AIR UNIVERSITY QUARTERLY REVIEW

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ATTENTION

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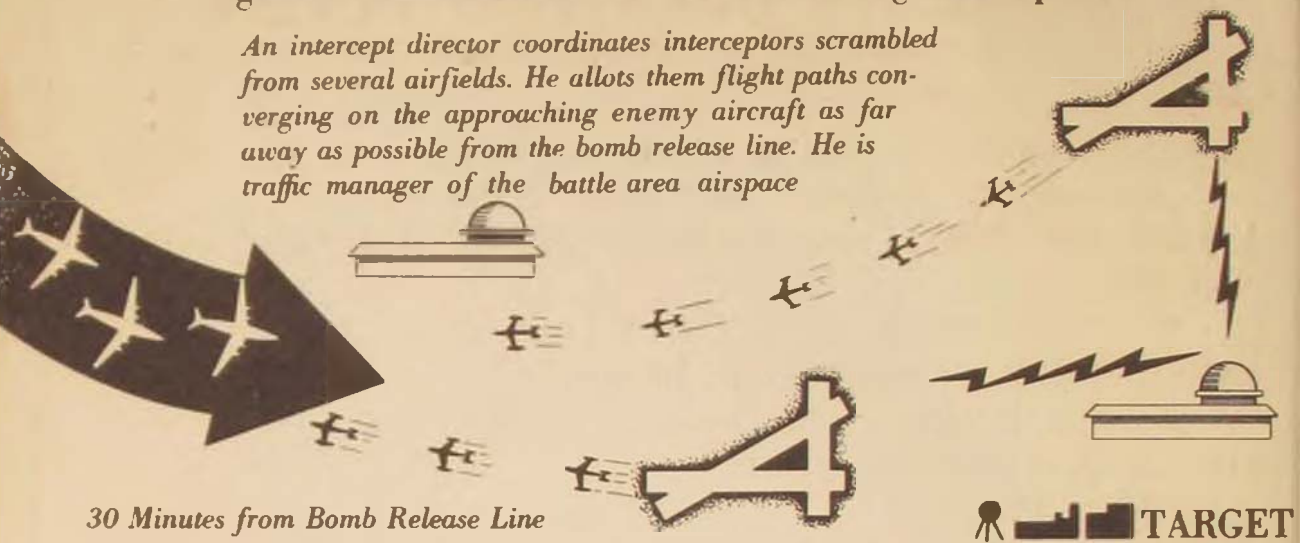
Every second is critical when hostile aircraft must be stopped short of the bomb release line. Precise air-ground teamwork funnels in unremitting interception.

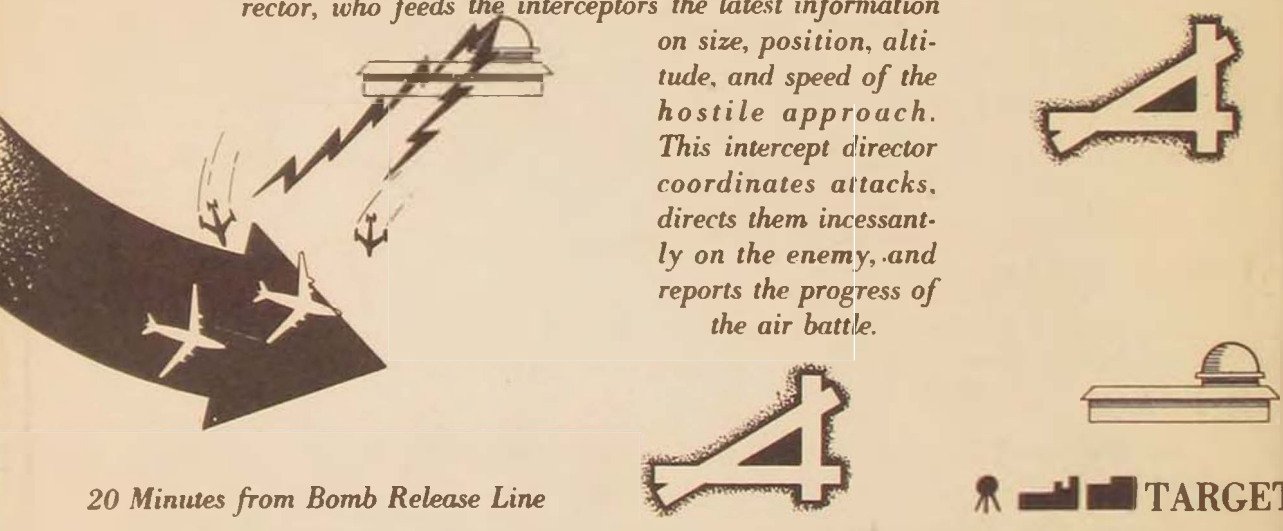
An intercept director coordinates interceptors scrambled from several airfields. He allots them flight paths converging on the approaching enemy aircraft as far away as possible from the bomb release line. He is traffic manager of the battle area airspace



30 Minutes from Bomb Release Line

TARGET

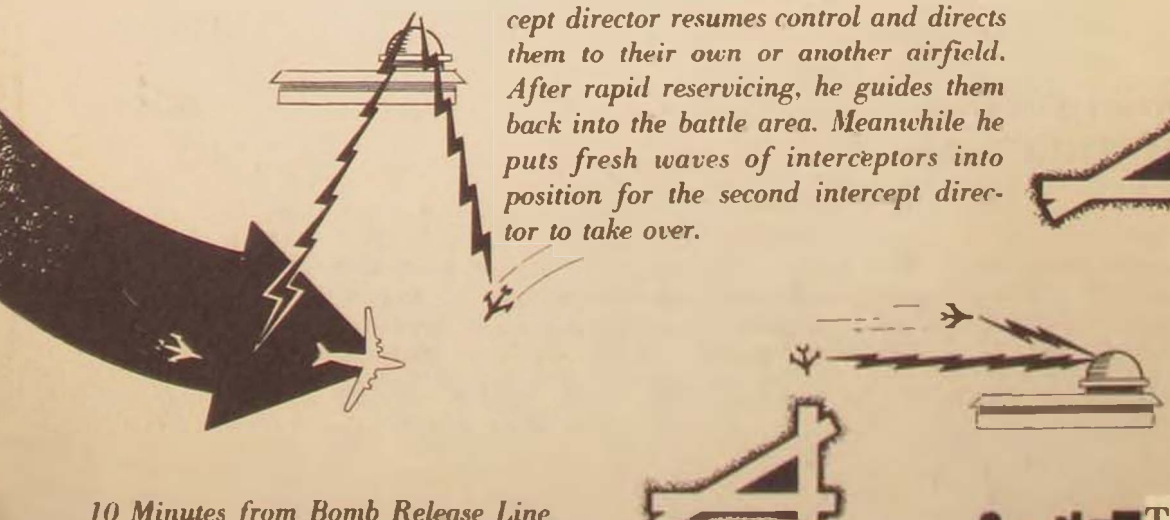
When the interceptors reach the battle area, the first intercept director passes control to a second intercept director, who feeds the interceptors the latest information on size, position, altitude, and speed of the hostile approach. This intercept director coordinates attacks, directs them incessantly on the enemy, and reports the progress of the air battle.



20 Minutes from Bomb Release Line

TARGET

As the first waves of fighters exhaust their ammunition or fuel, the first intercept director resumes control and directs them to their own or another airfield. After rapid reservicing, he guides them back into the battle area. Meanwhile he puts fresh waves of interceptors into position for the second intercept director to take over.



10 Minutes from Bomb Release Line

TARGET

Current Practice in Air Defense

Part I: Principles and Problems

Major General Frederic H. Smith, Jr.

IN any discussion of air defense it is well to separate the specific from the general connotation of the term. In air warfare, perhaps more than in other modes of warfare, the best defense is a good offense. Throughout World War II, in both the European and Pacific Theaters, the greatest air defense dividends were realized through carrying the war to the enemy. The destruction of the enemy's airframe and engine industry, the destruction of completed aircraft on the ground, and the attrition in the enemy fighter strength forced by our attacking bombers and their escorting fighters were the great factors in reducing the enemy air threat to our own forces. There is nothing in our current concepts of air warfare which contravenes this experience.

Though we accept the basic tenet expressed above, it is still apparent that one of the fundamentals involved in winning a future war is the provision of effective air defense measures in overseas theaters for the protection of our troops and essential facilities and in the Zone of the Interior for the protection of our war-making potential and our people's will and capacity to fight. Protection for the latter becomes even more vital when one considers the advances in long-range strategic air arms which make intercontinental air attacks possible on the very heart of a nation. Because defense against the air threat presupposes that the initiative lies to a greater or lesser degree with the enemy—with the ever-present possibility of tactical surprise—the air defense system and its weapons, while highly specialized, must remain sufficiently flexible to counter air attack from any quarter. Maintenance as well as combat personnel must be trained to a 24-hour capability with workloads which vary from "nominal" to "peak" in an

A serious new problem to confront U.S. military planners since the Second World War has been the very real threat of large-scale air attack on the economic and military structure of the United States. To bring *Quarterly Review* readers up to date on the art of air defense, Major General Frederic H. Smith, Jr., Vice-Commander of Air Defense Command, has written a two-part article reviewing current practice in air defense. Part I sets forth the general requirements for an air defense system. In Part II, to appear in the Summer issue, General Smith will show how the problems of air defense have been changed and intensified by high-speed aircraft and atomic munitions and will explain tactics evolved in response.

extremely short time. It is with the essential elements of such a defense system that this article treats.

Essential Elements in Air Defense

There are four major functions which must be performed in the execution of an air defense mission. These are detection, identification, interception, and destruction. Any effective air defense system must be designed to accomplish these successive functions in the minimum possible time. Our system must be designed upon the premise that the enemy will achieve tactical surprise, that the first warning of impending attack will be generated by the system itself. The vital importance of the time element thus becomes obvious. If we are to destroy the maximum number of aircraft in the enemy's attacking force, the time between first detection and interception must be minimized in order to bring effective fire to bear upon the enemy force as far in advance of the bomb release line as is possible. Thus our system must strive for the earliest possible detection of the approaching attack, it must be provided a means of rapid and ready identification of the approaching force as hostile; it must have friendly interceptor forces deployed in depth along the route the enemy must fly, in order to force attrition as early as possible and to continue the attack upon his elements by successive waves until he reaches the target area; and it must ensure that the armament employed by the interceptor force will have the highest possible lethality. Finally our most vital targets should have a local defense of ground-based antiaircraft weapons to engage those elements of the enemy force not destroyed by the interceptors in their role of area defense.

Detection

Since we have predicated the design of our air defense system upon the premise that the first warning of impending attack will be generated by the system itself, it is necessary to establish a positive detection capability as far out from our vital target areas as is practicable. In the ideal case this perimeter early warning may be assumed to be along an arc struck from the target complex we are defending, with a radius as long as possible and broad enough to compel the enemy to cross it rather than go around it by a circuitous approach to the target. The breadth of the arc, then, is dependent upon the range of the enemy striking force. If the enemy has a variety of base areas relatively far apart geographically, it is obvious that our outer perimeter must become a series of arcs rather than the smooth segment of a circle.

In order to bring the maximum possible fire power to bear against the enemy attack, we must not only detect his penetration of our system

but must track him consistently throughout his approach to the target. This dictates that elements of our detection system must be deployed in depth back of our perimeter warning screen, so that the enemy can be accurately tracked at all times. In the ideal situation this detection and tracking system would consist of a large number of radars to ensure accurate tracking at all altitudes. Because radar operates essentially on line of sight, the defense of a large area such as the United States would require a tremendous number of radars. The overlapping radar coverage provided by this system would mean that as many as four or five radars would sometimes be furnishing track information on the same aircraft. The problem of integrating and collating this information so that it would not appear at the control center as four or five different tracks or the track of the aircraft in question would not fail to appear at the control center, becomes increasingly difficult as we increase the number of sources from which air surveillance information is being received. The expense of the radar system itself represents only the first cost. The manpower involved, the communications circuits required, the installations necessary for a comprehensive display of the information available—all these factors represent a financial burden which increases with the complexity of the system. In practice, economic and other restrictions may make it necessary to supplement radar surveillance with that of human observers reporting to filter centers from which visual or oral observation data can be fed into the system. It may also be found necessary to accept a compromise from the ideal of solid coverage everywhere, to an aircraft control and warning system which provides solid coverage only in areas where capability for absolute identification is essential. The progress of aircraft through areas of marginal radar coverage or where radar coverage does not exist would then be followed by "dead reckoning."

Identification

In our reaction to enemy penetration of our outer detection screen valuable time will be lost unless our air defense system provides very rapid recognition of the detected force as "hostile." This objective requires an identification system which quickly correlates all friendly flights. Too long a delay in establishing a given track as hostile may well permit an enemy force to penetrate so far prior to defensive action that it cannot be destroyed before bomb release line; and the mistaken dispatch of interceptor aircraft against friendly tracks could well dissipate our fighter force to no purpose. The identification requirement therefore demands that advance information on all friendly air traffic through the defended area be channeled into the system and correlated rapidly with all other reported or detected tracks.

Once we are in a state of war the identification procedures become much simpler than when we are in a state of uneasy peace and facing the threat of a surprise initial assault. Once war is joined, control of friendly traffic, both in overseas theaters and at home, can be much more rigid and the number of friendly flights involved can be substantially reduced or regulated to ensure positive identification. But before the initial attack the problem is exceedingly complex and in a defense system in a populous area such as the United States where the air traffic averages over 25,000 aircraft flights per day, identification is one of the weakest points in the air defense system.

To reiterate, then, the capability for the positive identification of all air traffic is a prerequisite to effective air defense. To provide this capability, liaison must be established with the civil and military agencies controlling aircraft movements.

The weakest points in the techniques so far devised lie in the failure of aircraft, both military and commercial, to navigate within the limits considered necessary for effective correlation and in the handling of flight movement data in a timely manner. With the advent of war these should no longer be major problems in the identification of air traffic, although provision must be made to facilitate the movement of friendly air traffic under war conditions and to interfere with its passage as little as is possible. The part played by air commerce in maintaining our economic structure has rapidly increased in importance in the past decade. Disruption in the movement of air freight through our country and to and through overseas theaters, the hampering of the movement of military supplies, or a delay in the deployment of strategic air elements could very well prove fatal to any war effort upon which this country embarks. Air traffic must be allowed to flow, but is must also be subject to restrictions, consistent with the tactical situation, which may be imposed by the responsible air defense commanders. The air defense commander must be allowed to clear his sector of all nonessential air traffic and to conduct the defense of his sector unhampered by friendly air traffic not directly involved in the air battle.

Interception

Having detected and established a penetrating track or series of tracks and having established the penetrating force as hostile, we must, with a minimum loss of time, intercept the elements of that force with our fighter aircraft and bring fire power to bear on them. We are still fighting against time, and therefore the interval between detection, identification, and the launching of the fighter forces must

be held to the absolute minimum. This means at least a portion of the fighter force must be held in a state of readiness which will permit immediate take-off after a decision to scramble has been reached. It means we must have a high-performance interceptor which can position for attack in the minimum possible time.

As we must assume that an enemy would be capable of radar bombing during conditions of darkness or bad weather, our fighter force must be able to operate effectively under these adverse conditions. So that we can properly position our interceptors without excessive loss of time, our detection and tracking system must establish, definitely and within close tolerances, the location of the hostile force in space. Not only must we know its azimuth and range from the radar conducting the interception, but we must know its height. We must further, in the interception phase, be able to handle a larger number of fighter aircraft so that the maximum possible fire power is brought against the enemy during his approach to the target. The interception phase thus imposes a high track-handling capability as a requirement upon ground-based control. As the enemy track approaches those areas where we have provided local defense with antiaircraft weapons or guided missiles, information must be transmitted to the batteries so they can engage as soon as the hostile force comes within effective range of the guns or other weapons employed.

Advancements in the art of interception have not changed the mathematics of the intercept problem but they have made possible a more rapid solution. This reduction in time can only be achieved through precision of operation and coordination of activities. Interceptor directors must perceive and react instantaneously to any evasive maneuver on the part of the target aircraft. Interceptor pilots must receive and react automatically to changes in intercept instructions.

Destruction

In view of the limited endurance of jet interceptor fighters the space and weight limitations on their ammunition load, and the time required for accurate repositioning after initial attacks in bad weather or at night, interceptor weapons must have as high a kill probability as possible. Modern bombardment aircraft can absorb a great deal of punishment; the airborne weapons in our air defense system must have as much real punch as is possible. The ideal would be equipment capable of a sure kill per firing pass.

Insofar as antiaircraft fire is concerned, the period of engagement is so brief under normal circumstances that each individual projectile must have the maximum possible lethal area. For gun fire, improved gun-laying radar will increase kill effectiveness. But the kill prob-

ability per projectile fired will still remain rather low, and this puts a premium on the guided missile type of ground-to-air firing.

Communications and Command Control

The importance of rapid and reliable communications need not be reiterated here. Countless examples from World War II point up the vital necessity, in all military operations, of a communications system which guarantees adequate control at all echelons. The earlier discussion should have emphasized the scope and importance of the role played by the air defense communications system. Integration of the far-flung elements necessary to form air defense systems is only possible through use of an extremely well-planned communications network.

Because the first warning of an enemy penetration is generated by the system itself, a tremendous premium must be placed upon time. Each passing moment prior to overt action by the defender places the enemy that much closer to his targets. The difference between success or failure may hinge on the time lost in passing information from the radar or ground observer perimeter detection system to that echelon of command capable of assessing the situation and making the decision as to action required.

Once the decision has been made, communications continue to alter the tempo of the system from one of passive alertness to active resistance. Interceptors must be made airborne and guided to the aggressor by means of the position information gathered by the radar station exercising control responsibility. If remnants of the invading element are successful in their penetration, the burden of defense must be rapidly transferred to the fixed weapons which are grouped in close proximity to the target complex.

It can readily be seen that once an enemy has penetrated the system, his whereabouts must be known every instant. The combined facilities of the radar and ground observer systems must provide an accurate tracking capability, as well as perimeter detection. Within the system, track information must be quickly relayed from one radar station or ground observer filter center to those adjacent.

Because an air defense system must be sensitive to the enemy's choice of time and place of operation, all-hour, all-weather interceptor operation is essential. To minimize the expenditure of our defensive potential against false alarms, we must facilitate early recognition of friendly military and civilian aircraft by injection of movements information into the system. To obtain maximum utilization of aircraft and aircrews, their navigational facilities must be supplemented by radar information to aid them in returning to their

bases. In the event of mishap, air-sea rescue organizations must be alerted in an all-out effort to conserve our aircrews.

This, then, is the mission of the air defense communications system: to pass perimeter detection information from radar and ground observer stations to the appropriate command echelon and similar adjacent facilities; to alert interceptors and guide them to the aggressor, to link the command echelon with fixed defense facilities; to inject friendly aircraft movement information into the system; to provide aid and rescue facilities for interceptor aircrews—all with the utmost emphasis on speed, reliability, and accuracy. Starting at the perimeter, we therefore must build a communications network which laces together our radar stations and filter centers and provides for the rapid transmission of air situation information back through the system to the operations centers of the various echelons of command, with tie-ins to the miscellaneous agencies necessary for successful operation. Our area weapon, the interceptor, must be guided by manifold ground-to-air radio links located at the radar stations possessing ground controlled (GCI) capabilities.

Economy of force dictates that the decision as to what force will be dispatched to engage the enemy should be made at the highest echelon consistent with minimum time loss and the ability to assess accurately the air situation. Present data transmission techniques, which involves voice telling and hand plotting, restrict the initial decision-making job to levels far below the ideal, even when adequate numbers of land line and radio channels are provided. Our data transmission systems border on obsolescence. Improved techniques in data transmission, even at the expense of increased equipment complexity, must be developed if the problem imposed by the time element is to be surmounted. No mere increase in numbers of conventional equipment can remedy the situation. Communication techniques must be advanced to keep pace with the requirements imposed by modern concepts of warfare.

In the first fluid stages of the air war, battlefield and rear area defense will have to be improvised initially with single mobile GCI units directly controlling elements of the fighter force. But this improvisation must be corrected as rapidly as possible by bringing in, as far forward as the situation permits, equipment and circuits which will allow the assumption of control by higher echelons. Only then can the available fighter forces be employed most effectively. Thus, as in all present day military operations, simplicity is not the key to air defense. The capability of the system must equal or surpass the striking potential of a possible aggressor. Communications is the vital link that transforms the system into a coordinated,

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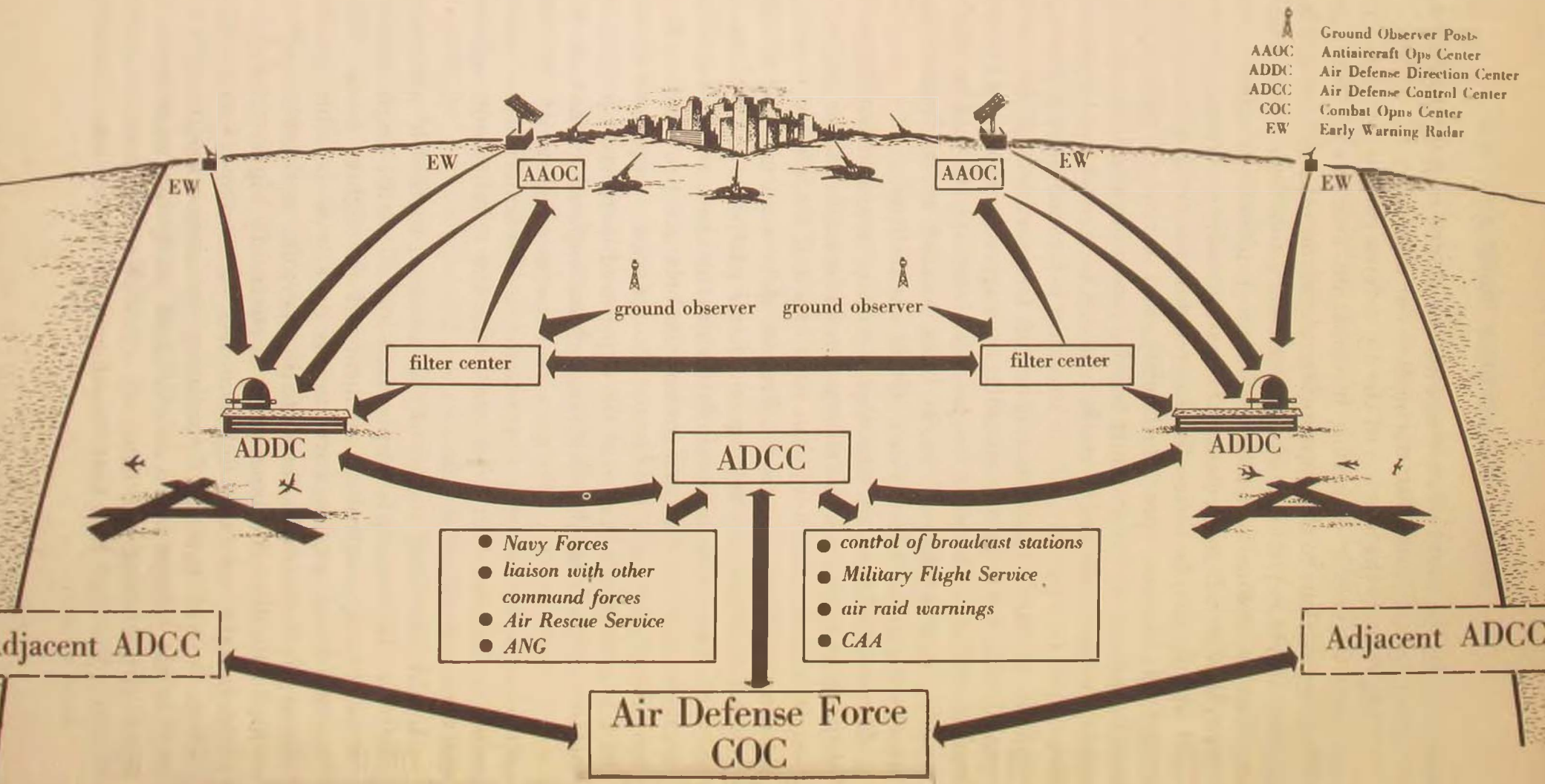
Part of a Typical Air Defense System



smoothly functioning operation that can exact a maximum of attrition from an enemy launching an attack without warning.

Tactics

In establishing and evaluating an air defense system, the basic consideration is its ability to meet and destroy a penetrating enemy force before it reaches the bomb release line. Hence an estimate of air defense capability must logically be based on the concentration of fire power and the duration of the engagement time. The number of penetrating enemy bombardment aircraft which may be destroyed before bomb release line is a function of the amount of fire power brought to bear on that force before it reaches the dropping point. Active air defense operations are considered to have ended once the bomber has delivered its payload to the target. Subsequent destruction of the enemy aircraft is a matter of attrition and can have no effect on the raid in-being. The requirement for stopping the attack short of the bomb release line determines the tactical disposition of fighter-interceptor forces so that initial interception can be made as far out as possible, and opposition to the enemy strike can be continuous throughout its penetration. This dictates deployment in depth, with our forward elements on or near the perimeter of radar control coverage. Range limitations of the enemy's aircraft may well force him to follow certain general routes to the vital target areas which it is our mission to defend. Where this limitation appears, our concentration would be along those routes. Similarly the importance of the defended target complex will affect the allocation of fighters in the same manner as antiaircraft dispositions and densities will be geared directly to the importance of the targets and to sufficient concentration of these targets to make gun or antiaircraft rocket defense applicable. A further consideration in the disposition of force is the effective use of various types of aircraft and equipment. With a choice of conventional aircraft, standard jet aircraft, and jet aircraft equipped with radar to permit them to seek out and destroy the enemy under adverse weather conditions, deployment is dependent on the prevailing weather conditions and the flight range needed in different areas. Conventional aircraft carrying several hours of fuel are better suited for use as a combat air patrol, with interceptions directed from the airborne position when this expensive tactic is justified by the situation. Conversely jet aircraft, with a comparatively short range and high performance characteristics, are generally reserved for scrambles from ground alert against a particular target detected by the aircraft control and warning system.

The size of the fighter force dispatched against penetrating hostile

bomber forces will depend not only upon the size of the enemy force but upon the relative kill effectiveness in the ensuing bomber-fighter duel. World War II experience would indicate that a four-to-one ratio of fighters to bombers is good practice. If fighter armament progresses faster in its development than does bomber armament, this ratio can be reduced. A highly lethal fighter weapon, enabling the fighter to fire from a position beyond the effective coverage of bomber armament, would upset the balance in favor of the interceptor.

It must be remembered that the problem of kill effectiveness increases as bomber aircraft go faster and higher. With detection range as a constant, the time for engagement prior to bomb release line is diminished as the speed of the bomber is increased. At the same time the physical ability of the interceptor to fly a curve of pursuit and close to effective firing range decreases with higher speeds and altitudes. If fighter escort accompanies the penetrating force it may influence the allocation of the fighter force to meet the attack, but only when the performance of the escorting fighters is roughly equivalent to that of the fighter-interceptor. A long-range, heavy escort fighter employed in the conventional sense, when opposed by short-range, light, high-performance interceptors, cannot influence to any great extent the accomplishment of the basic mission of the interceptor to engage and destroy the bombers.

After the initial engagement of the penetrating enemy force, the dispatch of successive waves of fighter-interceptors must be continued until the invading force has been destroyed or turned back—if possible, before reaching the bomb release line. Time to engage being so important, a premium is placed upon the ability of the ground controller to feed in successive attacks without confusion and to recover rapidly and efficiently those fighters which have expended their ammunition. This becomes a particularly acute problem in darkness or bad weather. A high degree of teamwork is required: first, among the controlling personnel; and second, between them and the aircrew. Under average circumstances this generally leads to a system whereby one controller at a radar station marshals and positions fighters for the attack, turning them over to intercept controllers as required for the attack phase. When the fighters have expended their ammunition, the first controller reassumes the control and returns the fighter to a position within range of landing aids at the home station or other bases. The capability of fighter-interceptors to perform more than one interception on a strike force is dependent upon the ability of the ground echelon of the fighter-interceptor squadron to reservice the aircraft fast enough for them to re-engage the attacking force before it has moved out of fighter range.

