Anglo-American war plans conference early in 1941, British and American staff planners completed on 27 March a document usually cited as "American-British Conversations No. 1," or "ABC-1," which contained a summary of strategic policies to be implemented if the United States entered the war. The conferees agreed to concentrate the main war effort against Germany. This Allied offensive would include blockade, a "sustained air offensive" against German military power, early defeat of Italy, and the preparation of forces for an eventual land offensive against Germany. The agreement visualized that as rapidly as possible the Allies would attain "superiority of air strength over that of the enemy, particularly in long-range striking forces."[7]

In response to a request by President Roosevelt to know overall production requirements necessary to defeat the Axis, the Army Air Forces Air War Plans Division completed AWPD-1, Munitions Requirements of the Army Air Forces, on 12 August 1941. This first major U.S. air war plan visualized a strategic air campaign against Germany that would disrupt her electric power system, her transportation network, her oil and petroleum resources, and would undermine the morale of the German people. The air planners estimated that the economic and social life of Germany was already strained by the war against Russia, that an Allied land offensive against Germany could not be mounted for at least three years, and that if the air offensive were successful a land offensive might not be necessary. The air planners stated a strong requirement for new B-29 Superfortress bombers and asked for the development of a 4000-mile-radius-of-action bomber (the future B-36). The strategic target system in Germany quite closely approximated the optimum system that the U.S. Strategic Bombing Survey would describe after the war's end. Long before Professor Greenfield would have us believe that the strategic air commanders "reluctantly accepted" the need to bomb Germany's transportation, Air Force planners had identified the importance of this target system. AWPD-1 also visualized an "ultimate force" of 239 air groups and 108 observation squadrons, an estimate remarkably similar to the 269 tactical groups that the Air Force would possess as its maximum strength during the war.[8]

The U.S. Army-Navy Joint Board accepted AWPD-1 as a statement of Air Force requirements, but it would not accept the idea that a strategic air offensive against Germany might eliminate the necessity for a land campaign. The board warned: "Naval and air power may prevent wars from being lost, and by weakening enemy strength may greatly contribute to victory. By themselves, however, naval and air forces seldom, if ever, win important wars. It should be recognized as an almost invariable rule that only land armies can finally win wars."[9] Again on 15 December 1941, AWPD-4, Air Estimate of the Situation and Recommendations for the Conduct of the War, recommended that first priorities in production should be given to the Air Force and that sea and ground force priorities should be allocated "in the light of their contribution to the Air Force mission." This air plan was also unacceptable. Meeting in Washington beginning on 22 December 1941, the Anglo-

American Arcadia conference was unwilling to accept overriding strategic air priorities but instead adopted a Victory Program calling for increases of air, ground, and naval forces in a sequence of limited schedules geared to successively approved operations.[10]

Reorganization of the War Department moved strategic planning up to the War Department General Staff Operations Division, thus effectively ending unilateral Air Force planning. The last major Air Force plan, entitled AWPD-42, Requirements for Air Ascendancy, issued on 9 September 1942, followed approved strategy and defined the air mission in terms of cooperation with a surface campaign. The missions were: an air offensive against Europe to deplete the German air force, to destroy construction sources of German submarines, and to undermine German warmaking capacity; air support for a land offensive in Northwest Africa; air support of land operations to retain the Middle East; air support of surface operations in the Pacific and Far East to regain base areas needed for a final offensive against the Japanese homeland; and defense of the Western Hemisphere, including antisubmarine operations. Indicative of the shift to the support for a surface strategy, AWPD-42 defined the priority targets in Germany as airplane assembly plants, aircraft engine plants, submarine yards, transportation, power, oil, aluminum, and rubber production facilities. There was another important change in the revised planning: AWPD-1 had expected that six months of intensified bombing against Germany would begin in mid-1943, but AWPD-42 recognized that this all-out air campaign could not be undertaken until late in 1944.

