AIR UNIVERSITY REVIEW

Assault Strike, Viet Nam

AIR POWER: SOUTHEAST ASIA...THE INVADER RETURNS...COPYRIGHT & MILITARY AUTHOR

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the cover

In our concern about the day-to-day events of the limited conflict in Viet Nam, we may tend to overlook the broader implications of the role of air power in the Far East. Major General Theodore R. Milton, in his article "Air Power: Equalizer in Southeast Asia," challenges us to adopt a somewhat wider perspective in this area.

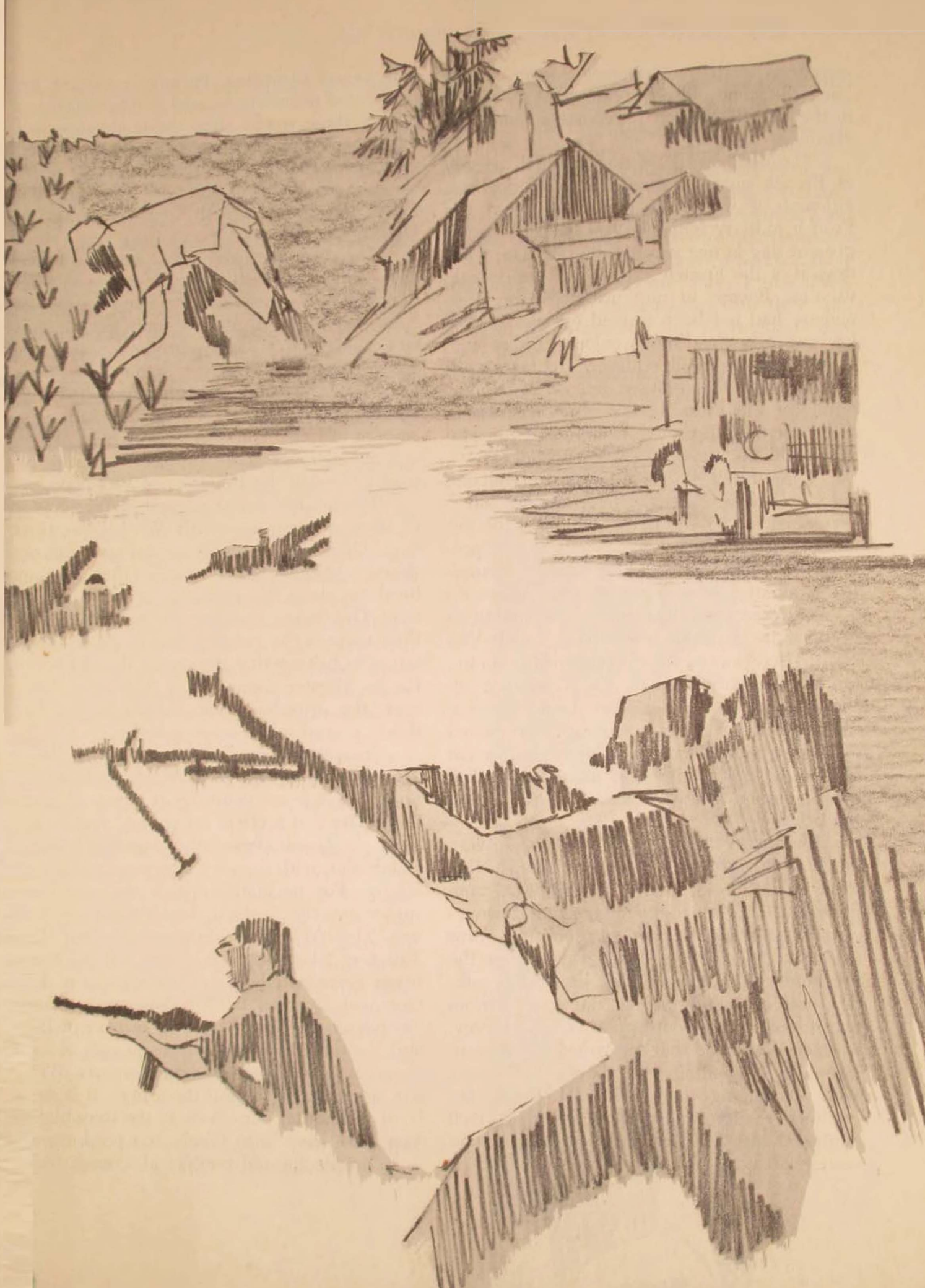
AIR POWER:

EQUALIZER IN SOUTHEAST ASIA

MAJOR GENERAL THEODORE R. MILTON

IN THE lush, green delta south of Saigon, work stops in a rice paddy as a B-26 bomber rattles by overhead. It is the same old B-26 the peasant watched in 1953. But the markings are Vietnamese instead of French, and the antagonists of record in this present war are Vietnamese against Vietnamese. Behind one side, of course, is international Communism. Behind the other, the United States.

The end of the French war in Indochina was marked by the Geneva accord, and before anyone can understand the military problems in Southeast Asia he must consider the terms of this accord. It did, of course, provide for the creation of an International Control Commission, operating under the general purview of the United Nations, chaired by the U.S.S.R. and England, and composed of military members from India, Poland, and Canada. The duties of this commission were to see that the provisions of the Geneva accord were carried out. Some nine years later this International Control Commission still functions. It is one of the more interesting sights these days at Tan Son Nhut, in Saigon, to watch the ICC



members board their ancient Boeing Stratoliner, the same old Stratoliner that TWA flew in the late 1930's, and set course serenely for Hanoi.

The accord of 1954 thus marked the end of French military dominance in Indochina, although it would be fair to say that the French military influence has lived on to the present day in one way or another. The withdrawal of the French left a very considerable vacuum. Except in rare instances, the Vietnamese had not been trained for positions of leadership in the French colonial forces and, as a result, were ill equipped to take over, without help, the military defense of the Republic of Viet Nam against either aggression or the increasingly active Communist minority within the country.

The United States provided this outside help. A Military Assistance Program, and a very substantial one at that, took on the job of bolstering the government. It was a program entirely dominated by classic ground-force thinking. Its aim was to train and equip a Vietnamese army capable of withstanding an invasion by a similar force from North Viet Nam. There was an Air Force in this program, but it was pitifully small. Overt external aggression has yet to come, but the situation in the Republic of Viet Nam steadily worsened as the Viet Cong took over larger and larger sections of the country and gained more and more support, whether voluntary or not, from the peasantry.

Finally, in the fall of 1961, it looked very much as though the government of Viet Nam itself would be in danger of collapsing from massive Hanoi-based infiltration and subversion unless immediate and sweeping measures were taken. General Maxwell Taylor, then the President's Military Adviser, brought a military and civilian group to the scene for an urgent and on-the-spot appraisal. The survey, in essence, showed that the armed forces were incapable of dealing with the kind of threat that was facing them. The Air Force, for example, though small, was reasonably well equipped with A-1H aircraft, but there was no vestige of a tactical air control system. Targets, when identified, became a subject for protracted negotiations, and it was sometimes two or three weeks after reconnaissance had located a target before permission was given to strike it. More often the permission never came. And so it was into this situation that PACAF and the Thirteenth Air Force arrived in December 1961.

The directives were clear, and the intent of the U.S. Government was even clearer. The directives were to go into the Republic of Viet Nam and establish communications, put in a tactical air control system, bring in an advisory tactical squadron, put new radars into position, build the cantonments necessary to house the troops, and to do it all in a minimum amount of time. The Administration's position was stated much more simply: it did not intend to lose in the Republic of Viet Nam.

The military scene suggested World War II all over again, and early World War II at that. Officers and noncommissioned officers stared unbelievingly at each other as they lined up, mess kits in hand, for their "C" rations. Old-timers, slogging through the mud to their tents in the evening, had to pinch themselves to believe that it was not the old South Pacific Theater come to life. This time, however, the priorities were a little higher and things moved much more quickly.

Scarcely a year and a half later the tents are almost all gone, and living conditions in Southeast Asia are generally at a pretty decent level. The first tactical air control system has been replaced, from the communications standpoint, with the very latest word in tropo-scatter. For navigational aids we now have TACAN and the Tactical Area Positioning System. The old French airdromes at Bien Hoa, Tan Son Nhut, and Da Nang are gradually being rejuvenated to modern standards. Detachment 2 of the 1st Air Commando Group has been in Viet Nam since December of 1961 and has now flown literally thousands of missions with its Vietnamese counterparts. Without attempting to detail them here, it is sufficient to say that our efforts in the Republic of Viet Nam have been timely and productive.

Outside the old borders of French Indo-

china, but essential to our military position in Southeast Asia, is Thailand.

There are few better places for an airplane buff than the flight line at Don Muang, Bangkok's big and only airport. Any day he can watch the international jets of 21 flag carriers—Lufthansa, Quantas, Garuda, Pan Am, United Arab Airlines, Cathay Pacific, and more. In between the comings and goings of the international traffic, our observer will see USAF F-102's on daily routine air defense scrambles and, from time to time, RF-101's. The Thai Air Force is flying F-86F's, F-86L's, and assorted transports and trainers. Across the runway he will see a C-46 taxiing out to take off for somewhere. C-130's are always in evidence.

It is a scene—here at Don Muang—of enormous activity. The civilian jets emphasize the commercial importance of the area. The F-102's, the F-86's, the C-46 call attention to the basic uneasiness in Southeast Asia. And the intense air traffic makes clear the importance of the airplane to Southeast Asia.

On the same flight line at Don Muang our observer will also see an old C-47 with the markings of Air Laos. The seats, while austere, are adequate, the air smells only slightly of fish oil, and the stewardess, in her Lao costume, is fetching. It is, besides, the only practical way to get to Luang Prabang.

Airports in Laos are C-47 airports at best. The one at Luang Prabang is a C-47 airport at its very worst—potholed, short, and without even the basic amenities. There are no modern air facilities in Laos, no place where jet fighters, for instance, could be based. At the same time there are few roads in Laos, and still fewer good ones. As everyone must know by now, Laos is a difficult place to get around in. What is worth remembering is that it is difficult for anyone, not just Western troops, to get around in Laos. And it is next to impossible to move military forces of any significance—that is to say, with equipment beyond that which can be carried on a man's back—without detection from the air.

In the few years before 1962 that the United States operated a Military Assistance Group in Laos, some progress was detectable in the right wing forces' capability. Not to overstate the case, the progress was modest. The Air Force, like the one in the Republic of Viet Nam, was a minor appendage to the program. When the U.S. Mission left Laos, there was not the vestige of a command and control system, and there was no reconnaissance capability. Lao pilots are able enough as stick and rudder men and have a fine disregard for in-flight emergencies. But they, and the Lao Air Force, do not represent a very great force at this time.

The two countries, Thailand and Laos, have much in common. Their languages are

very nearly the same. Their religion, Buddhism, is also the same, and over the years there has been considerable crossing back and forth across their common border, with consequent intermarriages.

The fact remains that there are more differences than similarities, at least in a military sense. Thailand is a prime base for any air activity on the mainland in Southeast Asia. The hard-core base is, of course, Clark Air Base in the Philippines. On the mainland, Thailand is the only country where we have the base complex capable of supporting a significant air effort. This base complex, together with the communications and the logistic stockpiles essential to a base complex, all represent a very considerable Military Assistance Program over the last several years. At Takhli, for example, where we keep a contingent of F-100's, we have a runway of over 9000 feet. At Korat the runway is 10,000 feet, and at Ubon over 8000 feet. Don Muang has over 10,000 feet. At Takhli, Don Muang, and Ubon we have permanent USAF contingents. Thailand, headquarters for SEATO, has also been the host country for most of SEATO's activity.

Bordering Thailand on the south is Malaya, a pleasant country of jungles and plantations. The military power to meet external threats is supplied by the British Commonwealth. The Far East Air Forces of the RAF have two splendid air bases, Butterworth in Malaya and Tengah in Singapore, capable of taking anything, including century-series fighters.

Cambodia, on Thailand's eastern border, is determinedly neutral. From a military standpoint it would be a very great help to the overall military situation in Southeast Asia if Cambodia were in one way or another an ally.

To the south of these countries of mainland Southeast Asia lies Indonesia, a huge and unaligned country equipped with more modern hardware than any other Southeast Asia nation.

And to the east lie the Philippines. Without the fortunate circumstance of our base in the Philippines, we could not have carried out the very extensive support of Viet Nam and Thailand in the past two years—certainly not, at any rate, in the time we were allowed.

If we include in our definition of Southeast Asia just these countries—Viet Nam (North and South), Laos, Thailand, Cambodia, Malaya, and the Philippines—we have a very big area. Adding Burma, Indonesia, and, of course, Borneo, makes it an area equal to about half the size of the United States. It is an area of poor surface communications, of mountains, swamps, and jungles. The countryside in that part of the world has not changed since World War II, and foot soldiers, for all their fine new air mobility, are essentially no better equipped to fight in an impenetrable jungle than they were in the days of Merrill's Marauders.

THE AIR operations of the past two years have, by lessons in the field, reaffirmed concepts for the use of tactical air that were developed from experience in World War II and the Korean War. They have also exposed several bogus ones. Let us deal with the valid lessons first.

First of all, the airplane is the equalizer in Southeast Asia. Whether you are fighting lightly armed guerrillas or contemplating a more ambitious conflict with a trained and fairly well-equipped force, such as the Pathet Lao, you must base your tactics on the use of air power. Without it you cannot move, you cannot see, you have no logistics. Without air power you are, in spite of your spectacular weapons, in worse shape even than guerrillas with homemade rifles. Their advantages in knowing the language and the terrain and in being acclimated offset your firepower advantages. This is not to say that the airplane solves all problems. It does not, by a very long shot, but it is essential to the solution of the problems. And it has to be used with considerable maturity. In Southeast Asia this maturity has not always been in evidence.

Two years ago air contributed very little to the struggle in the Republic of Viet Nam. There was no tactical air control system, and

thus no possibility of quick reaction. Targets were selected in a misty fashion, and decisions for air strikes were sometimes weeks in coming. Once again it was confirmed that air power without a command and control system is no air power at all. The decision for massive and, hopefully, decisive aid in the Republic of Viet Nam brought the U.S. Air Force into the tactical air picture. Now, less than two years later, the machinery for the control of air power in the Republic of Viet Nam is at a very high standard. This is our second lesson. The control machinery is there and, up to a point, it works very well. It is a good system, the tactical air control system, proved and refined in two wars. In the Republic of Viet Nam it could handle a great many more aircraft than it now has to deal with. In its present structure, it could support the employment of tactical air forces in an expanded war in that area.

A third lesson is pointed up by tactical reconnaissance in Southeast Asia, which two years ago was a primitive operation carried out largely with hand-held K-28 cameras. The RF-101's have clearly established the value of —the absolute necessity for—sophisticated, professional aerial reconnaissance in any sort of military operation in Southeast Asia. In this part of the world, intelligence is hard to come by. Aerial photographs, interpreted by knowledgeable and usually native photo interpreters, are a prime source of intelligence. It takes good cameras and expert pilots to get these pictures. This is one thing that we have learned or, if you prefer, proved again.

The fourth lesson, one which has been brought home time after time in the past three years, is the essentiality of Clark Air Base in any important military undertakings in this part of the world. It was comforting and quite obviously impressive to our allies in SEATO to see F-100's from Clark landing at Takhli in Thailand only five hours after the order to deploy had been given. The support, the planning, the very construction of our cantonments on the mainland have all depended, to a very great degree, on our base here in the Philippines. Beyond that, it is hard to know, in this volatile area of Southeast Asia, where the next trouble may come from. We cannot afford to disperse our resources too thinly. We are extremely lucky to have, secure from any insurgency problems and with no troublesome

borders with other countries, a close friend in the Philippines. Our base here has made the difference in our ability to react anywhere in Southeast Asia.

There are, unhappily, other less solid theories that are also being certified in the sometimes artificial laboratory of the Republic of Viet Nam. The war in the Republic of Viet Nam remains essentially, of course, a war between the government of that country and the Communist insurgents. But we are deeply committed, and our own people are being killed. Beyond that, equipment and, more significantly, some theories are being put to a test—presumably the ultimate test of actual combat.

THE ACTIONS that we have taken in the Republic of Viet Nam, as I have said earlier, have been both timely and effective. So long as this war can be confined to the borders of that country and remain a counterinsurgency campaign, it would be hard to find fault with anything we have done. The danger lies somewhat deeper.

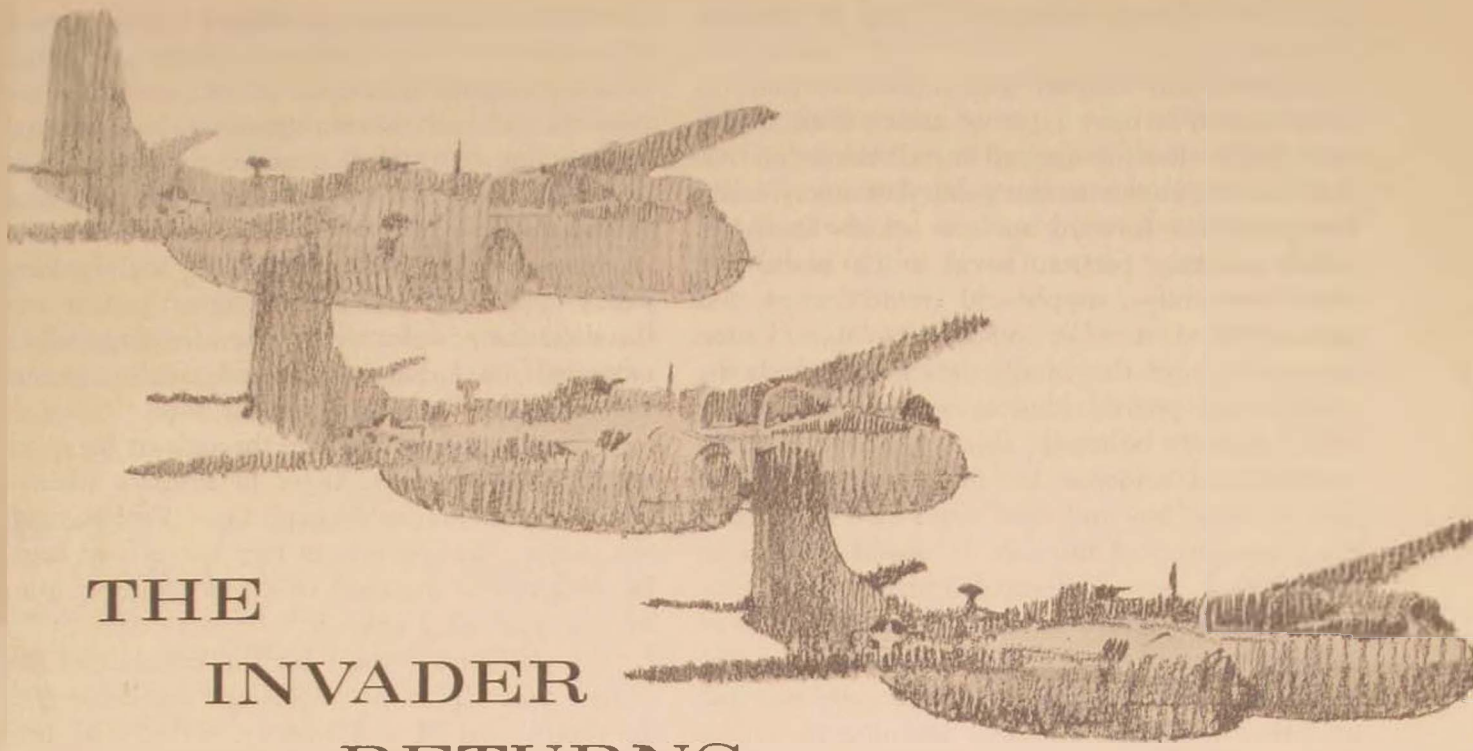
The Republic of Viet Nam, from the military standpoint, is essentially an artificial situation. The opposition, until now at any rate, has consisted of poorly armed although fiercely determined Communist-led guerrillas. So long as the opposition remains fairly primitive, without a genuine antiaircraft capability, to say nothing of any air capability, we can do pretty much as we please. In fact, it would not be hard to imagine the old observation balloon as being a likely counterinsurgency weapon.

But we must not get too bemused with a situation where the only hazard to our aircraft comes from small-arms fire. If we are not to suffer the same eventual fate that has overtaken other air forces that learned their lessons in artificial situations—and here I refer for example to the Italians in Ethiopia, the Germans in Spain—then we would be wise not to mistake success in this operation for proof that slow-flying, low-flying aircraft, either fixed or rotary wing, will survive against even moderately advanced opposition.

The borders of Cambodia, Viet Nam, and Laos appear on the maps, and, to an extent, they actually exist. But if one day, in response to our increasing success in the Republic of Viet Nam, we should find ourselves faced with "volunteer" troops of the Pathet Lao, China, or North Viet Nam, we should be prepared to operate once again as a tactical air force—without any painful, unlearning period as we transition back to present-day aircraft. Insurgents are not by choice poorly armed. It is entirely within the area of the possible that they, in some future campaign, would include defected elements of well-equipped regular forces.

We should stay flexible, and certainly we should maintain an open mind as to the tactics and techniques needed to defeat the enemy of the moment. But we must not allow these tactics and techniques to take on too much importance in the shaping of our force structure or the design of our new equipment.

Hq Thirteenth Air Force



THE INVADER RETURNS

COLONEL ROBERT D. JOHNSTON

IN A modern air age when jets fly faster than the speed of sound, encircle the globe in brief hours—when outer space vehicles are changing Buck Rogers fantasies into science reality—a comparatively medieval aircraft, an inveterate veteran, is again doing valiant service in the time of its second resurrection. This old warrior, modified and patched for its latest role as a counterinsurgency weapon, is the Douglas B-26 Invader.

birth of the Invader

The B-26 began its career as the A-26, an "attack bomber." The Douglas Aircraft Company began design of the plane for the Army Air Forces in January 1941, intending to incorporate in it the best features of the A-20, which then equipped the AAF light bombardment squadrons. Especial attention was given to developing greater range and heavier bomb load, in which characteristics the A-20 had shown its deficiencies during the early operations in the Southwest Pacific. The resulting A-26, aptly called a "hopped-up, tough big brother" of the A-20, proved to be the fastest, most versatile, and deadliest medium bomber developed during World War II.

To meet the Air Force specifications set forth in 1940, Douglas undertook to prototype three experimental models: (1) a light bombardment attack plane, (2) a night-fighter modification, and (3) an aerial destroyer mounting a large-caliber cannon. The A-26 was test-flown 10 July 1942 and went into production in September 1943. It first appeared in combat in 1944. By May 1945 six A-26 groups were committed to overseas theaters, and acceptances of the airplane reached almost 2500 by August 1945.

Early in WW II the usefulness of current attack aircraft, both Allied and enemy, tended to become limited as increasingly effective defense was brought about by improved fighters and ground weapons. As a counterbalance, the Air Forces needed a fast, light bomber with exceptionally heavy firepower and capable of operating

efficiently both at treetop level and at medium altitude.

Specifically desired was a plane to perform a half-dozen or more types of attack missions, all intended to destroy ground installations and immobilize the enemy to the point that a way could be paved for forward surface action. It would attack landing parties, naval craft, mobile or encamped troops, supply and ammo dumps, and moving trains. In order to survive in these varied missions against the deadly defense of which the enemy had proved himself capable, the plane would have to be tough, able to withstand heavy gunfire, and armored for its crew's protection. It had to fly "low and slow"—and then faster than the top fighters of the day. It would have to be armed with heavy offensive and defensive gunfire and carry great bomb loads long distances. Finally it had to be mass producible, and quickly. When the A-26 experienced delays early in 1942, at a time when the AAF was planning to replace all other medium bombers with it, General Arnold insisted he wanted the Invader "for use in this war and not the next."

The Invader was born of these needs and specifications, and the skill, foresight, imagination, and genius of many military and civilian agencies assisted in its birth. Among the many attributes claimed for it were the range of a very heavy bomber, the bomb load of a heavy bomber, the maneuverability of an interceptor, and the speed of a fighter.

An all-metal midwing monoplane powered by two Pratt & Whitney R-2800 engines, the A-26 Invader had a combat weight of 35,000 pounds and an airspeed of 360 miles per hour—more than 60 miles faster than other medium bombers. Its combat range reached 1000 miles with a two- to four-man crew, depending on whether the bombardier's nose and the rear gun position were installed. It was formidably armed with eighteen .50-caliber machine guns and fourteen 5-inch rockets, and by use of the bomb-bay and wing racks it could carry ordnance loads up to three tons, varying from fragmentation to 1000-pound demolition bombs. Overall length was 51 feet 3 inches, and maximum height 18 feet 6 inches.

The Invader's wings were of two-spar, full-cantilever, laminar-flow construction, with a 70-foot span. The fuselage was shaped and reinforced by aluminum ribs. Each of the two Pratt & Whitney engines developed 2000 horsepower for take-off, and each was equipped with an internal single-stage, two-speed, gear-driven blower. The Hamilton Standard full-feathering, three-bladed propellers were 12 feet 7 inches in diameter. The landing gear was fully retractable and hydraulically operated. A specially designed feature was the dual-slotted, electrically operated flaps which extended outward and downward, creating greater lift and drag than conventional flaps.

The A-26 was designed throughout for quick repairs and engine changes to simplify maintenance and minimize "down" time. For example, the engine cowling was in two halves and could be removed or installed in a few minutes, using only a spark-plug wrench.

A profound respect for the capabilities and demonstrated prowess of this old war-horse grew in World War II and lives on today. The boys who came in low, hit hard, and got the hell out chalked up enviable records for themselves and their "carriers." As noted previously, these Invaders could dish it out, but they also could take terrific punishment and still make it home on their own power.

After July 1944 production of the A-26 mounted steadily. It was truly proving itself in the war in Europe. In their first 17 missions over heavily defended targets in Nazi Germany, the Invader groups were "on target" every time and only one plane was lost. And although in the Pacific the A-26's were mainly assigned to low-level bombing and strafing attacks, few failed to return to base.

Pilots of the Invader claim a good deal of its success was due to the plane's easy handling. One veteran of 66 combat missions, Lieutenant Colonel H. G. "Tad" Hankey, stated, "You don't get the sensation of speed until you get close to the ground." To demonstrate his point, he took his A-26 out of the 300-mph straight flight and put it into a dive over a railroad track. He pulled up at the top of the telegraph poles and hurtled down the track at a speed which made the poles one long blur. He then pulled back on the wheel and put the plane into a climb, reporting later that he had been climbing better than 1000 feet

a minute and registering nearly 300 mph *in the climb*. On reaching an altitude of 7000 feet he resumed straight flight, then feathered the right engine, and continued cruising along at more than 200 mph. While still flying on one engine, he swung the airplane across the sky in long, easy turns and then climbed to altitude with no apparent strain.

Though a latecomer, the Invader compiled a distinguished combat record in World War II and won hearty acceptance by the crews who flew it.

first rebirth of the Invader

After World War II the Invader, now redesignated the B-26 after the USAF had abolished the attack classification in 1947, began slipping into oblivion like an old hero laid to rest. It was pickled, preserved, and put in storage. Although it had committed itself valiantly the Invader was being supplanted, supposedly, by the lightning jet aircraft of the future which were writing history in the skies.

Then came the dark days of the summer of 1950 and the advance of the Communist North Korean army into South Korea. Without question air power provided the decisive force which enabled U.S. and U.N. ground forces to retain a foothold on the peninsula. But in the thinly nourished postwar USAF modern aircraft were desperately short. For months to come the war had to be fought with the leftovers of World War II. Fortunately there were thousands of aircraft in pickled storage, among them many hundreds of B-26's. Dozens of others were found on almost every base, where they served for logging flying time or fast administrative flights.

The time was ripe for the resurrection of the old Invader. Off the air bases and out of the boneyards they came, first in a trickle, then in a steady stream as crews could be retrained and the aircraft restored to combat condition. Much praise is due the maintenance and production technicians on the aircraft lines at Ogden Air Materiel Area, Hill Air Force Base, Utah. During the Korean War years they reclaimed and reconditioned more than 1000 B-26's, averaging delivery of 18 to 20 aircraft a month to the combat lines.

The reconditioning was by no means routine. These B-26's that came off the production lines at Ogden AMA were recognizable as the sturdy, reliable, maneuverable old war-horses of WW II but "beefed up," revamped, and modified to meet the needs of the new "limited" war. The ingenious inventiveness of the work force at Ogden AMA brought many types of Invaders off the lines —reconnaissance, photographic (both day and night), night intruders, fighters, tow-target planes, and light bombers, all specially equipped. One unusual modification was a B-26 equipped with loudspeakers which, from one mile up, blared anti-Red information over the enemy lines.

Although the "MIG Alley" duels between the USAF Sabrejets and the Soviet-built MIG-15's received the attention of the press, it was aircraft like the Invader which applied direct pressure to the enemy on the ground, taking a tremendous toll of enemy manpower and equipment and ultimately making an armistice possible. Tales of the daring and successful night-intruder attacks by the Invader are legion, as are also its successes in interdiction missions and in dropping delayed-action parademolition and parafragmentation bombs on targets not requiring saturation bombing. The Korean communications system was widely scattered and offered few targets worthy of large groups of fighters or bombers. The Invader and other low-flying, slower planes were employed in relatively small numbers in seeking out and destroying Communist bridges, trucks, trains, barracks, and supplies. The "special purpose" paramunitions were parachuted from B-26's with deadly accuracy during daylight hours, and B-29 Superforts often dropped flares for the B-26 night intruder sorties. Their use in this conflict prevented excessive loss of personnel and equipment on the low-level strikes required for the small targets. They lent high morale and confidence to the aircrews.

in storage again

The years after the Korean conflict saw the appearance of the giant long-range jet bomber

and the sound-barrier-breaking jet fighter. The validity of professional opinion that the prime defense requirement was a capability for successful delivery of nuclear bombs or warheads on the enemy could not be denied. The emphasis in national defense policy was of necessity on the building of a modern force of long-range, strategic nuclear bombers and nuclear-tipped ICBM's. Powerful auxiliary ground and naval forces were also maintained against the prospect of limited war, other Koreas, perhaps more than one at a time.

In later years, in view of the inroads that Communist-inspired revolts, insurgencies, infiltrations, and guerrilla attacks were making, a careful restudy of our defense posture confirmed a need for special forces, equipment, tactics, and strategies in the realm of counterinsurgency (COIN) operations. While assuredly not wanting or intending to fight in all the free world's counterinsurgency battles, the United States armed forces recognized that they must lead materially in shaping the local struggles against Communist aggression. All-out efforts were bent toward training, advising, supplying, and equipping those who need help in effective COIN operations. Yet while United States policy dictates that American forces will not be committed to COIN engagements, the USAF could be called upon to fill in with air capability during the interim of development of adequate indigenous forces within the friendly nations.

the Invader's second rebirth

Recognizing that it had an aircraft which could meet the need and cope with the unique characteristics of COIN warfare, the United States Air Force early in 1961 again decided to resurrect the war-weary old B-26 Invader. Revamped and revitalized, this new version of the B-26 is proving to be the most versatile aircraft in the Air Force's counterinsurgency inventory.

