AIR UNIVERSITY QUARTERLY REVIEW

SPRING 1956

Vol. VIII No. 2

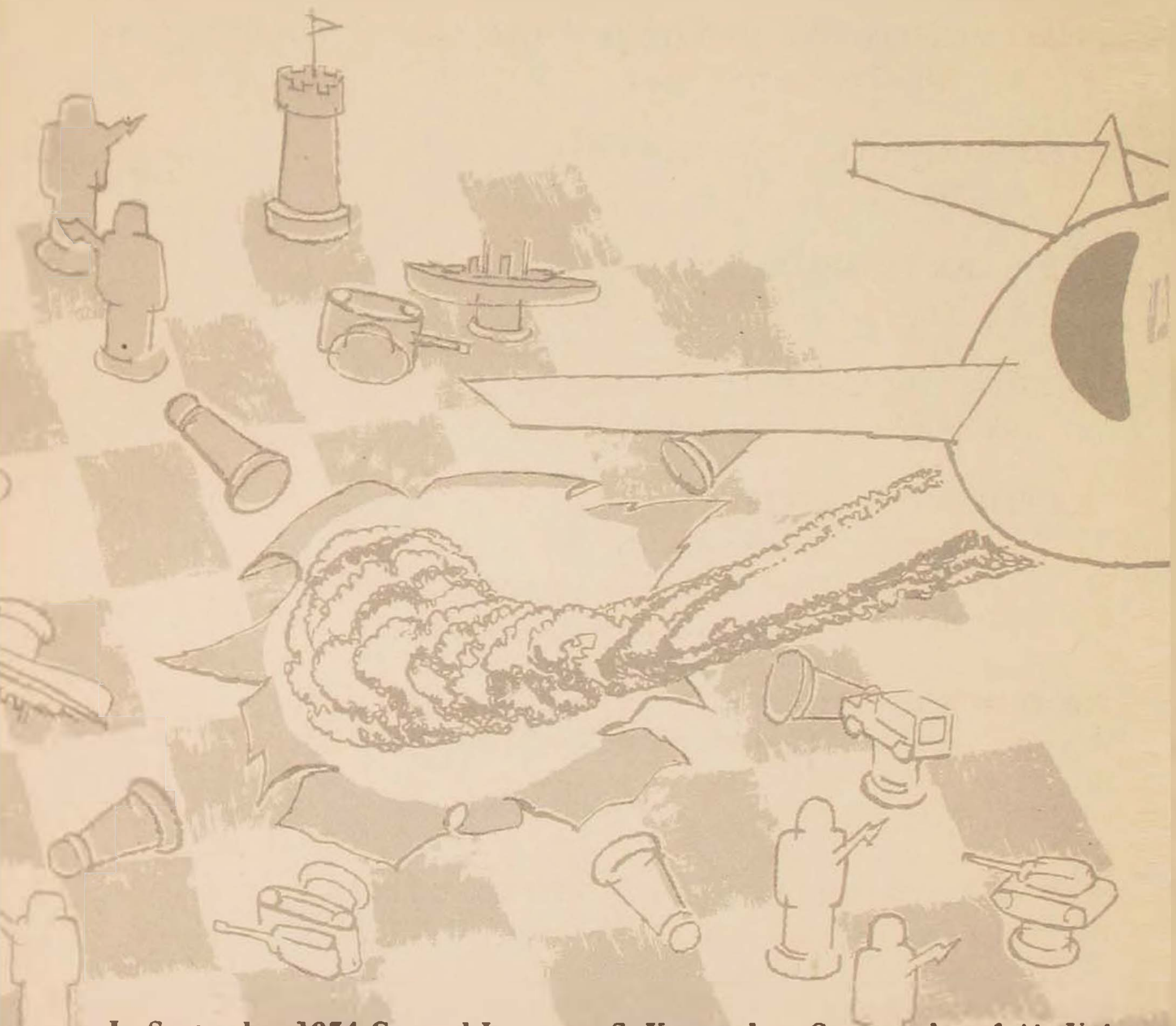
Published by Air University as the professional journal

of the United States Air Force

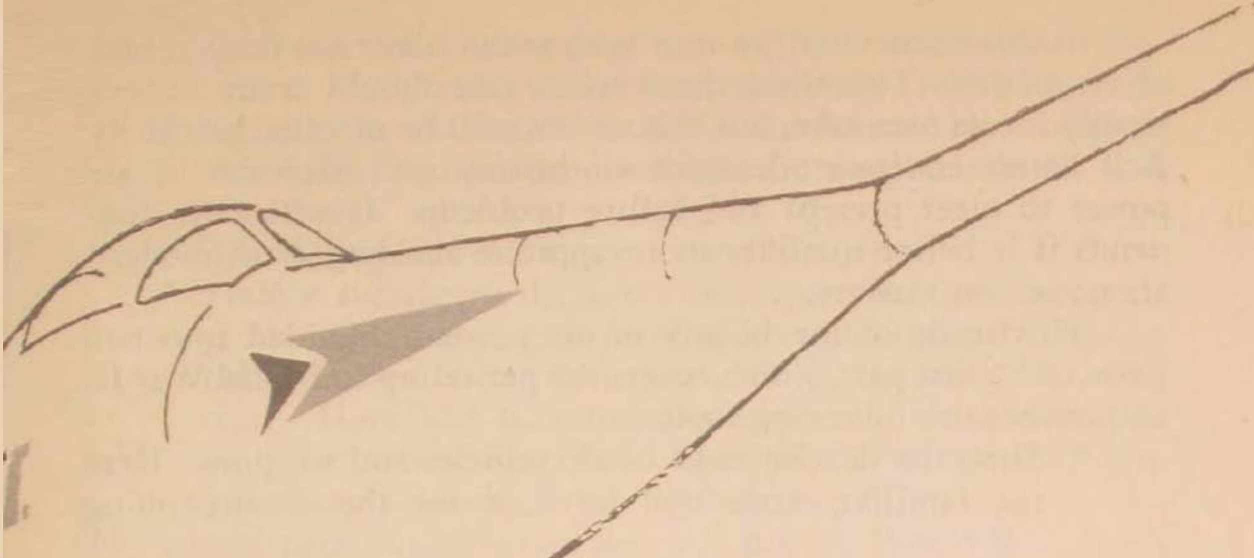
THE
UNITED STATES AIR FORCE
AIR UNIVERSITY QUARTERLY REVIEW

VOLUME VIII — SPRING 1956 — NUMBER 2

Address manuscripts to Editor, *Air University Quarterly Review*, Headquarters, Air University, Maxwell Air Force Base, Ala. The printing of this publication has been approved by the Director of the Bureau of the Budget, 3 July 1952. Printed by the Government Printing Office, Washington, D.C. Price, single copy, 50 cents; yearly subscription, $2, from Air University Book Department, Maxwell Air Force Base, Ala. Properly credited quotations are authorized. USAF Periodical 50-2.



In September 1954 General Laurence S. Kuter, then Commander of Air University, addressed the NATO Defense College, Paris, France. The Editors of the *Quarterly Review* consider his remarks a valuable contribution to the understanding of air history and have adapted them to article form and illustrated them. In tracing the hectic spiral of man's accommodation to the revolutionary advance of powered flight, General Kuter charts the pattern of military resistance to change and the consequent lags in exploiting new capabilities of the air weapon. He analyzes significant differences in the strategic environments of World War II and today and proposes the fundamentals of an air doctrine for the jetomic age. The decisive weapon in the present global struggle, he warns, may finally be the degree to which either side overcomes resistance to change. Now Commander of the Far East Air Forces, General Kuter is to be congratulated for his succinct and illuminating examination of the military reactions to man's conquest of the air.



An Air Perspective in the Jetomic Age

General Laurence S. Kuter

FROM time immemorial our ancestors dreamed of solving the mysteries of flight. In recent centuries men of vision went beyond dreaming and applied themselves to the development of a machine that would fly. The contributions and sacrifices of Leonardo da Vinci, that towering genius of the fifteenth century who invented the propeller and applied it to his small helicopter models, and such nineteenth-century fathers of aeronautics as Hensen, Phillips, Maxim, Stringfellow, Penaud, Ader, Lillienthal, Chanute, and Langley paved the way for man's launching into the air ocean.

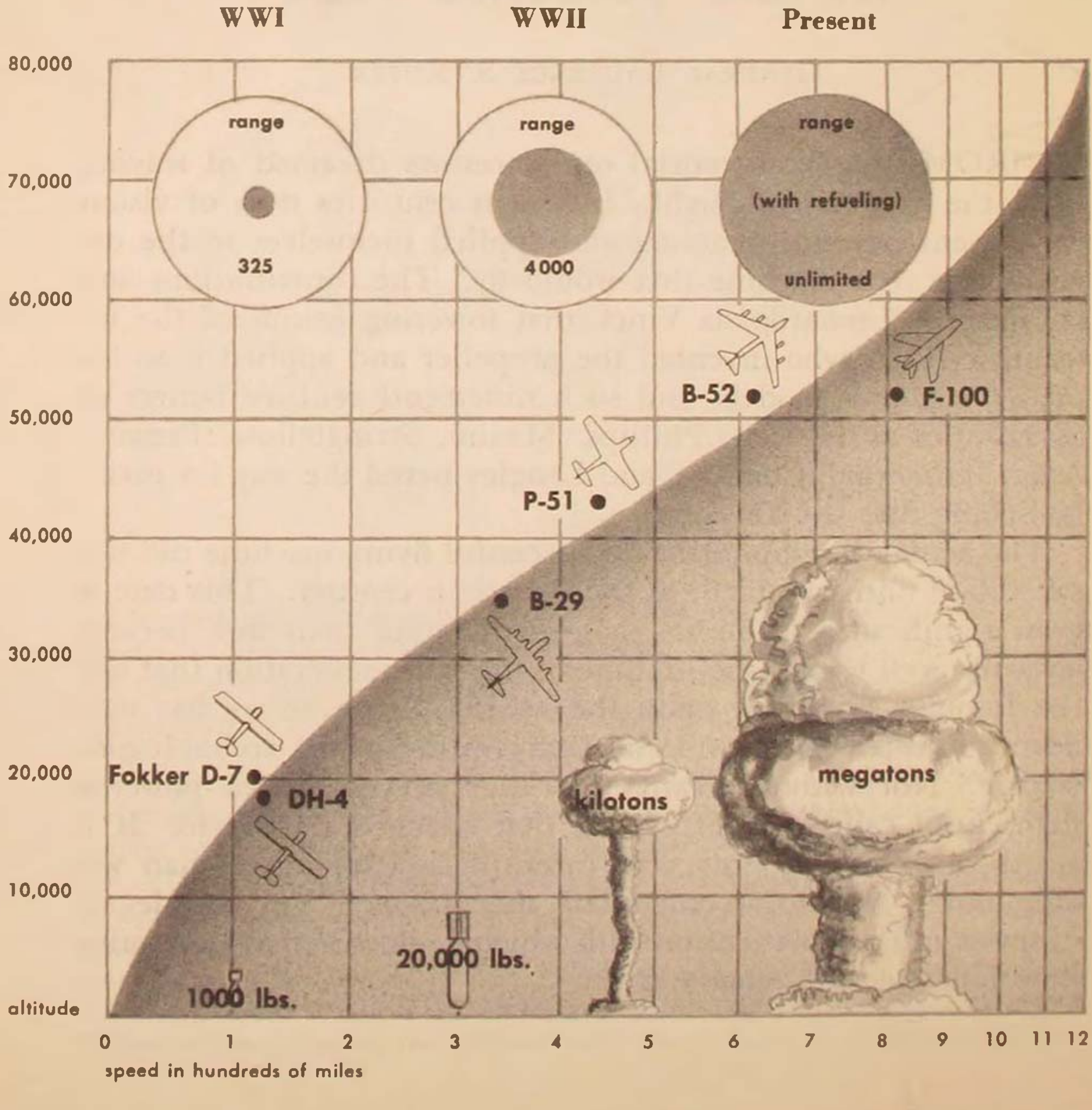
The actual development of a successful flying machine did not take place until the birth of the twentieth century. This date is most significant. It means that earth-bound man first became airborne well within the lifetime of the same generation that saw the Jetomic Age burst upon the world. Never before has man been subjected to such rapid and revolutionary technological change. Not without reason has the half-century of powered flight been called the fifty years that changed the world. It is worth our while to note very carefully how well free man was able and is able to accommodate such change. For the degree of speed and comprehension with which he does so may determine how long he will remain free.

In this connection we may review the historical background of air power. There are times when one should study history simply for its own sake, but this review will be of value primarily if it better equips students of air history and advocates of air power to meet present and future problems. It will earn dividends if it better qualifies us to appraise the impact of modern air power on warfare.

This study of the history of air power is divided into two parts. The first part, which covers the period up to World War II, emphasizes the following topics:

- First, the development of air vehicles and weapons. Here the familiar terms will be used for the distinguishing

Evolution of the Air Vehicle



qualities that characterize any military instrument: firepower, vulnerability, mobility, flexibility, reliability, etc.

- Second, the evaluations made of air vehicles and weapons as aviation evolved into modern air weapon systems and air power.
- Third, employment concepts and doctrine.
- Finally, significant decisions concerning the development, production, and employment of air vehicles and weapons that stemmed from their evaluations and resultant doctrine. Here will be noted the impact of these decisions on the aircraft industry and the difficulty of trying to buy increasingly precious time with money.

The second part, which covers the period from World War II up to the present, considers the following topics:

- First, pertinent aspects of World War II experience.
- Second, a comparison of the strategic factors that prevailed then with those before us today.
- Finally, a basic air doctrine applicable to our present strategic environment.

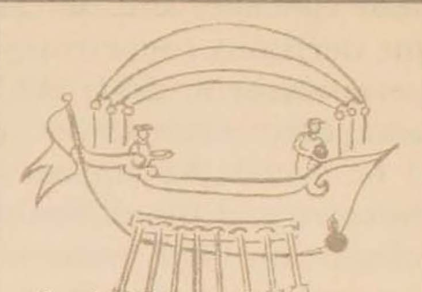
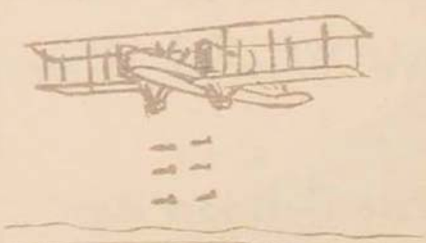
Whatever criticism appears in the course of this review is intended as objective and constructive. I realize that perfect hindsight is much more common than is even fair foresight. I agree with Disraeli that it is easier to be critical than correct.

Part I: Growth of Air Power Before World War II

The Balloon Age

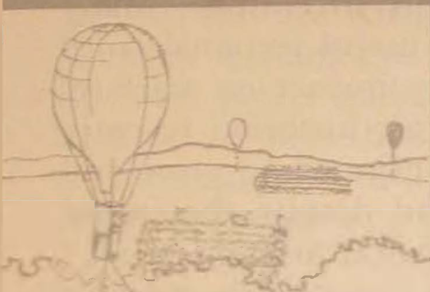
MAN technically became airborne in the Balloon Age, long before the twentieth century. Montgolfier made his initial experiments in 1783. Later, by suspending a sheep, a cock, and a duck in a basket below the balloon he demonstrated that life could be sustained in the upper atmosphere. Stirred by this accomplishment the noted French scientist, Pilâtre de Rozier, attempted to prove that human life could also be sustained in the higher air. During one of his tests, in which he used a captive balloon, he took along a passenger, Andre-Giraud de Villette. Villette, a civilian, was so impressed that on 20 October 1783 he

Evolution of

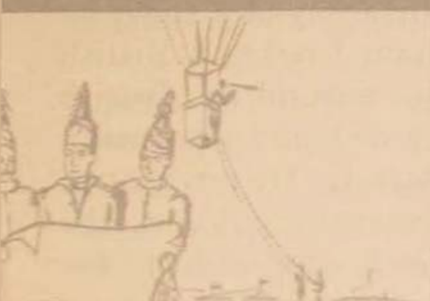
	Strategic	Tactical
Early Ideas	 fire-bombing from oar-powered airship held by German inventor—c. 1815	 Prussian General Staff envisions firing on troops from huge balloon—1805
Early Military Employment	 large-scale air bombardment first tested over Venice by Austrians—1849	 enfilade fire from balloon attempted by Russians against Napoleon—1812
World War I	 bombing of war centers leads to Trenchard's Independent Air Force—1918	 1500 planes committed by Mitchell to support St. Mihiel land offensive—1918
World War II	 strategic bombing forces Japanese surrender, after crippling of Germany	 4371 9th AF tactical sorties ensure success of D-day in Normandy landing

Air Warfare

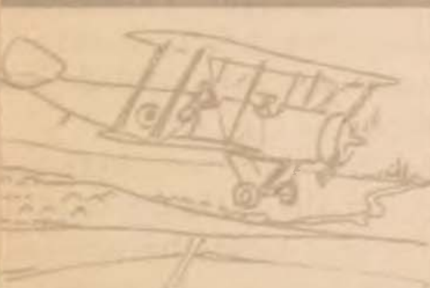
Reconnaissance



advantages of aerial command post foretold by British writer Cooke—1793



observation from balloon aids French victory at Battle of Fleurus—1794

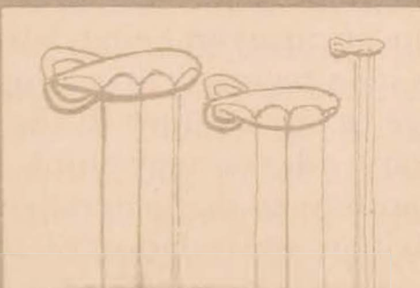


balloons, dirigibles, and airplanes employed to spot enemy ground activity

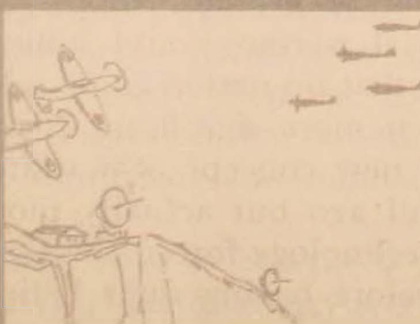
9th AF mounts 7400 recon sorties in 12 weeks during 1944 drive on Germany

Air Defense

balloon picket line around British Isles proposed by William Cooke—1793



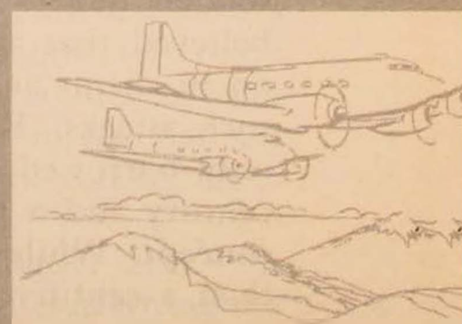
balloons, nets, cables, and ground fire defend against aerial bombing



ground-air defense versus bombers defeats Luftwaffe in Battle of Britain

Air Lift

decisive impact of airborne invasion described by Ben Franklin—1794



air invasion in Crete and Burma; air supply at Stalingrad, in CBI theater wrote to a Paris journal that he was convinced that this apparatus, costing but little, could be made very useful to an Army for discovering the positions of its enemy, his movements, his advances, and his dispositions.

What appraisal was actually made during the next century concerning the military significance of this invention? Many responsible civilians saw it as an extremely useful reconnaissance aid. Some saw it as having a revolutionary impact on warfare. Few military men shared either view. An air historian recently said: "Military aviation was born, as it continued to grow and develop, the product of civilian minds, and despite the initial inertia and later opposition of the conventional military mind."

The evidence for this conclusion seems reasonably convincing. The very year that Montgolfier released his first balloon, a cartoon in the *Journal de France,* captioned "Wars in the Air," depicted what appeared to be an airborne invasion of a town by a successful army. In the same year William Cooke, a British writer, proposed the creation of an air patrol around the British Isles to provide warning against impending attack and thus maximize the time available to mount a counterattack. He envisioned command headquarters in the air where generals could see the enemy, observe their own forces in action, and issue orders. He also foresaw the air vehicle as the eyes of the fleet at sea.

A year later Benjamin Franklin wrote that five thousand balloons would be capable of transporting ten thousand troops nearly anywhere in the world. He doubted that any country could afford to maintain an army-in-being adequate to repel such an airborne invasion. He believed that a force so airlifted could do irreparable damage to any country in the world.

On the military side we may think it significant that there were but two exceptions to the general rule that the military did not share early civilian appreciation of the potential of the new invention. The exceptions were Germany and Russia. As early as 1805 the Prussian General Staff had been thinking of the possibilities of a huge military balloon, armed to permit the sudden destruction of ground troops. Even in that day they believed that aerial warfare could inflict indescribable damage on an enemy and that no nation could adequately defend against such attacks. Even more significant is the fact that Russia not only borrowed a new concept of warfare from the Germans a century and a half ago but actually pioneered in applying the concept. While technology forced the Germans to wait for more than a century before testing their beliefs, the Russians apparently did so as soon as they borrowed the idea. While Napoleon was preparing for his Russian campaign, Russia was preparing to greet him with a new kind of warfare—war from the air. The new weapon was a balloon, designed primarily not for military reconnaissance or for troop transport but for strafing from the air. In this age Russian vision and initiative was a bit ahead of Russian technology. The Russian dream of stopping Napoleon with air power ended when French soldiers overran their huge balloon. For technological reasons it could not take off. In France, England, and the United States we find the contemporary military discounting both concept and technology. We can hardly be content to rest on the conclusion that the "conventional military mind" resisted the adoption of the balloon into the family of weapons. We need to ask: "Why, and with what consequences?"

Controlling military views concerning the usefulness of the balloon stemmed from a basic fact. The fact is that the military commander, then as always, understandably tended to concern himself primarily with the task immediately ahead of him. He found little consolation "today" in the promise that "tomorrow" would bring him an instrument that would then affirmatively satisfy his query, "Is there a new weapon available whose firepower, mobility, vulnerability, flexibility, or dependability characteristics will assuredly better enable me to capture, destroy, or neutralize the enemy force now opposing me?" Faced with today's responsibilities and distrustful of new instruments, he tended to cling to and rely on battle-tested, trusted ones. It seems logical that he would especially react this way if he honestly believed, either correctly or through ignorance, that existing conditions would permit the effective employment of familiar tools. Thus we find the Balloon Age commander deciding to let his cavalry perform his reconnaissance mission and for a long time resisting the adoption of the balloon.

But what of the consequences of such understandable inertia to innovation in military tool or military doctrine? History offers many examples of the long-range disastrous consequences of such reactions. The Romans paid dearly for waiting for the barbarians to demonstrate that a mounted infantryman was infinitely more maneuverable and more effective than the foot soldier of that day. However it may be suggested that, whether in the Balloon Age or later, the most significant and immediate consequences are these:

- Prevailing doctrine tends to become dogmatic.
- During interwar years complacency sets in concerning the

adequacy of existing weapon systems, especially if they can be at all improved.

- Development of new weapon systems lags through lack of emphasis.
- New weapon systems tend to be tethered by prevailing doctrine—if not by political decision—in the early stages of an ensuing war. This restriction, by denying the optimum opportunity for demonstrating the weapon system's full capability, thus serves to confirm previous evaluations and prevailing doctrine.

The Infancy of Air Power

During the period between the birth of the mechanical bird and the outbreak of the War of 1914 few agreed with H. G. Wells when he argued in 1908 that military aviation, by introducing a new dimension, would revolutionize the art of war. He noted that "in all previous forms of war, both by land and sea, the losing side was unable to raid its antagonist's territory and communications. One fought on a 'front,' and behind that front the winner's supplies and his resources, his towns, and factories and capital, the peace of his country were secure." This he felt would be changed by the new weapon.

In the main the airplane was looked upon as a source of diversion to flyers and of amusement to spectators. Flying became an exciting but expensive sport. Since it had no earning capacity except as an exhibition feature, its very survival, to say nothing of its growth, was thus heavily dependent upon popular subscription, with but meager government support.

Until shortly before the war the military paid little attention to the airplane. As an observation and reconnaissance vehicle it was neither recognized nor trusted by those in authority. Military manuals indicated that cavalry gained information, protected other units, and fought on the battlefield. Aircraft, they said, were good only for observation from a distance and were severely limited by weather.

Not until 1908 was the U.S. War Department finally prodded into contracting for its first airplane. When delivered a year later this craft weighed all of 1200 pounds—complete with its 30-horsepower engine, full load of fuel, and two men. On final acceptance test it made a 10-mile flight at slightly more than 42 miles per hour.

Such performance could have strong appeal only to the man of vision as an instrument of tomorrow. It had little appeal, if any, for the man faced with the task of the moment—and as little support. By the end of 1913 the United States had not built an airplane that could be considered satisfactory by any stretch of the imagination. Fatal crashes during 1914 provided little ground for public optimism over the future of the military airplane. Of the fourteen licensed pilots in the United States Army that year, eight were killed in crashes.

Even as late as March 1916, ninteen months after the start of the war in Europe, U.S. Army air power was represented by a force of 11 officers, 82 enlisted men, and one civilian mechanic, and 8 planes. This "force" was ordered one day to make a hundred-mile flight: a defective engine forced one plane to return to the starting point; three became lost and were forced to land; darkness compelled the remaining four to land before reaching their destination. Within a month, six of the eight airplanes were either abandoned or destroyed. The remaining two were condemned.

But what of England during this period? Permit me to cite Air Marshal Sir Robert Saundby:

> In this country little official attention was paid to the military possibilities of aviation until the formation of the Air Battalion of Royal Engineers in 1911. [Before this] a few progressive soldiers had begun to perceive the advantages of the third dimension for reconnaissance. A few keen young Naval and Army officers had devoted their leaves to learning to fly at their own expense, but their sole reward in those early days was the acquisition of a reputation for eccentricity.

In the case of Germany we find that for some years prior to 1914 the German General Staff, particularly its Chief, Moltke, and his principal assistant, Ludendorff, were very air-minded. The War Ministry and leaders of the German Army doubted the value of airplanes. Not until 1912, after a series of struggles between the General Staff and the War Ministry, did Germany give any considerable support to airplane programs. But having made the decision, the Germans moved in characteristic fashion during the next two years. With good support from a recently developed industry, they undertook an accelerated flying program that soon paid high dividends. German flyers were not long in establishing world records, notably the endurance flight of twenty-four hours accomplished by a German aviator a few months before the outbreak of war. Out of this timely recognition of the value of the new weapon was born Germany's initial superiority in the use of combat aircraft in World War I.

The influence of the political climate on the growth of the airplane during the prewar years is quite apparent. Differences in climate around the world were reflected in the yearly average appropriations for aeronautics during the period 1908-1913:

Germany	$5,800,000
France	4,400,000
Great Britain	600,000
United States	87,000

Appropriations for 1914 were:

Germany	$5,000,000
France	7,000,000
Great Britain	3,000,000
United States	125,000

These figures accurately reflect the political estimates of these powers concerning the likelihood of becoming involved in war. The United States, hiding its head in a traditional policy of isolationism and avoidance of war and entangling alliances, knew that it would not be involved in a war. Great Britain, fully aware of the storm clouds on the horizon, hoped to avoid the storm.

Air Power in the First World War

Within two days after the Germans marched into Belgium to start World War I, the Zeppelin Z-6 flew over Liege at about 1800 feet and dropped a bomb. Then descending to 900 feet it dropped twelve others, setting fire at several places in the city and causing consternation. This action, ordered by the Supreme Command of the German Army, which controlled all Zeppelin activity, provides the first good example of faulty employment of air power. Only one Zeppelin had practiced bombing before the war. Because no real bombs had been manufactured, the Z-6 carried only 400 pounds of artillery shells. Since it could only rise to 4700 feet with this load, it was shot so full of holes that it crashed on the way home.

Surely no competent staff could expect material benefits from such light and inaccurate firepower. Yet this same sort of malemployment of air force occurred repeatedly throughout the war. Men who knew the volume of artillery fire required to accomplish a given amount of destruction must have felt that there was some magic in the dropping of such projectiles from the air, a magic that multiplied the destructive capacity by hundreds or thousands.

Three weeks later, on 21 August, the Z-7 and Z-8, operating under a low ceiling in the Belfort area, investigated French dispositions from less than three thousand feet and were shot down by ground fire. After these incidents, patent examples of malemployment, the concept of daylight operations by Zeppelins lost its popularity. But for some men this experience reinforced the realization that, if properly employed, the air vehicle could serve a purpose in war in addition to that of reconnaissance.

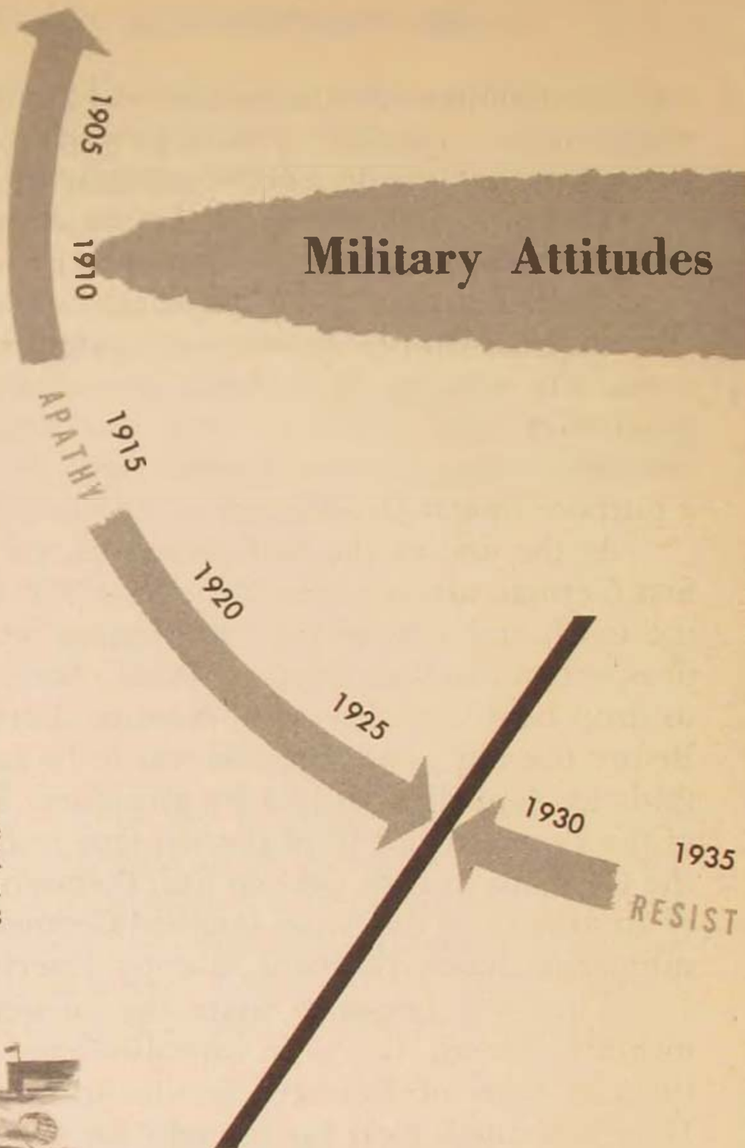
At the end of the first month of war the appearance of the first German aircraft over Paris served to stimulate the exodus to the south and west of the vast throngs who were terrified at the prospect of another siege of Paris. Soon German aircraft were to drop bombs on Louvain, Namur, Antwerp, and other places. Before the war's end England was to be subjected to 53 bombing raids by Zeppelins and 63 by airplanes. London was to take 12 of the Zeppelin and 19 of the airplane raids. Before the war's end the Germans in turn were to find themselves on the receiving end of air attacks, as the Allies bombed German cities, submarines and submarine bases, railroads, dumps, reserves, and similar targets.

Thus war began to write the answer to those who saw no military use for the new invention and to verify some of the theories born of Douhet's fertile imagination as early as 1909. Here was much food for thought for the equally fertile imaginations of the Trenchards and Mitchells.

Before the war's end such men would see major ground offensives preceded by air battles. They would see clearly, as de Villette had seen one hundred and twenty-five years before, that the airplane could "be made very useful to an Army for discovering the positions of its enemy, his movements, his advances, and his dispositions." They would see in it, as had H. G. Wells in 1908, a means of striking directly at an enemy's supply points and lines of communication. What they saw was to give birth to strategic concepts that were to grow and mature, painfully to be sure, in the hostile climate of traditional military thinking and of public indifference during the era of peace and good will among all men that the world so eagerly anticipated at the war's end.