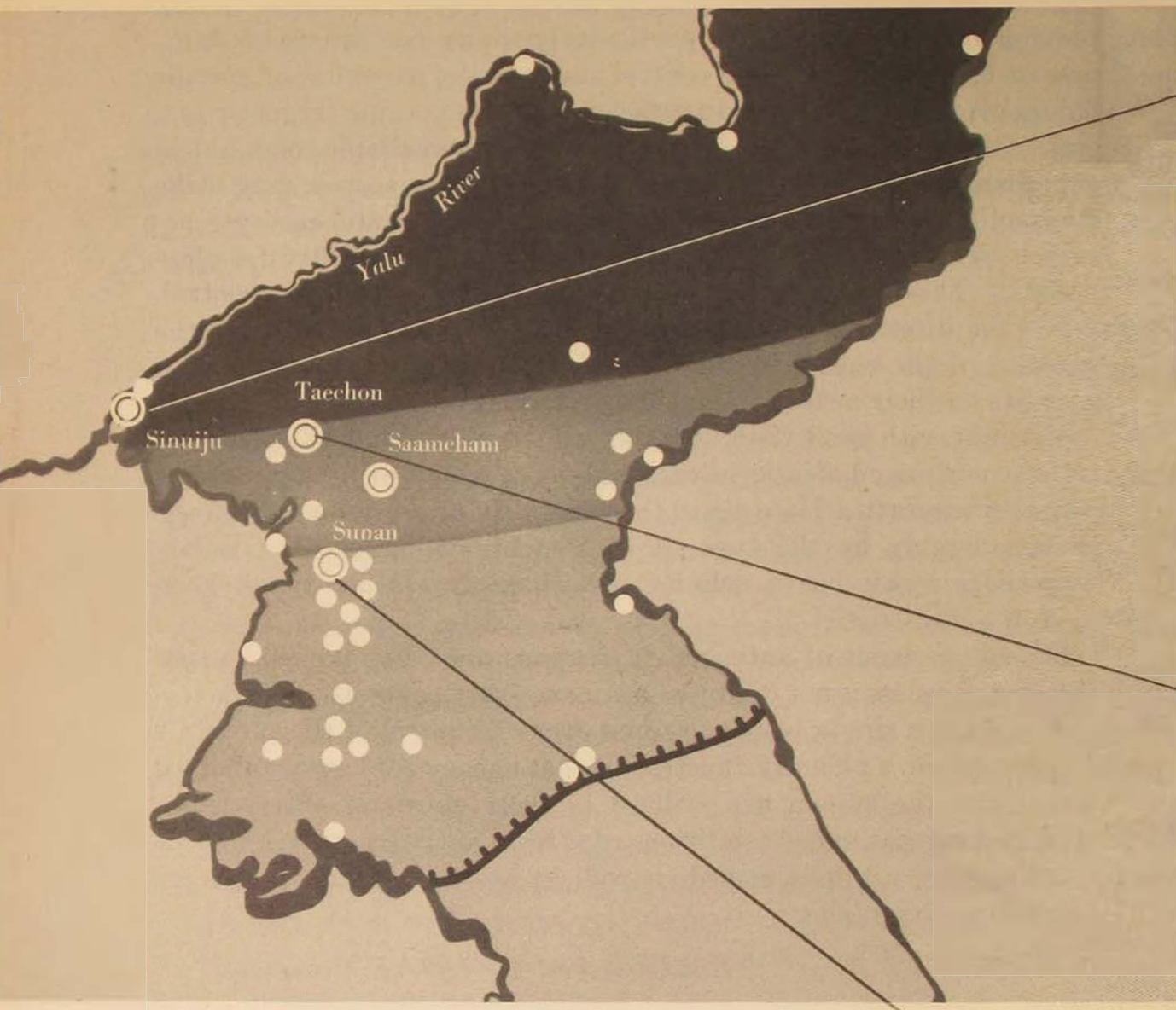
Close control of interceptions is the most efficient means of employing fighter-interceptors, particularly under conditions of darkness or bad weather. Close control involves the direction of specific fighter-interceptor aircraft in attacks against a specific target or targets. Against mass penetrations, congestion on available communication channels, as well as in air space and on radar scopes, may make this tactic impracticable. Successful electronic counter-measure activities by the penetrating force may deny us the capability for close control. Then it may be necessary to resort to broadcast control, where the directing ground radar station or stations broadcast the progress of the enemy tracks. Fighters receiving that information navigate on their own into the bomber formation or stream. Except in daylight with good visibility, this will usually result in individual and uncoordinated attacks as each fighter or group of fighters locates an enemy aircraft. Here again the capability of air defense is affected considerably by the type of equipment available. The radar-equipped aircraft has a definite advantage over other types when visibility is restricted.

The employment of antiaircraft weapons must be planned so that their effectiveness is not inhibited by unnecessary controls. While it is essential that a single agency exercise over-all control of the entire air defense system, a primary function of that agency is to ensure that all weapons in the system are utilized to their optimum effectiveness. This dictates that under conditions of attack, antiaircraft weapons be free to engage all unidentified, as well as hostile, aircraft that come within effective range.

Headquarters, Air Defense Command

(to be continued)

North Korean Airfields



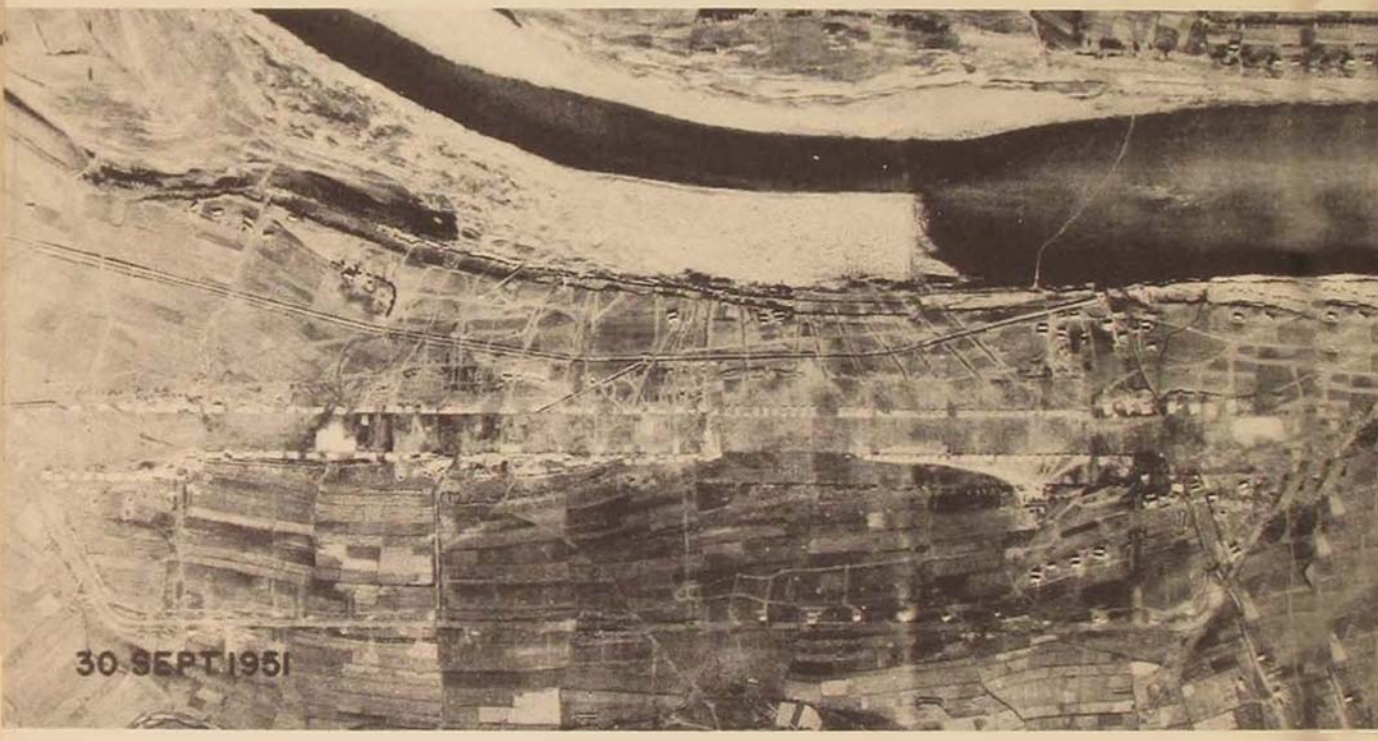
A major puzzle in the early months of the Korean war was the enemy's persistence in constructing new airfields in North Korea without any sizable attempt to operate aircraft from them. By the end of the first year of the war the Communists were constructing 33 airfields with runways of 4600 feet or longer. These airfields were under regular surveillance by U.N. reconnaissance, and runways were pot-holed every time repairs neared completion. The construction and the continuous repair effort, both achieved with practically no modern machinery, called for large-scale and continuous allocation of manpower. Yet no military profit was returned by the airfields, except possibly in absorbing a certain percentage of the total U.N. bomb tonnage which otherwise might have been dispatched to more sensitive targets. Study of the location of the airfields and the degree of readiness in which they are maintained suggests a more far-reaching strategic importance. Airfields immediately south of the Yalu are in such good repair that they could be made serviceable within 48 hours. The ones in the middle arc on the map above could be made ready within five to seven days, while the ones nearest the battleline would require two weeks' work. If the Communists commit an all-out offensive which includes the air forces hoarded in Manchuria, their plan might therefore turn upon a lightning-fast, surprise air attack in force against F–86 bases in South Korea, followed by a leap-frog campaign to

Sinuiju airfield, just across the Yalu from the massive Manchurian airbase at Antung, is kept in apple-pie order. Bomb craters remain along the sides of the 5700-foot-long-230-foot wide, packed-earth runway, but every one on the runway itself has been repaired. The piston-engined aircraft in the revetments frequently train here.

Taechon airfield, with a 6500-foot by 200-foot concrete runway built in October 1951, is systematically bombed and just as systematically repaired. This photograph was taken a day or two after a heavy bombing had shattered the runway. Repairs are already under way at both ends of the runway and will rapidly work toward the middle.

Sunan airfield, featuring a single concrete runway 6700 feet long and 200 feet wide, is in the zone nearest the present battle line. At one time its runway was being extended another 1400 feet, possibly for jet bombers. Its thoroughly bombed runway would probably require a full two weeks of uninterrupted work to be operational.


25 SEPT 1951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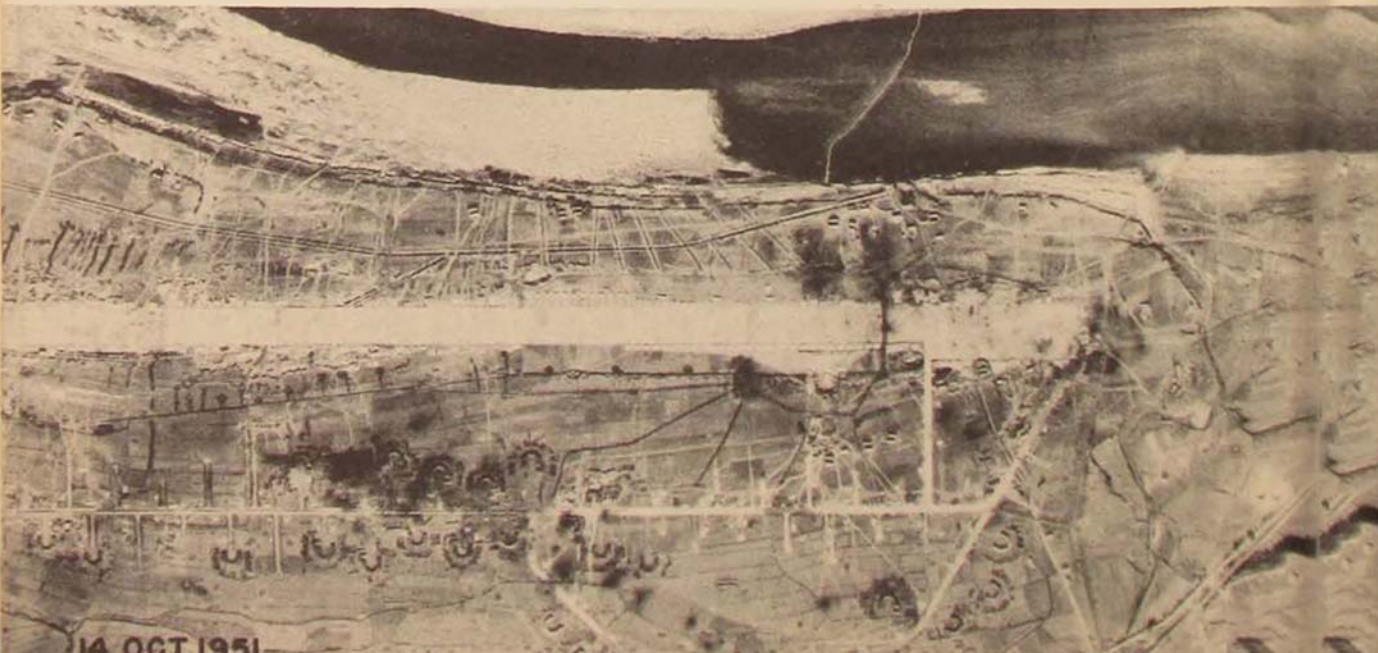
14 OCT 1951

A classic example of the speed and proficiency of Communist airfield construction, even though using primitive equipment and unskilled labor, is found in the history of Saamcham airfield (see map for location). On 25 September 1951 a reconnaissance photograph revealed the outlines of the new airfield. The runway area had been graded, construction materials were being accumulated, and the left end of the taxi strip had been graded. By 30 September the shape of the airfield was clear. The runway, 6600 feet long and 195 feet wide, now had its base layer. The taxi strip had been graded, and some of the revetment positions at the left end were being prepared. Cover on 14 October showed that progress had been so remarkable that the airfield had already been bombed. Runway surfacing was almost complete, as was that of the taxi strip. A total of 26 revetments had made their appearance in various stages of construction. Below the right end of the taxi strip, a supplemental taxi strip had been outlined and partly surfaced. A four-gun antiaircraft battery guarded the right end of the runway, and a string of automatic weapon pits were connected by a trench system between and parallel to the runway and the taxi strip. Four days later the history of Saamcham came full circle. Cover on 18 October showed the almost-completed airfield had been subjected to a devastatingly effective bombing. But extensive progress had been made in four days. The runway had been given a final polish, the auxiliary taxi strip completed, revetments were springing up, and one more antiaircraft battery had been added. In 21 days an open field had been transformed into a first-class operational airfield. No matter how severely such an airfield might be bombed, repairs, if protected by an effective air cover from further interruption, could be finished in considerably less time than the three weeks required to build the airfield from scratch. The Communists know this, and we should also recognize it.

move their air forces southward on Korean bases. If their nemesis, the F–86, were largely out of action, the enemy could then throw an air cover over the bases just beyond the Yalu, repair them in 48 hours, move into them, extend his air cover out over the middle arc, repair those in another five to seven days, move into them, and repeat the process on the airfields behind the front lines. From these airfields they could reach any point in South Korea with ample fuel reserves remaining for action. At this stage, their big problem might well be the B–29's based in Okinawa and Japan. The Communists have been relatively helpless against the night attacks by the medium bombers.

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Defeat of the Luftwaffe: Fundamental Causes

GENERALLEUTNANT ADOLF GALLAND (RET.)

THE defeat of the Luftwaffe has already been treated critically more than once by victors and by vanquished. Even in the more objective analyses, the error which has repeatedly crept in has been that of pulling out segments from a complex, interrelated structure of events which had a variety of causes and historical developments. Only in a very few exceptional cases is the resolution of a complex problem so simple that the events surrounding it can be torn apart and rearranged in two lists on a "true or false" pattern.

The rapid decline of the Luftwaffe in the Second World War has long fascinated Allied military analysts. Of the many reasons for this collapse which were advanced in the past eight years, the *Quarterly Review* listed the most salient and requested former Luftwaffe General Adolf Galland to comment on their validity and to add his own views. As General Galland pointed out in undertaking it, the article, by nature of its approach, deals with the negative rather than the positive aspects of German airpower. Rather than evaluating each specific comment, General Galland has interpolated his answers to them in a generalized interpretation of the ascendancy and decline of the German Air Force. This method allowed freer range to two of his chief convictions: that many of the seeds of Luftwaffe collapse lay in the hasty and uneven build-up in pre-war years and that the major fault of the comments of Allied analysts was the playing up of some single facet, thereby oversimplifying extremely complex interactions of many forces and decisions operating over an entire decade. General Galland wrote in German and has approved the *Quarterly Review* translation.

Few men are as qualified to give an authoritative account of the inner difficulties of the Luftwaffe as General Galland. Currently an advisor to the Argentine Air Force, General Galland commanded a fighter wing in the Battle of Britain as a lieutenant colonel. By 1942, at the age of 30, he was a general officer. During most of the war he served as Inspector General of German fighter aviation. As such he had much to do with the planning, programming, developing, and testing of German fighter aircraft. He was the first general officer to flight test the Me–262, in the spring of 1943, and was long a staunch advocate of concentrating German production efforts on the jet fighter as the only way to offset the overwhelming Allied superiority in numbers of aircraft. So strenuous was his opposition to Hitler's decision to use the revolutionary new aircraft as a bomber that in January 1945 he was relieved of his command. When Hitler finally was ready to compromise on the use of jet aircraft, General Galland was given command of a group of Me–262's which had been formed in a desperate effort to stem the Allied air attacks on Germany. Formed too late to affect the outcome of the war, in its few missions it achieved notable successes against the Eighth Air Force.

The following opinion must not be expected to contribute sensational new disclosures or a markedly extravagant point of view on the history of the German air war. Rather it is an attempt to note some of the interrelations between cause and effect, planning and execution, errors and consequences. As the reader will note, I shall allude to many professional problems without being able to go into them deeply.

I propose neither to attack the Allied critics nor to defend or vindicate German military leadership prior to and during the Second World War. Great mistakes were made on both sides; it therefore ill behooves one to generalize about an accumulation of unusual incompetence and stupidity in the high commands of the air forces in the last war.

One principle bearing on leadership might be stated in relation to resources in war: an enemy with superiority in technology and war potential who makes a series of wrong decisions may, to be sure, leave in doubt the outcome of a battle but he never loses the certainty of ultimate victory. On the other hand, his opponent, far inferior to him in these basic factors, will not be able to avert defeat in a long war, even though he avoids every error in command judgment.

I have therefore taken the liberty in many instances of going farther back than at first glance seems necessary in depicting a specific problem. Only thus, it seems to me, is it possible to distinguish between errors stemming from principles and errors in single decisions, and between imponderables and incompetence.

You must bear with me if, in considering Germany's problems of air strategy, I come back time and again to the more certain ground of my specialty, fighter aviation.

Factors Which Stem From the Organization and Training Period of the Luftwaffe

Consequences of the Treaty of Versailles: The German Flying Corps of World War I was dissolved at Versailles. The terms of the dictated peace treaty forbade to Germany the development, design, and construction of military aircraft as well as the training of flying personnel and highly specialized technical personnel. It also banned the maintenance of a General Staff for the study of the tactical-technical and strategic developments of the postwar period. No military, no ministerial authority was permitted to concern itself with the planning, organization, and maintenance of the basis of what would have been an illegal Luftwaffe. Not only an effective Allied Control but, even more seriously restrictive, controversy in domestic party politics prevented any aviation activity worth mentioning. There was almost no

expansion of research, development, designing, aircraft construction, training, tactical and strategic study, or planning.

Quiescence of Activity until 1933 Was the Cause of a Shortage in Unit Commanders and General Staff Officers. Even though a small group of Reichswehr (in pre-Hitler days, an army of 100,000 men) officers with World War I flying experience could be kept in practice and up to 20 young officers could be trained per year, this meager achievement was far from sufficient to form even the basic pool or cadre for the future unit commanders and superior commanders who would be needed in a new organization. The selection, training, and maintenance of a tactical-technical General Staff were completely discontinued. That kind of staff, moreover, was not what the Reichswehr representative of German Army opinion had in mind. The latter, harking back to World War I, saw the Air Force chiefly as an auxiliary arm of the Army.

Rivalry during Rearmament. This state of affairs continued until 1933. Later on when increasing official budgets for armament were provided annually and placed at the disposal of the three branches of the Armed Forces, the Army, Navy, and Air Force—independent after 1935—there began a very fierce rivalry between these services. It is to the credit of Goering that, with his political influence, he could elevate the expanding Luftwaffe to the place which was really its due in the over-all pattern of the nation's armed strength. In its status as an independent branch of the Armed Forces, as well as in the proportion of budget funds allotted to it, the Luftwaffe enjoyed conditions at that time far in advance of and more favorable than those experienced by air forces in the former Entente countries.

The Calculated Risk in Foreign Policy Forced Utmost Acceleration in the Tempo of Reorganization. In my opinion nothing decisive can be gained by determining whether the expenditure of funds was in every case the wisest in terms of the long-range goal—whether, for instance, the luxury in the installation of bases, of aviation garrisons, and of ground organizations was justified. On the other hand, it must be realized that there was simply nothing at the outset and that everything had to be planned and built from scratch. To aspects of domestic politics often involved in the matter was joined the overruling calculated risk in German foreign policy. The basic requirement was speed—all possible speed in getting past the critical point in Luftwaffe expansion and in achieving superiority in air war potential.

Bottleneck: Leaders for Key Military and Civilian Positions. In this period of Germany's build-up in personnel and matériel, results were undoubtedly achieved which until then had not been considered

possible. But precisely because everything depends on human limits of performance, especially those of civilian and military leaders, it soon became apparent that the pace of rearmament and expansion in organization was simply outstripping the supply of trained, seasoned men necessary to fill properly the key positions.

Many officers, civilian officials, engineers, and doctors who had had to follow private, civilian pursuits since the end of World War I, and whose military knowledge and aptitudes had remained at the level of those days, had to be called back to active duty almost without any training and without any particularly critical screening. A great many of them occupied important positions in all staffs and services of the Luftwaffe, especially in the ground organization and in supply. The Engineering Corps of the Air Ministry and of the Luftwaffe came out second best in a very stiff competition with industry for trained technical personnel because of the latter's better offers to engineers. It is therefore understandable that those engineers who took part in technical planning and direction were often not really top-flight.

Surrender of Officers by the Army and Navy; Recruiting System; Personnel Procurement. The Army and the Navy were repeatedly forced to give up officers for the expansion of the new Luftwaffe. That they did not release their best officers is understandable, especially since neither the Army nor the Navy had ever abandoned its demands for its own tactical air forces or naval air forces. Further friction appeared in the recruiting and apportionment of the annual contingents coming up for their universal military service. The rigidity of the system did not permit personnel to be allocated according to their own wishes, to their special aptitudes, or to the requirements of the individual branches of the Armed Forces. This held true to an even greater extent in the case of the rising generation of officer personnel. The Luftwaffe saw too late the vital importance of personnel procurement. This became especially apparent when war casualties had to be made up and the SS Armed Forces ruthlessly reserved the elite for themselves. The pace of training and organization had been excessively accelerated before the war. As a result the lessening in quality of unit commanders and of aircrews had set in too soon.

The Officer Corps and the General Staff. The supply of the required higher and senior commanders thus being a problem in personnel, and one strongly influenced by the subjective attitude and sympathies of the Commander-in-Chief, Reichsmarshal Goering, the officers of the General Staff played a special role. Because the earlier training of the General Staff officers, including junior officers, had been according to Army standards, the new generation of General Staff officers was not sufficiently prepared in its special functions for

coping with the fundamental problems of personnel, air matériel, and the conduct of aerial warfare. This may be partially explained by the fact that most of the senior commanders in the Luftwaffe themselves had no General Staff training and certainly no Air Staff training. As elsewhere in the world, qualified young officers flocked into the flying units. There they soon became commanders of units and as such were irreplaceable. Thus the rising generation of career officers for the Luftwaffe General Staff always had to be kept up to the necessary standard in the face of considerable difficulties and opposition. During wartime most of the Luftwaffe General Staff officers, as a result of their lack of air force experience, could barely follow the development of combat conditions. This made still more difficult any rewarding contact between command and troops.

I may have touched upon a purely personal attitude toward this problem without being able to go into it in more detail within the framework of the over-all subject. The only individuals I wish to criticize are the commanders of flying units who did not recognize in time or who refused to admit that their bitterness and antagonism toward the General Staff would perforce sooner or later boomerang against themselves. I too must confess to having made this mistake.

Change in the Hypothesis of a Possible War. Western Europe not Included in Offensive Possibilities. The hypothesis for a new war and the strategic mission assigned to the Luftwaffe naturally changed repeatedly during the expansion years of the Luftwaffe. Since in the concept of Hitler's foreign policy it seemed possible to exclude a conflict with Germany's neighbors to the West, including England, once a crisis had been weathered in the first phase of German rearmament (building of the West Wall corresponded strategically to this concept), the defensive character of the Luftwaffe changed more and more to an offensive one with its strategic sights turned toward the East.

The Luftwaffe's Strategic Concept. The Luftwaffe Always Was the First to Venture into New Fields of Strategy. In the beginning the Luftwaffe thought, planned, and organized altogether along strategic lines. If these reflections and plannings were in many cases not carried to their logical conclusions, the reasons are to be sought for the most part in other factors rather than in the fundamental concept. It must not be forgotten that the status of technological development of 1937–38, with which the war was begun, should not be compared with that of 1942–43, with which the war ended.

In between lies a frankly sensational progress in technology which, had it not been for the war, without any doubt would have taken three times as long. It must also be remembered that in the strategic

realm the Luftwaffe always had to take the first step into a new field which until then had not been explored at all. From the successes as well as from the failures of the Luftwaffe the Allies could derive lessons and exploit these one, two, or three years later when they had more and better aircraft and weapons.

The main thesis of German air strategy was always: first, the destruction or elimination of enemy air power, including its armament industry and sources of power. If this did not succeed in the Battle for Britain, the main reason is that, at least up until the beginning of the war, England had not been sufficiently considered as a probable opponent of Germany. I shall come back to this point later.

Douhet's Influence and the Underestimation of the Importance of Fighter Aviation. Douhet's ideas met with a great deal of approval in Luftwaffe leading circles before the war. Although in the first phase of organization it was the fighter arm which stood in the foreground, in the second it was unequivocally the bomber. I still remember clearly a period when the talk was all of strategic bombers and one referred with something of pitying condescension to "home defense fighters." As a matter of fact the advantage in speed possessed by the Dornier–17 and Heinkel–111 bombers *vis-à-vis* the old Arado–65, Ar–68, and He–51 biplane fighters had for a time confused the minds of the Luftwaffe High Command. With the appearance of the Messerschmitt–109 fighter plane, the picture changed again. After that one could even envisage a twin-engine long-range and escort fighter plane. The idea was absolutely correct and farsighted. Its technical execution in the form of the Me–110 was, however, a disappointment.

The strength ratio between bombers and fighters in the autumn of 1939 was about as follows: 30 Bomber *Gruppen* [Groups, about 27 to 31 aircraft each] and 9 *Stuka* [dive-bomber] *Gruppen*, as compared with only 13 Fighter *Gruppen* [40 aircraft each]. Thus from the very beginning the fighter arm stood on too slight a development basis, which again reflects how it was evaluated strategically.

The Stuka, the Egg of Columbus. Grave concern over the raw material resources of Germany in case of a long war was responsible for the fact that the Stuka concept, stimulated by impressions received in the United States, appeared to the German air strategists as the "egg of Columbus." Udet and other observers sent to the States were thoroughly "sold" on this concept. Instead of the commitment of major forces and area operations, small forces with pinpoint accuracy of fire became the slogan. With typical German thoroughness this concept was followed to the hilt; from now on, for instance, full diving capabilities were required of all medium and heavy bombers,

including the four-engine He–177. The consequences were neglect of pattern bombing, elimination of four-engine bombers from the development and construction programs, and retardation of the remaining types of bombers.

Lack of Cooperation on Tactical-Technical Requirements between Command and Troops on the One Hand and Development and Designing on the Other. Now here I must point out another weakness in the Luftwaffe: What we call "Tactical-Technical Requirements, Planning, and Testing"—by which we mean the collaboration of specialists in research, development, and aircraft design on the one hand and the Luftwaffe High Command, General Staff Officers, and unit commanders with peacetime and wartime operational experience on the other—never functioned properly in the Luftwaffe. Noteworthy in this connection is the fact that on neither side was there any lack of willingness for a close cooperation. It may be that some of the leading personalities in the Luftwaffe High Command had remained at a standstill, not progressing beyond their World War I experiences; that they did not properly recognize the rate and significance of technological progress; and that the younger generation, for which always and everywhere things move too slowly, could not yet carry its point. I will cite only three pertinent examples:

a. The German Me–109 fighter plane was not the product of any requirement nor the result of official specifications which might have given an impetus to such a design, but rather was originated and submitted by the Messerschmitt Aircraft Works. The Luftwaffe had so many faults to find with it—most of which were in reality long out of date, that its superior technical capabilities won its acceptance and adoption by only a narrow margin.

b. The downright catastrophic underestimation of the importance and future capabilities of radar, which likewise had been offered even before the war.

c. The constant additional requirements made by field commanders and staff commands with regard to aircraft already in mass production.

Doctrine and Strategic Mission Assigned to the Luftwaffe. The Magic Word: Improvisation. Neither a clearly defined doctrine for the conduct of aerial warfare nor a consistent, long-range strategic mission for the Luftwaffe existed. This deficiency had its negative effects in both the technical and the strategic fields. Instead of real planning, random improvisation prevailed. Whatever served the purposes and aims of the moment was regarded as timely, interesting, and decisively important. In this turbulent period what was

constant and logically consistent was precisely what had become a rarity.

By its very nature, what suffers most in such circumstances is the development of new technical equipment. To take one well-known example, the minimum time requirement in peacetime for designing, developing, testing, building, mass producing, and putting into operation a new aircraft model was three to four years.

Politics and Their Influence on Army, Navy, and Luftwaffe. I have previously stated that during the period of Luftwaffe expansion strategy often had to defer to politics or ideology. Goering the politician aggravated this tendency even more in his capacity as Commander-in-Chief of the Luftwaffe. Prominent Luftwaffe personalities such as Wever, Kesselring, and Jeschonnek, were unable to do anything about that. Until Hitler himself took over the supreme command of the Army in the winter of 1941–42, the Army had been able to hold itself almost completely aloof from this influence. In Hitler's sarcastic words, there was a "reactionary" Army, an "Imperial and Christian" Navy, and a "revolutionary" Luftwaffe. The Luftwaffe, however, gradually fell in grace from the status of the "privileged favorite child" to that of the "whipping boy" who more and more failed in everything and finally bore the blame for every disappointment.