In January 1961 Ogden AMA logistics support, maintenance, and supply personnel began to rehabilitate the B-26's that were stored at Davis-Monthan AFB, Arizona. Reparable control surfaces and other spares available at Hill AFB, Utah, were made serviceable, airlifted to Davis-Monthan, and installed on the aging airframes to fix them for a one-time flight to the production lines at Hill AFB. There approximately two B-26's a month were equipped for active duty and rolled off the lines to make history once again as they had during two previous conflicts.

At Hill AFB, the B-26's were completely dismantled and reworked, an average of 11,500 man-hours being expended on the overhaul of each aircraft. Many special pieces of equipment and devices not available in the Air Force supply system were specially manufactured there or were obtained through war surplus, cannibalization, or reclamation from other B-26's and installed in these aircraft. As they came off the line completely reworked with extra armament and improved equipment installed, they were flown to Eglin AFB, Florida, where they took their place with the T-28, the C-47, and other vehicles being used for counterinsurgency training under direction of the Special Air Warfare Center there. The rehabilitation process continued on other B-26's pulled from storage, and direct deliveries were made not only to Eglin but to the Canal Zone and Southeast Asia, where intensive training of Allied crews continued in all phases of airborne operations for counterguerrilla activities.

Carrying .50-caliber machine guns in its nose, rockets under its wings, and a great variety of bombs in its belly, this revitalized B-26 was and is a natural for jungle warfare. Technicians assigned to the System Support Manager for the B-26 as well as maintenance and supply personnel at Ogden AMA have for the past two years also worked unstintingly to support special projects from which the B-26 emerged as a prime COIN vehicle in the current world hot spots. In April 1961 the 4400th Combat Crew Training Squadron, "Jungle Jim," was activated at Hurlburt Field, Florida. This unit was committed to the special training of USAF personnel in the B-26 and other WW II aircraft and equipment, in order to provide for liaison and supervisory functions necessary to aid friendly foreign air forces in developing combat capability with similar equipment. Advanced training of friendly foreign air force personnel was also given in the operation, maintenance, and combat employment of these aircraft. The project also provided for further development of conventional weapons and tactics

and techniques of equipment suitable to the environment of newly emerging countries.

In November 1961 Project "Farm Gate," a detachment of Jungle Jims, began furnishing support to the Invaders and other COIN aircraft deployed to areas of insurgency in Southeast Asia.

In May 1962 a 60-man detachment from the Special Air Warfare Center at Eglin was deployed to the Canal Zone to instruct Latin-American forces in all phases of counterguerrilla activity. This project, "Bold Venture," ably supported the deployment and included three B-26's for use as trainers. Typical of Air Force units using the Ogden AMA-repaired Invaders is the 6th Fighter Squadron (Commando) of the 1st Air Commando Group. The B-26 is considered the backbone of this Florida-based squadron's array of aircraft, which includes another old favorite, the T-28 Trojan.

The special features of the B-26 which adapt it to meet the unique requirements of COIN warfare will bear elaboration.

• The overall strategic aim of COIN is to win the indigenous populace to the side of the free world, and we must protect the people while winning them over. The Communist insurgents are often intermingled with the indigenous peoples, and it would be disastrous if bombs were dropped promiscuously and noninsurgents were injured. Against no aerial opposition the Invader can be relied on to fly low and slow enough to "see" its target and pinpoint its bomb drop.

• Communist-inspired insurgencies are most probable in technologically backward, newly emerging nations with poor lines of communication. Sufficient modern airfields to support sustained operations are nonexistent. The time and manpower necessary to build such airfields during critical strike periods would negate the potency of a particular strike. In the interim until VTOL aircraft become available, the Invader with its short-take-off-and-landing capabilities can be deployed in the best possible tactical disposition to counter opposing forces.

• The insurgents' lack of significant air and of sophisticated weapons and munitions creates made-to-order conditions for the Invader's optimum capabilities as a close-support, reconnaissance, and interdiction aircraft. Its flexibility enables it to operate successfully against uncertain as well as anticipated wide-range enemy capabilities.

• The Invader's low and slow flying allows its crew time to see the fleeting targets. Its two-place "four eyes" enable it to circle for successive attacks with the moving targets still within visual range. Its two engines, armor plate, and fast-getaway power protect it from the small-arms ground fire of the insurgents.

the Counter Invader

At the present time a newly configured B-26 is being flight-tested at Eglin. It has been reworked by a private contractor from specifications provided by the Aeronautical Systems Division of the Air Force Systems Command. Upon completion of flight test and acceptance by the Tactical Air Command, additional aircraft will be modified and assigned to COIN duties in Southeast Asia.

This new Counter Invader has been prototyped for the Air Force as a research and development vehicle by the On-Mark Engineering Company. The old war-proved performer has been redesigned, modified, and modernized to become an even more versatile and formidable flying weapon, specially adapted to fit the peculiar requirements of COIN warfare as today's supersonic attack aircraft cannot do.

The B-26 Counter Invader possesses a diversity of armament and reconnaissance ability. On each wing are a rocket-launcher pod, a machine-gun pod, a 750-pound bomb, and a napalm bomb. If a longer mission is called for, the napalm bomb can be replaced by a 230-gallon-capacity fuel drop tank. To effect minimum speed loss, these units are spaced aerodynamically on the wing. Adding to its firepower, three .50-caliber machine guns are mounted in each wing. The nose firing power has been increased to eight .50-caliber guns, symmetrically positioned, making for greatly increased close-support capabilities. Bombs, flares, and/or torpedoes—up to 4000 pounds—rest in the bomb bay.

In only four man-hours the eight-gun nose can be replaced with a glass nose to adapt this

versatile aircraft to level-bombing and photo-reconnaissance missions.

Special technical features designed and worked into the new Counter Invader are:

- completely remanufactured airframe
- 2500-hp water injected engines (Pratt & Whitney R-2800, 103-W)
- fully reversible propellers with automatic feathering
- dual flight controls (right side removable for access to bombardier nose)
- 6000-pound-thrust JATO installations
- heavy-duty brakes with antiskid system
- nose wheel steering
- 100,000-BTU heater
- air-conditioning for cockpit
- deicer boots
- propeller, windshield, and carburetor anti-icing system
- complete fire detection, warning, and extinguishing system
- permanently installed wingtip tanks with dumping system
- quick-change nose capability
- electric elevator trim
- two 300-amp d.c. generators and two 2500-VA inverters
- provisions for a full complement of airborne electronics, including HF, VHF, and UHF communication, VOR navigation, LF/ADF, instrument landing system, TACAN, automatic pilot, IFF coder, LORAN, marker beacon, integrated flight system, intercom system, and radars.

Following the classic guerrilla pattern, insurgencies often take place in areas where the timely delivery or emplacement of troops is virtually impossible. The B-26 Counter Invader was developed to counteract this situation. Its long-range abilities, under full armament, allow it to reach these areas; its loitering ability allows its crew to locate the trouble spot; and its distinctive and diversified armaments allow the selection of weapons suitable for the target spotted. These abilities are unique with this new Counter Invader and are of vital importance in this vicious jungle type of COIN warfare.

If carrying no external or ferry fuel, a Counter Invader can cover a 500-nautical-mile radius with full stores, loiter for one and one-half hours in the process of seeking out and destroying targets, and return to base with an adequate landing reserve of fuel. During such a mission this B-26 can carry armament weighing 8000 pounds. If external fuel is carried, the radius can be extended to 800 nautical miles.

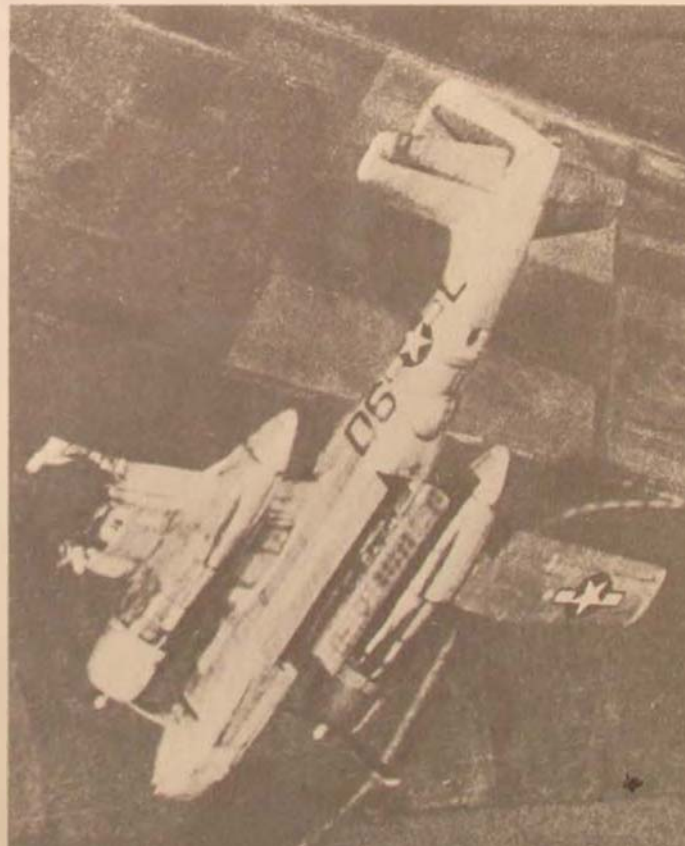
This new counterinsurgency weapon system is outstandingly capable of level bombing at altitudes to 30,000 feet, dive bombing, photoreconnaissance and electronic surveillance, and close ground support. Since it uses only proved components common to many U.S.-built military and civilian craft, its operation is simplified. By virtue of its years of tried and true service, the B-26 is no longer sensitive to the maintenance problems often inherent with new designs. It requires few special tools and little ground support equipment. The Counter Invader can be immediately available in quantity, by off-the-shelf procurement. It is capable of operation from small, unimproved airfields through a combination of low power loading, JATO, reversible propellers, and antiskid brakes, and its large, low-pressure tires permit operation from grass or unprepared fields. Truly it is a made-to-order vehicle to counter Communist guerrilla threats.

Taking a look at history past and the complexion of the present and trying to envision what may come, one can but paraphrase regarding this valiant old warrior the Douglas B-26: "Old Invaders never die—they just keep on being reborn, and reborn, and . . ."

Ogden Air Materiel Area

THE INVADER . . . PAST AND PRESENT

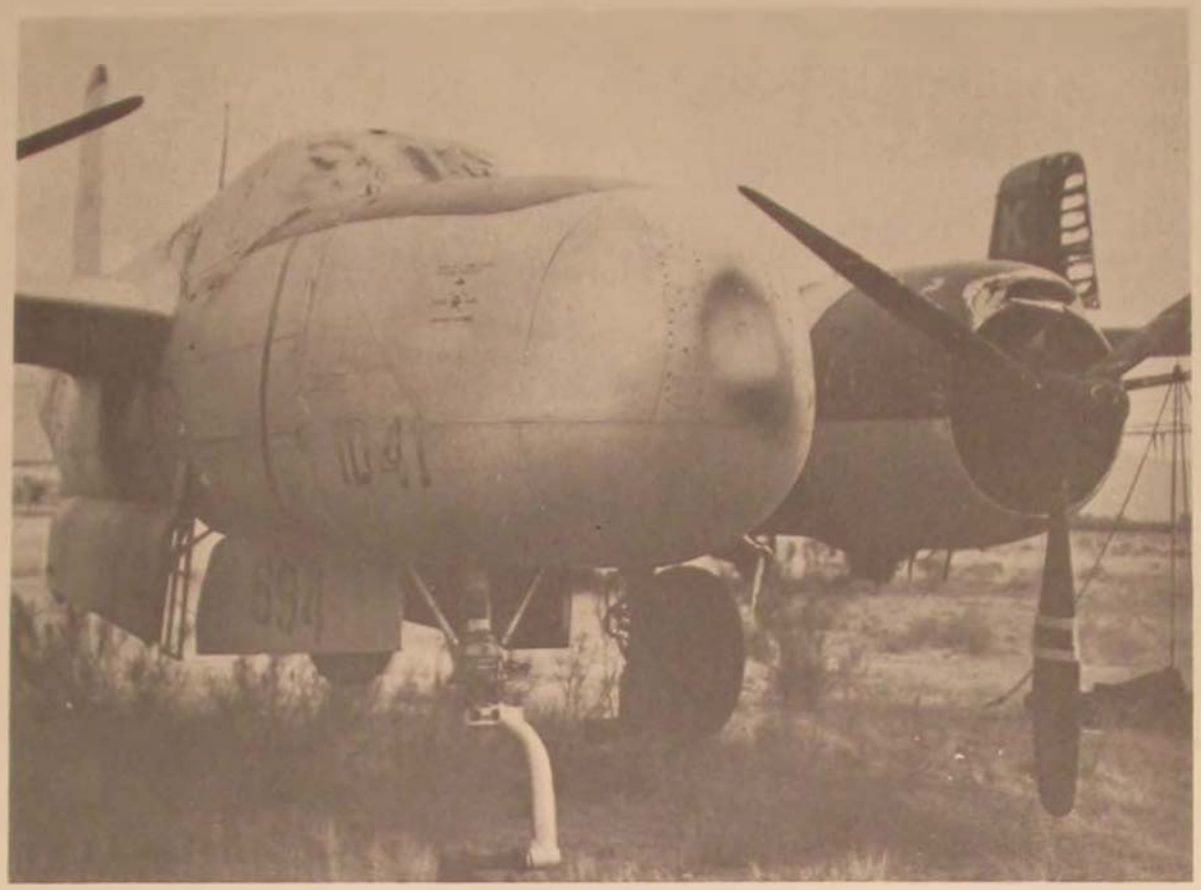
World War II. A formation of Douglas A-26 Invaders of the 9th Bombardment Division leaves a German ammunition dump in flames near Rheinbach, ten miles southwest of Bonn. Invaders harassed enemy troops and frequently separated them from their supply sources by attacking rail lines, roads, bridges, supply and ammo depots.



Death of an Invader. With bombs still in its bay, an A-26 of the 9th Bombardment Division plummets earthward after a direct hit by flak took off a wing tip seconds before scheduled bomb release over a dump in northern France.

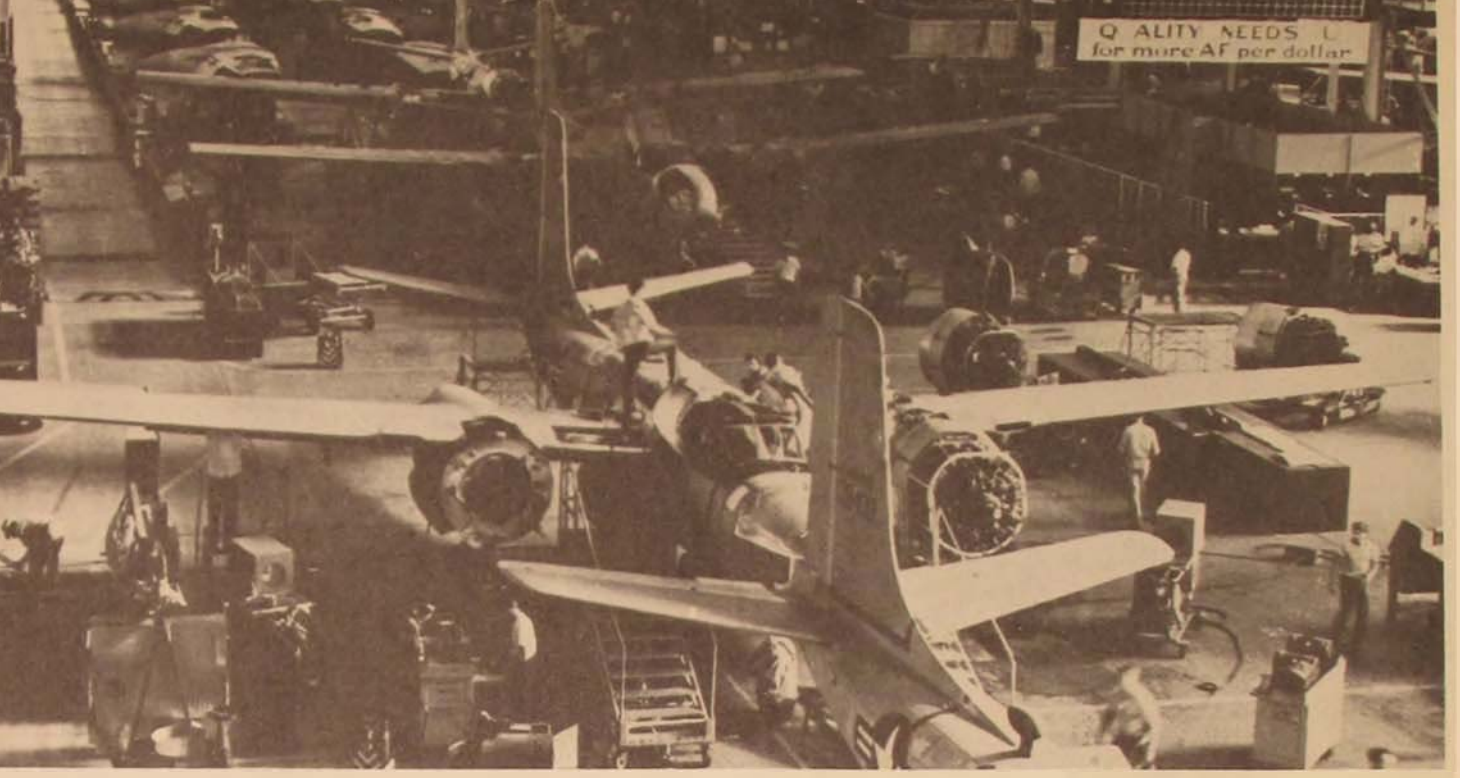
Invading Hitler's Germany. Two A-26's of the U.S. Ninth Air Force drop bombs on a Siegfried Line strong point in the path of American ground forces. Each flying day the A-26 ran missions on the Western Front in cooperation with actions by the three armies of General Omar Bradley's U.S. 12th Army Group. Note the precision of the two bombers. The twin engines and tail assembly of the second plane line up so well behind the lead A-26 as to be nearly invisible. The six bombs of the first plane are leading the following stick of six from the second bomber straight in to the target.

Pacific Invader. In the spring of 1945, with the German collapse near, A-26 units were among those redeployed from the European Theater to the Pacific via the U.S.A. to assist the anticipated invasion of Japan. One of the first A-26's to reach Okinawa was this one of the 48th Bombardment Squadron, 41st Bomb Group.



Out of the boneyard. A typically battered veteran of World War II is pulled from storage for reconditioning before being dispatched to a new war in Korea.

In storage. War-weary old B-26 Invaders (now redesignated) put out to pasture at Davis-Monthan Air Force Base, Arizona. Douglas Aircraft Company produced 2446 of these planes, and they were accepted by the Army Air Forces for service in Europe. After World War II some 400 of them were stored in the United States for use in future contingencies. Many others were allocated to USAF bases for proficiency flying.



Restoration. B-26 Invaders being rehabilitated at Ogden Air Materiel Area preparatory to combat service in Korea. The only B-26's available in the Far East at the start of the Korean War were two squadrons stationed at Johnson Air Base, Japan. Ten B-26's flown to Ashiya Air Base in western Japan for an exercise were the first Invaders to see action in the Korean War. They helped cover the evacuation of civilians and dependents from Seoul. These B-26's in their original configuration were soon followed by others that had been given bigger engines, more efficient propellers, extended nose cones, better armament, and higher load capacity for bombs and napalm. Many of them had been specially modified for night bombing operations. Altogether, the modified B-26 proved itself in Korea as a rugged and deadly offensive weapon, well worth the effort expended on it.

Combat ready in Korea. B-26's silhouetted against the mountains near Pusan await their next mission. The undispersed parking shows complete air superiority in the United Nations zone of the advance.

The hazards of winter. Snow removal crews ready a B-26 for another bombing mission. Elevators and wings were covered by improvised cloth sleeves as protection against the elements. The Invader was seldom grounded during the rigorous Korean winter.

Over North Korea. Invaders of the 3d Bombardment Wing drop quarter-ton demolition bombs on Communist territory. Deep-penetration bombing raids on supply and ammunition dumps were a specialty of the B-26, which carried 5000 pounds of bombs, rockets, 2 napalm tanks, and over 5000 caliber-.50 rounds.

Out of storage again. B-26 survivors of the Korean War are reconditioned and redesigned at Hill Air Force Base for the new Air Force counterinsurgency program. Again engines and propellers are replaced and a more serviceable and longer nose cone installed. In several new configurations, the B-26 Invader is a faster and vastly improved plane, successfully fulfilling numerous specialized missions.

Loaded for combat. The new YB-26K or Counter Invader is shown on a ramp at Hill Air Force Base, April 1963. With rockets under its wings, eight aerial machine guns in its nose, and other features which add to its firepower and maneuverability, the Counter Invader is proving an invaluable asset in the Viet Nam Air Force for COIN missions.

Attack mission, 1963. The Invader nears its third decade of combat operations.

COPYRIGHT LAW AND THE MILITARY AUTHOR

M. C. Freudenberg

THE MILITARY author today finds a fantastically increasing amount of copyrighted source material from which he may wish to draw information dealing with any subject, whether it be in an area of logistics, science and technology, medicine, administration, personnel, education, entertainment, or public relations. He faces the difficulty of determining the extent to which he can quote from or otherwise use such published source material without incurring personal legal liability or subjecting the Government to a possible suit for damages for copyright infringement. The following comments are intended to be generally informative about copyrights and helpful when copyright problems arise.

Although this treatise considers primarily the author's copyright infringement problems in works organized in words, occasional digression will make clear other areas of potential copyright infringement, i.e., drawings, music, statuary, etc.

The United States Constitution empowers Congress—

> To Promote the Progress of Science and useful Arts, by securing for limited times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.

This constitutional provision is the basis for both patent rights and copyrights as provided in the United States statutes. Before comparing these respective rights it is well to note that "Writings" as a category has been broadly interpreted so that statutory copyright protection is afforded for a variety of works of art, drawings or plastic works of a scientific or technical character, photographs, pictorial illustrations, and motion pictures in addition to the better-known categories of works which are literally writings, i.e., books, periodicals, newspapers, lectures, dramatic compositions, etc.

There is confusion in many minds between "statutory copyright" in the United States and that to which some refer as "common law copyright." The word "copyright" standing alone usually refers to the right created by statute in a published work. In the United States the common law right of an author to first publication of his unpublished intellectual property is recognized, but such

right expires upon general publication by or on behalf of the author and without restriction. This common law right is of indefinite duration whereas statutory copyright lasts for 28 years, with a renewal term of 28 years under certain circumstances.

statutory rights of copyright owner

The United States copyright statutes[1] define the exclusive rights of a copyright proprietor in both general terms and specific terms. These general and specific exclusive rights, to be discussed later, are the bases for legal redress to prevent any unauthorized person from copying or misappropriating the copyrighted work or unfairly encroaching upon the protected area without risking liability for infringement. Just what constitutes copying and what might be excused as a fair encroachment into a protected area will also be discussed.

Generally, a copyright proprietor has the exclusive right to "print, reprint, publish, copy, and vend the copyrighted work."[2] These words encompass the entire area of making and publishing or selling any original or copy of every copyrighted work.

Among the more specific statutory rights are the exclusive rights to translate or make another version of a literary work, and to arrange or adapt a musical work.

In the case of lectures, sermons, addresses, or other nondramatic literary works, there is an exclusive right to deliver, authorize delivery of, read or present, and play or perform the copyrighted work in public for profit or to exhibit, represent, produce, or reproduce it in any manner or by any method whatsoever. Exclusivity in this category of works also extends to making or having made any transcription or record thereof. There is indication that the words "transcription" and "record" include copies in stenographic shorthand or the like as well as any copies made by disc or tape recordings, although there has been little litigation in this area to provide a clear basis for statute interpretation.

As to musical compositions, exclusivity extends to public performance for profit. Profit in this instance is not necessarily of a direct pecuniary nature. Performance of a copyrighted musical publication in a restaurant or hotel dining room where there is no charge for admission is considered a performance for profit. Such performance is obviously not eleemosynary but is part of the total for which the public pays merely by ordering a meal, and the purpose of employing music is to realize greater profit for the establishment.[3] It has been suggested that increased enlistments because of the stirring performance of a military service band may be deemed an indirect profit to the Government.[4] Such a suggestion, however, goes far beyond the law of decided cases where the profit factor has involved attempted pecuniary gain. The mere broadcasting by a commercial radio station of a copyrighted musical work without authorization is recognized as an infringing performance for profit. So also it is a performance within the meaning of the statute to provide means for reception of a broadcast of a copyrighted work publicly, as in the case of radio receivers provided for hotel guests.[5]

Since statutory copyright can usually be acquired only after publication and proper marking of all copies with copyright notice, it will not coexist with a right existing at common law.[6] Statutory copyright is available for certain works not reproduced for sale, such as lectures, musical, dramatic, or dramatico-musical compositions, motion-picture photoplays, photographs, motion pictures, works of art, plastic works, or drawings.[7] Such works need not be published to enjoy protection of the statute. Notwithstanding that Section 2 of the copyright law states "Nothing in this title shall be construed to annul or limit the right of the author or proprietor of an unpublished work, at common law or in equity, to prevent copying, publication, or use of such unpublished work without his consent, and to obtain damages therefor," it appears that a compliance with the statute to register a copyright in a work not reproduced for sale will terminate common law rights.[8]

When a military author wishes to use material from some work which does not bear

prescribed copyright notice and when there is doubt that there has been a general publication thereof, he should not proceed with such use without either release from the author or consultation with appropriate legal counsel responsible for copyright matters. It must be kept in mind that personal liability for improper use of unpublished material may result because the law[9] which exempts a Government employee, acting in an official capacity, from personal liability for infringement of statutory copyright is not considered to extend to violations of the common law right of first publication, as pointed out later in this article.

copyright notice

According to Section 10 of the copyright statutes, a copyrighted work must bear a prescribed form of notice of copyright. It must appear on all copies of the work published or offered for sale in the United States by authority of the copyright proprietor. For certain works the location of the notice is also prescribed.

In almost every instance a copyrighted work will be marked "Copyright," "Copr." or © in addition to the year of first publication and the name of the copyright proprietor. The copyright notice in a book or other printed publication appears upon the title page or the page immediately following. The "page immediately following" is normally the reverse side of the page bearing the title.

The notice in a periodical appears upon the title page, upon the first page of text, or under the title heading. One notice in each volume of a book or in each edition of a newspaper or periodical is sufficient. Many periodicals are published with only a single general copyright notice covering the issue as a whole. Whether an individual contribution published without a separate notice is protected by the general notice ordinarily depends upon the arrangement between the periodical publisher and the author of the contribution. It is sometimes possible for the author to obtain from the publisher an assignment of copyright in the contribution. Where the contribution does not bear a separate copyright notice, however, no separate registration for the contribution can be made. If the contribution is a literary, dramatic, or musical work, the notice should appear on the first page (the title page) of the contribution.

The notice in a musical work appears either upon the title page or upon the first page of music. The notice in a motion picture should appear on the title frame or near it. For certain works, i.e., generally, graphic and artistic works, a special abbreviated form of notice which does not include the year of first publication is permissible. This may consist of the symbol ©, accompanied by the initial, monogram, mark, or symbol of the copyright owner, provided the owner's name appears elsewhere upon some accessible portion of the work.

liability for copyright infringement

In the event of infringement of a valid copyright, Section 101 of the copyright statute provides that the infringer shall be liable: to an injunction restraining infringement; to pay damages and account for profits; to deliver infringing articles for impoundment pending litigation; to deliver infringing articles for destruction; or to pay royalties for certain reproduction of musical works on records or tapes as permitted by statute. Section 104 is a criminal statute providing punishment by imprisonment and fine for willful infringement of copyright for profit.

The foregoing paragraph gives some indication of the extent of liability imposed upon private persons or organizations. When the United States Government is involved in the infringement, the exclusive remedy of the copyright proprietor, under a 1960 provision in the law, shall be by an action for damages against the United States in the Court of Claims.[10] However, prior to bringing suit, a copyright proprietor may seek administrative settlement for infringement of copyrights under a law[11] which was also amended in 1960 to authorize military departments to use certain appropriated funds to make settlement for

any infringements of copyright.

Prior to 8 September 1960 Congress had not given consent for the United States as a sovereign to be sued for copyright infringement, and a copyright owner could seek redress only against individuals directly responsible for the act of copying a copyrighted work even if they were Government employees acting in accordance with their official duties.

A 1940 court decision[12] had widespread repercussions among Government employees, making them much more aware of the rights of copyright proprietors. Two employees of the United States, who were members of the engineering staff of the Bonneville Administration, were found personally liable for damages as a result of making a negative print and twelve photostatic copies (8″ x 10″) of a copyrighted map which included some technical data. The court acknowledged that the employees were acting in what they believed to be the interest of the United States but held that their position as employees did not entitle them to the immunity of the sovereign as its agents.

A statutory amendment of 8 September 1960 added the following two subsections to Title 28, U.S. Code, Section 1498.

> (b) Hereafter, whenever the copyright in any work protected under the copyright laws of the United States shall be infringed by the United States, by a corporation owned or controlled by the United States, or by a contractor, subcontractor, or any person, firm, or corporation acting for the Government and with the authorization or consent of the Government, the exclusive remedy of the owner of such copyright shall be by action against the United States in the Court of Claims for the recovery of his reasonable and entire compensation as damages for such infringement, including the minimum statutory damages as set forth in section 101 (b) of title 17, U.S. Code: *Provided*, that a Government employee shall have a right of action against the Government under this subsection except where he was in a position to order, influence, or induce use of the copyrighted work by the Government: *Provided, however*, that this subsection shall not confer a right of action on any copyright owner or any assignee of such owner with respect to any copyrighted work prepared by a person while in the employment or service of the United States, where the copyrighted work was prepared as part of the official functions of the employee, or in the preparation of which Government time, material, or facilities were used: *And Provided further*, that before such action against the United States has been instituted the appropriate corporation owned or controlled by the United States or the head of the appropriate department or agency of the Government, as the case may be, is authorized to enter into an agreement with the copyright owner in full settlement and compromise for the damages accruing to him by reason of such infringement and to settle the claim administratively out of available appropriations.
>
> Except as otherwise provided by law, no recovery shall be had for any infringement of a copyright covered by this subsection committed more than three years prior to the filing of the complaint or counter-claim for infringement in the action, except that the period between the date of receipt of a written claim for compensation by the Department or agency of the Government or corporation owned or controlled by the United States, as the case may be, having authority to settle such claim and the date of mailing by the Government of a notice to the claimant that his claim has been denied shall not be counted as a part of the three years, unless suit is brought before the last-mentioned date.
>
> (c) The provisions of this section shall not apply to any claim arising in a foreign country.

Enactment of these statute provisions has exempted Government employees, acting within the scope of their official responsibilities, from both civil and criminal personal liability for copyright infringement.