But if airmen were seeing all these things, what of other military men? The harsh fact remains that surface commanders were obliged to view the passing scene through different-colored glasses. Basing their decisions on the characteristics of the tools at hand

Military Attitudes

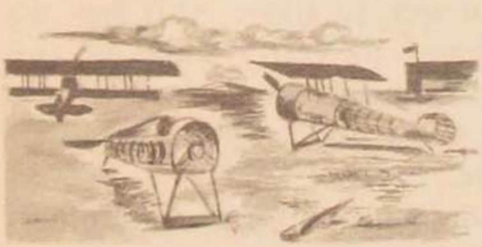


pre-WWI: cautious experiment

Low performance, limited capability, high fatalities, military conservatism, and isolationism inhibit U.S. military development of the airplane

WWI: minor auxiliary force

Despite foreshadowings of the offensive power of massed aircraft, air forces are used only in minor support roles



postwar decade: neglect

Isolationism, military resistance to change nearly halt development of military aircraft while civil aviation pioneers new equipment and planes

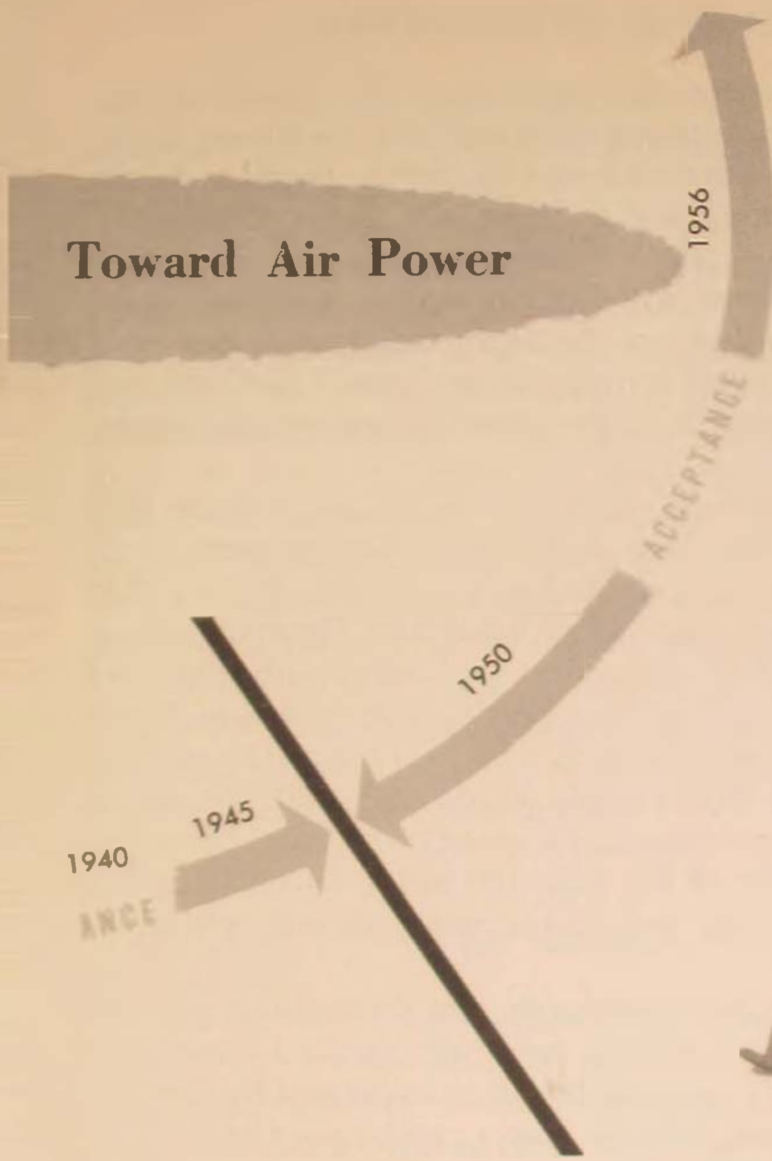
resistance to change

As military airmen speak out their claims for air power, military resistance assumes the concrete forms of budget cuts, restrictive agreements, etc.

prewar: reluctant compromise

Reasoned arguments for air power win grudging War Department permission to experiment, then to produce a fraction of the requested number of strategic bombers

Toward Air Power



1956: struggle over missiles

Acceptance of the air weapon's supremacy is once again demonstrated in the interservice competition to acquire the responsibility for U.S. missiles

1952: struggle over control

After Korean air battle is won ground force dependence on air close support stirs Army efforts to regain and decentralize control of tactical air

1949: struggle over missions

Navy tries to discredit before Congress the Air Force's B-36 bomber in favor of the naval aircraft carrier

WWII: tethered air power

Tactical and strategic air fettered and dissipated by ground strategy and command. Command battle is largely won, strategy remains earth bound

postwar: agonizing reappraisal

Proof of power in war wins independence and equality for Air Force, but missions assigned on WWII, pre-atomic basis they were obliged to accept the validity of the Clausewitzian axiom that "the ultimate objective of all military operations is the destruction of the enemy's armed forces by battle. Decisive defeat in battle breaks the enemy's will to resist and forces him to sue for peace." To them this axiom meant, unavoidably so in that day, that the enemy's forces, whether on land or sea, had to be met and overcome on land or sea. It meant that if necessary such meetings had to be continued until sufficient enemy territory and manpower had been captured or destroyed to compel concession of defeat.

It was really little consolation to the surface commander that on balance the air war had been a stalemate during most of its course. He could hardly be expected to appreciate the fact that under the pressure of war England, France, and Germany developed planes that could fly at 150 miles an hour, climb 6000 feet in 5 minutes, and cruise 100 miles. During the course of battle he was painfully conscious that even near war's end the aircraft of the Independent Air Force could carry only 500 pounds of bombs of not very effective design, at a speed of 80 miles per hour, with an operational radius of less than 100 miles, and deliver this puny firepower with only the doubtful accuracy afforded by primitive bombsights.

Engrossed as the soldier necessarily was throughout the war in achieving victory on the surface, he could hardly be expected to appreciate the airman's growing belief, as expressed by General Smuts before the war's end, that air power can be used as an independent means of war operations:

> Unlike artillery, an air fleet can conduct extensive operations far from, and independently of, both Army and Navy. As far as can at present be foreseen, there is absolutely no limit to the scale of its future independent war use. And the day may not be far off when aerial operations, with their devastation of enemy lands and destruction of industrial and populous centers on a vast scale, may become the principal operations of war, to which the older forms of military and naval operatons may become secondary and subordinate.

War's end found the surface commander unconvinced of the offensive power of aircraft and still demanding air patrols over key sectors of the front. On the other hand, some airmen applauded the views expressed by General Trenchard several years before when he enunciated his so-called strategic offensive policy. Trenchard had said that a defensive attitude, exemplified in aircraft barrages or umbrellas, invited defeat. He suggested that the way to protect aircraft in the air or objectives on the ground was for fighters to seek out the enemy air forces and destroy them far from the forces to be protected.

Whereas surface soldiers saw only the scattered efforts of weak air forces, some airmen saw the successful beginnings of the tactic of isolation of the battlefield. The surface commander accurately saw poorly trained bombardiers using primitive bombsights to drop limited quantities of TNT for little effect on the outcome of issues that were finally decided by land armies and naval blockade. Airmen were looking beyond the many inadequacies of existing equipment and were seeing the high potential reflected in the airplane's steep curve of improvement. Airmen were convinced of the need for an independent air force, a concept which surface commanders violently opposed. The relative intensity of these conflicting viewpoints, coupled with the impact of peculiar political, geographic, and other factors was to shape the development of air power in each of the major countries during the two decades between the wars.

The Interwar Years

Before reviewing the development of air power between the World Wars we should define air power. Up to this point we have done small violence to reality to think in terms of the air vehicle and its weapons. But henceforward the rapidity of technological progress dictates that we think and speak in terms of air power.

Fundamental to the establishment of a nation's air power is the capacity to design, develop, produce, and effectively employ commercial and military aviation in pursuit of national objectives. The ingredients of its composition include adequate raw materials, industrial capacity, scientific, technical, and managerial skills, airfields, communications, navigational aids, aircrew and maintenance personnel, and command arrangements, as well as the basic air vehicle and weapon. But these tangible ingredients of themselves do not produce air power. We must add certain major essentials of the mind and spirit:

- First, a proper evaluation of the potential of air forces to accomplish specific objectives under given conditions.
- Second, sound concepts for the employment of these forces.
- Finally, the determination to employ air forces and air concepts as necessary in furtherance of national objectives.

continued on page 108

Total Air Power and the Public

Colonel Jerry D. Page

FOR some time now it has been apparent that although the public has accepted and supported the role of the Air Force as the potent "big stick" that can deter world war, it has grasped very little of the versatility and range of capabilities that make air forces such an effective instrument for peace. Indeed the very existence of the mailed fist has tended to obscure the olive branch. The Air Force can do much more to get across to the public the larger story of air power. The extent of this opportunity was dramatically brought home to me when I encountered the misconceptions about the use of air power held by a group of our best-informed civilian leaders.

The occasion was a World Affairs Conference at the University of Colorado. Gathered there were some 100 prominent civilians from many walks of life. They were highly educated and responsive people—college presidents, business executives, scientists, diplomats, editors. They welcomed this opportunity to debate current international tensions. The discussion ranged from disarmament to the brush war, from the impact of science on policy-making to Indo-China. One of the most widely debated subjects was the Quemoy-Matsu crisis, which had threatened to produce a head-on collision between the United States and China. The views expressed on this subject provided an index to the shortcomings in the Air Force effort to convince the American public of its capabilities. Uniformly these prominent civilians regarded that crisis in the narrow frame of its geographical position rather than as one small part of a global picture in which the forces of the Free World stand opposed to the Communist world. They appraised it in terms of military forces—ships, tanks, guns, supplies—available in the immediate area rather than in terms of the total power capability of the opposing worlds. As a result their conclusions were far gloomier than the situation warranted.

From the comments of the delegates to this conference, men of experience, skill, and influence in many fields, I concluded that the limitations on their views of the Quemoy-Matsu problem stemmed from a general failure to recognize that modern technology has made the world very much smaller and more tightly interrelated, that because of this problems between Communism and the Free World cannot be studied or treated in isolation. Until this basic consideration is accepted there can be no real understanding of the role of U.S. power—particularly U.S. air power—in the treatment of these problems. In the eyes of these influential civilians an airman was a man straining at the leash to drop an A-bomb on Moscow as the answer to all problems. I came to realize that if these capable and intelligent men possessed such a limited and oversimplified view of the meaning and capability of air power, one could not expect a broader view from the general public.

But while I was confronted with the failure of the Air Force fully to persuade the citizenry of the meaning of Air Force capabilities in the cold war world, I discovered also the extent of its opportunity. After five days of expounding Air Force doctrine to these civilian leaders, I found that they accepted the soundness of it to a most heartening degree. I discovered that there is always a receptive audience for the explanation of the meaning of the Air Force as an instrument for global peace.

The leaders of the Air Force rank with the world's best practicing engineers of peace; under their direction the Air Force is waging peace every day. But in the light of such evidence as this conference provides—that the role of the Air Force as an instrument of peace is still not well understood—we, as airmen, must inquire how we can take advantage of the opportunities within our reach to increase understanding and support of the Air Force. Four questions are vital to an examination of this problem.

The first question:

> *Does the evidence indicate that the peace potential of the Air Force still is not understood fully?*

The answer is "yes," and it must remain "yes" until such time as Air Force capabilities in the cold-war, nuclear world are as familiar to the public as its material, mechanical assets.

Without doubt the material assets of the Air Force are reasonably well understood. Just about everyone knows that airplanes can fly fast and high and far, and that they can carry a great variety of weapons and cargoes. However, full understanding of the contributions of the Air Force to security from the many different kinds of Communist aggression can only come from an understanding of how these mechanical assets can be employed. In the clear explanation of these meanings lies the present opportunity of the Air Force.

One of the subjects presented to the delegates at the World Affairs Conference was their responsibility as individuals to understand air power as manifested in the capabilities of the Air Force. We summarized for them five misconceptions about air power that had grown out of the persistent opinion that the Air Force is a war-only instrument. The misconceptions:

(1) that air forces are decisive only in all-out war;

(2) that air forces and nuclear weapons are inevitably synonymous with the destruction of cities and populations, with indiscriminate destruction their total contribution to decision in combat;

(3) that the use of nuclear weapons, regardless of conditions under which they are employed, will automatically lead to general war;

(4) that air forces are useless as an instrument of policy or in combat unless they can use nuclear weapons; and

(5) that because the Communists continue to make gains in the nuclear era, air forces are proven to be ineffective.

That the peace potential of the Air Force is not fully comprehended is illustrated by the surprise of participants in the World Affairs Conference upon hearing that these views were *misconceptions*. "Those are the things we believe about air forces," one delegate said, summing up the prevailing reaction. In their view air forces could be operated effectively only in an all-out war. After the delegates had considered the evidence many of them decided that their previous views *had* been misconceptions. They accepted the Air Force as an instrument for peace just as completely as they had regarded it an instrument only of war.

This experience dramatizes the need for the Air Force to persevere in its effort to inform the public of the full range of air power capabilities. The Air Force's hope for its full and proper use as an instrument of national policy rests upon clear communication. Although airmen can influence the determinations on the use of air power, final decisions are made by civilians in government and, ultimately, by the people as a whole. It is essential that the average citizen, and especially civilian leaders, understand what the USAF means by air power and what we conceive its uses to be in peace as well as in war.

The second question:

What information can the airman use to eliminate misconceptions and to get the views of the Air Force to the public?

The Air Force individual is excellently supplied with information that he can use to dispel prevailing misconceptions of the ways in which air forces may be employed. His primary source is the basic doctrine of the Air Force.

Until recently the Air Force had not stated clearly the capabilities of air power in any other situation than a total war. Although total war remains a primary concern of the Air Force, we also recognize that between the extremes of total war and total peace exists a broad range of opportunities for the decisive exercise of air power. This concept is now official Air Force doctrine, and vistas for the employment of our air force, limited only by the bounds of imaginative initiative, lie open for those who decide its use. It behooves the professionals concerned with the operational employment of the Air Force to expand the views of the nonprofessional.

If the Air Force is to carry its views to the public successfully, its own members must understand clearly all the ways in which air power can be used as an instrument for the maintenance of peace. The doctrine of employment of air forces has been developed, a modern and forward-looking doctrine, in keeping with the present and foreseeable demands of a complex world situation. It is contained in a ten-page pamphlet, designated Air Force Manual 1-2, "United States Air Force Basic Doctrine." Here in explicit terms is the familiar doctrine for the employment of air forces in total war. But here also are the doctrinal concepts that give the Air Force flexibility in an era in which the world hovers between peace and war. Here one finds a concept in which air power becomes a potent instrument for global harmony.

The key statement in the USAF basic doctrine on the role of air power is this: "United States air forces are employed to gain and exploit a dominant position in the air both in peace and war. The desired dominant position is control of the air." In this concept of control of the air lies the significant expansion of Air Force doctrine.

Formerly we said that air forces were employed to gain and maintain air superiority. Although the two phrases may seem alike, they differ in their implications. The concept of air superiority reflected a traditional commitment of air forces during war to attain a potential for physical suppression of enemy air forces within a specific geographical area. Basically it reflected the negative effects that could be registered against an enemy through the active use of air forces in direct combat. What was needed was a concept that emphasized the affirmative effects obtainable by the use of air power, both actively and passively, in peace as well as in war. The answer was the concept of "control of the air," a situation achieved "when air forces in peace or in war can effect the desired degrees of influence over other specific nations."

In other words, the doctrine now states that air forces can be used to strengthen and encourage friends and allies as well as to oppose and discourage opponents. Control of the air represents the ability to *influence,* not simply the ability to fly over certain areas or to drop bombs in certain places. It is "gained and held by the appropriate employment of the nation's air potential," which means all the nation's air forces, since air forces must be regarded as an entity. It can be exploited continuously, day and night, seven days a week, 365 days a year, under any conditions—cold war, hot war, or peace.

The concept of control of the air opens up new directions for the employment of air forces as instruments of national policy. The peacetime significance of the control-of-the-air concept is summarized in Air Force Manual 1-2: "A nation's influence in international negotiations is strengthened or weakened by the state of its air forces. The capabilities of powerful air forces for achieving decision in major war are thus translated into a capacity for the maintenance of world peace." Thus the concept of control of the air renders the Air Force a potent instrument for the gaining of positive and desirable ends as well as a means to forestall the undesirable. In either instance air power may operate as a decisive force both in peace and in war.

As part of this view of its ability to contribute to the tranquillity of the world, the Air Force considers military power to be only one of four instruments of power available to a nation. In time of world quiet it must be used concurrently with the other three instruments — political, psychosocial, and economic — if the nation's objectives are to be achieved. The military instrument may make a contribution to peace by denying the enemy resort to active military operations to achieve his ends. Our military instrument has functioned in this manner through all the years of the cold war. In such a way the capability of the Air Force to achieve decision in major war is translated into a capacity for the maintenance of world harmony.

Although military power operates all the time as one of the four instruments of power available to a nation, it is only one of four, and in time of peace all four must be utilized jointly to advance national policy. The case of Indo-China is an illustration. An unfortunate situation had existed for years. Suddenly a crisis developed. The military was called on to put out the fire. But the basic problems that had allowed Communist successes in Indo-China would not have been remedied by military intervention. Indo-China did not primarily offer a military problem but one that had required earlier the simultaneous employment of all four instruments of national power. It is important to an understanding of air forces to keep such situations in perspective.

In addition to his own understanding of the capabilities of air forces, the airman has still another responsibility. Before he can undertake to help educate the public on the role of air forces in national policy, he must be sure that his own views are sufficiently broad. If the Air Force is truly a global force with global impact, its members must look at its affairs from a global viewpoint. As important as the question how to wage global war, this viewpoint must include the ideas and the means for waging global peace.

The acquisition of a global viewpoint puts problems of aggression in their true perspective. The tension over Quemoy and Matsu provides a case in point. Like the delegates at the World Affairs Conference, many persons automatically reacted as if these two islands were separate entities and not part of the total world picture. They started at the bottom, adding up guns, tanks, and planes and computing the distance from the islands to the shore in assessing our risks in the situation. But if one begins from the top, as Air Force doctrine prescribes, and views Quemoy and Matsu as part of a global struggle, he discovers that militarily the fate of these islands can make little impression upon the global conflict of which they are a part. The American forces facing Communist China are only token forces. In view of total capacities for war it is ridiculous to believe that Red China poses a threat to the United States. Should China invoke her assistance treaty with the Soviet Union, the latter must consider the possibility of a total nuclear war with the United States. It is difficult to believe that the U.S.S.R. would risk a global contest for the sake of Communist China if heretofore this risk has deterred the Soviet from provoking a major war. Thus if one considers the confusion over Quemoy and Matsu from a global point of view, he realizes that these islands comprise a political, economic, and psychosocial problem, not primarily a military one, and that our actions there must be determined by their impact on the Asiatic and other peoples, not by an effect on the balance of world power from the military standpoint. One gains insight into the true nature of a problem by acquiring a global point of view.

Obviously before the airman attempts to help inform the public about the contribution of air power to the national objectives of our country, he has a responsibility to inform himself about the true nature of these objectives. Not to do so involves the danger of contributing to current misconceptions about the use of air forces. For example, if an Air Force man agrees that our national objectives are to destroy the Soviets and to eliminate Communism, he will encourage those who accuse the Air Force of being trigger-happy. Actually our national objective is simply to live at peace in a decent world. We have never said that we want to eliminate the Soviets, or even Communism *in toto*. We have said we desire to remove from Communism any menace to our security—to lift its domination from peoples who did not choose it for themselves. To those people who believe that the policy of the military is one of mutual terror between nations, based on opposing arrays of nuclear bombs, we can reply that our policy is rather one of mutual and necessary respect for each other's capabilities. The Air Force must dissociate itself from the view that the only solution to our conflict with the Soviets is the military solution.

The airman should also be able to describe our military objective in terms of the Air Force's expanded view of the capabilities of air power. Our national objective is to control Communism, not necessarily to kill it. Even if we should ultimately have to kill it in order to control it, we should not commit ourselves to the theory that there is no alternative.

Basically the military objective of our country is to deny Communism the ability to use war as a means of attaining its aim. Even if the capacity of each country to inflict destruction on the other reaches such a level that war would become mutual suicide, nothing is changed. We are still achieving our military goal when we deny our opponent the ability to use his military instrument. Along with this continuing denial, the Free World must apply successfully the other elements of power—the economic, political, and psychosocial instruments—if we are to succeed in our objectives with regard to Communism. The Air Force has an opportunity and a responsibility to assist in the employment of these "peaceful" implements.

In this way the Air Force succeeds in translating the capability to wage a total H-bomb war into a capacity for the maintenance of peace. We have translated our capabilities for that war into an opportunity to triumph over the Communists at their own game. If the airman is able to broaden his view in this way and to express himself clearly, he will be in position to refute any belief that air power is effective only in war and that the Air Force is trigger-happy and eager to initiate a nuclear conflict. The concept of control of the air provides him with the doctrinal support for his views.

The third question:

How can the airman explain that control of the air is fundamental to our national strategy, with profound implications for the whole range of international relations?

Behind several of the prevalent misconceptions of air power as a national instrument is the assumption that a nation inevitably must shoot its way into a position of control of the air. Air Force doctrine holds that control of the air can be won, held, and exploited in any atmosphere of international relations. It can be won and exploited in war, but it does not have to be won and exploited that way.

We can go a long way toward eliminating this particular misconception by explaining that the control-of-the-air concept is not limited to the defeat, domination, or influencing of enemies in war. In its full sense control of the air means that our air forces must be prepared to wage total war, or to wage total peace, or between those extremes to conduct such operations in limited peace or limited war as will best benefit our national interests.

As airmen we should be able to explain that the effect of control of the air is global. In World War II the application of this global capability turned the tide in Europe and the Pacific. Air forces carried the war to Germany and Japan years before those nations were approached on the surface. This capability encouraged our allies as well as convinced neutrals that our victory was inevitable.

In some specific instances this capability may be manifested in action that is not global in a geographical sense, but such instances are not separate, unconnected instances of control. They are parts of a global condition. Korea illustrated the effect in a limited area of global capability to control the air. The global capability of the Strategic Air Command, as a force-in-being ready and able to strike anywhere on the globe with devastating power, substantially modified that war. Although the Communists had large jet air forces in Manchuria, they never seriously attempted to use their air forces as far south as our battle line. The Communists knew that if they attacked our crowded, exposed ports and airfields they would open Manchuria to the reaction of our global air force. In this case the global capability of air forces to prevent major war also meant the capability to prevent limited war from expanding to major war.

This same kind of global air capability gives NATO the strength to hold inviolate a line extending from Norway to Turkey. No local situation—NATO, Korea, Indo-China, or Quemoy and Matsu—can be evaluated as a separate entity, set apart from the influence of global air capability. By stating all of these facts clearly we can hope to eliminate many of the misconceptions about air forces and to clarify the employment of air forces as an instrument of peace.

As airmen we should also be able to make it clear that control of the air can affect friends, that it is more than being against something. It is more than the ability to destroy; it includes the ability to build, and to save, and to strengthen. It is more than a deterrent to an adversary's strength. It can also be a rallying force, an affirmative influence, an incentive in building and solidifying the strength of our friends and allies.

Air Force doctrine now states that the effects of the employment of air forces may be manifested, identified, and exploited in all types and gradations of conflict between nations. It means that the Air Force is prepared and able to earn its way every day, in all conditions of international relations, by effectively supporting national policy. It means that the Air Force expects to wage peace as well as to be able to wage war.

We must be careful to point out ways in which air forces can have positive political, economic, and psychosocial effects on other countries. We must be sure to identify these effects with the everyday operations of the Air Force. We must develop an instinctive recognition of the meanings of these operations, and we must be able to communicate these meanings to others, so that misconceptions will not persist. We must be able to show by actual example how the war power of the Air Force is translated into peace power.

Fourth question:

What examples can be used to illustrate the diverse capabilities of our air forces?

The airman may draw upon an endless supply of examples, new and old. One of the older ones is the Berlin Airlift. One of the newer ones is the recent Operation Gyroscope, in which regimental combat teams were rotated between the United States and Japan in a comparatively few operational hours.

Air forces were employed both actively and passively in the Berlin Airlift. We used them actively to supply the city—that is, to keep Berlin alive as a symbol of democratic freedom despite the Soviets' surface blockade. At the same time we used air forces passively to make the operation a success. The deterrent of our combat forces deployed around the world kept the Soviet fighters away from our C-54's. This combination of a passive dominance and an active dominance successfully advanced our national objective. Berlin was supplied. The Soviets were restrained from disrupting the operation, although they had available the aircraft to do so. The Communist Curtain was not permitted to envelop this vital outpost of the Free World. In addition, there is much evidence that the Berlin Airlift also exerted a strong psychological effect among neutral nations and our allies. The entire world watched this employment of air forces and waited for the outcome of an operation that had no political precedent.

We may assume again that a more recent example of the global capability of air forces, Operation Gyroscope, had strong psychological impact upon opponents, friends, and neutrals. This operation demonstrated American air mobility. It signified to every nation in the world that the United States has available airlift to meet aggression anywhere.

An example of the capacity of air power to further national objectives by peaceful and humanitarian means is Kinderlift, which operated last summer for the third successive year. In Kinderlift the Air Force flies thousands of underprivileged children out of Berlin, across the encircling Communist zone, to free areas where they spend vacations with German and American families. Kinderlift is not just a publicity stunt, but the planned employment of air forces for a constructive purpose. The United

States also collects a dividend from Kinderlift in the form of influence. The program is evidence that we are not atomic villains, bent only on war and destruction. It refutes Communist propaganda that we think only of war.

The Air Weather Service is one example of the diversity of Air Force activities which range the whole spectrum of international activities. In 1954 the Air Weather Service flew more than 57,000 hours on weather reconnaissance. In addition to military uses the information gathered in these operations protected lives and property throughout the Free World by forewarning of harmful weather conditions.

In the summer of 1954 floods in Pakistan reached the proportions of a national disaster. Pakistan appealed to the United States for help. In a matter of hours a global air operation had been organized to aid Pakistan. Airplanes from bases in the United States, in the Pacific, and in Europe converged on Pakistan bearing tons of urgently needed medical supplies and equipment and hundreds of technicians to assist relief and rescue operations. The use of USAF aircraft in this humanitarian operation displayed to all the world not only unmistakable evidence of the global character of our air power but of our wish to use it only for the world's good.

In these examples as in scores of other examples that could be cited one sees the translation of air forces' capability for war into a capability for peace. Once an individual acquires the habit of making this translation for himself, his misconceptions about the Air Force will disappear. One of our jobs as airmen is to encourage this process at every chance. For if the Air Force is to convey its views about the proper uses of air power in peace, airmen must be missionaries as well as politicians and craftsmen. Our capabilities will be properly committed if we are able to translate our conception of them into a demonstrated tool that our civilian superiors will be eager to use.

How can the Air Force do this? First it must provide the basic doctrine for the employment of air forces: what air power is, what it can do, how it can be used. This we have done. In the second place it must convey the implications of its doctrine to the public. To do this, we must have the trust and respect of the public. If the general public does not yet fully understand the real meaning of air power as a force for peace, it is the responsibility of the Air Force to render it intelligible. Airmen must themselves be certain that they can attract attention to their words and that their words are clear.

The quest for peace is the deeply felt and abiding concern of all Americans, civilians and military men alike. We of the Air Force conceive of our national air power as a vital instrument in the maintenance of global harmony. Yet there remains considerable room for improvement in our carrying to the general public a real knowledge of the capabilities of air forces not merely as instruments of war but also, and more important, as instruments of peace.

National War College

USAF Bases in Spain

Major Louis J. Churchville

THE construction by the United States of a system of bases and related facilities in Spain represents a decisive step in the history of both countries. For the United States, consummation of the basic negotiations and launching of the construction program climaxes a shift in policy since 1947 when the United States supported a U.N. resolution that resulted in the withdrawal of ambassadors from Madrid and the virtual diplomatic boycott of Spain. For Spain this historic step means an important position in the defense line-up of Western nations and participation in the programs of U.S. military and economic aid.

In assessing the progress made in the Spanish base construction program during the thirty months since the signing of the agreements, one should consider the objectives and the means available to realize them. The primary objective is to support the global mission of the Strategic Air Command and the operations of the Navy in the Mediterranean. Two basic requirements exist. One is to construct a complex of well-planned, efficient military installations from which modern aircraft can operate effectively. The other is to develop this capability with the funds available while avoiding undue impact on the local economy. Knowledge of local economic conditions and previous experience in similar programs underscore the importance of the latter. The general construction principles were formulated with these requirements in mind.

The present close cooperation between Spain and the United States began in 1951 with military discussions leading to a survey of Spanish facilities and potential sites adaptable to U.S. military requirements. Acting on the report of the special survey team, the Joint Chiefs of Staff recommended that the United States negotiate with Spain to secure the right to develop military facilities. In April 1952 a small group of officers arrived in Spain to begin these negotiations. The agreements signed in September 1953 granted the United States the right to construct, staff, and operate air and naval bases in Spanish territory. They are in force for ten years following the date of signature, with provisions for two automatic five-year extensions.

It was discovered early that the topography of Spain, the second most mountainous country in Europe, would severely limit the selection of sites for air bases. A relief map reveals only four general areas in Spain suitable for base development in terms of good approaches, logistics accessibility, and personnel welfare. First, there is the northern Ebro River valley, roughly on a line between Zaragoza and Barcelona. South of this is the relatively flat area along the Mediterranean coast between Barcelona and Cartagena. In the center of the country lies a relatively flat plateau between the cities of Madrid and Albacete. Finally, in the south there is the basin of the Guadalquivir River on the line from Cordova through Seville to Cadiz. The sites selected lie roughly in a diagonal from the southwest to the northeast corner of the country. Nearly all the bases will rise on the sites of existing Spanish fields, with rails and roads close by. Thus the new construction will require a minimum of earth moving.

The headquarters and largest USAF installation in Spain will be at Torrejon, 13 miles northeast of Madrid. Here will be housed the principal elements associated with Strategic Air Command and air defense operations. To make possible the operation of our medium and heavy jet bombers a runway of 13,400 feet is being constructed, part of it overlaying the existing 4000-foot runway. Torrejon will also have an extensive concrete parking apron.

A unique USAF facility will appear at Zaragoza, in the Ebro Valley about 100 miles south of the Pyrenees. Two parallel, staggered runways will be served by a common administrative and housing area. The easternmost half of this base includes the site of the municipal airport. The field already has a 10,000-foot, hard-surface runway and parallel taxiway of the same length. To bring them up to heavy-duty standards, the runway and taxiway are receiving an asphalt overlay. A 3500-foot concrete parking apron has already been completed. Arrangements have been made with the Spanish Air Force to use some of the existing base buildings for the duration of the Defense Agreement. The western runway of this complex occupies the site of the Spanish military field of Valenzuela. Here, on existing military property and on new real estate acquired by the Spanish Government, the U.S.

is constructing a 12,200-foot runway. The principal base administration and support area for the station will be located immediately to the south of this runway.

The southernmost USAF base in Spain will be at Moron, 25 miles southeast of Seville. Existing Spanish Air Force "real estate" can be used only partially, since better approaches are obtained by siting the runway a mile to the west. Additional property has been acquired, and the new runway, 11,000 feet long, is under construction, with adequate approach clearances in accordance with USAF standards.

A depot is to be located at San Pablo, adjacent to the Seville municipal airport. Built in recent years, the airport has a 7000-foot concrete runway and a 6500-foot cross runway of asphalt. The existing main concrete runway will support USAF transport aircraft. The Spanish Air Force has agreed to close a short north-south runway to permit erection of the depot facilities on the southern boundary of the field.

Jet fuel and aviation gasoline for all these bases will be furnished by a pipeline presently under construction. From Rota, near Cadiz on the Atlantic coast, it will run diagonally up through Spain to Zaragoza. The decision to build a pipeline and tank storage farms in Spain followed studies that revealed no other reliable way of furnishing the bases a continuous source of fuel in the quantities needed. The pipeline will pass close to the bases, and each will be linked to it by a connecting spur. Under construction simultaneously with the pipeline are major fuel storage areas at Rota, Seville, Madrid, and Zaragoza. Approximately 90 miles of the pipeline have been built.

Rota is the location of the principal U.S. Navy facility in Spain. Here a breakwater-protected port, including a POL pier,

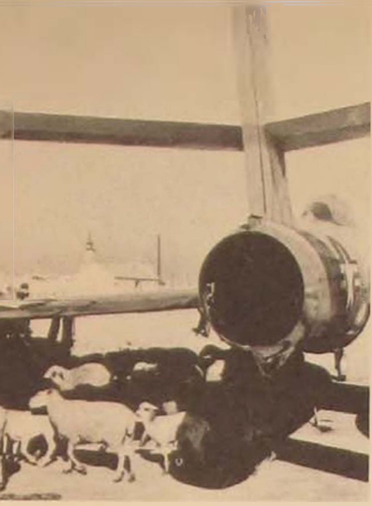
In Spain the United States is forging new links in the Western alliance chain of bases. Extending the range and mobility of the U.S. Strategic Air Command and servicing U.S. Naval units operating in the Mediterranean, the bases exploit the strategic advantages of the Iberian peninsula. Their establishment peaks a shift in Spanish-American relations. Their construction poses unique problems for U.S. engineers and builders. In a matter of months air bases will operate on a southwest-northeast diagonal across Spain, at Moron, San Pablo, Torrejon, and Zaragoza, linked by a fuel pipeline. A major Navy facility at Rota in the south and storage facilities at Ferrol in the northwest, Cartagena in the southeast, and Mahon on the Mediterranean island of Minorca complete the proposed facilities. Major Louis J. Churchville, Chief, Information Services, Joint United States Military Group, Spain, reports on the status of the Spanish base construction program. Pictures are from the USAF and from Bill Greene of Brown, Raymond and Walsh.

USAF Installations in Spain

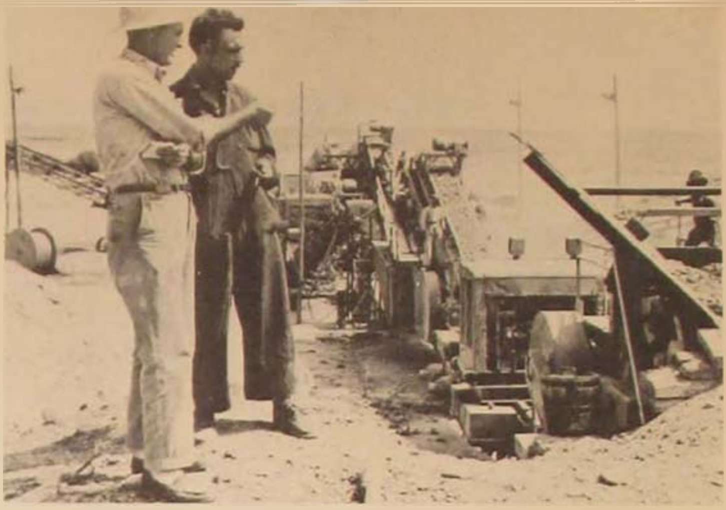
will be built to receive tankers feeding the pipeline and to service Navy aircraft carriers. A runway, parking apron, and various buildings are under construction for Navy air units.

Closely related to the construction of the bases themselves is the problem of family housing. Even in heavily populated areas, such as Madrid, Seville, and Zaragoza, housing is insufficient to meet the needs of the local population, much less that of American personnel who will be stationed on the nearby bases. The difficulty increases in more remote areas such as Moron Air Base, where the number of family houses is extremely limited. Under the solution proposed, private Spanish companies will build and lease housing to American personnel, with rental occupancy guaranteed for seven years and option to continue occupancy or to lease the entire project.

In December of 1955 Spanish firms were invited to submit proposals for housing in the Madrid, Seville, and Zaragoza areas.