This subjective, polemico-ideological evaluation of the three branches of the German Armed Forces did not correspond to their importance, their influence, or their real hegemony. Their real order of weight was as follows: Army, Air Force, Navy.

Decisive Internal Factors Precipitating the Decline of the Luftwaffe After the Beginning of the War

Extension of the War. Dunkirk, First Obvious Failure of the Luftwaffe. Self-Complacency over Brilliant Successes. The war early acquired an extension which in the beginning had not been foreseen. The Non-Aggression Pact and the secret agreement with Russia were intended to deter France and England from intervention. When they did intervene, the German Supreme Command strove to defeat one enemy at a time. This strategy succeeded up to and including France. The relative strength of the Luftwaffe and its technical armament had on the whole been adequate for the required operations, which had consisted almost exclusively of cooperation and coordination with the Army. Dunkirk, the first great failure of the Luftwaffe,

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was due to Goering's utter overestimation of Luftwaffe capabilities. Yet despite its superiority and small losses up to this time, the strategic limits of the Luftwaffe were already clearly recognized. These experiences were not, however, sufficiently evaluated. For purposes of propaganda, the early operations, which on the whole had been glorious, were played up. The result was a certain dangerous self-complacency over the technical and strategic advances achieved by the Luftwaffe.

Hitler's Stoppage-Order to Research and Development and Its Dire Consequences. Impressed by the rapid advance of his operations, Hitler intervened in research and development. He ordered the abandonment of all projects which could not be ready for introduction within two years. This measure was intended to accelerate the attainment of short-term technical objectives.

The order was never carried out to the letter. Long-term research work was continued, even though without the pressure of a requirement to be met and without the maximum funds to speed its progress. Thus, through the liberal interpretation of this order pregnant with severe consequences, there set in, instead of a vacuum, nothing more than a considerable delay in research and development. Even so, the significance of this shift in emphasis cannot be too greatly estimated, especially as regards V-weapons and jet-propelled aircraft.

Lack of a Clear Operational Plan for the Offensive against England. For the offensive against England there existed no clear plan at all. Consequently the strategic designation of targets changed several times, somewhat as follows:

a. Battle against England's supply line through attacks on ships and harbors.

b. Struggle for control of the air and extension of the all-out air war to all of England for the purpose of destroying her war production potential and of breaking England's will to fight.

c. Struggle for control of the air as a prerequisite for a combined landing operation.

d. Transition to the night air offensive.

Technical Factors Which Stood in the Way of Complete Success. The most important technical inadequacies for the accomplishment of these strategic tasks were:

a. Bomb carrying capacity: the bomb load carried per mission was too small.

b. Penetration depth: the radius of action of fighters and bombers was completely inadequate.

c. Too few fighters were available.

d. The intolerable performance of two German aircraft types, the

Ju–87 Stuka and the Me–110 twin-engine fighter, made it necessary to withdraw them from this operation.

e. The German standard He-111 bomber was at that time already inadequate in its performance with respect to ceiling and speed and its defensive armament. None of these met the requisites of a daytime air war against England.

f. There were neither control nor navigational procedures for these operations.

Breaking-Off of the Battle of Britain at a "Draw" for the Purpose of Mounting the Offensive against Russia. The preceding statements show that in armament and numerical strength the Luftwaffe was not yet sufficiently strong and superior, especially for a constantly changing strategic mission. To this circumstance was added the fact that day and, later, night operations could not be continued because of the seasonal bad weather. That was how the Battle of Britain, which, considered objectively, was by no means lost but rather was a "draw," stood when Hitler decided to crush Russia in a "strategic interlude." The reasons which induced him to make that decision play no part in the framework of this consideration. From here on the Luftwaffe was assigned a quite different strategic mission.

Withdrawal from the West for "Four to Five Months." The concentration of almost all forces to the Eastern front was planned to last four months, or at the most five. After that there were to be no further tasks of a strategic nature for the Luftwaffe on the Eastern front. Consequently the air armament plans did not undergo any change either. Quantitative increase at that time did not seem possible. This latter was a false estimate of the situation, since later it was proved under Milch's leadership that by stronger measures and a reduction in the number of aircraft types a considerably higher production could be achieved.

Victory in the East is the Prerequisite for a More Promising Continuation of War on the Western Front. When at the end of 1941 Russia was not defeated according to schedule, a spring offensive in 1942 was expected to complete the job. The air war in the West had to be further neglected, and even training capabilities had to be considerably reduced in favor of furnishing newly activated units for the Eastern front. The principle of "one opponent at a time" was still to be retained, although important prerequisites for that were lacking and the initiative in the air war in the West had passed to the British, if not yet to a strategic degree, and the Americans were already letting it be known what could be expected from them.

The Inititiative is Lost. No More Long-Term Planning. Main Concentration of Strength to Remain in the East. This would have

been just the time, in reaction to the above situation, to have effected a conversion in aircraft industrial production with the main effort concentrated on fighter planes—a measure which could have been accomplished easily by the cancellation of other aircraft and a long-overdue reduction in the number of aircraft types in the building program. But such highly important long-range decisions, planned far ahead, which are the very breath of life to an air force, were now seldom forthcoming. The few that did emerge were overridden by the requirements and exigencies of the moment. From this period on, the East-West two-front air war was characterized by the fact that until about the middle of 1943 as much of Luftwaffe strength was siphoned off to the Eastern front as could be withdrawn from the West by the application of a brutal yardstick. Not until the Allied strike against Hamburg in July 1943 did the strength ratio between the Eastern and Western fronts turn in favor of the West.

The Southern Theater of War. Effect of the Loss of Control of the Air and the Reaction of the Luftwaffe High Command. In the meantime the Southern theater of war, tieing up and attriting forces to a considerable extent, had also mounted operations. In August 1942 at El Alamein control of the air was unequivocally wrested from the Luftwaffe for the first time. Being hard pressed in the other theaters of war, the Luftwaffe High Command found itself forced to disregard the fundamental principle of modern war: that the first prerequisite for the operations of all branches of the Armed Forces is control of the air. It was impossible to make it understood that the fundamental conclusion to be drawn from this obvious loss of air superiority beginning with El Alamein should be to give priority to fighter aviation both in aircraft industry and in the conduct of air war. At this date such a shift would not yet have meant the changeover to the defensive. But instead the reasoning went as follows: if, because of their inferiority in performance and numerical strength, we can no longer commit our reconnaissance, our Stuka, and our ground attack planes, then we shall equip these units with fighter planes and everything will be all right again. By this measure a considerable number of aircraft, of which in any case there was already a shortage, were withdrawn from the fighter units and what was achieved was just the reverse of a resumption of the struggle for air superiority.

Overestimation of Flak Artillery and Lack of Night-Fighter Aviation in the Luftwaffe. The effect of German flak artillery, especially at night, was considerably overestimated, and it is a matter of common knowledge that the Luftwaffe entered the war without night fighters. "Night attacks? It will never come to that in this war," Goering had declared. Why he thought so is completely incomprehensible. The

greater the proficiency of the German Air Force and of German air defense, the greater the likelihood that England would indeed have to shift over to night operations. Much credit is due to Kammhuber, the organizer and creator of German night-fighter aviation. In the face of opposition and lack of understanding, and therefore with little support, he set up the radar and fighter-control organization as well as the night-fighter units according to an exceptionally masterly plan. However this was done only when nightly area conflagrations in western and northwestern Germany were already raging.

The Early Warning Organization and the Radar Network. Underestimation of the importance of radar techniques and its consequent neglect now had to be paid for dearly. The early warning organization, obsolete in every respect, just barely met the requirements of passive air defense. The chain of command relationships was so complicated that at first no tie-in with the new radar organization was possible and the latter had to be created as a parallel organization. Personnel and matériel requirements became astronomical.

No Night-Fighter Aircraft. No special night-fighter aircraft existed. Nor was any ever produced in any considerable numbers. At first the Me–110 twin-engine pursuit fighters were drawn upon. Naturally this caused a dearth of Me–110's on the Eastern front, where they were doing yeoman service in ground support missions; in the Southern theater; and on the Atlantic coast where, in addition to single-engine fighter interceptors, there was also an urgent need for fighter escort aircraft. In addition Ju–88 and Do–217 aircraft were needed for night fighting. That naturally increased the bomber production program at the expense of day fighters. We were caught short all along the line.

Failure of the German Air Defense System: British Jamming and Deceptive Measures. After the first flush of steadily mounting success in active defense by night fighters, the too inflexible German method failed when confronted with a change in British tactics in penetration flights. After conversion to a more flexible procedure, especially that of fighter pursuit, German tactics again suffered through mass employment by the British of active and passive interference measures. The jamming and deceptive actions of No. 100 Group of Bomber Command, RAF were masterful.

Single-Engine Night Fighter Aviation and Other Improvisations in Active Air Defense. Improvisations such as single-engine night interception over illuminated targets were of necessity affected by the same matériel requirements as special technical and aircraft production measures would have been. Despite much sound counsel, air defense was never permitted to be prepared for what was sure to come.

This was due in part to lack of foresight and planning, and often to the absolute unwillingness of the Supreme Command to admit the developments being made in enemy operations, even when they were clear-cut and substantiated by trustworthy intelligence. Furthermore—because of lack of forces—fighters, flak, and the mobile early warning and radar units were so constantly on the move that the saying came into fashion, "Here comes Air Defense arunning again after the last still-warm bomb crater."

Difficulties as to Jurisdiction in the Subordination of Night Fighters. Serious mistakes were made in subordination in the chain of command, which continued to be imperfectly resolved in the matter of jurisdiction. Night fighter aviation was subordinated to *Luftflotte Reich* (the Zone of the Interior Defense Command) and *Luftflotte 3* (3rd Air Force, France) instead of under a unified command. Never achieved was the logical subordination of day and night fighters, the early warning service, the radar and fighter control service, and the monitoring and jamming services under *one* territorial operational command for the conduct of active air defense. The lack of centralized command resulted in faulty cooperation, poor coordination, and a multiplicity of matériel requirements which curtailed the possibility for the development and improvement of the most important integral parts of active air defense.

The Me–262: The Unexploited Piece of Good Luck. Once again a tremendously great piece of good fortune was offered the Luftwaffe, already almost hopelessly inferior in number of aircraft. In spite of the 1940 stoppage-order on development, Messerschmitt and Heinkel each brought forward a turbojet fighter plane early in 1943. Neither British nor American developments were so far along. The capabilities of these fighters were so superior that for the first time all concepts of a numerical ratio could be scrapped. With these turbojet fighters in mass commitment against even four-to-five-fold numerical odds, air mastery over Germany might have been won back. There were several chief reasons for the Luftwaffe's failure to exploit these tremendous possibilities:

a. The stoppage-order on development;

b. The delay in the "green light" for mass production;

c. The lack of sufficiently high priority for the Me–262 in the armament program, starting from the beginning of mass production;

d. The employment of the Me–262 as a "Blitzbomber," which allocated this aircraft to bomber wings;

e. The complete dissipation of the monthly production of Me–262's among all possible types of employment. Because of overwhelming

Allied superiority in the air, all branches of the service naturally demanded this far superior aircraft.

f. The utter overorganization in the most varied chain of command relations for the operational employment of the jet planes and the appointment of special plenipotentiaries * and commissioners for their production when the realization struck home that in this field an incredibly great opportunity had been let slip and that an unconscionable lot had been done wrong. In all these questions Hitler had intervened with his personal decisions.

The He–162 "Volksjaeger" ("People's Fighter"). Toward the end of 1944, in an all-out effort, a new jet was intended to go into designing, testing, and large-scale production. In the remaining four months of that year and in the fifth year of the war the German armament industry did as a matter of fact achieve the start of mass production of this He–162 *Volksjaeger*. This fact, together with the simultaneous output of more than 2500 propeller-driven fighter planes per month and the constantly increasing mass production of the Me–262 despite serious inroads into the aircraft industry by Allied bomber attacks, proved what a development of Luftwaffe strength would have been possible with a timely concentration on this main point of effort. Had these capabilities been realized a year earlier, we would have halted the American day offensive. But the decision to concentrate on fighters was never willingly made on the grounds of a change in strategy. Rather it was forced on the High Command by the destruction of the synthetic oil industry in the middle of 1944 and by the loss of Romanian oil.—By the way, I was an opponent of the *Volksjaeger* project, in which I felt political fanaticism had replaced practical, tactical, organizational, and training realities. After the Me–262 and Ar–234, how could we in the Luftwaffe revert to the technical level of puberty in jet aircraft?

Hitler, Commander-in-Chief of the Army. The assumption of the Army High Command by Hitler, who therewith in one person was "Supreme Commander of the Armed Forces" and "Commander-in-Chief of the Army," had particularly unfavorable effect on the Luftwaffe also. Hitler was now necessarily induced always to consider the interests of the Army before those of the over-all conduct of the war and even more so before those of the air war. Proceeding from the notion that only he could lead the Russian campaign to a victorious conclusion and later that only he could halt the onslaught from the East, Hitler failed to appoint a "Commander-in-Chief of the Eastern Front" with full powers over the three participating branches of the

*Hitler and Goering had, for instance, each appointed his own special plenipotentiary.—Ed.

Armed Forces. Instead of that he personally commanded the divisions of the Eastern front from his headquarters in East Prussia and allocated the air support.

Attrition on the Eastern Front; Decline of the Luftwaffe. The unexpected bad turn which the Russian campaign took is therefore the real point of departure of the decline of the Luftwaffe. In the autumn of 1941, before the entrance of the United States into the war, Hitler had declared to me that he knew quite well that time was pressing for going back to the battle for Britain again. He said that the Russians were as good as beaten and that in a few weeks he would be able to demobilize 50 divisions of the Army and transfer them to the Luftwaffe and the aircraft industry. Instead of that the Eastern front held Luftwaffe units in its clutches for three and a half more years and methodically ground them down. Luftwaffe effectiveness became really nothing more than air support of ground forces on a numerically inadequate scale.

Ultimately it was not the Army which relinquished strength to the Luftwaffe, but vice versa. The Luftwaffe first organized its own field divisions, and then numerous "paratrooper" divisions, which had very little to do with parachutes, because of the lack of air transport capabilities and control of the air. Later quite radical surrenders of personnel were made to the Army until at the end, because of the lack of aircraft and aviation fuel, pilots and aviation cadets were enrolled into the last lines of defense. In this destructive line of progression lies an unusually tragic consequence for the Luftwaffe.

Effects of Allied Strategic Air Attacks

The British Night Air Offensive. Let us begin with the British night air offensive which, in its weight and area of destruction, soon assumed intolerable proportions, even when for the most part it did not directly strike at armament production capabilities. Only indirectly did the damage and destruction affect the Luftwaffe to a decisive extent.

The Tie-Up of Enormous Forces in Air Defense. The difficulties with which German night fighters, flak, the early warning service, and radar organization had to contend have already been touched upon. The amount of manpower working on overlapping objectives either in active night air defense or in the armament industry appeared to be oppressively heavy within the framework of the over-all manpower potential. If we also count in the personnel of the passive air defense, then we can talk literally about armies which night after night were engaged in the battle of defense alone and which were thus withheld from the armament industry or from the fronts.

Strength Ratio and Quota of Losses. I should like to answer the question as to whether our active air defense might have been in a position to check the night air offensive of the British by saying that mass attacks with several hundred bombers against a single target would in general not have been possible if German night fighters had in time had sufficient strength, the proper radar ground control organization, and its supplement of radar airborne instruments. In the main it was the ratio of attackers to defenders which determined the quota of losses in a mass break-through which, in time and space, had to be concentrated as closely as possible. The losses of the German flying units of *Angriffsfuehrer England* (Attack Leader England) which in 1943–1944 had to operate against England in an exactly reversed strength between attackers and defenders bear out this assertion. That the resultant excessive losses can force the discontinuance of this night offensive has likewise been proved by the British night air defense. On both sides flak always played an important supporting role but never a decisive one.

The Mortal Danger of Concentric Attacks. The fact that the range of British night bombers permitted a long approach flight over the North Sea or southward over the occupied territories, areas in which little in the way of a radar network could be provided, confronted German night-fighter aviation with additional problems. An intensification of attacks from the Mediterranean base of operations would have appreciably increased the difficulties for German defense.

The USAAF Day Attacks. The ideal strategic complement to the British night offensive was the American daylight air war. Like the British attacks, the American attacks also occurred from the west and to a less extent from the south. The logical distribution of the strategic round-the-clock offensive, the two directions of attack from the west and from the south, and the extensive area to be defended, together with the sheer numerical increase in attacking strength, brought German air defense face to face with the three most difficult problems. However, a stronger activation of the base of attack in the south and the establishment of such a base in the east would have confronted the German defense system with insuperable problems. Without having underestimated the logistic and political difficulties of that time, this possibility was always taken into account with concern on the German side.

Weaknesses of the Master Plan. I am far from considering the Allied bomber plan, the so-called Master Plan, as strategically creative. Also it repudiated the fundamental principle that a branch of war industry must be destroyed thoroughly and repeatedly. It gave the impression of being a series of compromises which finally included "a

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little of everything." Quite questionable objectives from a strategic point of view were represented.

It is beyond my purview in this paper to go into detail about the direct effects and consequences of the Allied strategic air offensive. This subject is exhaustively treated in the Speer Report (Speer, Reich Minister of Armament and Production during the war, has written, by order of the Americans, the most authoritative report on the effectiveness of the Allied air offensive). I shall only mention once again that neither the attacks on the aircraft plants nor those on fighter bases had any lasting effect. If, instead of that, the USAAF had destroyed the few German aero-engine works, the situation for the Luftwaffe would have become desperate much sooner and faster. In the same way its supply lifeline should have been struck and destroyed by earlier and more systematic destruction of the synthetic gasoline and the high-explosive factories. A different selection of targets and priorities, less changing from one target category to another, and adequate repetition of attack would have broken the backbone of the Luftwaffe and of its strategic war potential more quickly, with less expenditure of manpower and matériel, and more conclusively.

No Day Bomber Offensive without Fighter Escort. The USAAF furthermore had to learn from its own experience that day bomber formations without fighter escort cannot hold their own against fighter defense (as at Schweinfurt). The German bomber formations over England in 1940 had already found their limitations to be the radius of action of the fighter escort. That situation was not changed even in 1943 in spite of larger aircraft with defensive armament four to five times as strong. The effectiveness of flak was greatly limited by the high operational altitudes of attacking aircraft.

Air Superiority of the USAAF in the Field of Fighter Escort. The consistently increased range and penetration depth of American fighter escort was no surprise. It was the only possibility for successfully continuing the offensive of the strategic air war by day. Germany had accurate and certified data on American building programs and production figures. Air superiority over Germany shifted from day to day more and more in favor of the Americans because of their unequivocal and constantly mounting numerical superiority and penetration depth, especially of the fighters and only indirectly as regards the bombers. However, this knowledge, insofar as it was accepted by the High Command, produced no remedial action.

Almost Systematic Change-Over to the Strategy of Defense. After the catastrophe of Hamburg (July 1943), occasioned by a series of mass day and night air attacks, it was apparent that the moment had come to change over the concept of the German conduct of the air war

and that of the aircraft industry to an unequivocal concentration on air defense. Goering had called together all the interested leading personalities of the Luftwaffe and the aircraft industry. There was complete unanimity over the necessity of prevailing on Hitler to make the decision and to give the order for the air strategy of defense. After Goering's briefing Hitler made just the opposite decision, calling for the creation of an *Angriffsfuehrer England* (Attack Leader England); an increased production of bombers, especially of the He–177, the Ju–88, etc.; and a renewed and stepped-up resumption of the night air offensive against Britain. In Hitler's mind, the only rejoinder to terror was terror. Political, ideological, and psychological points of view were again placed above strategic logic. Despite better judgment, Goering gave in.

Air Superiority by Day a Question of the Strength Ratio. Toward the end of 1943 a full-strength Luftwaffe commitment against a large-scale American penetration flight with fighter escort mounted at most 300 fighters (including night fighters and twin-engine fighters in emergency day use). At this time the answer I gave Hitler when he asked what should be done to force the USAAF to discontinue the mass day air attacks was that fundamentally it was only a question of the operational strength of German fighters in day air defense. I guaranteed him that with a number of fighters three times that of the force of American four-engine bombers flying in by day, the Reich and the West could be so defended against bombers, whether they came from British or Mediterranean bases, that the Americans could talk no more about a strategic day air offensive. The attainment of this objective would, however, have presupposed the change-over to the strategy of air defense. And Hitler was an opponent of every concept of defense. Instead he harbored the illusion until the end that he could still retain the principle of offensive action.

Finale. In April 1944 the number of bombers in the production program was again raised, although the Production Board had recommended their elimination altogether. Subsequently bombers continued to be built until no more gasoline was available for their test flights and they had to be reduced to scrap on the very same airfields on which they had been built. Everything that was done from this moment on to multiply the number of fighters in Reich defense was destroyed by Allied superiority and the Normandy invasion. The daily commitment of forces of the strategic and tactical forces of the British and Americans was twenty times more than the numerical strength of the Luftwaffe at its peak. The times of opportunity had been let slip, and it was finally too late to alter anything in the course of events.

The last significant reserve build-up for a fighter arm reinforcement capable of real striking power was thrown into battle shortly before it would have been ready. But not into the strategic defense of the Reich. Hitler ordered it into support of the Ardennes offensive. This measure finally broke the back of fighter aviation—and that was now almost the entire Luftwaffe. Thick and fast the orders which had been due a year ago came tumbling down, together with others that increased the wide-spread confusion. In the general inferno not one of these orders could achieve strategic significance.

In the end the Luftwaffe was torn apart between the remaining poles of power. Long since, Goering, the founder and Commander-in-Chief of the Luftwaffe, had ceased to be one of these.

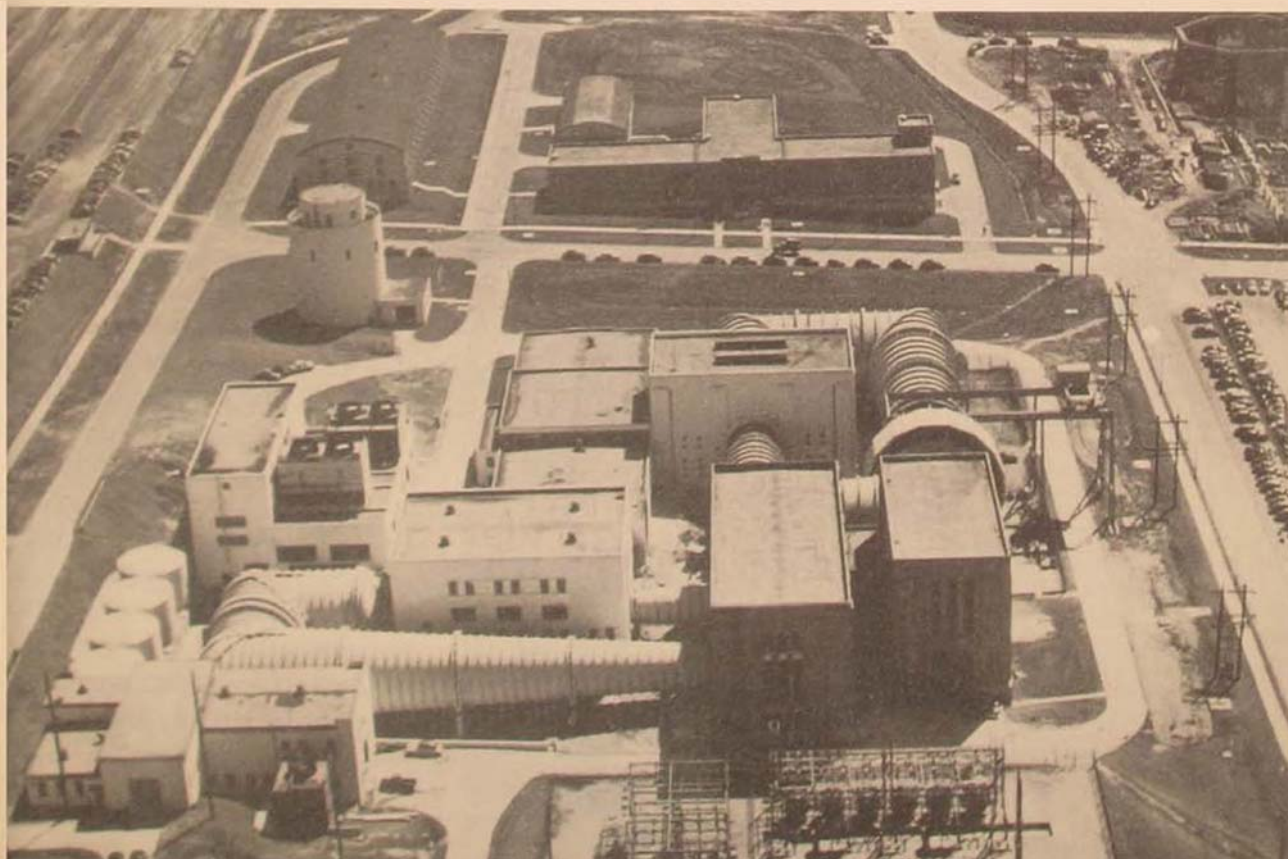
Buenos Aires

Aircraft Laboratory

When the USAF announces a new combat aircraft that flies at sonic speeds and extreme altitudes, climbs thousands of feet per minute, and possesses the fire power of an infantry battalion, the layman generally expounds complacently on the achievements of the American aircraft industry. And it is right that he should. But if pressed to explain what part the Air Force has in the design, building, production, and testing of a new aircraft, he might be puzzled, thinking that the Air Force merely tells the manufacturer what performance it must have from the finished product.

That is far from the way the Air Force buys a new aircraft. Bulking large in the procurement process is the Air Research and Development Command. The most important job of this entire command is to see to it that the Air Force and its aircrews are furnished with the most advanced and reliable aircraft and missiles, electronic systems, weapons, and personal equipment that it is possible to obtain and that all of these components are integrated in planning and research so that the aerial weapon is the best possible to do its assigned job. The maintenance of high standards is not left to chance. Thousands of Air Force officers and civilians are woven into a vast network for planning the purpose of each type of aircraft and drawing up detailed specifications for its performance. They reduce costs by showing contractors ways that they can use standard Government parts. They do supplementary research on problems posed by each new advance in speed,

The main section of the Aircraft Laboratory at Wright-Patterson Air Force Base, Ohio. In the foreground is the massive series of wind tunnels. The round, concrete building at the upper left is the vertical wind tunnel. In the center background the long T-shaped building is the Aircraft Laboratory Administration Building. Behind it is the small building of the Instrumentation Laboratory. On the flight line—not shown in this photograph—is the special hangar known as the Static Test Building.



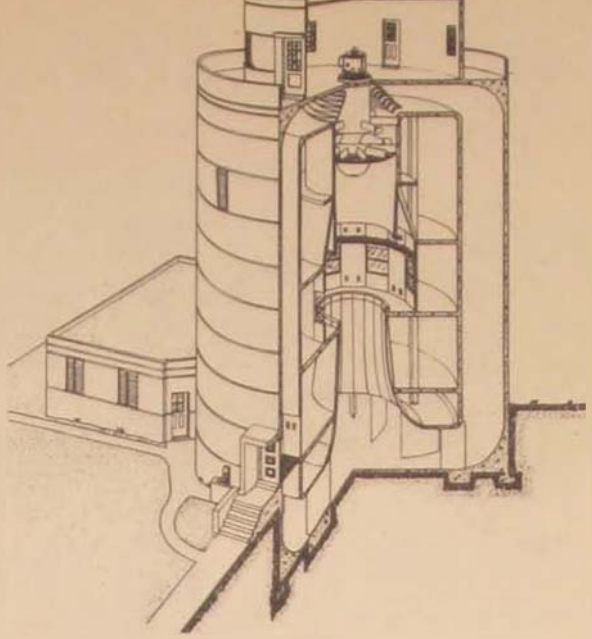
altitude, and range. They test each component of a new aircraft exhaustively for reliability and durability under all flight and weather conditions.

Since 87 per cent of the Air Force research and development budget is allocated to civilian organizations, a need remains for centralized monitoring and checking facilities under Air Force direction. In one of the nine centers of the Air Research and Development Command, the Wright Air Development Center at Wright-Patterson Air Force Base near Dayton, Ohio, the USAF has a larger staff assigned and more capital invested in research, development, and testing equipment than the largest aircraft manufacturing company could afford. The main concern of most of the twelve laboratories of the Wright Air Development Center is with the aircraft and its components during the planning and test-model stages, although they do follow each aircraft type and component throughout its service life, taking care of modifications and "Unsatisfactory Reports."

One of the twelve laboratories is the Aircraft Laboratory. It is responsible for the research, development, design, and tests required for continuous improvement of the airframe and airframe components of USAF aircraft and guided missiles. A brief survey of the Aircraft Laboratory's research and testing facilities for the airframe and one of the components, the wheel, will suggest the thoroughness and complexity of the work which the Air Force research, development, and testing network applies at various stages in the life of every USAF aircraft type, from birth to death.