As of the end of 1962 there had been no copyright cases in the United States Court of Claims under 28 U.S. Code 1498, so that this court's attitude toward the Government's use of copyrighted material and the application of the "fair use" doctrine in the area of Government publications or the writings of Government employees is somewhat uncertain.

This article cannot treat problems of patent or copyright infringement covered by paragraph (c), quoted above, because of the ap-

plicability of different laws in different foreign countries. However, the military author acting in the performance of official duty in a NATO country is exempted from personal liability under a provision of the NATO Status of Forces Agreement applying to activities in countries ratifying or acceding to this agreement.*

Government publications

From a practical point of view the military author should feel free to use in connection with his official duties any information available to him in publications of the Government unless the material is marked with copyright notice. There are instances where material with a valid privately owned copyright has appeared minus its copyright notice in Government publications. However, no such possibility should be permitted to interfere with the activities of the military author nor impose upon him any burden of investigating whether or not the material is wholly within the public domain.

Section 8 of the copyright law states that "No copyright shall subsist . . . in any publication of the United States Government, or any reprint, in whole or in part, thereof: . . ." However, it also states that "The publication or republication by the Government . . . of any material in which copyright is subsisting shall not be taken to cause any abridgement or annulment of the copyright . . ."

In the aforementioned statutes the term "publication" presents some difficulty in interpretation because it might appear to have dual meaning, i.e., either the act of printing and distributing, or the material being published in which the Government has a proprietary interest. One study concludes that the reference to Government publication means a published work produced by the Government, and perhaps to one owned by it, but not to the mere act of printing and publishing by the Government.[13]

In the case involving several speeches of Vice Admiral Hyman G. Rickover,[14] the Court of Appeals, District of Columbia Circuit, thought the copyright statute should be read "to refer to publications commissioned or printed at the cost and direction of the United States. These would be authorized expositions on matter of governmental interest by governmental authority." In remanding the Rickover case to the District Court, the Supreme Court failed to comment on these quoted interpretations but did criticize an Agreed Statement of Facts drawn between counsel as undetailed and loose, if not ambiguous, and woefully inadequate as a record for adjudicating the issues concerning the rights of the public versus the private copyrights in the speeches of Rickover.

Other cases have dealt with the issue of Government interest in works of Government employees and are in accordance with or at least not inconsistent with the above interpretations. A 1929 case[15] sustained the private copyright of a Government employee who was an instructor on military sketching at Fort Leavenworth. He prepared in leisure time, not as an incident of being an instructor, a text for general use including a part on military sketching. His superiors requested and received his permission to print this part as a pamphlet for limited use in instruction at the school. The pamphlet bore notice of copyright and was properly registered at the Copyright Office. The court held the pamphlet not to be a publication of the United States Government.

Interesting, but not too enlightening in points of law, is the case[16] concerning the writings of Clark of the famous Lewis and Clark expedition. Both men held commissions for this military venture, Lewis being in charge and directed by President Jefferson to keep an official record. Clark, second in command, kept unofficial notes of a similar nature although he was not under direct order to do so. Clark, at Lewis's request, sent his notes to Jefferson for perusal, and the evidence indicates the latter two considered Clark's journals as private and not of official character. These personal writings were deemed by the court not to be the work product of a Government rep-

*Article VIII, paragraph 5 (g), states: "A member of a force or a civilian component shall not be subject to any proceedings for the enforcement of any judgment given against him in the receiving state in a matter arising from the performance of his official duties."

resentative engaged in the performance of his duties and accordingly not public documents owned by the United States.

The Rickover case undoubtedly will be retried, and any new decision is apt to elaborate on the tests as to the Government versus employee rights in the area of copyright. In this case Admiral Rickover and several Government officials are now joined as codefendants. The plaintiff is a private party seeking free use of Rickover speeches on the basis that they are not properly copyrightable because of the relationship of the subject matter to Rickover's official Governmental responsibilities.

In the aforementioned study, *Copyright in Government Publications*, it is made clear that even among various Government agencies there are different views as to what is a "Government publication" within the meaning of 17 U.S. Code, Section 8. Even if a narrow definition in terms of works prepared for the Government by its employees in the course of their official duties is attempted under the existing law, there remain some areas within this definition where it seems practical and even desirable that copyrights should be obtainable by or on behalf of an employee.

Private publication of works produced for a Government agency, with copyright notice in the name of the private publisher, may be preferred over publication through Government facilities for several reasons, and there are apparently instances where this is being practiced. Private publication may be more expeditious, it may provide an edition of higher quality, a private publisher may cover a particular market more effectively thereby achieving widest preferred dissemination of information, and the private publisher will bear the cost of printing and distribution. Private publishers may be hesitant to assume such costs, however, unless they can obtain copyright proprietorship. Of course the Government interest in such instances should be protected by retaining or obtaining complete freedom to use or publish, and in some cases sell, the copyrighted material for Government purposes.

It can be argued with considerable merit that an employee has a right to secure private copyright in a work related to his official responsibilities when the employee has made a substantial or significant contribution to the work on his own time or outside of his official responsibilities. Efforts by an employee outside of his official duties and warranting private copyright may even be in the nature of a revision or reorganization of some official work where there is a recognizable literary or editorial contribution by the employee. Such private copyrights are particularly desirable when the copyrighted work might not otherwise be disseminated to the public. Most such situations can be readily distinguished from the case[17] holding that a copyright obtained by a Department of the Interior employee on a map was held in trust for the United States Government since (1) the map was related directly to the employee's work, (2) it was made with materials and information furnished by the Government, (3) it was printed and engraved by a division of the Department of the Interior, and (4) there was no evidence that the preparation of the map was not done on Government time.

copyrightability and use of copyrighted work

Since copyright appears to subsist in some source material, the question arises as to how and in what manner sources may be used without incurring liability to the copyright owner. Two principal categories of source material may be used without copyright liability. They are (1) material which is not copyrightable under the law and (2) material the use of which may be defended by assertion of the "fair use" doctrine. Neither of these categories is well defined, although there are hundreds of cases that tend to serve as guides for definition.

Merely determining that a work bears proper notice of copyright does not establish that the copyright proprietor enjoys an exclusive right to all parts of the work. Generally the copyright extends to an original manner of expression in the work rather than to the general subject matter treated by the author. The

protection afforded by copyright will not permit an author to withdraw basic ideas or conceptions from use by the public, thus depriving the public of the opportunity of achieving greater intellectual heights or activity in new intellectual areas.

If an author could, by copyrighting his work, withdraw ideas or information from the stock of materials available for other authors, each copyright would restrict literary and artistic development in science, fiction, history, and other areas of literature and the fine arts to the detriment of, rather than to the benefit of, the public.

The Supreme Court has said, concerning the extent of protection under a copyright, "Where the truths of a science or the methods of an art are the common property of the whole world, any author has the right to express one, or explain and use the other in his own way."[18] In this case there was no question but that the defendant had copied from a copyrighted treatise dealing with a system of bookkeeping, but the alleged infringer made a different arrangement of columns and used different headings. The court held here that the copyrighted book on the bookkeeping system was not infringed by a similar book using a similar plan which achieved similar results.

As indicated above, the decisions stress that copyright protection extends only to the manner of expression rather than to the plot, theme, idea, or thought expressed. However, Weil in his *Law of Copyright* goes a little farther in summarizing the law to be that where "there are truly original thoughts embodied in the work—not merely in the expression of thought, but *in the thought so expressed*, then copyright exists in such *intellectual creation throughout. The scope of copyright is, then, always measured by the extent of, and nature of, the original work embodied in a creation.*"[19]

A copyrightable work must be original in that the author creates it by his own skill, labor, and judgment. Even though a work contains noncopyrighted matter dedicated to the public, a copyright thereon is valid as to the new and original matter, and the degree of protection afforded by copyright is measured by what is actually copyrightable in the publication and not by the entire publication.[20]

Whether or not a particular part of a copyrighted work is copyrightable and thus protected is a question of law rather than one of fact. This was pointed out in a recent case[21] holding that bold statements of fact in a consumer magazine relating to testing and rating of dishwashers could hardly be stated in any different fashion and that such statements did not have any original literary form which would entitle them to copyright protection. On the other hand, this same case also pointed out that whether the defendant's use was "fair use" and whether there was proper copyright notice on the plaintiff's work were questions of fact.

One notable exception to the concept that mere facts are not copyrightable is found in compilations such as telephone directories, city directories, and similar efforts where there is no original literary technique or unique mode of expression involved. The courts respect the efforts of the author by preventing another from taking unfair advantage of a previous author's work rather than putting forth the same effort to make a similar compilation. If a similar or even identical compilation is made by independent effort, there can be no copyright infringement.[22]

Even if a copyrighted text is known to contain data copied from public lists such as those in public files of federal, state, or local governments, there may have been sufficient independent effort on the part of the author in organizing the material, rather than merely copying it verbatim, to warrant protection.

Historical facts are not copyrightable per se, nor are errors or misleading statements appearing as facts in published historical accounts.[23] The use of such misinformation has been urged as evidence of infringement of a copyrighted work, but a reader has the right to obtain it and re-express it in his own way.

News has no semblance of any kind to literary property, and the owner of a copyrighted report of a news event may prevent its appropriation, but the public is not to be

deprived of knowledge of the event. Others may develop a similar report, even using as a guide the earlier report. This conserves all interest of public policy, and no burden is imposed on the later user except to make no unearned profit at the expense of the first reporter. In a case involving competing news services, the taking of uncopyrighted news from early editions of a competitor and selling and distributing it without any original investigation or expense was not actionable under the copyright statute but was held to be unfair competition.[24] However, the question here was not so much the right of either competitor against the public as the rights of the competitors between themselves. Since the news was published, no right of first publication remained, and for the most part the news releases were not protected by statutory copyright. Therefore the court resorted to tort law of unfair competition to protect the property rights of the parties.

In holding a news account of Germany's submarine fleet in 1917 to be protected by copyright, a court gave the following test to distinguish copyrightable authorship and literary quality and style from noncopyrightable recitals of news or facts. "It reveals a peculiar power of portrayal, and a felicity of wording and phrasing, well calculated to seize and hold the interest of the reader, which is quite beyond and apart from the mere setting forth of the facts. But if the whole of it were considered as stating news or facts, yet the arrangement and manner of statement plainly discloses a distinct flavor and individuality of expression peculiar to authorship, bringing the article clearly within the purview and protection of the Copyright Law."[25]

Courts will not lend their aid to protect authors of immoral works.[26] In determining whether a work is indecent or immoral, some courts have adopted the tests laid down in cases arising under the Postal Statutes[27] denying mailing privileges to indecent works. Under those statutes the work must be considered as a whole and have a direct tendency to corrupt morals. Mere vulgarity or coarseness of language does not condemn it.[28]

Blank forms used in bookkeeping or charts used with mechanical instruments are not intended to communicate facts or ideas and are not copyrightable.[29] Articles intended for practical use in cooperation with a machine, mechanical devices used in production, gestures or motions of actors, movements of a dance or a spectacle, and mere arrangement of a musical composition apart from the original composition itself are not copyrightable. The property rights in an arrangement may be recognized, however, if it consists of unique elements which combine to produce a finished product which has a being or distinctive existence of its own.[30]

To try to elaborate further on copyrightable items is perhaps futile because there is a grave danger of misleading the reader as to the fine line between copyrightable and noncopyrightable material.

fair use

"Fair use" has crept into the law of copyrights from judicial decisions using this term to encompass an indistinct area wherein use of copyrighted material has been deemed to be justifiable without liability on the part of the user notwithstanding that there may have been actual copying. Probably the area of "fair use" will never be set out in the copyright statutes because of the difficulty of putting into words a workable definition having the requisite elasticity.

As a legal concept there are different points of view as to whether "fair use" is really no infringement at all within the spirit and intent of copyright law or whether it is an infringement which is justified and for which there should be no cause of action by a copyright owner. The first view would seem to be preferred, particularly if the military author is involved in any correspondence regarding the use of copyrighted matter to avoid any record which might be evidential as an admission against interest, i.e., correspondence should not contain any statements or implications that a contemplated use appears to be, or may be, an infringement.

As case law has developed, the bounds of this doctrine of "fair use" have continually changed, and the scope of the doctrine has varied depending upon the type of copyrighted works. The doctrine has wider application in the areas of science and education than in the area of the purer artistic creations.

Fair use accounts in part for the fewer law suits concerned with infringement of copyrights in the scientific and technological fields than in other literary fields. Of course it is also recognized that many copyrighted scientific works are published with the primary aim of achieving personal prestige by contributing to public knowledge with full reward by way of professional recognition rather than pecuniary reward by copyright licensing or enforcement. Another factor in minimizing copyright litigation in the technological fields may be the statutory protection afforded by patents. In this latter instance an inventor may obtain his reward by patent licensing and will benefit by unrestricted dissemination of information regarding his invention. Similarly commercial gain by sale of products or services may be enhanced by unrestricted publication of information concerning them.

Because of the desire for professional recognition by authors, military writers should give credit for material taken from another's work, particularly when it is copyrighted. The presentation of any copied matter as original is not "fair use" in the opinion of both literary men and the courts. "The want of acknowledgement or denial of indebtness is a very strong indication of an animus furandi, and excludes the question of fair use, or lawful abridgement. . . . Mere honest intention on the part of the appropriator will not suffice, . . . as the court can only look at the result, and not at the intention in the man's mind at the time of doing the act complained of, and he must be presumed to intend all that the publication of his work effects."[31]

Even though a book contains material which is proper subject for copyright, a part of it may still infringe the copyright of another. Such facts may affect the remedy available against an infringement by a military author in the case of a private publication that is not a part of his official duties. Depending upon the facts, the severity of an injunction against publication may be assessed, in addition to damages. Of course, no injunction will lie against publication by the Government because of the provisions of 28 U.S. Code 1498.

In 1841 Justice Joseph Story enunciated in the case of Folsom v. Marsh[32] several views on copyright law which have been repeatedly quoted and accepted in later legal decisions. This case involved the use of private and official letters of George Washington. The following quotations from the case are helpful guides to any author.

> In cases of copyright, it is often exceedingly obvious, that the whole substance of one work has been copied from another, with slight omissions and formal differences only, which can be treated as studied evasions; whereas, in other cases the identity of the two works in substance, and the question of piracy, often depend upon a nice balance of the comparative use made in one of the materials of the other; the nature, extent, and value of the materials thus used; the objects of each work; and the degree to which each writer may be fairly presumed to have resorted to the same common sources of information, or to have exercised the same common diligence in the selection and arrangement of the materials. Thus, for example, no one can doubt that a reviewer may fairly cite largely from the original work, if his design be really and truly to use the passages for the purposes of fair and reasonable criticism. On the other hand, it is clear, that if he thus cites the most important parts of the work, with a view, not to criticise, but to supersede the use of the original work, and substitute the review for it, such a use will be deemed in law a piracy.

A fair and bona fide abridgment is not a piracy.

> A mere selection, or different arrangement of parts of the original work, so as to bring the work into smaller compass, will not be held to be such an abridgement. There must be real, substantial condensation of the materials, and intellectual labor and judgement bestowed thereon; and not merely the facile use of the scissors; or extracts of the essential parts, constituting the chief value of the original work.

Justice Story further said:

> . . . the author of any letter or letters, (and his representatives,) whether they are literary compositions, or familiar letters, or letters of business, possess the sole and exclusive copyright therein; and that no persons, neither those to whom they are addressed, nor other persons, have any right or authority to publish the same on their own account, or for their own benefit. But, consistently with this right, the persons to whom they are addressed, may have, nay, must, by implication, possess, the right to publish any letter or letters, addressed to them, upon such occasions, as require, or justify the publication or public use of them; but this right is strictly limited to such occasions.

The copyright mentioned here would today cover both the right of first publication of unpublished letters as well as statutory copyright if the letters have been published with notice of copyright. Quoting further from Justice Story:

> . . . third persons standing in no privity with either party, are not entitled to publish such letters to subserve their own private purposes of interest, or curiosity, or passion.

It is not only quantity of appropriation but also value that is looked to. It is useless to refer to particular cases as to quantity.

> If so much is taken, that the value of the original is sensibly diminished, or the labors of the original author are substantially to an injurious extent appropriated by another, that is sufficient, in point of law, to constitute a piracy pro tanta.

The words "fair" and "unfair" seem to be the key words in many copyright decisions. Cases in which copyright infringement has been found have brought the copyright law close to the law of unfair competition. The directory, map, and dictionary cases are prime examples wherein literary effort is secondary to the fact of unfair saving of labor and expense. If a person preparing a new map should go out through a district and make original surveys and jot down his results, using the old map as a check or convenient memorandum tablet, or if in preparing a directory a canvasser should go to all addresses to be included and use the old directory as a pad or tablet rather than write out the names in longhand, no literary work would be saved, no literary property would be taken away, and no injury inflicted, except in saving a certain amount of copying and thus making the new work cheaper and easier to accomplish. In such cases infringement of copyright may depend more upon the idea of unfair competition and the unlawful saving of labor in order to avoid the necessary original research than upon the appropriation of any literary ideas or arrangement, based upon literary ability and studied plan.[33]

A paraphrase, parody, or burlesque of a copyrighted work is treated no differently from any other appropriation.[34] An extensive review of the "fair use" doctrine, its origin and application, is considered in the cases[35] holding that Jack Benny's television show burlesquing the motion picture "Gaslight" could not be defended as fair use.

The law may permit those working in a field or science or art to make use of ideas, opinions, or theories and in certain cases even the exact words contained in a copyrighted book in that field. In such cases the law implies the consent of the copyright owner to a fair use of his publication for the advancement of the science or art.[36] However, when the copying of scientific information is used for a purely commercial purpose, the mere copying of three sentences from a book has been found to constitute infringement, even when the infringer acknowledged the source of the information.[37] It was argued in this instance that the sale of the plaintiff's book, which was of a scientific character, was retarded by the commercialization of a part thereof in a cigarette advertisement. The commercialization cast reflection on the author's professional ethics. Although the official works of military authors would not be of a commercial nature, they should not use copyrighted material in any way that would reflect improperly on the copyright owner, for such use can clearly defeat a defense based upon the "fair use" doctrine.

A New York court stated that the doctrine

of fair use "permits a writer of scientific, legal, medical and similar books or articles of learning to use even the identical words of earlier books or writings, dealing with the same subject matter."[38] What constitutes a scientific document was questioned by the judge in this case. He referred to what he loosely labeled a "Sex Science Magazine—Illustrated" and said: "It is hard for me to perceive how the defendant's magazine could by the remotest possibility come within the classification of a scientific document. For instance, the article dealing with the sex problems of Mongoloid prostitutes, despite its rather imposing title, would, in my opinion, hardly aid the defendant's magazine in attaining classification as a work of science."

military regulations

At the present time the respective military regulations of the Air Force, Army, and Navy contain essentially the same recognition of proprietary interests of copyright owners. Each includes an admonition similar to that in Air Force Regulation 110-8, stating:

> Copyrighted matter will not knowingly be incorporated in publications prepared by or for the Air Force, except with the written consent of the copyright owner, or upon the approval of the Secretary of the Air Force or his duly authorized representative.

The unequivocal nature of such a regulation may raise some question as to its current practical application in view of the fact that it was drafted at a time when the personal liability of authors for the military was at stake, the Government not having consented to be sued for copyright infringement and instead exercising sovereign immunity. The cited 1960 amendment to 28 U.S. Code 1498 may ultimately be reflected in a change in regulations relating to copyright matters. Because this new law is in the nature of "eminent domain," some have urged that the policy be effected like that with respect to patent infringement wherein the exclusive remedy is also in the U.S. Court of Claims under 28 U.S. Code 1498. The Air Force does not have any prohibitory regulations regarding patent infringement but does respect any well-founded claims for patent infringement, such claims being usually handled administratively.

It is the view of this writer that the present military regulations might well be relaxed to prescribe more practical restraints for the military author, to merely preclude his use of copyrighted material except with approval of the copyright proprietor or proper military authority, whenever risk of copyright infringement is foreseen or where there is any doubt as to whether the "fair use" doctrine is applicable. Because of the "eminent domain" aspects of the law and because of the possible defense of the "fair use" doctrine to negate infringement, it can be argued that much of the red tape required by literally following present regulations might be avoided. It is understood of course that no military department can be absolved of liability for claims of copyright infringement, but such a change in regulations would take cognizance of the different status under the present law of the individual and the Government and would probably reduce the number of instances where copyright releases need be obtained.

Even the present military regulations offer no guide as to what is "copyrighted matter." It is probably imprudent, however, for any military author to assume without advice of legal counsel that any part of any work bearing proper copyright notice is not copyrighted matter, since this is a question of law rather than one of fact.

Office of the Judge Advocate General, Hq USAF

Notes

1. 17 U.S. Code, Sect. 1.
2. 17 U.S. Code, Sect. 1a.
3. Victor Herbert *et al.* v. The Shanley Co. (1917), 37 S. Ct. 232, 242 U.S. 591.
4. Piracy in High Places, Maurice B. Stiefel, 24 Geo. Wash. L. R. 448.
5. Buck v. Jewell-LaSalle Realty Co. (1931), 51 S. Ct. 410, 283 U.S. 191, 9 U.S.P.Q. 17.
6. Banks v. Manchester, 128 U.S. 244, 9 S. Ct. 36.
7. 17 U.S. Code, Sect. 12.
8. Universal Film Co. v. Copperman, 218 Fed. 582 (2nd Cir. 1914); Photo-Drama Motion Picture Co. v. Social Uplift Film Corp., 220 Fed. 448 (2nd Cir. 1915).
9. 28 U.S. Code, Sect. 1498.
10. 28 U.S. Code, Sect. 1498.
11. 10 U.S. Code, Sect. 2386.
12. Towle v. Ross, 32 F. Supp. 125, 45 U.S.P.Q. 143.

13. Study #33, Copyright in Government Publications, by Caruthers Berger, October 1959, prepared for Senate Committee on the Judiciary, 86th Cong. 2d Sess.

14. Public Affairs Associates, Inc., v. Rickover, 284 F. 2d 262, 127 U.S.P.Q. 231 (1960), later vacated by the Supreme Court and remanded, 365 U.S. 841, 132 U.S.P.Q. 535 (1962).

15. Sherrill v. Grieves (S. Ct., D.C.), 57 Wash. L. R. 286 (1929).

16. United States v. First Trust Co. of St. Paul, C.A. 8 (1958), 251 F. 2d 686, 116 U.S.P.Q. 172.

17. Sawyer v. Crowell Publishing Co., D.C. S.D.N.Y. (1942), 46 F. Supp. 471, 54 U.S.P.Q. 225.

18. Baker v. Selden, 101 U.S. 99 (1879).

19. Emphasis added in Harold Lloyd Corp. *et al.* v. Witwer, C.C.A. 9 (1933), 65 F. 2d 1, Cert. dismissed 54 S. Ct. 94, 296 U.S. 669.

20. Dorsey v. Old Surety Life Insurance Co., C.C.A. 10 (1938), 98 F. 2d 872, 39 U.S.P.Q. 92.

21. Consumers Union v. Hobart Mfg. Co., D.C. S.D.N.Y. (1961), 199 F. Supp. 860, 131 U.S.P.Q. 438.

22. Jewelers' Circular Pub. Co. v. Keystone Pub. Co., C.C.A. 2 (1922), 281 F. 83, affirming 274 F. 932, Cert. denied 259 U.S. 581, 42 S. Ct. 464.

23. Oxford Book Co. v. College Entrance Book Co., C.C.A. 2 (1938), 39 U.S.P.Q. 7.

24. International News Service v. Associated Press (1918), 248 U.S. 215.

25. Chicago Record-Herald v. Tribune Assn., C.A. 7 (1921), 275 F. 797.

26. Richardson v. Miller, C.C. Mass. (1877), Fed. Case No. 11791, 20 Fed. Case 722.

27. 18 U.S. Code, Sect. 334.

28. Cain v. Universal Pictures Co., D.C. S.D. Calif. (1942), 47 F. Supp. 1013, 56 U.S.P.Q. 8.

29. Baker v. Selden, 101 U.S. 99, 25 L. Ed. 841; Brown Instrument Co. v. Warner Register of Copyrights (1947), 161 F. 2d 910, 73 U.S.P.Q. 427

30. Brown Instrument v. Warner *supra;* Supreme Records v. Decca Records, D.C. S.D. Calif. (1950), 90 F. Supp. 904, 85 U.S.P.Q. 405.

31. Lawrence v. Dana, C.C. Mass. (1869), Fed. Case No. 8, 136, 15 Fed. Case 26, 4 Cliff 1.

32. Circuit Court, Dist. of Mass., Fed. Case No. 4901, 9 Fed. Case 342.

33. West Publishing Co. v. Edward Thompson Co., C.C. E.D.N.Y. (1909), 169 Fed. 833 (843).

34. West Pub. Co. v. Edward Thompson Co., *supra;* Loew's Inc. v. Columbia Broadcasting Co., D.C. S.D. Calif. (1955), 131 F. Supp. 165, 105 U.S.P.Q. 302; affirmed C.A. 9 (1956), 239 F. 2d 532, 112 U.S.P.Q. 11; affirmed Columbia Broadcasting System Inc. v. Loew's Inc. (1958), 356 U.S. 43, 78 S. Ct. 667, 2 L. Ed. 2d 583; rehearing denied 356 U.S. 934, 78 S. Ct. 770, 2 L. Ed. 2d 764.

35. Loew's v. C.B.S., *supra.*

36. Holt and Co., Inc., *et al.*, v. Liggett and Myers Tobacco Co. (1938), 23 F. Supp. 302, 37 U.S.P.Q. 449.

37. Holt & Co., *supra.*

38. Thompson v. Gernsback, D.C. S.D.N.Y. (1950), 94 F. Supp. 453, 87 U.S.P.Q. 238.

AIR WAR COLLEGE 1946-1963

COLONEL JOHN A. MCCANN

THE MISSION assigned to the Air War College at its founding in 1946 was "To prepare selected officers for the employment of large Air Force units to insure the most effective development of the Army Air Force as a whole and to consider the broad aspects of air power."

On the same day that Air University activated and established the new senior school for USAF and other service officers, 15 March 1946, Major General Orvil A. Anderson was assigned as its Commandant.

When the first class of the Air War College began on 1 September 1946, vacancies in the membership of staff and faculty were filled from the student body. Additional students were drafted into service on the faculty as the course progressed, so that instructors and students graduated together at the end of the first class.

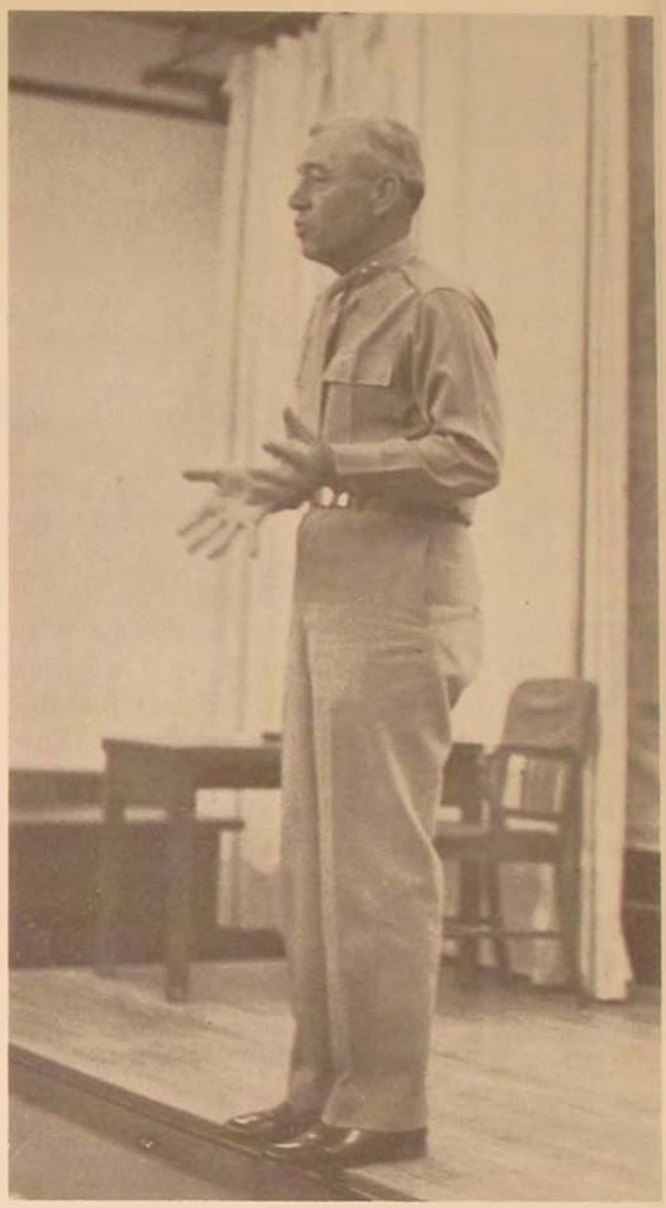
The members of the first class to attend the Air War College were, almost to a man, distinguished combat veterans newly returned from the various theaters of war where they had held critical positions of responsibility. They knew intimately the problems and strains that needed resolution in the conduct of the air war, and they were chosen to attend the new school to broaden their horizons and enhance their potential for future high command and staff assignments. The war-expanded facilities of Maxwell Field made it possible for families to join the students in residence as they pursued ten months of education relatively free from the extra duties, rank-inherent harassments, and tight schedules associated with previous assignments. The entire program of the Air War College was designed to produce an atmosphere conducive "to expanding man's comprehension and enlarging his thinking powers," in the words of the first Commandant.

"General Andy," as he was called, adopted the seminar system of instruction and instituted the principle of academic freedom, both of which are vital concepts still valid and practiced by today's Air War College. Guest lecturers, outstanding in their individual fields, were utilized almost exclusively to present the various subject areas of the curriculum. General Anderson on occasion mounted the rostrum to emphasize an idea or to analyze a concept, so that the students had the benefit of his thinking and comprehension. One graduate of that first class claims that "General Andy practically dared you not to think." This unique combination of talented headmaster, imported subject specialists, and a highly select student body gave the Air War College a distinguished inaugural.

During the ensuing three years of operation, the Air War College faculty undertook refinement and improvement of its programs. A thesis program was introduced, a reading

improvement course made its appearance, the Extension Course Division was created, and a civilian educational adviser became a member of the Commandant's staff.

Initially it was expected that the Air War College would be concerned primarily with military problems directly related to the employment of large air units. National and international affairs were not to be neglected but rather were to be accorded a supporting role. However, over the relatively few years the college has been in existence, there has been a continuous reinterpretation of the school's mission and how it should be accomplished. Particularly after 1947 it became increasingly apparent that the traditional relative isolation of military officers from domestic and international policy matters had to be discarded. The complex interservice relationships which developed, the realities of a prolonged cold war with the Soviet Union, the continued utilization of Air Force officers in nonmilitary Governmental agencies following World War II, all tended to change the emphasis on the qualifications required of senior officers for high command and staff positions. Without diminishing the requirement for instruction in pure military art, the need for raising the study of national and international affairs by senior officers from a supporting role to something approaching coequal status became evident. The task of developing sound concepts for the employment of aerospace power could be carried out only if those conducting the study had a proper awareness of the influence of political, economic, and psychosocial factors on national objectives and resultant national and military strategies.