At the Casablanca Conference on 21 January 1943, the Anglo-American heads of state directed the execution of a combined bomber offensive against Germany designed to secure "the progressive destruction and dislocation of the German military, industrial and economic system, and the undermining of the morale of the German people to a point where their capacity for armed resistance is fatally weakened." This air offensive, however, was to be preparatory to a surface invasion: the Casablanca directive, for example, required the strategic bombers to give first priority to attacks against German submarine bases and construction yards. Accepted as a result of President Roosevelt's insistence and without any military debate, the Allied objective of "unconditional surrender" demanded absolute ground conquest of the enemy nations.[11] "The air weapon system," General Laurence S. Kuter later observed, "was assigned a supporting role to facilitate the implementation of this conventional surface strategy."[12]

Even though the Allied combined bomber offensive against Germany was designed to prepare the way for a surface invasion of the Continent, the buildup of American strategic bombers in Europe was relatively slow, and, in the end, the major weight of the strategic bombing attack followed rather than preceded the invasion of Western Europe. In January 1943 the Army Air Forces had only 12 heavy bombardment groups deployed in theaters against Germany, and it did not attain its maximum strength of 62 heavy bombardment groups against Germany until May 1944, less than a month before the invasion of Normandy on 6 June 1944. The total of first-line B-17's and B-24's deployed against Germany increased from 413 in January 1943 to a maximum of 5072 in March 1945.[13] The Royal Air Force Bomber Command's strength increased from a miscellany of 515 light, medium, and heavy bombers in January 1943 to a total of 1609 Halifax, Lancaster, and Mosquito bombers in April 1945.[14] Of the total of 2,770,540 tons of bombs dropped by AAF and RAF aircraft against Germany, only 17 per cent fell prior to 1 January 1944 and only 28 per cent prior to 1 July 1944.[15]

In common with air power critics, Greenfield repeats the findings of the U.S. Strategic Bombing Survey which stated that prior to the summer of 1943 the Allied bombing effort had had "no appreciable effect" on Germany's munitions output or national economy and that, until July 1944, the total armaments production of Germany steadily increased. "The two strategic forces, the British by night and the Americans by day," Greenfield wrote, "had for two years been pounding Germany with increasing mass, continuity, and violence. . . . Yet when the United States Strategic Bombing Survey made its searching study in 1945, it was found that before the summer of 1944, this huge effort had produced far less effect than had been supposed." (pp. 112-113) As the bomb tonnage totals noted above indicate, the Allied bombing effort prior to July 1944 was hardly "huge." Greenfield, moreover, is only partly correct when he concludes that the bombing effort had failed to reckon with the fact that German industry was incompletely mobilized in 1942-43 and had a large cushion that could be employed to expand production in 1943-44. (p. 114)

As a matter of fact, most of the lack of positive results attained by the Allied strategic bomber offensive in its first year and a half lay in the relatively small number of bombers available and their commitment to objectives selected in terms of the planned surface campaign. From January to June 1943, the strategic bombers were required to devote their principal effort to attacks against submarine bases and pens, both of which were targets that were relatively invulnerable to bombs.[16] In June 1943, the Combined Chiefs of Staff directed that first priority be given to attacks against German fighter forces and the industry upon which they depended. Lacking enough bombers to handle the German aircraft target system, the U.S. Eighth Air Force chose to try to destroy a "long-chance objective." Back in Washington, General Henry H. Arnold's Committee of Operations Analysts had recommended that antifriction ball bearings were a potential bottleneck in German war industry. This committee—composed mostly of civilian industrialists and economists—believed that the destruction of a few ball-bearing plants would tie up German aircraft production.[17] Although about 12,000 tons of bombs were dropped on Germany's ball-bearing plants after 17 August 1943, the U.S. Strategic Bombing Survey later reported "there is no evidence that the attacks on the ball-bearing industry had any measurable effect on essential war production."[18]