The requirements in performance and mission capability for a projected aircraft are established by Headquarters USAF. The design section of the Aircraft Laboratory then goes to work on its contribution to the detailed specifications that must be furnished to the aircraft company selected to build the aircraft. Preliminary design studies determine the general features of the aircraft. These studies must compromise theoretical and practical requirements to set up a sound basis for preliminary design—compromises such as the one between the thick wing desirable for structural strength and the

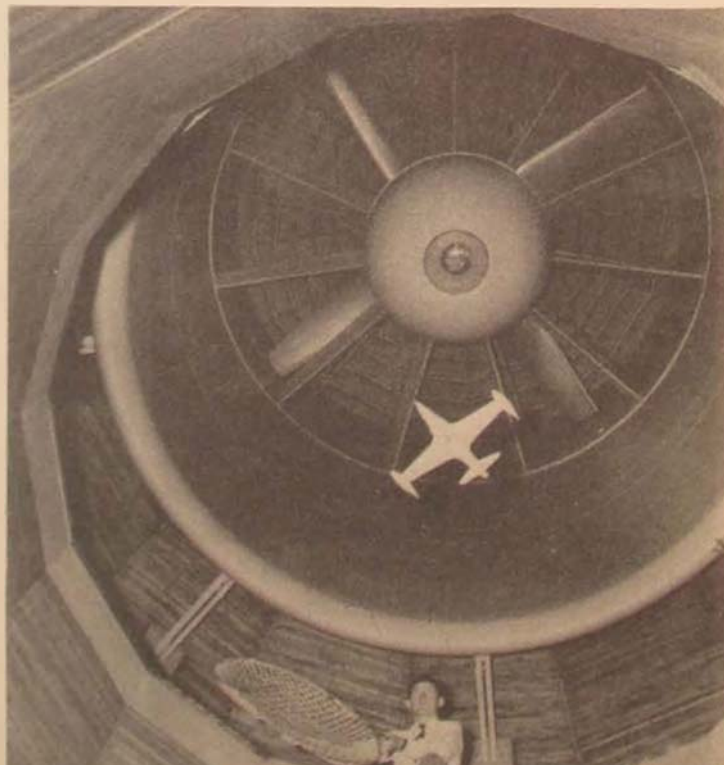
An aircraft fuselage with wing roots is in position for testing in a subsonic wind tunnel. Testing aircraft fuselages with and without engines comprises about 70 per cent of the work for this tunnel. Other wind tunnels at Wright-Patterson include a transonic tunnel, a small supersonic tunnel, and a vertical wind tunnel. These tunnels permit research in the aerodynamics of fuselages, wings, tail surfaces, and other external airframe components.



Unique among the wind tunnels at Wright-Patterson Air Force Base is the $750,000 12-foot vertical wind tunnel. This cross-sectional drawing shows its general construction. A 1000-horsepower motor located at the top provides the tunnel a Mach range of 0.13.

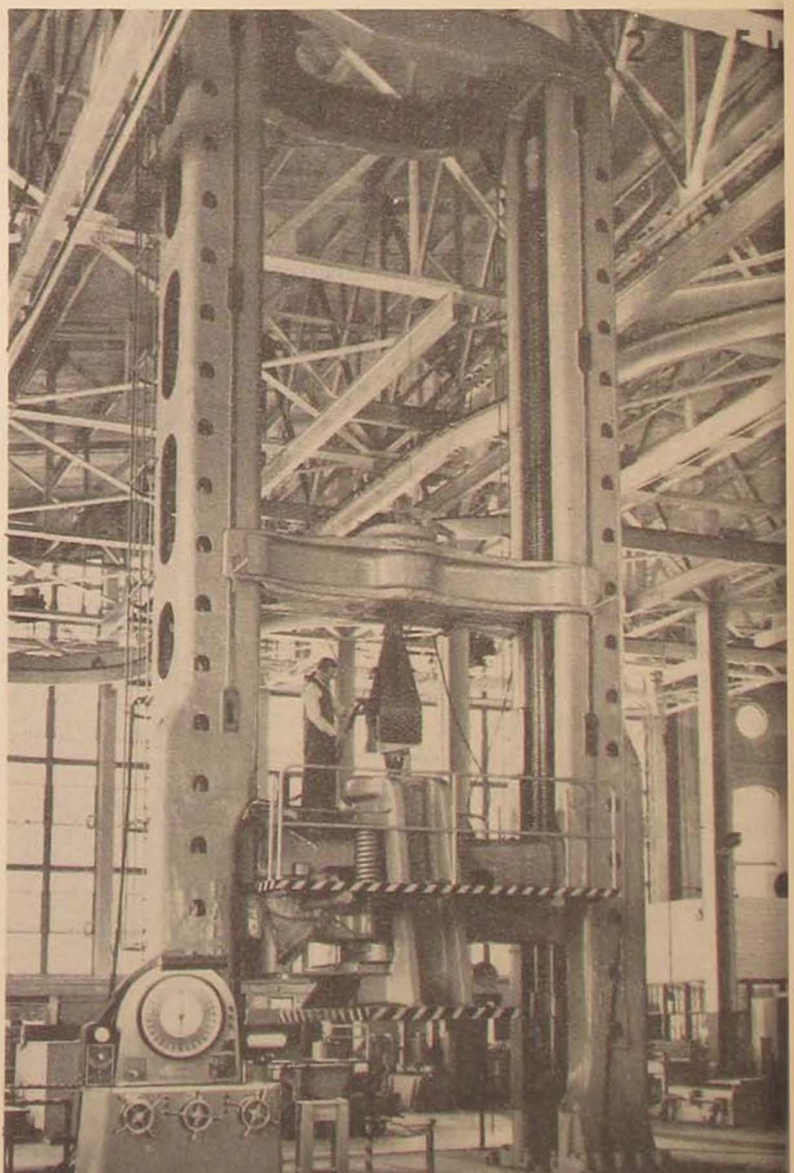
extremely thin wing desirable for best aerodynamic performance. Data from the preliminary studies are used again in evaluating the formal design proposals of the contractor and later in evaluating his final product.

As part of this procedure all phases of the aircraft's development are monitored with regard to aerodynamical features by the Aircraft Laboratory, which conducts both theoretical and laboratory aerodynamic investigations on its own and by sponsored research. Aerodynamic design is tested in the Wright Air Development Center wind tunnels, with both scale models and full-sized aircraft. The six wind tunnels include subsonic, transonic, and supersonic tunnels, with a 12-foot vertical wind tunnel used primarily to test spin characteristics. These tests all seek information on the flow of air around bodies and lifting surfaces. Or in a new investigation called "internal aerodynamics," they reveal the efficiency of various shapes of ducts and inlets which allow air to flow through bodies. Outside research is sponsored in such subjects as stability and control, methods of drag reduction, and methods for measurement of high-speed flow phenomena.

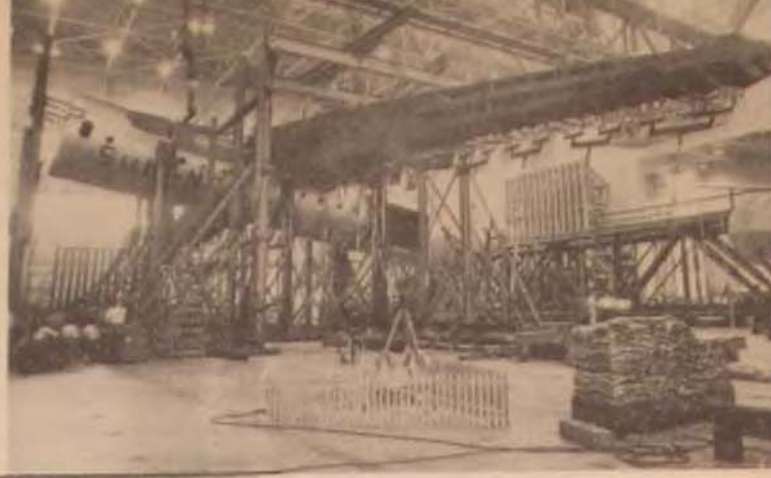


Inside the vertical tunnel a test model is being put through its aerodynamic paces in the air blast generated by the big fan. Vertical tunnel tests are divided between spin investigations—90 per cent of the work load—and parachute load and stability tests.

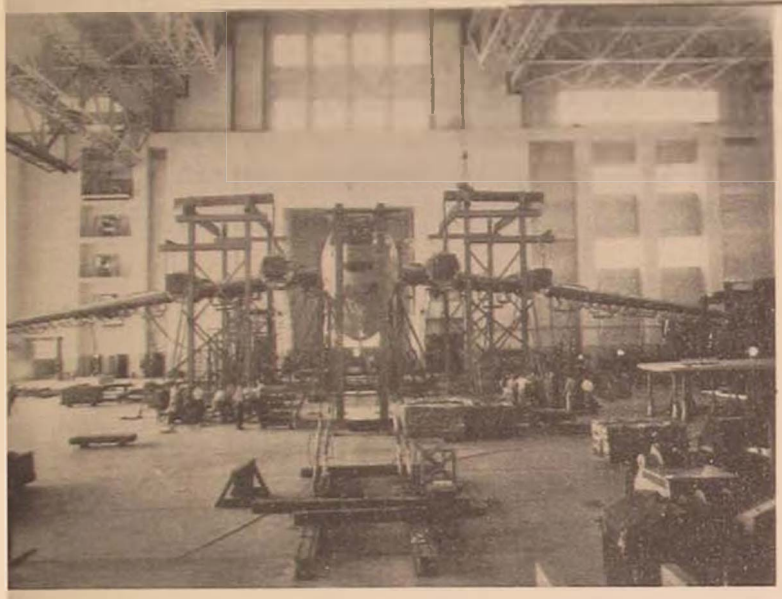
One of the dynamic tests is shown above, as an engineer painstakingly calibrates this model of an F–89 wing and aileron in preparation for flutter investigations.



This huge 3,000,000-pound compression and 1,000,000-pound tension testing machine towers 40 feet high, with its operating mechanism 20 feet beneath the floor. Accessories adapt it for wheel and tire testing.



Airframes undergoing static tests. Hangar floor space is 250-by-170 feet. The main overhead crane can lift 300,000 pounds on the main hook, 50,000 pounds on the auxiliary hook, and an additional 20,000 pounds can be accommodated on the monorail hoist.



The test pressure is terrific. The tie-downs in the 30-inch thick concrete floor can withstand 10,000 pounds of tension every five feet in any direction. These facilities can duplicate any conceivable strain to which an aircraft might be subjected.

Dynamics tests on USAF aircraft deal with vibration, flutter, noise, and dynamic load problems. Vibration is inevitable in powered aircraft, but it can be greatly reduced and its effects can be offset by the development of antivibration devices, such as dynamic mountings for propulsion systems. Flutter is the self-excited vibratory instability of wings, stabilizers, or fins and their associated control surfaces. Other vibratory effects of lifting and control surfaces which must be anticipated or remedied are the unique ones occurring at extremely high airspeeds. Dynamic loads are the additional pressures of impact to which the airframe is subjected, as in landing, flying through rough air, or firing its guns. Noise in the aircraft is the concern of a group that formulates scientific standards for measurement of aircraft noise and vibration and sets up and operates test instruments for its measurement.

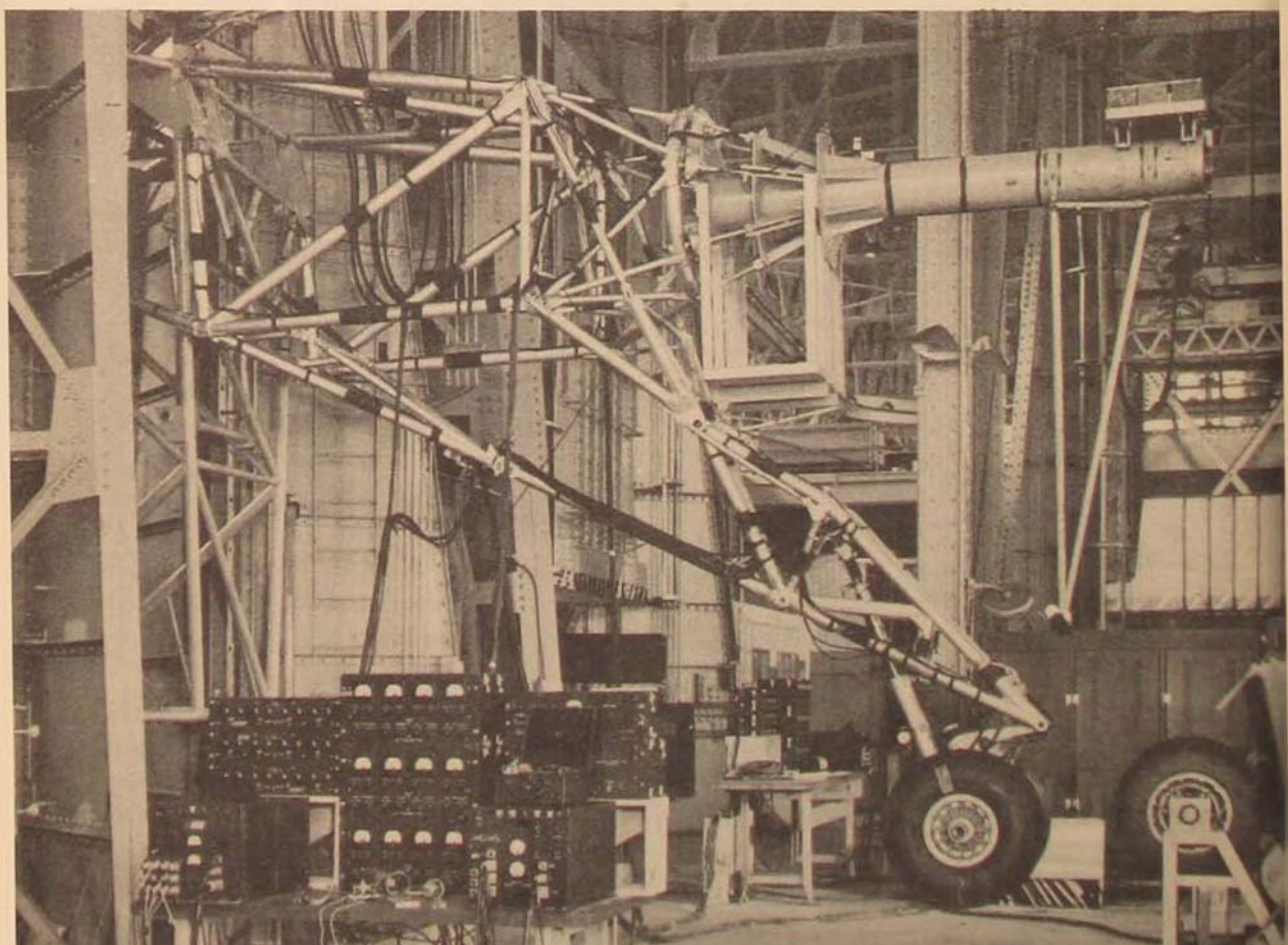
The actual structural strength of an aircraft is measured once by theoretical analysis, again by stress tests in the laboratory, and a third time by a series of flight tests. Laboratory tests include static, dynamic, and fatigue tests. The Static Test Building, a 250-foot-by-170-foot hangar with a heavily reinforced concrete floor and huge overhead cranes, can accommodate six different aircraft at one time for testing. Under ideal conditions a fighter aircraft could be static tested in two months, a medium bomber in four months. Tension patches, hydraulic cylinders, or dead load provide test loads.

While the basic airframe of the aircraft is researched and tested, the integral airframe components, such as hydraulic systems, wheels, tires, bearings, valves, hose, all undergo comparable testing in other sections of the laboratory. The wheel and brake assembly, for example, is analyzed and tested

from the time the specifications are drawn up for the manufacturer through inspection of the mock-up aircraft, examination of its first installation in the aircraft, and flight testing in the field. In fact, analysis and testing continue during the entire operational life span of the assembly to remedy any service difficulties which crop up. An inertia brake-testing machine can test the brake-wheel-tire assembly at load pressures up to 300,000 pounds and at speeds up to 250 miles per hour. Other machines test tension and compression, balance, and even the metal in the wheel itself. As for all components, strenuous efforts are made to standardize each item to make possible its use on as many other aircraft as is possible. For example, brake, wheel, and tire components are furnished to the aircraft manufacturer by the Government. Contractor components such as the hydraulic system must be tested and approved by the Aircraft Laboratory.

What the Aircraft Laboratory does for the airframe and its components, the other laboratories at Wright Air Development Center and in other Air Reseach and Development Command Centers do for the vast array of components and systems that go together to make a modern aircraft. The Air Force knows what it is getting when a new aircraft rolls off the assembly line.

Hydraulic landing gear, wheels, and tires are subjected to tremendous strains in d tests. The bank of instruments (at left) connects with strain gauges. In the b ground are three large drop testing machines, producing pressures from 250 to 1 000 pounds. The spin-up rig (lower right) whirls test wheels at extreme spe



Clausewitz and Strategic Bombing

Captain Robert H. McDonnell

SINCE the collapse of the Japanese Empire in 1945, the vital function of a strategic bombing force in the military structure of the United States has stood incontrovertible. Yet in nearly every established area of military thinking, both in the United States and abroad, strong opinions still hold to the argument that strategic air power is at best an auxiliary force, incapable of producing a decision in its own right. This contention is supported by an impressive array of authorities—people whose sincerity cannot be impugned and whose arguments are based on their interpretation of experience and tradition.

Among the very best of these critiques is an absorbing and characteristic little book which appeared in Great Britain in 1946. Written by Admiral Sir Gerald Dickens and entitled *Bombing and Strategy—The Fallacy of Total War*, the book is a thoughtful attempt to discount the decisive nature of strategic air power by labeling its employment a digression from the fundamental principles of war. "With the rise of the air forces," wrote Admiral Dickens, "a new strategic doctrine was born. This doctrine differed from previously held convictions in that the latter were insistent on the principle that the subjugation of an enemy country was best accomplished by defeating its armed forces in battle."

Certainly there is nothing new in such pronouncements. We have encountered them only too frequently in the years since the end of World War II. They have found expression in academic debates, in the legislative houses of several nations, in the memoirs of professional soldiers, and even within the Air Force itself. As arguments they are most destructive to a correct understanding of a new and valuable method for the employment of telling weapons against the vitals of an enemy nation. They are destructive because they stem from the very roots of traditional military thinking and therefore thrive wherever professional soldiers gather. They possess, in effect, a *carte blanche* in the established areas of military thinking. They raise all debate above the level of weapons and aircraft and insist upon dealing in first principles. And in so doing they exert a marked influence upon those minds which must make the final decisions how our military structure shall be constituted, and how, with what weapons and methods, it shall be employed.

Dr. Robert M. Hutchins once remarked that the worst kind of

troublemaker is the man who insists upon talking about first principles. But we should not find such an opponent to our disliking. If his argument possesses even the essence of validity, we shall have learned a great deal about our own weaknesses as we seek to counter the strong points of his theory. Indeed there can be no better base from which to argue a case than the ground of first principles. This is no less true for strategic bombing than for the concept of war itself.

Despite variations in form and content virtually every standard criticism of strategic air power stems from a single source. This source is the principle of war which calls for the prior destruction of the enemy's *military* forces as an absolute prerequisite to victory. The principle is not a new one. It has been repeated on countless occasions in support of the traditional concepts of strategy. It is the original dictum of the renowned German theorist, Karl von Clausewitz.

Perhaps no military writer in the past two hundred years has dominated military thinking in the manner of Clausewitz. His success in itself is a tribute to the great potential for good which lies in the analysis of basic principles. His books, for the first time in a thousand years, catalogued the elements which constitute the employment of force as a final arbiter in the affairs of nations. It is impossible to overestimate the influence his theories have exerted upon professional soldiers everywhere. The broad lines of strategy in World War II all bear the indelible stamp of Clausewitz.

More difficult to appreciate are the myriad deviations, conclusions, assumptions, and extensions of thought which continue to emanate from Clausewitz' writings. This breeding potential for new and more expansive theories is inherent in any statement of basic theory, and Clausewitz is no exception. Once a keynote has been struck, the flood of individual and limited concepts follows, and in each concept there appears a special subjective effort to justify a particular case, to hammer and mold it into absolute conformity with the general rule. Conversely, for each opposing concept there exists the apparent obligation to discredit it by marking all the ways in which the disputed concept deviates from the accepted general rule. Thus objectivity is stifled and dies.

Probably no better targets for such intellectual sharpshooting exist than the writings of von Clausewitz. For the practitioners of a profession which, in the great man's own opinion, deals heavily in uncertainty, a set of ironclad rules is an understandable panacea. The trend has been to derive these dicta from the writings of Clausewitz. But Clausewitz, if he ever intended to impart anything to his students, certainly taught over and over the tremendous need for flexibility and

adaptivity in the application of basic theory. The tendency to read into Clausewitz meanings that were never intended has played havoc with our objective thought processes for many years. The Germans themselves were notable extremists in this regard. They seized upon Clausewitz' boldest outlines for total war to the utter exclusion of his modifying principles. In our own post-war military structure Clausewitz has suffered long and arduously at the hands of contenders who insist upon pulling his lines from context to prove particular points. And as a result we find that we have been invited to debate the case for strategic bombing not only with contemporaries, but with Alexander, Jomini, and Frederick the Great. The inherent defect in such an invitation is that it ignores completely the real need for a closer examination of Clausewitz' principles. When the results of this examination are combined with objectivity, we see that strategic bombing has not created a new strategic doctrine, but instead has made available a new and potentially decisive instrument for the accomplishment of traditional objectives.

The very statement that the prior destruction of the enemy's armed forces is an absolute prerequisite to victory is an unparalleled example of the misinterpretation to which Clausewitz has fallen prey. Studied and read in his entirety, he never intended such a meaning at all. Yet one of the most effective arguments against strategic bombing continues to be the contention that no amount of destruction to the vitals of an enemy's national structure can induce a collapse so long as his armies are not destroyed.

WHAT did Clausewitz actually seek to convey by this principle? In his own words, "the military forces must be destroyed, that is to say, *put into such a condition that they can no longer continue to fight.*" (Italics are mine.) Immediately thereafter he goes on to say, "we take this opportunity to explain that in what follows the expression destruction of the enemy's military forces is to be understood only in this sense." Here most clearly lies the key to von Clausewitz' meaning. By positive definition of terms he states that his use of the word "destruction" connotes a condition of the enemy's forces in which they can no longer carry on the fight.

But he does not leave the clarification of principle at this point. In his discussion of the ends and means in war he draws an even clearer picture:

> We see that there are many ways to our object in war, that the defeat of the enemy is not in every case necessarily involved, that the destruction of the enemy's military forces, the conquest of enemy provinces, the mere oc-

> cupation, the mere invasion of them, enterprises aimed directly at political relations, and lastly a passive expectation of the enemy's onset—that all these are means which, each in itself, may be used to subdue the enemy's will, according as the peculiar circumstances on the case lead us to expect more from the one or the other. . . . We may say that the number of possible ways of attaining the object in view rises to infinity.

From these words we can draw only one conclusion: the inescapable fact that Clausewitz acknowledged in all its forms the changing character of war, and what is even more important to our problem, the thousand subtle influences by which the objects of war are achieved.

Those who use these points against strategic air power by claiming a background of first principles thus find an initial setback in their own limited interpretation of von Clausewitz. They find that they have built their argument upon a false structure, upon a tenet which in reality is not a basic principle at all, but only an incomplete fragment of Clausewitz' complete and original hypothesis. In justification of their denial of the effectiveness of strategic bombing as an instrument of national power, capable of achieving a decision in itself, they have sought to use Clausewitz' principle of destruction but have passed over the interpretation that the author himself imposed upon it. And in trying to convince their contemporaries that there is only one road to victory, they have ignored every other road which Clausewitz pointed out to them.

Certainly the old master deserves a kinder fate than this. It seems only fair to him and to the Air Force to point out the fallacies of those who disagree with us. In so doing we do not diminish the need for a resounding proof of our own concept. Such a proof is not only possible, but when its lines are drawn clearly, it stands as a confirmation of those guiding principles most characteristic of von Clausewitz.

The key to a correct understanding of strategic bombing is tied to Clausewitz' statement of the "peculiar circumstances" encountered in every war. Just as Clausewitz pointed out the multiplicity of ways to achieve the object in war, "according as the peculiar circumstances of the case lead us to expect more from the one or the other," so do we in our own time find ourselves faced with a multitude of situations, each unique and each demanding its own special application of arms to achieve national objectives. Surely none of us can escape the reality that we do not engage in standard, stereotyped wars but rather in particular wars against specific enemies under circumstances not wholly unexpected.

Strategic bombardment is a method of weapons employment designed to win just such a particular war. We cannot avoid, however much we try, the inevitable fact that this country is engaged in

a battle for the minds of men. The resort to force is only an extension of the battle, in one sense only a phase of the battle, and it is not necessarily the final phase. The initial phase is normally the time of mounting tension in which conflicting wills, seeking expression through the voices of governments, contend for ascendancy over each other. The middle phase may well be the resort to arms, but the clear-cut lines which in the past delineated the beginning and end of armed conflict do not now provide the same sharp contrast to the war of words. Our own times afford innumerable examples of this mixed transition—such as the Berlin Airlift, Greece, Indo-China, and the Korean stalemate. Activity of the middle phase is both mixed and sporadic, and subsidiary battles are won and lost by combinations of diplomacy and force and in many cases solely by the deterrent effect of forces representing a threat to one of the contenders. The ultimate extension of the middle phase is a general war.

The final phase often is marked by a cessation of armed hostilities, an ostensible period of peace. But the battle still goes on. For so long as our ultimate objectives are the minds of men, we are bound to pursue the conflict until we have captured those minds. The last phase goes far into the period of peace, wherein we seek to educate, to influence, to impress. But it remains a conflict, and it still calls for a wise employment of ways and means. In our own century, this battle to win the minds of others has resolved itself into a crusade against brutality and inhumanity. Over a span of only fifteen years we have had arrayed against us certain political entities whose sole objectives have been the suppression of human rights, the extinction of human dignity, and the reduction of free man to the status of a will-less servant of the state. Our national objective, however blurred it might be at times, has been to bring sanity to these political entities, to restore man to his individual dignity, to wipe out government by terror, and to convince those peoples who have lived with these crimes that life can have purpose and worth.

In the course of this battle we have been obliged to resort to force on a number of occasions. We have learned the need for a proper military establishment. What we seem not to have learned is the need for the very special design of this establishment. As we have seen, Clausewitz recognized quite clearly the "peculiar circumstances" of individual wars. Today the United States is faced with a combination of such circumstances, and with an enemy whose identity is neither unknown nor obscured. The objectives of this enemy are clearly stated, and his major intentions are self-evident. It remains for us to design the military establishment with which we may be required to oppose him.

The problem thus becomes one of choosing the instrument which can most effectively and economically accomplish the task. We are under no obligation to make this instrument conform to tradition or standard design. It must be capable of only one thing: accomplishment of the objective in a better way than any other instrument. If it were possible, for example, to achieve the objective by introducing teams of expert saboteurs into the enemy nation to destroy his vital centers sufficiently to cause capitulation, this method would be perfectly acceptable. If it were possible to achieve the objective by economic strangulation alone, we would be under no obligation to look further for a solution to our problem. Naturally these examples are simplifications of existing conditions, but they serve to remind us that each case must be judged on its own merits and that, all things considered, the day may come when such seemingly simple actions could produce the desired results. There is nothing in all of recorded history which binds us to the ground battle as a sole method for achieving victory—nothing but our own reluctance to seek a better method. Surely we can envision the day when new weapons and the means for their delivery will render even air forces as we know them obsolete. In this search for an instrument and a method to achieve our objective we cannot afford to be either subjective or selfish. The only standard by which a system can be judged is its capacity for doing the job.

The concept of strategic bombing represents a combination of two elements: the modern weapon of mass destruction and the vehicle by which this weapon can be delivered most effectively. The atomic weapon has no counterpart in the modern military force. Delivered in sufficient concentration and with sufficient accuracy, it can wreak a degree of destruction which no industrial nation can stand for long, much less supply its own armies or its satellites with the tools for offensive action. There are many individuals who contest a reliance upon weapons or weapons systems, arguing that the principles of war are the major determinants in any conflict and that even superior weapons exert only negligible influence. History refutes this attitude at every turn. Consider the effects of gunpowder, the cross bow, the submarine, the advent of Mongol cavalry, even the use of mass armies by the Communists in Korea. They are all examples of the employment of specific weapons to achieve objectives. Strategic bombardment is in every sense a weapon, or, in the final analysis, a vehicle facilitating the delivery of a weapon. As such it assumes none of the marks of a new doctrine, nor does it seek to abrogate established principles. But as a weapon, strategic air exhibits a potential decisive nature unique in the history of warfare.