Major General Orvil A. Anderson addressing the first Air War College class in September 1946.

Plans to revise the curriculum along these guidelines were well established by the end of the 1949–50 school year. Before the revision had progressed meaningfully, however, the Korean conflict suddenly emerged, necessitating the revision of all USAF peacetime schedules. On 20 June 1950 a teletype message from the Pentagon suspended Air War College student operations indefinitely.

During the period which followed this abrupt cessation of instruction, revision of the curriculum was carried forward, accounting for the shifts from its original concepts. This planning activity was accelerated when subsequent orders from Headquarters USAF directed the preparation of a plan for continuing Air War College instruction through the establishment of a correspondence-type course to replace the regular resident course. Somewhat later the Pentagon's indication that the resident program might be reinstituted early in January 1951, on an accelerated basis, provid-

ed additional impetus to the curriculum revision then well under way by the faculty, which had remained relatively intact after the shutdown in June.

General Anderson as Commandant of the Air War College challenged the reasoning that had resulted in the closing of the college on the basis of its lack of prudence as to USAF's ultimate welfare. He pointed out the shortsightedness of denying the Air Force the opportunity to produce, on an orderly basis, highly qualified officers because of a temporary shortage in overall officer strength. He cited the examples of the U.S. Army, which at that very time was reinstating its War College, and the U.S. Navy, which had not curtailed any aspect of its professional educational efforts. The General concluded his reclama on the school's closing by pointing out that professional military education is a critical requirement in the evolution of an effective Air Force and is essential to the Nation's security.

The General's persuasiveness, abetted by the Nation's reassurance to the managers of its military establishment in terms of manpower and money under President Truman's leadership during the Korean affair, brought about a modified reversal of the directives that suspended the college's resident program. New directives stipulated that the Air War College could conduct two courses per year of five and one-half months each. On 10 June the Air War College was notified that the normal ten months' course for the class of 1952 would be reinstituted with a commencing date of 9 July 1951.

As THE senior professional school in the Air Force educational system, the Air War College continues to maintain a graduate-level environment. Its student body is composed of a highly selected group of mature, successful, and ambitious men. The learning environment of the school is oriented toward freedom in the expression of ideas and toward making it possible for each student to pursue independent, analytical, creative thinking. The distinctive task of the Air War College is to educate senior officers in a way that will prepare them to plan and conduct future military operations in the national interest.

It has been traditional with professional military schools to prepare for war in time of peace. This preparation has become increasingly important within the past two and a half decades. Traditional military functions have expanded enormously. First, senior officers have become increasingly concerned with international affairs—with the premises of military policy, with the purposes for which military forces are used, and with the terms of reference under which they will be deployed. Second, senior officers have had to concern themselves with a greater number of military support functions. Problems such as finance, supply, research and development, public relations, manpower, and management have grown more complex and more demanding of the senior officer's time and attention. These developments have complicated the task of senior military education. In the future the problems confronting the officer in high command and staff positions will be even more complex than in the past.

A key development of our time has been the idea that national security is a function that encompasses the responsibilities of both military and nonmilitary agencies. Military agencies have thus become partners in an enterprise greater than the military alone. For example, the Communist exploitation of insurgent movements in underdeveloped areas of the world has required the United States to generate a unified national effort dedicated to the achievement of stability and conditions favoring harmonious international relations. With the passage of time this concept of national security as a Government-wide function has become increasingly explicit. This broad function is reflected in the curriculum of the Air War College, as indeed it is in all the senior military schools today. Implicit in this concept is the consideration that senior military officers and civilians will participate in the formulation and execution of diverse

national security policies and programs. This consideration will be paramount until national security itself ceases to be a concern of U.S. national policy. Such a prospect is not likely in the foreseeable future. Thus the Air War College curriculum is designed to prepare senior officers to function in the increasingly complex roles which they are required to play in American and Western society.

The Air War College does not provide approved solutions to the problems that are presented to the student body throughout the academic year, nor does it attempt to prescribe or suggest in any manner what the solu-

More than 2300 Air War College graduates—senior officers of the Air Force, Army, Navy, Marine Corps, Royal Air Force, Royal Canadian Air Force, and a few civilian Government officials—attended the school when it was housed on the "old campus."

tions should be. In general, the military problems that must be dealt with in the higher echelons of command and staff are so complex and diversified and frequently include so many intangible and elusive factors as to preclude solution by formulas or established precedents. Therefore the Air War College student and his seminar group should arrive at solutions to problems through individual study, analytical reasoning, and reflective thinking. The value of solutions will depend in large measure upon the degree to which the student or the seminar group applies orderly, judicious, and logical thought processes. In fact the basic approach to solutions of problems affecting the national interest is the avoidance of traditionalism, rigidity of thought and doctrine, standardization of instruction, and the provision of dogmatic answers to problems of the future. The Air War College is not a postwar school. It is a prewar school.

The faculty of the Air War College requires officers who are especially selected on the basis of individual background, experience, interest, ability, and potential. Generally these individuals are graduates of a senior service school or joint college at the Air War College level and of a civilian college (master degree desirable), senior officers in the grade of colonel or lieutenant colonel with considerable career potential, officers with experience in joint or major commands, and officers with specialized or technical knowledge that uniquely fits them for duty with the Air War College.

The faculty prepares and implements the curriculum and its underlying theory. However, faculty members working directly with student seminars as faculty advisers serve more as counselors than instructors. As faculty advisers they are primarily concerned with ensuring that each student fully understands his assignments and treats all elements of the course of instruction in a logical, thorough, and timely fashion. In addition to serving in an evaluative function, each faculty member is assigned to a study area in support of the mission of the Air War College, where he pursues individual professional scholarship designed to develop his capabilities and enhance his professional stature as a member of the faculty and as a senior officer of the Air Force.

The nature of the mission and objectives of the Air War College establishes the inherent requirements to increase the scope and depth of thinking and to develop in the student a capacity to treat military problems objectively and with facility and competence. These requirements, together with the high experience level of the students, have resulted in the selection of a system of instruction that emphasizes lectures and seminars as the principal means of informing the students of the current phases and problems studied in the resident program. Lectures are presented by outstanding visiting specialists, who are expected to deal, in a critical and comprehensive manner, with the central issues and problems met in each aspect of a study area. Primary emphasis in the lectures is placed upon a clear statement of the overall situation, on an analysis of major conditions and controlling factors, and on the interpretation of past experience, present trends, and possible future developments. Free and frank questioning of lecturers and joint discussion of the subject by the lecturers, faculty, and students are encouraged.

Seminars are designed to supplement the lectures and the individual research of students. These sessions afford opportunities for informal discussion in small groups and sometimes with visiting specialists on matters that relate to problems assigned to seminars. The seminars further provide students with valuable experience in conducting and participating in discussion groups, in extemporaneous presentation of ideas and viewpoints, and in analysis of problems under discussion.

Reading assignments are designed to provide the students with appropriate background and source material. They include not only a variety of commercially published materials and Government publications but also numerous reports, memorandums, and policy documents available only in Government files.

NEVER CEASING refinements have evolved the current Air War College curriculum into a planned sequence of interrelated studies. These studies provide the student with a comprehensive understanding of the nature and scope of international relations and conflicts; the formulation of national security policy; the basic concepts for the employment of military forces—particularly air forces—in general, limited, and unconventional wars; and the application of these understandings and concepts to current and future national and military strategy in the attainment of U.S. and allied objectives.

The thesis program, the major portion of the Air War College students' research activity, complements the lecture, reading, and seminar parts of the curriculum. Each student selects a problem dealing with some aspect of national defense for detailed research and analysis. The objectives of the program are to increase the individual's professional knowledge, to improve his analytical and writing abilities, and to provide an opportunity for the development of ideas or concepts dealing with significant problems of national defense. The operation of the program is flexible enough to permit each student to work at his own educational and experience level, to develop his ability to analyze a problem, and to write effectively about it. The program thus provides the Air Force with new ideas, new analyses, and frequently with a fresh treatment of old ideas.

Another enrichment program in the resident school curriculum is the annual National Security Forum. A group of prominent civilian leaders from the United States and Canada, representing the executive strata of business, industry, education, news media, publishing, professional, government, and other important fields, is invited to participate for a week with the students of the Air War College in a special phase of their instruction.

During the early spring of each year approximately thirty senior officers of the Air Reserve Forces (generals one year, colonels the next) are offered the opportunity to join the student body for an entire week. The purpose of this course is to provide information to non-active-duty Air Reserve Forces senior officers which will bring them up to date on the military aspects of our national security policy. In addition, a résumé of Air Force plans, programs, and problem areas is presented.

Additionally, field exercises are conducted each year for the students and faculty at a number of Department of Defense installations. These exercises provide a firsthand acquaintanceship with information and problems not available in textbooks or from lectures but the knowledge of which can provide a realistic conception of operations vital to the security of the country.

In recognition of the increasing importance of officers in high command and staff positions holding academic degrees in addition to having broad military schooling and experience, an off-campus George Washington University Center of the College of General Studies was created on Maxwell Air Force Base. Established in the fall of 1961, the center provides an opportunity for Air War College students, faculty, and previous graduates to further their formal academic education in off-duty hours. Courses are offered toward the Bachelor of Arts degree in the College of General Studies and toward the degree of Master of Arts in International Affairs. Both these courses are complementary to the Air War College resident program and may be pursued by individual option.

AIR WAR COLLEGE education is not confined to those officers fortunate enough to attend the resident school. By 1960 it had become apparent that a need existed to present the War College curriculum for nonresident students in a shorter course designed specifically for the active-duty senior USAF officer who could not attend the resident school. To meet this need the Extension Course underwent a series of modifications. This nonresident program was reorganized in 1962 into the Air War College Associate Program, comprised of the Air War College Cor-

Since July 1962 the Air War College has conducted its resident and nonresident programs from splendid facilities on Air University's Academic Circle, Maxwell AFB.

respondence Course and the Air War College Seminar Course. The missions and objectives in both courses of the AWC Associate Program are identical with those of the resident program.

The AWC Correspondence Course continues to offer a modified Air War College study program through correspondence methods.

The AWC Seminar Course represents a novel educational concept that offers a new methodology of study presentation for selected active-duty senior USAF officers. It combines the advantages of guided self-study with those of group discussion. Through the successful merging of group and individual learning techniques, more comprehensive and meaningful results in the understanding and appreciation of course materials are achieved. Briefly, the Seminar Course provides for the establishment of seminar groups of approximately fifteen officers each at selected Air Force bases. These officers meet once a week for 80 two-hour sessions for discussion of a modified version of the Air War College resident curriculum.

The course includes two broad areas of achievement: the seminar phase, which is a group effort directed toward a guided course of study, and the thesis program, which is an individual undertaking.

In the seminar phase, normally expected to be completed in two years, students, in addition to participation in the group discussions, are also required to make individual oral presentations to their seminars and to submit written papers for evaluation by the Air War College faculty.

The principal individual effort, a thesis concerned with some aspect of aerospace power, is introduced into the curriculum at the end of the first year of the seminar program. During the second year, students may accomplish their theses in conjunction with their seminar work and thereby complete the entire course in two years. Those students who prefer to work on their theses after completing the seminar schedule must do so within one year in order to achieve graduation.

Study and instructional materials, guidance, and evaluation are provided by members of the Air War College faculty. The text for each week of the seminar phase of the course is presented in the form of a chapter, containing all the study materials: a statement of the lesson objective, an introduction to the subject being studied, suggested topics for discussion and analysis, required readings, and a list of references for those desiring to do supplementary reading.

USAF has incorporated the Air War College Seminar Course into its permanent educational structure. Authorization has been granted to maintain 60 active seminar groups at all times. The program is worldwide in scope; active groups now include four in Europe and six in the Orient. It is expected that groups will be established in the Canal Zone and Alaska in the near future. Already the five groups begun on a test basis have completed all seminar requirements. No significant number of simultaneous thesis completions was expected of this initial test group; however, it is noteworthy that already some theses have been presented which have fully satisfied all requirements for graduation.

THE PRESENT organization of the Air War College has evolved slowly throughout the years. From an early staff of the Commandant and his assistant, with many academic divisions directly subordinate, through various intermediate modifications, the educational structure has evolved to the present organization. Serving as key members of the Commandant's staff are the Deputy Commandant, an Assistant to the Commandant who counsels on educational matters, RAF, State, Navy, and Army Advisers, and four Directors representing Administration, Curriculum, Associate Courses, and Evaluation and Plans.

As of 7 June 1963, 2618 individuals had successfully completed the requirements for graduation from the Air War College resident, correspondence, and seminar courses.

Normal size of the Air War College resident classes during the period 1956 through

1962 was 166 students. This quota was increased to 184 students for the class of 1963. The size of the current class, which began on 5 August 1963, is 277 students. Nine new members have been added to the faculty to accommodate this larger student body and to ensure quality standards expected of the Air War College.

This increase in the student body, the dynamic nature of the curriculum, the opportunity to sustain improvements through the evaluation process now in force, as well as the contributions already manifest from the Air War College Associate Program, should enable the Air War College to fully meet its mission requirements in the future. To be sure, continued achievement of USAF expectations of the Air War College will require skilled leadership, constant ingenuity, and dedicated effort, but current estimates of the situation for the near future appear most favorable.

Alumni, students, and faculty are well aware of the high honor accorded them in their selection for assignment to the finest professional military education in the Air Force. It is expected that this education should enable them to competently exert their proper influence in meeting the worldwide power challenges to U.S. national security.

Air War College

SCIENTISTS IN BLUE

Colonel David R. Jones

IN A SPEECH at the Naval Research Laboratory in 1961, Dr. Harold Brown, the Director of Defense Research and Engineering, stated a growing concern within the Department of Defense for the loss of service in-house capability in the scientific, engineering, research, and development areas. He went on to cite four "very good and clear reasons for performing research, development, test, and evaluation within the Defense Laboratories." These were, generally, to explore new ideas, to manage contract work more intelligently, to provide scientific direction to research and development programs, and to develop technically proficient officers for future operational needs. More recently the Assistant Secretary of the Air Force for R&D, Dr. Brockway McMillan,* emphasized the unique role of the military scientist and engineer and suggested some steps that could be taken to improve the career motivation and opportunities for the military officer in R&D. The purpose of this paper is to describe a laboratory in which at least some of these goals are being attained and to point out some of the administrative considerations that might facilitate the progress on in-house capability within the Air Force.

Federal defense laboratories have varied greatly, in both organization and purpose, since the Springfield Arsenal was established in 1794 to satisfy the arms requirements of a young nation. They have ranged from organizations designed to do specific tasks, like the arsenals of the Army, to those whose missions were stated in rather broad terms, like the Naval Research Laboratory. A common characteristic of all these organizations has been their reliance on civilian scientists to staff their research and development efforts. In none of the defense laboratories or research organizations was any serious attempt made to rely upon the military staff to accomplish technical work. Rather, the military members of the organizations tended to assume the role of managers or administrators.

There are some very definite reasons behind this reluctance to build up a technical staff of military scientists, but the bases for them seem to be more traditional than real. One of the most often cited has to do with the notion that every officer should be considered a potential chief of staff and therefore he should spend his time being trained to handle a broad range of problems, instead of working within the narrow confines of a specific discipline. A military officer was trained to be a leader of troops and a commander of organizations; any additional training was acquired only for its broadening influence. The working scientist in the defense laboratory was a civilian, and for the most part the military man was an administrator.

*In a speech delivered at Material Central, quoted in AF Policy Letter No. 116, February 1963.

Many present-day Army and Navy officers have received graduate training, and many are and will continue to be expert in their field, but for the most part service emphasis on career goals has precluded their pursuing these interests without frequent return to "line" duties. The Air Force has generally approached the problem somewhat differently, so that officers assigned to research and development activities are not penalized by the promotion system.

Since military scientists were neither considered for the positions nor available in sufficient numbers to fill them, the military departments have relied largely on civilian scientists to staff their research facilities under Civil Service rules and regulations. Many of these laboratories have rendered remarkable service to the country. During times of national emergency they have solved many of the Nation's most urgent and pressing defense problems. In peacetime the more appealing and satisfying work in the basic or applied sciences has tended to draw the senior scientists back to the campus or to industry, where an additional incentive could be found in a pay scale more attractive than that of Civil Service.

These same incentives are very appealing to the good young men just out of school who perform the bulk of the actual laboratory work and from whose ranks come the future research leaders of any organization. Defense contractors can afford to offer these men salaries commensurate with the going rate for their abilities.

If, in fact, it is difficult to establish and maintain a quality research effort in a defense laboratory, why must we fight the problem? Why not buy research services from nonprofit research organizations, much as we buy weapon systems? In the first place, there are rules which forbid anything smacking of control of Government funds by non-Government employees. There are also reasons to believe that the objectives cited by Dr. Brown would not be achievable through this device, particularly in the development of technically proficient officers. More than this, I believe that developing an in-house capability is fundamental to the whole problem of national defense and the operation of the military services which provide for that defense. In today's technology, decisions governing the selection of weapon systems and their employment frequently require value judgments sensitive to the defense needs of the Nation. Experience has shown that such judgments, difficult at best, are literally impossible to achieve unless competent management talent is available within the Government and the military services and then only if this talent is backed by the advice of competent, unbiased scientific talent intimately acquainted with problems associated with the defense of the Nation.

I submit that this unbiased advice can be provided only by technical talent, that is, by those who have worked in some depth on the science associated with the problem, in contrast to the hand-waving expert currently in vogue who frequently is asked to render opinions or give advice without adequate study of the problem. This should not be construed to be disparaging of the many dedicated scientists who have worked unstintingly on defense problems with as deep a sense of patriotism as any man in uniform. The Nation could not long continue in the present technological race without counting heavily on these people for technical advice. There will always exist, however, an area of decision-making in which the scientifically expert but operationally uninformed adviser is at a distinct disadvantage and in which he cannot and should not play a major role. It is this area in which there exists the greatest need for technically trained officers, proficient in both the military and scientific disciplines, who can provide the technical judgment required to meet operational needs. The more favorable environment indicated by recent pronouncements by high Government officials gives some justification for optimism on the outlook for science in the services. Dr. McMillan, in the cited speech, stated the need quite succinctly in calling attention to the very real difficulties encountered in training technically qualified officers to be the R&D leaders of the future. He pointed to the Materials Laboratory at Wright-Patterson as an excellent example of the kind of organization equipped to provide such training. And indeed

there is an impressive number of ranking R&D officers who are alumni of that laboratory.

the research laboratory's difficulties

How does one go about creating within a defense laboratory an in-house capability that will achieve the goals stated by Dr. Brown? There seem to be certain essential characteristics of a laboratory that must be present in order to encourage the growth of scientific talent. One of these has to do with the nature of the laboratory effort, another with the management philosophy under which it operates, and another with the different kinds of people required if the laboratory is to perform work of sufficient quality to justify its existence.

Since we are concerned here strictly with research laboratories operated within the Department of Defense, the type of problems which they attack and their method of operation would bear in some way on defense matters. There have been times, especially during wars, when research organizations have indeed studied problems relating in a very direct way to defense problems of one sort or another. In periods of relative peace, however, there has been a decided tendency to view such operational problems as being too shallow for good research. These defense organizations, almost without exception, have then reverted to a policy of doing research which perhaps pertained in a general way to operational problems but which in the main was oriented towards the accumulation of basic knowledge.

The conduct of basic research for its own ends can hardly be the sole justification for a defense laboratory. There are many educational or nonprofit organizations where such research is more properly performed. The argument is frequently advanced that the competence of the individual scientist of a defense laboratory to solve defense problems is enhanced by his work in basic research. Undoubtedly his scientific competence in a particular discipline is increased as a result of this activity, but his competence to answer questions on problems with which he has no daily contact can hardly be better than that of the hand-waving expert. All too often these scientists soon refuse to bother with the shallow treatment they must give such problems and learn to avoid them, thus depriving the Nation of a source of technical opinion. Basic research should occupy at least a portion of a defense laboratory's total effort, for the reason that there are frequently encountered in almost any discipline high-risk projects which might be unattractive to a university but which could yield such large rewards for defense that they must be explored. The investigation of new ideas beyond the capability of privately funded organizations is another reason. But basic research programs in defense laboratories should meet certain other requirements, such as the interchange of personnel between laboratories to avoid the "ivory tower" complex, or perhaps these programs should be confined to those fields having a direct and important bearing on the mission and capability of the service.

The proper research objective of a defense laboratory is the study of problems directly related to national defense. I do not think anyone will quarrel with the tenet that fundamental defense problems are broad enough and deep enough to absorb all the research effort the Nation can afford to apply. These problems will support fundamental research basic enough in nature to satisfy any scientist. Only by working on problems directly associated with national defense can a scientist develop and maintain a competence to provide the technical judgment needed to direct the defense effort.

But how is the research organization, specifically the scientists who make up its working body, to be made aware of national defense problems? Certainly not by working in an "ivory tower" atmosphere in splendid isolation from the real world around them, hoping that people will go away and let them carry out their own private research projects. It is a disturbing fact that weapon system developers, the engineers and hardware designers, often are so busy with the real problems associated with developing a workable system that problems vital to the performance of a new weapon system have not been considered until quite late in the development cycle. They must then be investigated belatedly at considerable ex-

pense and worry. Some system is needed whereby the defense scientist can be brought into the picture earlier.

This deficiency would indicate that there is a proper role and place for the defense laboratory within the management structure of the Department of Defense and the military services. A defense laboratory without a direct tie to the system developer and the using agency is working in a vacuum and cannot be considered as contributing to the defense effort in any real way. The defense research scientist must get to understand the details of defense systems as they may be affected or influenced by the environment of which he is knowledgeable, and he must be introduced to the problems early enough in the planning stage of the system to make the maximum contribution of which he is capable. This does not reduce him to the role of a fireman, provided an intelligent judgment is made on the scientific merits of the particular problem.

Another and far more pragmatic problem that hampers the operation of defense laboratories is the anachronistic management system, a direct carry-over from a typical military organization, which a research agency certainly is not. Most of these laboratories are operated under a hodgepodge of rules and regulations that tend to hamstring the research effort. Existing procurement regulations give very little freedom to the scientist to obtain necessary services and equipment from sources which in his opinion are best qualified to provide them at a time when they will be of most value. The defense scientist is expected to use the same supply procedures to conduct research as those used by the maintenance people to keep aircraft in commission, despite the great disparity between the two activities in their ability to predict supply requirements. There have recently been some encouraging signs of improvement in this area, but much more needs to be done.

Another source of irritation to the defense scientist is the tendency to centralize control of research activities and programs at a level inconsistent with sound management principles. Instead of exercising broad control by specifying objectives and then providing funds and granting freedom for the laboratories to pursue these objectives in a manner dictated by their scientific judgment, all too frequently the military services and DOD agencies require that the various research agencies justify their programs in detail before funds will be made available. In the course of regular budget reviews, intermediate and necessary goals are sometimes lost sight of, making the development of a cohesive research program extremely difficult. Fortunately this criticism does not hold across the board and a few research organizations have been given fairly broad latitude in developing their programs, but these few are indeed exceptional. A very discouraging feature of this management system is the severe loss of morale through lack of confidence in the integrity and competence of laboratory directors. This factor alone has influenced many promising technically trained officers to leave the service.

THUS FAR I have pointed out some of the difficulties encountered in the operation of a research organization within the Department of Defense. Generally these have been problems associated with keeping a fresh new outlook among the personnel of the laboratory, conducting research under the restrictive procurement and supply procedures presently in force within the Department of Defense, and the limited management responsibility passed down by the DOD. The picture would be pretty black were it not for some small signs of improvement, albeit in a very limited area of work. At least one example can be cited which may point the way towards a much better research effort within defense laboratories.

Nuclear Effects Research Laboratory

The Nuclear Effects Research Laboratory is the name given to a group of activities within the Air Force Weapons Laboratory, Kirtland AFB, New Mexico. These activities have been largely concerned with the role of nuclear weapons in ballistic missile warfare, although not exclusively. The Nuclear Effects Research Laboratory is presently made up of a theoretical

group, a mathematics group, an experimental group, and a contracts group. The theoretical group makes an effort to understand the fundamental nature of the problems undertaken by the laboratory and to explain these in the form of hypotheses or theoretical models. The mathematics group supports the theoretical group and the entire laboratory by providing digital computer facilities and techniques for numerical analyses of physical problems. The experimental group conducts the in-house laboratory effort, carrying out sufficient experimental research so that a broad appreciation of the nature of the problem is gained. The contracts group enlists the research effort of the Nation's industries on those laboratory problems deemed suitable for this approach. Contracted problems must, as a guiding principle, be understood well enough by the in-house personnel so that they can provide intelligent management. More simply, we contract only those things which we know how to do. All exploratory and pivotal efforts are done in-house.

Under the operating philosophy of the Nuclear Effects Research Laboratory, only those problems are accepted which can reasonably be expected to lend themselves to a solution or better understanding with a few years of concerted laboratory effort. The total number of problems that can be accepted is determined by the size of the laboratory force, the number varying also to some extent with the quality of the personnel. Considering the average of the quality we have seen in several years' experience and the number of technicians and clerical people necessary to support them, we have arrived at an optimum figure of about 200 personnel. This assumes a certain level of base support, such as machine shop and electronics buildup, and does not include the number of people required for the procurement and supply functions.

The laboratory has been fortunate enough in the past to be supported in its work by fairly broad guidance and adequate funding, so that the particular direction of the group effort was largely determined by the group itself. The results are remarkable considering the short time the laboratory has been in operation. Since most of the work accomplished is classified, it is difficult to cite specific examples in more than general terms. One of the most outstanding achievements has concerned the vulnerability of ballistic missile systems to effects produced by a nuclear weapon detonation. In one program a postulated kill mechanism was theoretically explored, experimentally simulated, and described in terms of kill radii for specific systems. The results were then confirmed with definitive experiments during the recent nuclear tests. In another program the fundamental work of the laboratory towards understanding the phenomenology of high-altitude nuclear detonations led to the calculation of the trapping efficiency for electrons injected into the earth's magnetic field by a high-altitude nuclear detonation. These are called Argus electrons, after the series of high-altitude tests in 1958 which bore the name of Project Argus and in which the phenomenon was first observed. It was again observed and measured in the latest series of high-altitude tests in the Pacific. These and other research programs being conducted in the laboratory have thrived under the rather broad management policies in force for the past three years.

In accordance with its personnel policies, the Nuclear Effects Research Laboratory is essentially a "blue suit" organization, made up for the most part of military scientists drawn from the several sources available to an Air Force organization. As previously indicated, Air Force personnel policy permits an officer to pursue a career in research and ordinarily does not penalize him for this specialization. Thus there are a number of career Air Force officers with advanced degrees in the physical sciences who are available for assignment to the laboratory and who generally have sufficient maturity and experience to provide the necessary management structure. These officers, usually captains or majors, come from civilian educational institutions through the Air Force Institute of Technology programs or from the AFIT residence school itself at Wright-Patterson AFB. Another source of technically trained officers is the Air Force ROTC program, the last two years of which commit the cadet

to four years of military service. The more valuable of this last group of officers are those who obtained a deferment of their military obligation and pursued advanced degrees. There are indeed some exceptional new officers at the baccalaureate level who perform very well, but the officer with the advanced degree can usually do something of significance in a matter of months or even weeks whereas the officer with only a bachelor's degree generally requires a substantially longer time.

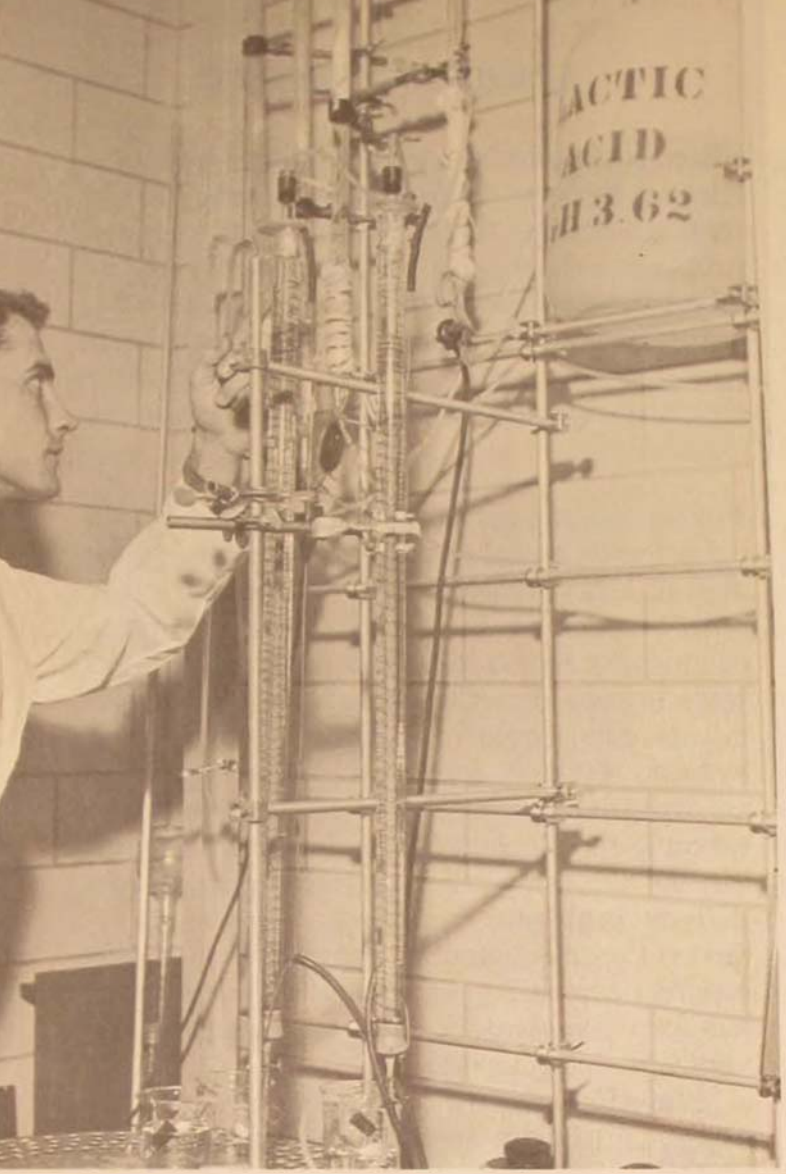
One of the most frequently voiced reservations about staffing a research laboratory with military scientists is the instability of the organization as a result of the personnel turnover. However, a degree of instability perhaps provides the means of infusing into the organization the new blood and fresh ideas mentioned earlier. To achieve this balance in the laboratory, we are counting on duty tours of about five years for career officers and four-year tours for ROTC-committed officers. In addition a stable force of Civil Service personnel is maintained at about 30 per cent of the total strength. Although the replacement rate for the military personnel does not seem excessive, amounting to about 14 career officers and 37 ROTC officers per year, the care with which they must be selected makes the task a fairly difficult one. There are about 200 regular or career Air Force officers graduating each year with advanced degrees in the physical sciences, and some 150 from the ROTC source. Of this number those who can conceivably make a contribution to the research effort must be identified, and steps must be taken to get them assigned to the laboratory.