While seeking to destroy ball-bearing factories, Eighth Air Force heavy bombers sustained large losses on long-range penetration missions to Schweinfurt and Regensburg on 17 August and on a return mission to Schweinfurt on 14 October 1943. The usual interpretation is that these heavy-bomber losses forced a reassessment of the U.S. strategic bombing effort. Greenfield states that the losses were "intolerable." (p. 93) "The fact was," concluded *The Army Air Forces in World War II*, "that the Eighth Air Force had for the time being lost air superiority over Germany. And it was obvious that superiority could not be regained until sufficient long-range escort became available."[19] Actually both of these interpretations miss the mark. A close reading of Air Force correspondence of this time period reveals a confidence that strategic bombers, employed in force, could still perform their missions over Germany but that an early attainment of Allied control of the air was necessary if the OVERLORD invasion in Normandy and the ANVIL invasion in southern France were to succeed in mid-1944.[20]

"It is a conceded fact," General Arnold told the Commanders of the Eighth and Fifteenth Air Forces on 27 December 1943, "that OVERLORD and ANVIL will not be possible unless the German Air Force is destroyed. Therefore, my personal message to you—this is a MUST—is to, '*Destroy the Enemy Air Force wherever you find them, in the air, on the ground and in the factories.*' "[21] Effective on 1 January 1944, General Spaatz was given command of the U.S. Strategic Air Forces in Europe (USSTAF), a headquarters that combined control of the British-based Eighth Air Force and the Italian-based Fifteenth Air Force. Between October 1943 and February 1944, the number of heavy bombardment groups operating against Germany increased from 26 to 48. Equipped with external fuel tanks, P-47 and P-51 fighters began to fly long-range escort for the heavy bombers. At the end of December 1943, Field Marshal Hermann Göring (ignoring the basic fact of air fighting that when aircraft of roughly equal performance meet, the one who seeks to avoid combat commits suicide) issued orders to Luftwaffe fighters to avoid Allied fighters and concentrate their attack on the bombers. To take advantage of Göring's mistake, Allied fighters were allowed to take the offensive—to pursue and destroy enemy fighters—rather than to provide position defense to friendly bombers. The Allied counter-air campaign took advantage of all these developments. Begun on 20 February 1944 in the "Big Week," the Allied air superiority campaign had virtually eliminated the effectiveness of the Luftwaffe by the time of the Normandy invasion. One of the major factors in the defeat of the Luftwaffe was a centralization of control of Allied air units. Although the U.S. Ninth Air Force had been designated as the support force for American ground armies in Europe and it was busily engaged in high-priority fighter-bomber training, General Spaatz was able to use Ninth Air Force fighters in the air superiority campaign. "There was no difficulty," Spaatz said, "in using Ninth Air Force fighters when we needed them. If we had a mission, we could always get them."[22]

In the months that followed the "Big Week," USSTAF strategic bombing capabilities were employed in attacks against German V-weapon sites and in missions in support of Allied ground troops going ashore in France. Even though General Spaatz was permitted to begin attacks against Germany's oil resources on 12 May 1944, it is fair to state that a massive sustained air campaign against strategic air targets in Germany did not begin until after D-Day, when Allied ground troops were safely ashore in Normandy. By December 1944, German reserves of fuel were insufficient to sustain effective military operations. Undertaken intensively in September 1944, the strategic air campaign against Germany's transportation was later described as "the decisive blow that completely disorganized the German economy." Contrary to the intention of early AAF planners, the German electric power system was never a principal target. "Had electric generating plants and substations been made primary targets . . . ," the U.S. Strategic Bombing Survey stated, "the evidence indicates that their destruction would have had serious effects on Germany's war production." Under the full force of strategic bomber attack and with war requirements multiplying more swiftly than production could handle, the economic life of Germany virtually collapsed by December 1944. "The German experience," stated the U.S. Strategic Bombing Survey, "suggests that even a first-class military power—rugged and resilient as Germany was—cannot live long under full-scale and free exploitation of air weapons over the heart of its territory."[23]