Superior weapons soundly utilized can exert a tremendous influence upon the outcome of any military action. The strength of the American nation has rested consistently on these factors of superior arms, equipment, and services. The atomic bomb is only one step in this striving for superior weapons, but it is a step which has given us at least a temporary advantage over a potential enemy. As this advantage of the weapon diminishes, we are brought face to face with the second element in the concept of strategic bombing: the vehicle by which the weapon is delivered. The development of this vehicle, along with the production of the hydrogen bomb, constitutes whatever immediate advantage we may possess over the enemy before us. While the long-range strategic bomber still lacks the refinement to make it the perfect component of a weapons system, it nevertheless packs, pound for pound, the most economical punch known to man. When this vehicle becomes, as it will in the near future, an all-jet aircraft capable of operating from the continental limits of the United States with electronic bombing devices of improved accuracy, we shall possess a sufficiently devastating combination of weapon and vehicle. True, it will still be susceptible to interception. But if the experimental research advantage is maintained, if the atomic engine is developed with reasonable success, we shall maintain superiority over the potential enemy and so strain his industrial processes that he will be hard put to devise adequate defenses against our offensive force. By the same token we can so turn his productive effort toward the building of defensive systems as to hamper the production of his own offensive power. The key to success will be the maintenance of technical superiority. There is no single weapon, other than eternal vigilance, that will provide us with unqualified security.

Those who discount the value of strategic bombing as a primary offensive system favor a number of standard counter-proposals. One such proposal is the concept of balanced forces in the form that insists a properly constituted fighting machine is derived from an equal distribution of money, manpower, and matériel among land, naval, and air components. Around this concept swirls the never-ending battle for appropriations. It is entirely conceivable that such a force could be desirable under certain circumstances and against a certain enemy. But those circumstances and that enemy do not exist today, and the concept of the balanced force is rooted in the traditional consideration that dictates a parity of land, naval, and air strength regardless of the strategic situation at hand. Such an attitude represents only a stubborn unwillingness to face the fact that we are paired off with an enemy who is neither nebulous nor fictitious,

244060 O - 53 - 7

but who actually exists, conditioned and molded by physical realities of economy, geography, and ideology.

We would be worse than foolhardy if we reserved anything but our most devastating force for such an enemy. Consider, for example, the nature of the Soviet Union today. Before us we have the prospect of a Eurasian land mass so extensive in depth as to defy the imagination, into whose land area alone we could fit the combined areas of Canada, the United States, Mexico, and Central America. If the Siberian Arctic limits of the Soviet Union were superimposed on the British Isles, her western limits would lie beyond the coast of California. Into this land mass put some two hundred millions of people living in a span of cultures, terrain, and climate unlimited in scope. Add to these physical quantities the populations of Communist China, the Balkans, and those areas of Asia which linger even now in the tentative grasp of Communism. Then consider the prospect of a traditional war against these formidable combinations. We could not hope to penetrate such a fortress in a hundred years, even with a lavish expenditure of manpower and the help of strong allies. Even if we could, we would so ravish the earth over which we moved that its reconstruction would claim the labor of generations. Korea, a relatively limited operation, has demonstrated the terrible attrition in men and arms inevitable in such a process. And in submitting to these influences, we would be fighting not on our own terms but on those of the enemy.

In the light of these facts it is possible for us to turn to strategic bombing and to note that we possess therein the single military force capable of winning a decision against this particular enemy, should the need arise. This force must be tailored to meet a specific enemy and a particular circumstance. A hundred years from now, some other device, infinitely more complicated or perhaps much simpler, may prove equal to the conditions or the times. But we are now in the middle of the twentieth century, at a precise moment in history, opposed by inescapable realities. Strategic bombing is the instrument which can *reach* the enemy. It is the device which, in Clausewitz' words, can put the enemy's military forces "into such a condition that they can no longer continue to fight." By developing and training such a force to a high peak of performance, we shall have attained a specific instrument designed to achieve the national objective against a specific enemy. We shall have avoided the creation of a military establishment which, however

equally constituted, would be unsuitable for the translation of our fullest technical capability into offensive power.

The problem which should be of first concern to those charged with the execution of this method is the development of an unparalleled operational technique for the accurate delivery of weapons. This technique can never become static if performance is to keep pace with the technological superiority of American industry. The people who operate the vehicles and drop the bombs must exhibit an improvement comparable in quality to the equipment they use and superior in tactical employment to the defensive systems of the enemy. The record of strategic bombing in World War II is mentioned frequently to dispute the claim that the heavy bomber possesses a decisive capability. We are told that the balanced force won that war. What cannot be ignored, however, is the tremendous contribution which strategic bombing made to that effort and the conjecture of what more it alone could have accomplished if permitted to operate with greater support. The final immobilization of von Rundstedt's armies after the Ardennes counteroffensive was the direct result of the strategic bombing of German oil. By the beginning of 1945 the attacks on German coal and transport had brought German heavy industry to its knees. Assuredly these factors worked effectively to reduce the Wehrmacht to such a condition that it could no longer continue to fight.

Japan stands as further evidence of the effects of strategic bombing. While the point is well made that the main bodies of her fleet and army had expired in the amphibious campaigns which characterized the Pacific War, the battle for Okinawa remains as mute evidence of the savage action which would have attended the invasion of Japan proper. The mounting strategic air offensive, culminating in the initial use of atomic weapons, marked the end of the Pacific war. These events in themselves are not easily dismissed. It is true that the combined elements of land, sea, and air, of amphibious campaign and naval blockade, so weakened Japan as to limit her capacity for pursuing the war. On the other hand, it was the air offensive, mounted over little more than one year, that so vitiated the remains of the empire that Japan surrendered without a single ground action having been fought in the home islands. Indeed the very bases from which the Twentieth Air Force flew were the primary objectives of both land and naval forces in the exploitation phases of the war.

The Korean conflict has served as a sounding board for added criticism of strategic bombing. A great deal is made of the fact that the strategic air components operating in the Far East seem to have

contributed only incidentally to the progress made there. The real truth lies in the fact that strategic air operations in Korea are a classic example of the mal-employment of a military force. This fact raises the most important single consideration in the entire concept of a force designed to counteract a particular enemy under particular circumstances. For, if having constructed this force, we proceed to employ it in operations for which it was not designed, we forfeit the optimum performance that would accrue from a correct employment. Strategic air has made its contribution to the Korean effort. It has done an admirable job in view of the targets available to it. We must remember that transportation targets have held a high priority in Korea and that many of the successes which appear to possess only tactical value were incurred through a joint use of tactical and strategic air. Nonetheless Korea points up a warning we cannot ignore in future planning.

In the event of a general war, we cannot allow ourselves to be baited into military activity where we do not possess the fullest superiority. To fight the enemy on his own terms, on his timetable and with weapons of his own choosing, is to court disaster. In so doing, we not only sacrifice the advantage of a primary military force but negate the entire technological superiority entrusted to our care by the hands, the hearts, and the brains of American industry. If we enjoy these advantages in the first place, we cannot escape the responsibility for seeing that they are used properly. A system of strategic bombing is perhaps more susceptible to mal-employment than any other military force. The truth is that such a force must be held in readiness and committed to action only when the final decision is made to destroy the enemy. It is not an instrument which can be committed piecemeal. Its very existence implies the coexistence of the intellectual courage to use it with vigor and determination when our safety is threatened. Our enemies would like nothing better than to engage us on a medieval battlefield with shields and swords, where their superiority in numbers and the depth of their land mass would devour us. This is not so fantastic as it sounds. We have already retrogressed dangerously in that direction. Still, there is little need to endure the strangulation of power contingent upon such thinking. We possess within our own material and moral reservoirs the elements of national power which can make us the proprietors of a decisive strategic bombing force.

In all these considerations we do not imply that such a bombing force automatically obviates the need for land and naval forces. Until we possess a completely intercontinental high-speed bomber force, the requirement for forward area operations will continue to exist.

Ground and naval forces with associated air support teams will be with us for some time to come. Their operations may well exceed in space and content the operations of World War II. In this sense the balanced force will persist in our plans and thinking. But the balance will consist of a *proportionate* distribution rather than an *equal* distribution of resources among the services. The proportion will depend upon the job at hand and the circumstances peculiar to the situation. The fighting machine will be designed around a primary offensive force.

The mission of this offensive force will be to render impotent the military forces of the enemy, to put them into the condition from which they can no longer carry on the fight. This mission will in no way abrogate the first principle of von Clausewitz. In fact, by circumventing the tedium and destruction of a long war of attrition, it will bring to bear more effectively the infinite "number of possible ways" which he saw to accomplish an objective. Such a force with its logical mission and a courageous policy for its application can pull us out of the archaic battlegrounds upon which the enemy seeks to engage us. It can bring us quickly to the realization that an enemy's military forces, like our own, do not exist solely in men and guns. The enemy would like things that way. But he realizes that the gap which once existed between a nation's fundamental civil components and its military forces has been closed. The dividing line which now separates the military from the civilian is almost imperceptible. The element which has closed this gap is the technological development of weapons. This development has fused the economies and the military structures of great nations into single units whose powers stem from the entity rather than from sections of the entity. So it is obviously to the advantage of a potential enemy to fight in those areas where he is strongest and to divert our offensive actions away from his industrial complex. Those who continue to quote Clausewitz out of context without explaining his full perceptive meaning are unwitting contributors to this diversion.

Thus we see that a strategic design centered on a powerful bomber force is compatible in its entirety with the principles of von Clausewitz. In the initial phase of operations it works as a deterrent to aggression. In the middle phase it is capable of producing a decisive collapse of the enemy's national structure through the medium of functional bombing, rendering armies impotent and industries unusable. Such a device channels the enemy's major efforts into the manufacture of defensive systems. It capitalizes on the tremendous advantages latent in our technological capacity and, when soundly utilized, forces the enemy to fight in those areas of national power

where he is weakest. And when the armed conflict has ended, the force will have attained the objective economically and with a minimum of destruction to the land masses involved.

The task becomes then another problem: rejuvenation, reeducation, the withdrawal from terror, and the return to peace. This job of rebuilding homes and lives and governments is no less a problem than that of war itself, and it requires no less a strategic plan. It is the characteristic stigma of any war. It will be with us so long as our ultimate objectives are the minds of men.

91st Strategic Reconnaissance Wing

Morale in a Prison Camp

Oliver Philpot

WHEN the airman lands by parachute in enemy territory after his aircraft has been hopelessly shot up, he will be shocked (in the medical sense) to some extent, and what he does then will largely depend on his own morale and that of his group. Training he will have had, but the alacrity with which he sets about concealing his parachute and turning himself into a woodsman hangs on his mental outlook on the problem. All this is, of course, well understood these days, and aircrew are well drilled in survival and evasion techniques and are carefully coached until they seem likely to respond with the pushing and pioneering spirit which is necessary.

A lot of thought has gone into the above subject, but it may be doubted if quite so much has been given to what men are meant to do if they end up in prison camps, or what their mental attitude should be. The reason is not far to seek. Once men end up behind the wire, history suggests that they usually stay there and hence are of but little operational interest. Moreover no commander in the field wants someone cheerily addressing his battle-trained-to-the-nth-degree-front-line-men with the words, "Now when you are captured and are in a prison camp, remember . . ." This is understandable, yet the subject can perhaps be pursued notwithstanding, possibly in the spirit of a go-ahead shipping company which nevertheless insists on life boat drills. Moreover it is generally thought in military circles a good thing to escape and also to embarrass the enemy as far as possible. Maybe more important is the fact that the prisoners are still citizens of their country, and as they are (presumably) coming back, their well-being and morale must be of importance. This factor—and the public's interest therein—is sometimes underestimated during a war (the prisoners are out of sight and hearing), as is shown by the original plan "Eclipse," which envisaged that British prisoners in German hands would "stay put" in their camps before being repatriated by surface transport. Luckily "Bomber" Harris* and others came to hear of it, were appropriately scandalized, and Bomber Command naturally flew the POW's back. The public, in England, had always assumed that this would be so; their interest in POW's well being was quite extraordinarily intense at that time.

When does a man first show the state of his morale after he has

*[Air Chief Marshal Sir Arthur Harris, wartime chief of the RAF Bomber Command.—Ed.]

been captured? Almost immediately. It will be seen in the way he treats his guard. He will watch him, as an "old sweat" watches a weak sergeant major. He will play on his weaknesses. Told not to put his feet on the seat of the railway carriage, he will get them there. Told that he must not lie on the floor during the night, he will be found lying there, close to the steam pipes. The eternal battle between captor and captive has begun. Each will, perhaps without realizing it, tussle for the initiative from this point on.

The captive will undergo his interrogation with success or failure according to his training and his morale.

In camps run by our European foe in World War II, the Germans, you could practically see the morale growing, once we, as captives, were released into a common compound and we began to achieve something a little bit bigger than the sum total of our individual morales. This process did not really begin for some days, until the prisoners had told and retold one another of their experiences. "There I was . . . one engine on fire . . ." "I got no reply from the rear gunner . . ." "I couldn't open that damn hatch . . ." And so on. Seasoned men could scoff, but the psychological release must have been valuable.

Then the men turned their attention towards their guards, and they sought to work out a way of living—a painful process. The obvious things to concentrate upon were water, food, clothing, and housing. If there were precisely four cold taps for 800 prisoners, these weren't enough. Soup and potatoes were not sufficient. Half the men lacked greatcoats. The housing was damp and overcrowded. And it was precisely in this field, to start with, that the prisoner's morale was built up and where leadership counted for so much. Queerly enough, success in getting an adequate standard of living was not necessarily the morale builder. It was the way the demand from the prisoners was presented. If the senior officer (automatically in charge) pushed his demands firmly, yet not too rigidly, and with occasional bursts of temperament or waves of Machiavellian cunning, this was applauded. No boxer was ever studied more carefully as he warmed up to his opponent than a senior officer in his negotiations with the camp commandant. If the officer could combine a knowledge of what his boys wanted with a skillful putting over to them of what he thought best—and then set out with courage (and at least some humour) to beard his captors—then the camp would be behind him to a man. He could use what arguments he liked—and usually did. He would probably invoke the Geneva Convention of 1929 and start from there. This was a document which was more closely read by Germans in 1945 than in 1939.

Someone once asked me if you could write down what the senior

Bleak, "impregnable" Stalag Luft III, photographed by American former prisoner, Martin R. R. Goldman, had been made specially escape-proof because it was to imprison some 3600 captured British and American airmen. It took the ingenuity and daring of the fabulous Wooden Horse escape to outwit German watchfulness. Former RAF Flying Officer Philpot, in his book, "Stolen Journey," recently published by E. P. Dutton and Company, tells how he and two British companions laboriously tunneled beneath the double fence while other prisoners "exercised" on the wooden vaulting horse which covered the tunnel entrance. Once outside, Philpot, equipped with prisoner-forged papers and home-made compass, traveled the danger-fraught railroad to Danzig. There he climbed up the mooring cable of a neutral ship, stowed away, and finally reached safety in Stockholm, the first man to reach freedom from Stalag Luft III.

officer in a camp is meant to do. My answer was that man is either a leader, or he isn't. You can't even define leadership, except dictionary-wise. Wing Commander H. M. A. Day did a lot for prisoner morale by refusing, for a period, to continue negotiations with our captors at all—and none of his demands got anywhere, just then. We existed very cheerfully in squalor in Poland. Colonel Clarke of the U.S.A.A.F. lifted our morale by chasing us around (rightly) and having us build proper sanitary arrangements—called by the insubordinate, with gratitude, as "Colonel Clark's . . . -in-comfort scheme." There are no rules—high morale simply follows a leader.

Gradually a way of living emerges. One somehow (in our case by the International Red Cross) has the essentials. It will be realised that I am speaking of camps of above Belsen level, such as Dulag-Luft, Spangenberg (castle and lower camps) Oflag IX A/H, Schubin-Oflag XXIB, and Sagan-Stalag Luft III.

Man being man, he starts thinking, or trying to, and does two things. He tries to strengthen his links with home, and he tries to get there—to escape.

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As regards the former, it would be difficult to say which is the most important, for a camp to have a regularly operated illicit wireless or a good mail connection with home. Luckily the two are not competitive, and well-run camps had both. The stimulus to morale was terrific when we heard of the first thousand-bomber raid, on Cologne, and the German version that it had killed many people was capped by Bomber Harris's statement on our wireless that this "was a mere zephyr compared with the hurricane which was to come." That was the prisoner's link with the Allied forces who were always going to "invade this year and end the war by Christmas."

Their link with their fathers, mothers, wives, best girls, brothers, and sisters depended on the mail. This could take (England-Germany) anything from ten days to three months, according to the whim of the captor. Such mail was devoured—there is no other word. Yet letters could say so little. One wondered if the people back home realized the disproportionate effect of what they wrote. A letter would be read a dozen times. Hidden meanings would be assumed—innocent phrases misunderstood. The imaginative sheep, at home, separated themselves from the unimaginative goats who also attempted to write letters who would say: "You won't believe it, my boy, but the Government has actually banned hunting." "Your father and I had to spend Christmas in a hotel, and they would not let us have a coal fire." "There was no chicken, so we had a roasting duck." Goat-letters, such as these, were sometimes read out publicly by the recipients in the concrete barracks at 16 below in Poland, and the resultant hilarity raised morale (perversely). Semi-goat letters—just consistent plugging ones with dull lack of understanding all through were murderous to morale, as were the "matrimonial" letters. The latter would announce that "we didn't really get on as well as we thought we would . . . don't you agree, darling? . . . and I feel so much more content with Derek . . ." (and happily) "I'm sure he and I are meant for one another."

The prisoner could survive the first type of goat-letter. It could be talked about. The second type hit him so that he couldn't hit back—or talk the thing over with the others—and there is no special leave for prisoners to settle their domestic problems.

The most amazing incident regarding this all important link with home—the mail, was a case where *no* mail was sent by a father in England to his son in camp. The son had stumbled, wounded, out of a blazing aeroplane into the guns of Nazi soldiers, by whom he was, not unnaturally, captured. His father considered it disgraceful to be a prisoner, so refrained from writing more than one letter to state his view. This from a member of a nation which has in its time been

considered by various temporary tyrants in Europe, and others, as soft, unmilitary, always seemed to me to be carrying the spirit of the war effort a little too far! Yet there is a point here. Many prisoners fight their battles over again but with a tortured remorse for what they might have done ("if only . . ."), and their morales are shaky as a result.

Prisoners stare through their wire, or out across their moat, and see their captors, always there. They wonder when liberation is due or when a letter from home is coming and sometimes think, "if only I had dived to the left when caught in that beam."

General morale is restored when a good senior officer snaps them out of this and gets them teaching one another the skills they have. An accountant holds a class—a French speaker teaches French. Above all he also sees that there is some form of amateur dramatics. This lifts prisoners out of their gloomier thoughts better than anything else, and stimulates them. We cursed when the preparations for our "Wooden Horse"/"Stolen Journey" escape were delayed by "A Midsummer Night's Dream," but we tunnelled better and planned better because of it. Other morale lifters were debates and discussions. The classic POW debate? "That members of this House would rather be married to Ginger Rogers than to Mrs. Beeton."* Discussions would take an international trend under the guidance of that redoubtable American Major John B. Dodge. Within hearing of an uncomprehending sentry a Frenchman would describe his country, an Australian his, and a South African his. By an American it would be stressed that all U.S.A. is not New York—and a New Zealander would point out that his country had no connection with the Colonial Office in London.

CONSTANTLY, and often in sudden surges not unconnected with spring weather, prisoners attempted escape.

It has been said that the way to promote morale in a camp is by encouraging escape. This is a gross over-simplification. If escape is difficult, you may be piling frustration upon frustration, and morale will sink, not rise. Such a blimpish statement is usually made by the unimaginative, who are content with the statement that "escape is a duty." Graft on to this conception, however, a skillful encouragement of a man's natural desire to be "there, not here," add a moderately balanced regime of food as well cooked as may be, of plays acted as well as possible, and you have the morale background where individual initiative may take root—and most important, the effort will be willingly supported by the community. Moreover a good escape or at-

*[An expert on cookery—author of cook books.—Ed.]

there by a team, who don't function if their morale is low. So it is with escaping from behind the wire.

You could dream up a wonderful character which you were to adopt for travel through enemy territory, but once you had equipped yourself with all that your friends had to offer, you felt an added responsibility to succeed. It meant, to put is conversely, that to be caught just outside the wire and for the camp to see the guards calmly remove your (their) precious forged papers would be as unbearable as to break your aeroplane on landing in front of your Commanding Officer and other members of your squadron. It would be an affront to the morale of the group in each case—whether it was camp or squadron.

Maybe these things count more with some than others, but I remember distinctly when, having climbed as far as I could go up the wrong cable of my Swedish ship which was going to take me from Danzig to Sweden, I knocked hopelessly with my knuckles (before swarming all the way down) on a port-hole, and thought "Anyway, I can tell them when I get back to Sagan that I knocked on the port-hole of my neutral ship." A stupid thought, in a feverish moment, but perhaps significant in its recognition even at that instant of the performance expected of me by the camp. . . . I then climbed up the correct rope.

To summarize, morale in a prison camp (we took German camps—World War II) depends on the captive wanting to get "on top of" his captor. By combining with his fellows, he increases the moral strength of all the prisoners thereby. The captive has to shake off shock and to hack out a way of living so that his elementary needs are supplied. In the process he will follow a strong leader, who may not get everything but who presents the camp case firmly to the captors. The captive thinks of home, as a country and domestically, and can be enormously encouraged, or the opposite, by what he learns. A camp is the better, and the more effective at escape, if it has some balance that causes it to support other activities, such as plays. Most prisoners want to escape. Lucky ones do, and are materially and mentally assisted by high morale in their camp.

London

Geophysical Research

Doctor Helmut E. Landsberg

MANY new words have entered the military vocabulary during and since World War II. One of these is geophysics. This one word encompasses a host of problems, most of which are not at all new to the art of warfare. Geophysics is the science dealing with all physical manifestations in, on, and around the earth: the air and the weather, the ocean and the waves, the soil and its tremblings, as well as the gravitational, electric, and magnetic fields of the globe. In short it is the physics of the environment in which we live. This environment acts mostly independently of our wishes, but it interacts with everything we do.

In the past it was one of the big unknowns and part of the noncalculable risks in military operations. When men and weapons could not cope with the environment, warfare simply stopped. It may sound strange today, but less than two centuries ago it was standing operating procedure to move into winter quarters when snow and ice began to cover the ground. History also tells us how many well-planned campaigns with good leadership and stout fighters ended in disaster because of adverse environmental conditions: examples range from the storms that crippled the Armadas, to the mud and snow of the Russian campaign of Napoleon, right up to present day cases.

Bigger and better "hardware" has not changed this picture: as late as September 1952 a single tornado at Fort Worth, Texas, wreaked 40 million dollars' damage on U.S. strategic air power.* It is not pleasant to contemplate what this might have meant to our striking potential had it happened at the "wrong" moment.

The list of examples of major and minor environmental interference with military operations could be readily extended into a sizable book. Here it should suffice that the problems are sufficiently important to make it imperative that the whole complex of questions be removed from the "incalculable" class. The first step in this direction has been to get timely warnings, and the next step is an attempt to change natural events. Neither can be accomplished without a great deal of research work.

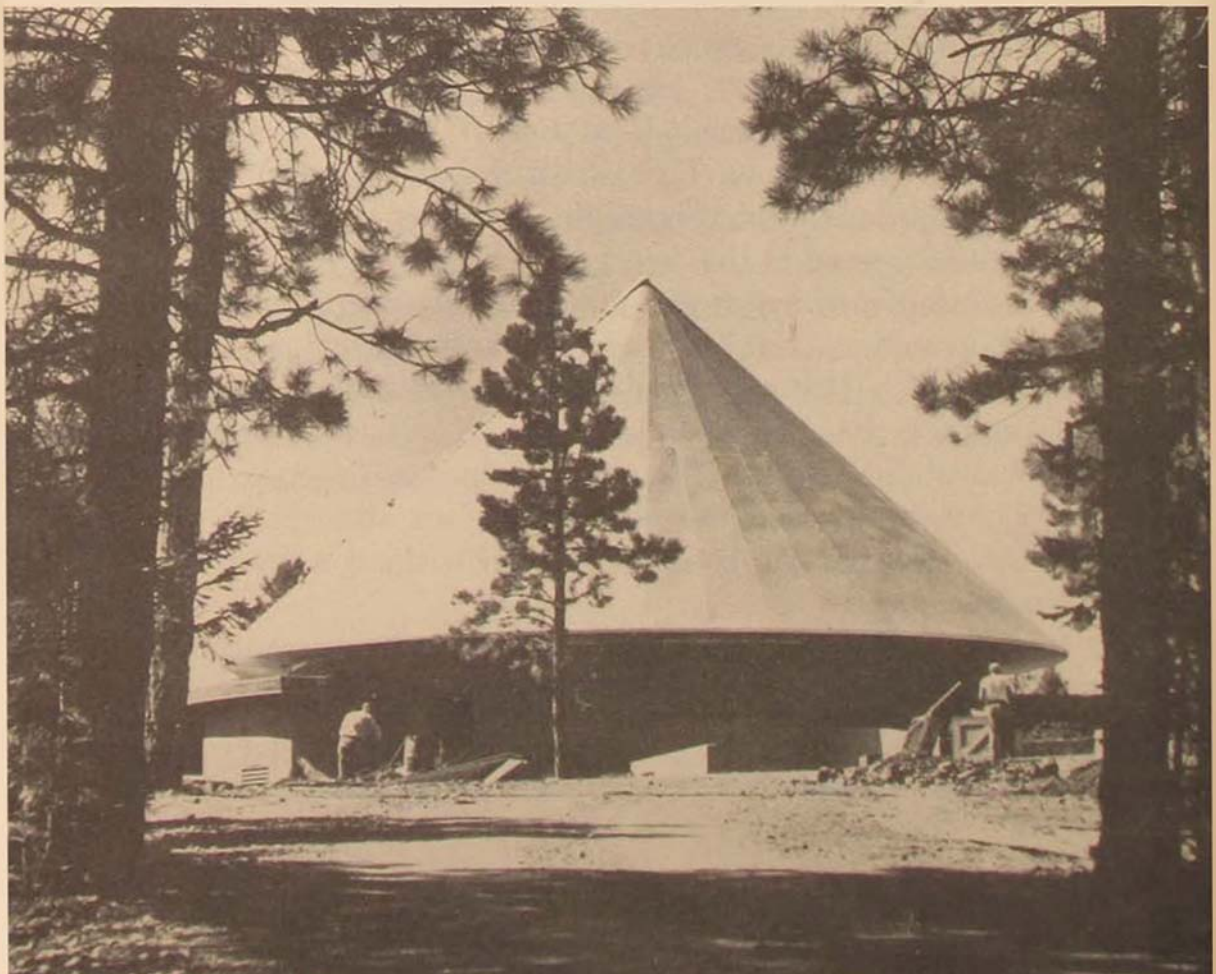
Prior to World War II geophysical research was essentially the province of academic institutions, oil companies, and, on a very modest

*[For an account of Air Force progress in forecasting tornadoes, so that protective measures can be taken to minimize damage, see "Forecasting Destructive Thunderstorms," this issue, p. 108.—Ed.]

scale, of government bureaus such as the Coast and Geodetic Survey, the Weather Bureau, and the Geological Survey. The global scale of the war threw into sharp relief the fact that this area was filled with major problems for the military. Particularly did it demonstrate the sensitiveness of the air forces to the vagaries of the medium in which they operate. Perhaps no better example could be given of how critical can be the need for accurate advance knowledge than the case of the weather forecast for D-day in Normandy. It was correct, thanks to a superb team effort of the Allied weather services—and luck. We knew then—and this is still true today—that weather science does not permit forecast accuracy approaching anywhere near certainty.