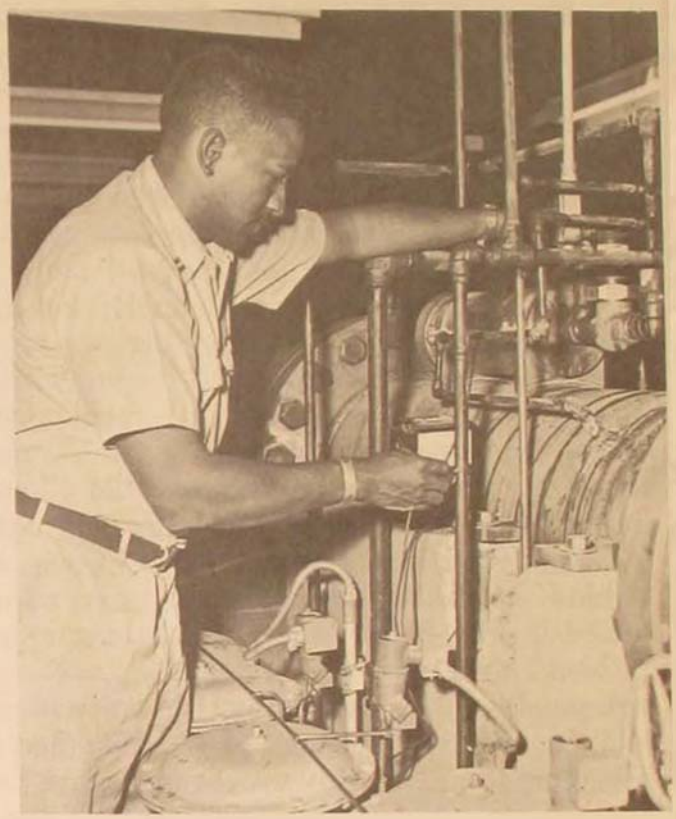
There is considerable competition within the Air Force for the services of career officers, but until recently there has been little difficulty in obtaining selected ROTC officers. I believe this reflects the attitude held by most research or development organizations, that the military officer could not be seriously considered as a scientist because of his other interests. Slowly coming about is the realization that younger people can do some substantive work early in their careers, especially if they are at the Ph.D. level. During the past two years we have been encountering more and more competition in obtaining selected people from those available.

THE WORTH of a research organization depends upon the technical quality of its people, probably to a far greater extent than in any other type of activity. Furthermore the particular complexion that a research program will assume bears a direct relationship to the special talents of its people. In an organization devoted to basic research, such as a university, this is an accepted way of life. It is also true to an extent in the Nuclear Effects Research Laboratory, where the work is directly applicable to defense problems. Securing adequate priorities on the selection of specifically trained officers by name and qualification is a major problem for the laboratory today and one that may very well determine its fate.

In effect, we are conducting a large-scale experiment in the operation of a defense laboratory based on the concept that scientists in uniform frequently contribute as much to national defense as those in mufti—occasionally even more. At the Nuclear Effects Research Laboratory we have been fortunate in the high degree of motivation among the staff that has made this experiment a successful one. We intend to continue this effort to demonstrate, within the bounds of the mission of the Air Force Weapons Laboratory, that an in-house capability can be achieved, technically proficient officers can be realized, and a quality laboratory that is responsive to problems of national defense can be operated within the Department of Defense.

Air Force Weapons Laboratory

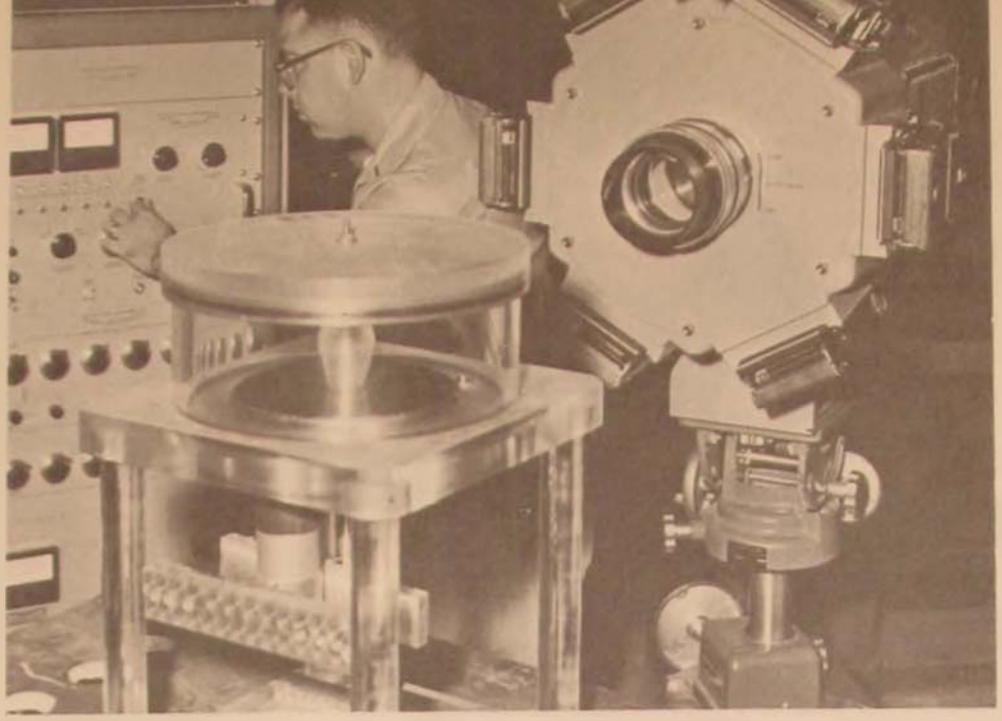




1st Lt. James F. Lamb (left)—M.S., chemistry, North Texas State Teachers College —checks progress on an ion exchange separation system setup in the Biophysics Radio-chemistry Lab. Capt. William F. Hargraves II (right)—M.S., physics, Miami University—notes the voltage output on gas gun facility in Physics Division.

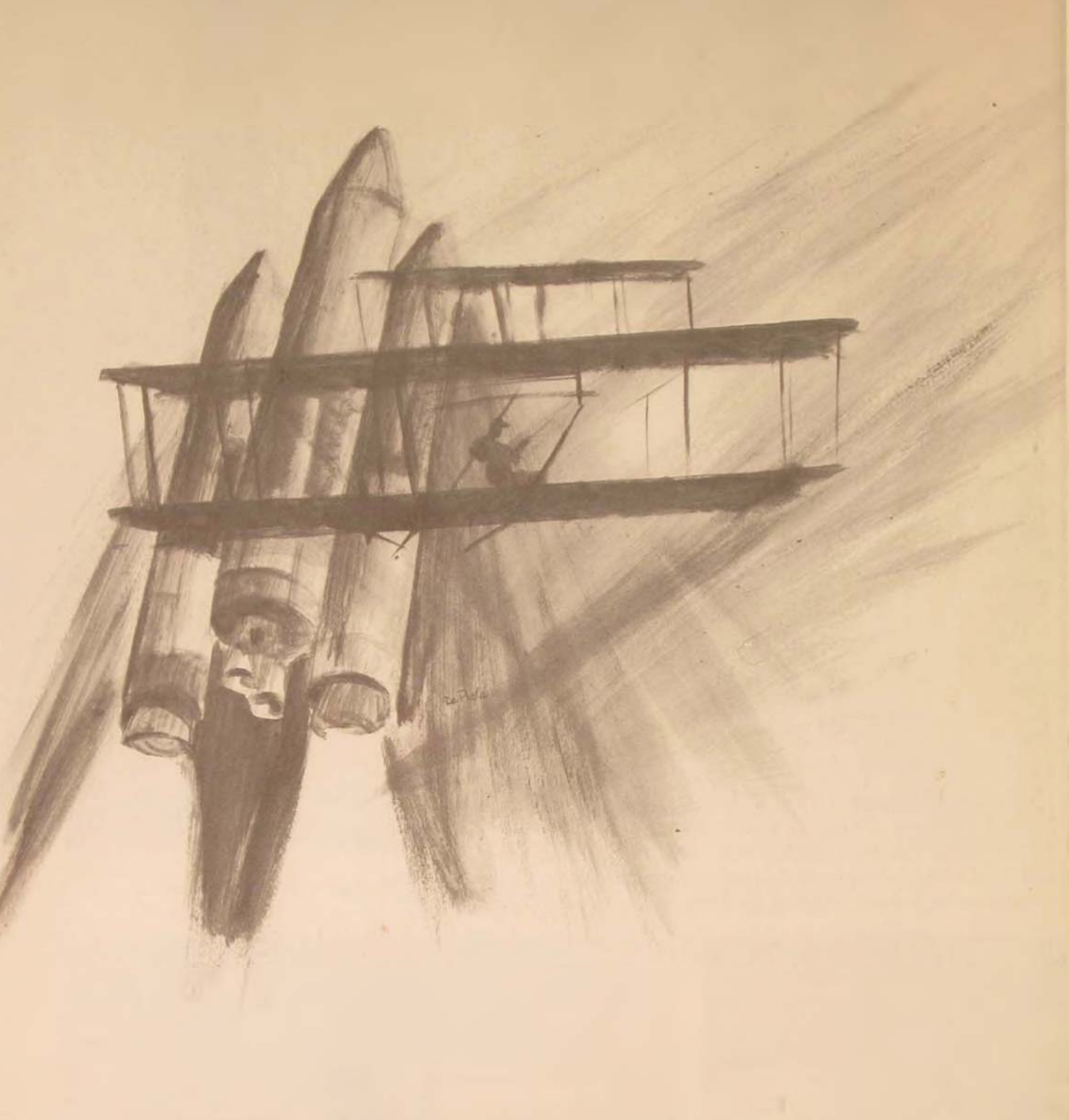
Military Scientists

The Air Force Nuclear Effects Research Laboratory at Kirtland AFB, New Mexico, is a "blue suit" organization, staffed largely by military personnel with degrees in the physical sciences. In the laboratory's facilities they investigate a variety of problems, most of which relate to nuclear weaponry for ballistic missiles.



1st Lt. Richard Witkover—M.S., physics, University of California at Los Angeles—prepares to photograph a plasma physics device with the KCF-600 camera, shooting at a rate of 100 million frames per second.

1st Lt. David Davis (left)—B.S., physics, Ohio Wesleyan—works the console for plasma research experiments. In the Structures Division, 2d Lt. Early Eastburn (right)—B.S., civil engineering, The Citadel—and 1st Lt. Joe Johnson—M.S., engineering mechanics, Columbia University—solve a shock isolation problem on the Bendix G-15 computer.



ARE YOU READY FOR SPACE?
OR
LOST IN THE LAND OF ΔV?

Colonel Francis X. Kane
and
Major Jack W. Hunter

WE ARE in the second half of the opening decade of the space age. Soviet and U.S. achievements have made this a familiar, accepted fact. However, the military uses of space are still undefined. We face three forms of skepticism in determining the role of space in our defense:

(1) Is manned space flight technically feasible?
(2) Do military space operations have any military worth?
(3) Do they fill any strategic need?

Our technical strategy in answering these three questions is to confine our efforts in space to research and development. In large measure, we are concentrating on the first question only. Presumably, the effort to answer the others will follow.

In a historical context, we are in a period analogous to the decade immediately preceding World War I. In that period extensive research and development was accomplished in an effort to answer Question 1, about manned flight. Some limited demonstrations were conducted to answer Question 2 about manned air operations. For example, the United Kingdom fired the first machine gun in an aircraft (1911), used the radio for air/ground communications (1911), and flew some support during army maneuvers (1912). The U.S. dropped the first bomb (1911). The Italians were the first to use the airplane in war (the capture of Tripoli from the Turks in 1911).

There was one underlying theme in the ferment of this early experimentation and demonstration—individual initiative. All these events did not just happen. They were made to happen by men with imagination, curiosity, foresight, and energy. These pioneers were "self-starters." They were not pushed out onto the frontiers of technology, operations, and strategy. They went there early. To get there, they had to use a new world of knowledge, of principles, and of data and had to apply it to specific projects, inquiries, and demonstrations. Dihedral, camber, chord, aspect ratio, lift/drag became their language. Meteorology took on new importance. Understanding of the internal combustion engine became critical.

Today we are in a period of experimentation in space. Demonstrations of the use of space are off in the future. Efforts to answer Questions 2 and 3 are not under way. We in the Air Force must be ready to try to answer them when the time comes. This means that we, as individuals, must have the knowledge of the principles underlying space operations. We must know the language of space, *understand* it, and be able to apply it.

Most of the principles of space operations come from astronomy and celestial mechanics. They have evolved over the centuries. Others, such as Newton's laws, are basic to any understanding and use of the physical environment. As we acquire additional knowledge of the phenomena of space, such as radiation belts, solar flares, and meteorites, we will have to know their effects on space operations. Let us look at a few of these principles and data and then examine how they apply to space operations.

Among the fundamentals of space operations are the notation and orbit orientation depicted in Figure 1. Terms such as apogee, perigee, true anomaly (sometimes called merely "anomaly"), lines of apsides and nodes, and orbit plane are the ordinary, working language of those involved in space activities. The inclination of the orbit plane (i) will nearly always be a consideration because launchings into equatorial orbits will be fairly rare. This inclination is expressed in degrees. The inclination of the Mercury orbits, for example, has been approximately 28°. Launchings from Vandenberg have put our Discoverers into polar orbit, 90° inclination.

Some of the fundamental laws and equations of orbital mechanics shown in Table 1 are, of course, the same laws used in physics, or derivations therefrom. A few observations are nonetheless interesting. For instance, the velocity of a satellite in a circular orbit 300 nautical miles above the earth is precisely 24,888 feet per second, while that of a circular orbiting satellite 200 nautical miles lower

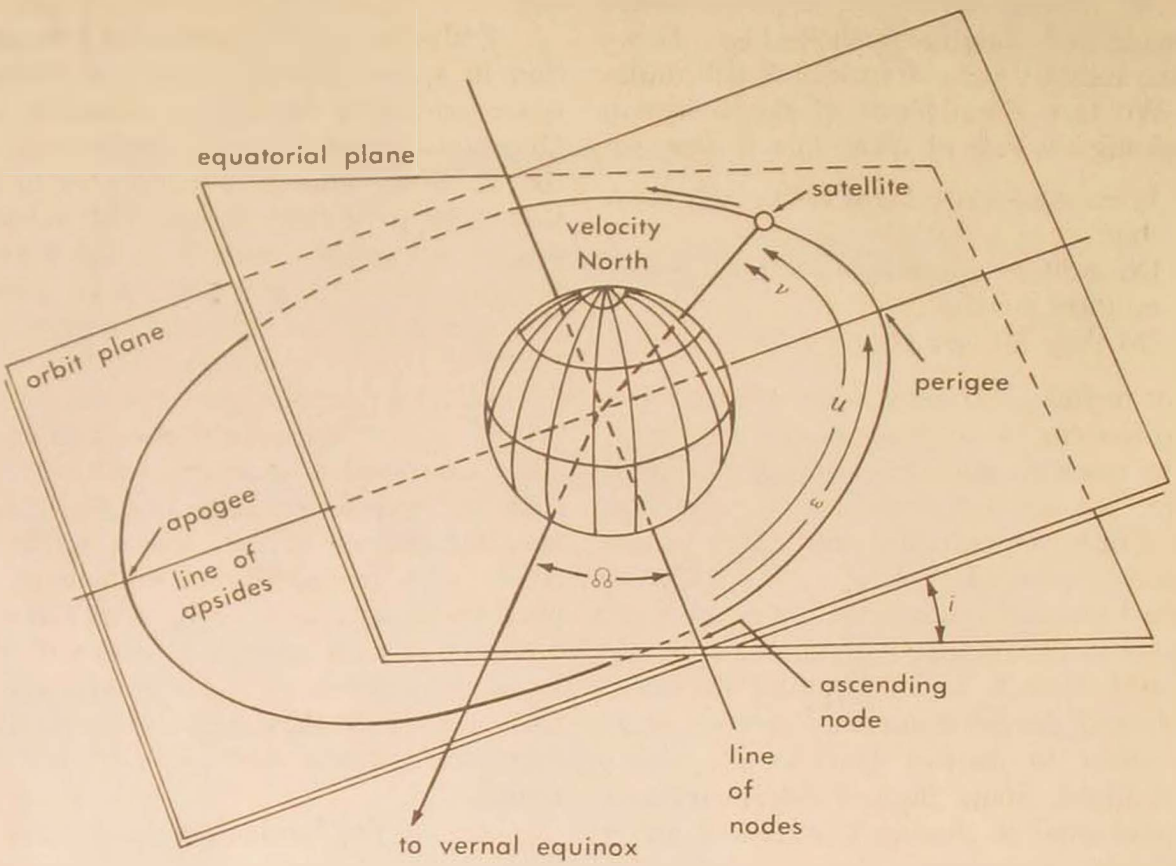


Figure 1. Notation for a geocentric orbit

i, the *inclination of orbit*, or angle, between the orbital plane and the equatorial plane.

line of nodes, line at which the orbital plane intersects the equatorial plane.

ascending node, point where the satellite crosses the equatorial plane going from south to north.

Ω, the *longitude of the ascending node*, or angle between the line of nodes and the direction of the vernal equinox. The value of Ω fixes the orientation of the orbital plane and together with the value of i defines the plane precisely.

ω, *argument of perigee*, or angle from the ascending node to the perigee as measured along the orbit. The value of ω gives the direction of the major axis of the orbit with respect to the line of nodes and so describes the orientation of the satellite orbit in its plane.

line of apsides, a line of indefinite length that passes through the foci of an ellipse. The major axis of the orbit is a segment of the line.

u, *argument of latitude*, or angle from the ascending node to the satellite, measured along the orbit.

v, *true anomaly*, or angle from perigee to the satellite, measured along the orbit.

is about 700 feet per second greater. At either altitude, the tremendous kinetic energy of a satellite in orbit is one of the most significant fundamentals of the orbital mechanics when one contemplates a procedure for "changing direction" in space. An example of the amount of velocity increment (or ΔV) required for a spacecraft to change its orbit plane elevation is readily shown by Equation 3 of Table 2. If a plane change of 60° is considered, a simple calculation indicates that as much energy is required to change orbit plane as is required to maintain a circular orbit.

On the other hand according to Equation 4 of Table 2, for nominal values of I_{sp}, a maneuvering engine weighing 10,000 pounds (with 5000 pounds of propellant) used to propel a 15,000-pound spacecraft would provide only about 2500 feet per second velocity increment. The comparison here between ΔV required and ΔV available is somewhat exaggerated but serves to emphasize two points: first, orbit plane changes should always be made at the higher altitude (lower v_s); and second, higher values of I_{sp} will almost certainly be required for appreciable increases in ΔV available from maneuvering engines.

A few other words used in space operations, defined in Table 3, were chosen to point up the discussion which follows. *Transfer* will be basic to space operations whether circumearth or circumlunar. *Dogleg* is used in most changes of orbit plane, although another method is described later. Also, note that *rendezvous* names a fairly gross maneuver as compared with *docking*.

Figure 2 illustrates a particular type of transfer, the Hohmann transfer. This is the path which is followed to change from a lower altitude to a higher altitude in the same orbital plane with the minimum expenditure of energy when time required to reach the new altitude is not a primary consideration.

Holding in a parking orbit at an altitude of about 100 nm will generally precede transfer to higher altitude orbits, particularly when rendezvous with an orbiting satellite is required. Because of the earth's rotation, a launch site such as Cape Canaveral passes

Table 1
Laws of Orbital Mechanics

1)	$F = \frac{Gm_1m_2}{r^2}$	F – force of attraction G – gravitational constant m_1 – larger mass (earth) m_2 – smaller mass (satellite) r – earth radius plus altitude (where earth considered point mass)
2)	$\frac{1}{2}v^2 + gr = E$	$\frac{1}{2}v^2$ – kinetic energy gr – potential energy E – specific mechanical energy
3)	$vr = H$	vr – angular momentum H – specific angular momentum

Table 2
Common Equations of Orbital Mechanics

(1)	$v_{cs} = \sqrt{\frac{\mu}{r}}$	v_{cs} – circular satellite velocity μ – Gm_1 or $g_E r_E^2$ (14×10^{15} ft³/sec²) r – earth radius plus altitude
(2)	$v_{esc} = \sqrt{\frac{2\mu}{r}}$	v_{esc} – escape velocity
(3)	$\Delta V = 2v_s \sin \frac{\Delta i}{2}$	ΔV – required velocity increment for orbit plane change v_s – satellite velocity Δi – orbit plane change
(4)	$\Delta V = I_{sp} g_E \ln \frac{W_o}{W_o - W_p}$	ΔV – available velocity increment I_{sp} – specific impulse of propellant W_o – total initial weight W_p – propellant weight

Table 3
Definitions

ephemeris.	Orbital path.
anomaly.	Arc distance between two vehicles in coplanar orbits.
transfer.	Maneuver by which a spacecraft changes orbital altitude.
dogleg.	Maneuver by which a spacecraft changes orbital plane, executed at apogee of transfer orbit if altitude change involved.
rendezvous.	Maneuver by which a spacecraft is placed in proximity (within 20 nm) to a target vehicle, executed either by direct ascent from launch site or by transfer from parking orbit.
docking.	Maneuver by which a spacecraft makes soft physical contact with a target vehicle.
intercept.	Maneuver by which a spacecraft is placed at a specific point (target vehicle) in space at a specific time, executed as a continuous trajectory from launch site or parking orbit.

through orbital planes inclined greater than about 30° twice a day. However, in order to launch into a plane of 45° from Canaveral without doglegging, for example, as much as a 16-hour delay can be encountered. And even after waiting 16 hours for the launch site to rotate into the plane of the orbit, it is very likely that a satellite with which rendezvous is required will not be in the proper location for direct-ascent rendezvous. In fact, when Canaveral passes under the 45° plane, a satellite in that orbit could be over Australia. Instead of waiting several days (or perhaps weeks) until the orbiting satellite is in the right position, we will simply launch into a coplanar parking orbit and wait until the two vehicles are in the correct position relative to one another for the execution of a Hohmann transfer.

The dogleg is not the only maneuver that can be used for a change of orbit plane. The synergetic plane change shown in Figure 3 is a maneuver available only to spacecraft with hypersonic lift-to-drag ratios greater than one. By making this maneuver, the astronaut can change his orbit with as much as 50 per cent reduction in the amount of energy required up to altitudes of about 600 nautical miles. Aerodynamic lift available during the precisely controlled turn at low altitude (about 35 nm) to the desired orbit plane accounts for the reduction in energy required as

Figure 2. Hohmann transfer

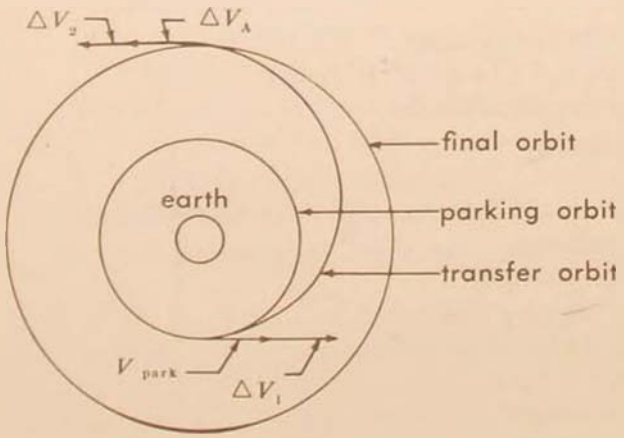
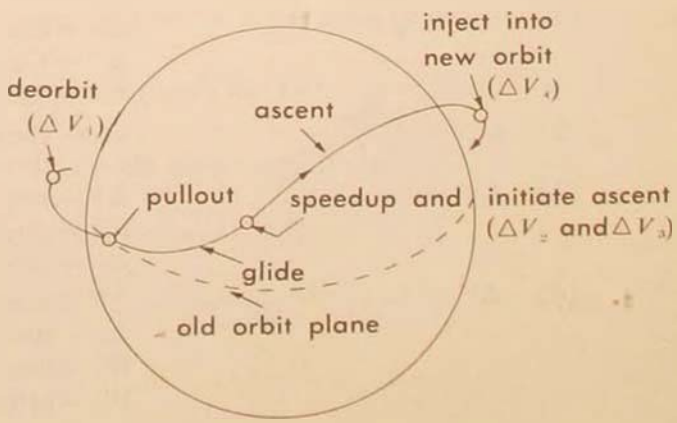


Figure 3. Synergetic plane changing



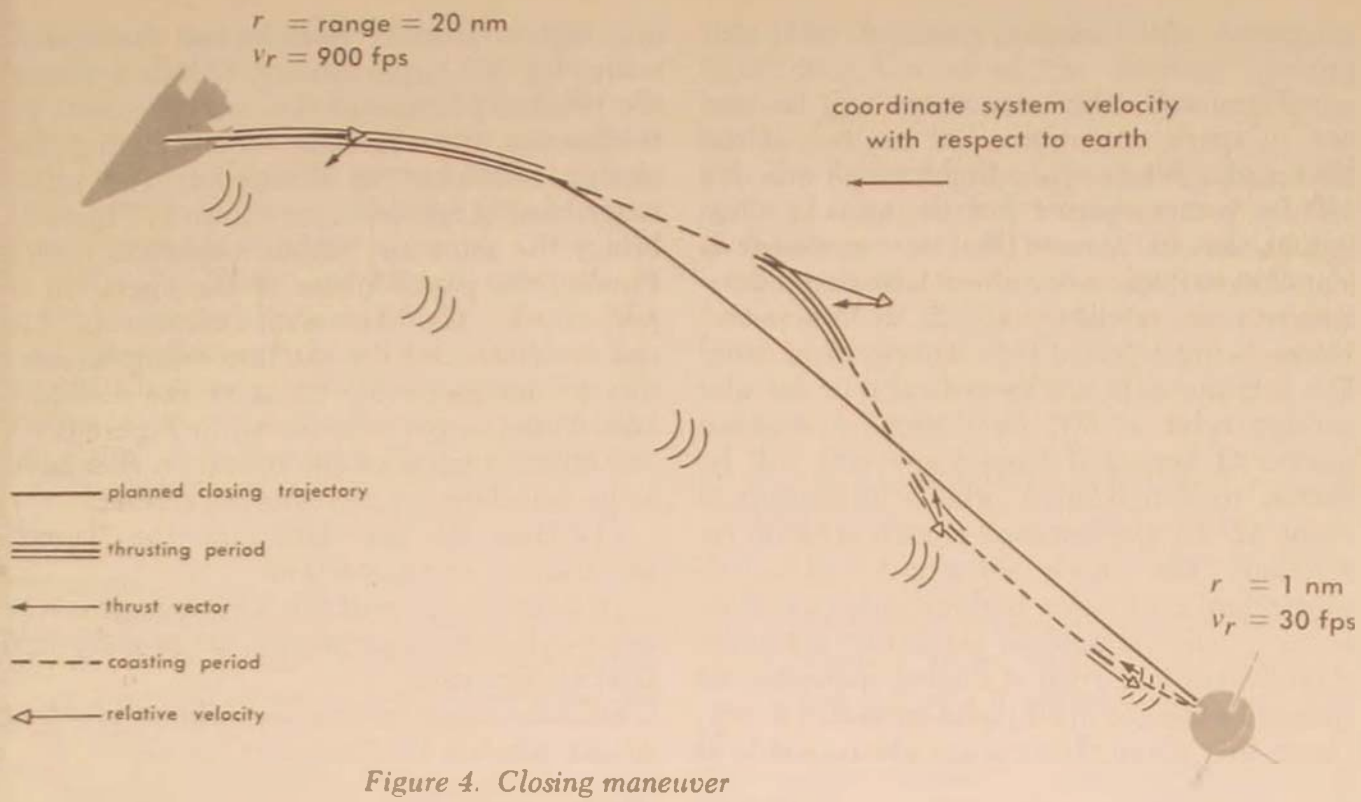
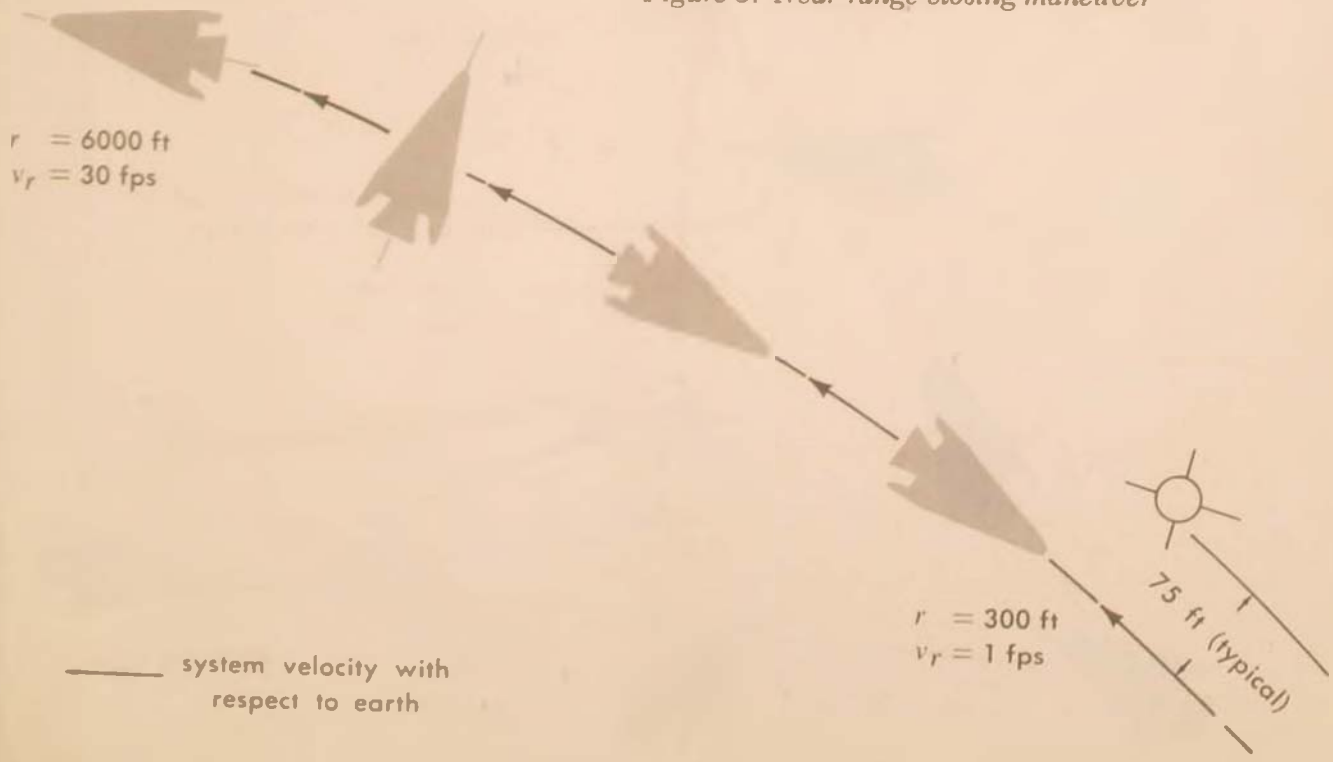


Figure 4. Closing maneuver

Figure 5. Near-range closing maneuver



compared with changing plane at orbit altitude.