In the Pacific the pattern of Allied operations and commitment of forces was different from that employed in Europe, but the strategy relative to the employment of air power was essentially the same. Because of Japanese expansion in the first two years of the war, Air Force planners recognized that even the very-long-range B-29's would be unable to reach the Japanese homeland until the enemy's perimeter had been reduced. "Our armed forces in the Far Eastern Theater," stated AWPD-42, "are not within effective striking distance of the vital sources of Japanese military policy. . . . Hence from the standpoint of air requirements, the Far Eastern operations may be divided into two phases: (1) Air operations in support of our land and sea forces to regain bases within striking distance of Japan. . . . (2) Air operations against Japan proper to destroy her war making capacity."

At the Quadrant Conference in Quebec during August 1943, the Anglo-American Combined Chiefs of Staff approved advances toward Japan both through the Central Pacific and along the New Guinea–Philippines axis. Air Force planners favored the Central Pacific route as being likely to give B-29 bases at the earliest date. In the autumn of 1943 following Quadrant, U.S. joint staff planners sought to prepare an overall plan for the defeat of Japan. The initial draft of this paper stated that it had been clearly demonstrated in Europe that air forces were incapable of decisive action and that surface invasion of the Japanese home islands would be necessary to conclude the war. The best that the Air Force representative could do in the way of getting this statement changed was to secure a new statement to the effect that a preliminary air offensive against Japan would be essential to the ultimate invasion of the home islands. At the Sextant Conference in Cairo during December 1943, the Combined Chiefs of Staff authorized the beginning of B-29 attacks against Japan from bases far in the interior of China by May 1944 and from bases in the Mariana Islands before the end of the year.[24]

Because the B-29 wings would mount the strategic air offensive against Japan from bases located in several different theaters of operations, General Arnold secured agreement permitting the Twentieth Air Force to be established in Washington directly under the Joint Chiefs of Staff to control the XX Bomber Command in China and the XXI Bomber Command in the Marianas. As set forth by the Joint Chiefs of Staff, the mission of the Twentieth Air Force was: "To achieve the progressive destruction and dislocation of the Japanese military, industrial and economic systems and the undermining of the morale of the Japanese people to a point where their capacity for armed resistance is decisively weakened."[25] General Arnold's Committee of Operations Analysts recommended that B-29 attacks be directed against

Japan's merchant shipping, steel production, urban industrial areas, aircraft plants, antifriction bearing factories, and electronics industries. Japan's steel industry appeared to have a "long-chance" target: it depended upon coke produced in only a few ovens at sites in Manchuria and Kyushu. The operations analysts also pointed out that Japan's urban areas housed many small factories and were very vulnerable to incendiary attack.[26]

With the exception that the Japanese army and navy air forces had already suffered grave losses of experienced personnel, the early operations of the Twentieth Air Force's XX Bomber Command from bases in China were not unlike early Eighth Air Force operations from Great Britain. The XX Bomber Command represented a piecemeal commitment of too little capability; it was also based in a remote area, far from all industrial targets, and where logistical support was difficult to obtain. The China-based B-29's attempted to destroy the "long-chance" coke-oven targets, but they had very little success in the effort.[27] As time passed, it was more and more obvious that the burden of the strategic air campaign against Japan would have to be flown by the Twentieth Air Force's XXI Bomber Command, which was prepared to go into operation as soon as bases were built in the Marianas. Construction of these new airfields began only a few days after Admiral Chester Nimitz' forces invaded Saipan on 15 June 1944, but the airfield work did not get overriding priority, since Nimitz also required new fleet bases to support surface invasions of Iwo Jima and Okinawa and the planned invasion of Japan.[28]