The recognition of this and similar problems led to an important but hastily organized research effort during World War II. After the war the three services embarked upon large-scale and long-range research projects, which, under guidance from the Committee on Geophysics and Geography of the Research and Development Board, have developed into a well-coordinated, broad program. Each service covers those fields closest to its peculiar requirements, but there are

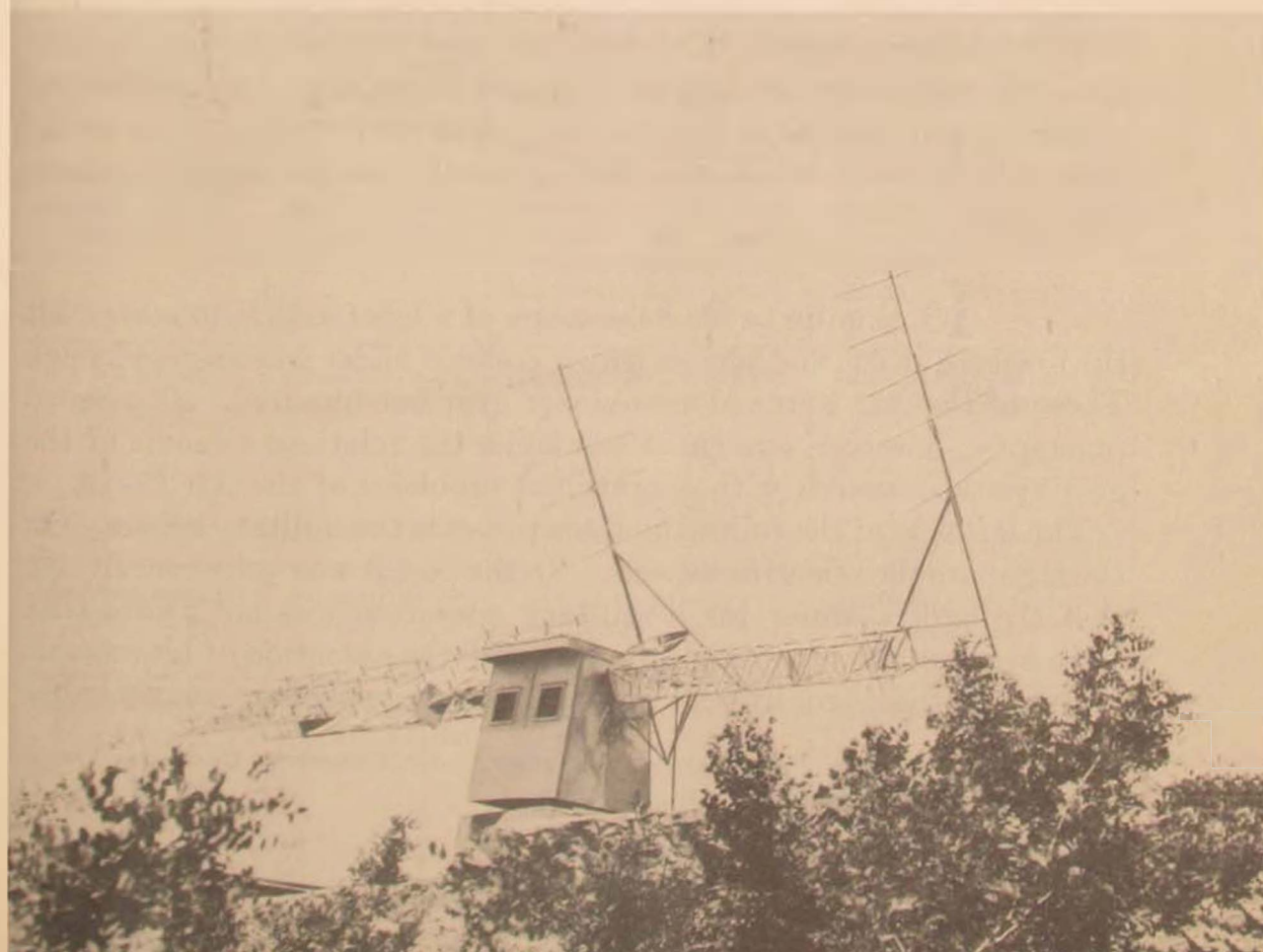
Plate 1. The solar observatory at Sacramento Peak, N. M. This building houses the coronagraph, an instrument designed to permit continuous observations of the solar corona by simulating the effect of an eclipse which blacks out the disk of the sun.



also a number of joint efforts. It is quite natural that the major interests, though by no means the exclusive interest, of the Air Force lie in the realm of atmospheric science, those of the Navy in oceanography, and those of the Army in earth sciences, such as soil and ice mechanics, geology and cartography. In fact, there are more problems than there is scientific talent to solve them. And the dollar cost of the program remains an obstacle. As in most fields of science nowadays complicated apparatus, specialized facilities, and large teams of scientists and technicians are needed to tackle the problems.

The need for extraordinary facilities not available to academic institutions engaged in geophysical research before the war, is one of the reasons why the military departments have established geophysical research groups of their own. The intimate relation of the geophysical research to other more orthodox military development work makes this quite logical. The best example is the exploration of the high stratosphere with rocket-borne instrumentation. The vehicle may be a fully or partially developed weapon but its payload is often a miniature laboratory which records the interaction of weapon and environ-

Plate 2. These big radio telescopes are also on Sacramento Peak, N. M. Their antennae permit the reception of certain wave lengths of radio frequency noises which originate on the sun. These noises often accompany solar eruptions and disturbances.



ment.* It is quite clear that the expensive launching and range facilities, as well as the vehicles themselves, are beyond the reach of nongovernmental research institutions. Moreover the vehicle, the telemetering devices, the propulsion fuels, and other incidental equipment may bear security classification and security is often difficult to maintain on a college campus. Even some of the exploratory research is occasionally classified. Many academic institutions do not like to engage in classified research, except in emergencies. Secrecy in universities is quite contrary to the tradition of unrestricted search for the truth and the free publication of the results. This principle had advanced science rapidly ever since its emancipation from the unenlightened Middle Ages and the services, for their own ultimate benefit, respect it. If every scientist were engaged in classified research, science would eventually grind to a halt. On the other hand it is quite obvious that strictest security has to be maintained for certain projects. For some of these no competent contractor can be found; hence the solution of the problems falls to those who are in the government service.

An analogous argument applies to directed versus undirected research. An operating agency may have a research requirement which is urgent to them but in which nobody in private laboratories has any interest. Then the work has to be performed by a service research agency. The combination of the problems of facilities, security, and directed research has compelled the Government to participate in some research in geophysics. Yet even so, over half of the geophysical research work done for defense purposes is performed by contract in academic and industrial laboratories. The cooperation of the scientists in these laboratories with their governmental colleagues has been exemplary.

IT is quite beyond the scope of a brief article to review all the projects, tasks, and phases which are now under way in geophysics. Those of the Air Force alone number over one hundred. The broad principles, however, emerge if we depict the relations of some of the geophysical research with operational problems of the Air Force.

The left side of the following table presents the military sphere. On the right are the scientific aspects. In the past it was quite conceivable that the staff planner for a military operation was not aware that some event on the sun might interfere with the execution of his scheme. Conversely the astrophysicist studying the chromosphere was probably

*Dr. Marcus O'Day, "Super-Altitude Weather," *Air University Quarterly Review* (Winter 1951–52), V, 24–37.

quite unconcerned about the after-effects of a solar flare upon a military communication system. The USAF geophysical research program is designed to bring about the linkage between the rather theoretical sounding studies on the right column and the military operations on the left side.

Some projects of rather general interest deserve further discussion here. One concerns the solar studies. It has been known for nearly three decades that eruptive activity on the sun is the cause of ionospheric disturbances and thus is directly responsible for anomalies of radio transmission. It has also been surmised for a long time that weather is somehow related to changes in solar radiation. On a statistical basis some rather tenuous relations between sunspots and various weather elements have been established. In the last few years evidence has been accumulated to the effect that certain types of solar disturbances are followed by pressure changes in the earth's atmosphere. Last year German investigators even claimed that temperature changes observed in the lower stratosphere with balloon-borne equipment were traceable to preceding solar changes. It has been

System	*Operational Problem*	*Related Geophysical Problem*	*Studies in Progress*
operation of aircraft	flight planning, flight safety	weather forecasting weather hazards weather modification	numerical prediction thunderstorms cloud physics
operation of missiles	navigation and control	atmospheric influences on radio transmission magnetic and gravitational fields	magnetic and ionospheric disturbances shape of the earth
strategic planning	time and area	long-range weather forecasts climatic conditions, (arctic, desert, other strategic areas)	general circulation of the atmosphere solar influences on atmosphere ice island exploration
defense against chemical agents	concentration and transport	micrometeorology diffusion	micro-eddies, fall-out of particles
superweapons	blast and radiation effects	atmospheric structure reaction of ground and buildings	turbidity seismic wave propagation

apparent to students of the atmosphere that the key to many forecasting puzzles in the high atmosphere and possibly even for lower layers lies in the sun. For the study of these solar terrestrial relations the Air Force has established a solar observatory on Sacramento Peak near the Holloman Air Development Center. The scientific activity there is part of the geophysical research program undertaken and sponsored by the Air Force Cambridge Research Center. Sacramento Peak's present study is centered around coronagraphic and solar radio noise studies (Plates 1 and 2). Personnel of Cambridge Research Center, along with contract scientists from Harvard and Cornell Universities, are maintaining a continuous close watch on solar changes. Interpretation of the meaning of these changes and their utility for forecasting purposes will require years of intensive work, but the prospects for success are good.

The sun only supplies the energy which sets the atmosphere in motion. What happens to the input of power and how it is transformed and ultimately consumed is a complicated mechanism full of unknown factors. A double-pronged attack on these is under way. One employs the favorite approach of the physicist: nature is duplicated in laboratory models so that one parameter after another of the problem can be varied under rigid controls. A contract project at the University of Chicago simulates hydrodynamic analogues of the atmosphere by the use of liquids in rotating dishpans with differential heating. Many flow patterns have been produced that are close duplicates of those observed in nature (Plate 3). Especially the now universally known *jet stream* in the substratosphere, which was such a surprise in the B–29 operations around Japan early in 1945, has been reproduced in the laboratory experiments.

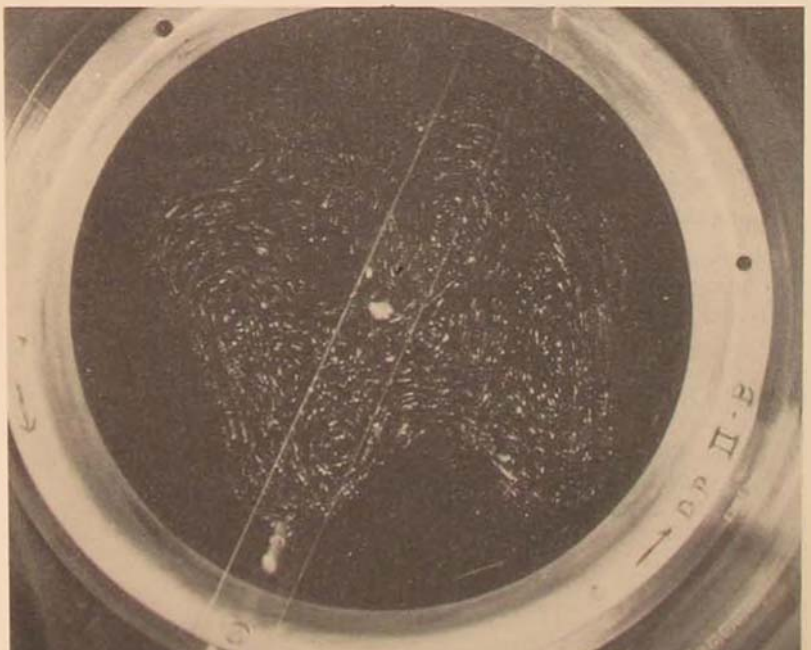


Plate 3. These flow patterns and eddies are produced in a rotating, differentially heated dishpan. Aluminum powder floating in the liquid follows the swirling current movements and makes them visible. Experiments reproduce various atmospheric airflow conditions. (Photo by courtesy Dr. D. Fultz, U. of Chicago.)

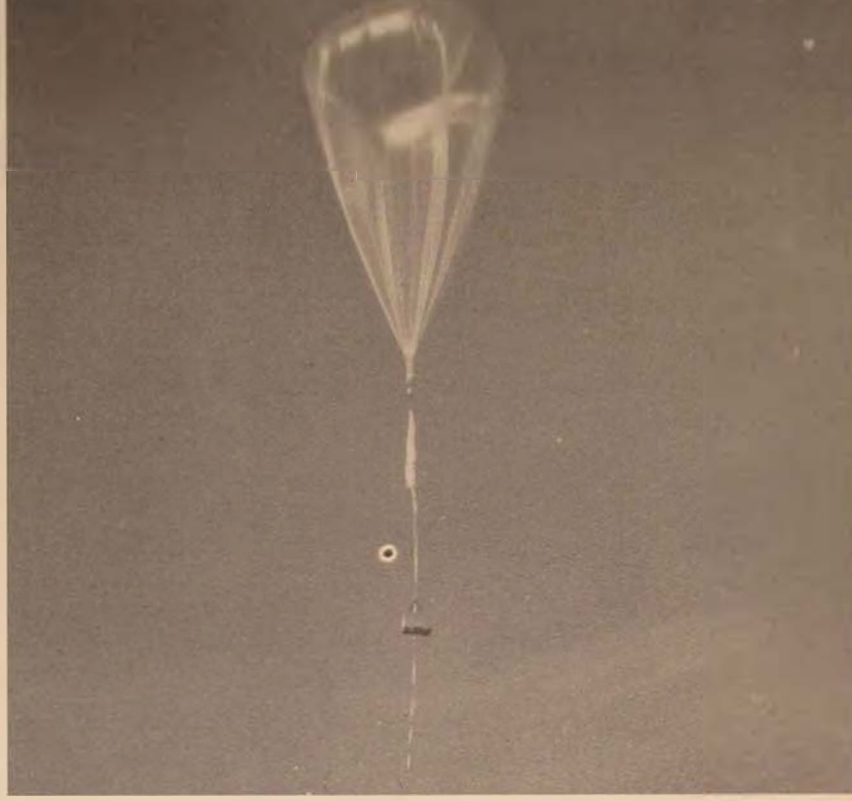


Plate 4. A "Moby Dick" balloon is shown ascending. The box underneath contains instrumentation which keeps the balloon floating at a constant predetermined altitude. Progress across country is tracked by radio direction finders. The parachute folded above the instruments brings them safely to earth when balloon bursts.

The second approach is a field experiment which studies atmospheric flow patterns at high levels with balloons floating at constant levels. There are not the ordinary small weather balloons. They are plastic giants, and their size was possibly responsible for the project nickname of "Moby Dick." The balloons with their attached instrumentation float along at predetermined altitudes (Plate 4). Their position is determined by radio direction finding, and the meteorological information is picked up in the usual fashion. As their flight time is measured in days rather than minutes, their range is several thousand miles. The present flight record is 96 hours. A regular flight schedule from the West Coast launching points is now in progress with a daily quota of at least three balloons. As has been the case in past balloon projects, we expect the usual rash of flying saucer stories, but our main purpose is to learn about air trajectories. Knowledge of winds in the 40,000 to 100,000-foot layer of the atmosphere is very deficient, but accurate forecasts of these currents are required for operations of jet aircraft. The stage is now set to obtain this knowledge.

NOT all weather problems are created from above. Some very undesirable ones receive their impetus from below. For instance when swift air currents are forced to cross mountains, giant eddies and extraordinary vertical accelerations are created in the air flow. These events have technically been designated as *mountain waves.* They occur in particularly spectacular form in the

Plate 5. Rising columns of dust outline the tremendous mountain wave in the lee of the Sierra Nevada Mountains (on right). Updraft brings dust from the surface (4000 feet altitude) to cloud level (30,000 feet). The fierce currents were strong enough to lift a P–38 aircraft, with propeller feathered, from 15,000 to 30,000 feet.

Sierra Nevada during winter. Their behavior has been investigated through a large cooperative project in which Air Force scientists played a leading role, with participation from the Office of Naval Research, the Air Weather Service, the Weather Bureau, the University of California, and the Southern California Soaring Association.* Among the tools employed in this study were gliders, one of which reached a height of 44,500 feet in the updrafts of the wave. Lifts of 5000 feet per minute were observed, while in other parts of the wave system downdrafts of like magnitude occurred (Plate 5). With possible altimeter errors of 1000 feet introduced by these conditions, plus the extreme turbulence, the mountain wave is a flight hazard of wicked proportions. How many of the previously unexplained aircraft accidents in mountains can be attributed to this phenomenon will remain unknown, but now at least the basic knowledge to forecast such conditions is at hand.

*Carl F. Jenkins, "Flying the Mountain Wave," *Flying Safety* (November 1952), VIII, 2–6.

The frontiers of geophysical studies are being expanded not only upward but also northward. The landing on Ice Island T–3 (Fletcher's Island) near the North Pole by the Alaskan Air Command in March 1952 was immediately followed by the establishment of a weather station and a scientific outpost of the Cambridge Research Center. The present work party also includes an oceanographer working under Navy auspices and a glaciologist of the Army's Snow, Ice, and Permafrost Establishment. One of the most important questions has already been answered by the first year of occupancy: it is possible to live on the island, to do scientific work there, at least with suitable aircraft and skilled personnel, and to conduct flight operations there for a considerable portion of the year (Plate 6). Our research adventurers can roam up there with the assurance that any answers they find for the following questions will be new contributions: how old is the island? where did it originate? what are the laws governing its drift? how thick is the ice? how deep is the ocean beneath? what are the climatic conditions at the surface and aloft? what are the melting and freezing rates? The answers are already beginning to take shape, and some have considerable operational value. In this connection it should not be forgotten that, whereas the surface of the Arctic is not likely to be a theater of human conflict, there is intrinsically nothing that would prevent if from being the broad highway of future air operations, especially when unmanned vehicles replace present weapons.

The weather scientist is particularly happy to get current observations from the polar region and would like to have more of them. This area is still a big void on the weather maps, but perhaps many a nasty front has its origin there. Better observational coverage there and in other areas is particularly desired for new schemes of short-range forecasting which employ modern computers. An experienced forecaster can often adequately bridge a gap in the observations; a machine needs the data. For some years teams of theoretical meteorologists and mathematicians have developed kinematic equations which attempt to predict the future atmospheric pressure field from current observations. The solution of such equations is so tedious that it would take weeks and months to make one forecast if everything had to be done by people. Modern computing techniques have radically changed the situation. Work on both the theory and suitable computers at Princeton's Institute of Advanced Studies has been sponsored jointly by the Office of Naval Research and the U.S. Air Force. The results have brought the day closer when the short-range (24 hour) forecast of pressure fields may soon be

Plate 6. Living quarters, storage, and "laboratory" are now established on Arctic Ice Island T–3. In addition to sending badly-needed information on Arctic weather, scientists of all services are using this floating laboratory to research problems which the Arctic poses to any future military operations in the northern latitudes.

"untouched by human hands." At the USAF Cambridge Research Center, operational tests are now under way which employ some special atmospheric models for machine forecasting. These are hopeful developments but there is no reason to cheer yet. Even a good forecast of tomorrow's pressure pattern will still have to be translated into weather terms, such as winds, precipitation, clouds, ceilings, and visibilities. This translation is by no means simple and will require a great deal of future work.

I suppose every commander would like to have his weather made to order: fog for concealment, clear sky for visual bombing, low clouds and a flood to cover a retreat, a few weeks of dry weather for an armored blitzkrieg. In one form or another all these weather events turn on the presence or absence of clouds and precipitation. There is also very little difference between military and civilian desires about

the weather. Farmers and hydro-electric power engineers want rain, at least for certain seasons; baseball and football managers look for sunshine; people concerned with air and surface transportation would like to be rid of fogs. The question is can we fill any of these wishes. Reams have already been written about the feasibility of weather modification and the utility of the various schemes which have been tried in recent years for this purpose. Most of it has centered around rainmaking. There is no point to add fuel to the controversy which has developed about this problem. Suffice it to say that there are hopeful leads toward successful modification of clouds on a local scale—and also that there are more open than answered questions in this field. There is certainly enough incentive, both for civilian and military ends, to spare no effort to get the answers. At the present time we don't even know precisely how nature produces coagulation of droplets in clouds. That type of knowledge will remain the target of research for some time to come. After the basic answers are acquired, the applications will readily follow.

There has also been a great deal of loose talk about the influence of nuclear weapons on weather. Much of it is without regard to the orders of magnitude involved. It is safe to say that nature still holds the upper hand and is more apt to alter the effects of these weapons than the other way around. This brings to mind a little-known but spectacular episode which led to the start of one of the geophysical projects of the services. In June of 1945 there was a grand eruption of Okmok volcano on Unmak Island in the Aleutians. It was of such proportions that the evacuation of the large air base at Fort Glenn was seriously contemplated. In the midst of a war an evacuation would have been most undesirable. With this as a warning a study of the Alaskan and Aleutian volcanoes is being jointly conducted by the three military departments and the U.S. Geological Survey. The purpose is to prevent the establishment of future military installations within dangerous proximity of volcanoes and to devise a technique by which to predict activity which might interfere with military operations. This is not an idle occupation, because a full-scale volcanic eruption can, as has often been shown, raze human settlements and installations with as yet unmatched fury.

This brings us back to what we stated before in slightly different words: to fight men is difficult; to fight nature is more difficult. If warfare, and especially air warfare, ever becomes truly global, knowledge about this terrestrial sphere, from the interior to the boundary of the atmosphere and beyond will be an important asset.

Air Force Cambridge Research Center.

In My Opinion . . .

WHICH OFFICERS SHOULD BE EDUCATED?

Lt. Colonel Wendell A. Hammer

Why, out of all the capable young officers in the Air Force, did they send that lieutenant to the Squadron Officer Course? What chance has an officer like me to get to the Air War College? How can four thousand graduates of the Field Officer Course perform duties requiring fifteen thousand?

These are typical questions being asked throughout the Air Force. It is well that they are being asked, for they relate to a problem which touches the career of practically every officer, a problem which is of utmost concern to those responsible for the officer educational program of the Air Force. Simply phrased this problem is *which officers should receive instruction in the general service courses of the Air Force?*

That this question is important to each officer is supported by cold fact. For under present eligibility criteria and student quotas, assuming an Air Force of the conservative size of 125,000 officers, and using the best planning data available, the following conclusion is mathematically certain: in the next twenty years not more than one in seven eligible officers will attend the Squadron Officer Course; not more than one in three, the Field Officer Course; and not more than one in eight will reach the Air War College.

General Service Course Requirements and Quotas

Squadron Officer Course: For company grade officers under 35 years of age who have not less than one year nor more than six years of commissioned service. USAF yearly quota: 3227.

Field Officer Course: For field grade officers with less than 13 years promotion list service if Regular, or less than 38 years of age if Reserve. USAF yearly quota: 854.

Air War College: For regular colonels who are permanent majors or above and have less than 18 years promotion list service. Reserve colonels or generals under 45 years of age. USAF yearly quota: 130.

Eligibility criteria for the paralleling correspondence courses offered by the USAF Extension Course Institute are broader, and may be found in the *USAF Extension Course Catalog, 1952 Edition.*

This article deals only with the Field and Squadron Officer Courses of the Air Command and Staff School and with the Air War College, and the paralleling correspondence courses offered by the USAF Extension Course Institute. Such other instruction as that offered by the Special Staff Courses of Air Command and Staff School, the resident and civilian institutions programs of USAF Institute of Technology, and specialist training in Air Training Command is not included.

How does this prospect correspond to Air Force requirements for professional officers? According to the findings of a study in which the writer participated,[1] an Air Force of 125,000 officers will at any given time have an *essential* requirement of approximately 80,000, 15,000, and 2125, for graduates of the three courses. The foreseeable student output of the resident and correspondence courses, considering various attrition factors, means that the Air Force faces continuing graduate deficits of around 65,000, 10,000, and 1500, in the three categories.

Certainly this situation must be remedied. The proposal contained in this article grew out of an analysis of the present system, and of alternative proposals which have previously been offered.

The analysis began, quite logically, *with the present system for selecting officers to attend the three resident courses and for allowing others to enroll in the paralleling correspondence courses.*

The current procedure which permits the major Air Force commander to nominate officers to attend the Squadron and Field Officer Courses has an obvious advantage in its recognition of his jurisdiction over and responsibility to his personnel. He can select the most deserving and best qualified officers for the courses and schedule their absences so as to minimize the effect on the essential activities of his command.

Selection of Air War College students by a Headquarters USAF board of senior officers whose sole interest is to pick officers with the greatest promise to the Air Force likewise has obvious merit, at least in theory. The present procedure possesses the added advantages of extreme simplicity and flexibility.

But the present selection system also has damaging weaknesses. By far the most serious is its failure to provide a means whereby

[1] Submitted to the Director of Training, Hq USAF, 8 February 1951. This study, which reviewed every officer space in the Air Force, indicated that the USAF has an *essential need* for graduates of the three courses at any given time amounting, respectively, to 64, 12, and 1.7 per cent of the total officer spaces authorized. The *desirable need* ran much higher.

general service courses graduate a sufficient number of officers to meet the essential educational requirements of the Air Force.[2]

Almost as serious is the fact that luck and expediency largely determine who are selected to attend the resident courses. Consequently, the better qualified officers frequently fail to be selected. Such parasites upon the courses as the quota filler, the operational misfit, and the perpetual school-goer are but extreme manifestations of this failure. It is quite probable that if the selection board procedure now used at Headquarters USAF for Air War College students were moved down to the major commands where board members might supplement their present paper knowledge of candidates with important personal knowledge and if this method were extended to all three courses, their input would be improved.

Another weakness of the present system is its failure to utilize the full educational resources of the Air Force. Enrollments in the three correspondence courses could be immediately increased by 50 per cent without appreciable increase in monetary or manpower costs to the Air Force. Other weaknesses in the present system are shared by the proposals which follow.

One proposal would *select students for the resident courses who meet present eligibility criteria according to their relative effectiveness to the Air Force.* The measure of relative effectiveness would be the average score on the Officers Effectiveness Report. This method would probably improve the over-all quality of the input of the resident courses, and consequently the quality of their output should also be raised. Most of the educational parasites should be eradicated, and, to the extent that more education rubs off the superior graduate onto his colleagues, the educational deficits facing the Air Force would be reduced.

This proposal also recognizes the fundamental proposition that the comparatively few officers who will be able to attend the resident courses should be those having the greatest promise for the Air Force. An additional strength is that the average OER score would constitute a standard which would minimize variations in student nomination practices throughout the Air Force. It shares, however, the great weakness of the present system in its gross failure to provide enough graduates to meet the educational needs of the Air Force. And many officers might be reluctant to accept the Officers Effective-

[2] These requirements were stated at the beginning of this article, along with maximum yearly output of the three resident courses. While the number of graduates from the correspondence courses cannot be predicted with any degree of accuracy, it may be significant that to date only 2615 have completed the Squadron Officer Correspondence Course, only 175 the Field Officer Correspondence Course, and none the Senior Officer (Air War College) Correspondence Course. And an indeterminate number of these graduates are not on active duty.

ness Report as a valid instrument for measuring effectiveness to the Air Force. Although one might ask what instrument is more valid, this proposal would certainly add heavily to the burden of that much-maligned document.

An especially attractive proposal would *select officers otherwise eligible for the resident courses according to their relative scores on a battery of intelligence, aptitude, and psychological tests.* This solution shares the strengths and weaknesses of the preceding proposal and has some which are distinctly its own. There can be no doubt that students chosen through such a screening would be above average in those traits which the tests measure. Thus it should increase the over-all quality of the resident student bodies and provide an instrument for standardizing student selection. On the other hand it has weaknesses which, because of their fundamental nature and the fact that they have gone almost completely unnoticed, will be examined in some detail.

Proponents of this solution point to its success in selecting students who do well in civilian educational institutions. They quite logically reason that it would do the same for our resident courses. This comparison rests on a basic educational fallacy in that it is focused upon the student's performance in school rather than upon his performance after graduation. The school is thus viewed as an end rather than as a means to an end—a humbug which has plagued higher education throughout its history.

Another fallacy holds that a substantial number of officers are incapable of benefiting from the instruction offered in our general service program. So the proposed battery of tests is needed to separate these stragglers from the flock.

Every bit of objective evidence refutes the existence of such non-educable officers. Rather it indicates that while our officers may vary in their ability to learn, each can and will learn readily if afforded the proper experiences under proper motivation—that is, if given good instruction. To use the proposed battery of tests to single out and brand officers as being non-educable thus would be as misguided as firing a rocket barrage at friendly troops. None for whom the highly effective procedure was developed would be hit, but those hit would be severely and wrongly hurt.

Another fallacy appears in likening our general service educational program to that of civilian universities whose students must be limited to the intellectual elite of the nation. Our program compares more properly to the nation's over-all system of education, whose function is to increase the competence of all members of society, while identifying and providing for full development of those with superior potentialities. Success of the Air Force mission depends in a very

real way upon how well each of its officers performs his individual duties. To the degree that our general service courses contribute to successful performance of these duties—and such is their sole defensible justification to Congress and the taxpayer—we cannot operate under the tempting delusion that only a few of our most capable officers should benefit from them, whatever their level. Our program must be open to every officer whose duties place him in need of education. If the resident courses can accommodate only the most capable, then the correspondence courses must provide for the great majority remaining whose performance is also necessary to the Air Force.

In this light, it becomes apparent that the more logical time for taking the proposed battery of tests is not when the officer becomes eligible for one of the resident courses but prior to his selection as an officer. For once he becomes an officer, he will be performing duties for which the tests would predict his capability. We would not think of delaying pre-tests on a parachute until after it has been launched into the air-stream on the back of its wearer.

A third proposal would *make relative performance in each course the primary criterion for selection to the next higher resident course in the general service ladder.* The Air University system of general education was designed as a coordinated program geared to the officer's progress through the increasing responsibilities of his career. This proposal would make such a program a practical reality, at least for some officers. It would also lend strong motivation to student performance in the two lower resident courses.

But it leaves selection for the Squadron Officer Course completely unprovided for. More important, by restricting attendance at each successive course to segments of the same original group of officers, it would actually decrease the total number of officers who receive *some* instruction in the general service program and thus would increase the total education deficits facing the Air Force. It would also subvert the resident courses into instruments for establishing and perpetuating a closed educational caste system. This system would, in turn, be based upon a lottery, wherein—as noted earlier—the odds would be seven to one against the Air Force meeting its most essential educational requirements with the right officers, as well as against an individual officer having an opportunity to benefit from the education offered in the resident courses.

ANOTHER solution would leave present selection procedures unchanged but would *make successful completion of either the Squadron Officer Resident or Correspondence Course a prerequisite for promotion to the grade of major; completion of the Field Officer Resident or*

Correspondence Course, a prerequisite for colonel; and completion of either the Air War College or the Senior Officer Correspondence Course a prerequisite for promotion to the grade of brigadier general.[3] This proposal has obvious advantages which are totally lacking in any of those previously discussed, and its apparent disadvantages, when seen in proper perspective, either disappear or emerge as arguments in its favor.

Most important among the obvious advantages is that the powerful motivation exerted by the promotion system would erase the Air Force's educational deficits in short order. For the first time the Air Force would receive full value from the system it has created to meet its essential educational requirements.