USAF comes to Spain



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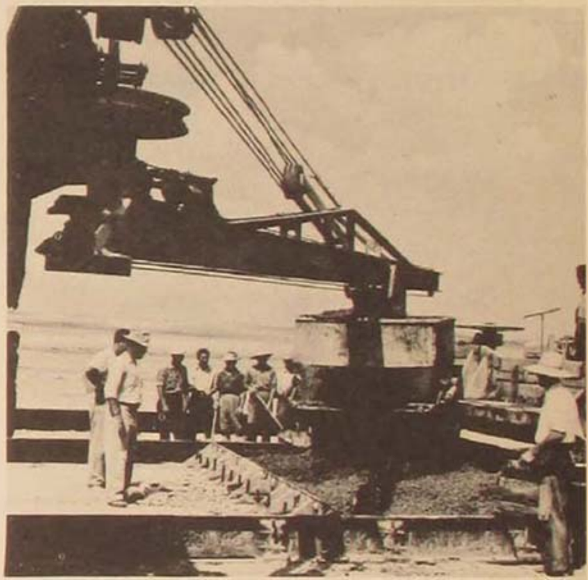


Twelve groups showed keen interest. After evaluation of their proposals, two organizations were issued letters of intent and discussions leading to contracts are in progress. One company will construct houses for 866 families at Torrejon on the outskirts of Madrid and for 158 families at the Zaragoza location. The other will construct a combined housing project of 494 units for the bases at San Pablo and Moron. Actual construction of these projects will begin about 1 June 1956 and occupancy is forecast for October 1957.

Although all facilities must meet high standards, every effort has been made to adapt the design and construction work to local conditions. The architects and engineers have consistently used the materials predominant in each region, so that the buildings at each base will resemble the prevailing architecture of the local-

. . . and Spanish labor

. . . excavate,

. . . lay fuel pipelines,

. . . and build fuel storage facilities.

ity. At Torrejon the red brick abundant around Madrid will be used; at Zaragoza the basic material will be large brown bricks; in the south block or tile stuccoed with white plaster will be used to deflect the heat of the Iberian sun.

The facilities at the Spanish bases will match those of our best-equipped USAF installations. They are designed to support modern SAC and air defense operations and at the same time to ensure the efficiency and welfare of the personnel stationed on them. They will provide a valuable increase in the mobility and potential striking power of the Air Force as a whole. Excluding San Pablo, each base will be capable of supporting bomber, fighter, and tanker operations, but for the immediate future USAF planners are anticipating full peacetime use only of Torrejon, the headquarters site and largest base of the group. Permanent caretaking detachments at the Moron and Zaragoza bases will keep facilities in constant readiness should SAC suddenly need them. In a matter of months Torrejon will be ready for rotational exercises by units of Strategic Air Command flying directly from home stations in the United States. Limited maneuver activities probably will also begin at Zaragoza at about the same time.

To safeguard SAC operations on the Spanish bases, Spanish and American units will cooperate closely in an air defense network. The system will be equipped with a radar network of both heavy and light stations, embodying the more important procedures developed in the United States and in northern Europe. The center at Torrejon will control a series of stations with overlapping coverage, substantial back-up facilities, and distant recognition capability. USAF fighter units are programmed to be available for defense purposes. The Spanish Air Force will obtain a number of F-86F squadrons through the Mutual Defense Assistance Program. A communications network will link the air defense system by direct lines to the various bases and radar sites and between the pertinent command posts.

A unique organizational setup supervises the construction program in Spain. Over-all supervision is the responsibility of the Joint U.S. Military Group. JUSMG reports to the Secretary of the Air Force, the Executive Agent for the Department of Defense for the entire program. The Bureau of Yards and Docks of the U.S. Navy is the agency responsible for overseeing actual construction. An admiral of the Civil Engineer Corps, in the dual role of JUSMG Deputy Chief for Construction and Director of Construction, acts as the primary monitor of all construction activity for the Chief, JUSMG. The Officer in Charge of Construction, who is the representative of BuDocks, supervises three principal subordinate agencies: the prime contractor, his resident officers-in-charge of construction at the various base sites, and the architect-engineers.

Prior experience dictated that United States firms, under the general direction of BuDocks, should supervise both the architect-engineering and construction phases of the Spanish program. Three firms combined as Brown, Raymond and Walsh to become the prime contractor for the program. This joint company is composed of Brown & Root of Houston, Texas; Raymond Concrete Pile of New York; and the Walsh Construction Company of Davenport, Iowa. Similarly the architect-engineers are a special group of experts from Frederick R. Harris, Inc.; Medcalf and

Eddy, Inc.; Pereira and Luckman, Inc.; and Shaw, Metz & Dolio, Inc. These firms have worked on many Defense Department construction and planning projects.

Certain definite principles based on past experience and existing local conditions guide the construction program. The first of these is to avoid a "crash" program by careful planning and organization prior to awarding the contract and beginning construction. The purpose is to obtain cost-saving, competitive lump-sum contracts where practicable; to build only those facilities required; to keep costly changes to the minimum; and to buy only materials actually needed. The second principle is to inform the appropriate Spanish governmental agencies of every important matter that affects them and to coordinate all actions with Spanish authorities in order to obtain their support. The third principle is to use the Spanish construction industry and labor forces as far as practicable, as well as whatever local equipment and materials can be spared without harm to the Spanish economy. By using Spanish engineers, technicians, and labor in construction, maintenance, and administrative functions, the cost, transportation, administrative support, and care of numbers of American civilian and military personnel have been reduced to the practical minimum.

The prime contractor does not perform the actual construction work, but plans and supervises the jobs through Spanish subcontractors, when they can undertake the job, or through combinations of an American firm and a Spanish company. An example of the latter is the contract for construction of the pipeline: Benson and Montain of Oklahoma City; Merritt, Chapman, Scott; and Agroman of Spain joined together to handle this project.

U.S.-owned surplus equipment available in good condition elsewhere, particularly in French Morocco, is being used where possible. Brown, Raymond, and Walsh lease this equipment, plus any new equipment required, to the Spanish companies. They have trained Spanish workmen in the operation of complicated heavy modern machinery by establishing schools for operators as part of the contracts. Spanish construction workers have assimilated this training with surprising rapidity. The total cost of the Spanish base program is estimated at approximately $350,000,000. Local currencies in a special fund generated by U.S. economic aid cover a portion of the construction costs.

Like every major construction program undertaken in unfamiliar territory, the projects in Spain have produced problems calling for extra effort and in some cases have delayed the program. There was difficulty initially in obtaining the land needed. The government of Spain agreed to furnish all land necessary for the U.S. military construction. But the pertinent agencies were insufficiently staffed at first to handle the paper work on the large number of land parcels requested. As in all countries the legal procedures whereby land can be expropriated are quite involved, and for several months in early 1955 it seemed unlikely that some land requirements would be cleared in time to let the contracts. Concerted effort resolved the difficulties and the rate of award of the contracts improved. An indication of the magnitude of the task is that the Spanish authorities made available to the United States approximately 14,000 acres of land for construction needs, in addition to the right-of-way for the 500-mile pipeline.

The problem of water supply for the bases was foreseen but has been difficult to overcome. Only at Moron does there appear to be a suitable on-base supply, and even there only time and use will prove whether the quantity is sufficient. If not, a 20-mile pipeline will have to be constructed to tie in with the water system at Seville, a series of wells which must also supply San Pablo by means of a 4-mile pipeline. At Torrejon several test wells failed to produce enough water, so the main source will be the Jarama River, its water being pumped to the base through a 4-mile pipeline. At Zaragoza the nearby canal system was thought to be adequate for the needs of both Sanjurjo and Valenzuela, but tests proved that an expensive purifying plant and large storage reservoirs would be necessary to assure a good supply when the canal is low. It is now planned to connect a 2½-mile pipeline to a group of wells which engineering studies indicate contains an adequate supply of good water.

Despite the legend of sunny Spain the weather has presented another difficulty. During the first few months of 1955, when the subcontractor at Torrejon planned to do the majority of his earth moving, the rains were four times the 10-year average. Work was impossible for eight consecutive weeks. The unprecedented cold of January and February 1956, accompanied by sustained freezes and nearly continuous rain from October 1955 to April 1956, greatly hampered outdoor work, especially the batching and laying of concrete.

In retrospect the Spanish base program to this time can be divided into two general phases. The period from October 1953 to June 1954 was devoted to selection of the prime contractors and the architect firms, the build-up of their staffs, and the design and engineering work prior to letting the first subcontracts. Care and thoroughness in planning called for relatively large numbers of highly trained personnel. Toward the close of this first phase, construction funds finally were made available to JUSMG and BuDocks (May 1954), following reprogramming clearances by various committees of the Congress.

The second phase began about June 1954 and by 9 September 1954 the first contract had been let, calling for the grading, drainage, and paving at Torrejon. In May 1956, contracts are being let for the runway, apron, and drainage facilities at all sites, as well as for the pipeline, navigational aids, control towers, buildings, and fuel storage systems. In this second phase construction work and related procurement totaling $200,000,000 will be contracted for—roughly the half-way point of the program. In the third period, June 1956-June 1958, practically all the line items expected to be authorized and funded will be completed.

In the spring of 1957 the Spanish bases will be sufficiently advanced to support air operations on an austere basis. Pavements, fuel, and communications will be available at that time. By early 1958 sufficient buildings, warehouses, shops, and barracks will be complete to consider the bases ready for full operational use.

Joint United States Military Group, Spain

Tactical Air in Limited War

Colonel William M. Reid

IN 1950, when the United States faced in Korea the new and unexpected problem of "limited" or peripheral war, tactical air power was not in a position to cope adequately with this new wrinkle in Communist aggression. Its capability was hamstrung by previous rigid restrictions of the military budget and by the shell of complacency that had settled over the hard-learned lessons of World War II.

At the close of World War II air power at long last seemed likely to gain the respect and admiration it deserved. Some strategists were beginning to grasp the significance of its employment as an entity on a global scale—passively and actively—in peace and war and to explore its almost limitless potential in the thermonuclear era. The American public in general had accepted it as the most dynamic instrument of military power. But one major obstacle remained to obstruct its full development. The wave of economy which engulfed the military budget during the first few postwar years reduced the once magnificent air striking force of some 225 wartime combat groups to approximately 40, a fraction of that necessary for defense of the country in a national emergency.

Then when the U.S. was confronted by the peculiar and unfamiliar characteristics of "limited" or peripheral war, as best typified by the Korean conflict and in a different way by the struggle of the French with Vietminh in Indo-China, we immediately forgot many of the lessons of World War II concerning the employment of air forces. Among the most important of these lessons was the one inexorably taught by the series of defeats and near disaster in North Africa in 1943 when tactical air power was parceled out in small packages to each ground commander to use as he saw fit. The enforced revision established a system of control for tactical air that was designed specifically for exploitation of its inherent flexibility and potential for rapid concentration. Under the revised system ground and air commanders were given positions of equal authority, directly subordinate to theater commanders. Each controlled his own forces, but in joint planning both commanders acted in close unity. Under the theater ground force commander were the army groups and numbered armies. Their equivalent air units were tactical air commands and numbered air forces under the theater air commander. The theater air commander could, under this system of organization, move his entire air force strength, if necessary, to meet any emergency, threat, or commitment of any kind whatever. The effectiveness of the system was proved during the successful air-ground campaigns in Europe, from 1943 through 1945. It was battle-tested in every theater. It was evolved through experience, not theory, by both ground and air commanders, and was fully endorsed by both.

Yet directly following the outbreak of hostilities in Korea, and because of difficulties encountered in getting air-ground operations properly coordinated initially, the entire concept of tactical air employment was again laid open to attack from all sides. Rumors, counterrumors, and conflicting statements were published and broadcast by columnists, commentators, and critics of air power, both civilian and military. As a result the average American citizen was once more in a state of general confusion regarding the usefulness of air power in limited or any other type of action.

> The record in Korea shows USAF in the remarkable position of having air superiority but unable to give its own troops adequate support. (newspaper item, 13 July 1950)

> The contribution of the Far East Air Force in the Korean conflict has been magnificent. They have performed their mission beyond all expectations. (Gen Douglas MacArthur, 25 July 1950)

From World War II emerged the concept of the unified control of tactical air forces in a theater of operations. In the Korean conflict the United States encountered the new menace of "limited" or peripheral war. Momentarily many of the lessons of World War II seemed forgotten as an unprepared nation strove to counter the Communist assault. When air-ground operations began to function smoothly, political restrictions hampered the full employment of tactical air. In Indo-China the Western world again faced "limited" war. The French, ignoring the lessons of World War II, failed to utilize effectively their advantage in tactical air. Colonel William M. Reid, Evaluation Staff, Air War College, reviews the role played by tactical air in these two conflicts. He concludes that neither case proves that air power is indecisive in "limited" war. Rather he finds that both struggles affirm the concepts for use of tactical air derived from World War II: tactical air power must be carefully coordinated through the proper use of centralized control; it must be employed in relation to the total available air power; and it is best employed within the larger framework of a dynamic political or military policy.

> Korea taught the same old, old lesson of war: The military factor of ultimate importance which finally subdues the enemy is the man on the ground. (newsletter, 15 October 1950)
>
> There has never been anything like this in my experience. Without air support, we would have been pushed into the water. (Major General Hobard Gay, 11 August 1950)
>
> The Marines, with close air support, moved 27 miles in four days with light casualties. The Army, which had the usual air coverage, bogged down after suffering many casualties. (war correspondent, 15 August 1950)
>
> The truth was exactly opposite. Army units fighting side by side with the Marines had lighter casualties and actually had to wait for the Marines to catch up. (columnist commenting on same action, 30 September 1950)

These statements give some idea of what the general public was receiving as "authentic information" on tactical air power in Korea. It is no wonder that the man in the street was left in considerable doubt over the entire issue.

Many exponents of air power were, and still are, inclined to treat this situation rather lightly. They believe that to judge air power on happenings in Korea or any such "peripheral" war is to limit one's perspective to an unacceptable degree. This is true. They also believe that the question of air power skeptics as to why air power was not decisive in Korea is in many ways similar to asking why the New York Giants could not play a championship brand of baseball in a plowed field, crisscrossed by barbed wire fences. They believe the question to be so absurd, or the answer so obvious, that to belabor the issue further is not worth while. This is also true to a certain extent. But—unless the world situation undergoes a major and unforeseen change—this type of war is probable for an indefinite period. Since it will be necessary to live with the fact, a proper understanding of the air role in actions of this nature, past, present, and future, is vital. For a beginning, the record should be set straight on Korea.

FIRST, as has been so in every war since the American Revolution, when the Korean War began we were not prepared to fight. Incredible as it may sound, it is nonetheless true. By June 1950, in support of United Nations policy, both the Army and the Air Force had withdrawn all their personnel from Korea.

The United States had left the defense of the Republic of Korea to its own forces, except for a military advisory group and limited amounts of munitions, weapons, and money sufficient only to meet internal uprisings.

In Japan, U.S. Army and Air Force units were responsible for occupation duty and defense of the Japanese Islands only. The Eighth Army was a four-division occupation force dispersed throughout the area. The Fifth Air Force had, as a primary role, the defense of the islands against airborne or seaborne attack. Its F-80 groups were equipped and trained for an air defense based on fixed communications and radar equipment of a normal air-defense system.

Neither the Army nor the Air Force was equipped or adequately trained to switch rapidly from defense and occupation duties to intensive air-ground battles on the mainland. The Eighth Army had engaged in practically no training whatever with air units. It possessed hardly any of the communications equipment or trained personnel to constitute an air-ground team under established Army-Air Force doctrine. Air Force personnel were trained in the use of aircraft weapons, but there had been practically no air-ground exercises. As a result of economy cuts, the Army had only one signal company in air-ground operations, and the Air Force only one tactical control group in the entire world. Both of these vital units were in the ZI on training status. Under the circumstances it is no wonder that confusion reigned for the first few weeks of the war.

As is normal in operations which begin in chaos due to unpreparedness, air-ground operations in Korea gradually smoothed out. In the beginning there was some disagreement on target priorities for tactical air. All responsible commanders generally agreed with the established doctrine that air superiority should come first. Fortunately this did not prove too much of a problem, since the North Korean Air Force was destroyed in the first few days of combat, and the MIG-15's operating south of the Yalu River were kept under control by our fighters. There was never a really serious air threat against our surface forces. However, many Air Force authorities believe that their second-priority mission—interdiction—suffered because too much emphasis was placed on close support, especially during the first three months of the war. Statistics show that during this period two out of every three sorties flown by Far East Air Forces were flown in close support. This was another direct result of unpreparedness and of course was due to the desperate position of our ground forces, which had to be thrown piecemeal into combat against heavy numerical odds. Even so, in most cases, by far the best way of lessening the pressure of ground force strength is to destroy forces concentrated for transport and to destroy means of transport, including equipment and supplies. When control of the air is assured, isolation of the battlefield, generally speaking, is the next-most-productive job of tactical air. Our ground forces in Korea seemed slow to realize this, but eventually an understanding was also worked out.

There remained one road-block to proper interdiction which the Air Force had never experienced before, and in many ways this was the most frustrating feature of the entire war. It was the diplomatic decision not to allow operations north of the Yalu River, a decision that allowed the bulk of the enemy's war manufacturing centers to remain immune to our strategic air power.

This decision seriously weakened air power's effectiveness in Korea and denied the frontline forces the full measure of the support that air power can offer. This full capability goes far beyond air cover in the immediate battle area, beyond strikes on nearby supply depots and lines of communications, to the depots, assembly areas, and railheads and behind these to factories and to the workers who manufacture the implements of war. In the Korean War these sources existed in Manchuria and China. Thus the diplomatic restriction never permitted the full force of American air power, as it was developed during World War II and as it has since been further refined, to function in Korea against the most vulnerable points exposed by the enemy.

Thus in evaluating air power's effectiveness in Korea one must remember that here was a truly "off limits" war. During times when the front line was close to the Yalu the Air Force was unable to interdict the enemy at vulnerable transportation points. And since we were not allowed to cross the Yalu, the Air Force could not conduct full-scale counter-air operations or hit the vital enemy airfields in Manchuria, which were a continuous threat to the U.N. forces.

In summary, it was the old story of unpreparedness, and the new story of diplomatic restriction. But in spite of these and other obvious handicaps, it was generally agreed that within the limitations imposed, tactical air operations were satisfactory in quantity and quality, that without this support our ground forces could not have remained in Korea, and that the Joint Army-Air Force doctrine on air-ground operations, as contained in the Joint Training

Directive for Air-Ground Operations, dated 1 September 1950, is sound in principle and applies equally as well to limited actions as it does to major war.

CLOSELY following the end of hostilities in Korea came the final defeat of French Indo-Chinese forces by Vietminh Communists at Dienbienphu. Since the French had some 400 aircraft available in the theater for tactical operations and the Vietminh had no air force whatever, the question was raised again as to why air power was not decisive in this conflict. The answer may be divided into two parts, either of which would have destroyed the effectiveness of available air power.

(1) French tactical air was not properly employed or controlled.

(2) French top-level decision called for fighting a purely defensive war in Indo-China.

The real reason for lack of effective control of air-ground operations is difficult to surmise. In late 1942 and early 1943, all the French Tactical Air Forces and all the French Army then in existence were in action in Tunisia. They were present when the Allies faced defeat because their tactical air power was split up into parcels, each parcel subordinated to the ground commander and bound by doctrine to operate within a specified area. They saw the disastrous consequences of this concept during the debacle of Kasserine Pass. And they saw an Allied victory made possible when Allied tactical air power was placed under central control and unleashed to exploit its flexibility and concentrate its power anywhere as required in any situation throughout the battle area. They heard Air Marshal Coningham, Commander of the Northwestern African Tactical Air Force, say, "The soldier commands the land force; the airman commands the air force; both commands work together and operate their respective forces in accordance with an Army-Air Plan." They heard Field Marshal Montgomery say, "Nothing could be more fatal to successful results than to dissipate the air resources into small packets placed under the command of army formation commanders with each packet working on its own plan."

What happened? In Indo-China the French immediately dissipated their air resources into small packets under the command of Army formation commanders with each packet working on its own plan. Air Force strength was divided into three "sector commands," each under a ground force commander, and further parceled out to battalions and sometimes even to companies operating in jungle areas.

There was no provision made for joint air-ground planning on any level. Tactical decisions were made by ground force commanders and then transmitted to air units for implementation. There were no tactical air control parties, as we know them, and practically all air-support strikes were coordinated through small observation aircraft, when these were available and communications worked properly.

As was proved previously in the North African campaign and in other compaigns, air support under such circumstances cannot possibly operate effectively.

There was another factor of equal importance in reducing the usefulness of tactical air power. This was the political decision of the French to fight a purely defensive war. They, here again, adopted a "Maginot" concept, retired to several defended strong points, and were content to repulse Vietminh attacks. They appeared to have no real objective and therefore no over-all plan of operation. They operated on a day-to-day basis. No real battle line ever developed, and most tactical air sorties were flown for a kind of piecemeal interdiction against any targets which happened to appear. These sorties were largely ineffective because of inadequate intelligence, the nature of the terrain, and the ability of Vietminh forces to repair quickly any damage caused. Interdiction targets of significant importance were almost nonexistent. No real railroad line or marshaling yards existed in Vietminh territory, and not one major industry was operating in enemy-held areas. Thus interdiction attacks were largely confined to such targets as jungle road intersections and bridges, which could be by-passed with little effort.

Airborne operations were carried out in countering Vietminh attacks at widely scattered points with varying success, and supply and transport operations were effective in maintaining troops in the scattered defensive strong points. But in the absence of the desire and ability to mount a real offensive these operations only served to postpone the inevitable end. One by one French positions were evacuated in the face of mounting Communist pressure.

At the time of the final battle for Dienbienphu, the French had a considerable number of tactical aircraft available, but the only base remaining for fighter employment was a strip 3000 feet long and 210 miles away. There were three possible bases for light bombers, the nearest of which was 300 miles away. If the French had developed a means of effective air-ground control and had used sufficient navigational aids, the story might have had a different ending even then. But lack of these, plus existing weather conditions, made decisive air support a hopeless proposition, and so another bastion was lost to democracy.

In the two "limited wars" under discussion, it has been rather clearly shown that tactical air power often operated at a disadvantage. In one the disadvantage was largely due to a political restriction which made real interdiction impossible. In the other it was due to an outmoded concept of employment and lack of an offensive strategy. Neither action proved that air power, as such, is "indecisive" in limited war. Both actions proved that the world's finest military instrument can be blunted by mismanagement, political or otherwise.

So much for the past. The present is a time of great transition and change for air power as a whole, especially for tactical air power. It is a time of opportunity unlimited for the reorganization and development of tactical air power into one of the most potent forces for control of aggression in existence. It is a time for integrating new and more effective weapons. It is a time for concentrated preparation and training, for tactical air forces must be versatile forces. They must be prepared and trained to execute a multitude of divergent missions at any time. Depending upon an existing political situation, they must be prepared to use nuclear or conventional weapons in air superiority, interdiction, close support, and even strategic missions as required. This should give emphasis to the idea, now adopted by many experts in tactical air employment, of a task force, or a number of task forces, specifically organized, trained, and equipped for "putting out fires" in any part of the world on a moment's notice.

In the future, tactical air power, in limited or any other type war, must be carefully coordinated through proper centralized control. This is the only means of really exploiting its most valuable characteristics—flexibility and concentration.

Tactical air forces in limited war must be employed always in relation to total available air power. This discussion has been limited to those forces generally regarded as "tactical" rather than the "strategic" type, but it must be remembered that air power is indeed an entity and that one segment cannot be divided from the whole. The allocation and employment of air power in any theater must be geared to the global situation, both political and military, and must be governed by its total impact and influence, though sometimes at the expense of a localized area.

And finally, air power is dynamic power and is best employed in support of a dynamic policy, political or military. A combination of the two in proper proportion could well make another Korea or another Dienbienphu impossible.

Air War College

The Emerging Shield

A Quarterly Review Staff Study

Part I: The Air Defense Ground Environment

THE jet age and nuclear firepower have posed enormous problems in air defense. Jet bombers flying at double the bomber speeds of World War II have slashed the time for the defense to detect, identify, intercept, and destroy aggressor aircraft. Nuclear weapons have tremendously multiplied the offensive firepower of bombers. Small formations of bombers that in World War II would have been ignored by air defense as a nuisance raid could today inflict catastrophic damage on a nation.

In the defense of the North American Continent against air attack the air defense ground environment has worked toward two broad goals in attempting to meet the speed and firepower of the jet-age offensive threat. Early planning called for the defense warning system to be moved outward from the target areas. Through such developments as the Distant Early Warning (DEW) Line, picket ships and Texas Towers at sea, and flying radar stations a massive purchase of additional warning time is well along toward completion. On another front, in 1951 the Air Force launched an all-out technological effort to speed up the reaction time within the air defense system. The recent public announcement of the development of the Semiautomatic Ground Environment System (SAGE) heralded the first major victory in the technological attack. As SAGE is phased into the air defense structure it will provide the first basic improvement in air defense ground systems since the coming of the jet age. Until the outer perimeter warning screen is completed and until the integration of SAGE, air defense ground environment will continue to operate with improved World War II equipment and techniques.

The over-all purpose of an air defense ground environment is to provide an integrated system for the detection of hostile aircraft, for identification of the aircraft as hostile, for positioning the air defense weapons to meet the attack, and for directing the air battle. The final step, destruction, must be left to the air weapons carrier and the air armament. These basic functions of air defense have remained unchanged from the time of the earliest military use of air power in World War I. The basic problems inherent in carrying out these functions also are still with us, but they have enlarged in direct proportion to the technological advances in air and nuclear sciences.

Shortness of time is the over-all problem in air defense today just as it was a decade ago. How critical time has now become is revealed by even a brief examination of the classic divisions of air defense—detection, identification, interception, and direction of the air battle—in terms of priority in the jet age and of the progress of the air defense ground environment in meeting the problems it has introduced.

Detection

The detection system built into an effective air defense network must not only be able to warn of the approach of unidentified aircraft and to define course, speed, and altitude, but must also, upon identification as hostile, be able to track the hostile constantly along his line of approach to the target. Information from such a system must be collated, evaluated, and stored for use of others in the defense chain. The timely transmitting of this information from place to place and displaying it in a form that will enable commanders to direct the air battle constitute the greatest difficulty of detection. These actions are often referred to as preparing an air picture or generating surveillance information.

The year-to-year status of Air Defense Command, since its establishment a decade ago, has been marked by a series of interim developments in concepts, weapons, and techniques designed to hold the line in air defense pending the development of a better system. For several years air defense planning has included both a long-range program—to provide the foreseeable ultimate in vehicles, weapons, and control structure—and an interim program—to provide as much defense as can be had in the meanwhile. Recent public announcement of the Semiautomatic Ground Environment System (SAGE) heralded the first major development in the long-range program. To give Air Force officers a more complete picture of the current and immediate-future status of air defense, the Editors of the *Air University Quarterly Review* in two studies, "The Air Defense Ground Environment" and "Air Weapons for Air Defense," summarize the ground and air environments of air defense. This material was prepared in consultation with Headquarters Air Defense Command.

Problems of building a detection system for the jet age remain essentially the same as they were when aircraft first came upon the military scene. But increased speed, range, and altitude capabilities of jet aircraft compound the problems, make their solution more difficult and more demanding. The basic source of detection information for the air defense of the continent of North America is still the radar net, but it has had to be improved and extended to cover an increased air space. Detection information still has to be stored and displayed, but more quickly and with less chance of error.

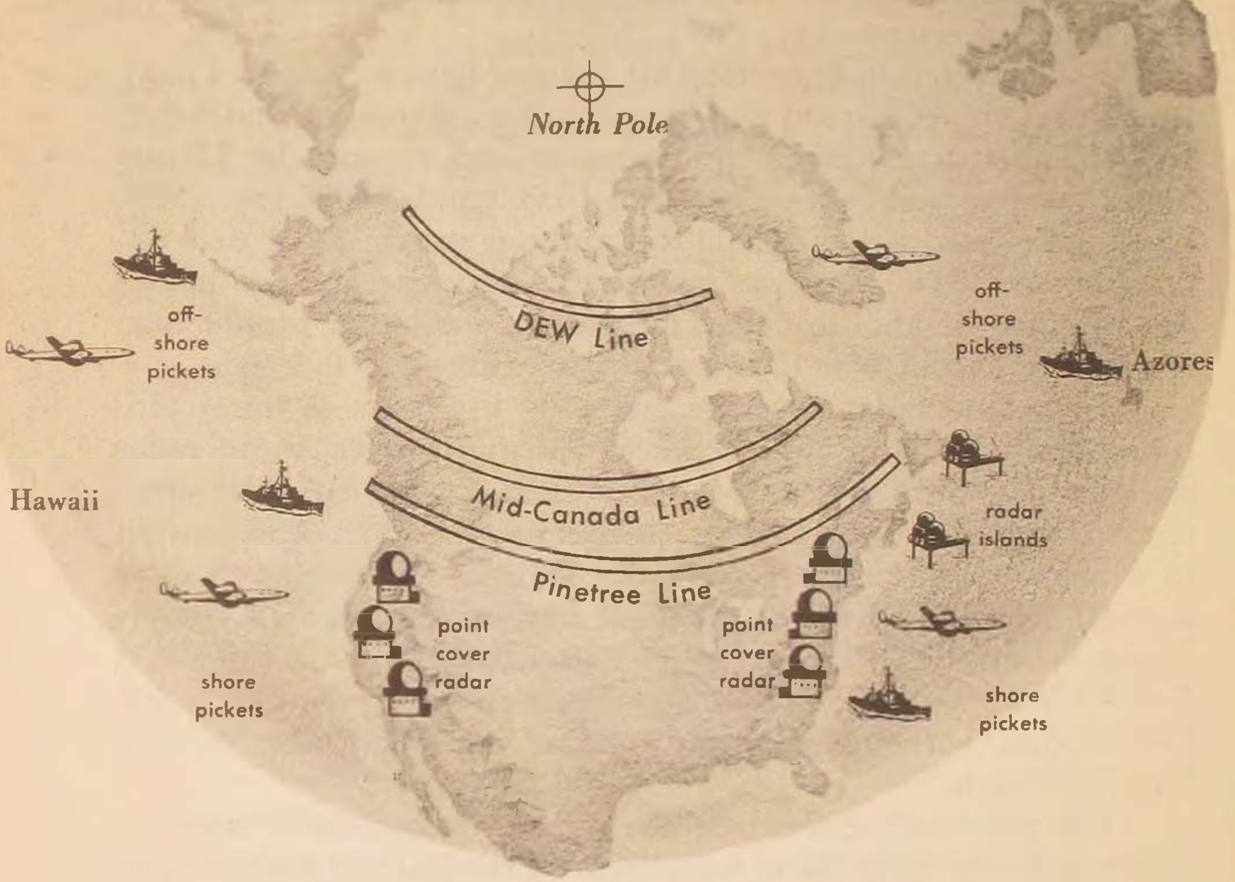
The first step in bolstering air defense detection was to institute a program to extend and improve the continental radar net. In 1952 our surveillance of the air over and around the United States was reasonably good between 10,000 and 30,000 feet. Serious holes existed below 10,000 feet and our capability to find aircraft above 30,000 feet was practically nonexistent. In the jet age we must be able to detect targets far smaller in profile than the B-17 of World War II and at altitudes above 60,000 feet.

To extend radar coverage and plug the holes at lower altitudes along the land approaches to North America, more radar stations have been added. Many of these are low-altitude, unattended, gap-filler radar that automatically send their information to a nearby long-range search-radar station. Navy picket ships and Air Force and Navy flying radar stations have made a similar improvement in continental seaward approaches. Air Force Texas Towers, manned radar stations now being built at sea off the Atlantic Coast, will further improve radar surveillance on the seaward approach.

The major effort to extend the warning system away from the target areas has been the development of the Distant Early Warning (DEW) Line, a chain of radar stations stretching from coast to coast in the Canadian Arctic. Information obtained from the DEW Line and from the sightings of the Canadian Ground Observer Corps will be accurate enough to permit a fairly reliable prediction of the enemy's point of penetration of a second radar chain, the Mid-Canada Line. The deployment and spacing of the two lines is based upon the need for warning in both Canada and the United States. The communications system supporting these two initial detection systems is such that intelligence information can be readily exchanged between the warning system and the combat zone, where a third radar chain, the Pine Tree Line, has been built to provide further defense in depth. It is here that aircraft are first committed in the air defense of North America.

Extension of Warning

Extension of air defense early warning beyond U.S. radar sites was the first step in buying the warning time for jet-age air defense. A detection system in depth, lying behind a perimeter warning screen, permits accurate tracking of hostiles. To provide for adequate warning and detection across Canada, three massive radar chains are under construction: the Distant Early Warning (DEW), the Mid-Canada, and the Pinetree Lines. Radar towers off the east coast, radar picket ships, and flying radar stations extend and deepen warning along seaward approaches.



To improve the air defense capability to detect targets at altitudes above 30,000 feet, it has been necessary to improve our World War II-vintage radar sets. Radar sets presently in operation throughout the ground environment system are effective at altitudes at which current aircraft are flying.

With each increase in the volume of air in which the air defense battle might be fought, the requirement for height information becomes more critical. A three-dimensional air situation has become a definite requirement. Height finders that will provide accurate height data to coincide with the range of current search radar have been developed and are being introduced into the system.

The second step in improving and speeding up the detection function has been in data processing. It began with a program to standardize the methods of plotting the position of detected aircraft by color codes, code lighting of planning and plotting boards, standardization of operations-room layouts, etc., in an attempt to gain time through a reduction of human error. This nearly-completed interim program makes the grossly inadequate World War II techniques more efficient until an entirely new system can be implemented within the next few years.

Air Defense Command investigated a number of possible methods to hasten the transmission and display of weapons status information before making the decision in 1953 to introduce digital computers into the air defense system. This decision resulted in the Semiautomatic Ground Environment System (SAGE), a new concept in data processing and display. SAGE combines current detection techniques with the use of high-speed, electronic, digital computers. Speed and efficiency of the present detection system depend upon a human reaction to a spot of light on a radar screen. Once SAGE is fully integrated into the detection function the reaction to the spot of light will be electronic.

Identification

Identifying a detected aircraft is basic to any effective air defense ground environment. In time of war, identification constitutes no real problem for air defense planners. After hostilities have begun, the defense system literally shoots at anything that comes into the perimeter radar warning screens from known hostile directions. Friendly air traffic is severely regulated. Commercial air traffic will be minimal, and military air traffic will largely be preplanned combat flights rather than training and proficiency flights.