During the summer of 1944, Twentieth Air Force target planners became skeptical of the high priority given to Japan's steel industry as a target system, and General Arnold asked the Committee of Operations Analysts to submit a fresh target study based on alternative assumptions that Japan might be defeated solely by air attack and sea blockade or by these plus a surface invasion. Under the first alternative, the operations analysts recommended a general air campaign against shipping, attacks against aircraft industries, and saturation bombing of six urban industrial areas. Under the second alternative, they recommended priority attacks against the aircraft industry, with secondary effort against urban industrial targets and shipping. Discounting the possibility that Japan would surrender without invasion, the Joint Target Group in Washington recommended that emphatic priority be given to the destruction of Japan's air power and that the urban attacks and antishipping operations be delayed.[29]

After postponements caused by bad weather and limited facilities, Major General Haywood S. Hansell, Jr., sent the XXI Bomber Command on high-level attacks against Japan's aircraft-production factories beginning on 24 November 1944. Japanese fighters and antiaircraft artillery were not very effective against the high-flying B-29's, but, in the months that followed, the precision-bombing effort did not appear to be very successful. Bad weather scattered formations, obscured targets, and reduced bombing accuracy. The long flights to Japan and the need to lift heavy bomb loads to 25,000-foot bombing altitudes strained engines and caused substantial losses of aircraft at sea. Impatient with the XXI Bomber Command, General Arnold moved Major General Curtis E. LeMay to its command on 20 January 1945, but neither the new commander nor the commitment of a second B-29 wing to the Marianas appeared to give much better results. Actually, Japanese aircraft production had dropped substantially because of the B-29 attacks and a high degree of confusion produced when the Japanese attempted to disperse the aircraft plants.[30]

As late as 6 March 1945, General LeMay considered that the XXI Bomber Command had not "really accomplished a hell of a lot in bombing results." With the arrival of a third B-29 wing in the Marianas, however, General Arnold issued a new target directive on 19 February which continued aircraft factories in first priority but moved incendiary attacks against urban industrial concentrations into a strong second priority. Although the fire raids were desired and ordered by Washington, General LeMay kept his own counsel on the tactics to be employed on the great Tokyo fire raid when it was mounted on the night of 9/10 March 1944. LeMay called for a stream of bombers from the three wings to come in low (4900 to 9200 feet) and drop their incendiaries on fires started by pathfinder crews. Fearing that gunners unused to night attack might shoot at each other's planes, LeMay ordered both guns and gunners removed from the

B-29's. The weight saved by the removal of armament and the low altitude of attack permitted the B-29's to carry exceptionally heavy loads of incendiaries. Over the target in a steady stream in the early morning hours of 10 March, the B-29's sustained moderate losses as they kindled fires which destroyed about one fourth of metropolitan Tokyo. General LeMay had staked his career on his decision to operate the bombers at low level. "This decision, combining technical acumen with boldness of execution," General Hansell later said, "was one of the classic air decisions of the war."[31] Greenfield observes: "General LeMay could be satisfied that he had shown what independent air war can do." He suggested, however, that LeMay's "ambition to do so" had led him to take a "grave risk." (pp. 120, 137)

In March 1945 the Japanese government began to take serious steps to end the war. Top-level officials in Washington knew of Japan's desire to end hostilities, but in September 1944 the Combined Chiefs of Staff had committed the Anglo-Americans to the seizure of "objectives in the industrial heart of Japan." At Yalta in February 1945, this surface strategy was reaffirmed, and the Soviet Union obtained territorial concessions in return for promises to join the war against Japan. In April, American soldiers and marines began bloody battles to take Okinawa, and in support of this invasion General LeMay was required between 17 April and 11 May to divert 75 per cent of the XXI Bomber Command's capability to attacks against enemy airfields on Kyushu and Shikoku. In the waning weeks of May and the early days of June 1945, however, the XXI Bomber Command continued to burn Japan's principal industrial areas. When Arnold visited Guam early in June, LeMay told him that 30 to 60 of Japan's cities and every industrial target would be destroyed by 1 October. Never successful against night-flying B-29's, Japanese fighters made their last effective opposition against a daytime B-29 attack on 5 June, and, thereafter, the Japanese air forces elected to save their remaining planes for *kamikaze* attacks against the expected Allied invasion forces.[32] On 20 June, Emperor Hirohito told his council that it would be necessary to have a plan to close the war at once, but Japan's militarists argued against unconditional surrender. These militarists clung to the expectation that Japan's ground defenses would still be able to inflict enough casualties on Allied surface invaders to win a negotiated peace.[33]