This proposal, moreover, would provide for an obligation which our officer corps as a profession has thus far refused to accept. Practically every responsible professional group, including the officer corps of the Navy, has made educational advancement either a tacit or an explicit condition to advancement in the profession. The indifference and rationalizations behind which we retreat in this matter can only be attributed to professional immaturity, if not irresponsibility.

The principal weakness of this proposal lies in its failure to specify just how officers would be selected for the resident courses. Would those who have the intelligence and initiative to complete the correspondence courses early be given preferential consideration? Or would the laggards be smiled upon? Any reasonably sophisticated officer knows that, in practice, one group or the other would inevitably be favored. If the laggard were favored—and there are some who have actually advocated that correspondence graduates be disqualified from attending the parallel residence course—the advantages of the solution would disappear amid the resulting chaos.

Other objections have been raised to this proposal which do not stand up under careful scrutiny. The charge that educational advancement is not a valid criterion for promotion is blunted by its acceptance by other professions and by our disappointing search for objective promotion criteria possessing greater validity.

The assertion that many officers do not have time for the correspondence course study which this proposal might impose and that the harder working among them would thus be discriminated against in

[3] A similar solution has actually been approved in principle by Headquarters USAF. On 19 January 1950, the Commanding General, Air University, submitted to Headquarters USAF a staff study which recommended this solution and presented details of how it might be implemented. This study was approved with minor revisions by that headquarters on 21 March 1950. Its implementation was prevented by the Korean outbreak.

promotions, is refuted by a review of the duty assignments of present enrollees in the correspondence courses. Sixty per cent are on active duty, over a third of these are Regulars, and the percentage of overseas personnel enrolled, including those in Korea, is higher than the percentage among Zone of Interior personnel. A substantial number of these enrollees have especially exacting and time-consuming assignments.

A third objection is that this proposal would lead to wasteful duplications if an officer completes both the resident course and its paralleling correspondence course. But if the resident and correspondence courses rise to the opportunity, they would supplement rather than duplicate each other. Both have intrinsic strengths which make them basically distinct educational programs. The resident course features group association, direct instructor contacts, and instructional aids; the correspondence courses feature study within an actual operational situation and flexibility to meet the student's optimum learning pace. An obstacle to full effectiveness within the relatively short resident courses is the large number of hours required to orient and provide basic information to their students. If this obstacle were removed by previous completion of a parallel correspondence course, the resident courses should be able to reach goals which are now totally unobtainable.

But what if there is some duplication? It would not be wasteful, for the expansion in the correspondence course program resulting from this duplication would cost very little. Officers enrolled in the correspondence course would remain at their assigned duties. And repetition, as duplication in this case would be, is a time-honored and most effective learning procedure. In this respect, it should be noted that where an officer attends an Army, Navy, Joint, or foreign school, he and the Air Force would certainly benefit from his having previously completed the paralleling Air Force correspondence course.

While the problem of which officers should receive general service instruction has been argued on still other bases, they tend to share the strengths and weaknesses of the foregoing. This aggregate of strengths and weaknesses provided the raw material for constructing a list of criteria to guide the development of a "best possible" solution. Such a solution, according to these criteria, should:

1. Above all, provide a sufficient number of officers with the general service education needed to meet the essential long-range requirements of the Air Force.
2. Insure that officers attending the resident courses are those most capable of benefiting the Air Force from such instruction.

3. Insure full utilization of both the resident and correspondence educational resources of the Air Force.

4. Exploit to the fullest the intrinsic strengths of the resident and correspondence course types of instruction.

5. Be compatible with the educational requirements of the Regular Air Force, the USAF Reserve, and the Air National Guard.

6. Insure that the officer corps of the Air Force meets its professional educational obligations.

7. Be compatible with and adjustable to combat and operational requirements of the Air Force.

8. Be practical—workable in the face of monetary and manpower restrictions.

9. Be realistic—not geared to artificial or irrelevant standards.

10. Be simple—easily understood and administered.

11. Be fair—non-discriminatory between commands and between officers of like potential value to the Air Force.

12. Be sufficiently flexible to allow:

a. For reasonable freedom of choice by commanders in filling student quotas for the resident courses.

b. For sudden, unexpected increases or decreases in student quotas.

c. For substantial changes or modifications in the organization or content of the resident courses.[4]

13. Insure that officers complete each course in the educational ladder before moving to the next higher rung.

14. Encourage individual initiative toward self-improvement—motivate every officer to complete the general service courses in a commendable manner.

These criteria leave but one answer to the question of which officers should receive instruction in a general service course: *every officer should be given the educational foundation provided by these courses as he progresses through his career; furthermore, those officers who are capable of benefiting most from such instruction should be afforded an opportunity to build upon this foundation.*

This answer is not, of course, a complete solution to the problem. The crucial pay-off lies in a procedure through which the action prescribed can be effectively carried out. Such a procedure appears equally well defined:

1. Retain the age, grade, promotion-list, and other eligibility requirements presently prescribed for the resident and correspondence courses.

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[4] For example, the Director of Education, Air University, has submitted for evaluation a change in the organization of the resident courses which, among other features, would permit each student to complete a core program of study and additional electives to meet his individual needs.

2. Make successful completion of the resident or correspondence Squadron Officer Course prerequisite to promotion to the Regular, Reserve, Air National Guard temporary or permanent grade of major and to the highest grade of warrant officer; make successful completion of one or the other Field Officer Courses prerequisite to similar promotion to colonel; and make successful completion of either the Air War College or the Senior Officer Correspondence Course prerequisite to promotion to brigadier general.

3. Select students for each resident course in the following manner:

a. When an officer completes a correspondence course, a percentile score indicating his relative standing among all other officers completing the course during a given period of time would be placed on his Form 66. Thus if he finished thirtieth among a group of three hundred, his percentile score would be 90; if eightieth, his percentile would be 77.3.

b. Headquarters USAF, as now, would assign student quotas for each resident course to the respective major commands. But these quotas would be based on the relative number of eligible officers within each command having paralleling correspondence course percentile score above a selected figure—say 50.

c. Separate boards of senior officers at each major command would nominate officers to fill its quota, plus alternates, for each of the three resident courses and paralleling non-Air Force schools. Each board would consider only those officers whose scores for the paralleling correspondence course were within the percentile area fixed by Headquarters USAF. For instance, the command quota for the resident Squadron Officer Course might be thirty-five, and the number of eligible officers within the command above the 50 cut-off percentile for the Squadron Officer Correspondence Course might be ninety-six. The board would consider all factors bearing on the potentialities of each of these ninety-six, including recommendations from lower echelon commanders and effectiveness reports, and nominate a sufficient number to fill the quota and alternate slots.

4. The procedure would be instituted three years from the date of its approval. This period of time would permit each officer to complete the correspondence course appropriate to his grade and prerequisite to his promotional needs.

Headquarters, Air University

Air War in Korea: VII

TWO YEARS OF MIG ACTIVITY

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On 1 November 1950 Russian-built jet fighters of the Chinese Communist Air Force made their initial appearance in the Korean air war when six MIG–15's attacked four F–51's over Namsidong. Eight days later the first MIG was destroyed, knocked from the skies by an RB–29 tail gunner. Thus a new force, the CCAF, and new equipment, the MIG–15, entered the Korean conflict.

That the Communists have failed to produce a fighter-interceptor which has a pilot-and-plane combination equal to that of the USAF is particularly evidenced by the results of MIG–15 and F–86 engagements over the two years of MIG activity from 1 November 1950 through 31 October 1952.

Friendly vs Enemy Claims: 1 November 1950 to 31 October 1952

	USAF Claims: MIG–15's destroyed or damaged			Enemy Claims: USAF aircraft destroyed
Type of USAF Aircraft	Destroyed	Probably Destroyed	Damaged	Destroyed by MIG–15's
F–86	447	57	511	59
F–84	8	11	83	18
F–80	6	8	32	14
F–51	0	0	9	10
RF–80	0	0	0	1
B–26	3	0	1	0
B–29	16	7	11	13
Totals	480	83	647	115

MIG activity over the past two years falls into four rather distinct phases of operations, each apparently resulting from a change in the enemy's operational concept.

(1) The first ten months, November 1950 to August 1951, was one of build-up—a period of acquiring aircraft and operational experience.

(2) The next eight months, September 1951 through April 1952, saw the enemy send large numbers of aircraft over North Korea. The nature of the tactics then employed by the enemy indicated that this was a phase of mass training and familiarization.

(3) Throughout May, June, and July 1952 activity was reduced. It appeared that the enemy had, for the time being, settled on a concept of operations under which U.N. forces were engaged by the more proficient enemy pilots in a more or less token effort, while the majority of Red Fighters were carrying out their training over Manchuria rather than over Korea.

(4) August 1952 marked the beginning of the fourth distinct phase of MIG operations. It is believed that MIG pilots are now engaged in another training program over North Korea. While the mass characteristic of the second

phase of operations has not been observed, recent displays of pilot inexperience and unaggressiveness indicate a program of combat orientation and indoctrination of new pilots.

Phase I: The Build-up

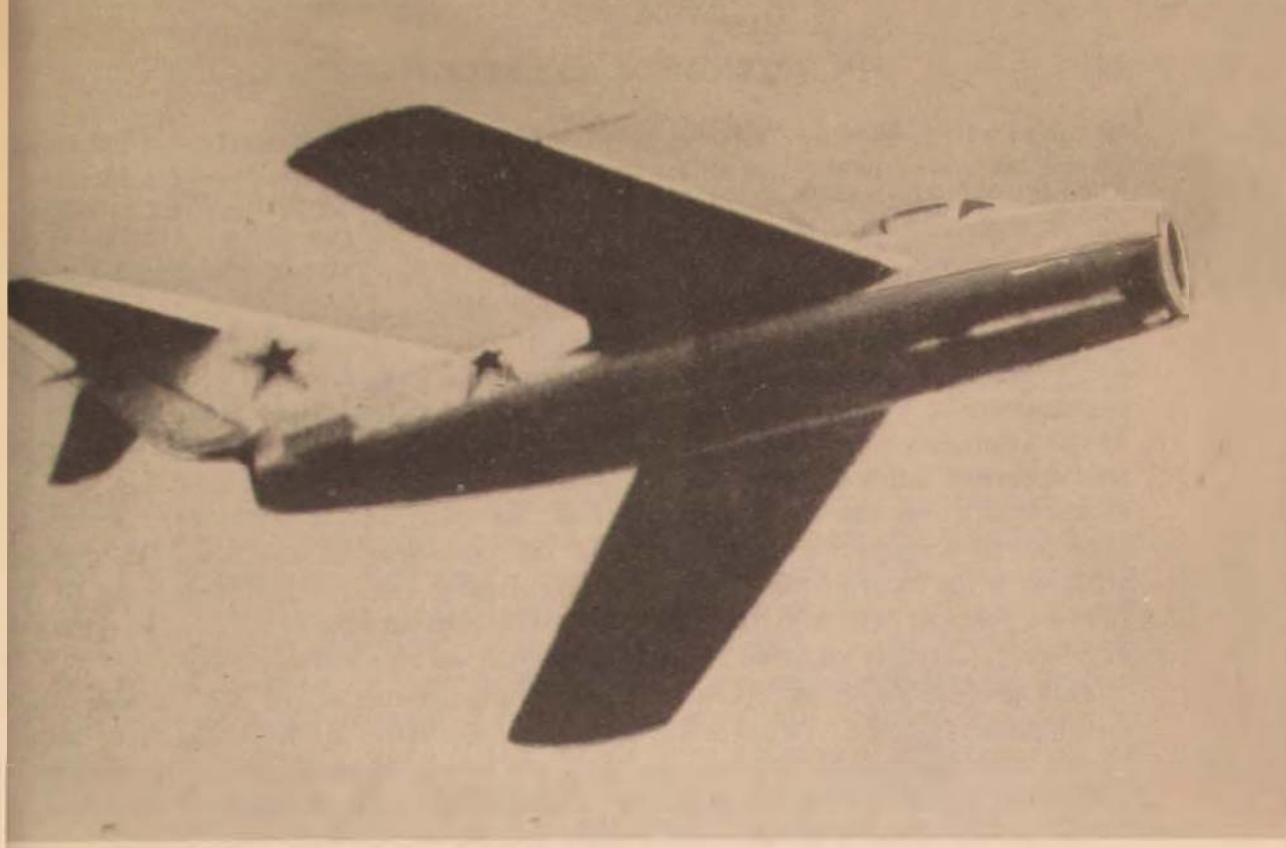
DURING the first ten months of history's first chapter on jet-against-jet aerial warfare (November 1950 to August 1951), MIG sightings were confined largely to the Yalu River section. Red jets were seldom seen and even less frequently engaged more than a few miles south of their Manchurian sanctuary. As USAF pilots approached the Yalu patrol area, they often observed dust clouds raised by MIGs taking off from Antung airfield just across the river. After climbing rapidly to altitude, in most cases a height greater than that of USAF aircraft, the enemy jets swooped across the border, generally in flights of four, breaking into elements of two for the attack. The first element would intentionally overshoot the friendlies and serve as decoys. When USAF pilots closed for the "kill," they often found themselves to be targets for the second MIG element closing rapidly from five to seven o'clock. One pass seemed to satisfy the Reds, after which they immediately raced back to their Manchurian bases. These hit-and-run passes characterized initial Communist tactics in air-to-air combat between jet aircraft and were continued against the F–86 Sabrejets, which appeared over Korea in mid-December 1950 in the role of fighter-interceptors, relieving F–80's, F–51's, and other U. N. fighters of that function.

By April 1951 increasing numbers of MIGs were spreading southward, being encountered frequently over the Sonchon-Taechon area, and were occasionally engaged as far south as Sinanju. Employing a somewhat more refined version of the tactics first displayed over Korea, MIG pilots used the sun to hide their initial pass and continue to rely upon the exceptional climbing ability of their aircraft to evade back into the sun after a swooping attack.

Increased Red pilot aggressiveness was evidenced by engagements with USAF B–29's—even above a complete undercast, through which they dived after making their pass. On the morning of 12 April 1951 the enemy launched his most determined and largest counter-air effort to that date. Then 100 to 105 jet fighters opposed 46 B–29's, escorted by 46 F–86's and 54 F–84's, in the vicinity of Sinuiju. These MIG pilots appeared to be more experienced and more determined, as they pressed attacks against the Superforts through their own flak and in spite of heavy losses. Friendly pilots claimed 14 MIGs destroyed, 10 probably destroyed, and 20 damaged. Two B–29's were destroyed.

May and June of 1951 saw enemy jets venturing as far south as Pyongyang. On 8 July a MIG–15 strike against escorted B–29's in the immediate Pyongyang area represented the most determined southerly penetration during daylight hours. While the CCAF had been credited with the capability of extending its air defense operations to include this area, it had not previously done so except at night.

During this period increased pilot proficiency and a new Red air tactic were discernible. The new maneuver was promptly and appropriately labeled the "Yo-Yo." Twenty or more MIGs would orbit at an altitude exceeding that of the U.N. formation and, from that group, some of the Reds would swoop down upon Sabre flights, then climb back upstairs, while others repeated the routine. MIG pilots frequently continued to "yo-yo" after the Sabres descended in spirals to altitudes where the enemy lost the advantage of his superior performance at high altitude.



The MIG–15 (named after its Russian designers Mikoyan and Gurevich) made its combat debut over Korea on 1 November 1950. This swept-wing fighter was developed after World War II in answer to the threat of USAF strategic bombing. The MIG has a conventional semi-monocoque, stressed-metal-skin fuselage. Its 6000 horsepower engine was copied from the 1948 Rolls Royce "Nene" centrifugal-type turbojet acquired from the British. Weighing 12,500 pounds, the MIG–15 measures 33-by-33 feet. Two 23mm automatic aircraft guns are mounted on the lower left side of the nose, with one 37mm automatic cannon on the lower right side. Guns are aimed by a lead-computing optical gun sight. Underneath the wing panels are attachments for external fuel load or bombs. USAF pilots considered the combat capabilities of the MIG to be superior to the F–86 in climb and maneuverability at high altitudes but inferior in range and dive speed. Its armament has been effective against slower aircraft but less so in high-speed aerial combat. The Sabrejet's 8-to-1 kill superiority over the MIG is attributed to USAF pilot skill and to constant analysis of MIG tactics.

In spite of sporadic indications of improvement, over-all enemy pilot proficiency seemed to be greatly inferior to the MIG performance characteristics and capabilities. While he had been spurred on to greater efforts with the December 1950 appearance of Sabrejets, the enemy had found his pilot-aircraft combination to be a poor match for that of USAF pilots flying F–86's. He was far less reluctant to oppose F–80, F–84, and B–29 aircraft, over which he had a decided advantage.

Night activity on the part of the MIG–15 was extremely limited and ineffective. Six MIGs did jump four F–51's returning from a dusk raid at 1945 hours on 28 June 1951, but this first engagement by enemy jets at so late an hour can hardly be considered night activity because of the visibility that prevailed. Other reports of enemy jet sorties at night have been predicated upon observations of a glow moving at speeds characteristic of jets. Piston aircraft were predominant in enemy night action.

Phase II: Mass Training Over North Korea

For approximately eight months—September 1951 through April 1952—a significantly different type of aerial war developed in Korean skies. During this period, enemy air activity was characterized by mass training over North Korea with attendant pilot inefficiency and poor gunnery.

MIG operations were generally concentrated over the great triangle formed by Sinuiju, Chinnampo, and Wonsan. Fighters were frequently observed and engaged in the Pyongyang area. The climax to limited enemy operations south of the triangle occurred when a flight of four aircraft, believed to be MIG–15's, was observed south of Seoul on 3 December. Mass sorties were mounted by the Communists over the eight-month period. As many as 366 MIGs were observed over North Korea on a single day, and 180 were seen at one time. December 1951, with its total of 3997 observed MIG sorties, remains the record month of the two years of MIG activity. In spite of the high number of sorties the number of aircraft actually engaged decreased steadily as the weeks passed.

This second phase of operations saw the introduction of MIG pincer and envelopment tactics. Often a force of 60 to 80 MIGs would cross from Manchuria over the Suiho Reservoir on the Yalu and head southeast. As this force continued down the center of Korea, small units were dropped off to attempt engagements with U.N. aircraft flying counter-air patrols just north of the Chongchon. Scouting flights were usually dispatched to the Wonsan area at a high altitude for flank patrol. At the same time a similar MIG force would proceed from Manchuria down the west coast of Korea, also dropping off intruder units and sending out scouting flights to the Chinnampo and Cho-do Island areas. Coming over the Yalu at around 35,000 feet, these forces would converge over Pyongyang and drop to between 15,000 and 20,000 feet before sweeping northward over the main supply routes in search of U.N. fighter-bombers and homeward-bound F–86's. An additional force of MIGs usually would come straight down the jaws of the pincers as far south as Sinanju in time to provide cover for other Communist fighter-interceptors withdrawing to their bases across the Yalu.

One occasion when these tactics were successful was when an estimated 140 MIGs encountered U.N. medium bombers during daylight hours of 23 October 1951. The 28 F–84's escorting the bombers were unable to cope with such odds, and three of the B–29's were destroyed.

That this eight months was chiefly intended to give training and familiarization to enemy pilots is indicated by the masses of jets that flew high over North Korea with no intent to engage, while their more experienced brothers demonstrated combat tactics through occasional engagements—usually when they enjoyed a decided numerical advantage. Perhaps the Reds believed something could be gained by having their new pilots observe the application of classroom theory, even while flying at relatively high altitudes, and by displaying an overwhelming force in order to impress U.N. pilots. Sabrejets continued their attempts to join contact with a generally reluctant enemy, but it became increasingly difficult to bring him to grips. By no means did engagements keep pace with the enemy sortie rate. For all indications the Reds were pursuing a training program that was not necessarily aimed at turning out fully experienced pilots but was intended to furnish pilots in sufficient quantity to man the ever-increasing numbers of aircraft supplied by the U.S.S.R.

MIGs carrying auxiliary wing tanks of the pylon or F–86 type were sighted

and, on a few occasions, the fighters appeared under coats of camouflage. In spite of a reluctance to engage, the enemy's losses continued to exceed by far those of the U.N., thus proving his selection of this new "training ground" to be tactically and economically unsound. Activity during April 1952 wrought more destruction upon enemy fighters than had been claimed for any preceding month. Of the MIGs engaged, 44 were destroyed, 6 probably destroyed, and 51 damaged. Shortly afterward the Communists altered their operational concept and withdrew their fledglings for training in the inviolate skies over Manchuria.

Phase III: Determined Attacks

AFTER the period of mass aerial training, there followed a three-months span (May to July 1952) of greatly reduced enemy sortie totals, the highest for a single month being 620 MIG sightings in May, with only 298 in June and 404 in July. Communist air operations were concentrated over northwest Korea near the Yalu River and were characterized by a relatively low daytime sortie rate and an increase in night activity. This precluded effective utilization of the MIG–15. MIG pilots flew infrequent sorties into areas as far south as Pyongyang, but usually when USAF F–86's were elsewhere. Engagements no longer appeared to be for training but displayed the aggressiveness of more proficient Red pilots. The enemy was obviously committing his better-trained fliers to combat. Despite indications of greater proficiency, however, the Communist pilot-plane combination remained greatly inferior to its U.N. counterpart.

The reduced number of MIG daytime sorties and the accompanying increase in Communist proficiency and aggressiveness, taken in conjunction with a stepped-up night sortie effort by piston-engined aircraft, indicated more than a change in the enemy defensive operational concept. The increase in efficiency and the economy of curtailed daylight operations were probably designed for the purpose of achieving maximum combat readiness of personnel and jet aircraft.

A new tactic was introduced by MIG pilots in July when "end-runs" were made around F–86's, the latter being either decoyed away or engaged in other areas in order to set up attacks on friendly fighter-bomber and reconnaissance aircraft. Ground radar (GCI) was apparently used for vectoring the MIGs into cloud-cover near roving friendlies, since some of their attacks were initiated directly from an overcast. The employment of such equipment on certain occasions, and the device of "end-runs" on others, were significant factors in the changed picture of enemy aggressiveness.

The frequent interception of U.N. weather and other aircraft in the coastal areas of the Sea of Japan and the Yellow Sea indicated a high state of alert. Both day and limited night intercepts were made by MIG–15's which evidently had been vectored into the area of the friendly aircraft.

Of interest is the fact that on 23 June 1952 no MIG opposition was encountered against the U.N. strike on the Suiho hydro-electric plant, despite the total of 250 jet aircraft observed on Antung and Tatungkou airfields immediately prior to the U.N. attack. No airborne MIGs were observed until after the fighter-bombers had left the area. At approximately the time the U.N. attack was broken off, visual reconnaissance reported that the jet count on the two airfields had fallen to 90. Although the bombing was taking place less than 60 miles away and lasted some thirty minutes, the 160 MIGs that had taken off made no gesture of interference, but completely disappeared. One possible explanation

is that these aircraft were withdrawn to rear areas from which they might operate in defense of the Antung complex should those facilities be attacked. Another possibility is that the presence of more than 100 escorting Sabrejets made the enemy reluctant to engage.

Enemy night activity during June and July 1952 was the most intensive observed up to that time and employed a limited number of jet aircraft. On 10 June a MIG–15 was identified among the 12 jets which attacked four B–29's bombing the Kwaksan rail bridge. As a result of this engagement the first night loss of B–29 aircraft to enemy air action was recorded, when two of the medium bombers were destroyed. Brilliant moonlight seemed to contribute significantly to the enemy's success, since on the night of 30 July 1952, the over-all ineffectiveness of Communist night interception was highlighted by the failure of the enemy's largest observed intercept attempt to damage a single medium bomber during a 60-plane B–29 attack on the light-metals plant in northwest Korea. Although the Reds used jet aircraft and many techniques for countering the B–29's, none of the jets was positively identified as a MIG–15.

Phase IV: Pilot Orientation and Indoctrination

THAT the Communists again changed their operational concept in August 1952 is evidenced by several factors bearing on MIG activity. This shift marks a fourth phase of over-all MIG operations—a phase primarily devoted to the orientation and indoctrination of Red pilots in aerial combat over North Korea.

The Red lull in sorties ended during the first week of August when the total number of observed MIGs skyrocketed to 673 during six days of action—the highest figure for a week since that ending 4 April 1952. Engagements and U.N. claims paced the rise in sorties. Friendly fighters claimed 37 of these MIGs destroyed or damaged—losses far in excess of those inflicted upon the U.N. aircraft. Then for several days there was an almost complete cessation, and at no time throughout the remainder of August did the number of MIGs observed on a single day total more than 97. September proved to be the most lucrative month of MIG destruction in the Korean war, despite the fact that seven days of that month produced no enemy fighter activity. All claim records were shattered when 64 MIGs were confirmed as destroyed, 8 probably destroyed, and 61 damaged.

It is possible that the enemy, heartened by a drop in the ratio of his losses to those of the U.N. between 15 April and 31 July, initiated in August a moderate effort to defeat the F–86's by attrition. He is doubtless well aware that were the Sabrejets to be eliminated, a potent barrier to his achieving air superiority over Korea would be removed. But if such an idea existed, the concept was obviously revised. While MIG sortie totals fluctuated radically over the weeks from the beginning of August to the end of October, they remained substantially high throughout the over-all period. The resultant heavy losses apparently made the enemy realize that his training had not progressed sufficiently to cause significant attrition of the Sabrejets. Consequently, Red pilots returned to the objective of acquiring more experience and proficiency but displayed a greater reluctance to tangle with the superior friendlies.

The late fall and winter of 1952 have brought to the scene Communist pilots displaying a wide variation in their pattern of aggressiveness and numerous MIGs with coats of camouflage. At times, early in the period, all prèviously developed tactics were used by the MIG pilots to position themselves for combat.

"End-runs," "Yo-Yo's," and "decoys" were prominent on several occasions. More numerous, however, were the Reds who sought every means of escape—cloud cover, violent maneuvers, and protection in the area north of the Yalu. MIG pilots frequently appeared to panic at the approach of F–86's and broke into their familiar evasive tactics. Noteworthy were the MIG-Sabrejet engagements at extremely low altitudes. Some battles took place at under 100 feet, apparently an attempt by the Reds to get below the Sabrejets who were screening the fighter-bombers. This maneuver generally proved futile when the F–86's dropped down to attack.

Accounts of the over-all engagements indicate that a majority of the MIG fliers were inexperienced, lending credence to the probability that new pilots had been committed to the Korean air war and that they were being sent out for combat indoctrination. Failure in their attempts to close on their targets in combat pointed to the lack of pilot experience and proficiency. Increased use of camouflage for escaping detection and their runs for the Yalu served as protective measures for new and inexperienced pilots who were undergoing a more practical phase of training than could be afforded through theory alone. There were no indications that the enemy had decided to make more than a token effort against U.N. fighter-bombers. Red pilots continued to sift through the Sabrejet screen, occasionally jumping British Sea Furies and other naval aircraft in the Chinnampo, Wonsan, and Sariwon areas.

Two new tactics appeared in the enemys night intercept effort when jet aircraft, believed to be MIGs, were involved. One was the reported use of flares on two occasions to illuminate the U.N. bomber stream. Since on one instance there was no undercast, it seems evident that this tactic was designed to assist enemy night interceptors in locating the B–29's. Despite the flares the night effort proved ineffective, and no damage was inflicted on the medium bombers by hostile aircraft. Another variation appeared during late September with the possible use of aircraft to act as spotters for antiaircraft batteries. This tactic was likewise futile.

Two years of jet warfare over North Korea have failed to produce a MIG aircraft-pilot combination of a high standard. While in general the characteristics of the MIG itself are considered to be on a par with those of the F–86, the Red pilots have rarely demonstrated the ability to exploit fully the aircraft's capabilities. However, in certain engagements enemy pilots have shown a proficiency in a variety of tactics and have demonstrated their ability to maneuver with the best of U.N. pilots. Despite their evident willingness to alter their operational concept when the need arises, the Communists have not yet produced an effective countereffort against the USAF F–86-pilot team.

While MIG pilots, on occasion, have succeeded in penetrating the screen of Sabrejets protected fighter-bombers, generally they have been reluctant to engage the F–86 without a decided numerical advantage. Such penetrations, when pressed, have usually been costly to the MIGs. Attacks on B–29's during daylight operations north of the Chongchon made the employment of medium bombers in that area practical only during the hours of darkness.

At the close of these two years of aerial jet warfare, MIG losses, as opposed to those of its Sabrejet counterpart, stood at approximately eight to one.