This applies well enough to war already in progress. But the chances are that in any future big war the first and the critical air attack on the continent of North America will be screened by an all-out effort by the aggressor to mask his decision to attack until the force is airborne and as near its targets as can be attained. The onslaught will be sudden and all-out. The fact that one minute we would be at peace and the next the target of already-committed enemy intercontinental bombers places immense premium on rapid, positive identification of all continental air traffic. At the time of attack the air over and around North America will, as usual, be filled with thousands of civil and military aircraft. When the enemy force is detected, its identification as hostile must be swift and unerring. Otherwise near-sonic speed may enable it to penetrate so deep prior to defensive action that it cannot be destroyed before it reaches its bomb-release line.

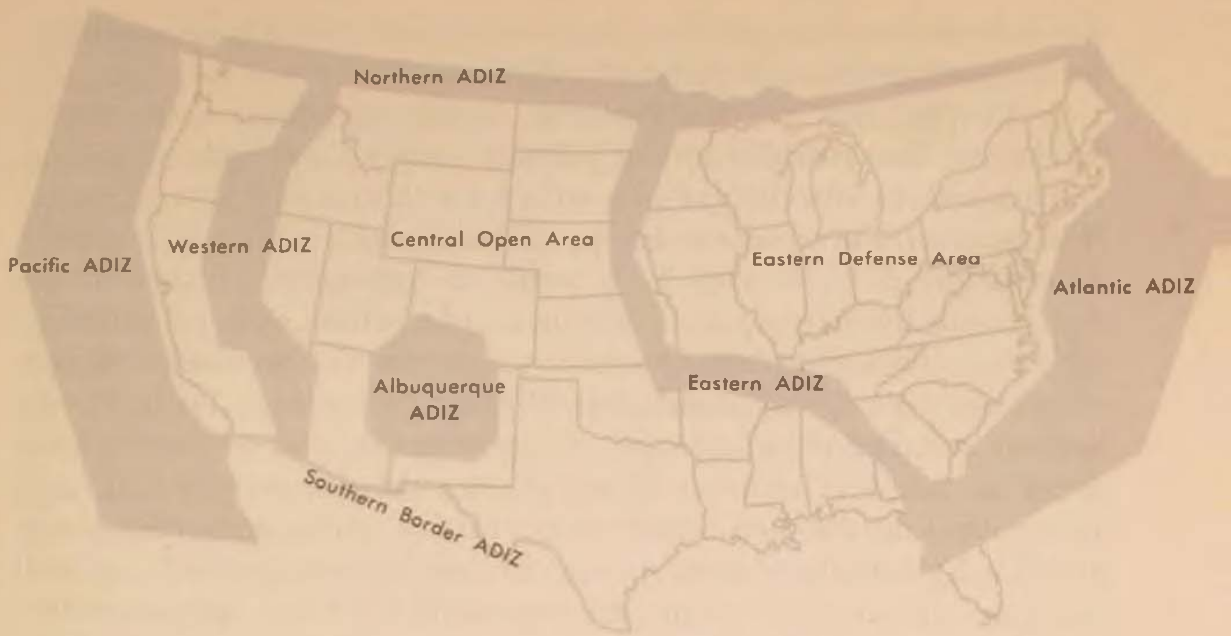
Present identification procedures depend largely on a manual system of flight-plan checking and matching within an Air Defense Identification Zone (ADIZ) established around certain critical areas. This system assumes that an aircraft flying to a given location, appearing at a prearranged heading and altitude at a prearranged time, is the one for which a certain flight plan was filed. A certain amount of tolerance—plus or minus five minutes and plus or minus ten miles—is permitted to allow for unpredictable variables such as wind and error in navigation.

For aircraft flying into this country from overwater areas these same variables, plus the added difficulties of accurate navigation over the ocean, have necessitated additional operational requirements. The pilot is assigned one of five ten-degree corridors converging on a navigational aid near the identification zone. The pilot must fly within this corridor and must come to within plus or minus five or ten minutes of his estimated time while within the corridor. If he should miss the corridor or stray from it, he is challenged to perform a maneuver outlined for him in a sealed envelope that was given to him at his point of departure.

The multiple-corridor system is in operation at three points in the United States—at San Francisco, Los Angeles, and Boston. It is scheduled for implementation at other points as equipment becomes available. Before it existed, some 30 per cent of all aircraft arriving at San Francisco and Los Angeles from overseas were identified as unknown. The multiple-corridor system has reduced the number of aircraft identified as unknown to approximately three per cent.

Ideally an identification system would automatically provide positive identification almost at the moment of detection. The closest approach to this goal lies in the application of electronic aids and automatic data processing. Although rapid advances have been made in this direction, full achievement of the ideal system is still a long way off. It will require foolproof equipment in all friendly and nonhostile aircraft as well as on the ground. The Semiautomatic Ground Environment System (SAGE), when fully implemented, will advance identification nearer the desired goal through automatic correlation of flight-plan information.

The Identification System



Against the threat of air-delivered nuclear weapons the air defense system must be able to identify each of the 30,000 daily flights over the American continent. Backbone of the identification technique is the Air Defense Identification Zone, ADIZ (shaded areas). Perimeter ADIZs rim three borders of the United States; internal ADIZs guard critical target areas. Each aircraft entering an ADIZ must approach at a time, altitude, and heading corresponding to its flight plan on file. If deviation from the flight plan is more than minimal, defense interceptors scramble, intercept, and force down the aircraft unless it can be quickly identified by visual inspection. Fixed air corridors for domestic airliners and multiple corridors for aircraft approaching overwater also help identification.

Interception

In the combat zone, where hostile aircraft can be tracked continuously, detection equipment takes on additional duties. It provides information helpful in directing the air battle and plays a major role in the positioning of defense weapons to meet the attack. In the jet age the importance of placing an interceptor in the correct position relative to its target has greatly increased. Until recently this had been merely a problem of indicating the general avenue of approach and approximate location of the enemy aircraft. Pre-jet-age air speeds and altitudes allowed positioning to be a relatively simple and unhurried operation. In World War II, for example, a mistake in properly positioning interceptor aircraft could be rectified in most instances by the simple expedient of repositioning him for another attack before the enemy reached the bomb release line. As late as 1952, interceptor control in U.S.

air defense consisted of directing the relative position of two blips on a radar screen to a point of collision.

The jet age, with its fantastic closing speeds of fighters and bombers, has made curve-of-pursuit attacks unproductive and minimized the interceptor's chances for a second pass at the enemy. Today the requirement is for precision control under all weather conditions, day and night, to position high-speed, high-altitude fighters on the firing pass in a minimum of time, with no mistakes allowed. Technical improvement to extend the areas of coverage of ground-based search and control radar equipment has been one way of meeting the challenge. Other interim improvements have been in the development of scales and aids for use by intercept controllers on the face of the radar position indicators. Also being installed throughout the system are analog computers that will increase the capacity of an intercept director from approximately two intercepts to five or six.

In terms of jet-age needs, battle control is still largely an antique operation. Display of the battle situation depends upon oral telephone transmission to operators who plot the track of aircraft while other operators jot down defense weapon information and kill status. If the battle action moves into the range of another radar site the information must be transferred verbally to the adjacent control center. Since future air battles would be fought at supersonic speeds, these techniques are clearly inadequate.

The Semiautomatic Ground Environment System (SAGE) will provide the first major step in advancing the intercept control and battle command function of the air defense ground environment. Today control of manned interceptors is maintained by the man at the radar site. Under SAGE, command guidance will be more centralized. SAGE will aid commanders in making intercept decisions. It will also automatically transmit position directions to piloted and unpiloted air defense weapons once the decision has been made.

SAGE—Semiautomatic Ground Environment

The Semiautomatic Ground Environment System (SAGE), scheduled for introduction into air defense within the next few years, combines the talents of man with the best aptitudes of machines. The SAGE system is basically an interconnected network of huge digital computers into which defense radar and human controllers feed defense information. The digital computers store, collate, and process the information, calculate instructions for the air battle, and present a pictorial display of the air battle situation for human controllers. Many of the problems facing air defense in the jet age should be solved by the possibilities of the SAGE system.

SAGE will aid considerably in centralizing the functions of air defense by bringing the search areas of several radar installations under the control of a single direction center. These radars are linked by telephone circuits or UHF radio directly to a high-speed digital computer. Locations of aircraft anywhere within the range of the ground-based search and control radars are relayed continuously and automatically to the direction center. Other data are supplied to the computer from such sources as height finders, Texas Towers, picket ships, Air Force and Navy flying radar stations, Ground Observer Corps, flight plans, and weather stations.

Once a computer has digested all this information, it translates it into a composite picture of the complete air situation. Through televisionlike picture displays, the computer presents the air situation as it develops and thus provides the information on which to base human judgments essential to tactical decisions. For the operators SAGE calculates automatically the most effective way to use such air weapons as interceptors, antiaircraft guns, and guided missiles. A radio-data-link system in the computer will allow all-weather interceptors and, in time, long-range missiles, to be automatically positioned in the path of the enemy aircraft. As the air battle moves from one area to another, the battle information is automatically transferred from the losing computer to the one in the new area. Information is also forwarded electronically to a next higher echelon that supervises several direction centers. A computer is used at this next echelon to combine the pictures from its subordinate direction centers.

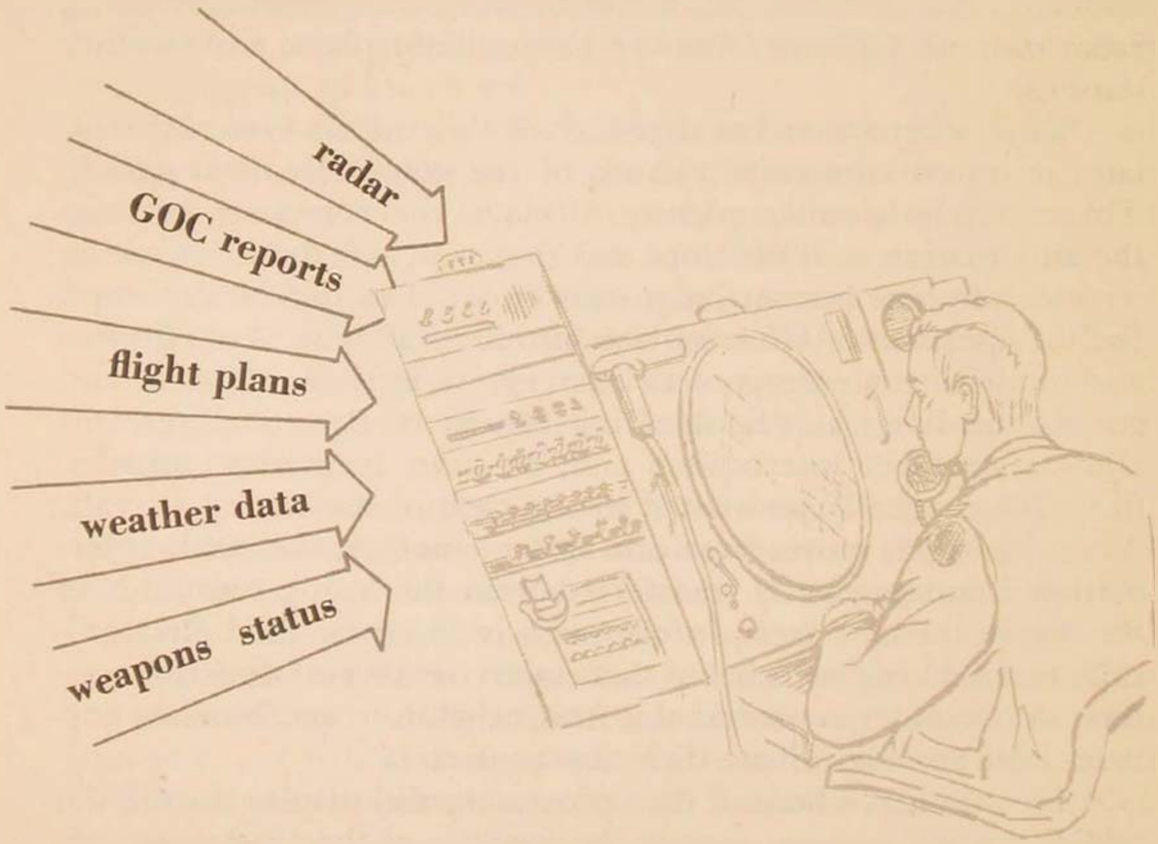
Electronic methods of data processing and display during the SAGE era will increase greatly the capacity of the air defense system for tracking and interception. Also the pace of these actions will be greatly accelerated through computer "advice" in allocation, commitment, and handling of air defense weapons.

Private industry has played, and continues to play, a leading role in developing this amazing new defense weapon. The Air Force has signed contracts with three private firms: an equipment contract with International Business Machines; a management contract with the Western Electric Company, which designs and builds the structures needed to house SAGE and sets up communi-

Air Defense in the SAGE Era

1 SAGE Keeps the Books...

- receives data
- memorizes data
- collates variety of data
- displays its findings
- recommends course of action



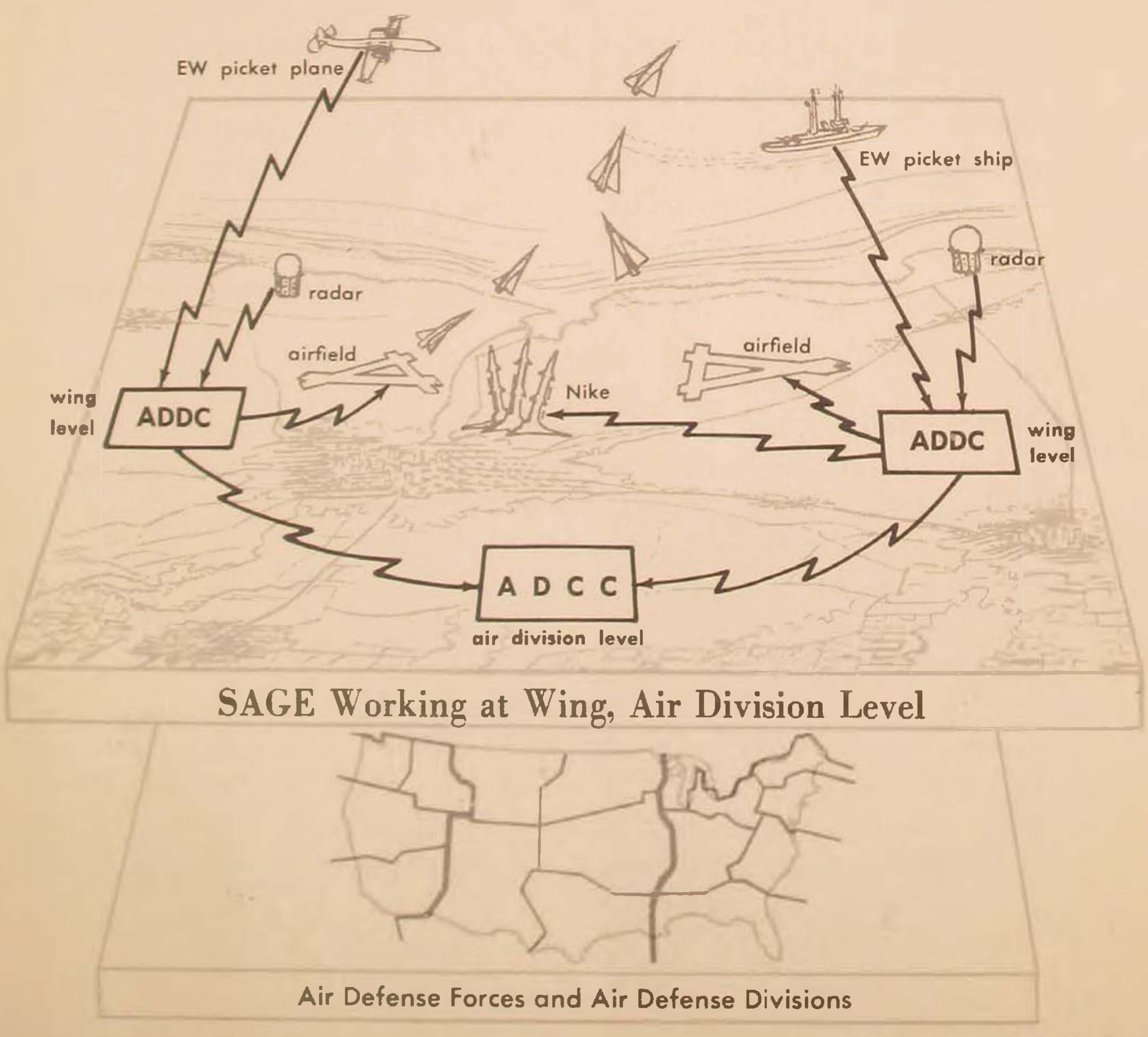
2 Man Decides...

- monitors SAGE
- evaluates situation as displayed
- makes decisions
  - whether to intercept
  - with what weapons
  - with what tactics
  - from what sites
- sets decision into SAGE

3

SAGE Directs the Air Battle...

- solves intercept equations
    - course of target
    - speed and altitude of target
    - point of interception of target
- guides manned interceptor or unmanned missile to vicinity of target
    - with data-link radio to auto-pilot
    - with voice radio
- guides manned interceptor back to base
- centralizes air battle control at wing level
- depicts battle situation concurrently in adjacent air defense division and at higher echelons
- automatically transfers information from one computer to another as air battle moves to new area



cations; and a lease of telephone lines from the International Telephone and Telegraph Corporation.

SAGE is expensive. Just leasing the telephone lines will cost close to a quarter of a billion dollars a year. But air defense planners feel that SAGE is worth the money. In the words of Deputy Chief of Staff for Development, Lieutenant General Donald L. Putt: "SAGE is an extremely important step towards adequate air defense. The evolution of high-speed, high-performance aircraft and missiles posed a changing threat which had to be met by an air defense control system superior to what we had. We feel that SAGE is just that."

Part II: Air Weapons for Air Defense

THE air environment for the air defense of North America had to be created practically from scratch. From the rudimentary beginnings of World War II it had to overtake the tremendous effectiveness of offensive air striking power introduced by the jet engine and nuclear weapons. Its burgeoning development program had to be kept in phase at each step lest the complicated system be jeopardized by lag or failure at one critical point. It had to include both a long-range program—to provide the vehicles and weapons desired—and an interim program—to provide as much defense as could be had in the meanwhile.

Air defense has already licked many of the problems of jet-age air defense and removed many of the undesirable expedients we were forced to adopt after World War II. The present weapon systems, or those expected soon, promise to complete a major improvement in the defensive air environment. Against the threat of 500-to-600-mile-an-hour bombers, the Air Force is placing in service the supersonic, delta-wing F-102A. To assure a kill in the limited intercept time available and at night or in adverse weather, air defense planners have developed air-to-air rockets; a new concept of interception, the lead-collision attack; and precision automatic fire control. For the future a family of four basic weapon systems, comprising manned interceptors and unmanned missiles, is programmed to operate with the SAGE ground environment to meet the airborne threat.

Aircraft

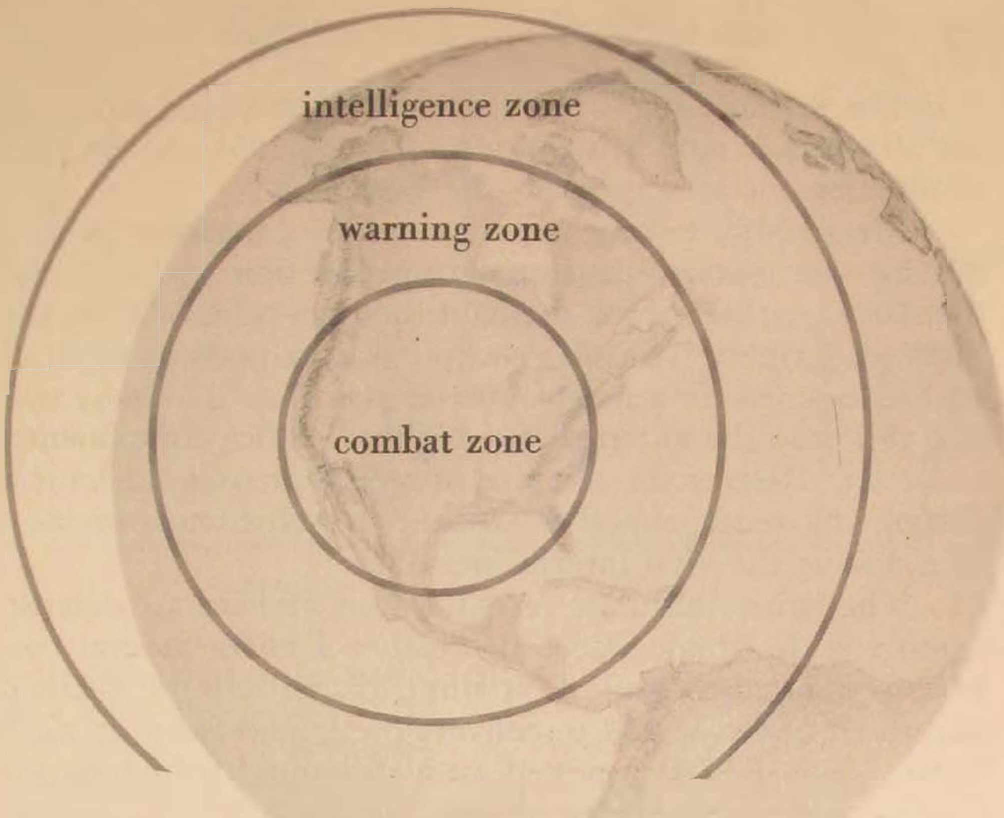
Air Defense Command's rocket-firing, faster-than-sound F-102A has come a long way from its warborn ancestors, the night-fighting P-61 "Black Widow" and the postwar F-82 "Twin Mustang." Its development has resulted from the programming concept of the need to integrate into one deadly machine a counter-weapon to the 1954-1960 air threat.

Early in the evolution of all-weather interceptors the Air Force realized the interdependence of the various development processes leading to a combat-ready aircraft. To achieve a maximum kill potential, the airframe, the power plant, the radar, the armament, the coordinating ground environment, even the ground support and test facilities, would have to be integrated for a specified tactical objective. Representatives of the Air Force, the aircraft industry, and the electronics industry approved the weapon-system concept for development of the 1954-1960 interceptor in a conference in May 1949. Because of the greater lead-time needed, competition for the new interceptor's fire-control system opened in October 1949. In May 1950 the Hughes Aircraft Company entry was selected. Airframe competition began in the same month, and in June 1951 three contractors started preliminary development work: Convair, Republic, and Lockheed. Upon re-evaluation of the airframe program in September 1951, Lockheed withdrew because of other commitments and the radical and ambitious Republic proposal was reoriented as a long-term research development. Convair was selected as the exclusive contractor. The new interceptor was designated the F-102, and the Hughes integrated electronic control system was designated the MA-1. The Falcon guided aircraft rocket was selected for the basic armament, to be augmented by small, unguided rockets.

When it became apparent in 1951 that production of the F-102 must await further basic research on advanced design features of the airframe, engine, armament, and fire-control elements, it was decided to bring out an interim version of the aircraft, the F-102A. The original requirement was redesignated the F-102B. All the major components of the substitute F-102A were to be the most advanced models available to meet the production schedule of the airframe. The configuration selected included the J-57 engine, the Falcon missile, supplemented by 2.75-inch folding-fin aerial rockets, and the MG-3 fire-control system. Later it was found possible to add a more advanced development of the MA-1 system—the MG-10.

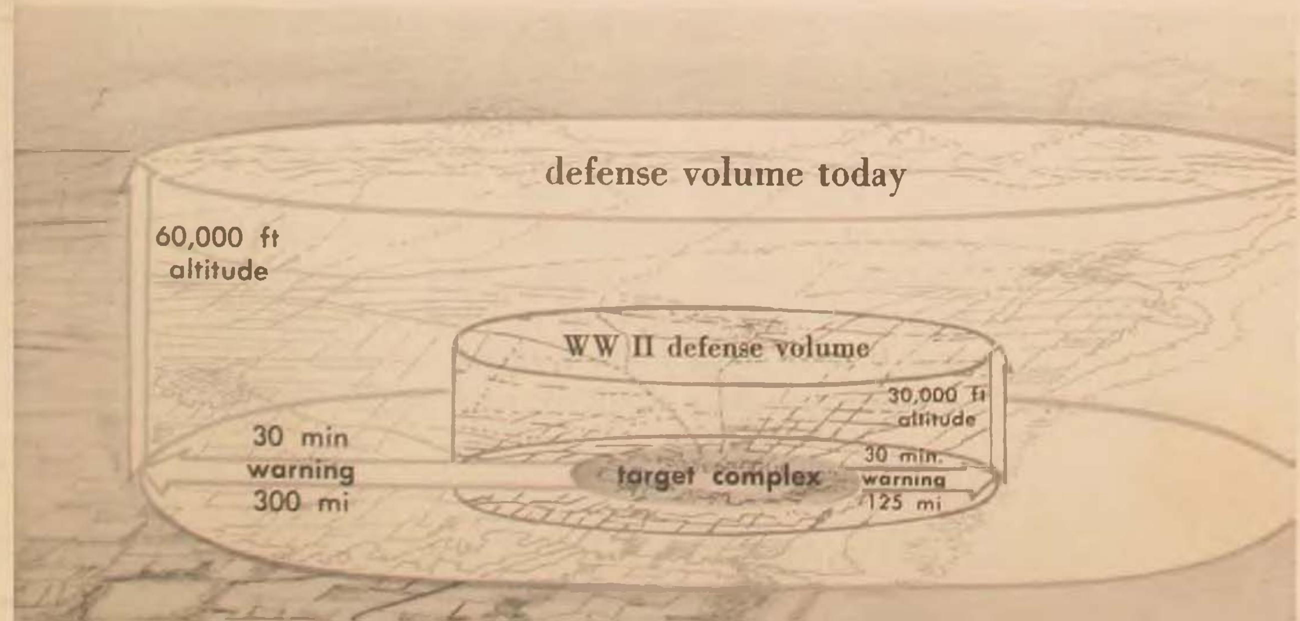
The F-102A, now in limited production, will considerably enhance the capability of air defense. Supersonic speed and rapid rate of climb will offset the time and height advantage gained by newly developed jet bombers. Future all-weather capability will be made possible by interlocking ground and air-intercept radar and automatic fire control to permit night and all-weather tracking and destruction of air invaders. The F-102A's armament provides the punch to kill an intruder on a single pass.

Supplementing the F-102A in ADC's interceptor stable is a trio of all-weather interceptors developed to provide air defense in the interim period 1948-1956. First planning of a jet night-interceptor began in late 1945. Development contracts were awarded in early 1946. In 1948 the twin-place, turbojet Northrop



Air Defense Concept

Concentric perimeter zones of today's air defense, designed to attain maximum warning time and defense in depth. Older systems featured point defense—a concentration of weapons around specific major targets—or area defense—the deployment of weapons to guard extensive regions of population or industry having many point targets. Jet power doubled the speed and altitude of attack, forcing the defense far out from the bomb line in order to hold the same time for intercept that was possible in World War II (below). At the same time the potency of a nuclear air offensive calls for an uncompromisingly high kill rate against attacking bombers. The new system meets these problems by defending not isolated targets but the entire continent. Information of impending hostile action may first come from intelligence sources in the outer zone. Radar in the warning zone detects approaching hostile aircraft in flight and enables weapons controllers to predict the point of penetration of the vital inner zone. In the combat zone enemy aircraft can be tracked continuously and kept under attack from entry to target.



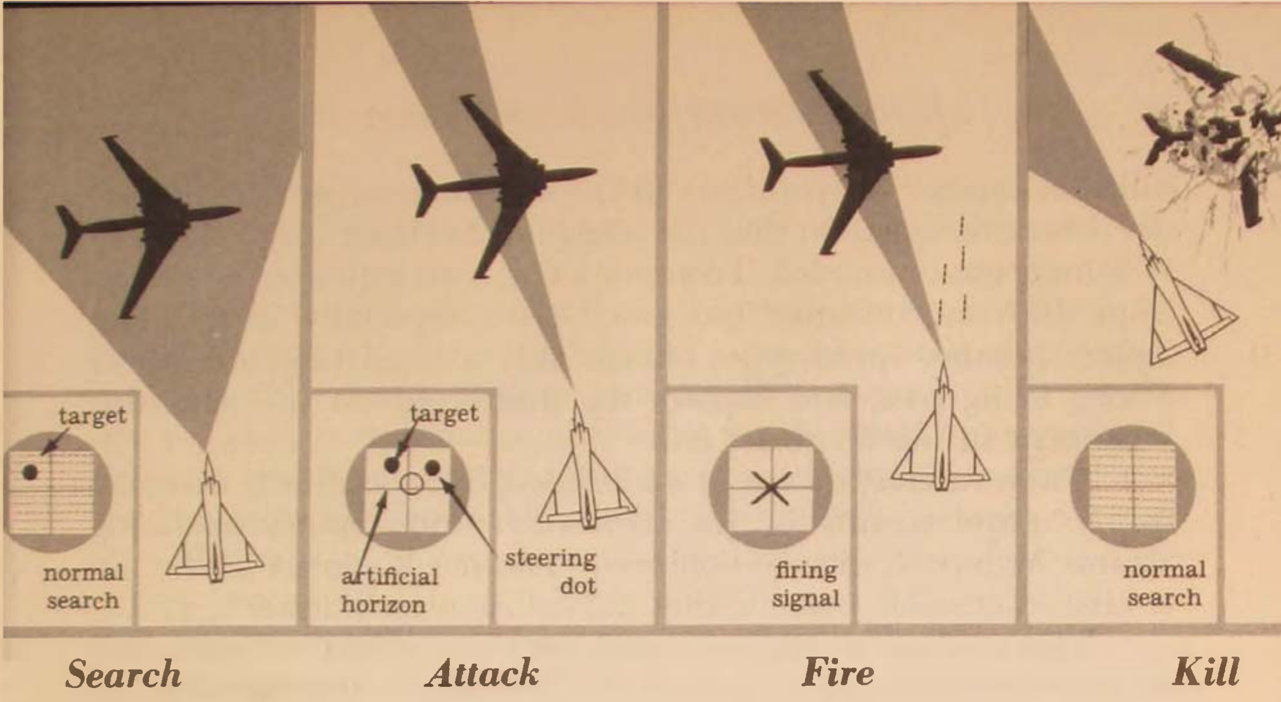
F-89 was selected, with modifications of the production contract for all-weather employment. In October 1951 the first quantity-production model appeared—the F-89C.

Meanwhile, to give America's cities a measure of protection during the research-development-production cycle of the F-89, the Air Force undertook to adapt the high-performance, two-place T-33 jet trainer. The rear cockpit was stripped of flight controls and redesigned for a radar-observer position. The nose was modified to house the antenna and high-frequency components of the radar set. Despite the sacrifice of recent progress in basic aircraft design, the redesignated F-94A and B helped to provide protection during the vital interim period.

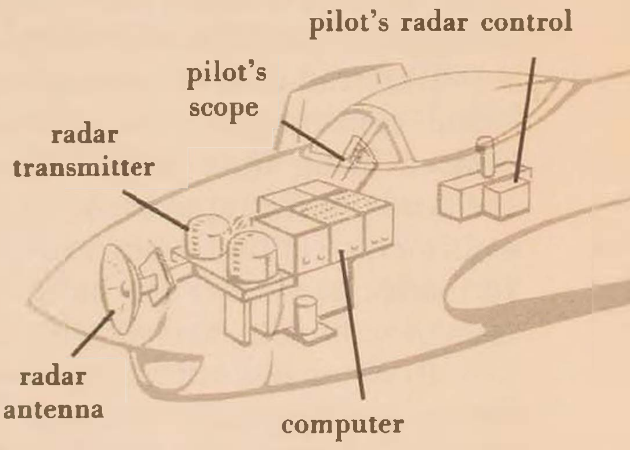
The third and most recent of the interim air defense interceptors is the single-place, all-weather F-86D. Several considerations prompted the radical attempt to combine the duties of pilot and radar-observer and to convert the famed Sabre to air defense duties. The F-86A possessed an airframe with high-performance characteristics that appeared suitable for modification. Improved automatic fire-control radar and a vastly improved autopilot reduced pilot and radar-observer tasks. Weight and space saved by eliminating the second crew member and accompanying equipment improved aerodynamic performance. Very quickly the F-86D became the mainstay of the present air defense inventory.

Weapons

The interceptor of the future will down its unseen target in a single pass at supersonic speed and at a range beyond the reach of defensive machine gun or cannon fire. Initially guided by the aircraft's automatic fire-control system, the interceptor's armament, a guided air-to-air rocket, will seek its victim by its own electronic guidance system. The new guided rocket, called the GAR-2 or "Falcon," was selected to be the primary armament in the F-102 weapon-system program. Its development was made possible primarily by improvements in rocket design and the miniaturization of electronic components. The Falcon, in development by the Hughes Aircraft Company since January 1947, flies a true collision course with its target, making corrections by means of its guidance system. Its advantages over an unguided rocket are that it can be fired from a much greater range, has a higher kill potential against a maneuvering target, and allows a



How automatic fire-control system tracks a bogey for a lead-collision-course kill. Vectored into position by ground control, the interceptor finds the enemy aircraft by search radar (above, left). The pilot's radarscope displays the initial contact and all following actions (insets). Taking over control of the interceptor once the hostile is within the radar cone, the fire-control system "searchlights" its target with a narrowed radar beam, feeds course data into the interceptor's computer, flies a corrected near-collision course with the enemy plane, and fires a salvo of rockets at the precise instant for a hit. Flashing the firing signal on the radarscope, it abruptly veers the interceptor away from the debris.



greater flexibility of interceptor tactics because of its increased range and maneuverability. Equipped with a highly lethal warhead, the Falcon will substantially increase the destructive power of future interceptors.

Two other developments in interceptor tactics and armament have improved the kill ability of current air defense aircraft. They answered the interceptor's need to hit an unseen target with a highly destructive force in an extremely short time period.

The standard concept for intercept attack now is the lead-collision course. Very quickly in the evolution of air defense tactics it became apparent that the lead-pursuit attack of World War II fighters was outmoded. To attack a target on a quartering course from the rear consumes too much time, especially with a low fighter/bomber speed ratio, affords only a small target, requires a long firing pass, and exposes the interceptor to the defensive armament in the bomber's tail.