These and other maneuvers will be routine in space operations. Let us look at the phases of a future space flight which one day will be commonplace. For the sake of illustration, let us assume that an astronaut is planning to inspect one of our unmanned communications satellites which malfunctioned before being injected into its operating orbit. The satellite is in a 300-nautical-mile circular parking orbit at 60° inclination. A manned spacecraft launched from Canaveral will be limited to a maximum orbital inclination of about 52° by the imposed launch azimuth restrictions. Thus, after being put into a 100-nautical-mile circular parking orbit, a Hohmann transfer is used to reach the 300-nautical-mile altitude with a dogleg maneuver at apogee to change orbit plane from 52° to 60°. (Note that plane changes are always made at the higher altitude because of the lower energy or ΔV requirement.) Figure 4 shows the relative position of the two spacecraft at rendezvous, the astronaut then initiating the closing maneuver as illustrated. The near-range closing maneuver, as shown in Figure 5, brings the astronaut within inspection range. Finally, the payoff phase of the operation is performed. The astronaut maneuvers his spacecraft around the satellite, using his sensors to determine the cause of the malfunction. This maneuver is shown in Figure 6.

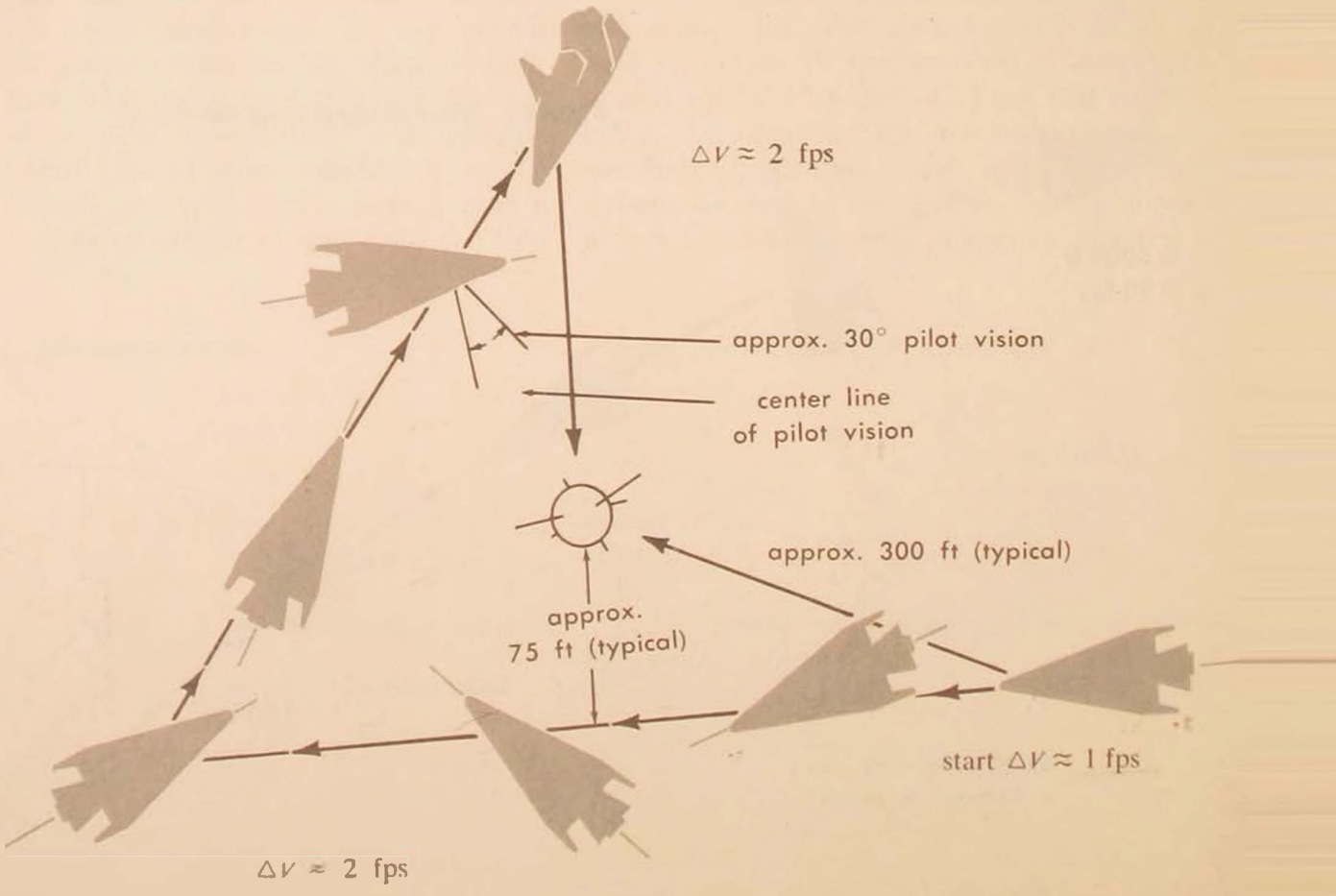
Other aspects of the operation that have to be calculated are left for the reader.

(1) How do you determine the "launch window" for this inspection?

(2) How long must the astronaut remain in orbit before he can initiate his re-entry and land at Edwards?

(3) Assuming his spacecraft has a lift/drag of .30, what is his "footprint"?

Figure 6. Inspection maneuvers



To HELP in finding the answers, a bibliography is given. References 12 and 17 will be particularly useful. One suggestion is made: In trying to visualize space maneuvers, have a globe handy. The wall map of the air operations planner is an unsatisfactory tool for the space operations planner.

The Air Force has several programs to educate space planners and operators. The Aerospace Research Test Pilot School at Edwards is training our X-20 astronauts. The Air Force Institute of Technology gives formal education up to the doctorate level for scientists. Air University conducts the Aerospace Operations Course of the Warfare Systems School. The output of these schools is quite limited.

If you want to be among the pioneers of space planning and operations, you should do as the air pioneers did over a half-century ago —take the initiative to understand the new environment and the principles on which operations in it are based. By preparing yourself, you wil not be lost in the Land of ΔV, but ready for space.

Hq Air Force Systems Command

Bibliography

1. American Astronautical Society. *Advances in the Astronautical Sciences*, Vol. 6, Proceedings of the Sixth Annual Meeting, New York City, 18-21 January 1960. New York: Macmillan, 1961.

2. Benson, O., Jr., and Strughold, H., (ed.) *Physics and Medicine of the Atmosphere and Space*. New York: John Wiley & Sons, 1960.

3. Brouwer, D., and Clements, G. *Methods of Celestial Mechanics*. New York: Academic Press, 1961.

4. California, University of, Engineering and Physical Sciences Extension. *Space Technology*. Berkeley: University of California, March 1958; New York: John Wiley & Sons, 1959.

5. Duncan, Robert Clifton. *Dynamics of Atmospheric Entry*. New York: McGraw-Hill, 1962.

6. Ehricke, K. A. *Space Flight*. Vol. 1, "Environment and Celestial Mechanics." Princeton: Van Nostrand, 1960.

7. Helvey, T. C. *Space Trajectories*. New York: Academic Press, 1960.

8. Herrick, S. *Astrodynamics*. Princeton: Van Nostrand, 1961.

9. Jenson, Jorgen. *Design Guide to Orbital Flight*. New York: McGraw-Hill, 1962.

10. Koelle, Heinz Hermann. *Handbook of Astronautical Engineering*. New York: McGraw-Hill, 1961.

11. Macko, S. *Satellite Tracking*. New York: John F. Rider, 1962.

12. Markey, Winston R. *The Mechanics of Inertial Position and Heading Indication*. New York: John Wiley & Sons, 1961.

13. Ordway, Frederick I., Gardener, James P., Sharpe, Mitchell R., Jr., Wakeford, Ronald C. *Applied Astronautics: An Introduction to Space Flight*. Englewood Cliffs, N. J.: Prentice-Hall, 1963.

14. Stearns, Edward V. B. *Navigation and Guidance in Space*. Englewood Cliffs, N. J.: Prentice-Hall, 1963.

15. Thomson, William Tyrrell. *Introduction to Space Dynamics*. New York: John Wiley & Sons, 1961.

16. USAF Academy, Astronautics. *Elements of Free Flight Trajectories*. (Instructional text only.)

17. White, J. F. *Flight Performance Handbook for Powered Flight Operations*. New York: John Wiley & Sons, 1962.

18. Wolff, Edward A. *Spacecraft Technology*. Washington, D.C.: Spartan Books, 1962.

Air Operations in Viet Nam

THE VIET NAM AIR FORCE

CAPTAIN MACK D. SECORD

WITH A history spanning barely more than a decade, the record compiled by the Republic of Viet Nam Air Force (VNAF) belies its tender age. In terms of combat sorties flown, numbers of enemy soldiers killed, and quantities of supplies destroyed, this 12-year-old organization has more than proved its worth in battle.

Before any then-and-now comparison of facts and figures, let us look for a moment at how the VNAF has traveled the often-bumpy road of expansion from an original force of less than 300 men to today's manpower total of something over 6000.

Just as the U.S. Air Force first flew as an arm of the U.S. Army, so it was with the VNAF. Organized by the French in 1950 to supplement the French Air Force in the battle for Indochina, its original name was the Air Department of the Joint General Staff. Not until 1956 did it become a separate operating arm of the Vietnamese Department of National Defense.

During its infancy the air unit was composed of an observation squadron, a liaison squadron, and a headquarters agency. For observation missions the French-built Morane-Saulnier-500 was used, while the liaison squadron fulfilled its requirements with several MS-500's, two C-47's, and a pair of C-45's. The latter unit was based at Saigon's municipal airport, Tan Son Nhut. The observation squadron split its forces between Nha Trang, on the coast of the South China Sea, and Saigon. In 1954 a light combat squadron was added to the inventory and equipped with 16 twin-engine Marcel Dassault-312 light bombers, giving VNAF its first real combat arm. All previous missions had been in the realm of combat support, since VNAF pilots flew only liaison and observation missions, leaving the actual fighter strikes to the B-26's and F-8F's of the French Air Force.

Concurrent with the establishment of the VNAF was the beginning of a program to train

crews for it. The initial group of pilot trainees, 11 in number, reported to Nha Trang Air Base in December 1951. Just as in America, the eager cadets divided their days between long classroom sessions in aerodynamics, navigation, and military studies and occasional airborne instruction in the sturdy MS-500. All the teaching was done by French instructors in the language of their homeland.

Following graduation of the 11 pilots in October 1952, some were integrated into French aerial units in the Hanoi area, while others joined the newly established VNAF units. The Air Training Center at Nha Trang began training observers the same month the first class of pilots was graduated, and this group of six candidates won their wings in April 1953. VNAF students who were destined to become bomber or transport pilots received about two months of schooling in light airplanes in France, then went to Morocco for a year to sharpen their skills in the North American T-6. They returned to France for more training in the MD-312 until they sailed to Viet Nam four months later, ready to master C-45, C-47, or MD-312 cockpit duties.

The Geneva conference in July 1954 produced the armistice which ended the eight-year battle between the French and the Viet Minh. This agreement also divided the country in half at the 17th parallel and marked the beginning of the decline of French influence in the Republic of Viet Nam. From that date forward French fighting forces were gradually withdrawn, and the four-year-old Vietnamese Air Force had to assume an increasingly important role in the country's fight against the Communist guerrillas, who remained behind after the signing of the Geneva accords. The last French Air Force personnel departed in 1956.

As a result of the withdrawal of the French Air Force, 1956 was a busy year for the VNAF. In January Tan Son Nhut and Bien Hoa Air Bases were activated, and the liaison squadron at Nha Trang was moved to Tan Son Nhut to provide better service to the headquarters located there. Bien Hoa, 17 miles to the northeast, became the home of the 1st Fighter Squadron and the Air Depot. The latter, which came into being in April, provided maintenance and supply support for the entire VNAF.

To provide communications and navigation aids, the Air Traffic Center was also established that spring, as was the Air Medical Center. In June the 1st Fighter Squadron received 25 F-8F Bearcat fighters, and the 1st Air Transport Group accepted 32 C-47 transports from Military Assistance Program sources. The forerunner of today's Joint Air Operations Center was activated at Tan Son Nhut in July, with the title of Air Operations Center. Major Tran Van Ho was selected as first commander of the newly renamed VNAF.

After the momentous growth of VNAF in 1956 activities leveled off as the VNAF continued its fight to drive the insurgents from their hiding places in the jungles and rice paddies. It was only in the fall of 1961 that another buildup of any significance occurred in the Vietnamese air arm as a result of the American decision to offer increased assistance to the Vietnamese republic. When the French armed forces personnel left the country, the United States began sending military advisers to this war-torn Southeast Asia land. The number of these advisers, however, remained quite small until the fall of 1961, when the U.S. advisory complement began to grow rapidly to meet the increasing challenge of Communist domination in the small republic.

In January 1962 records show that the VNAF flew a total of 251 combat sorties with their one squadron of AD-6 fighters. In startling contrast is the April 1963 figure for combat missions, which

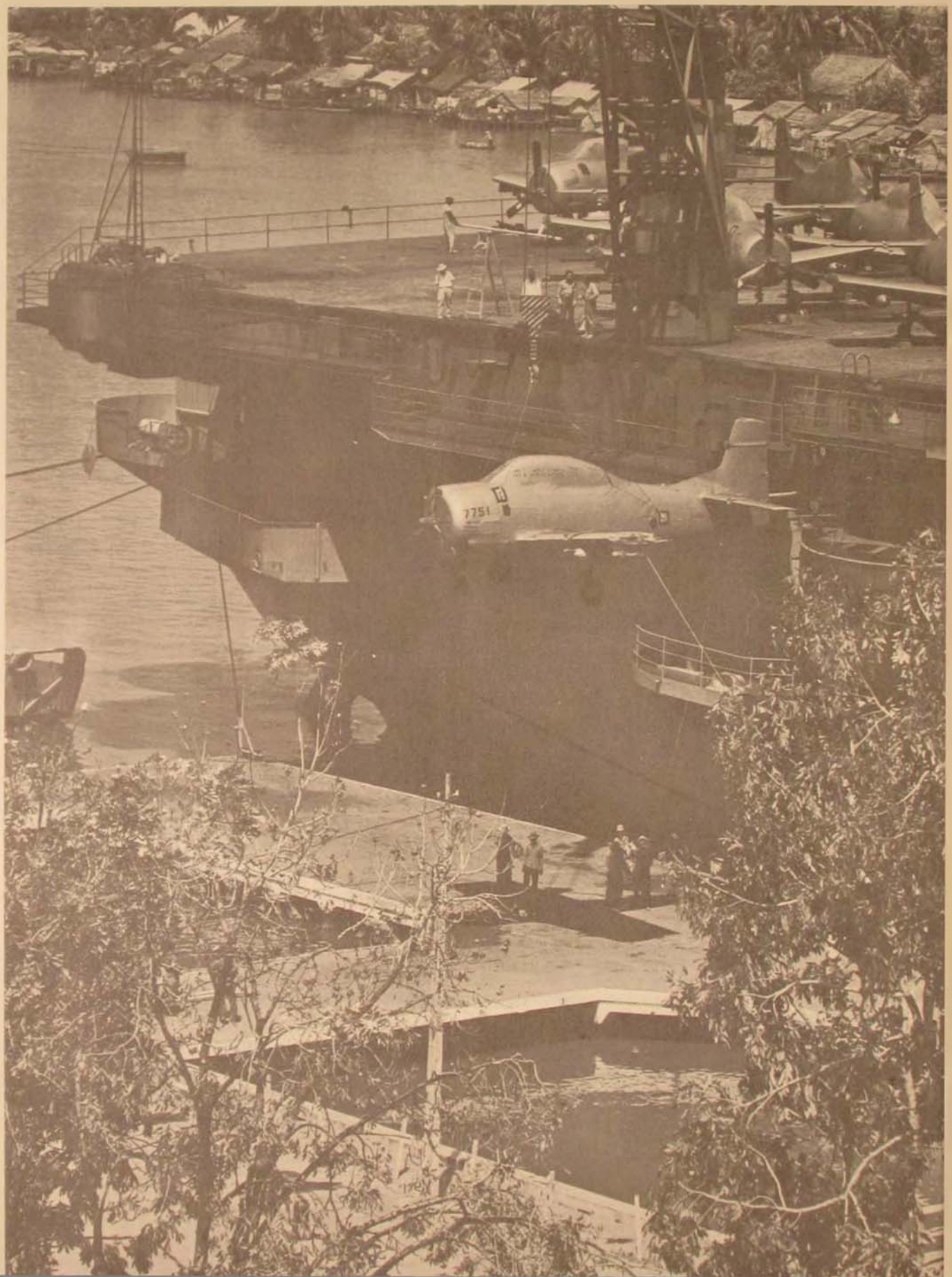
continued on page 66

Editor's Note

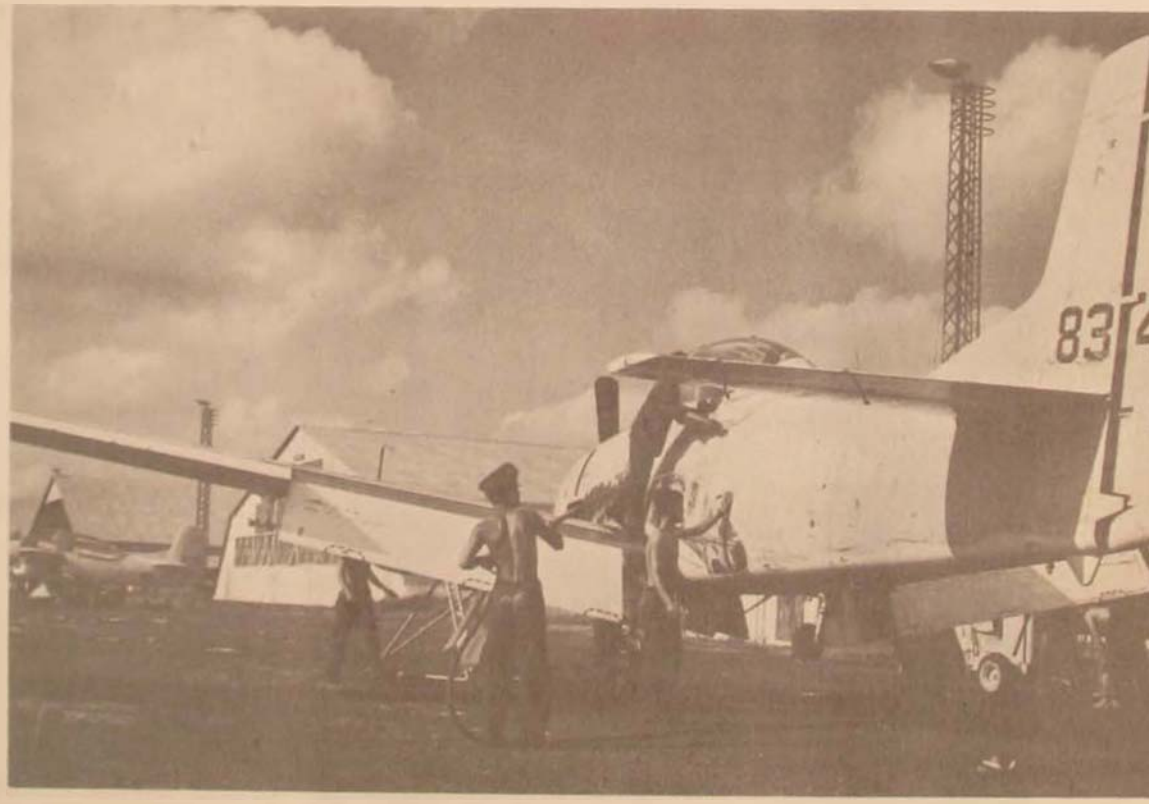
Progress Report

USAF tactical air experts work side by side with their Vietnamese officer and airman counterparts in molding the Viet Nam Air Force to the tactical air concepts and doctrines for COIN operations. The VNAF that has developed exemplifies the principle of central control of all tactical air power in the theater. It is integrated into a tactical air control system and operates its own Joint Air Operations Center. Fast becoming a deadly-effective tactical air force, the VNAF is officially credited with more than one-third of all Viet Cong casualties. Its combat sorties have increased from 250 a month in early 1962 to almost 1500 a month in April 1963.

Saigon Harbor. T-28 aircraft arrive by carrier deck after President Kennedy declared U.S. assistance in building up Viet Nam armed forces.



Earmarked for the Viet Nam Air Force, the T-28's wait for truck delivery to nearby Tan Son Nhut Air Base.



At Tan Son Nhut Viet Nam ground crews scrub down their new aircraft and prepare them for flight.

Ready for the next sortie. Typical Viet Nam Air Force pilots, average age 24–25, have been trained by the French or in USAF flying schools. Each has logged well over 100 combat sorties.

Taxiing out for another strike against the Viet Cong guerrillas, VNAF T-28 fighters are armed with rockets, napalm bombs, and .50-caliber for strafing runs.

A T-28 fighter-bomber element showing the tiger-head emblem of the 516th Fighter Squadron, VNAF, climbs over Nha Trang Bay for a combat strike against the Viet Cong. The target lies in the mountains, which rise from the bay and extend on inland.

reflects a total of almost 1500 offensive sorties flown against Viet Cong personnel and emplacements. The 1962 tabulations for Viet Cong killed and wounded in action show almost 4000 troops in these two categories, the majority in the KIA group. More than 11,500 structures belonging to the insurgents were destroyed or damaged by VNAF air strikes, and more than 1500 boats were sunk by firepower from VNAF aircraft. The latter accomplishment may seem somewhat inconsequential, but in the Mekong River delta region of Viet Nam boats represent virtually the only means of transportation in an area that has few roads, even fewer bridges, and literally thousands of canals and other waterways.

In addition to the usual interdiction, close-air-support, and reconnaissance roles of a tactical air force, the VNAF has proved itself worthy in the field of helicopter escort. During the first five months of 1962 a total of only a few helicopter escort sorties had been logged. After some intensive indoctrination, U.S. Air Force advisers and their VNAF counterparts convinced ground force commanders that air escort of all heliborne operations would result in an immediate and marked decline in helicopter losses. Escort sorties jumped over 600 per cent in August 1962, and the number has remained fairly constant since that time. VNAF tacticians have refined rotary-wing escort techniques based on their experience with this kind of mission and have been extremely successful at preventing helicopter losses to the often deadly Viet Cong ground fire.

One major difference between the U.S. Air Force and the VNAF is that all air power in the Vietnamese republic is assigned to and controlled by the Viet Nam Air Force. There is no army or navy aviation. Consequently heliborne operations, although planned and carried out by Army of Viet Nam forces, involve VNAF aircraft and crews for transportation from the pickup point to the landing zone. Helicopter training for VNAF pilots has been carried out at Tan Son Nhut Air Base since February 1963 by Military Assistance Advisory Group instructors from the USAF school at Stead Air Force Base, Nevada, using H-19's for training vehicles.

Another area in which VNAF has proved its mettle is in convoy and train escort. Between January and July 1962 these sorties totaled slightly over 100, and by fall of that year the total was nearing 200 a month. Losses from Viet Cong ambushes (their favorite method of attack) declined sharply when VNAF began to put an L-19 forward air control team and a flight of strike aircraft above each important convoy. A similar result was achieved when strike aircraft began escorting both passenger and freight trains along those portions of the railway where Communist attacks were most frequent.

An operation with the nickname "Night Angel" has been the salvation of many outposts and strategic hamlets in the strife-torn country. Since Viet Cong attacks on village defenses come most frequently under cover of darkness and especially in the period just before daylight, VNAF crewmen fly an all-night vigil over certain portions of the country in C-47 flare ships, ready to heed the call of a besieged outpost with an umbrella of light. Often just the brilliant illumination produced by the paraflares is enough to halt the attack, but in most cases fighters are scrambled from the nearest base to add their persuasive power to the battle. This airborne alert not only gives a much faster reaction time in case of attack but also serves as a powerful deterrent to all within earshot of its engines.

VNAF liaison missions, carried out with L-19's and L-20's located at Tan Son Nhut, Pleiku, and Da Nang, have also shown a steady increase since the early days of 1962. From January of that year to March 1963 the sortie rate increased 250 per cent.

In the airlift category, VNAF's fleet of C-47's continues to provide a lifeline of support to isolated bases. Resupply by any other method is virtually impossible, so the dependable "Gooney Birds" make daily drops of food, ammunition, and other supplies to the many settlements cut off from all other means of outside aid. Tonnages of cargo offloaded by the VNAF fleet have remained relatively stable since late 1961, averaging 250 tons per month, of which more than one third is airdropped. Passenger manifests have shown a significant increase, the April 1963 figure more than doubling the January 1962 tally of some 5000 passengers.

USAF advisers have been particularly impressed with the ability of VNAF crews to perform troop-carrier and aerial resupply missions. Their

accuracy in dropping paratroopers into a forward battle zone or resupplying a remote outpost has given USAF observers new goals to shoot for. Cows, pigs, ducks, and chickens practically fall at the feet of waiting ground forces, as do bags of rice, canned goods, and other of the less perishable foodstuffs. Whenever ammunition supplies run low, ARVN forces know they can depend on VNAF to deliver planeloads of whatever their artillery, mortars, or rifles require. On many occasions a sudden and prolonged Viet Cong attack has been repelled by ammunition delivered during the heat of the battle by VNAF C-47's dropping their cargo from treetop level while dodging ground fire.

One area that continues to plague both VNAF and their USAF advisers is evaluating the effectiveness of the variety of firepower delivered by strike aircraft. Jungle foliage grows to almost unbelievable thickness in Southeast Asia, effectively screening most strike results that might otherwise be observed by fighter pilots. The foliage also prevents assessment by ground forces, who might have to spend several days clearing a trail of less than a mile in order to count Viet Cong losses. In relatively open areas intelligence reports confirm that the 2.75 rockets expended by T-28's, A-1H's, and B-26's have been especially effective. Of the variety of bombs available for delivery, best results have been obtained with clusters of six 20-pound fragmentation bombs.

Spearheading the VNAF's concerted effort to drive the Viet Cong from the Republic of Viet Nam is 34-year-old Col. Huynh Huu Hien. He was selected VNAF commander in October 1962, replacing Col. Nguyen Xuan Vinh, who went to the United States to study at a civilian university. Colonel Hien, a graduate of the French Air Force pilot training program in 1954, is equally at home in the cockpit of an A-1H or a C-47, since he has previously commanded both fighter and transport squadrons. At least once a week, and sometimes more often, he leaves his office at Tan Son Nhut, climbs into a T-28 or an A-1H, and flies a strike mission.

Colonel Hien's youthful appearance, like that of the men he commands, hides a grim determination to win the long, often-frustrating battle against a hit-and-run enemy that seeks to overthrow the elected government and turn free men into slaves of a Communist regime.

Hq 2d Air Division

AIR ESCORT—A COIN AIR TECHNIQUE

Lieutenant Colonel James F. Sunderman

AMONG THE air tactics used by the Viet Nam Air Force and its USAF advisers in the war against the Communist insurgent guerrillas is air escort of trains, truck convoys, U.S. Army helicopters, VNAF and USAF combat airlift support aircraft, and inland and coastal waterway shipping.

Prior to the beginning of aerial escort in the summer of 1962 by VNAF/USAF tactical aircraft, surface movement of troops, supplies, and equipment was a hazardous gamble for Army of Viet Nam ground forces. Well-armed bands of Communist insurgents, expert in the art of ambush, plagued Viet Nam's single north-south rail line, the limited roadways in the country, and the many miles of navigable river and canal waterways.

It was highway banditry on a bold and profitable scale for the Viet Cong. Ambush provided them a lucrative source of food, ammunition, weapons, and war supplies, not to mention an effective quick-strike means to kill Vietnamese soldiers and their U.S. advisers.

A large portion of the military personnel and combat logistical support moved throughout the country via USAF C-123 in-country airlift, supplemented by the C-47 "Gooney Birds" of the VNAF's 43d Transport Group. Yet military requirements dictated certain amounts of surface transport, especially short-distance movements within province sectors or areas contiguous to fortified villages, outposts, or garrisoned establishments.

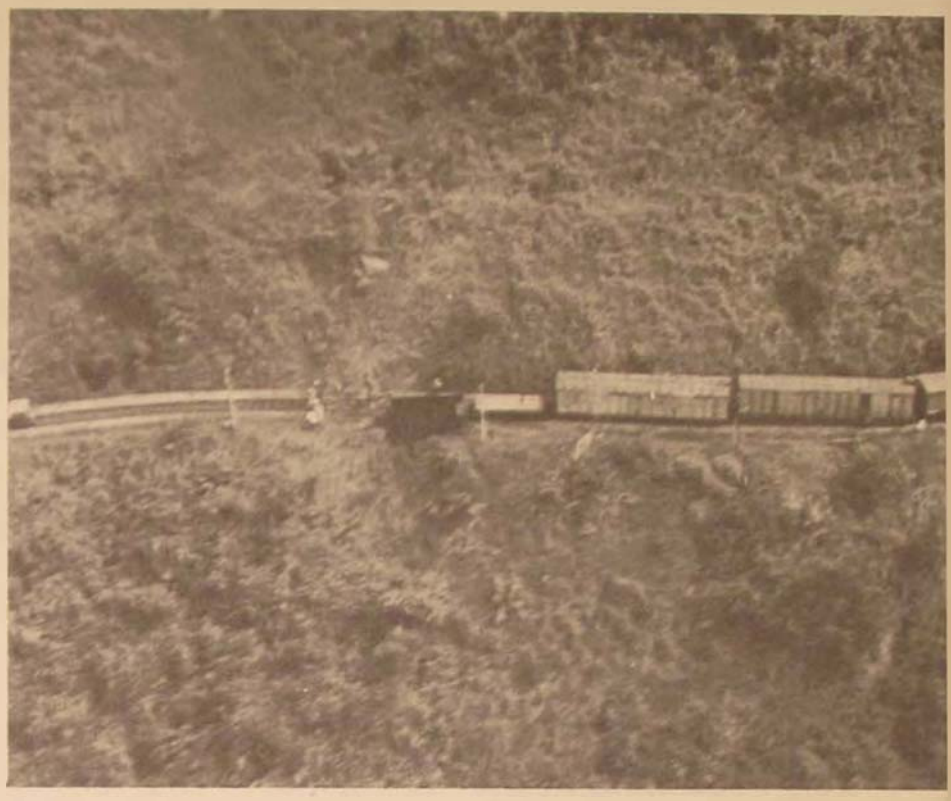
Then, too, a single-line railroad ran from Saigon eastward through flat country to the coastal town of Phan Thiet. From there it traced a course northward, winding through the coastal mountain ranges and along the seashore to Nha Trang, Da Nang, and up to the 17th parallel, which divides Viet Nam. Government use of this rail system to haul large amounts of food supplies, construction materials, and heavy bulky equipment for civilian and military use was absolutely essential. The rail line also provided a good setup for the piratical Viet Cong, especially where the trains moved through mountainous country, into and out of steep canyons, over bridges, and through densely foliated areas.