The revolutionary employment of nuclear air weapons against Hiroshima and Nagasaki and the Soviet Union's declaration of war on 8 August tended to obscure the contribution of the sustained air offensive to the victory when Japan's conditional offer to surrender was accepted on 12 August 1945. "Without attempting to minimize the appalling and far-reaching results of the atomic bomb," General Arnold wrote, "we have good reason to believe that its actual use provided a way out for the Japanese government. The fact is that the Japanese could not have held out long, because they lost control of their air. They could not offer effective opposition to our bombardment, and so could not prevent the destruction of their cities and industries."[34] Based upon detailed investigations within Japan, the U.S. Strategic Bombing Survey reported that "certainly prior to 31 December 1945, and in all probability prior to 1 November 1945, Japan would have surrendered even if the atomic bombs had not been dropped, even if Russia had not entered the war, and even if no invasion had been planned or contemplated."[35]

IF HISTORY is to be considered as nothing more than the cold recording of accumulated experience, Professor Greenfield is entirely correct in his conclusion that in World War II Allied air operations did not attain the "dream and ultimate goal" of producing surrender with only incidental help from other forces. He is equally correct when he says: "The defeat, then, both of Germany and Japan, was inflicted by a combined team of Allied ground-sea-and-air forces." But the greater strategic lesson of World War II may well be that the Anglo-American heads of state and war commanders never fully grasped the revolutionary potentialities of a strategic air offensive. Had the war leaders been willing to trust air power's capabilities as an independent force, the strategic air offensives would have been properly designed to prepare for such exploitative ground occupation as might have seemed proper. The selection of strategic target systems for an independent air campaign, moreover, would have been quite different from those selected to support concurrent air and surface operations. And, as General Spaatz observed in final summary: "Had the revolutionary potentialities of the strategic air offensive been fully grasped by the men running the war, some of the fateful political concessions made to hold the Russians in the European war and to draw them into the Japanese war might never have been made."[36]

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Notes

1. Maj. Gen. Orvil A. Anderson (USAF, Ret), "Development of U.S. Strategic Air Doctrine, ETO World War II," lecture to Air War College, 20 Sept. 1951, p. 28.

2. U.S., 79th Cong., 2d Sess., *Military Establishment Appropriation Bill for 1947, Hearings before the Subcommittee of the Committee on Appropriations, House of Representatives* (Washington: Government Printing Office, 1946), pp. 366-367.

3. Kent Roberts Greenfield, *The Historian and the Army* (New Brunswick: Rutgers University Press, 1954), p. 84.

4. W. F. Craven and J. L. Cate (eds.), *The Army Air Forces in World War II* (7 vols.; Chicago: University of Chicago Press, 1948-1958).

5. Gen. Carl Spaatz, "If We Should Have To Fight Again," *Life*, 5 July 1948, p. 35.

6. *Ibid.*

7. Ray S. Cline, *Washington Command Post: The Operations Division* (Washington: Office of the Chief of Military History, 1951), pp. 58-59. Craven and Cate, I, 136-141.

8. AWPD-1, Munitions Requirements of the AAF, 12 Aug. 1941. USSBS, *Summary Report (European War)*, 30 Sept. 1945, pp. 5-14.

9. U.S. Army-Navy Joint Board No. 355 (Serial 707), Joint Board Estimate of United States Over-All Production Requirements, 11 Sept. 1941.

10. Craven and Cate, I, 237-251.

11. Craven and Cate, II, 274-307. Sir Charles Webster and Noble Frankland, *The Strategic Air Offensive Against Germany, 1939-1945* (London: Her Majesty's Stationery Office, 1961), II, 10-21.