A new intercept concept was needed, one specifically designed to the requirements of jet all-weather interceptors operating against high-performance bombers. The development of the air-to-air rocket made possible the lead-collision technique.

This method of attack differs from a true collision course only in making allowance for travel of the rockets after leaving the interceptor. Its advantages are many: the flexibility of air defense operations is increased by the interceptor's ability to attack from any angle; attack from the beam improves the interceptor's chance of survival; a beam attack presents a greater target area for both radar and armament; and the straight-line flight path and single firing-point computation simplify maneuver and computation.

But lead-collision attack requires that the interceptor fire a lethal concentration of explosives instantaneously. Because of limited firing time in jet interceptions and the disadvantages of the lead-pursuit approach, the caliber .50 machine guns and 20-millimeter cannon were seen to be inadequate against high-performance bombers even before the Korean War. The present interceptor force is armed with the 2.75-inch folding-fin rocket.

Rockets had already proved their value. In World War II they had been used extensively as ground-to-ground, as air-to-ground, and occasionally as air-to-air missiles. They could be fired in large salvos with the probability that any one hit would mean a kill. To conserve space and maximize firepower, the folding-fin device was selected. Experimental work with early-model folding-fin air rockets in World War II had been discouraging, but the difficulty came from poor firing-tube stability and unsatisfactory propellants, not from the folding-fin principle itself. Further development work overcame these shortcomings, and a 2.75-inch folding-fin rocket was created suitable for air defense use. The small unguided rocket has made the lead-collision attack feasible and paved the way for the guided rocket. The 2.75-inch rocket is now the chief weapon of the current air defense arsenal.

An indispensable component in present-day interceptors is automatic fire control. The all-weather interceptor must be able to kill its target without resort to optical aids. The E-4 fire-control system currently in the F-86D and the E-5 and E-6 systems in the F-94C and F-89D give these aircraft both lead-collision and all-weather capability.

The developers of a fire-control system were confronted by four problems: the curtailed reaction time demanded of jet interceptions; the requirement to complete a mission at night or in adverse weather without optical aids; the eventual appearance of air-to-air rockets as an interceptor's primary armament; and the need for growth potential to keep pace with future weapon systems.

The most advanced radar fire-control equipment developed during World War II and used in the P-61 and F-82 night fighters was unsatisfactory for the new aircraft, armament, and tactics under development. Unsatisfactory pressurization made it virtually useless above 20,000 feet. It lacked vital automatic features, had insufficient range, and could not complete a firing pass without optical assistance.

But as with the F-94 airframe development program, available techniques were studied carefully in order to obtain an interim fire-control system. The radar tail-gun control on the B-29 bomber was seen to possess such features as increased range, automatic tracking, and ability to accept lead-firing information from the central fire-control computer. Its basic design features were used in the development of a fire-control radar for jet interceptors.

The result was the Hughes E-1 fire-control system, the first equipment to possess a complete all-weather capability. Its salient features were radar ranging, automatic lock-on and target tracking, and lead-pursuit firing computation. Installed in the F-94A and B and in the F-89A, B, and C, it provided capability for all-weather firing passes in a lead-pursuit attack with machine guns and cannon.

When the appearance of air-to-air rockets made the lead-collision technique possible, the E-4 fire-control system was developed for the F-86D interceptor. A logical development from the E-1, the E-4 employs a similar basic radar system and incorporates more recent electronic advances. The major difference lies in the computer section. The E-1 derived its lead-firing computation from an optical sight computer. The E-4 solves the lead-collision firing problem by incorporating its own analog computer which automatically determines the firing instant and releases the rockets. It also gives the pilot a "pull-out" signal immediately after firing. The development of two-place versions of the E-4, the E-5, and E-6 provides the F-94C and F-89D with similar capability.

The end to development of fire control is not yet in sight.

A new electronic control system, the MA-1, is under development by the Hughes Aircraft Company, to be placed in the 1954-1960 interceptor with guided rockets.

Missiles

The weapon of the future for air defense is the guided missile. Missiles can become airborne, climb, and cruise more rapidly than manned interceptors. In all respects they satisfy the requirement for speed in modern air defense. Free from human tolerance limitations they can operate at higher altitudes and perform tighter maneuvers without cumbersome environmental facilities. As a one-shot weapon the interceptor missile is without such problems of manned interceptors as durability of materials, long-term maintenance, and return-to-base and landing systems. Opposing these advantages is the versatility and power of decision that only a human brain on the spot can apply. Once launched a missile is irrevocably committed. Although better control and data-transmission systems may overcome these limitations, the interceptor missile is not likely to replace the manned interceptor totally or even in large part in the air defense force for many years to come. Instead these pilotless aircraft will unite with manned interceptors within the same ground environment to provide a varied and potent air defense capability.

Interceptor missiles currently programmed for air defense include the surface-to-air Talos and Bomarc. The former, originally developed by the Navy for fleet defense, will be deployed first. It will be followed shortly by Bomarc—a longer range missile which resembles a piloted interceptor in operation as well as in appearance. In addition to interceptor missiles, the continental air defense system includes the Army's short-range Nike surface-to-air missile. Nike, logical successor to antiaircraft artillery, is already deployed for the local point defense of vital target areas. It is operated by the Army Antiaircraft Command in close coordination with other air defense facilities.

The Future Problem

Air Defense is essentially a counter-weapons business. The level of defense is dictated by the potential threat. The greater and more varied the threat, the more stringent the requirements for the air defense weapons to counter it. The index of national survival is no longer the number of bombers destroyed but the number that wins through to deliver nuclear weapons. To achieve an adequate air defense, the utmost resources of technology will be demanded to produce effective weapon systems.

The air defense in the making calls for a versatile system that will be effective against any type of airborne threat. It will center on four basic weapon systems—a "Family of Four": a long-range interceptor, a medium-range interceptor, a medium-range interceptor missile, and a short-range surface-to-air missile. These systems will operate in the SAGE ground environment complete with seaward and northern extensions. Within imposed budgetary and manpower limitations this defense should provide the optimum kill potential against a threat whose exact nature cannot be predicted with certainty.

Air University Quarterly Review

AIR FORCE IN THE INTERNATIONAL GEOPHYSICAL YEAR

Milton Greenberg *and*
Dr. Alan M. Gerlach

JUST as the bull fiddler looks with envy on the piccolo player when it comes to carrying instruments, so the geophysicist envies the scientist who can carry his instruments with him, or, worse yet, is able to pursue a lifetime of investigation without stepping outside his laboratory.

Ideally the geophysicist should travel everywhere, including outer space. This is true because the object of inquiry of the geophysicist is the earth, its land and water surfaces, and its atmosphere; the other planets and stars, especially the sun; and the outer space which contains them. In other terms the broad field of geophysics includes the sciences of meteorology, oceanography, terrestrial physics, atmospheric physics and chemistry, ionospheric physics, solar and stellar physics, and space physics.

It is generally characteristic of these sciences that the primary way to investigate them is to go out into nature and study the physical, chemical, and electronic processes as they occur. Of course there are exceptions. Significant meteorological investigations are being conducted with laboratory models, and laboratory experiments are undertaken to determine such things as the absorption coefficients of atmospheric gases and to study the formation of water droplets in a cloud chamber. But the basic empirical data which give rise to theories and experiments, and test them and make them meaningful, must be obtained in the vast, possibly limitless, universe of nature. To this must be added the complication that since many geophysical phenomena are interrelated and interdependent, they must be observed simultaneously and on a large scale. It is these facts which make geophysical investigations so difficult, time-consuming, and expensive. The much-criticized and lampooned ability of the weatherman to forecast tomorrow's weather is but a reflection of the vastness, complexity, and intricacy of the atmosphere whose processes he is trying to predict.

The International Geophysical Year

THE purpose of the International Geophysical Year (IGY) from July 1957 to December 1958 is to plan and carry on research in the geophysical sciences on an international cooperative basis, using the competencies and support of many countries to render these investigations less difficult, less time-consuming, and less expensive. That this is a desirable goal is demonstrated by the fact that some forty-two countries have developed plans for participation in the IGY. This is especially noteworthy and gratifying to the scientific world, both civilian and military, since in many of the research areas the simple-minded "practical applications" are neither evident nor imminent.

IGY is the third international scientific year. The first was held in 1882-1883 and was called the First International Polar Year. Plans were then formulated to conduct similar programs at 50-year intervals. According to schedule, the Second International Polar Year was held in 1932-1933, despite the economic depression. As the names make clear, these efforts were primarily geophysical explorations of the North Polar regions, with emphasis on meteorological, magnetic, and auroral observations. The Second Year saw in addition the establishment of an ionospheric observation program in the Arctic.

Because of the rapid advances in scientific techniques, especially for studying the ionosphere; the developing needs for additional information; and the routine availability of new modes of transportation, a group of American scientists suggested in 1950 that a third polar year be conducted in 1957-1958, after a 25-year, rather than a 50-year, interval. Formal action was taken in 1950 by the Mixed Commission on the Ionosphere to present this proposal to the International Council of Scientific Unions (ICSU). The proposal was endorsed by the International Union for Scientific Radio, the International Astronomical Union, and the International Union of Geodesy and Geophysics. The International Council of Scientific Unions set up a Special Committee in 1952 and invited the countries supporting the International Council, and the Soviet Union, to form national committees to organize their participation in the proposed polar year.

In late 1952 the International Council, reflecting the growing opinion of several scientific unions, broadened the proposed program to include the entire world rather than only the polar regions, and consequently redesignated the effort the "International Geophysical Year." An augmented Special Committee met for its first plenary meeting in Brussels, Belgium, during 30 June—3 July 1953, and established eleven groups to consider programs, proposals, and problems. These working groups included one on publication and ten on scientific areas: (1) meteorology, (2) latitude and longitude determination, (3) geomagnetism, (4) ionosphere, (5) aurora and airglow, (6) solar activity, (7) cosmic rays, (8) glaciology, (9) oceanography, and (10) world days. To these the second plenary meeting of the Special Committee in Rome during 30 September—4 October 1954 added: (11) rocket exploration of the upper atmosphere, and (12) seismology and gravity. Geographic areas of special effort were defined as the Arctic and Antarctic regions, the tropical zone, and three special meridians (70-80° W., 10° E., and 140° E.).

The Rome meeting also explicitly stated the criteria governing inclusion of programs in the IGY. First priority is given to investigations requiring coordinated synoptic or simultaneous observations over a large portion of the earth. Second priority is allocated to investigations which will be significantly enhanced by the availability of such synoptic observations. The third class comprises those geophysical observations which exploit the occupation or establishment of stations in relatively unexplored areas for some other, primary purpose. Finally, observations are to be made of slowly varying geophysical phenomena, for comparison with similar past and future observations during different epochs.

U.S. Participation

The U.S. National Program, which has been coordinated with the national programs of other countries as part of the International Program, includes activities in each of the proposed scientific and geographic areas. It was developed by the U.S. National Committee for the IGY, established by the National Academy of Sciences—National Research Council. The eminent scientists who comprise the National Committee and its panels formulated their research programs simply from the point of view of the objective investigator exploiting to the maximum the scientific opportunities offered by the IGY.

But as the Committee has increasingly been concerned with the implementation or actual operation of the planned national program, its technical panels have been turning to the universities, observatories, private institutes, public agencies, and the Department of Defense for assistance. In the light of DOD guidance the three services are cooperating with the IGY by affording two kinds of assistance: first, logistic support—for example, the provision by the Navy of ships and construction crews for the Antarctic expeditions—which IGY planners counted on from their earliest considerations; and secondly, direct participation in the scientific program of the Committee. The Air Force, as also the Navy and Army, has accepted responsibility for implementing certain portions of the proposed program and has carried on further detailed planning. The Air Force IGY programs are in most cases expansions of or complements to the existing and planned projects of the Geophysics Research Directorate, Air Force Cambridge Research Center (AFCRC), of the Air Research and Development Command.

Perhaps the two most striking undertakings in the U.S. National Program are the Antarctic Expeditions and the Upper Atmosphere Explorations by research rockets and earth satellites to challenge man's last physical frontier—space.

Antarctic Expeditions

Eleven nations are scheduled to man about 50 stations in Antarctica to carry on the international scientific program on that least-known continent. Participating countries include the United States, Britain, France, Russia, Australia, New Zealand, Japan, Norway, Argentina, and Chile. The U.S. Antarctic program ("Operation Deepfreeze") calls for the establishment of a six-station network consisting of the Little America, Byrd, South Pole, Weddell Sea, Knox Coast and Adare (with New Zealand) scientific stations, and the McMurdo Sound logistic support station. The Little America station will be the major U.S. base, from which expeditions will carry equipment and supplies for establishing and maintaining the Byrd station. The South Pole station will be established primarily by airlift operating out of McMurdo Sound, which itself will be supplied by Air Force airlift from Christchurch, New Zealand, over 1950 miles of desolate ocean.

After a preliminary survey of Little America, which was accomplished in March 1955 by the crew of the USS Atka, Deepfreeze I was initiated in early November 1955. The icebreakers Edisto, Eastwind, and Glacier and four other vessels of Task Force 43, comprising 81 officers and 1013 enlisted men, departed from East Coast ports with the advance party, which included some 300 construction personnel for the Little America, Byrd, and Pole stations, and scientific equipment. In the period from December to March 1956 this group established a 73-man station at Little America in Kainan Bay on the Ross Shelf Ice, and a 93-man station on Ross Island in McMurdo Sound, 400 miles to the west. Five hundred tons of cargo were stockpiled at McMurdo Sound for airdrop at the future Pole station and 550 tons at Little America for the 25-man station to be built next season in Marie Byrd Land. About 150 construction Seabees are wintering over the Southern Hemisphere winter to begin construction of the Byrd and Pole stations in November 1956.

As the construction program gets underway, one task unit of Deepfreeze II will depart from the U.S. in November with resupply equipment and all IGY scientific parties for the Little America, Byrd, and Pole bases. Other task units will carry equipment and personnel for establishment of the Weddell Sea and Knox Coast scientific stations. When the scientific expedition arrives at the Little America base in January 1957, the scientific parties will be flown to the Byrd and Pole bases. About 95 scientists and technicians and 53 operating personnel will winter over. This group will be augmented by 18 scientists for summer activities only. There will be two 18-month periods of operation, with most personnel being rotated at the end of the first period in April 1958.

The resupply and replacement expedition will leave the U.S. in November 1957 (Deepfreeze III), and the final expedition (Deepfreeze IV) will leave the U.S. in November 1958 to evacuate the scientific parties and operating personnel, together with their equipment and records, by April 1959.

The American Antarctic scientific program will include investigations in eight scientific areas. Since all American scientific stations are within or near the auroral zone, an extensive auroral observation program is planned, using patrol spectrographs, all-sky cameras, visual observation, and scanning spectrometers. Observations with identical equipment at Northern Hemisphere counterpart stations will permit investigations into the simultaneity of auroral phenomena in the two hemispheres.

The cosmic radiation program will be concentrated at the Little America station, where a monitor telescope will provide a continuous record of total cosmic ray intensity. Balloon flights will be made from shipboard with small counter telescopes, and photographic emulsions will be exposed at high altitudes. A neutron intensity monitor will operate throughout the IGY period on an icebreaker accompanying the expeditions.

Standard magnetic observations will be made at the Little America, Byrd, Weddell Sea, and Knox Coast stations, each of which will be equipped with normal-speed and rapid-run magnetographs. A visual recorder will be maintained at the Little America station, and a semiportable 3-component variograph will measure transient variations at the Pole station. Again, observations with similar equipment at Northern Hemisphere conjugate stations and in the equatorial Pacific will permit investigation of the simultaneity of geomagnetic disturbances and related phenomena in the two hemispheres.

The glaciology program is designed to obtain information on the present volume of the Antarctic ice, its history and its probable future; the topography of the ice surface and the land beneath; and the related meteorological and oceanographic factors. Observations will be carried out at the stations, on oversnow traverses, by airborne parties, and by aerial mapping and photography. Ice cores and englacial temperatures will be obtained through the Ross Shelf Ice and to a depth of 1000 feet in the inland ice. Tritium content of the glacier and shelf ice will be measured to determine the age of the ice at various depths. The limits of the ice sheet will be mapped, and observations will be made of the glacial geology and geomorphology of the exposed land areas.

Plans for ionospheric physics measurements in the Antarctic include vertical incidence multifrequency ionospheric soundings at all scientific bases to measure the virtual heights and critical frequencies of the ionospheric layers; continuous recordings of atmospheric radio noise at the Byrd and Knox stations; and observations of whistling atmospherics at the Weddell station, for correlations with those recorded at the conjugate point in Labrador.

A complete surface and upper-air meteorological observation program is planned for all U.S. stations in the Antarctic. These stations will complete a pole-to-pole line of meteorological stations, and in conjunction with Antarctic stations planned by other countries, will form a weather network on that subcontinent and adjacent areas. A Weather Central at Little America will issue weather forecasts and advisories required for operations. Special meteorological observations will include total atmospheric ozone, surface ozone, carbon dioxide, sky brightness, and net radiative heat flux.

The Antarctic rocket program will consist of Rockoons (small rockets released from balloons at maximum ascent) which will be launched from an icebreaker en route to Antarctica and off the coastal ice-shelf. These rockets are expected to reach an altitude of 100 km (60 miles) and will be instrumented for experiments in geomagnetism, cosmic rays, and aurora. Launchings will be coordinated with pertinent surface measurements in Antarctica and with simultaneous upper-air launchings in the Northern Hemisphere.

The seismic and gravity programs will be conducted primarily during the summer traverses. Portable seismographs and gravimeters will be used to determine shelf and inland ice thickness and internal structure, the depth of water, and the character of the subglacial topography. To establish a permanent gravity reference on the Antarctic continent, pendulum equipment will be flown from New Zealand to McMurdo Sound and an absolute value of gravity will be determined at that station. Fixed station seismographs will record earthquake waves, microseisms in their relation to weather, and the development of cracks and crevasses formed by movement of the inland and shelf ice.

The Air Force Cambridge Research Center is providing the Deputy Chief Scientist of the Antarctic program, who is also the project leader for the glaciology, seismology, and gravity programs in the Antarctic. He will winter over at the Little America station and will be responsible for actual field administration.

As a result of recommendations made at the third plenary meeting of the Special Committee of the ICSU in Brussels on 8-14 September 1955, the U.S. National Committee is at present formulating an Arctic program along the lines of the Antarctic program.

Upper Atmosphere Explorations

The common use of rocket vehicles for carrying scientific instrumentation into the high atmosphere had its beginning in the American firing of captured German V-2 rockets after World War II. Because of their limited numbers and expense, the V-2's were followed by Aerobee and Viking rockets, developed specifically for research purposes. These rockets have generally been fired from Holloman Air Force Base, New Mexico, by the Air Force and at the White Sands Proving Grounds, New Mexico, by the Army (Signal Corps) and the Navy. Although a few shipboard launchings have been accomplished by the Navy off the USS Norton Sound, the almost complete restriction to the atmosphere above New Mexico has produced greatly limited, highly selective, and thus scientifically incomplete data.

One evident way to overcome this limitation is to establish additional rocket launching facilities for firing existing types of research rockets. A more economical approach is to develop a simple rocket probing system which will be independent of special ground installations. The "ultimate," but expensive, capability is the earth satellite.

Rocketry Program

When the planners of the original American IGY upper atmosphere research program made their decisions in January 1954, they had no advance knowledge of U.S. Government intentions regarding earth satellites, nor of the resolution on satellites which the Special Committee of the ICSU would pass in its meeting at Rome in October 1954. They were aware of the capabilities of the Rockoon, the small balloon-borne Deacon rocket fired at the point of maximum ascent of the balloon, and of its present limitations of small payload and uncontrolled direction of rocket flight, which dictate that experiments must be simple and firings confined to unpopulated regions, such as ocean areas.

It was likewise known that the Air Force (AFCRC) has under development the Rockaire, a 40-lb. payload rocket launched from a fighter aircraft at the peak of its vertical ascent. A second aircraft contains the receiving equipment to pick up the radio signals from the rocket and thus completely eliminates the need for a ground installation. The only limitation on this sounding system is the range of the fighter aircraft from a suitable airstrip.

Since independence of permanent ground stations in these probing systems has to be purchased at the cost of smaller payloads and lower altitude capabilities than the Aerobee and Aerobee-Hi rockets (70 and 140 miles), and in recognition of the development status of the Rockaire, it was decided to establish a new permanent facility primarily for launching Aerobee and Aerobee-Hi rockets. An exciting opportunity was provided when the Canadian Government invited the U.S. to conduct a portion of the IGY rocket program at Fort Churchill, Manitoba. Plans were developed for the proposed Fort Churchill site and were later endorsed by the U.S. National Committee. On 21 March 1955 the Department of Defense assigned responsibility to the Army to establish, operate, and maintain a rocket launching facility at Fort Churchill for the IGY rocketry program.

Fort Churchill (lat. 58° N.) is a Canadian army post which provides facilities for Canadian military and research organizations and certain American military organizations. It is used as an Arctic test station, because of the bitter persistent cold and windchill effect on human beings. Average daily mean temperatures in winter are -11° F (December), -19° F (January), -17° F (February), -6° F (March). The month of maximum average daily mean temperature is July with 54° F.

It is in this environment that a complete rocket research facility is being established. The basic requirement is for an instrumented firing range about 50 by 100 miles in dimension. At the primary site there will be a fixed, nearly vertical launching tower for Aerobee and Aerobee-Hi rockets and a launching stand for Cajun rockets. The Cajun has been developed by the National Advisory Committee for Aeronautics and will be fired with a modified Nike booster. In addition there will be a preparation building, for final rocket assembly and prelaunch test and checkout; a blockhouse for rocket firing control, timing, and communications; a propellant building, for gas pressurizing and propellant servicing; storage buildings for boosters and igniters; an ionosphere station with 60-foot tower; and trailers for overnight stay at the launch site.

Associated ground stations will be established for radar tracking of rockets, receiving the telemeter signals from rockets, and positioning rockets by DOVAP, which operates on Doppler principles.

A second ionosphere station with 60-foot tower and a sound-ranging station will be located downrange, and ballistic cameras required for the rocket grenade experiment will be installed crossrange.

Other facilities include laboratory space, machine shops, equipment maintenance, film processing capabilities, power supplies, and weather service.

Housing and messing accommodations will be required for a peak load of about one hundred scientists, technicians, and operating personnel for the rocket program. Airlift of personnel as well as supplies and equipment to and from Fort Churchill is being organized by the Air Force (AFCRC), which will establish and operate the Winnipeg Intransit Station. The airlift will be provided by Military Air Transport Service from Winnipeg to Fort

Churchill. On the range itself it is planned to use helicopters to accomplish nose-cone recovery for experiments which require the use of cameras.

The upper atmosphere program finds its justification in the need for empirical data which ground experiments cannot provide. The latter experiments are valuable insofar as they provide data which are obtained by indirect means. But it is precisely because these data are obtained indirectly that it is not only highly desirable, but necessary, to check them by means of direct measurements. In addition, direct probing techniques yield new kinds of data. For example, solar radiations of certain wavelengths are wholly absorbed in the atmosphere and thus cannot be studied on the ground because they never reach the ground. The only way to study them is to penetrate the atmosphere to a point above the region of their absorption.

These data are required to test existing theories and generate new theories on such matters as the formation of the ionosphere and the aurora; changes in the earth's magnetic field; solar-terrestrial relationships, especially as they are significant for low-altitude weather; and the energy balance of the upper atmosphere.

To provide the data needed for these and similar problems, the rocketry program will include experiments in atmospheric structure (pressure, temperature, density, winds), atmospheric composition (O_3, NO, water vapor, ions), radiation studies (auroral Lyman alpha and air fluorescence, dayglow, solar UV, solar Lyman alpha and X rays), particle studies (auroral, cosmic rays), and ionospheric and geomagnetic measurements (charge density, total magnetic field).

The American program at Fort Churchill will include about one hundred rocket flights (Aerobees, Aerobee-Hi's, Cajuns) during the IGY period. The agencies firing these rockets are the Geophysics Research Directorate of AFCRC, Naval Research Laboratory, Ballistic Research Laboratory, and the Signal Corps Engineering Laboratories; with the University of Michigan as contractor both to AFCRC and the Signal Corps, the University of Utah also a contractor to AFCRC, and State University of Iowa a contractor to the Naval Research Laboratory.

The Air Force Aerobee program at Fort Churchill consists of three experiments to measure pressure, temperature, and density with alphatron gages; two experiments to measure dayglow, using photomultipliers and filters; and three experiments to measure the electron density in the ionosphere by means of a rocket-borne pulse transmitter. In addition, four density and temperature experiments using the falling-sphere technique will be flown in Cajuns at Fort Churchill. Twelve Cajuns will be used for a temperature and winds experiment with the DOVAP positioning equipment.

Parallel to the Fort Churchill program will be the continued use by the Air Force of Holloman Air Force Base, where AFCRC will fly two dayglow experiments, two solar UV spectrum experiments with sunfollowing spectrographs, and three rockets to measure electron density in the ionosphere.

Tentative programs still under consideration are additional firings of Cajuns at unspecified locations for density determinations, and of Rockoons

Solar Activity

The purpose of this program is to compile detailed and comprehensive records of the activity of the sun, especially sunspots, flares, plages, coronal emissions, solar magnetic fields, and radio-wave emissions at various frequencies, during the IGY period of sunspot maximum.

Existing observing programs or patrols will be continued by various observatories, and special efforts will be made for maximum coverage by photographic flare patrols using interference H-alpha filters and for spectroheliographic observations. At least three indirect flare detectors will be installed for the rapid detection of ionospheric effects of solar flares. Radio noise patrols will be continued, and various special studies will be undertaken, such as the systemic measurement of solar magnetic flares and solar granulation studies.

The Air Force program consists of coronal-emission patrol, flare line profiles, indirect flare patrol, photographic flare patrol, plage-frequency spectra, radio-frequency spectra, and special solar observations at the AFCRC Sacramento Peak Observatory. The solar experiments of the rocket research program at Holloman Air Force Base are an important part of the over-all program. A major effort will be made by AFCRC to observe the solar chromosphere at various stations in the Pacific during the 12 October 1958 total eclipse of the sun.

Cosmic Rays

This program is designed to obtain data on the mass and energy spectrum of the primary cosmic radiation, especially the low-energy end of the primary spectrum, and fluctuations of cosmic ray intensity. To study the primary spectrum, a series of nearly simultaneous flights will be made at various latitudes with both balloons and rockets carrying Cerenkov counters, proportional counters, pulsed ionization chambers, Geiger counters, and photographic emulsions. Shipboard measurements will also be made with neutron counters and ionization meters. Study at ground stations of fluctuations in intensity will require in addition cosmic ray telescopes and air shower detectors. The observational program will embrace the U.S., Canada, Alaska, Greenland, Central and South America, the Pacific, India, and Antarctica.

The Air Force program in cosmic radiation will be carried on wholly contractually by such institutions as the University of Chicago, University of Maryland, and New York University. Data will be used by AFCRC in its continuing geomagnetism, auroral, and ionospheric projects.

Longitude and Latitude

The purpose of this program is to determine astronomical longitudes and latitudes by observing stars with astrolabes, timed with quartz-crystal clocks, in order to ascertain differential shifts between continents; and to undertake a moon-photography program to obtain data for problems of uniform time, the irregular rotation of the earth, and the size and shape of the earth.

This program will be carried out by the U.S. Coast and Geodetic Survey and the U.S. Naval Observatory. The Air Force is interested in the Markowitz moon-photography technique for geodetic purposes.

Glaciology

The glaciology program seeks to conduct detailed field investigations in the western U.S., Alaska, the Arctic, and the Antarctic to record the status and behavior of glaciers in the IGY period for comparison with observations made in the past and in other parts of the world. These studies will include determination of the heat balance in accumulation areas, studies of the thermal and hydrological regimes, measurement of velocity profiles, surveys by terrestrial and aerial photogrammetry, meteorological observations, and measurements of snow depth, snow and ice ablation, and runoff.

Oceanography

This program consists of the Island Observatory project to obtain an understanding of short- and long-period sea-level changes and their relations to other oceanic and atmospheric phenomena, by establishing temporary stations in the Atlantic and Pacific Oceans; and Operation Deep Current, which is a study of the deep circulation of water moving northward from the Antarctic, the equatorial current systems, and detailed studies of areas of convergence in the north-central Pacific and north-central Atlantic. The Air Force is interested in this program but is not participating.

Seismology

The seismic program is concerned with seismic exploration of the crustal structure of the solid earth, including sea, coastal, and continental exploration; earthquake studies; and Antarctic studies. With the exception of the Antarctic Expedition, existing earthquake observatories and research vessels will be used. For the earthquake work, three-component long-period and intermediate-period seismographs, and two-component Benioff linear-strain seismometers will be installed in various existing seismograph stations. Vertical seismometers and clocks will be used as auxiliary equipment.

The Air Force is interested in the seismology program but has no projects in it.

Gravity

The purpose of the gravity program is to extend current knowledge of the earth's gravimetric field, to relate existing gravity data to a common base, and to ensure that future gravimetric work has the same standard of reference. Pendulum measurements are planned to extend the existing European-African calibration line to Capetown, South Africa, and to Australia; and the Fairbanks-Mexico City line to Cape Horn, South America. Gravimetric measurements necessary to tie together existing networks will be taken at remote areas in conjunction with other projects; submarine pendulum measurements are planned for lines across the Atlantic, Indian, and Pacific Oceans; and underwater gravimetric measurements will be taken along the continental shelf out to the 50-fathom line, in order to evaluate submarine gravity values and tie them to land values.

The gravitational solar-lunar tide will be observed at about ten stations with special LaCost-Romberg gravimeters to obtain an improved determination of the rigidity of the earth. It is also planned to take corresponding tidal-tilt observations at the same stations.

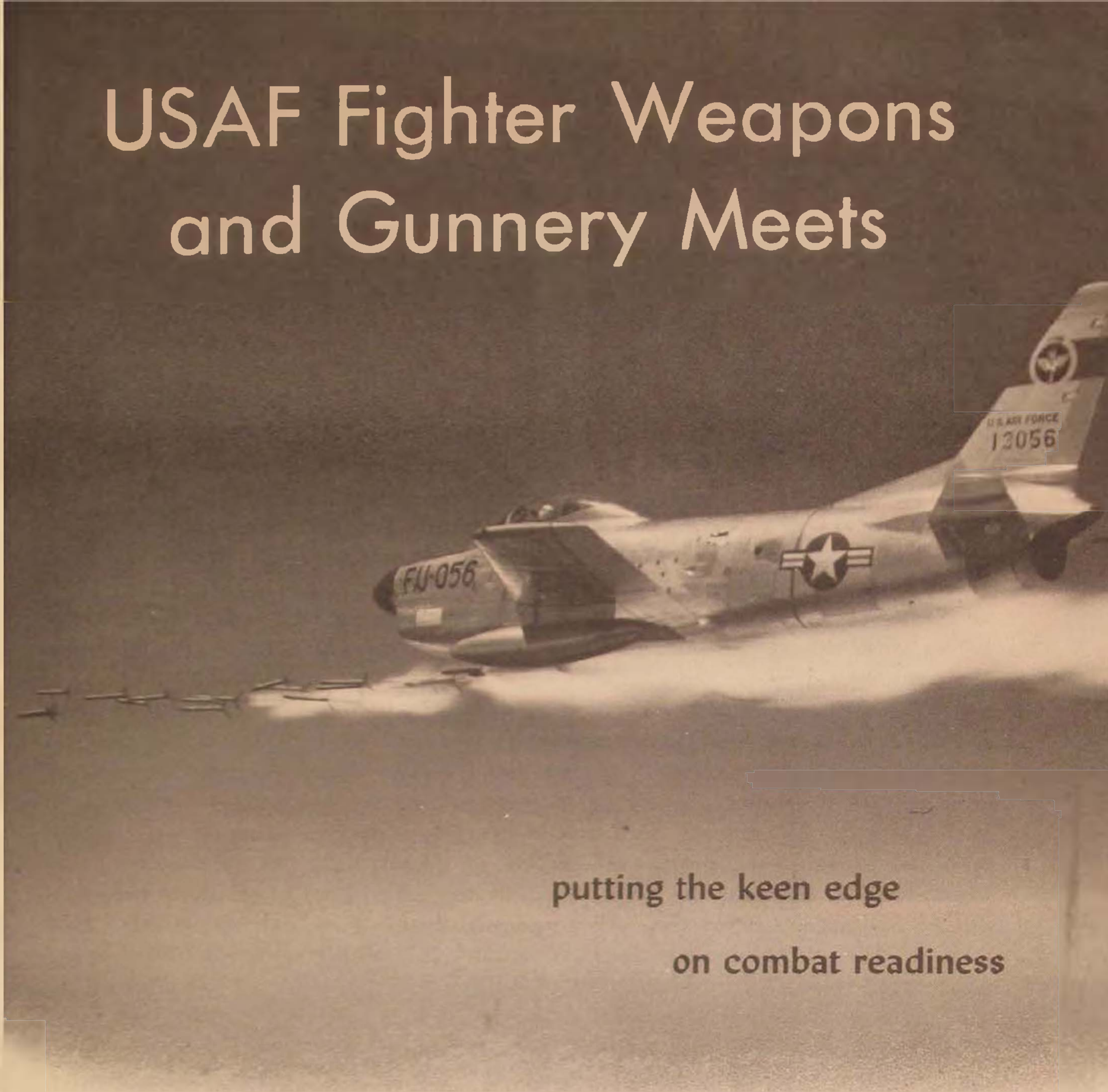
Although the Air Force has at present no formal participation in this program, the IGY pendulum measurement program is a continuation by the University of Wisconsin of its current work under contract to AFCRC.

World Days

Since the 18-month period of the IGY is a long time for sustained geophysical observations, four types of "days" or series of "days" have been designated for special observational efforts. Three or four Regular World Days per month have been specified in advance. These will be two consecutive days at new moon, with the other (s) near the quarter moon and prominent meteor showers. World Meteorological Intervals, which are series of ten consecutive days each calendar quarter, including the solstice or equinox day and also three Regular World Days, have also been established. For transient phenomena which cannot be forecast, a world-wide Alert, broadcast when unusual solar activity is observed, will warn of the probability of occurrence of solar flares and subsequent geomagnetic disturbances. A Special World Interval will be called on 24-hour notice when there is a strong possibility of an ensuing geomagnetic disturbance within 24 hours following the start of the interval. The communication network for disseminating notices of Alerts and Special World Intervals will be centered at the National Bureau of Standards at Fort Belvoir, Virginia, and Anchorage, Alaska.