The frequency of Viet Cong ambush increased on the roads and rail line in the fall, winter, and spring of 1961–62. In the months immediately prior to aerial surveillance escort, almost every supply and troop train traveling the system was ambushed. The Viet Cong employed a variety of ambush techniques, including dynamiting the rails, ripping up sections of the rails, neatly removing a section of track and resetting it sufficiently to derail the locomotive and the cars. Other tricks of the Viet Cong involved removing the spikes from a stretch of rails or removing one very small section of a rail. Log piles across the tracks would do the job too.

Most ambushes involved techniques that would not destroy the rolling stock but merely enable the Viet Cong to steal the contents of the boxcars. It was in the insurgents' best interests if the government rail equipment remained intact and the trains kept running.

It is interesting to note that the Viet Cong never ambushed a passenger train. On occasion in the past passenger trains were stopped (and they still are), and the passengers were robbed in the best American Wild West fashion before the train was allowed to continue. But the sole victims of the ambushes were the freight supply trains.

Aerial escort. A Vietnamese Air Force B-26 twin-engine light bomber makes a low pass over a truck convoy traveling through Viet Cong-infested territory in the Republic of Viet Nam. Ambush by Communist insurgent bands constantly plagued such convoys until Vietnamese officials called for tactical air power to fly truck and train escort missions.



A frequent sight along Viet Nam's single north-south rail line before aerial escort was employed to ride protective cover for freight and troop trains. Viet Cong soldiers "take off" as the camera plane approaches this ambushed section of a freight train northeast of Saigon in early spring 1962. Open door on the boxcar indicates that supplies were in process of being carried away. Since VNAF started riding "aerial shotgun" for trains in summer 1962, not one train has been ambushed that had protective air cover.

The armed VNAF T-28 fighter-bomber makes a low pass over a slow-moving freight train as it passes through a densely wooded Viet Cong-suspect area in the mountains north of Phan Thiet. Armed with four air/ground rocket pods and two wing-mounted .50-caliber machine-gun pods, the T-28 packs a heavy wallop of firepower which the Viet Cong have learned to respect. The L-19 FAC spotter and radio control plane are flying up ahead of the supply train inspecting tracks, bridges, and adjacent cover. The T-28's fly in pairs, the partner on this escort mission orbiting overhead, ready to strike instantaneously.

An L-19 forward air control radio plane inspects a river bridge crossing. The L-19 maintains radio contact with the train under escort and with fighter-bombers patrolling nearby. Its flight pattern takes it back and forth over and ahead of the train, to check the bridges, rail line, and adjacent right-of-way. If signs of possible Viet Cong ambush are detected, the L-19 radios the train to stop and calls in the fighter-bombers. The Vietnamese observer in the back seat, a target intelligence expert, is armed with an automatic rifle.

Flying in pairs, one T-28 maintains high cover position. The other goes down on the deck to inspect the train and the densely wooded countryside along the tracks. On escort duty the T-28 carries a rack of antipersonnel fragmentation bombs, an air/ground rocket, and a .50-caliber machine-gun pod under each wing. All told, the two T-28's carry sufficient firepower to deal with any size Viet Cong force that may attempt to ambush the train.

The single-seat A-1H fighter-bomber (former AD-6 Navy dive bomber) is the big brother to the T-28 in the VNAF. With its 12 external under-wing bomb racks and four 20-mm wing-mounted cannons, the A-1H packs a heavier firepower than the lighter T-28.

On the road the frequency of Viet Cong ambush of military truck convoys moving personnel and equipment became critical as U.S. military assistance increased. Weapons and ammunition badly needed by the Communists were removed from the dead and wounded victims of the ambush by the insurgent forces.

The techniques for truck convoy ambush varied, but it was a more deadly game than railroad ambush, with the objective to kill, steal, and destroy. In either case, train or truck ambush, by the time rescue forces arrived at the scene the elusive enemy had faded into the countryside.

First step in the evolution of air escort to surface travel in Viet Nam came in the form of strip alert for fighter aircraft on bases in various sections of the country. Upon receipt of a radio warning of an ambush or impending ambush, the fighters would scramble to the scene. It was quickly learned that in the time lapse between scramble and arrival at the ambush area the Viet Cong had completed their damage and disappeared.

Continuous air escort from point to point was the next step. This tactic proved highly successful and was adopted as operational procedure.

Air escort today normally comprises a force of three aircraft, one L-19 forward air controller liaison plane and two T-28's or A-1H's (AD-6's). Frequently one B-26 substitutes for a pair of fighters. The L-19 FAC serves as a radio relay station between radio operators on each end of the train or truck convoy and the circling fighters or light bomber. It also acts as target spotter and attack director for the heavily armed fighters in case Viet Cong ambush is detected or groups of Viet Cong are spotted near the road or rail line. The L-19 flies at low altitude, weaving, "essing," or circling over the slow-moving train and out ahead to inspect the tracks, bridges, and areas paralleling the road or rail bed. Orbiting in the near vicinity, sometimes sweeping low alongside or ahead of the train or truck convoy, the armed fighters always stay within strike distance, ready to react to the command of the L-19 FAC aircraft.

Every freight and supply train traveling the government's one rail line is now escorted by VNAF tactical aircraft between certain points where the Viet Cong are most likely to strike. Generally speaking, these points are in mountainous or heavily wooded areas.

Because of central government control of rail traffic, the problem of scheduling air escort for trains is a small one. This is not the case in the military truck convoy department. Army of Viet Nam units are spread throughout the country. Local commanders schedule their own convoy movements, and it is their personal responsibility to request air escort from the Joint Air Operations Center (JAOC). Unfortunately many convoys continue to travel the open country without air escort. It follows that enemy ambush still occurs, and of course when it does happen it attracts press headlines.

Statistics portray the rising utilization of tactical air escort for train movements in the Republic of Viet Nam. In the five-month period August through December 1962, aerial escort sorties for trains numbered less than 100. In the first five months of 1963, air escort missions for trains rose to nearly 250, a 150 per cent increase. Comparable figures on air escort for ground forces truck convoys during these same periods show very little increase in the utilization by ground force commanders of this successful tactical air technique. In the August–December 1962 period truck-convoy escort sorties numbered around 180, while the January–May 1963 sortie figure stood at about 200.

The only category in which VNAF tactical air escort sorties have declined significantly in this comparative time period is in air protection flights for U.S. Army helicopter operations. The drop here has been from over 700 in the August–December 1962 period to around 350 helicopter escort sorties from January through May 1963. Tactical air escort for helicopters is flown by the VNAF, using T-28, A-1H, or B-26 aircraft, only when requested by ARVN officials and their U.S. Army advisers.

Greater use of air protection, most Air Force officials feel, is a matter of education. Until ground commanders learn to take advantage of it and coordinate their convoy movements with the JAOC *and request air escort*, little can be done to wipe out this remunerative Viet Cong tactic that provides the insurgents a source for arms and ammunition.

As the number of tactical air escort missions increases, the number of Communist Viet Cong ambushes and the amount of ground-fire opposition decline. While air escort is no permanent panacea for this military problem, it does offer the best

solution available to date. This conclusion rests on the fact that not one rail shipment or truck convoy air-escorted by VNAF aircraft has been hit by Viet Cong ambush.

Experts credit the success of this COIN air technique largely to the fear which the Viet Cong forces have of tactical air power. It has been proved from captured Viet Cong soldiers and documents that the presence of escort aircraft—even one unarmed L-19 weaving over and ahead of a slow-moving freight—has been sufficient to deter the Viet Cong from carrying out a planned ambush.

The rapid reaction capability of the fixed-wing tactical aircraft, combined with its selective variety of firepower, makes it the one counterinsurgency weapon that can counter decisively the Viet Cong's operating techniques in the rugged mountains, jungles, and swamps of Southeast Asia. The Viet Cong have a deep respect for the capability of the tactical air weapon.

Hq Pacific Air Forces

RESUPPLY IN THE PICKLE BARREL

THE USAF aircrews resupplying many isolated COIN outposts or footholds deep within Viet Cong-infested territory prove daily that they can hit the pickle barrel with paradropped bundles.

The C-123 assault transport is the mainstay of the airlift for COIN warfare in Viet Nam. In combat cargo missions alone this versatile aircraft airdrops 10 to 15 tons per day in small packages of food, ammunition, weapons, and medicines to remote strategic hamlets, Vietnamese government outposts, and U.S. and Viet Nam Special Forces detachments.

The paradrop zone is normally marked with a circle 50 feet in diameter as near as possible to the fortified compound or bivouac. Pinpoint accuracy is mandatory to prevent the supplies from falling into the hands of the always lurking Viet Cong guerrillas. The drops are usually made from altitudes of 200 to 500 feet, depending on the terrain. USAF aircrews have developed the bull's-eye technique to perfection.

An armed Viet Nam Army outpost from the copilot's position of a C-47. A fenced and ditched perimeter guards the compound. Troops are housed in the typical Vietnamese thatched structures. Such isolated outposts, with no surface roads for access, must depend entirely on aerial paradrop missions for food and supplies.

Point defense position of a remote Vietnamese post. Artillery weapons in circular revetments have 360° field of fire against ground attack.

Paradrop chutes with cartons attached are launched from inside a C-123. Hitting the drop zone takes trigger-quick coordination and actions between the loadmaster in the rear compartment and the pilot up front. The rough, densely forested mountain terrain, so characteristic of much of Viet Nam, makes a hazardous job even more dangerous.

Self-loading accuracy. A paradrop carton almost settles into a waiting truck parked in the drop zone. The 50-foot circle, marked by strips of white canvas in right foreground, forms a bull's-eye target for the aircrews. Additional paradrops have clustered all cartons in a very small area. Vietnamese soldiers from a nearby outpost recover supplies before guerrillas arrive.

The sturdy, dependable C-123 assault transport returns to base accompanied by Viet Nam Air Force T-28 fighter escort, after completing several paradrop missions. The swollen stream and dense forest are typical of the terrain in the southern delta region.

COMMAND AND CONTROL AND THE DECISION-MAKING PROCESS

LIEUTENANT COLONEL CLIFTON L. NICHOLSON

COMMAND AND CONTROL: what is it and why all the emphasis? It has been vaguely thought of as everything from command systems in support areas, such as research and development, logistics, and supply, to the guidance systems in drones and surface-to-air missiles. There is really nothing new about command and control or command and control systems. Military commanders have always devised organizations and methods to secure knowledge needed to make intelligent decisions and issue intelligent commands. However, the time compression brought about by new weapon systems has established requirements for decisions to be made within minutes on matters of national security. The problem is to mechanize the flow of information required in the decision-making process in order to keep pace with modern weapons. This, of course, requires an understanding of (1) the basic decision-making process, (2) the assistance that can be provided to the decision-maker by technology, and (3) the military commander's requirements.

In order to clear up any misunderstanding, the standard military definition for command and control is: an arrangement of personnel, facilities, and the means for information acquisition, processing, and dissemination employed by a commander in planning, directing, and controlling operations.

A command and control system is a composite of equipment, skills, and techniques which is capable of performing the clearly defined function of enabling a commander to exercise continuous control of his forces and weapons in all situations by providing him with (a) the information needed to make operational decisions and (b) the means for disseminating these decisions. A complete system includes all subsystems, related facilities, equipment, services, and personnel required for operation of the system so that it can be considered a self-sufficient unit in its intended operational environment.

From these definitions it is evident that a command and control system can exist at any level of command where decision-making authority resides regarding the control of forces. This system, at a lower command level, can also be a subsystem of a higher-echelon command and control system. All these systems then become subsystems of a national system responsive to the President as commander in chief of the armed forces. The total system, if properly designed, should provide each level of command with the information

needed to make appropriate decisions. These decisions and execution orders should follow established command channels to ensure proper delegation of authority and responsibility, which has proved to be the most important key to successful military management.

the decision-making process

An understanding of the fundamentals of the decision-making process is necessary prior to the design of an automated command and control system. Many erroneous images of the decision-maker exist. Some see him as a commander who suddenly rouses himself from thought and issues an order. Others see him as a happy-go-lucky fellow with a coin poised ready to risk his action on a toss. Still others see him as a commander at a staff meeting in the process of saying "yes" or "no." All these images ignore the whole lengthy, complex process of alerting, exploring, and analyzing that precedes the final decision.

Decision-making comprises three principal phases: determining the necessity to make a decision, finding possible courses of action, and choosing among courses of action. The amount of time spent on each phase depends upon the level at which the decision is to be made. Only a small fraction of the time involved is spent in making the final decision or choice, while the majority of effort is spent on the other two phases.

Decisions are generally of two types: programed decisions and nonprogramed decisions. Decisions are programed to the extent that they are repetitive or routine. They are nonprogramed if they are novel, if there is no cut-and-dried method for handling the problem since it has not arisen before. Such was General Eisenhower's D-Day decision in Europe.

Traditional techniques for programed decisions have usually been understood and applied. Habit is the most general of all techniques. The collective memories of organizational members are vast encyclopedias of factual knowledge, habitual skills, and operating procedures. Closely related to habits are standing operating procedures. While habits are recorded in the central nervous system, standing operating procedures are formal, written programs. These recorded programs provide a means for bringing habitual patterns into the open where they can be examined, modified, and improved. An organizational structure is itself a partial specification of decision-making programs. It establishes a common set of presuppositions and expectations as to organizational responsibilities for decisions; it establishes subgoals to serve as criteria of choice in various parts of the organization; and it establishes operational data-collecting and reporting responsibilities in particular organizations so that they can communicate events requiring attention to appropriate decision points.

Traditional techniques for nonprogramed decisions are not easily described. When executives or military commanders are asked how they make unprogramed decisions they generally describe the use of "judgment," which depends upon experience, insight, intuition, and possibly creativity. This does not really explain the process and leads to further examination. One thing that is known is that training in orderly thinking helps in nonprogramed decision-making. The military "estimate of the situation" is an excellent example of such a procedure. It is well known that some men have developed the decision-making skill much better than others. This skill is developed through professional training in basic principles and through experience and job rotation that the organization itself provides. The detailed process of acquiring decision-making skills is as mysterious as the basic learning process. The only known technique for improving nonprogramed decision-making is to select men who have demonstrated a capacity for it and continue their training and planned experience.

electronic data processing

The introduction of the computer and electronic data-processing techniques in the

area of programed decision-making has extended the range of accuracy of programable decisions in many areas. While computers were initially conceived as devices for solving mathematical problems, it gradually became clear that there were other ways of using them. If a model or simulation of a situation can be programed for a computer, the behavior of the model can be ascertained over a whole range of conditions. The computer then becomes a powerful tool to assist the decision-maker in all decision areas. The computer, of course, cannot have insight or be creative and can only do what it is programed to do.

In general, problem solving proceeds by establishing goals, detecting differences between present situation and goal, finding in memory or by search the tools or processes that are relevant to reducing the differences, and applying these tools or processes. Each problem is normally broken down into subproblems. Each subproblem is then broken down into others until a subproblem is found that can be solved. By successive solution of such subproblems the overall goal is eventually achieved—or given up. This general technique of problem solving can be programed in a computer, e.g., chess and checkers playing programs that are capable of beating proficient players. It is this type of program that suggests future innovations in the use of computers to assist in the decision-making process.

desired concept

In the desired concept, the information base required for automating command operations is the primary concern and the direct task of the commander's staff. This staff must also maintain the information base, develop plans, lay out programs, establish planning factors, specify operating procedures, etc. Thus it is from the daily work of the staff, from the dynamic perspective of the command context, that the specifics of the informational requirements of a command center must be generated.

Extreme care must be taken in establishing the data base in a command center. Consider all the questions a commander *could* ask. The number is virtually infinite. For example, there are several thousands of the form "Where is the _____?" or "Who is commander of the _____?" Let us say, for the sake of argument, that on any given day he *could* ask any of one billion questions. However, the chance that he may ask a given question is not random. There are certain questions which he is almost certain to ask; others he is almost certain not to ask. The important thing to recognize is that the *estimate* of that probability is a very nonlinear function of the efficiency of staff work. A poor staff will have only a hazy idea as to what the commander is thinking, and therefore it may be forced to prepare for a wider range of possible questions than necessary. Indeed, it is the feeling of inadequacy in keeping in close touch with what is really relevant that prompts the desire to have more and more facts around "just in case." The first-rate staff anticipates what information the commander will require. In fact, by anticipation of the problems and considerations that are going to arise, by being acutely aware of his traits and habit of mind, the staff leads his thoughts and conditions his interests.

Unless the information base is established by the staff as a result of real and present needs, the volume of data can climb astronomically while relevance plummets and the system becomes glutted by "information" that does not inform. This problem is greatly aggravated by industry's encouragement of the designing of such systems around elaborate electronic equipments and the conducting of "systems analyses" by civilian engineers whose training has been predominantly in hardware or computer programing and *not* in the concrete problems of military leadership or the rigors of the military staff.

The essence of the concept of operational control systems can be stated concisely:

(1) The information base of the command center will be maintained by the center staff

in the memory of the center's computer system.

(2) The computer itself will act merely as a highly sophisticated communications device serving the staff by linking its members directly with the information base.

(3) Each command staff office will have direct access to the information base on a nearly instantaneous basis through its own console or display units.

(4) The system will allow multiparallel access to the computer system for all staff offices.

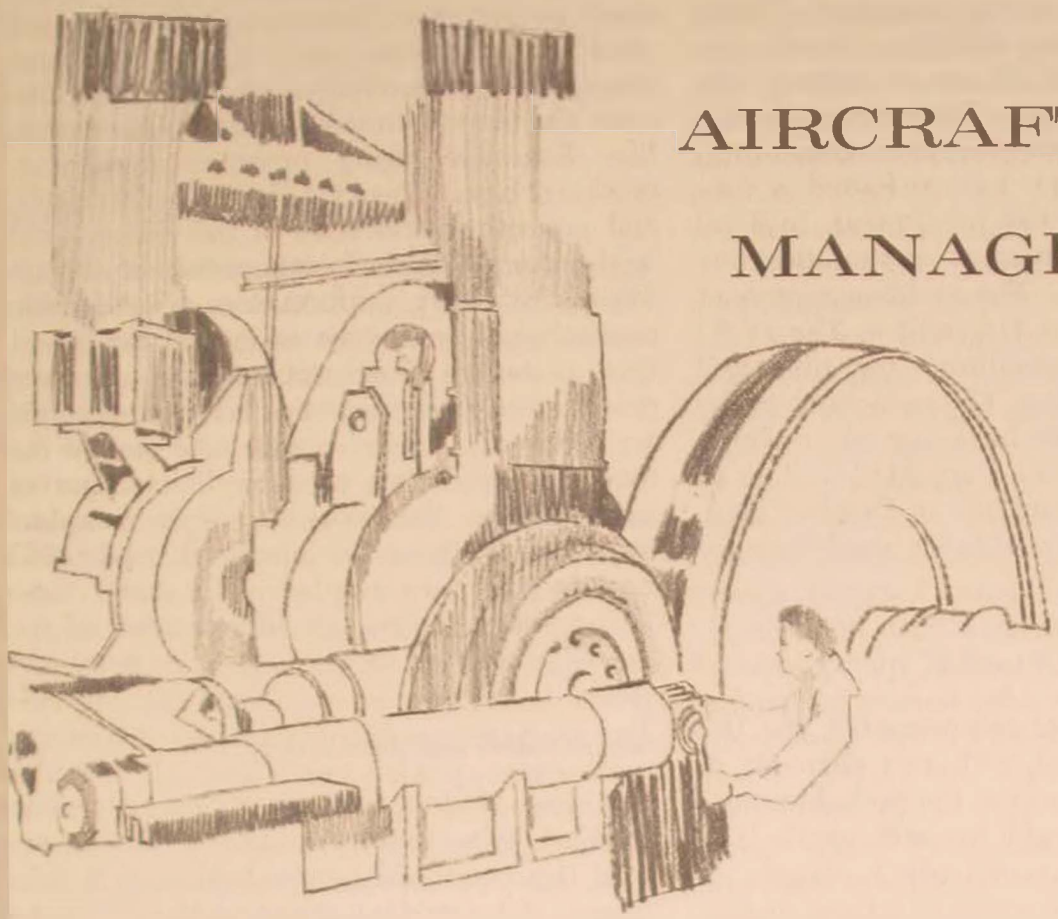
Thus the information base in the computer system becomes a dynamic tool for the command staff. The information base in the computer system is solely the product and responsibility of the staff. Each staff office maintains that part of the base for which it is responsible. The information base becomes in fact the context of command, as current as the staff maintains it, as responsive as the staff molds it to staff needs, and as sophisticated in its calculations as the staff is sophisticated in carrying out its functions.

This concept of automating command operations is the only one that has the potential of greatly enhancing command capability in the time-tested patterns of military command doctrine. It augments the capability of a commander and his staff to exercise command prerogatives, rather than putting him in the position of a spectator overwhelmed by facts about events that are already history.

FROM THE initial definitions it is seen that command and control is an organized decision-making process which, within the concept discussed, is particularly amenable to automation through the use of computers and data-processing equipment. This includes both the operational and "business" areas within the military. Under this concept, each staff functional area or agency supporting the recently approved National Military Command Center must analyze its own activities to determine the desired information base to be put into a computer in conjunction with the desired programs and operating procedures. The information requirements established at the national level prescribe the inputs desired from the next lower level of command. This principle then continues down through normal channels of command to the lowest level. It is obvious that each subelement of the national system must be compatible with higher-echelon systems in terms of data elements, codes, and operational language. Therefore the design of command and control systems will tend to be a relatively centralized function, with representation from each functional area working intimately with the appropriate technical personnel.

The recent emphasis on military command and control has resulted from the realization that electronic data-processing equipment can greatly assist commanders at all levels to make accurate and timely decisions that otherwise could not be made without considerable human effort. Such automation presently in progress will most surely result in proposals for major changes in organizations and level of authority and responsibility. One thing, however, must not be forgotten concerning military command and control automation: that is, a peacetime system must not be devised that cannot operate under wartime conditions. The appropriate delegation of authority and responsibility will be as valid in any future war as it has been in past wars. Individuals properly trained and experienced in the decision-making process *remain* the most valuable asset in any command and control system.

Hq United States Air Force



AIRCRAFT TIRE MANAGEMENT

COLONEL ELMER G. PROHASKA

SATISFYING Air Force customers' needs for aircraft tires is one of the most important responsibilities of the Air Force Logistics Command and, more specifically, of the Ogden Air Materiel Area.

Contrary to popular belief, aircraft tires and ground vehicle tires are alike only in that they are both round and mounted on wheels. The essential need for aircraft tires that can safely withstand the stresses of high-speed take-offs and landings and the great weights of modern aircraft is obvious. The difficulties faced by the tire inventory manager at Ogden Air Materiel Area stem primarily from a multitude of intangibles which are both difficult to predict and control. He has the dual task of reducing these uncertainties to known planning factors and at the same time finding ways and means to perform his job at reduced costs. Some of the tire manager's support problems, their solutions, and the management techniques employed to minimize support costs merit closer consideration.

inventory

To support 52 aircraft types, ranging from the L-20 to the B-58, 248 different tires are procured, stored, and distributed to approximately 400 bases worldwide. The present 248

master stock numbers represent a reduction from 400 master items, a reduction that stemmed from a comprehensive Air Force/industry analysis of tire requirements. This is a continuing program, with the ultimate objective of having but 125 master items in the Air Force tire inventory. This item reduction program, coupled with other management improvement techniques, has permitted a substantial reduction in tire investment. In fiscal years 1959–61 the average annual tire buy exceeded $39 million. The FY 62 procurement was slightly less than $15 million. The FY 63 actual obligated expenditure for tires and tubes was $12.7 million. The reductions in the procurement program have served to lower the total tire inventory from $112 million in October 1960 to $43 million in October 1962, the date of the last worldwide stock balance report.

tire life

In computing tire requirements, the tire manager is concerned with two elements of tire life. The first concerns the probable number of landings that each tire will accrue. The unpredictability of demand which plagues all materiel managers is present to a large degree in making this estimate. The many combinations of relative crew proficiency, aircraft loading, and runway serviceability cause consumption rates to vary greatly on both sides of the estimate. The second element is the shelf life of a tire. Jet aircraft tires have a service life of three years; reciprocating-engine aircraft tire life is five years. These obsolescence factors represent the skeleton in the tire manager's closet, since he must avoid unacceptable losses due to obsolescence. (This need has led to such programs as the "hand me down" concept of tire retreading and the ground vehicle program, each of which is discussed later in this article.)

tire storage

Cool, dry, and dark areas afford the ideal conditions for tire storage. Temperatures above 80 degrees are detrimental and induce early deterioration. Wet or damp conditions, as well as strong air currents, are avoided as much as possible. Tires stored in a vertical position experience less deterioration than those stored horizontally. The age of an aircraft tire plays an important role in its service life. Excessive aging promotes hardening, cracking, ozone checking, loss of volatile oils, and general deterioration of the rubber used in the tire. All these factors reduce or detract from satisfactory performance. Considerable research has been done to extend the life of tires in storage. Good stock control and issue practices relative to issuing oldest items first are followed. Colored plastic tape around the tread is now being used to denote year of manufacture. For example, tires manufactured in 1962 have a white band, while 1963 manufactures are banded with green tape. This permits positive age identification of the tires at all storage sites.

transportation and distribution

Most aircraft tires are manufactured in the East. When Shelby AF Depot, Ohio, managed this commodity, cross-hauling was minimized. After OOAMA assumed the inventory function upon phaseout of Shelby AF Depot in 1958, single-point depot distribution involved contractor deliveries from various Eastern plants to Hill AFB, Utah. Customer requirements were then filled by distribution from OOAMA's single-point storage. A study was undertaken to determine the optimum distribution pattern. Two basic conclusions were reached. It was determined that four types of tires were required in such large numbers that a direct vendor-to-user distribution pattern would be feasible. During the first half of FY 62 this procedure permitted a savings of over $30,000 in transportation costs. The second conclusion, that other tires should be distributed from more than one storage point, resulted in the designation of two storage and shipping locations in addition to OOAMA. These locations are the Middletown AMA, Olmsted AFB, Pennsylvania, and Okla-

homa City AMA, Tinker AFB, Oklahoma. The geographical areas serviced by the three activities are reflected in the accompanying map. In addition to shortening the depot-to-user pipeline, this three-point distribution pattern will save approximately $1 million in transportation costs annually.

maintenance/failure reporting

The maintenance data collection system prescribed by AFM 66-1 has provided an extremely useful tool for the tire manager. When tires are removed at base level, for any reason, a failure data card containing a description of the failure, when discovered, and other supporting data is prepared and routed into the data-processing system which supports the data-collection system. From the reports furnished the inventory manager, mean-time-between-failures (MTBF) can be established or revised, and necessary materiel improvement projects (MIP) can be established which may lead to changes in tire specifications and technical manuals. Such data, properly analyzed, can also pinpoint bases that experience an excessive number of irregularities, such as foreign-object damage to tires. Accumulated failure data may also form the basis for initiating research and development projects to increase tire service life or otherwise reduce costs. When used in conjunction with tire issue and usage information, these failure data also serve a useful role in the determination of quantitative requirements for tires.

tire retread program

Through extensive laboratory and field testing, it has been determined that a restricted aircraft tire retread program is practical, safe, and economical. Retreads can be used on the B-47, the B-50, the KC-97, the KC-135, the B-57, and the B-66. New tires only can be used on the B-52, but B-52 tires can be retreaded and used on the B-47. New B-47 tires, when due for retread, can be retreaded and used on the B-50 and KC-97. The use of retreaded tires on aircraft other than the type on which originally installed is referred to as the "hand-me-down" concept. Tires for the KC-135, B-57, and B-66 can be retreaded and reused on the same type aircraft. Two retreads of a given tire are permissible in these instances. With an anticipated recovery rate of 35 per cent on new tires and 45 per cent recovery of the first retread, it is estimated that $2.8 million of "new buy" cost can be avoided annually.

Serviceability standards are of course much higher for aircraft tires than for ground-vehicle tires. In the past aircraft tires that could no longer be used on aircraft have been disposed of as scrap rubber. Air Force studies indicate that many such tires have sufficient service life remaining to warrant use on ground vehicles—an extension of the "hand-me-down" procedure. Such tires fall into three groups. Group I can be mounted on ground vehicles and used immediately without modification. Group II tires require minor modifications for ground-vehicle use, such as slight trimming of the tire bead to permit mounting on the vehicle rim. Group III tires require modification of both the tire and the ground-vehicle wheel. Phase tests in Group I and II have been completed, and Phase III tests are under way. The potential savings in this program are extensive, as indicated by the volume shown in the accompanying tire usage chart.

tire improvements

Improved tire technology has been a joint Air Force/tire industry effort for many years. Keeping pace with the rapid technological advances in aircraft design, increased loads, and higher take-off, landing, and taxi speeds has been difficult.

As previously stated, there are few similarities between an aircraft tire and a ground passenger vehicle tire. The accompanying tire comparison chart indicates the superior technical requirements for the aircraft tire as compared to a ground passenger vehicle tire. The passenger tire listed is used on some American compact cars. The aircraft tire is used on the F-104. Similarity of the two tires ceases with

Aircraft Tire Usage on Ground Vehicles

Aircraft Tire Size	*Aircraft Application*	*Annual Wear-out Generation*	*Ground-Vehicle Application*
18x4.4	F-100D, F	20,792	Mowers, wheel-barrows, motor scooters
18x5.5	F-101 nose	13,308	Power mowers, motor scooters
30x8.8	F-100/102/106 main	84,000	Fork lifts, pickup trucks
38x11	C/KC-135 nose	3,240	Vehicles with 750x18 tires
44x13	B/RB-57 main	1,656	Vehicles that use size 1100x20 tires, such as dump trucks, dollies, etc.
24x7.7	F-105 nose	2,964	GAM-77 trailers

Tire Comparison, Aircraft v. Passenger Ground Vehicle

	Aircraft	*Passenger*
Size	25x6.75	6.50x13
Diameter, outside (inches)	25.0	25.0
Section width (inches)	6.50	6.50
Ply rating	18	4
Load rating (pounds)	13,000	835
Deflection (per cent)	32	17
Maximum speed (mph)	275	100
Efficiency (load lb/tire lb)	400	40
Rated inflation pressure (psi)	300	25

diameter and section comparison. The F-104 tire is 18-ply, the automobile tire 4-ply. The load rating ratio of the two tires is 15:1, or 13,000 pounds to 835 pounds. Deflection (bending) requirement of the aircraft tire is 32 per cent or nearly twice that of the auto tire at 17 per cent. Although aircraft ground speed is intermittent as compared with the consistent speed of an automobile, the F-104 tire must withstand speeds up to 275 miles per hour. One of the most significant indexes of relative quality is the tire load capacity per pound of tire weight. In our example the load is 10 times greater on the F-104 tire than on

the automobile tire. Inflation pressures are directly proportional to tire load. Since 1945, when 120 psi was maximum for Air Force aircraft, inflation pressures have risen steadily until today they stand at 300 psi.