12. Gen. Laurence S. Kuter, "An Air Perspective in the Jetomic Age," *Air University Quarterly Review*, VIII, 2 (Spring 1956), 113.

13. AAF Statistical Digest, World War II, Dec. 1945, pp. 4-7, 154-156.

14. Webster and Frankland, IV, 428.

15. USSBS, *Over-All Report (European War)*, 30 Sept. 1945, p. 10.

16. *Ibid.*, p. 37.

17. Webster and Frankland, IV, 158-160. Report of Committee of Operations Analysts, 8 Mar. 1943.

18. USSBS, *Summary Report (European War)*, p. 6.

19. Craven and Cate, II, 705.

20. Bernard Boylan, *Development of the Long-Range Escort Fighter* (Maxwell AFB: USAF Historical Division Study No. 136, 1955), pp. 73-102.

21. Craven and Cate, III, 8.

22. *Ibid.*, II, 733-756; III, 30-66. AAF Statistical Digest, World War II, p. 8. Anderson, pp. 20-21. USSBS, *Summary Report (European War)*, pp. 6-8. Interview with Gen. Carl A. Spaatz by Brig. Gen. Noel F. Parrish and Dr. Alfred Goldberg, 21 Feb. 1962.

23. USSBS, *Summary Report (European War)*, pp. 8-10, 12-14, 16.

24. Craven and Cate, IV, 549-550.

25. *Ibid.*, V, 33-41.

26. Report of Committee of Operations Analysts, 11 Nov. 1943.

27. USSBS, *Summary Report (Pacific War)*, 1 July 1946, pp. 14-15.

28. Craven and Cate, V, 536-545.

29. *Ibid.*, V, 546-576. Revised Report of the Committee of Operations Analysts on Economic Targets in the Far East, 10 Dec. 1944.

30. USSBS, *Japanese Aircraft Industry*, May 1947, pp. 31-66.

31. Craven and Cate, V, 608-618. U.S., 81st Cong., 1st Sess., *Investigation of the B-36 Bomber Program, Hearings before the Committee on Armed Services, House of Representatives* (Washington: Government Printing Office, 1949), p. 151.

32. Craven and Cate, V, 627-635. USSBS, *The Strategic Air Operation of Very Heavy Bombardment in the War Against Japan*, 1 Sept. 1946, pp. 12-19. Gen. H. H. Arnold, *Global Mission* (New York: Harper, 1949), p. 564.

33. USSBS, *Japan's Struggle To End the War*, 1 July 1946, pp. 5-7.

34. Arnold, *Third Report of the Commanding General of the Army Air Forces to the Secretary of War*, 12 Nov. 1945, p. 36.

35. USSBS, *Japan's Struggle To End the War*, p. 13.

36. Spaatz, p. 35.

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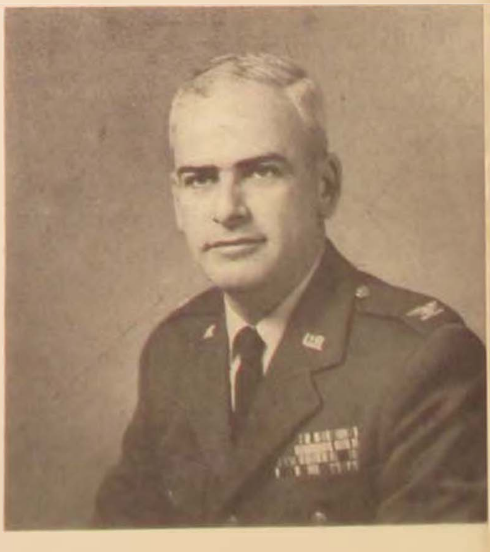