Air Force Cambridge Research Center

USAF Fighter Weapons and Gunnery Meets



putting the keen edge on combat readiness

IN THE deadly earnest competition of crack combat teams the Air Force proves the tactics and machines of its fighter, interceptor, and training forces. Although war remains the decisive test of combat effectiveness, the annual USAF Fighter Weapons and Gunnery Meets provide the best available substitute to compare and evaluate training methods in the use of fighter and interceptor aircraft. Underscoring the importance of the combat-simulated competition at these Air Force-wide meets is the realization that decision in modern air war depends on the thoroughness of preparation before war begins.

In line with the specialized capabilities of modern fighter aircraft, the Weapons and Gunnery Meet is divided into three phases: day fighter, special delivery, and interceptor rocketry. The day-fighter and special-delivery phases are held at Nellis Air Force Base, Las Vegas, Nevada, with Air Training Command as host, and the rocketry phase at Yuma County Airport, Yuma, Arizona, under the supervision of Air Defense Command. The training functions and facilities of Nellis and Yuma fit them particularly for the conduct of the competition.

The organization of each annual meet has remained basically the same since 1949. Each base has the responsibility to program and carry out the operation of its share of the program. Dry runs before the meet smooth out plans for its management. Scoring and judging officials are painstakingly briefed to function promptly, accurately, and impartially.

Teams from a wide variety of Air Force components—ATC, SAC, TAC, ANG, FEAF, USAFE, ADC, AAC, and NEAC—participate in the meet. Each team previously has won an elimination competition in its own command. Each day-fighter team has four primary and two alternate members, with a twenty-five-man support element of officers, industry technical representatives, and airmen. The team captain, who must be a wing or group commander or wing operations officer, is required to fly all missions. Alternate members may not be used except in cases of ground abort by regular members. The interceptor rocketry teams operate under the same rules and basic composition, with the addition of two controllers selected from the same air division as the aircrews and fifteen support members. Each team is authorized eight aircraft but can declare only six for the competition.

The division of the meet into three phases parallels normal combat functional designs of the aircraft, with the events in each phase designed to simulate specific combat objectives. But although realism is desirable, flying safety and the requirements for a simple, equitable scoring system take top priority.

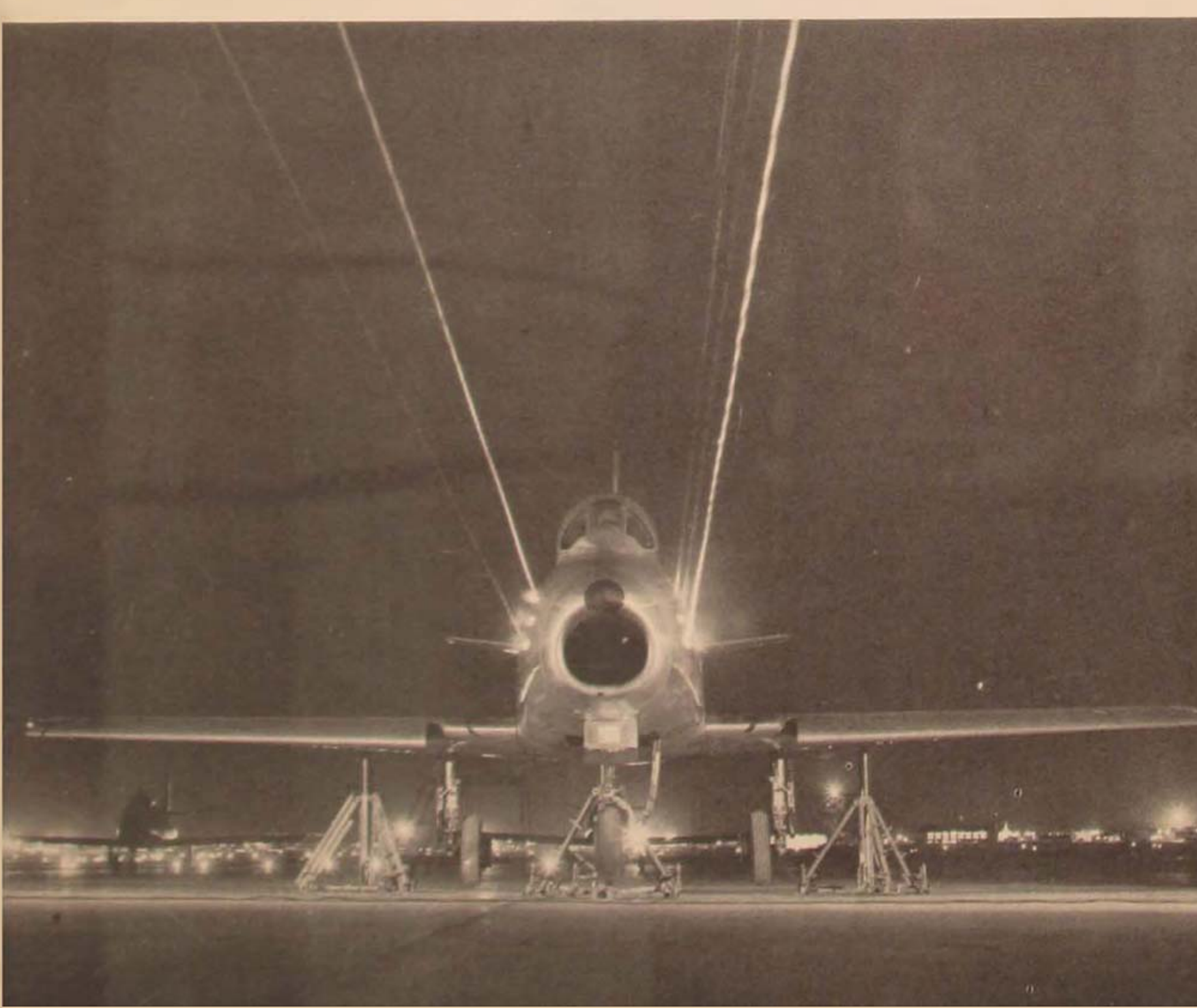
The air-to-ground event of the day-fighter phase, consisting of dive bombing, rocketry, and panel gunnery, is a test of techniques for general front-line support of friendly troops and interdiction of enemy supply lines. It simulates the selection and destruction of single, small-dimension targets, such as armored vehicles, gun emplacements, bunkers, small troop concentrations, bridges, shipping, and targets of opportunity. A requirement for high airspeed shortens the firing time on any given pass to simulate the combat necessity for hitting the target and withdrawing as fast as possible. Still more realism is added by restrictions on the altitude of release and the firing range to prevent unsound combat techniques.

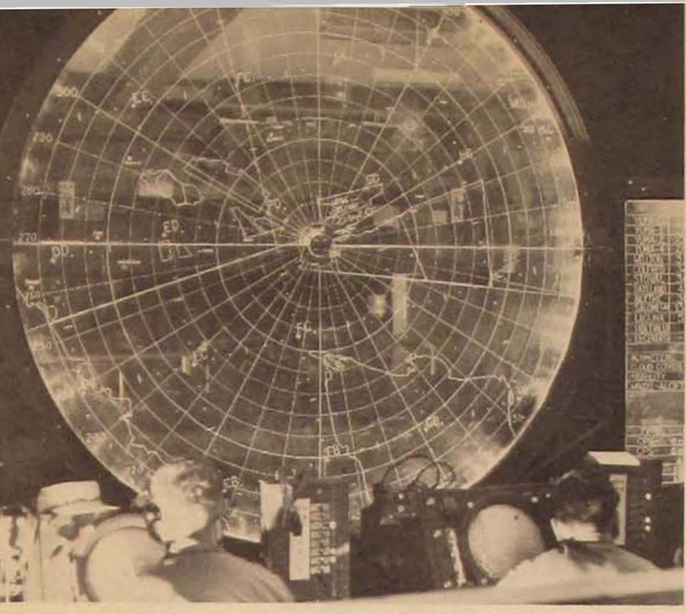
In the day-fighter air-to-air event a 6x30-foot banner target is fired upon at altitudes of 20,000 and 30,000 feet. For safety the target must be flown straight and level, sacrificing a degree of realism. But since the deflection shooting demanded is comparable in difficulty to combat firing, the results are highly indicative of gunnery proficiency. The gunnery event at 30,000 feet severely tests the pilot's ability to maneuver his aircraft at high altitude and to position it properly for maximum use of the two-second period during which the rules permit him to fire on any attack. He is further restricted in the angle from which he may fire. Fouls are accurately determined by measuring the length of the holes caused by strikes in the target.

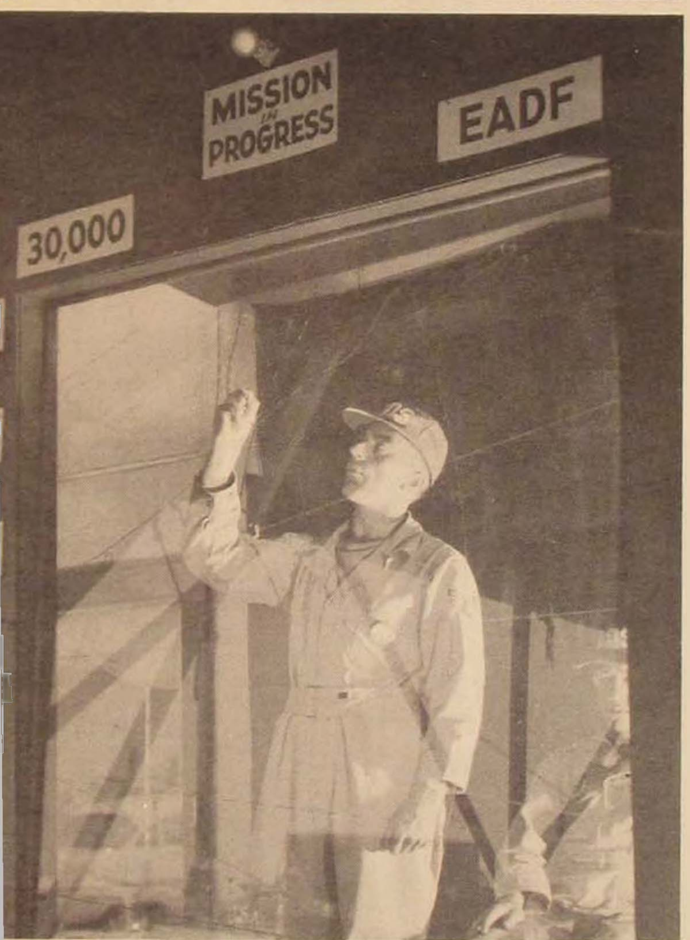
Today as never before our national security depends upon the effectiveness of our forces-in-being on D-day. The United States will not have the time to organize equip, and train combat-qualified forces before the issue of victory or defeat is settled. The annual USAF Fighter Weapons and Gunnery Meets, by serving as a peacetime proving ground for the tactics and proficiency of men and machines in fighter, interceptor, and air training forces, contribute to our success in developing combat-ready air forces before war begins. In conjunction with the Air Defense Command and the Crew Training Air Force the Editors of the Quarterly Review *describe the most recent of the meets and their effects on future preparedness.*

The Groundwork

Each team entering the annual USAF Fighter Weapons and Gunnery Meets brings to the competition a crew of officer and airmen specialists and industry technical representatives to provide the necessary element of support on the ground. Countless hours and thousands of adjustments are required to prepare the high-speed interceptors, fighters, and their weapon systems for a firing pass of only a few seconds. At the right, an armament crew at Yuma AFB loads the rocket pods of an F-94C Starfire interceptor with 2.75-inch folding-fin rockets. Below, another armament team at Nellis AFB harmonizes the guns and checks the fire-control system on an F-86 Sabrejet.







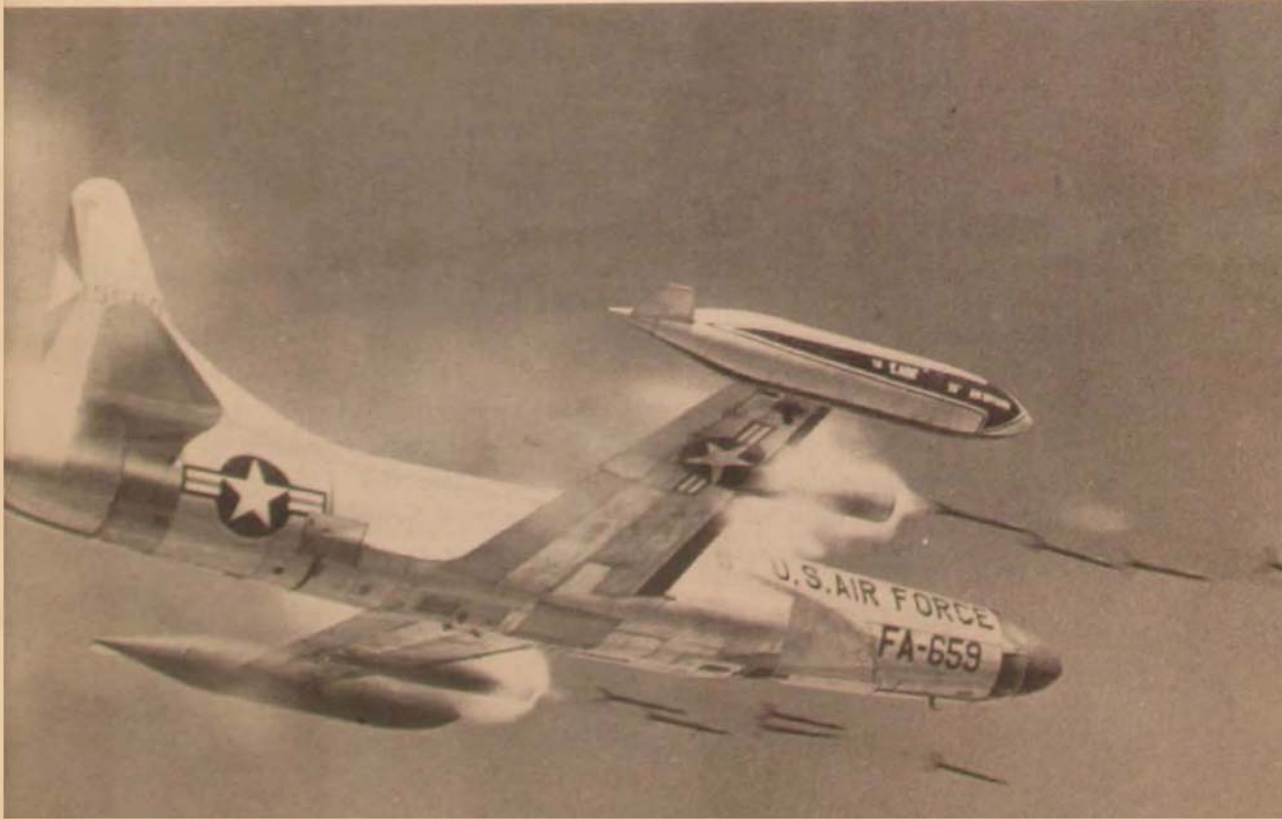
Keeping Track

In the interceptor-rocketry phase of the meet, sponsored by Air Defense Command, firing passes are made on 9x45-foot banner targets at altitudes of 18,000 and 30,000 feet. Tracks of airborne targets over the range are plotted on huge, transparent boards (top, left) so that radar operators can vector the interceptors to the targets. Progress of individual missions is recorded on another plotting board (below). "Contact" indicates initial detection by the interceptor's radar. "Judy" means the airborne radar has "locked on" the target. "Fired" shows that the interceptor has let go a salvo of rockets at the "enemy."

BECAUSE the second phase of the meet involves the day-fighter delivery of special weapons, it is generally classified. It can be said that the techniques demonstrated, such as dive bombing and high- and low-angle bombing, are those that might be used by fighter aircraft employing special weapons to destroy targets of great military importance—centers of industry, enemy airfields, communications and supply centers, and troop concentrations. As in the two other phases the sorties are planned for realism in the tactical delivery of a special weapon. The pilot navigates to target without radio-

The Firing

Division of the USAF Fighter Weapons and Gunnery Meets into three phases parallels the normal combat functions of the aircraft. Above, an F-84F fighter-bomber darts in to drop napalm and complete the destruction of a ground target as it would in interdiction or close support. Below, an F-94C interceptor has "locked on" its airborne target and fired its lethal salvo of 2.75-inch folding-fin rockets.



navigation aids. His flight path must conform to certain restrictions that prevent him from adjusting course to make an accurate "time over target." Possible decisions to be made in a tactical situation concerning variations in the delivery method are likewise the pilot's responsibility in the meet. Certain other inflight operations essential to successful delivery that cannot be evaluated in the air are performed by each pilot on the ground, using the aircraft and other special equipment, to display his proficiency and arrive at part of his score.

The third phase of the Gunnery Meet at Yuma features the all-weather fighter interceptor, almost 85 per cent of which in the USAF inventory carry only rockets.

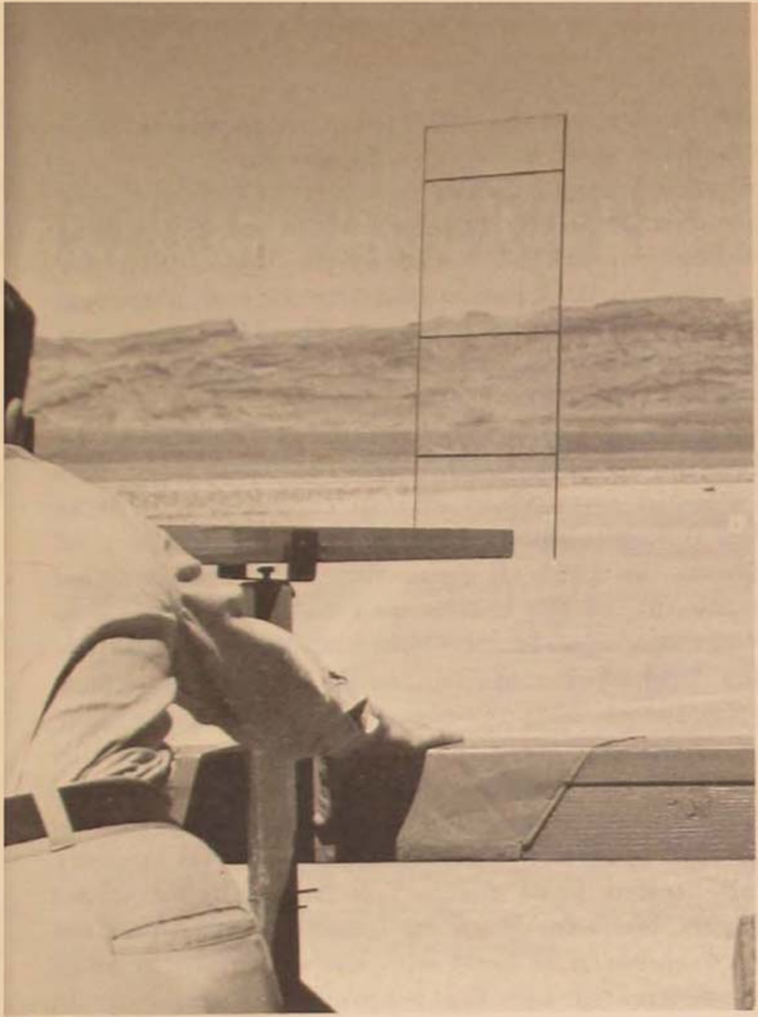
Each competing team in the air-to-air rocket-firing program pioneered by Air Defense Command is allotted specified times on the range. Action really starts on the apron, where ground-crew specialists condition the aircraft. The radar-maintenance technician packs the delicate Hughes fire-control mechanism in the airplane. The armorer loads and arms the rockets. The tuning of the aircraft requires the best efforts of many highly trained specialists. During range time each team scrambles its aircraft, intercepts the target, and completes its firing passes. Once the interceptors are airborne, the crews follow directions transmitted by their GCI controllers, the ground half of the intercept team. The controllers vector the aircraft into position for a "lead-collision course" to the target, that is, a right-angled approach. Within airborne radar range of the target and after the target has been located, the aircrew itself assumes control of the intercept.

The actual intercept and the firing of the rockets are nonvisual. Hoods are pulled into place en route to the range and checked by the chase pilots, and the entire intercept mission is flown blind on instruments. The pilot pulls the trigger, but the release time for the rockets is decided automatically by the interceptor's airborne computer when the proper position in the "lead-collision course" is reached. Subject to the speed and altitude capabilities of the target, every effort is made to simulate the actual all-weather conditions under which the interceptor would operate in combat.

Rocket-firing passes are made at 18,000 and 30,000 feet. For the passes at 18,000 feet a B-29 does the tow-target chore, dragging a 9x45-foot banner target 5000 feet at its rear. Two metallic spinners are attached to the target for the radar-directed fire-control system to "lock on." For the 30,000-foot runs jet B-45's tow the target.

Each aircraft is allowed six sorties on the target, three at each altitude. Only actual hits are scored, with 1000 points awarded for a hit or hits on the first run, 800 on the second run, and 600 on the third. Team score for any event is the total of the team's aircrew points for the event.

The Air Force profits significantly from the Fighter Weapons and Gunnery Meet. The results of each year's meet become standards by which Air Force units may measure their combat capability. The effect of the meets on over-all proficiency may be reflected by the fact that the lowest scoring team in the 1954 day-fighter meet scored more points than the winning team in 1950. The results in Phase III of 1955 are a specific example of how the meets help to create a defense-capable force. After the 1954 meet Air Defense Command undertook an intensive, determined firing program to qualify its units for combat. The methods and techniques used by the 1954 winner



The Results

Results of the USAF Fighter Weapons and Gunnery Meet each year become standards by which Air Force units measure combat capability. To ensure effective evaluation, scoring officials are briefed to function promptly, accurately, and impartially. Using an altitude measuring device (top, left) a scoring official checks the approach of each aircraft on a ground gunnery mission. An improper approach may disqualify the pilot for that run. In the air-to-air rocketry only actual hits are scored. Rockets fired by the interceptors make large holes in the targets (top, right), the size of the hole indicating the angle of attack. Each air-to-air target is returned to base for scoring. For each team only the captain may be present at the time of scoring.

were disseminated to the field. As a result the 1955 competition was so keen that the winner was not determined until the last sortie was flown.

Each year's meet is well attended by representatives from industry, who carefully check the way their own items of equipment stand up under pressure. Many important modifications can be traced to the opportunity for factory representatives and the using Air Force units to thresh out in concert the problems of bringing weapons to bear on a target. The 1955 meet saw an unparalleled use of test equipment, scope film, and firing-mechanism evaluation for the purpose of weapon improvement.

In the special weapons field, of which most details are classified, the achievements of 1955 indicate the advances made during the past year. The 1954 meet was the first to attempt comparison of unit capabilities. During the 1954 meet there had been skepticism concerning the real accuracy of the established delivery methods. In 1955 all competing units demonstrated significant advancement in the use of the tactics and techniques first employed in 1954. Their performance clearly established and emphasized the role of fighter aircraft in the field of special-weapons delivery. The experience gained in conducting the special-weapons phase of the meet thus materially assists Air Training Command to train the fighter pilot for successful delivery of the great destructive power he carries.

One serious technical limitation highlighted by the meets is the inadequacy of existing targets. Full operational performance in aerial gunnery and rocketry cannot be fully tested until faster and higher-flying target equipment matches the fighters Mach-for-Mach in speed and foot-per-foot in altitude. Substantial improvement is at hand with the activation in 1956 of the first target drone squadron to use the jet-propelled robot target "Firebee." The 12-foot-wing-span Firebee is driven by a moderately low-powered jet engine to a speed of 600 miles per hour and an altitude of 30,000 feet. Robot targets, if successful, will markedly increase the interest and the realism of future Fighter Weapons and Gunnery Meets.

A less tangible but no less valuable achievement of the meets is the spirit of friendly competition and camaraderie. Each member of a team, a pilot or ground crew, is essential in his team's success. Under the pressure of competition each man recognizes the measure of his debt to his teammates. The competitive spirit and will to win revealed by the participants is exactly the spirit that brings out the best in men and equipment and knits all into smooth-working, tight units. The result is combat readiness.

Air University Quarterly Review

Books and Ideas . . .

Soviet Military Literature and Soviet Air Doctrine

LEONARD N. BECK

IN THE absence of an official expression of Soviet air doctrine Western military intelligence must turn to unclassified materials for reflection of Soviet military thought about the employment of air power. R. L. Garthoff's invaluable study, *Soviet Military Doctrine*,* justifies Professor H. A. DeWeerd's assertion that "the great libraries of a nation are among the first sources of really useful military intelligence." Garthoff's book demonstrates by example that the primary requirement for any study of Soviet air doctrine is the systematic digestion of its military literature.

Yet the means available for the investigation of Soviet military literature is limited. Otherwise excellent reviews of Garthoff's work are marred by wishful thinking that "there must be" significant postwar Soviet military manuals and periodical articles available in addition to Garthoff's meager list. On the basis of the open-source, unclassified materials reaching a research institution like the Library of Congress, the answer is that while there certainly should be, there just are not. In this article I wish to indicate something of the nature of Russian military literature, using as a focus of exposition the striking changes in the expression of air doctrine apparent since the publication of Garthoff's book.

The scarcity of informative Russian military literature cannot be traced to Soviet ineptitude or indifference to printed discussion of military affairs. Total Russian book production exceeds our own, and a large percentage of this total is listed under the rubric "Military and Naval Sciences." But much of it is written for the DOSAAF paramilitary organization (*Dobrovol 'noe Obshchestvo Sodeystviya Armii, Aviatsii, i Flotu*, Voluntary Society for Assistance to the Army, Air Force, and Navy), and another part is unavailable because of an export ban amounting to a security classification. All Russian military writing is vitiated qualitatively by a propaganda that employs a special language with a limited terminology and constant repetition. In this atmosphere the discussion of military doctrine does not flourish.

Soviet military literature can be divided into three major groups—manuals, the periodical press, and specialized monographic studies. The official manuals are least corroded by propaganda and most clearly depict the actual theory and practice of each arm. The 58 manuals (Ustavy, Nastavleniye, or Rukovodstva) listed by Garthoff represent 36 years of Soviet military activity,

***Soviet Military Doctrine, by Raymond L. Garthoff (Glencoe, Illinois: The Free Press, 1953, $7.50), 587 pp.**

assuming that March 1953 was Garthoff's cut-off date. The very few received with a later date are interservice manuals on such topics as internal service, guard and patrol duty, and drill. Revised editions of manuals predating 1953 but not available before then do not substantially modify the earlier editions. A few elementary pages on chemical warfare were added to the Air Force sergeants' manual, but the postwar edition of *Field Fortifications* is an exact reprint of its predecessor.

Of the titles antedating Garthoff's work but not cited, the most interesting are probably the *Navigation Service Manual of the Long-Range Air Force* (1944), and the *Instructions for the Aviation Engineering Service.* But like other attempts to confine a vigorously evolving technology between the covers of a book, they probably were soon outdated. It seems safe to assert that no new direct information on air doctrine can be gleaned from these manuals.

The second major category, the military periodical press, ordinarily paraphrases, popularizes, and enriches official theory and its application as expressed in the manuals. But Garthoff's impressive list of periodicals reads to the librarian like an obituary column. The periodicals cited may not have suspended publication, but they certainly are lost to Western readers. The chief casualty is the highly important *Voyennaya Mysl' (Military Thought),* which today in Russia probably does not circulate below the level of division commander. The only newcomer is *Grazhdanskaya Aviatsiya (Civil Aviation:* first publication, January 1955), which deserves mention since nowhere are civil and military aviation more truly two sides of the same coin than in Russia. Of Garthoff's list, the only three journals of specialized aviation interest still received are *Vestnik Vozdushnogo Flota, Krasnaya Zvezda,* and *Kryl'ya Rodiny,* and the last is written for the aeromodellers and their clubs.

The first of these three, *Vestnik Vozdushnogo Flota,* is written for junior officers up to squadron commander, to whom several articles on training are specifically addressed. The allotment of articles to the different subject fields

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Editor's Note: Inspired by Dr. Garthoff's pioneering study, the following two reviews describe the problems confronting the student of Soviet military doctrine, indicate the sources and approaches available, and attempt to trace the history of Soviet air doctrine since World War II. Mr. Leonard Beck, Air Information Division, Library of Congress, analyzes available Soviet military literature. Writing in December 1955, he then concluded that Stalin's military dogmas had recently undergone drastic revision, especially in the field of air doctrine. The startling political repudiation of Stalin since the preparation of his review confirms his diagnosis. The fact that the trends he noted months ago are now confirmed by open discussion in the U.S.S.R. underscores the value of utilizing open-source research materials to predict developments in military thought. Dr. Kenneth Whiting, Research Studies Institute, Air University, points out the contrast in Soviet military doctrine since World War II, especially air doctrine, as presented in print and as operating principles expressed in the new weapons that have been developed in the U.S.S.R.

undoubtedly results from deliberate editorial policy. Examination of the file for 1954 reveals the following distribution:

Subjects	*No. of articles*	*Per cent*
Editorials, political and character training	12	8.5
History of the Soviet Air Force	9	6.4
Air tactics (8 on fighter tactics, 1 on ground support, 1 on staff training)	10	7.2
Flight training (including piloting, gunnery, bombing, navigation, meteorology, reconnaissance, Arctic training, night flying)	70	50.
Technical training (including theoretical articles on aerodynamics, aircraft power plants [mainly jet], electronic equipment, and practical articles on maintenance of aircraft and airfields, particularly in winter)	38	27.1
Antiatomic defense	1	0.7
Miscellaneous (review of foreign aviation, answers to readers, book reviews)	—	.1

The *Vestnik* is a serious magazine, relatively free from propaganda, and similar to its Western counterparts. Certain generalizations can be made: (1) primary emphasis is on fighter tactical aviation; (2) the fighter plane is a jet plane (the piston power plant began to disappear from the pages of the *Vestnik* in 1953); and (3) relatively little space is given to such problems as Arctic flying, night flying, and instrumentation.

The second of the three specialized journals still received, *Krasnaya Zvezda (Red Star)*, is the official organ of the Ministry of Defense of the U.S.S.R. As such it must publish party and government decrees and some rewritten TASS news reports. Some issues are entirely turned over to such material; they occupy a quarter to a third of every issue. But *Krasnaya Zvezda* provides an ore which must be mined. Problems of political and military training occupy most of the remaining space, with the emphasis always on "socialist self-criticism." Occasional articles appear on specific military, technical, and political subjects.

Probably the most important statement for air doctrine in *Krasnaya Zvezda* appeared on 9 June 1954: "The appearance of the atom weapon poses certain problems of the military art in a new light." To realize the implications of so seemingly trite a statement, we must remember that we are dealing with a regime in which the importance of any official can be determined by measuring his distance from the center of the *Pravda* photograph. On 25 September 1946 Stalin told Alexander Werth:

> I do not consider the atom bomb such a serious weapon as some political leaders are inclined to consider it. Atomic weapons are designed to frighten nervous people, but they cannot determine the final outcome of war, because atomic weapons are quite insufficient for such a goal.

The distance between Stalin's statement and the sentence in *Krasnaya Zvezda* took nearly 8 years for the Soviets to travel—or to admit having traveled. Accompanying this sentence in *Krasnaya Zvezda* was the first and "most extensive, albeit popular" series of articles on atomic energy and atomic weapons to appear in the Russian press. Thus the subject of atomic weapons, though not mentioned in textbooks on dialectical materialism, began to appear in a military journal as a topic for instruction.

The emphasis given to defense against atomic weapons reveals Russian awareness that tactical atomic weapons so greatly increase the firepower of Western forces that Russian manpower superiority is canceled. Antiatomic defense is discussed in 1954 by Major Gen. V. Olisov on 3 August, by Col. A. Glushko on 25, 26, and 28 August, and by Major A. Dorofeyev on 23 October. Articles on the subject in available issues of *Krasnaya Zvezda* for the first 10 months of 1955 appear on 25, 27, 29, and 30 January, on 1 February, on 25 May, and on 21 August. Related articles also appear in *Vestnik Vozduzhnogo Flota* in February and May 1955.

The substance of these articles is as follows: (1) bourgeois military scientists erroneously believe that they can decide wars with fission and thermonuclear weapons; (2) they suffer generally from what Frunze called the "fetish of technique," an overemphasis on technical equipment and underestimation of the role of human beings; and (3) atomic weapons can be neutralized. The last point is elaborated: (1) units subjected to radiation need not withdraw but should continue their activity; (2) surprise is the great danger, but one that reconnaissance can counter; and (3) the basic defenses are local cover and special protective equipment. A civilian echo is noted in the TASS statement printed in *Pravda* (17 September 1954) that in testing one type of atomic weapon "worthwhile results were obtained which permit Soviet scientists and engineers to decide successfully problems of defense from atomic attacks."

Citing at random from *Krasnaya Zvezda* in 1955, one finds an editorial on 26 January on the low caliber of dissertations in military science. It complains that they present "no insights into the future on the basis of generalizations from the development of weapons and techniques in the last few years." The only American book reviewed is Reinhardt and Kintner's *Atomic Weapons in Land Combat* (17 February). After the usual abuse of America and American policy, Major Gen. Petrov concludes that the data and opinions contained in the book deserve careful attention.

Before looking further for signs of developing Soviet doctrine in *Krasnaya Zvezda,* we should examine the last major category of Soviet military literature, the specialized monographic literature. This exposition must be prefaced in turn by summarizing the military dogmas undergoing change. The first dogma appears in Stalin's *Prikaz* 55 of February 1942, in which he analyzes and differentiates between transitory and permanent factors influencing the outcome of war. The only example given of a transitory factor is surprise. Stalin was obviously minimizing the near disaster of the German attack in 1941. Whereas in Clausewitz's definition surprise is most probably simply the condition which permits the concentration of superior forces on a given point, for the Russians, surprise, Clausewitz, and "blitzkrieg" are synonymous and equally hateful. The second dogma appears in Stalin's letter to Comrade Razin in March 1947 in which, flushed with his victories, he condemns Western military thought from Clausewitz on and proclaims the indigenous nature of Soviet military doctrine. The letter to Razin begins the official canonization of Stalinist military doctrine, considered eternally valid and beyond need for emendation, particularly from the West, because of its success in the Second World War.