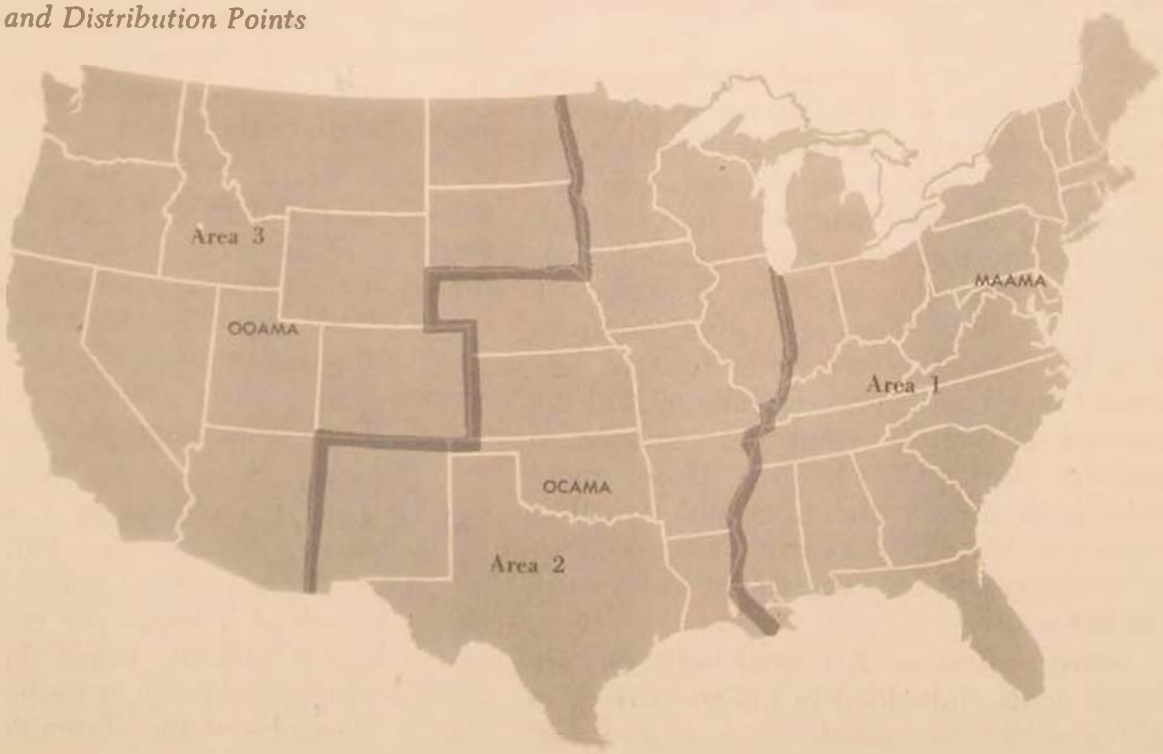
About the time that speed and inflation requirements became significantly critical, tubeless tires were introduced. Although these helped, they created other problems, such as diffusion of the air through the carcass and leakage at the bead seat area. This diffusion of air increases the tendency toward separation because of increased pressure throughout all plies and components. This is plausible when one considers the amount of stored energy from high inflation pressures. The tire used on the B-52 has 603,000 foot-pounds of potential energy, sufficient to put a piece of tread the size of a golf ball into orbit.

Prior to the jet age, nose-wheel and tail-wheel tire loads decreased with increased runway speeds during take-off so that maximum loads were existent only for short periods. For this reason increased loads during braking were permissible. However, with radical aerodynamic changes in modern aircraft, nose-wheel tires are now held on the runway at high speeds under high dynamic loads. While considerable research and development is still needed in this area, substantial improvement has already occurred. In 1945, 222 pounds of load was carried for each pound of tire weight on a typical aircraft tire; by 1950 this had increased to 310 pounds, by 1955 to 375 pounds, and today is up to 400 pounds. This increased efficiency has been attained with added safety, despite the increased severity of utilization.

The constant search for improved designs to utilize available materials in the most efficient manner has resulted in two major design contributions: low profile tires and utilization of reinforced or fabric treads.

Another major industry contribution to safer tires is its ability to test tires under conditions similar to those to which they are subjected while on the aircraft. Aircraft tire-testing today is a rather complicated process, necessitating complex equipment satisfactory for programing all variations of tire loads and speeds as well as incorporating other required features, such as camber, yaw, and the heating of tires experienced on supersonic aircraft.

Tire Storage and Distribution Points



The tire industry has invested large sums for procurement of testing equipment to duplicate realistic operating conditions.

Typical test equipment is the 320-mph "runway" facility used to create 1970's tires today. It is housed in a specially designed building to accommodate the most advanced concepts in dynamometer technology. The test wheel is spun by two electric motors delivering 8600 hp with maximum torque of 50,000 foot-pounds. It can spin a tire under rated load from standstill to 300 mph in only 18 seconds. Simulated take-off and taxi loads of over 80,000 pounds can be imposed on tires from 16 inches to 6 feet in diameter. The opposite end of the motor shaft drives a unique tire-on-tire test unit that appraises new materials, designs, and construction at a top speed of over 500 mph. All four test units of the machine can be operated independently at any desired load or speed. Tires can be preheated to 800 degrees F to simulate the effect of supersonic flight. Yaw and camber up to 15 degrees can also be introduced. Precise control of all operations is afforded by complex electronic instrumentation, both automatic and manual. An electronic programmer, following taped instructions, programs tests, which are recorded and monitored via closed-circuit television for safety.

The need for a material combining some of the properties of both rubber and steel is very real, to keep pace with new developments in other components of our aerospace vehicles. With this realization, many thousands of dollars and man-hours are being expended in research and testing in an effort to produce a material that will effect substantial improvements in tires. The transition to this new material may come very suddenly, as did the necessary conversion from pure rubber to synthetics during World War II, or more gradually as in the switch from tube-type tires to tubeless. Some of the current tire specification improvement projects scheduled for early completion are:

Wear Indicators. Tire wear indicators are colored cords embedded in the tire casing so that operating personnel can readily determine when a tire has reached its maximum-wear service life. Many different cord colors are being used today. The object of this specification change is to standardize the colors to be used.

Tread Reinforcement. The tire improvement needed in this area amounts to a tread that will withstand foreign-object damage and increase service life.

Ice Grips. Ice-grip tires have the tread loaded with wire bits. The size, length, and amount are being standardized and will be included in the specification at the conclusion of a test program.

Tread Pattern. Operational usage and tests have proved that grooved treads give better service on high-performance aircraft than dimpled or other types of tread. Further tests are being conducted to determine and standardize the quantity of grooves required per tire.

Wear Criteria. Tread patterns and traction qualities have a definite bearing on wear criteria. Wear requirements are being defined and will become a part of AF specifications.

Tread Vulnerability to Foreign-Object Damage. Laboratory tests provide certain information; however, field experience is being obtained through the maintenance data-collection system. Tire improvements will ensue from analysis of these data.

Dimensional Tolerances. All dimensional tolerances maintained by the tire manufacturers must be compatible with those maintained by the airframe contractor. If tolerances are relaxed, operational problems develop (e.g., tires overgrowing wheel-well envelopes). Dimensional tolerances in current specifications need to be tightened.

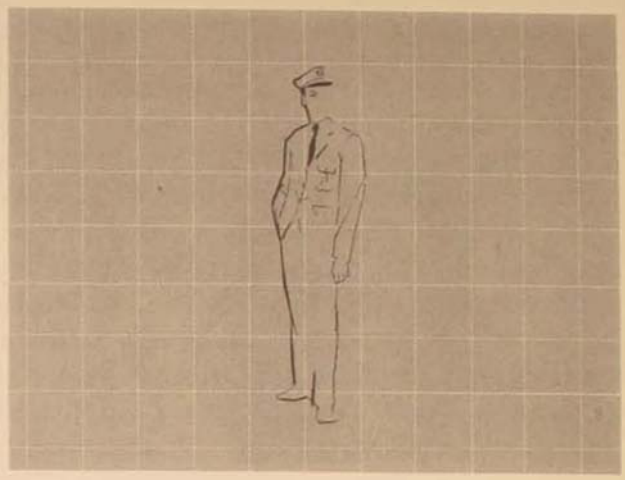
Deflection Parameters. In dynamometer testing, deflection parameters are inadequately controlled (i.e., 32 per cent plus 3 per cent or minus 4 per cent). Qualification on the dynamometer at a lower per cent deflection and a higher inflation range does not adequately duplicate the temperatures incurred during operation at the allowable higher per

cent deflection. Specifications are being upgraded to overcome this deficiency.

THE AIR FORCE and the tire industry, working side by side, have made substantial progress in improving the quality of aircraft tires and in the management of this high-dollar-investment program. Many additional improvements are foreseen, and, particularly on the technical side of the program, they are essential to keep pace with technological advances in the aircraft programs to be supported. Most of all, a concentrated research and development effort is needed to produce the breakthrough that will create a tire material which provides a completely safe, longer-wear tire for use on both the current and future aircraft fleet. As Major General Don Coupland, OOAMA Commander, recently put it to an Air Force/industry meeting: "While I'm not in the development business, I would like to urge the entire industry to go 'way out.' My idea of the tire we need is one that is vastly different from the one we are all accustomed to seeing in the warehouse today."

Ogden Air Materiel Area

Air Force Review



JOB-KNOWLEDGE TESTING IN THE AIR FORCE

Dr. Chester J. Judy

JOB-KNOWLEDGE tests have long been used by the military services, but little of their history is documented either in the literature on testing or in that edited for the professional military person. Although tests of the aeromechanical skill of enlisted personnel have been used since the Twenties, aeronautical job-knowledge testing has received its chief impetus and development during the past fifteen years. Through research, experimentation, and validation these job-knowledge tests constitute a major factor in the evaluation of USAF enlisted personnel.

The first extensive use in the United States of examinations for men engaged in military aeronautical activities came after the passage of a bill by the Congress elevating the air arm of the Army to a corps, the Army Air Corps, in 1926. At this particular time many of the better qualified men were leaving the Army Air Service. The Congress therefore allowed the Army Air Corps to establish procedures for identifying preeminently qualified personnel who would be eligible to receive supplementary pay for duties essential to flying. To that end, Air Mechanic (AM) ratings were established. Eligibility for these ratings became, in part, a matter of a candidate's being able to perform relatively well on a paper-and-pencil test covering his job. A *practical* grade, however, based upon performance, was added to written test scores to arrive at an overall evaluation for each examinee. By mid-1928 some 900 men from a total of 9500 enlisted persons in the Army Air Corps held AM ratings. In

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1930 the corps enlisted strength had climbed to 12,000 men, and 1500 of them were rated AM's.

The examinations used in AM testing were assembled from the item files maintained at the service training centers, where the subject matter of part of the curriculum was the same as that of the required tests. Questions in the modern paper-and-pencil format were chosen to sample information assumed to be important for those individuals who were, or were soon to be, responsible for maintaining aircraft, aircraft engines, aircraft electrical systems, aircraft hydraulic systems, or other such equipment or subassemblies. In each examination an attempt was made to duplicate the relative emphasis given the various topics in particular courses. In an engine examination, for example, 15 questions might touch on the topic of carburetion, 25 might touch on the topic of ignition, 10 on lubrication, and so on.

In the years immediately before World War II an extensive series of job-knowledge examinations was developed for the AM testing program, and most enlisted persons working in aircraft maintenance activities had opportunity to take one or more of these tests. However, with the expansion of the armed forces at the beginning of World War II and organization of the Army Air Forces, the AM testing program and AM ratings were abandoned. Instead, those holding these ratings were given advanced rank to compensate for the loss of AM pay. It was evident at the time that many of the AM duties required highly intelligent and able men who either were not to be found in the lower grades or should not have been kept there. Yet under the AM system it had been possible for a person in the grade of private to earn as much as a technical sergeant, excluding rations and quarters allowances. In 1941, the last year the system was used, 8500 men from a total enlisted strength of 134,000 held AM ratings.

During World War II no explicit attention was given to the further development and use of job-knowledge tests. But with the establishment of an independent Air Force and the initiation of a Career Guidance Program after the war, the making and giving of job-knowledge tests again became a large activity. Three separate programs were started, each with a slightly different orientation and with slightly different overall purposes. Two of the programs were established within Air Force research organizations where job-knowledge tests were developed as necessary or preliminary parcels of the total research effort. The tests developed in one of the research units evolved into operational tools of continuing value. The third program, which extended in time beyond the experimental efforts of the research organizations, was an outgrowth of the career guidance concept and is still in existence. To enable the interested reader to learn more than the basic history and underlying educational philosophies of these first three Air Force test-development organizations, a few key references will present information concerning the characteristics of the examinations these organizations devised.

Technical Training Research Laboratory, Chanute AFB (1949–52)

Procedural aspects of research on job proficiency conducted within the Human Resources Research Center (HRRC) of the Air Training Command required the development of measures on a number of hypothesized kinds of job knowledge such as "basic" knowledge, "functional" knowledge, or "troubleshooting" knowledge. Altogether, about 50 tests were constructed by or under the contract sponsorship of personnel of the Chanute laboratory. These tests covered a number of the more important technical specialties of the time and were used extensively in the research program of the laboratory. All were paper-and-pencil tests, and most were multiple-choice in form. Demaree *et al.* present a good description of tests used in one study on the proficiency of Q-24 radar mechanics.[1] The "Tab" test used in that study demonstrated an early, if not the first, application of "branch programing," which has come to be associated with the name of Norman Crowder in the field of automated instruction. Other members of the laboratory have reported research in which prominent use was made of the tests constructed at the laboratory.[2, 3, 4]

The Chanute tests are now of historical interest, principally. Acceptable levels of accuracy (reliability) and relevance (validity) were attained, but the extended use of permanently assigned technical experts and the additional use

of highly qualified technical representatives from manufacturing concerns made the test-development operation an expensive one. So far as the writer is aware, no subsequent attempt has been made to duplicate the procedures or any of the special kinds of tests pioneered by the Chanute group.

Human Resources Research Laboratories, Bolling AFB (1949–52)

As compared with the Chanute enterprise, a somewhat greater amount of attention was concurrently and later given to the matter of job-knowledge test construction by elements of the Human Resources Research Laboratories (HRRL), Headquarters Command, USAF. There, also, a critical need existed for good measurements of job knowledge that could be used in researching on-the-job proficiency. The initial emphasis was on oral examination techniques, in which specially trained evaluators were needed.[5] Later, paper-and-pencil tests, constructed with the help of experienced airmen, were substituted for the oral examinations.[6]

After HRRL became the Human Factors Operations Research Laboratories (HFORL) under the Air Research and Development Command in 1952, a larger program was started in which an attempt was made to provide examinations covering the jobs of airmen responsible for the maintenance of all major weapon systems then used by the Strategic Air Command and the Air Defense Command. When HFORL became a part of the Air Force Personnel and Training Research Center (AFPTRC) in 1954, additional tests on the pattern established by HRRL were prepared, published, and used by the Strategic Air Command and the Air Defense Command. A report by Morsh gives detailed information on one of the tests constructed under the sponsorship of HFORL.[7] One of the last examinations constructed under the sponsorship of AFPTRC (which was dissolved in 1958) covered the knowledges necessary on the part of personnel responsible for the maintenance of B-52 aircraft. The development of this test has been described by Buckner.[8]

Unlike the Chanute tests, written examinations of the variety which derived from the early research at HRRL are of more than historical significance. They continued in use after 1958 within the Strategic Air Command, and tests covering assigned equipment (or assigned jobs) seem to be a continuing requirement for the evaluation of command job training programs.

2200th Test Squadron, Mitchel AFB (1953–58)

In 1949 two new units were established, one in the Air Training Command at Scott AFB and the other in the Air Materiel Command at Wright-Patterson AFB, for the purpose of constructing job-oriented tests for the selection of Air Force warrant officers. The two units were expanded to include the development of other job-knowledge tests required in the new airman career program, and the total workload eventually became so great that a third unit was established in the Continental Air Command at Mitchel AFB. In 1953 the three units were consolidated and designated as the 2200th Test Squadron, which on 1 January 1958 was reorganized as the Airman Proficiency Test Branch, Personnel Laboratory, Lackland AFB, then a part of the Wright Air Development Center. As of May 1963, approximately 225 tests are being developed or revised annually, so that a goal of a revision every two years for each test may be achieved. At the present time tests are available to cover the jobs being performed by about 85 per cent of the airmen in the Air Force. Each year these tests are taken by approximately 200,000 airmen stationed throughout the world.

A good description of test development accomplished by the 2200th Test Squadron, including types of tests, construction procedures, administration and control, processing and analysis of the tests, has been provided by Gilhooly.[9] Most of what Gilhooly said is still true of the program now in existence, though the job-knowledge tests and airman proficiency tests are now designated as specialty knowledge tests (SKT). The SKT program is designed to measure the job knowledge required for an individual to progress in his career field.

Useful information about the limitations and potential contribution of job-knowledge tests in Air Force settings is contained in the numerous reports that have been prepared as a part of the research and evaluation effort associated with the

on-going test development programs. (Sixty-six of the reports prepared at the 2200th Test Squadron, all unpublished, are in the library of the 6570th Personnel Research Laboratory, Lackland AFB, Texas.)

Where do we stand today in job-knowledge testing?

Because job-knowledge tests enter into important decisions, it is proper to inquire into their adequacy from the standpoint of their relevance to those decisions. Among people responsible for building tests, this matter is covered under the concept of "validity," and most test psychologists would say that it is the most important characteristic of an examination. This accounts for the extreme care generally taken to ensure that a test really does cover the important aspects of a job and that the information called for is unquestionably needed, not merely something "nice to know." One aspect of that carefulness is the close attention given to the selection of the most knowledgeable of the available persons to serve as subject-matter consultants. The judgments of these persons are crucial when it comes to the identification of the important things to cover in a test. Fortunately, the procedures used by the Air Force can be, and usually are, specified in much detail in manuals, regulations, and other technical publications. These materials are unquestionably the appropriate point of departure for test construction.

Test validity is essentially a matter of judgment, and many test psychologists who have been closely associated with job-knowledge testing programs in the Air Force have maintained that careful judgments obtained from subject-matter specialists concerning test content are more meaningful than judgments of another kind used in the typical "validation" study. In such a study, judgment or opinion of peers, supervisors, or others concerning the rating or ranking of a sample of airmen on some scale of "proficiency" is compared with their scores on a job-knowledge test. In the Air Force situations these relationships have been found to be rather low, generally.[10, 11, 12] McQuitty, Wrigley, and Gaier have demonstrated further that Air Force supervisors tend to describe trained mechanics (those selected on the basis of varying proficiency) much more in terms of interest and motivation than in terms of the amount of job knowledge possessed.[13] Some of the work of Humphreys and Schmid supports the notion that the best measure is a consensus obtained from several *different* ways of defining proficiency, specifically including the use of printed tests and the ratings of supervisors.[14] These findings have important implications for the *use* of tests. These implications will be mentioned later.

One traditional concern with respect to the matter of validity, i.e., whether or not job-knowledge tests measure what they are supposed to measure, has to do with the circumstance that they are written tests and may to a large extent be measuring ability to handle verbal material. Of course the ability to read and understand technical publications may be one valid aspect of "proficiency," but test psychologists have given some attention to the larger problem. One facet of the general matter was investigated by Polin, who found a mean reading level (using the Forbes-Cottle Readability Formula) of "11th grade" for tests of four specialties in the intelligence field.[15] Chajet, using the Flesch formula with 24 tests, found a mean reading level corresponding to the "12th grade."[16] His syllabic count was equivalent to that of the second year of college, but the average sentence length corresponded to the eighth grade. These levels are not above the range of reading levels of airman groups now entering the Air Force.

Another point of view is that written job-knowledge tests tend to be "book tests," which greatly favor those with academic interests and skills. Most of the research involving test scores and measures of formal education have shown the relationships between them to be low and nonsignificant. As a result, one writer observed that "irrelevant academic factors are not playing an important role in the measurement of job knowledge."[17] More recently, however, with the use of information on the completion or noncompletion of certain high school courses rather than a gross measure such as "years of education," it appears that the relationships may be higher. These findings are being explored further, but a time may soon be coming when more information on the formal education of airmen will be used in selection

and assignment. In that event it may eventually be unnecessary to include examination questions on physics, mathematics, or chemistry. The reader may remember newspaper accounts of a speech given by the Commander, Air Training Command, before a World Affairs Council meeting in Los Angeles in 1961, in which he mentioned that the Air Force must teach mathematics and electricity to many new airmen before they can be taught their jobs.

A few years ago a study was conducted which seemed to indicate that the Air Force might expedite its *total* training task if it would send the bottom portion of the aptitude group selected for any specialty to technical school and assign the high-aptitude airmen directly to the job.[18] Of course, as the reader knows, this sort of thing is just not done, in the Air Force or anywhere else. But the research did point up the circumstance that there is a wide variation among individuals when it comes to the capacity to benefit from experience. The formal, structured learning situation in the technical school may have been better for those with limited capacities, whereas the brighter boys may not have been overly handicapped by the unstructured environment found in on-the-job learning situations (some may have been better off, actually).

Measures of experience have been often used as one of the criteria against which job-knowledge tests have been "validated," but measures of experience have not been found to correlate particularly well with job-knowledge test scores.[19,20,21,22] One way of explaining these findings, as far as the present specialty tests are concerned, is to point out that experience is necessarily gained on specific equipment, and it is doubtful that a general examination, covering a whole specialty, should be expected to discriminate between high-experience and low-experience groups. In certain assignment situations, or in specialties in which airmen have a good chance to gain experience in several shreds, test–experience relationships may be higher. But "knowing the answers" and being able to perform in a manner characteristic of those with experience are not, of course, identical. Training people, especially those in the Air Force, are very much aware of this, and they generally provide schedules which give heavy emphasis to "learning by doing." Not all aspects of good training, which necessarily includes some "doing," can be measured by paper-and-pencil tests.

The last variety of investigation that will be mentioned here, and one that also bears indirectly on the matter of validity, is the one which shows the marked relationships existing between scores obtained on job-knowledge examinations of the kind now used in the Air Force and grades earned in Air Force technical schools. Brokaw, for example, reports a median product–moment correlation of .55 for 46 Air Force specialties.[23] Other studies have shown the same general level of relationship between measures of job knowledge and technical school grades. Thus it appears that many of the knowledges and understandings measured by the present specialty examinations are similar to knowledges and understandings developed in technical training courses. A portion of whatever utility can be claimed for technical school grades, as predictors of good performance on Air Force jobs, can also be claimed for job-knowledge tests of the kind now constructed.

The largest difference between the present SKT system and the older AM tests is in the utilization of test scores. As indicated earlier, an attempt was made in AM testing to weigh a *practical* score into a composite evaluation for each examinee. The present undertaking is to establish a series of check points at each of which supervisory opinion is an important factor. The airman must first be recommended for testing by his supervisor. After he has passed an examination, he must be recommended for skill upgrading by his supervisor. After he has been certified at a higher skill level, any actual promotion in military rank is dependent upon the size of existing promotion quotas for his specialty and, again, upon the current desires of his supervisor or commanding officer. Thus major provision is still made for supervisory opinion to play an important role in the total evaluative procedure. In practice, however, overwhelming emphasis may come to be given to test results.[24]

AMID A CERTAIN amount of difference of opinion concerning the role, meaning, interpretation, construction, and use of job-knowledge tests in the Air Force, it is believed that a majority of well-

informed persons would support most, if not all, of the following statements.

• Tests of achievement in job-knowledge areas meet a continuing Air Force need for feasible, manageable, and economical evaluation devices.

• The limitations as well as the strengths of written tests should be fully recognized. Such tests can give valid indications concerning performance potential in actual jobs, but performance itself is also a function of a number of other factors, such as motivation and interest.

• Optimum personnel evaluations are obtained when some balance is reached with respect to the relative emphasis given job-knowledge test scores and performance factors such as those that can be observed by supervisors.

• Pressures generated through the use of test scores in command evaluation systems may result in personnel and training practices that do not contribute to the achievement of training goals.

• Knowledge of research findings such as some of those mentioned here, if they are properly interpreted, can be quite useful to an Air Force manager faced with decisions concerning the use of job-knowledge tests.

• Test development requires a parallel research effort if the product is to be analyzed, understood, and improved.

Hq 6570th Personnel Research Laboratory

Notes

1. Robert G. Demaree, Norman A. Crowder, Edward J. Morrison, and Melvin S. Majesty, *Proficiency of Q-24 Radar Mechanics I. Purposes, Instruments, and Sample of the Study*, Research Bulletin 54-50 (Lackland AFB: Air Force Personnel & Training Research Center, November 1954).

2. George B. Simon, *Evaluation and Combination of Criterion Measures by Factor Analysis: A Study of B-25 Preflights*, Research Bulletin 54-23 (Lackland AFB: Air Force Personnel & Training Research Center, May 1954).

3. Chester J. Judy, *A Comparison of Peer and Supervisory Rankings as Criteria of Aircraft Maintenance Proficiency*, Research Bulletin 53-43 (Lackland AFB: Human Resources Research Center, November 1953).

4. Robert A. Swanson, *The Relative Effectiveness of Training Aids Designed for Use in Mobile Training Detachments*, Technical Report 54-1 (Lackland AFB: Air Force Personnel and Training Research Center, March 1954).

5. Howard J. Hausman, Joseph T. Begley, and Howard L. Parris, *Selected Measures of Proficiency for B-29 Mechanics: Study No. 1*, HRRL Report No. 7 (Bolling AFB: Human Resources Research Laboratories, July 1949).

6. Howard J. Hausman and Joseph E. Morsh, *The Aviation Mechanic Testing Program in the Operational Commands*, Development Report 56-53 (Lackland AFB: Air Force Personnel & Training Research Center, May 1956).

7. Joseph E. Morsh, *Development of the Written Evaluation of Mechanics' Proficiency (WEMP) Measure for B-50 Aircraft*, Development Report 56-75 (Lackland AFB: Air Force Personnel & Training Research Center, June 1956).

8. Donald N. Buckner, *Construction of a Proficiency Examination for Maintenance Personnel on a New Weapon System*, Development Report 56-105 (Lackland AFB: Air Force Personnel & Training Research Center, August 1956).

9. Francis M. Gilhooly, "Proficiency Test Development and Research for Airman Career Program of the United States Air Force," *American Psychologist*, 11 (1956), 547-553.

10. James A. Thomas, "Analysis of Selected Variables of Air Force Sample Survey," Research Report 5711, 2200th Test Squadron, Hq ConAC, September 1957.*

11. George Chajet and Joseph Schwartz, "Interim Report on Sample Survey Data for Air Traffic Control and Warning (27) and Supply (64) Career Fields," Evaluation Report 5610, 2200th Test Squadron, Hq ConAC, October 1956.*

12. Chester J. Judy, *A Regression Analysis of One Set of Airman Proficiency Test Scores*, Technical Note 60-139, ASTIA Document No. AD 240-361 (Lackland AFB: Personnel Laboratory, Wright Air Development Division, June 1960).

13. Louis L. McQuitty, Charles Wrigley, and Eugene L. Gaier, "An Approach to Isolating Dimensions of Job Success," *Journal of Applied Psychology*, 38 (1954), 227-232.

14. Lloyd G. Humphreys and John Schmid, Jr., "A Reanalysis of Criterion and Predictor Variables for Q-24 Radar Mechanics," Technical Memorandum 57-16, Personnel Laboratory, Air Force Personnel and Training Research Center, August 1957.*

15. A. T. Polin, "Readability of APTs," Evaluation Report 5409, 2200th Test Squadron, Hq ConAC, July 1954.*

16. George Chajet, "Readability of APTs with Low and High Cutoff Scores," Evaluation Report 5506, 2200th Test Squadron, Hq ConAC, September 1955.*

17. Judy, *A Regression Analysis of One Set of Airman Proficiency Test Scores*, p. 5.

18. Chester J. Judy, "Field Training Versus Technical School Training for Mechanics Maintaining a New Weapon System," *Journal of Applied Psychology*, 42 (1958), 384-388.

19. Eleanor F. Maxwell, "An Analysis of the Proficiency Test Performance of Airmen Working in Field, Organizational, and Depot Maintenance—AFSC 43271, Reciprocating Engine Technician," Evaluation Report 5504, 2200th Test Squadron, Hq ConAC, June 1955.*

20. Eleanor F. Maxwell, "An Analysis of Test Performance of Shredout Populations on the APTs for AFSCs 43151 and 43171," Evaluation Report 5510, 2200th Test Squadron, Hq ConAC, June 1955.*

21. Eleanor F. Maxwell, "A Comparative Study of the Test Performance of Airmen in the 47130 and 47131 AFSCs who were administered the 47150-51 Airman Proficiency Test," Evaluation Report 5401, 2200th Test Squadron, Hq ConAC, January 1954.*

22. Captain Ernest Madril, Lloyd E. Buttram, and Peter W. Hemingway, "A Comparison of the Performance of Senior Reciprocating Type Aircraft Mechanics and Senior Jet Type Aircraft Mechanics on the Aircraft Maintenance Supervisor-Technician (AFSC 43170-43171) Airman Proficiency Test," Evaluation Report 5302, 2200th Test Squadron, Hq ConAC, November 1954.*

23. Leland D. Brokaw, *Prediction of Air Force Training and Proficiency Criteria from Airman Classification Battery AC-2A*, Technical Note 59-196 (Lackland AFB: Personnel Laboratory, Wright Air Development Center, October 1959).

24. Air Training Command Advisory Board, *Eighth Report* (Randolph AFB: Air Training Command, 20 October 1962).

*Unpublished paper available on loan to DOD agencies from the Library, 6570th Personnel Research Laboratory, Lackland AFB, Texas.

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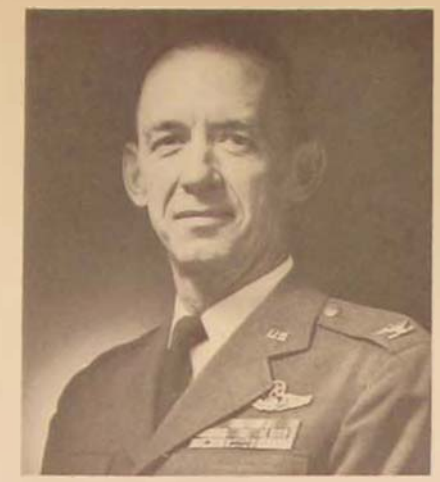

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ATTENTION

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