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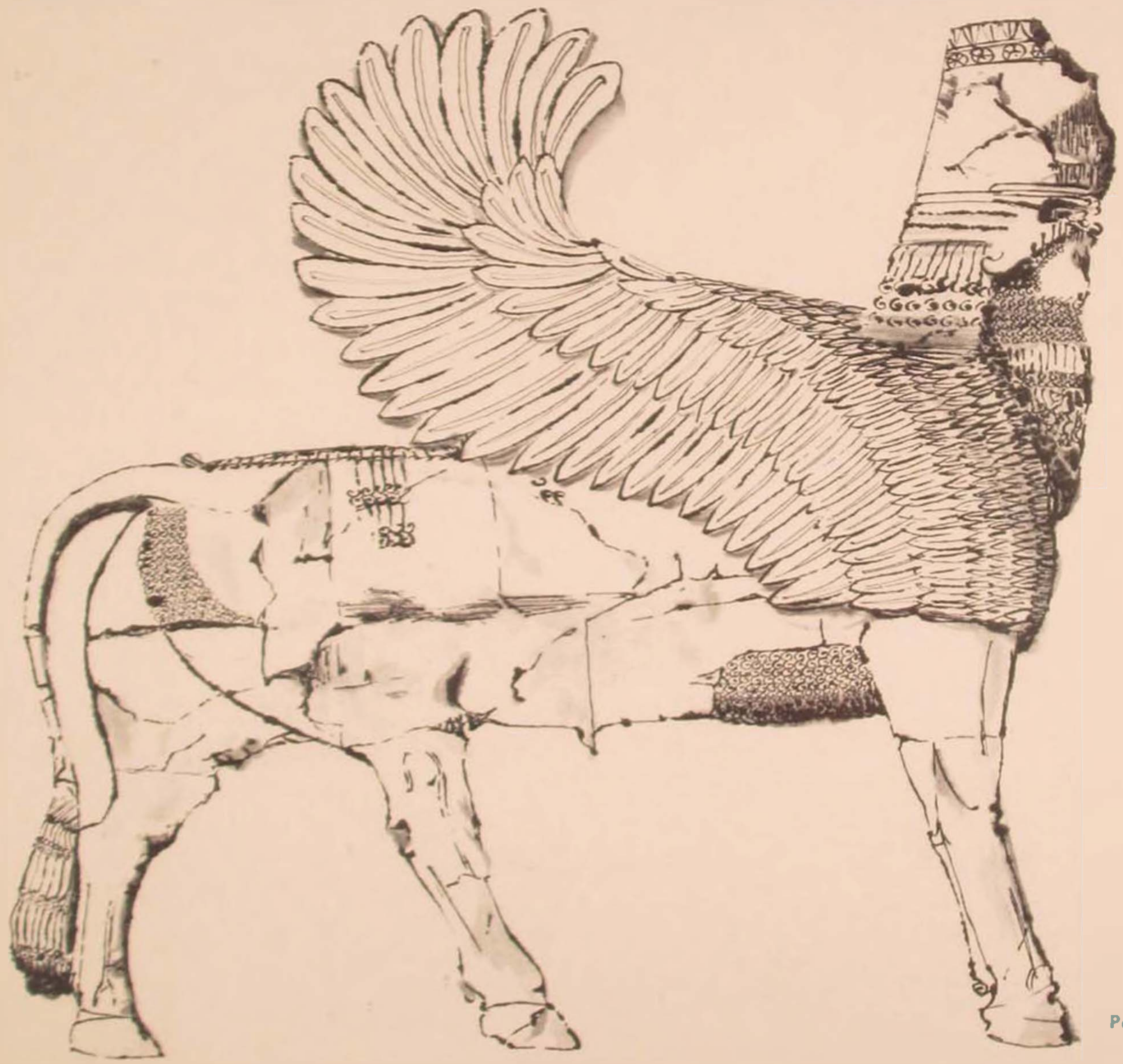

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UNITED STATES STRIKE COMMAND—STATESIDE AND GLOBAL . . . EXERCISE DELAWAR, USSTRICOM AND MATS

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