Two books not cited by Garthoff disclose the doctrinal position of the Soviet Air Force under Stalin: Col. V. P. Moskovskiy's *Air Forces of the U.S.S.R.* (1948) and Col. N. Denisov's *Fighting Glory of the Air Force* (1953). Moskovskiy writes: "[Stalin] teaches that the Air Force must be considered one of the basic arms. Its main mission consists of combat cooperation with the ground force." Denisov summarizes Lapchinskiy's refutation of Douhet:

> Soviet military science insists that victory in modern war is achieved through the combined efforts of all types of troops, that the basic task of the air force is the support of the ground troops throughout the combat action. Decisively refuting the Douhet humbug about strikes from the air at cities to terrorize the population as the main mission of the air force, our air force thought considered action on the war industrial centers and lines of communication of the enemy as necessary, but evaluated this effect as a complementary means which in no way replaced operations conducted by the efforts of all armed forces.

Although Denisov adds that victory results from the combined effort of all arms, five years later he is still repeating Moskovskiy on the subordination of air to ground forces.

Those books in which air doctrine is cited within discussions of general military doctrine reveal the same rigid attitude. The most important member of the group not available to Garthoff is Col. M. V. Taranchuk's *Constant Effective Factors Deciding the Outcome of War* (1st ed. 1953; 2nd ed. 1954), which is of course an elaboration of Stalin's *Prikaz* 55. Taranchuk repeats after Stalin that non-Communist military thinkers are unable to discern the scientific bases of war. They take individual factors for fixed principles.

> Some of these theorists suppose that the determining factor is the talent of the Commander-in-Chief; others that the principal means is armored troops, or aviation, or the surprise attack, etc. Modern theories prevailing at present in the capitalist world are those of atomic and bacteriological attack.

The pregnant idea here is the minimizing of "surprise attack." Taranchuk's scorn of the atomic bomb and strategic bombing will be referred to later.

The "harmonious coordination and development of all forces" is the thesis of Col. I. V. Maryganov's *Advanced Character of Soviet Military Science* (1953). For Western bourgeois theorists to conceive such a principle is impossible:

> One-sided also appear the views of American militarists on this question since they clearly exaggerate the role of aviation in the decisive judgment of war. Among circles of military theorists in the USA, a unique religion—the belief in the force of the atom bomb—receives wide diffusion. In the cult of the "absolute weapon" some of them say that the atom bomb displaces all other kinds of weapons and relegates them to the museum.

The fear of a mass army, of the people in arms, is the real reason for American emphasis on the atom bomb and strategic bombing. Has not Stalin shown the absurdity of the trust American militarists place on the bomb?

The series of essays entitled *On Soviet Military Science* has not reached the Library of Congress, but the book is the subject of a long review in *Novyy Mir* for February 1955. The reviewer mentions atomic energy only once and then in connection with American economic mobilization. Fourteen characteristics are given as typical of Soviet military art: decisiveness, initiative, flexibility, etc. No reason is demonstrated why these qualities should be peculiarly or even specifically Soviet. The date of February 1955 is significant for in the next month, on 18 March 1955, Marshal of the Armored Troops Rotmistrov definitely breaks the continuity of the Stalinist pattern expressed in this book.

Rotmistrov charges that Soviet military literature is abstract, vague, and unreal. It does not take into account "those changes that have taken place in the Soviet Armed Forces and in the armies of the imperialist states." His ostensible target is Taranchuk, particularly Taranchuk's treatment of surprise. (Rotmistrov does not need to spell out S-T-A-L-I-N.) He agrees with Taranchuk that surprise is the weapon of the aggressor and has always occupied a special place in the plans of the imperialist—for example, the Germans in 1941—

> . . . but still in this author's deliberations, there somehow appears an underestimation of the surprise attack. . . . Precisely what is the view of Comrade Taranchuk on the role of surprise in view of the availability of atomic and hydrogen weapons? Can a surprise attack play a serious role under such conditions?

Had Comrade Taranchuk daringly and creatively approached his problem, there might have been an answer, but "he is captured by the past."

Rotmistrov warns that a surprise attack is not only conceivable, but is more probable than ever before. The reasons are the progress of technology and the appearance of newer, more destructive weapons. "Some American military leaders, for instance, consider the surprise attack the basic and only guarantee of victory in war." Direct quotation best conveys the impact of Rotmistrov's new thesis:

> In their aspirations for the domination of the world the imperialists may embark upon any crimes and it should be straightforwardly stated that in certain cases the surprise attack with the use of the atom and hydrogen weapons may appear as one of the decisive conditions for achieving successes not only in the critical period of the war, but also in the war as a whole.

Garthoff's careful documentation discloses some intimations of this change, but with the words "in the war as a whole" Rotmistrov formally recognizes that fission and thermonuclear weapons have cracked the "monolithic unity" of "Stalinist military science."

In the second part of his article Rotmistrov implicitly contradicts Stalin's letter to Comrade Razin on Clausewitz. He says that Taranchuk and Petrov (the author of the article on "Constant Factors Deciding War," in the collection *On Soviet Military Science)* give the impression that only Soviet leaders can evaluate the permanent factors. Because of the vices of capitalist society, bourgeois militarists cannot always exploit these factors scientifically, but "the very existence and development of bourgeois military science cannot nihilistically be ignored. While we develop and advance our Soviet military science, we must also become familiar with bourgeois military science, we must know its basic precepts, its deliberations on the means and methods of war, on the principles and organization and use of the armed forces." His view contrasts sharply with the usual rant on the "special," "pure," "scientific" nature of Soviet military theory with its "revelations" of the "reactionary character" of Western thought. Then the question arises: What can the U.S.S.R. learn from the West? Little or nothing about ground forces surely, or tactical aviation. What the Russians can learn most about is, of course, strategic bombing.

It is important to note that Rotmistrov is not alone in emphasizing the importance given to surprise by the new weapons. His colleague is no less than Marshal Sokolovskiy, Chief of the General Staff. Sokolovskiy's commemoration in *Krasnaya Zvezda* (8 May 1955) of the tenth anniversary of the victory in the West contains the statement: "The unprecedented development of modern aviation and jet techniques, the appearance of new atomic and hydrogen weapons, have strongly increased the significance of the factor of surprise." This sentence is actually a rewording of an earlier statement reported in *Izvestiya* on 23 February 1955. In both articles Sokolovskiy also includes an appeal for vigilance and initiative by all troops and officers of all echelons.

For the next relevant statement we return to the official periodical, *Krasnaya Zvezda*. In his article "Soviet and Bourgeois Military Science" (30 August 1955), Major Gen. Ye. Boltin straddles the issue of surprise. Although Soviet military science relies on the well-known theory of the constantly operating factors, "at the same time it takes into consideration the importance in modern war of the factor of surprise and of other temporary factors." On the question of what can be learned from the West, Boltin is more positive: "Soviet military thought should soberly consider the actual capabilities of the armies and navies of imperialist states, and the capacity of their military units to solve present tasks in the field of armament, organization, and leadership on the field of battle." The point is that Russia faces a possible opponent who "possesses powerful arms, whose armed forces are organized on modern lines, and whose military art is adequately developed." Specifically, "it is impossible to accept the assertion made in our press that modern bourgeois military science overestimates the role of technique and underestimates that of man." One of the many places Boltin may have found this assertion was in Taranchuk only a year before:

> Though recognizing the importance of armament in contemporary war, Soviet military science unmasked the absurdity of the theory developed by Douhet, Fuller, and the American "atomic war strategists" attributing absolute predominance to technical equipment, which they consider the only factors in ensuring victory.

The book *Marxism-Leninism on War, the Army, and Military Science* is the most recent and clearest summary of the distance Russian military thought has traveled since Stalin and of its present yeasty ferment. The publication date is 1955, but there are obvious and essential differences between this collection of essays and the essays in *On Soviet Military Science* preceding it by only 8 months. The differences are even more irreconcilable with Taranchuk's *Constant Effective Factors,* which has achieved the "immortality" of mention in the *Great Soviet Encyclopedia,* and from which, like Beria, it will probably have to be removed in future editions. As example I will select citations from *Marxism-Leninism on War, the Army, and Military Science* on three salient themes, using quotations to give the intellectual empathy unavailable by paraphrase alone.

Surprise: Col. V. K. Kargolov: "It should not be forgotten that the newest war techniques significantly increase the role of the surprise attack"; Major Gen. N. Pukhovskiy: "Soviet military science considers that in modern war the role of surprise is increased and it becomes one of the decisive factors of the war." The importance of all-out surprise attack no longer needs demonstration but is stated as incontrovertible fact.

Importance of technique: Col. G. Fedorev: "In war, fundamental, qualitative, and revolutionary changes occurring from time to time destroy old structures and form new ones for the armed forces, and compel new ways of conducting war"; Col. I. Sokolov: "[Even] bourgeois military specialists themselves acknowledge that the creation of a new type of arm and of new war techniques inevitably effects changes in the method of conducting combat and operations, and in the organization of the Armed Forces." The bourgeois military thinkers given as examples are former Assistant Secretary of Defense Roger Kyes and the brothers Alsop, the "Pentagon troubadors." Although the phrase *new techniques* is euphemistic, it certainly covers atomic and thermonuclear weapons.

Can we learn from the West? Col. Fedorev: "There is absolutely no foundation for the assertions that the imperialist powers are not capable of creating new ways of conducting war. Such statements are oversimplifications and harm our military posture." Preoccupation with the experience of World War II is also decried. Col. Fedorev: "It would be completely fallacious to think that the Soviet way of conducting war should remain in its fundamental characteristics exactly what it was in the course of the Great Fatherland War. New war techniques which develop as quickly in our country as in capitalistic countries can call into being completely new ways of conducing war"; Major Gen. G. I. Pokorovskiy: ". . . any effort at dogmatic projection into the future of what seems to be the lessons of history now can cause more damage than at any other time in the past. At the same time, the experience of the past should not be ignored. But it must not be regarded as something unchangeable."

In addition to this new testimony on old problems, an entirely new note is struck in *Marxism-Leninism on War, the Army, and Military Science.* This is the repeated recognition that the new techniques have implications that call for action. Major Gen. G. I. Pokrovskiy says that the influence of the new arms and techniques on the military art is limited by a number of factors, the first of which is "their organic introduction into the system of the armed forces." Under present conditions, Col. O. Zakrzhevskiy writes, "in addition to its previous problems, strategy has to decide the questions of the organization of the neutralization of the military potential of the enemy, and the active defense of the targets of its own strategic rear." This he calls a task "unprecedented" in the development of military art, a word that will strike a responsive chord among his opposite numbers on this side of the Atlantic.

Col. Zakrzhevskiy's reasoning will also be familiar to Americans. The stronger the dependence of the armed forces on the economic and moral potential of the country, the more intensively will the strategic rear be subjected to enemy action. In addition, the more powerful the new armament, the smaller the quantity required to produce decisive changes in the conduct of operations and of the war as a whole, e.g., hundreds of thousands of machine guns, but only a few thousand airplanes. The undisturbed development of the economic and moral potential of the zone of the interior depends increasingly on its antiaircraft defense. The development of aviation and the appearance of new long-range weapons of attack in the Second World War permitted effective action against the enemy's rear and thus lowered his military potential. "The increase in the radius of action of aviation, in its speed and in its bomb-load, the stormy development of jet reaction techniques, and the appearance of new powerful means of destruction have even further widened the possibilities of action on the enemy's zone of the interior."

Study of Soviet military literature of the last two years reveals that the eternal, immutable cast that Stalin thought he had given to military doctrine has been broken. The old set of quotations from Stalin on surprise, the inherent inferiority of the West, and the relative insignificance of atomic weapons has been revised and even rejected. The Russians have had to face the problem of whether a change in methods of war as fundamental as that represented by the intercontinental bomber carrying nuclear weapons does not revolutionize all previously accepted military codes. What their ultimate answer will be no one knows surely. The difference between doctrine in print and doctrine in performance is illustrated by the discrepancy between Soviet theory and practice before and after 1941. About Soviet practice there are no experts; there are only varying degrees of ignorance. But there can be no doubt that doctrine in print is being rethought.

There is no present ground for thinking, however, that the Russians have gone beyond considering the strategic air force as an integral part of the combined arms team, whose base remains the coupling of infantry and tactical aviation. Conventional ground forces still seem to fit best the Russian military situation and Russian politico-military objectives. The growing capability of the Russian long-range air force reflects awareness that the center of American power is beyond the reach of the infantry-tactical aviation team in an age when the U.S. is able to damage critically Russian war-power sources with fusion weapons. In a sense, therefore, the creation of a Soviet long-range air force, in spite of the Soviet emphasis on the "harmonious coordination" of all arms, results from the influence of American doctrine.

As to the reason for existence of the Soviet long-range air force there can be no confusion. The account in *Izvestiya* (4 July 1955) of the 1955 air show at Tushino, particularly the last sentence, is worth reading:

> These ships of the air have unprecedented speed and can fly at unprecedented altitudes. They have reliable navigation equipment; their crews can fly long distances in any weather and at great altitudes by instruments. On July 3, they flew low so that all present could have a good look at them. . . .

The study of military doctrine, like every other form of active thought, must obey the essential laws of intelligence, the first of which is common sense. Gen. Thomas D. White says:

> The Soviets have no use for a long-range bomber except to attack the United States. Last year we saw one Soviet model. This year we saw numbers of them in formation.

Air Information Division, Library of Congress

The Search for a Soviet Air Doctrine

Dr. Kenneth R. Whiting

AMONG the problems confronting the student of Soviet affairs, none has been more difficult than to assess Soviet military doctrine. Identifying a describable air doctrine within the sphere of Soviet military doctrine itself is even more baffling.

Although most Soviet military thought derives from World War II experience, development of nuclear weapons and long-range aircraft has invalidated World War II concepts for the employment of air forces. But Soviet military writers have been most coy in this field. Garthoff's *Soviet Military Doctrine* is an admirable study of this elusive subject and is probably accurate for all other branches of the Soviet military forces. That it cannot be depended on for Soviet aviation doctrine is not so much criticism of the book as lamentation at the paucity of information available on the subject. Now that both the United States and the Soviet Union possess nuclear weapons and vehicles to deliver them, our difficulty in getting a clear picture of Soviet air doctrine is both frustrating and dangerous.

The chief puzzle since the Second World War has been the contradiction between (1) the apotheosis of Stalin as the architect of a military "science" based on the tactics and strategy of the U.S.S.R. in her struggle with Germany and (2) the suspicion that no competent military leaders would confine their planning within the framework of such a theoretical hodgepodge while facing the task of utilizing a radically new weapon system in a completely changed strategic situation. But while Stalin lived, his doctrine was constantly reiterated, at least publicly. The new weapons of mass destruction were derided or ignored, and the analogy of the failure of the Nazi blitzkrieg was applied whenever the strategic bomber was mentioned. As late as January 1955 Lt. Gen. N. F. Grichin proclaimed that Western reliance on an atomic blitzkrieg was reminiscent of Goering's pre-World War II posturings and would fail just as dismally if tried on the Soviet Union.

Immediately after the war the Soviet propaganda machine went into high gear to glorify the all-wise leadership of the great Stalin. A curtain of obscurity descended upon such popular military leaders as Zhukov who might steal some of the glory. Soviet victories from Moscow and Stalingrad to the smashing of Berlin were attributed to Stalin's personal guidance. It was even hinted that the sorry showing of the Red forces in the Ukraine and in Byelorussia in 1941 was at least analogous to the glorious Russian tradition of 1812 and Kutusov. A mighty chorus, led by Voroshilov and Bulganin, praised Stalin as the greatest military thinker of the ages. Stalin, superbly using the tools of Marxian analysis, had developed the Stalinist "science of war," had established the "permanently operating factors," and had brought the counteroffensive to the point of a personal creation. In short, Soviet military doctrine—at least that given public expression—was synonymous with the Stalinist "science of war."

The Stalinist doctrine can be summarized quickly. Its simplicity, or rather triteness, is appalling. According to Bulganin, Voroshilov, Taranchuk, and others who sang its praises, its great advantage was its being "military science" as opposed to bourgeois "military art." This science enables one to appraise correctly the economic and moral capabilities of his own country and the enemy's. The Germans in World War II, so the Soviets argued, relied on military plans that were unsuited to their own economic and moral capabilities and that completely disregarded those of Russia. Having ascertained the over-all picture, Stalin formulated the "permanently operating factors" developed by him between 1918 and 1945: the stability of the rear, the morale of the army, the quantity and quality of divisions, the armament of the army, and the organizing ability of the command personnel. A sixth one is sometimes added—the importance of reserves. What is baffling is that these factors have no deep, hidden meaning; they mean just what they say and are hardly the sole possession of Soviet military thinkers. To complete this picture of the deification of the trite, the adulators praise Stalin's "invention" of the counteroffensive.

The dependence of the new "military science" upon Soviet experience in World War II is more vividly revealed by the list of so-called "temporary or fortuitous" factors that cannot bring victory in a war. These are usually listed as surprise attack, outstripping the opponent in speed of mobilization, experience in warfare, and transformation of the national economy to war production in peacetime. The Germans had the advantage in all these "temporary" factors in 1941, according to the Soviet theorists, and still they went down to defeat. Thus they are not vital factors in winning a war.

In this doctrine air forces are only one component part of the whole. One writer, A. G. Ordin, even goes back to the defense of Stalingrad to show how Stalin used air in his coordination of the various arms. According to his (until recently) official biography of Stalin, the Premier worked out in World War II "the interdependence of types of troops and combat techniques in conditions of modern warfare, the role of great masses of tanks and aviation in modern war. . . ." Russian aviation in World War II apparently was synonymous with close support of the ground forces. There existed an ADD (Long Range Aviation), but it was never used consistently or on the scale that the Western Allies used strategic air. The Soviet policy of playing down the role of the West in the defeat of Germany and Japan led them to belittle the effectiveness of the long-range bomber and to emphasize large masses of aircraft in close support of ground forces.

At the end of the war the power positions of the United States and the Soviet Union rested upon very dissimilar strategic concepts. The Soviet Union contributed to Germany's defeat by trading huge land areas until it could adequately organize and deploy a local superiority in manpower, artillery, and armor. As a logical sequence the Soviet Union at the end of the war seized the traditional "platforms of invasion" in the Baltic, Eastern Europe, and the Balkans, consolidated its position on the Pacific littoral and in Central Asia, and built up a huge ground force. On the other hand, the United States acted to acquire control of the seas and to use strategic air power. Also the United States emerged from the war with a monopoly in nuclear weapons. In short, the United States fought on a world-wide scale and developed the weapons and strategic concepts for such a war; the Soviet Union, for all intents and purposes, fought a local war using battering-ram tactics and did not develop the weapons and strategy that would enable her to reach the United States. It is not surprising that postwar Soviet spokesmen stressed Stalin's military science with its glorification of the infantry and artillery, and avoided mentioning the nuclear threat, or did so only in a derogatory manner.

But in spite of this obeisance to artillery as the god of war, with air power as only one of the handmaidens, there must have been agonizing reappraisals under way in the Kremlin. The Russians were sitting under SAC's bombsights, and they were not happy. By 1949, however, they had conducted a successful atomic test and were ready to challenge the United States' nuclear superiority. The Soviet hydrogen explosion of 1953 made the United States' advantage even more tenuous. Along with their atomic development program the Soviet Union undertook to build a strategic air force, based first on the TU-4 and later on high-performance bombers of Soviet design. The Bison, Badger, and Bear bombers, unveiled in 1954 and 1955, demonstrated the success of this effort. Certainly these facts speak more loudly than any written doctrine could: no nation would put so much of its national resources into developing nuclear weapons and long-range bombers if it were firmly wedded to an air doctrine solely concerned with close support of ground forces. It is this contrast between what is said and what is done that makes the writings on Soviet military doctrine seem so unrealistic.

At present the position of military planners in the Soviet Union is vastly different from that in the years immediately after the war. They now have, or are about to have, a sufficiency of nuclear weapons. The bomb detonated in December 1955 was a thermonuclear device in the megaton range. Furthermore, the day when the Soviet long-range air force depended upon its copies of the B-29 is now past. The Bison and Badger are respectable jet bombers, and the turboprop Bear has good legs. Defensively the Soviet military planner can now look more complacently at the United States' advanced bases that ring the U.S.S.R. Offensively he now has the ability to reach the only nation that can really challenge the Soviet Union.

Since the death of Stalin in March 1953 Soviet military thinkers have been able to look at World War II realistically. Already there are reports that the fiasco of the summer of 1941 is being recognized for what it was—a bad job of planning and strategy. As Leonard Beck shows in the accompanying article, surprise, the "transitory" factor so consistently played down in the Stalinist theory, is again being stressed by Soviet strategists. Not being obliged to defend the Stalinist strategy, military theorists can look more realistically at how nearly the German *surprise* came to defeating the U.S.S.R. in 1941.* By analogy they can point to how serious this threat can be again, substituting nuclear weapons and long-range aircraft for German panzers. In a speech honoring the tenth anniversary of VE-day, Marshal Zhukov vividly described how disastrous an attack with atomic weapons would be for the densely populated Western powers. That bombers can fly in two directions must be obvious to Zhukov, and the industrial areas of the U.S.S.R. are well populated.

Since Stalin's death the army has become a powerful force in the Soviet political balance. Zhukov came out of the wildernesses of Odessa and the Urals to become the Minister of Defense in February 1955. At the 20th Party Congress in February 1956 he was promoted to candidacy for the all-powerful Presidium (named first on the list of candidates out of the traditional alphabetical order). It seems certain that the military has had a hand in the recent downgrading of Stalin. The result for the military would seem to be a chance for more independent thought and a stronger voice in the councils of the Kremlin.

Mr. Beck's article reveals a relative increase in the number of statements on air power in the past two years. But even a careful sifting of these statements does not produce anything like a reasonable air doctrine for the weapon system now available to the Soviets. It would seem that either the Iron Curtain is extremely invulnerable or that Soviet theorists are just not setting to paper a clearly delineated air doctrine, assuming that they have one. Although one must agree with Beck and Garthoff on the value of in-

*"The Element of Surprise in Modern Warfare," by Colonel Jack D. Nicholas, to appear in a forthcoming issue, discusses current implications of "surprise" and its connotations with regard to the U.S.S.R. Concerning the 1941 debacle Colonel Nicholas shows that despite the intense German effort to mask their impending attack the evident intelligence should have been ample to alert the Soviet command, had facts and events known in Moscow been appropriately handled.

tensive research in Soviet unclassified materials, it also seems necessary to investigate other approaches. Three of these are obvious: careful examination of the problems of the Soviet Air Force in launching an offensive against the interior of the United States; evaluation of the means available now and in the future for this task; and careful consideration of the intellectual environment in which the Soviet military thinker operates.

The primary problem of the Soviet Air Force in the event of hostilities should make it globally minded. The geographical situation almost dictates the direction of attack on the United States—through the Arctic. That the Soviets realize this fact seems borne out by their intensive scientific efforts in the Polar regions, the opening up of new airfields in this area, and their dedication to making the northern sea route a "routine" transportation system.

The interplay of doctrine and new weapons is a tricky one, a "chicken and egg" proposition. Is it doctrine that dictates the development of new weapons in the Soviet Union? Or does the new weapon call for new doctrine? The history of warfare shows that new weapons are not always skillfully utilized. The inertia of tradition is an ever-present obstacle to their most effective employment. The supposition that certain weapons automatically imply a definite change or evolution in the military doctrine of the Soviet Union is not necessarily valid. But the opposite tack, to assume that doctrine is not changing with the new weapons, is far more dangerous.

Close analysis of literature on Soviet military thought, such as Garthoff's, enables one to theorize about the psychological biases of Soviet military strategists. Soviet thinkers, military or political, are victims of their intellectual setting. Some propaganda is bound to stain indelibly those who manufacture it, as well as those who are passive recipients. In searching for Soviet military doctrine it is necessary to put some credence in the written word, even if it is propaganda primarily. Long before Stalin put Soviet thought into a straitjacket, Frunze, Tukhachevsky, and others were applying Marxian precepts to military doctrine. Marxist-Leninist-Stalinist dogma is too all-embracing to allow any group as important as the military to evade it.

Even a casual look at Soviet thinking in the last 35 years shows that it is based on an image of the Soviet Union surrounded by a world desirous of its destruction. The inevitable assumption is not whether there will be a conflict, but merely when and in what form. The Russian Communist seeks to take the initiative (Garthoff refers to it as the mania for the "offensive"), so that he can control the situation. But this does not imply a series of rash or impetuous steps. On the contrary, both a "plan" and superiority of forces are mandatory before the attack can begin. Soviet strategy and tactics in World War II and in the postwar expansion followed this tack. This dependence upon both a carefully developed plan and possession of overwhelming superiority of forces before attacking could partly explain the Soviet peace offensive in recent years: they may have the plan but are still building up the forces.

Trying to describe Soviet air doctrine accurately is no easy task. It involves assiduous research into Soviet publications and the use of oblique methods along the lines suggested above. It is possible that the Soviets have no clearly thought-out doctrine, but this does not mean that they are not operating along ascertainable lines. It took Mahan to formalize for the British their long-standing doctrine of sea power, although the British had been quite successful without having it in print. In the present situation, however, no task could be more important than deriving some kind of reasonable picture of Soviet air doctrine.

Research Studies Institute, Air University

An Air Perspective in the Jetomic Age

continued from page 17

So far this historical review has touched on most of the major nations involved in the early development of modern air power. From here on the broadening scope of its progress dictates that we focus primarily on the interests of the United States.

As soon as the War of 1914 ended, the United States again buried its head in its traditional sands of isolationism and avoidance of war. It had yet to learn that technology was rapidly shrinking the globe and fast making its inhabitants close neighbors, though not yet teaching them to live as good neighbors. The military strategy of the United States once more assumed the defensive and was aimed essentially at enforcing the century-old Monroe Doctrine.

The aircraft industry developed in World War I barely survived. In the immediate postwar years there was no military and practically no commercial demand for airplanes. War-surplus planes met the small demand for several years after the war. The industry barely existed on the meager diet, producing an average of 531 military and commercial airplanes a year for the first seven years after the war and 710 military and 2600 civilian planes during the five years from 1924 to 1929. Then came the depression. From 1929 to 1933 aircraft production declined more than seventy-five per cent. Aircraft company stock, representing a capital investment of over a billion dollars, dropped in value to a mere fifty million dollars.

That the aircraft industry survived at all was due largely to the market provided by the slowly growing commercial use of the airplane and the modest requirements of the military services during the later years of this period. Transcontinental, polar, and round-the-world flights by pioneering military aviators stirred public interest. Charles Lindbergh's thirty-three-hour flight from New York to Paris in 1927 provided the final spark that ignited public interest in air travel.

By 1930 aircraft manufacturers who were still in business were producing larger and better transports. Soon transcontinental commercial service was available, as were regular flights between North and South America. Five years later regular passenger service was established to the Orient. In the same year the Douglas DC-2 became standard equipment on many American airlines. The growing though modest demands of both commercial and military aviation led to improved magnetos, oil and water pumps, spark plugs, generators, radios, tires, and other ancillary equipment and accessories and to the development of higher-octane fuel.

The 1930's also witnessed important developments in aircraft design. These included the adoption of the monoplane design and the growing use of all-metal construction and retractable landing gear. The result was a marked decrease in vulnerability and an increase in mobility. By the outbreak of World War II, bombers could operate at a top speed of over 200 miles per hour and had a combat radius of 900 miles. They had effective operational ceilings of 24,000 feet and bomb-load capacity of 6000 pounds. Their capability represented two and one-half times the speed, nine times the combat radius, and twelve times the bomb-load capacity of the 1918 bomber.

Similarly fighter aircraft had a speed of over three hundred miles per hour, a range of two hundred to three hundred miles, and an effective ceiling of over twenty thousand feet, more than twice the speed and more than three times the ceiling and range of the 1918 fighter. Air weapons had also improved. In place of the poorly designed 500-pound bomb of World War I 2000-pound bombs with good ballistic properties were now available. These accomplishments lead one to wonder what greater achievements technology might have made during this period had it been properly encouraged.

The retarding effect of the prevailing political climate has already been noted. What influence did prevailing military doctrine exert? We all recognize the mutual interdependence of doctrinal, technological, political, and other elements. Any attempt to assess one as the controlling factor soon dooms one to "chicken-first-or-egg-first" metaphysics. Although this study devotes relatively more time to the doctrinal element, no suggestion is meant that it was the controlling factor in setting the rate of development of air power.

Air power was a highly controversial subject during the interwar years. Surface commanders continued to support the Clausewitzian view that "the ultimate objective of all military operations is the destruction of the enemy's armed forces by battle." Air leaders were firmly convinced that strategic aviation would be decisive in a future war.

The official United States military doctrine in 1923 was that "no one arm wins battles," but the "coordinating principle which underlies the employment of the combined arms is that the missions of the other arms are derived from their powers to contribute to the execution of the infantry mission." Even the manuals of the air arm, then part of the Army and subject to the control of a General Staff that exercised approval authority over the formulation of combat doctrine, stated in 1926 that the organization and training of air units should be "based on the fundamental doctrine that their mission is to aid the ground forces to gain decisive success."

All this has a rather familiar ring by now. Like his predecessors of the Balloon Age and of 1918, the surface commander appraised the existing air weapon—or the air weapon as he last knew it—and decided that the task immediately ahead would still have to be accomplished by tried and trusted means and methods.

But increasing numbers of airmen, with their eyes fixed on the fast-rising curve of air power's potential capability, thought and said otherwise. Their cardinal principles, born of the advanced views of Trenchard and Mitchell, were that the airplane was essentially an offensive weapon and that the first mission of aviation was to gain mastery of the air through offensive action. In 1925 the role of military aviation as that of serving the needs of the Army had been reaffirmed by the President's Board. But in that year General Mitchell, the same General Mitchell who was largely responsible for the greatest demonstration of massed air power in World War I when fifteen hundred Allied planes took to the air in the St. Mihiel offensive, now presented his argument for air attacks against an enemy's national resources rather than his armed forces. Later he reflected the views of many of his fellow airmen when he argued that "war is the attempt of one nation to impress its will on another nation by force after all other means . . . have failed. The attempt of one combatant, therefore, is so to control the vital centers of the other that it will be powerless to defend itself." Again, "the advent of air power which can go to the vital centers and entirely neutralize or destroy them has put a completely new complexion on the old system of war. It is now realized that the hostile main army in the field is a false objective and the real objectives are the vital centers. The old theory that victory meant the destruction of the hostile main army is untenable. Armies themselves can be disregarded by air power if a rapid strike is made against the opposing centers."

I do not suggest that all airmen subscribed to these views unreservedly. Some airmen willingly accepted the War Department limitation on the role of the air striking force to activities that were essentially of a defensive nature. As World War II began most air officers, those who had watched the air power growth-curve climb from its first feeble flutterings, at long last had good reason to believe the day close at hand when, in words to be spoken by Winston Churchill several years later, "For good or ill air mastery [would become] the supreme expression of military power."

Part II: Air Power in World War II and Its Implications for the Jetomic Age

ALTHOUGH the Germans had very efficient long-range aircraft in the years preceding World War II, the prevailing military concept of the high command caused the orientation of available air strength primarily to the objective of supporting the *Wehrmacht* and advancing a battle line over the surface of the earth. This was essentially the tested strategy of World War I. Accordingly, little support was given either to development or to production of long-range bombers with the result that German aircraft of the time, while adequate in terms of firepower and vulnerability, were grossly deficient in mobility, specifically in range. As a result the Germans were outranged as well as outnumbered by the Allies and increasingly were forced to react to Allied air initiative, that is, to assume a defensive posture. Since wars cannot be won from a defensive posture, the end followed inexorably.

The Allies also entered World War II with an essentially World War I strategic concept. However the early months of the war made it crystal clear to the European and British Allies that a new and potent factor, air power, was forcing its way onto the strategic scene. The position of land and sea forces as strategic forces in their respective media had previously been unchallenged. Ground weapon systems had not encroached on the strategic capacity of sea weapon systems and vice versa. But air power had developed to the point where it could and did encroach on the strategic

Limitations on Air Power in World War II and Korea

Germany: **Air operations were geared to a strategy of invasion and occupation by surface forces.**

Consequences: **• priority awarded air forces did not permit air attacks in sufficient mass and firepower until 1944**

• air strategy was disrupted by frequent diversions of air power to unremunerative targets in support of surface action

• the invasion of France followed too closely on the heavy air attacks to take advantage of their effects

• invasion deprived the air forces of the chance to compel a German surrender by air action.

Japan: **Air operations were geared to the dual surface strategies of naval blockade and ground invasion and occupation.**

Consequences: **• acquisition of air bases for concerted air attacks on Japan was subordinated to air support of land and sea campaigns**

• air strategy was possible only for B-29 forces

• priority of air forces did not permit air attacks on Japan in mass until 1944

• invasion of Japan remained basic strategy and was displaced only by Japanese surrender under air attack.

Korea: **Air operations were geared to surface strategy for defeat of Communist army and land occupation of North Korea.**

Consequences: **• air forces operated under ground restrictions, against targets and with weapons dictated by ground strategy**

• for last two years of the war, air forces furnished the only offensive pressure against the enemy to gain truce terms acceptable only to a future ground strategy.

capacity of land and sea forces. Now neither could claim supremacy in its own medium unless it was first guaranteed command of the air over its field of battle.

It was becoming obvious to those who watched the air power progress-curve that he who had command of the air probably could invade when and where he chose. Early in 1941 the British Chiefs of Staff, living within range of the *Luftwaffe,* concluded that "we do not foresee vast armies of infantry as in 1914-18. . . . There would be no advance from line to line in the old style." They envisaged final surface action by a limited number of highly mobile armored forces whose primary function would be to apply a *coup de grâce* after the war had literally been won by the air offensive. They formally declared:

> It is in bombing on a scale undreamt of in the last war that we find the new weapon on which we must principally depend for the destruction of German economic life and morale . . . for only the heavy bomber can produce the conditions under which other offensive forces can be employed.

United States airmen shared this view. The first air war plan, drawn about this same time, that is, mid-1941, visualized a similar bomber offensive aimed at achieving a like objective.

The next four years produced ample evidence of the validity of these views. For example, in a letter dated 30 June 1944, Albert Speer, Reich Minister of Armament, reported to Hitler:

> Our aviation gasoline production was badly hit during May and June. The enemy has succeeded in increasing our losses of aviation gasoline up to ninety per cent by June 22. Only through speedy recovery of damaged plants, has it been possible to regain partly some of the terrible losses. In spite of this, however, aviation gasoline production is completely insufficient at this time.

Within another five months the fuel shortage had reached catastrophic proportions. On 15 March 1945, Speer informed Hitler: "The German economy is headed for inevitable collapse within four to eight weeks." At war's end General Eisenhower was able to report: "The overwhelming Allied superiority in the air was indeed essential to our victory. It at once undermined the basis of the enemy's strength and enabled us to prepare and execute our ground operations in complete security."

Nevertheless, a review of World War II strategic decisions makes it clear that our military strategy rejected the views which the British Joint Chiefs of Staff had presented so clearly in 1941 and relied essentially on the classic conservative concept of two-dimensional warfare. General Marshall clearly expressed the dominance of ground strategy in the strategic concept: "Not unmindful that the invasion across the English Channel against an entrenched German army was an operation unequalled in possibility for a major disaster, the Allied commanders decided to undertake the great strategic bombardment that was to weaken Germany militarily, industrially, and economically. . . ." To his mind the classic surface strategy was firmly established at Casablanca:

> . . . the American and British Air Force commanders were directed to launch and increase steadily the intensity of an assault that would continue day by day, around the clock, to reduce the enemy's capacity to resist when our armies would come to grips with the German Army on the continent.

The United States Strategic Bombing Survey, an independent group established by the Secretary of War under a directive from President Roosevelt, added its testimony on the nature of our World War II military strategy in the Atlantic area:

> In both the Royal Air Force and the United States Army Air Forces there were some who believed that air power could deliver the knockout blow against Germany, and force capitulation. This view, however, was not controlling in the over-all Allied strategic plan. The dominant element in that plan was invasion of the Continent to occur in the spring of 1944. Plans called for establishing air superiority prior to the date of the invasion and the exploitation of such superiority in weakening the enemy's will to resist. . . . The deployment of the air forces opposing Germany was heavily influenced by the fact that victory was planned to come through invasion and land occupation.

This evidence and a wealth of additional data lead to certain conclusions: First, our World War II military strategy was a strategy of invasion and occupation by the surface weapon systems. The air weapon system was assigned a supporting role to facilitate the implementation of this conventional surface strategy.

Second, the air attacks prior to 1944 lacked mass and sufficient concentration of firepower in time and space to be decisive. Before and during World War II, conventional military thinking largely predetermined these first two conclusions. This thinking was typified by the American reply to the British proposal in mid-1941 that we employ an air strategy for fighting and winning the war against Germany: "Naval and air power may prevent wars from being lost and, by weakening enemy strength, make great contribution to victory. . . . It should be recognized as an almost invariable rule that wars cannot be finally won without the use of land armies."

As a result of this kind of thinking, we, like the Germans in their use of Zeppelins in the early days of the first World War, found ourselves malemploying the limited numbers of aircraft we did have in the early years of the war. We piecemealed our efforts and sent "boys" to do "men's" work. General Arnold ruefully noted: "The interservice and intertheater war for priority [for aircraft] continued as steadily as any effort against the foreign enemy, with no holds barred." The Lord Tedder was prompted to remark: "Many were the authorities who found 'essential' jobs for the bomber force to carry out. It is perhaps not the first time that the Cinderella has come to be the maid of all work. Nearly everyone has vital jobs for the bombers." The clear fact remains, however, that even a limited TNT-Age air campaign had by mid-1944 fatally weakened Germany's capacity to conduct effective military operations.

A third conclusion is that although the invasion of France and the subsequent campaign in Europe were conducted in complete security from air attack, maximum military benefits did not accrue to the invading forces because the invasion came so soon after the heavy air offensive. The impact of the German economic collapse had not yet been felt by the German people or the German forces. Our invasion forces therefore felt only a small portion of the effects of our strategic bombing.

The final conclusion is that, launched when it was, the surface "Crusade in Europe"—a crusade aimed at compelling unconditional surrender—took from the air weapon system any opportunity to achieve German capitulation as a result of air action alone. What might have been the nature of that invasion experience, if the air weapon system had been given an early overriding priority in production and manpower and if the invasion had been timed to follow the full exploitation of that system, is suggested by the findings of the United States Strategic Bombing Survey:

> The German experience suggests that even a first-class military power—rugged and resilient as Germany was—cannot live long under full-scale and free exploitation of air weapons over the heart of its territory. By the beginning of 1945, before the invasion of the homeland itself, Germany was reaching a state of helplessness. Her armament production was falling irretrievably, orderliness in effort was disappearing, and total disruption and disintegration were well along. Her armies were still in the field. But with the impending collapse of the supporting economy, the indications were convincing that they would have to cease fighting—any effective fighting—within a few months. Germany was mortally wounded.

Strategic Factors in World War II and Today*

In comparing significant differences between the strategic environment of World War II and that of today we should examine changes in characteristics of the air weapon system, in phasing of war actions, and in geographic and economic considerations.

Our development of bombers by the end of World War II had finally made them capable of carrying 20,000 pounds of bombs to targets 1600 miles away, at speeds of 350 miles an hour, and at altitudes of over 35,000 feet. Today one modern bomber can carry a million times the punch of all B-17's that bombed Berlin in World War II.** As for range, a refueled B-47 bomber recently set an endurance record for jet aircraft of 35 hours in the air, 17,000 miles nonstop at jet speed.

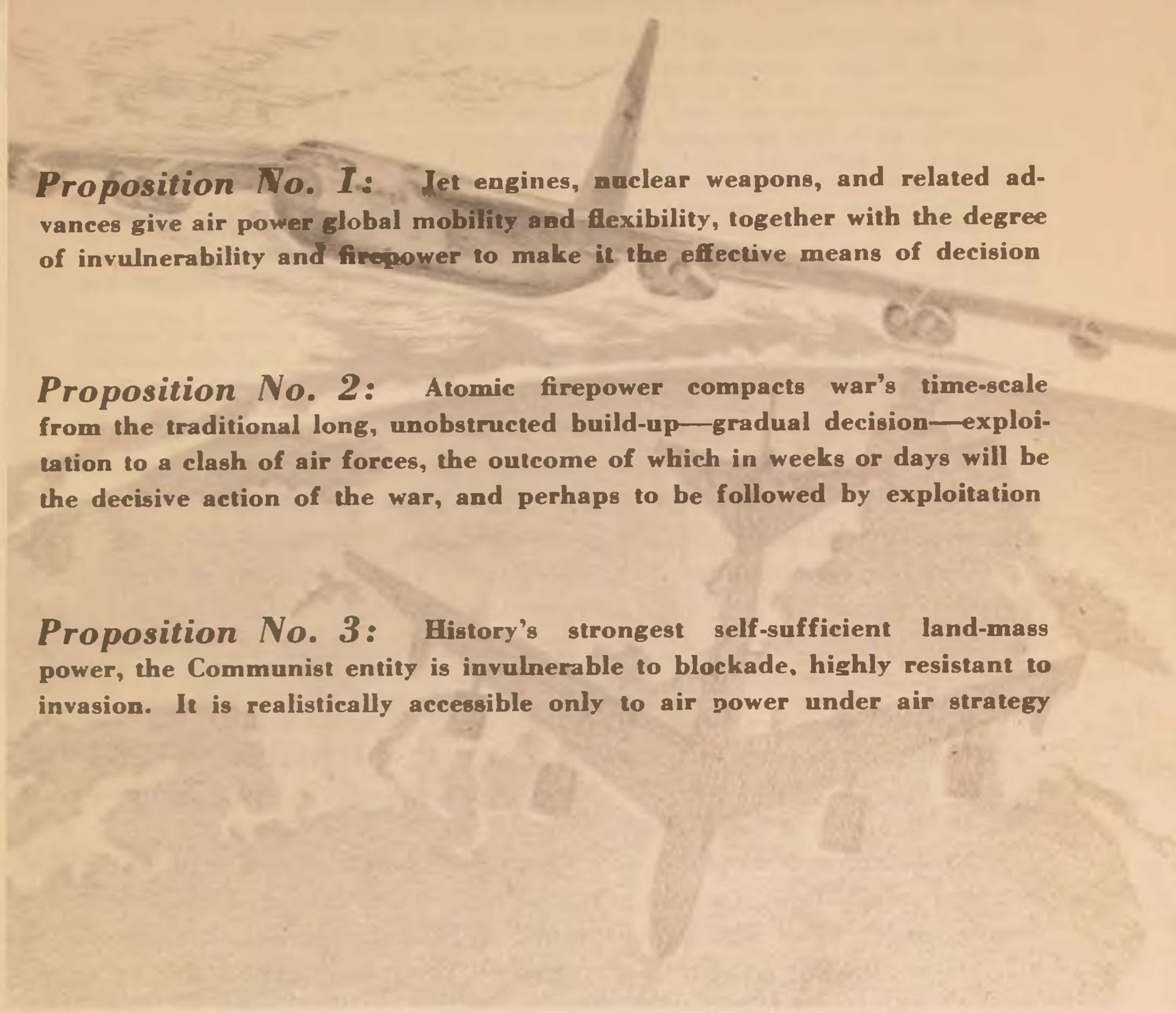
By the end of World War II, fighter aircraft had speeds reaching 500 miles per hour, effective ceilings of 35,000 feet, and combat ranges of 1300 miles. But today's fighter travels at supersonic speed, has an effective ceiling of well over 50,000 feet, and, using refueling or other techniques, enjoys practically unlimited range.

There have been similar changes in military air transport capabilities. One thousand aircraft were required to provide supplies during the Battle of the Bulge in World War II. The same tonnage was delivered by 68 planes in the Korean War. Please note that the average distance was longer for Korea than it was in the Bulge operation. Today one flight of 25 modern troop-carrying military aircraft could airlift 5000 men from the United States to the coast of France, return to the United States, and deliver 5000

*In this section and the following one on air doctrine I do not intend to introduce the question of the probability or inevitability of a total war. I accept the assumption that we are determined to achieve our objectives short of war but that we must be sure that we can win a general war if it is forced upon us. It is not necessary to belabor the proposition that the United States and its allies abhor war as a chosen instrument of national policy, regard war as the court of last resort after all other instruments of policy have been fully exploited and have failed to avert the threat to our security.

**[This figure is startling because it estimates the total *destructive* force of the nuclear weapon rather than the usual translation of only the *explosive* force of the bomb into an equal explosion of TNT.—*Ed.*]

Strategic Factors Today



Proposition No. 1: **Jet engines, nuclear weapons, and related advances give air power global mobility and flexibility, together with the degree of invulnerability and firepower to make it the effective means of decision**

Proposition No. 2: **Atomic firepower compacts war's time-scale from the traditional long, unobstructed build-up—gradual decision—exploitation to a clash of air forces, the outcome of which in weeks or days will be the decisive action of the war, and perhaps to be followed by exploitation**

Proposition No. 3: **History's strongest self-sufficient land-mass power, the Communist entity is invulnerable to blockade, highly resistant to invasion. It is realistically accessible only to air power under air strategy**

more in France, before the average seagoing transport capable of carrying 5000 troops could complete a single one-way trip.

Based on available evidence and my personal dealings with the Russians during World War II, I can attest that the Soviets have paid very close attention to the curves of improvement in air vehicles and weapons and to the lessons taught by war. I have great personal apprehension that we may mistakenly feel that the Soviets are deeper in the rut of precedent and military conservatism than we. I am no expert on Russia. My experience consists of only five days' personal contact and observation of Stalin, Antanov, and Khudyvakov (then Deputy Chief of the Red Air Force) at Yalta in 1945. But at that time it was clear to me that in five years of war the Russian air view had registered on the Russian government and the Russian General Staff at least as effectively as American and British airmen had been able to register on their governments and military authorities in twenty-five years. Documentary proof now shows that Comrade Stalin was not at all inhibited by established military theory. On 30 January 1946 Professor Colonel Razin of the Voroshilov Supreme Military Academy asked Stalin, "What should be our attitude with regard to the military and theoretical heritage of Clausewitz?" Let me quote two paragraphs of Stalin's reply.

> Should we criticize the very basis of Clausewitz' military theory? Yes, we should. From the point of view of the interests of our cause and the military theory of our time, we must subject to criticism not only Clausewitz, but also Moltke, Schlieffen, Ludendorff, Keitel, and other representatives of the German military ideology. In the course of the last thirty years Germany has twice forced the bloodiest kind of wars upon the world, and both times she was defeated. Is this a coincidence? Of course not. Does this mean that, not only Germany as a whole, but also its military ideology, has failed to stand the test? There is no doubt of it. Everybody knows with what respect the military men of the whole world, including our own Russian commanders, used to look up to the military authorities of Germany. Is it necessary to put an end to this undeserved respect? It is necessary. Well, for this we need criticism, and especially from our own side—from the conquerors of Germany.
>
> As regards Clausewitz in particular, he of course has grown obsolete as a military authority. Clausewitz, strictly speaking, was a representative of the hand-manufacturing phase of warfare. Now, however, we live in the machine phase of warfare. It is more than clear that the machine phase requires new military ideologists. It would be ridiculous to take lessons from Clausewitz today.

The Russians are not unmindful that air power is highly dynamic. We too must learn this primary lesson of air history if we are to appreciate the revolutionary impact of air power on modern warfare.

The phasing of military actions in World War II followed the traditional pattern. There was a clearly distinguishable build-up phase, a decisive phase, and an exploitation phase. The United States enjoyed an especially long build-up phase.

Aircraft production did not reach its peak until six months prior to Normandy, despite the fact that, as in the case of World War I, British and French aircraft orders provided the aircraft industry with a badly needed shot in the arm prior to Pearl Harbor.

No longer can we plan on the luxury of a significant and unobstructed build-up phase before we enter the decisive phase of war. The destructive power and reach of modern weapons, coupled with the extreme difficulty of effectively denying a properly executed air campaign, argue that any future D-day could be in fact the Decisive Day of the decisive phase of war. This means, of course, that the ultimate outcome of a future war may well be predetermined by the decisive characteristics, quantitative and qualitative, that we build into our military weapon system prior to D-day.

World War II evidence cited earlier proves that the decisive phase of the air war (and therefore the whole European war) was over by June 1944. For by that time the German Air Force had been decisively defeated. It was only after the air war was won that we dared risk the invasion of continental Europe in what in effect was the exploitation phase—albeit a rough one, for the reasons already suggested.

We need also to keep clearly in mind these additional advantages that we enjoyed when our ground forces stormed Fortress Europe:

(1) With the Battle of the Atlantic won, our logistic pipeline was secure and logistic support for the surface weapon system was assured. Our mastery of the air placed the enemy's logistic pipeline at our mercy.

(2) The enemy's surface weapon system opposing our invading forces not only had been weakened seriously by our air attacks and by five years of fighting on two fronts, but the economic base that supported his military

weapon system also had been critically undermined. By contrast our own forces were then built up to peak strength, as was our supporting base which throughout the war had enjoyed practically complete freedom from enemy action. The question arises: Can we assume other than that these advantages would be denied to us on a future D-day?

The difference in the geographic position of our World War II enemy and our enemy now is accented by comparing the position of Japan during the last war with that of the U.S.S.R. today. Because of Japan's geographic position and her dependence on external sources of raw materials, the Allies did not need to implement a strategy of invasion. Invasion of the homeland by the Allied armies was by invitation from defeated Japan, after air forces, in conjunction with surface forces, had won control of the air over the Japanese homeland.

By no stretch of the imagination can the Communist bloc be considered an island. The Soviet Union is not only a land-mass power, it is *the* land-mass power. It is substantially self-sufficient both in foodstuffs and industrial raw materials. Except for industrial diamonds the raw materials in which it is seriously deficient, tin and rubber, are found in abundance in Southeast Asia. Consequently the Soviets can operate mainly on interior lines of communication. They are not dependent upon sea lines of communication for survival. While a blockade strategy could be decisive against Japan, the same strategy of blockade and strangulation could not conceivably have any such effect on them.

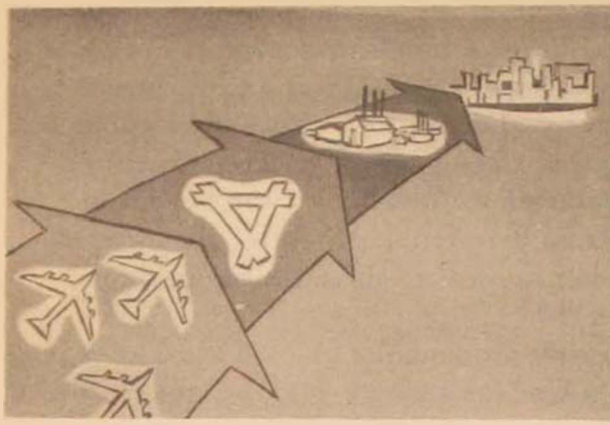
The projection of surface weapon systems against the Soviet Union would require a logistic pipeline that by its length, across both water and land, would constitute a built-in strategic vulnerability. It is well to remember that the location of the fountainheads of Soviet political and industrial power, coupled with the traditional Russian strategy of trading space for time, would necessitate deep penetration in the decisive phase of any air or surface war. Whether or not we accept the assumption that the decisive phase would be fought during the very early stage of the war, it is obvious that only air power is capable of bringing under attack the entire spectrum of the Soviet's warmaking capability.

This is not to say that surface weapon systems are no longer needed. It is to say that the present-day capabilities of land, sea, and air weapon systems must be placed in proper perspective and given the necessary priorities so that the core of our strategy is selected with a complete regard for modern technological developments and for our economic capacity to maintain forces-in-being.

Basic Air Doctrine for a Jetomic Age

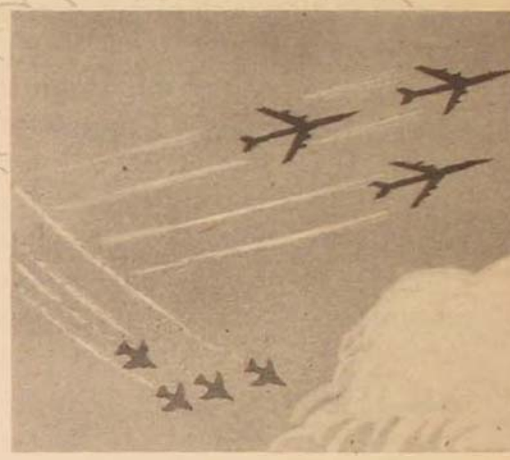
With the previous history as background we may now consider basic air doctrine valid in the present strategic environment. Unfortunately, current arguments continuously prove the persistence of radically differing views on almost all aspects of air power.

Basic Factors in Air Doctrine Today



Totality of Striking Power

Modern air weapon systems can be applied directly and decisively against an opponent's air power, his industrial and governmental control structures, and his deployed surface forces



Primacy of Control of the Air

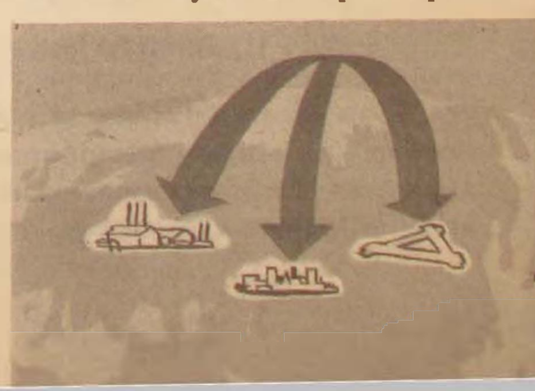
The first and most essential air objective must be control of the air

Unity of Air Strategy and Command

Decisive employment of air forces requires centralized air command for commitment to priority objectives

Mobility, Versatility of Air Commitment

The ability of air forces to concentrate effective striking power at the decisive time and place allows them to undertake a wide variety of tasks simultaneously or in rapid sequence



Less than a year ago a discussion in the British House of Lords reflected the soundness of the French proverb that "*plus ça change, plus c'est la même chose.*" During an exchange of views Viscount Trenchard is reported by the *Times* of 23 October 1953 as pleading that "people should realize what the air age meant." According to the *Times* he said:

> If we went into war as unprepared as we did in 1939-45, and if the enemy were ready to hit us and we were not ready to hit him in his own country, the second battle of Britain would be fought with the atom bomb [over our heads] and all that that meant. The offense would always get through. That is more true today, with machines going faster than the speed of sound, and it will be much worse in the guided missile age. The offense will widen the gap in relation to defense.

The Lord Tedder joined Viscount Trenchard in arguing that "air power was the dominant factor in victory in the last war." He argued that at the outset of another war "we must be strong enough to hit [the enemy] and go on hitting with long-range bomber forces with the best and biggest weapons that science could produce until he could do nothing but try to cover up!" He then pointed to the contention held by some that the advent of the atomic weapon did not affect the basic principles of war. In his view that was a good staff college principle, but he had a shrewd suspicion that the new weapons did threaten the existence of Great Britain as a nation.

In that exchange of views the Minister of Defence, Earl Alexander of Tunis, argued that although the next war would be considerably different than the last, depending upon when it might come, the government could not afford to ignore the obvious, vital, short-term requirements. The *Times* reports he added that if war came in the immediate future, he did not think it would be very different in form from the last war, except that the atomic bomb would be used on the battlefield.

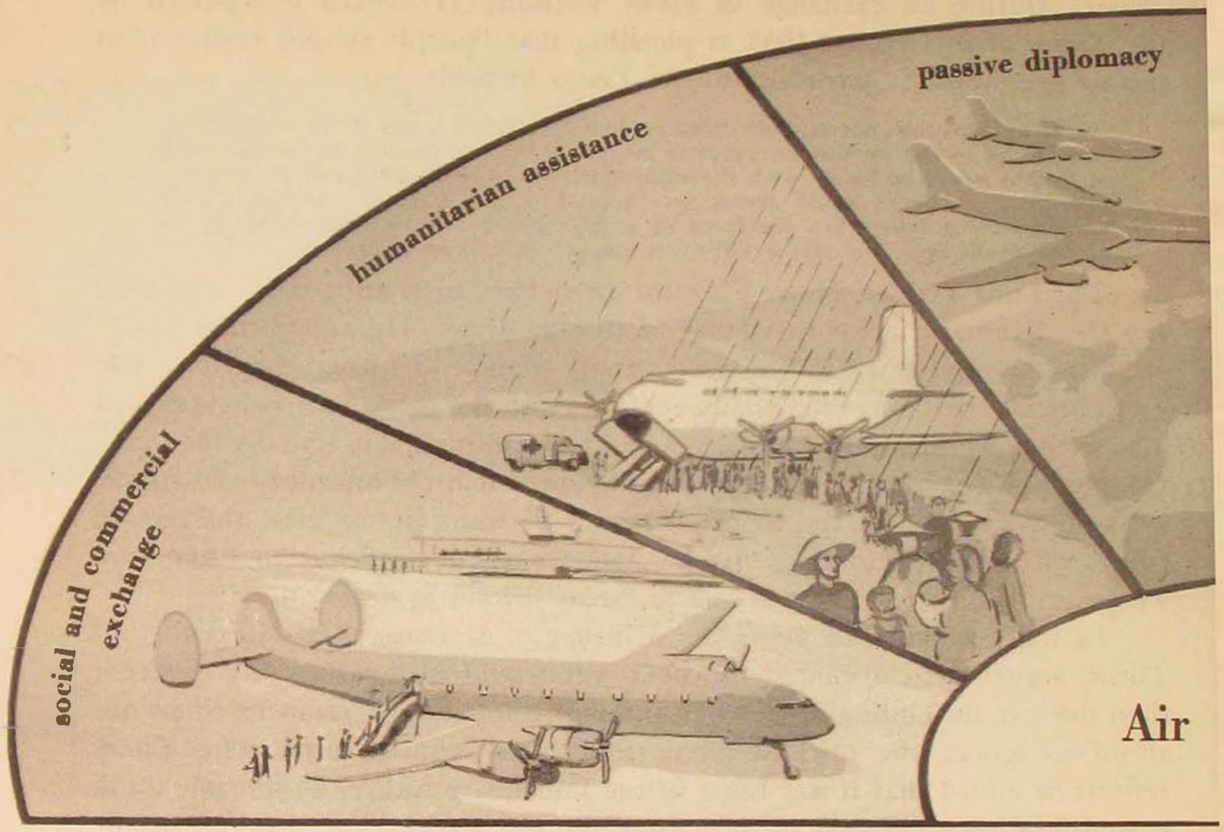
At this point The Lord Tedder must have been tempted to repeat a passage from his book:

> . . . as modern weapons develop, the potentiality of the initial blow tends to grow and grow. More than ever is it necessary to make sure that the lessons of the latest war have been clearly disentangled with judicial objectiveness from the welter of sentimentality, glamour and blind traditions, professional bias and personal prejudices, and sometimes deliberate misrepresentation, which so often cloaks the real truth concerning military operations.

Today, as in the past, able men have radically different views on air power. Bitter and bloody experience in two great wars proves that intelligent men can be grossly mistaken about air power even after the grim realities of the battlefield. Heretofore war allowed time in which to learn, time in which to correct unsound doctrine. There was then time to apply valid doctrine, time to win subsequent battles, and finally time to win that war. In this Jetomic Age there is no bank of time to draw on. There will be no time in future war in which to experiment and learn, no cushion of time after D-day in which to correct false doctrine. In the Jetomic Age there is no tolerance for gross mistakes about air power. We must be right—and right the first time.

But, one may ask, "How can we be sure of being right about air power—right the first time?" Valid air doctrine, understood, accepted, and followed, is one very important means of improving the chances that we will be right

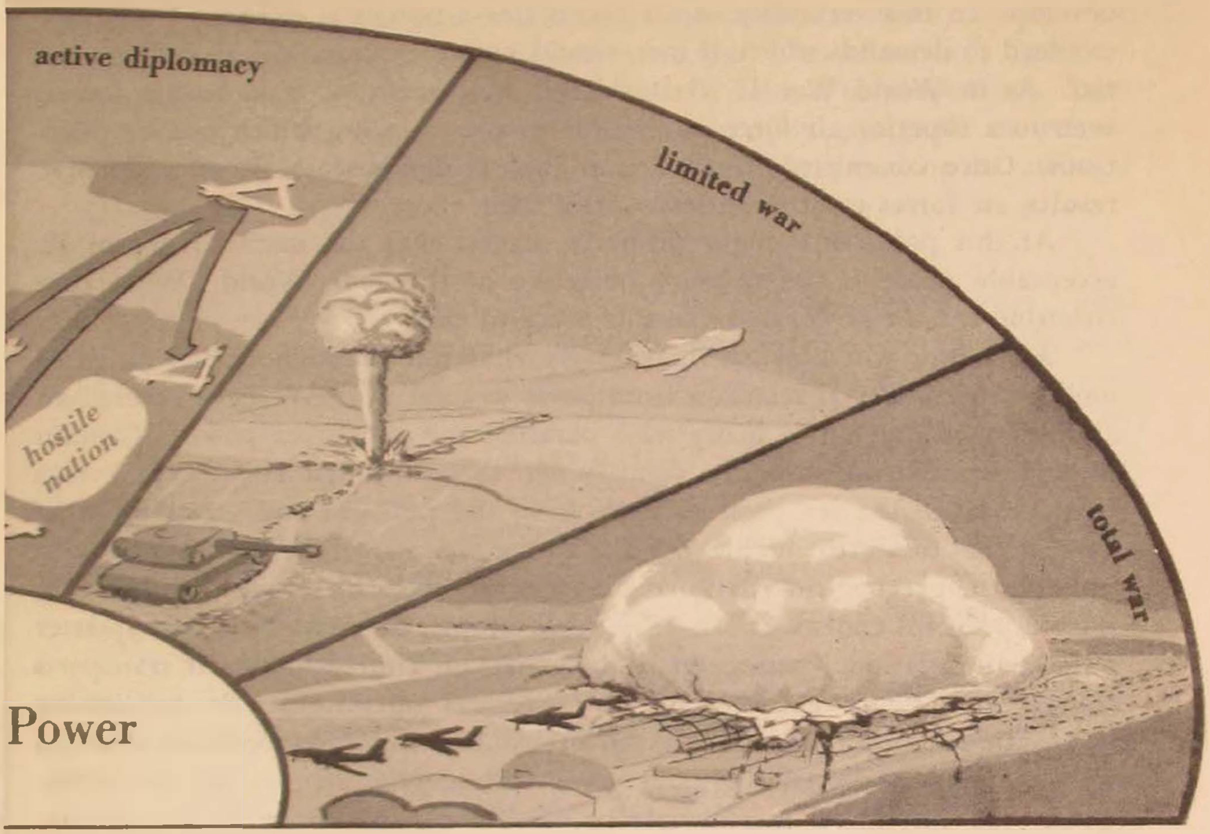
Air Power in the Spectrum



the first time. The essence of such an air doctrine consists of the following fundamentals:

- We must understand and accept the fact that modern air weapon systems can be applied directly against an opponent's air power, his industrial and governmental control structures, and his deployed surface forces. Modern air weapon systems properly employed can critically reduce an opponent's capacity and will to fight, as it both neutralizes his air power and cripples the supporting aspect of the power that feeds his peripherally deployed forces.
- We must clearly understand that the conclusive effects obtainable by air attacks on enemy heartland targets, especially those air power elements which represent the greatest immediate threat, require the priority commitment of air forces to this task.
- It cannot be emphasized too strongly that the main objective of air forces must be to achieve command of the air. Bombing other than that aimed at achieving command of the air is actually incidental to this main objective, or represents exploitation of the command of the air. Without command of the air, surface forces are incapable of offensive action. With it they can exploit boldly and sweepingly.

# of International Relations



• We must understand that neither while the decision in the air war is being sought nor after it is won can we hope to enjoy absolute control of the air. With the advent of jet aircraft carrying atomic and thermonuclear weapons, conditions may never again exist wherein surface forces can mass and maneuver with the necessary immunity from devastating air attack that has been provided in previous combat. It should be repeated that air forces must, as the primary consideration, neutralize opposing air forces. Otherwise they can neither assist the homeland air defense force in providing security from air attack nor can they fully exploit their striking power to assist friendly surface forces. This does not mean that surface forces will be stripped of all air support during the decisive phase of the air war. It does mean that the air forces committed to peripheral actions for the purpose of neutralizing the deployed enemy forces also will have the priority task of gaining and maintaining such control of the air as is possible in the Jetomic Age.

• Finally, we must clearly understand that the ability of air forces to concentrate effective striking power at the decisive time and place allows them to undertake a wide variety of tasks simultaneously or in rapid sequence. Unity of effort in the employment of air forces can result in the delivery of a decisive blow upon any chosen point of attack and makes it possible for air forces to take maximum advantage of enemy weaknesses as they develop. In this versatility of air forces lies a potential danger. Versatility can lead to demands which, if met, would vitiate exploitation of their potential. As in World War II ill-considered assignment of tasks to air forces, even to a superior air force, can result in piecemealing which can be disastrous. Once committed to air action that is designed to produce decisive results, air forces must relentlessly press their effort.

At this point one might properly suggest that the maintenance of an acceptable peace is the primary objective of the Free World. What contribution can air power make to this peaceful end?

Air power will play an increasingly vital role throughout the range of modern international relations from peace to total war. We have entered an air power era, which in many ways parallels the era of sea power. Captain Mahan pointed out almost a century ago that "the first and most obvious light in which the sea presents itself from the political and social point of view, is that of a great highway." Today the airways, which know no bounds, provide the greatest international highway on which men may travel as they pursue peaceful endeavors. In 1954, for example, over two and three-quarter million international passengers were carried on United States air transports alone. This figure excludes military overseas operations. By facilitating international social and commercial intercourse, air power becomes a means for achieving understanding and good will among peoples of the world. Thus used, air power increasingly becomes a dynamic force in the interest of peace.

We are also familiar with many examples of the use of air power, military and commercial, both for humanitarian purposes and as an instrument of diplomacy. Air power increasingly is being called upon to meet the challenge of disease and hunger around the world. We can recall the Berlin airlift that so dramatically held the central portion of the international stage in mid-1948. This was one of the greatest air transport operations the world had then seen and "for the first time in history, air transport [became] a conspicuous expression of [Free World] air power, and an effective weapon of diplomacy." As a result the Soviets lost the first battle of the cold war. Today there stands at Tempelhof airport a monument to those who gave their lives that West Berlin might live.

Moving along the range, we can point to the firm conviction expressed in 1949 by Winston Churchill: "It is certain that Europe would have been communized like Czechoslovakia, and London under bombardment some time ago, but for the deterrent of the atomic bomb in the hands of the United States."

Here the question might well be injected: "This is all to the good, but what can Free World air power do to maintain the peace in the face of the unacceptable threat posed by the ever-growing Soviet air power capability?"

The British used air power 30 years ago to impose effective control over disturbers of the peace in the Middle East, in Africa, and on India's northwest frontier. Such use of air power by Great Britain was on a limited scale and against primitive tribes. Nevertheless the evidence accumulated by the British that air power in the hands of a peace-keeping authority can effectively deny aggression and command submission to higher authority merits our serious attention and study. This evidence has been described by many military and civilian writers and can be directly related to proposals to form an international Air Police Force. It merits our study as a guide to the use of Free World air power in meeting the growing threat posed by the growing Soviet air power capability.

Finally, we must always be reminded that for ages past military men have tended to remain wedded to familiar weapon systems and traditional strategic concepts. But the Jetomic Age demands that we now recognize rapidly changing strategic environments and guarantee that the nature of our military strategy harmonizes with the facts of modern life. We of the Free World must not forget that:

(1) The British introduced the tank in World War I—but the Germans exploited it as they drove the Allies to Dunkirk in World War II.

(2) The Free World gave birth to the airplane—but we suffered air power inferiority at the time we entered both World Wars.

The record yet to be written must not read: "The Free World developed jet aircraft and nuclear weapons—which the Soviets successfully exploited in their conquest of the world."

In the final analysis it may turn out that the "Secret Weapon," the "Decisive Weapon," the "Ultimate Weapon" in the struggle between the Free World and the Slave World is the ability to overcome resistance to change.

Headquarters Air University

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AIR UNIVERSITY QUARTERLY REVIEW

SUMMER 1956

Vol. VIII No. 3