Headquarters, Far East Air Forces

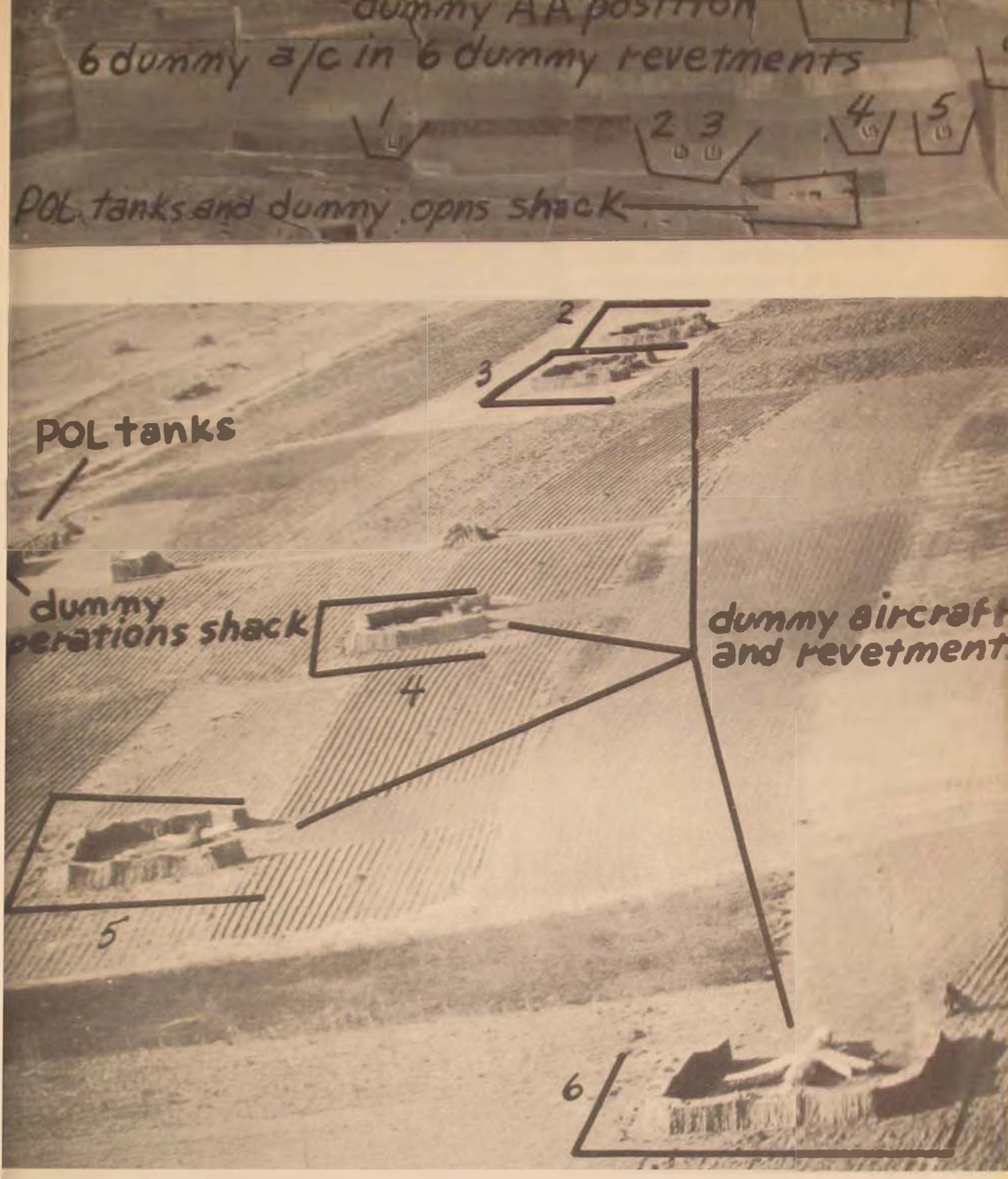
Communist Camouflage and Deception

A little publicized but extremely effective Communist device to circumvent the USAF interdiction campaign has been expert, extensive use of camouflage, deception, and dispersal of military targets. Laboriously repaired runways are dotted with dummy bomb craters to look as if they are still inoperative. In daytime, trains and truck convoys hide in tunnels and roadside shelters, then scuttle out after dark. Damaged bridges, railroad tracks, and highways are repaired and the repairs camouflaged with straw or dirt. Troop concentrations, vehicles, aircraft, or huge supply dumps are spread over several square miles, protected from effective air attack by dispersal and by a phenomenal amount of "rat-holing"—excavating caves and revetments out of cliffs and digging thousands of large trenches along mountain slopes or in open fields, to be filled with supplies and covered over. Such extremes of passive defense testify to the impact of U.N. aerial interdiction. They also decisively exhibit several important enemy characteristics. Although deficient in engineering equipment, he has expert engineering assistance. He has inexhaustible hordes of laborers, and the speed and general quality of their work in large measure counterbalances their lack of modern machinery. His long, varied experience in limited and guerrilla warfare pays off in cunning, skills, and disciplines peculiarly suited to operations in rugged and primitive Korea. Like any shrewd soldier, he has squandered his most plentiful resource—man power—to protect his weak point—modern equipment and supplies. Reconnaissance photography has recorded his methods. He has not defeated our interdiction campaign, but he has made it more difficult and has limited its results, even though it has cost him heavily to achieve this.

Airfields and Military Installations

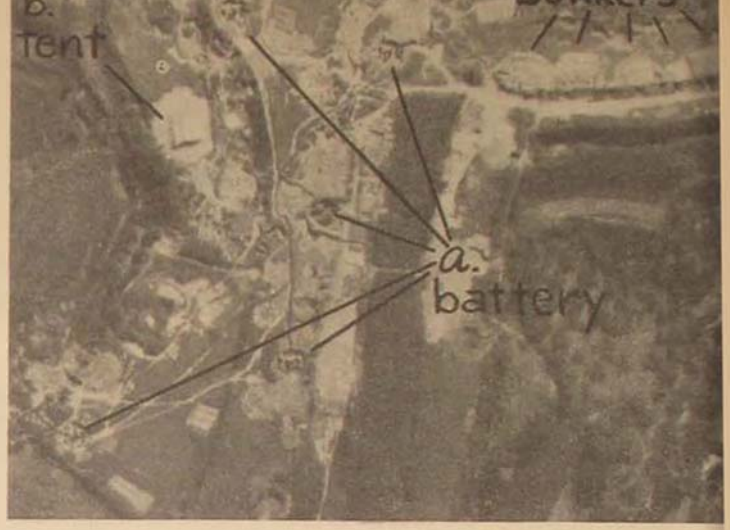
Since sprawling airfields and other large military installations cannot be completely hidden from the prying eye of visual or photographic reconnaissance, the Communists have contented themselves with basic camouflage of buildings, deceptive devices, and dispersal. Their airfields seldom have hangars. Aircraft are maintained and protected in thick-walled earth revetments frequently

On this heavily bombed runway in North Korea all except two or three of the numerous craters have been filled in, although some have not as yet been resurfaced. At each end of the runway, rings of dirt around repaired craters simulate unfilled holes.

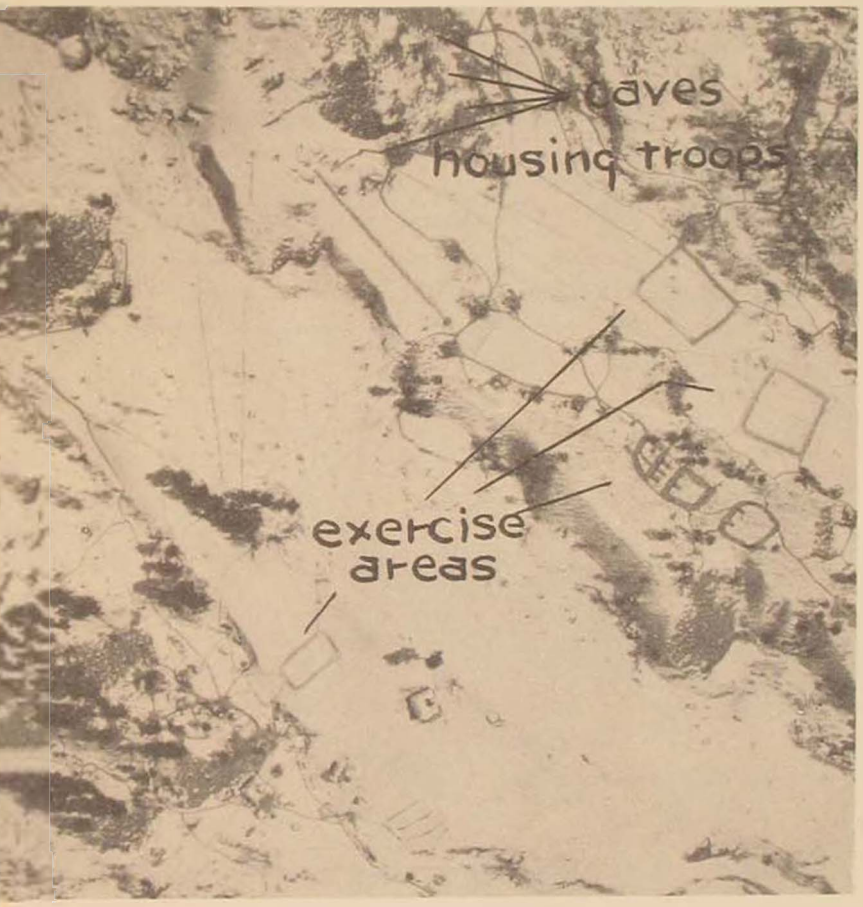


This elaborate dummy Communist airfield is complete down to a dummy antiaircraft battery, six revetments with a fake MIG in each, an operations shack, and a small petroleum, oil, and lubrication dump. The oblique photograph shows the care lavished on the dummy aircraft. They are even raised off the ground so they cast shadows.

two or three miles from the airfield. Wherever possible revetments are built into cliff faces. Dummy bomb craters are dotted on runways to make the airfield appear inoperative. Elaborate dummy airfields are constructed to draw bomb loads destined for real airfields. The Communists are very skillful in their use of local natural materials—brush, dirt, rock—to camouflage buildings and gun positions. Their discipline in minimizing tell-tale track activity around installations is excellent, a high achievement for any army.



This massive five-gun heavy antiaircraft battery blends with the scenery. Grass and shrubbery are planted on the slopes of the gun emplacements (a). Earthwork, except for the new clearing around the tent (b), has been toned in with the terrain. Along the road, ammunition storage bunkers (c) are visible only by the tunnel openings.



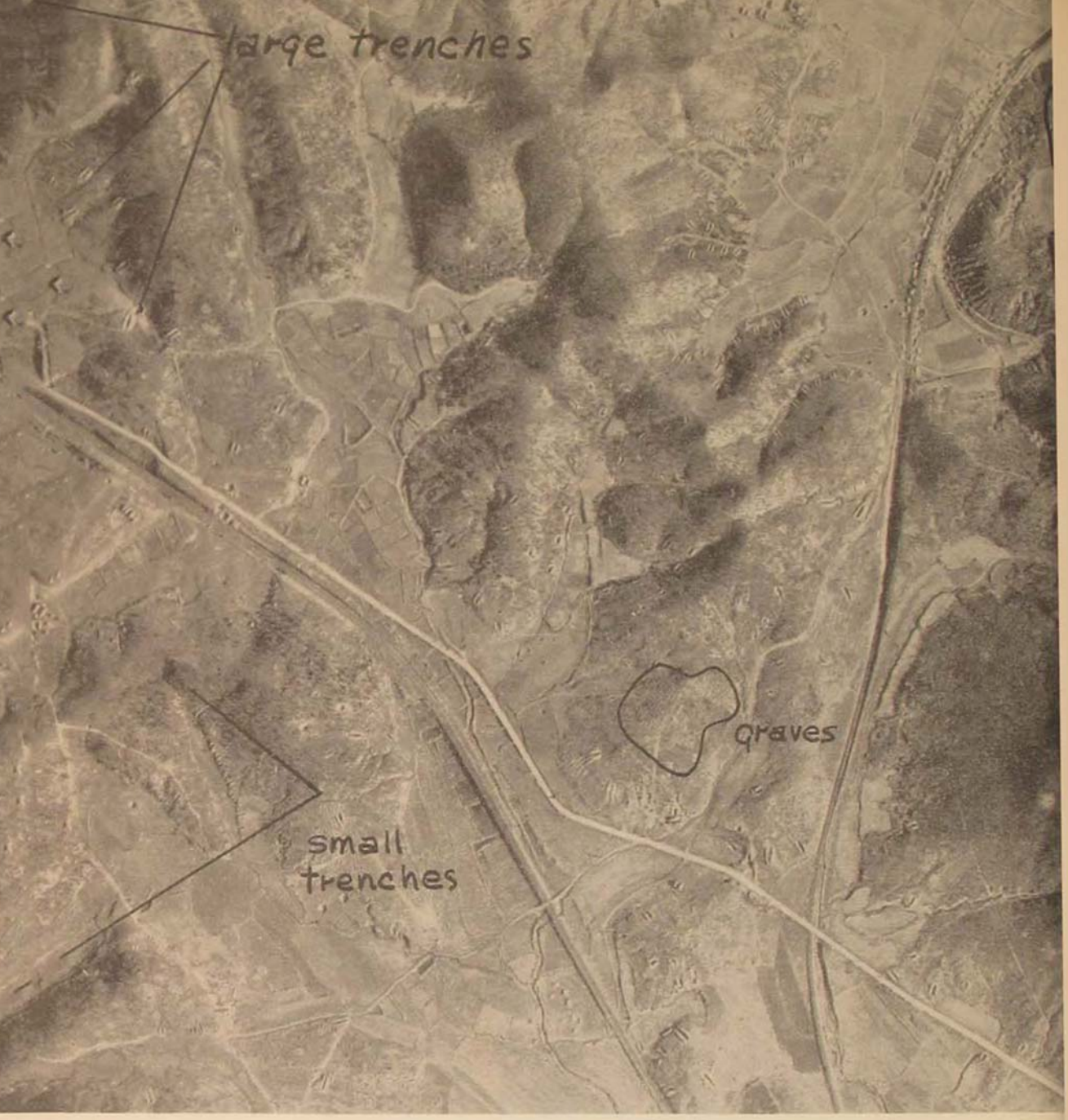
Snow always helps disguise inactive military targets but is a dead give-away to track activity. This dispersed bivouac area can easily be spotted by the exercise rings tramped out in the snow. Paths leading from the rings reveal the locations of caves dug out of the hillsides to house most of the troops. The black smudges on the left mark bomb explosions from a recent air attack.

The effectiveness of Communist camouflage can be seen in this photograph of a vehicle repair shop. The two large buildings (lower left) are almost indiscernible, so well have their roofs been blended with the earth around them. In the cluster of small buildings at right some roofs have been left light and others darkened to break up the sight pattern.

Transportation

Transportation is a sensitive chink in the enemy's armor. To protect key points on his railroads and highways and to hide his vehicles he has been forced to resort to numerous and varied devices. Both highway and rail bridges are strenuously kept in repair (for a fuller exposition of his bridging methods, see "Enemy Bridging Techniques," *Air University Quarterly Review* V, No. 4 [Winter 1952], 49–59). By-pass bridges are constructed, often before the permanent bridge has been bombed, so that one of the two or three alternate bridges can keep traffic moving. Sections of repaired bridges are placed in position at night when the traffic moves, then removed in the day to make the bridge appear inoperative. Repaired bridges are covered with patches of debris to simulate disrupted roadbed, or their sides are covered with foliage to make the underpinnings look like earth fill. Some bridges are completely camouflaged; others are built under water. Trains hide under camouflage or in tunnels by day. Special shelters have been built along the highways for trucks to hide in while they wait for darkness. Trucks disguised as small houses pull off the road into the fields when aircraft are sighted. Oxen are driven in front of a truck or a tank covered with straw to disguise it as a farm cart. Vehicle dispersal areas are provided near large supply areas and bivouacs, the type varying with the terrain. Often they are tunnels dug into hillsides. Wooded areas, orchards, and hedgerows frequently conceal rows of vehicles. In the winter canvas shelters are erected and covered with snow for effective camouflage. When all other means of moving supplies fail, the enemy has recourse again to his tremendous manpower. Thousands of coolies are loaded with packs of ammunition, gasoline, or other supplies. Like streams of ants, they crawl over the mountain where the tunnel has been blasted and ford the river beside the broken bridge. Flexible, invisible, and unending, these human supply trains constitute one of the major breaks in the wall which U.N. aerial interdiction has thrown up between Communist front lines and their supply areas back in Manchuria.

A truck being ferried across the river is crudely disguised with pine boughs. Personnel hastily swimming for the bank seem to have no faith in their own handiwork.



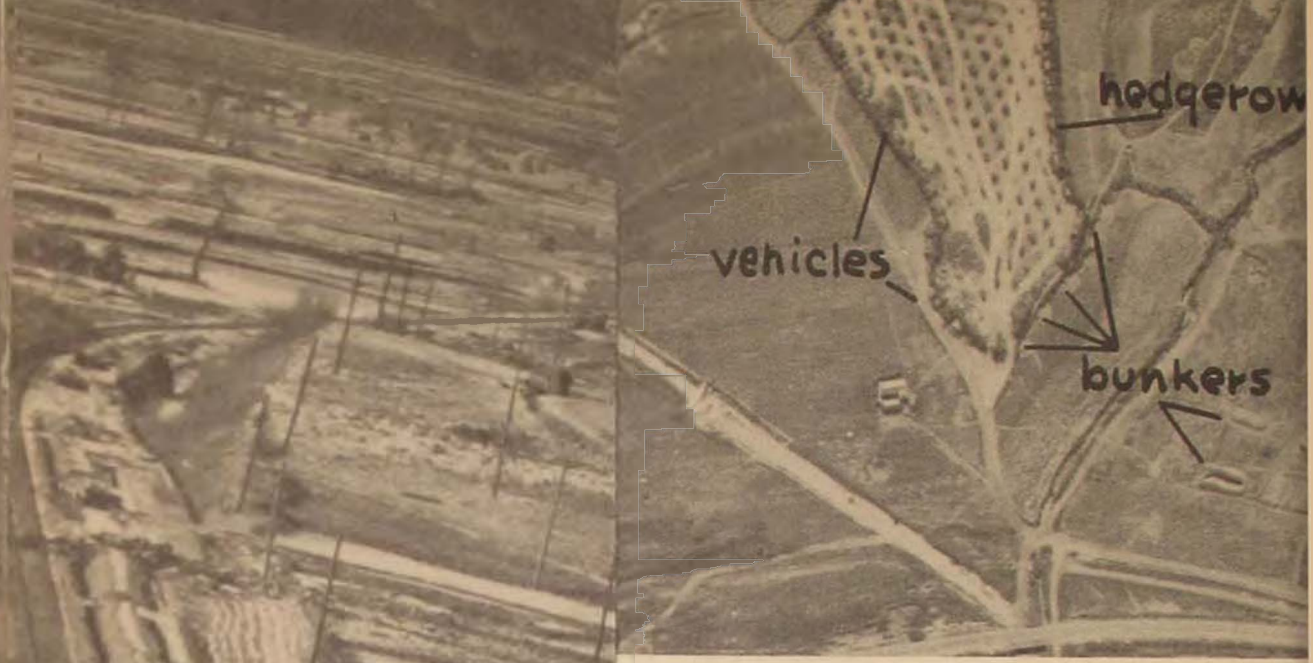
This photograph, on a scale of approximately 1: 10,000, shows plainly the extent of one dispersed supply dump in North Korea. The hills to the left are ringed with varying-size supply trenches, and others are still being dug. The inset at top right gives a close-up view of both open and closed-over trenches. Along the railroad

Supply Camouflage and Dispersal

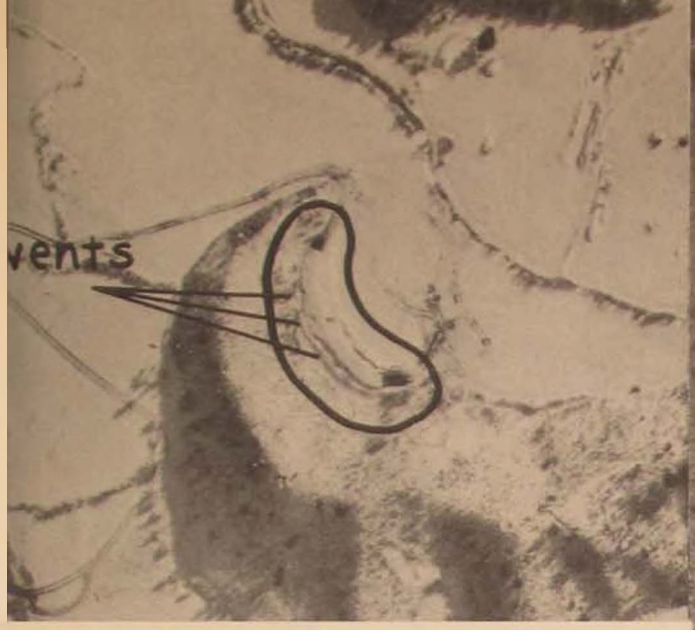
Desperate at the smashing and burning their regular supply dumps take from the USAF interdiction campaign, Communists go to extremes in dispersing and hiding supplies. In every kind of terrain, reconnaissance photographs reveal scattered rows of trenches filled with supplies and covered. Cellars of bombed houses are stocked and roofed over. Villages are evacuated and the houses used for storage. Ruins offer good cover for odd-shaped piles of supplies. Drainage ditches along roads become huge trenches

supplies which were unloaded from the train disappearing off the top of the photograph are stacked by the track, awaiting removal to the trenches. Rows of trenches, some of them still open, rim several of the open fields. Twenty-four heavy antiaircraft gun emplacements under construction attest to the importance of this supply area.

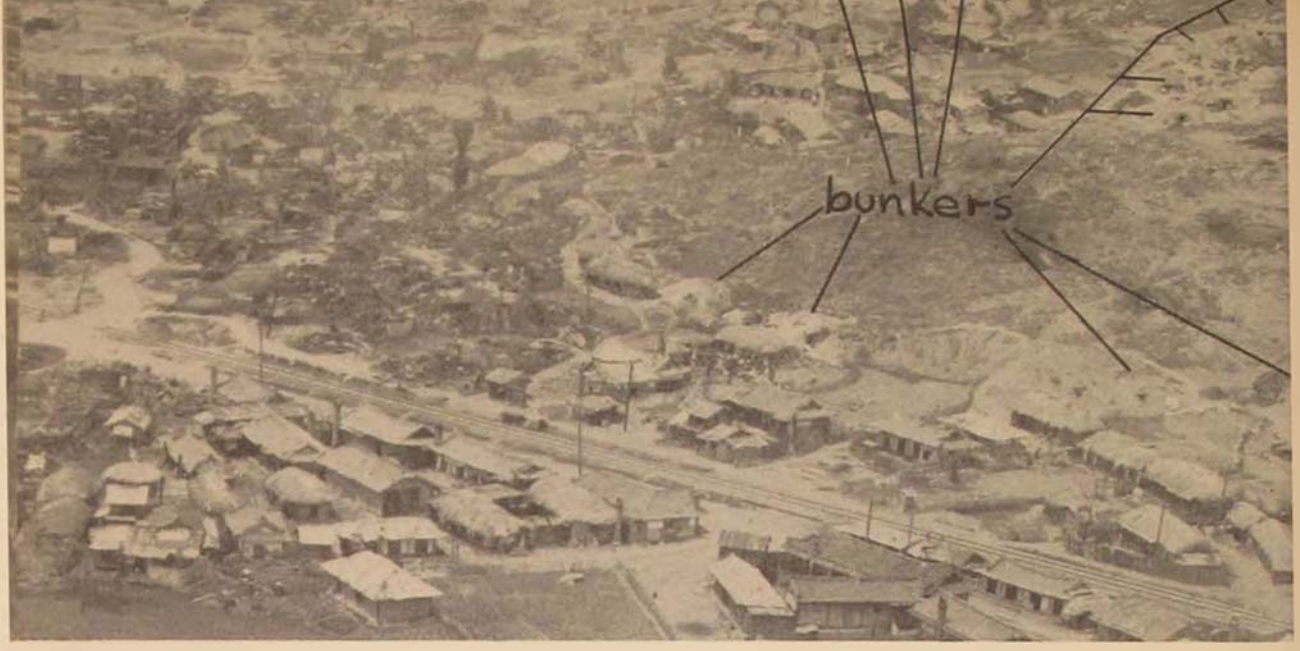
filled with camouflaged supplies. In open fields irregular stacks of supplies resemble boulders from the air. Regular stacks covered with rice straw take on the normal pattern of the farmer's gathered crop. In wooded areas, boxes or crates are scattered under the trees and in the underbrush, along the edges of orchards, and in hedgerows. In the mountains bombed-out railroad tunnels are used for storage. Caves are dug in hillsides, or roads running through deep cuts are roofed over. Only a profligate use of manpower provides this radical dislocation of supply centers. Its military disadvantages are enormous, underscoring the plight of a land force without air protection in the face of a well-organized, persistent aerial offensive.



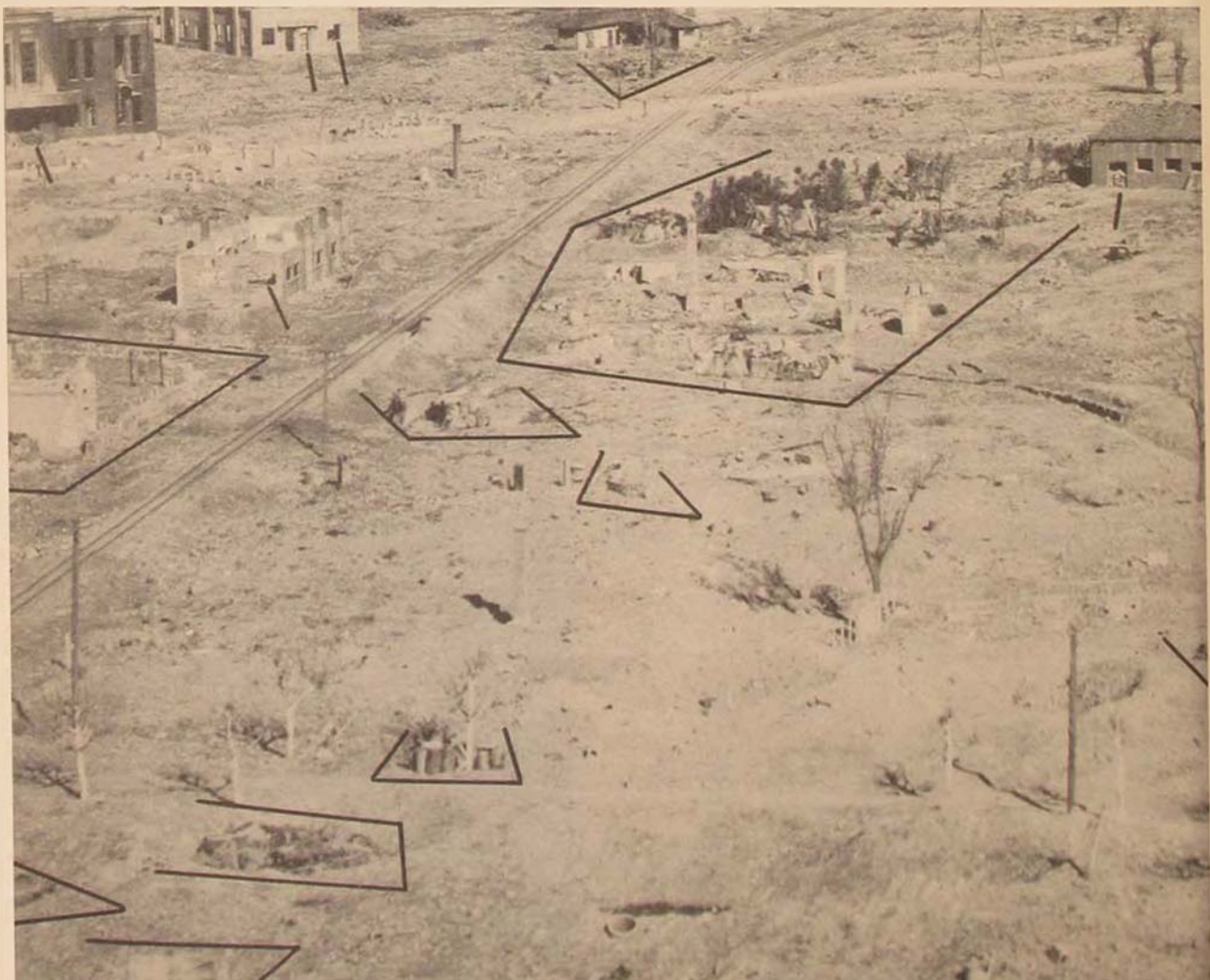
Reconnaissance photographs are painstakingly examined for new Communist dispersal areas. The small orchard above immediately draws the eye because of the unusual amount of track activity. Closer scrutiny reveals a line of vehicles hiding along the hedgerow which encircles the orchard. To the right of the hedgerow a series of small supply bunkers are carefully camouflaged. Another variety of supply dispersal is the long, irregular line of covered-over supply pits (left) flanking a single-track railroad and dug in the part of roadbed formerly occupied by a second track.



Communist dispersal areas do not lack variety. Above, tracks in the snow point a long finger to a cocoon-like shelter nestled against the hillside. Air vents along the top suggest that the purpose of the building may be vehicle repair work rather than storage. Bomb hits have caved in the roofs of twin railroad tunnels (above, right). The left one is now serviceable. The other remains blocked for trains but can be used for storage. In photo at right, stacked supplies are irregularly dispersed in cultivated fields and covered with rice straw to look like a gathered crop.



The Communists use North Korean villages, both before and after their destruction by USAF strikes, to disperse and conceal their supplies. In the village above, huts are used for storage, and low, camouflaged earth bunkers have been constructed on the fringes of the village for both air raid shelters and supply storage. After a village has been destroyed, the shattered rubble is still very useful for camouflage. In the ruins shown below, irregular stacks of supplies are spread throughout the village to take advantage of the broken contours and jagged shadows of the wreckage. Skillfully done, this deception is extremely difficult to spot from any altitude.



AIR DEFENSE COMMAND PROCEDURE FOR EXECUTIVE CONTROL

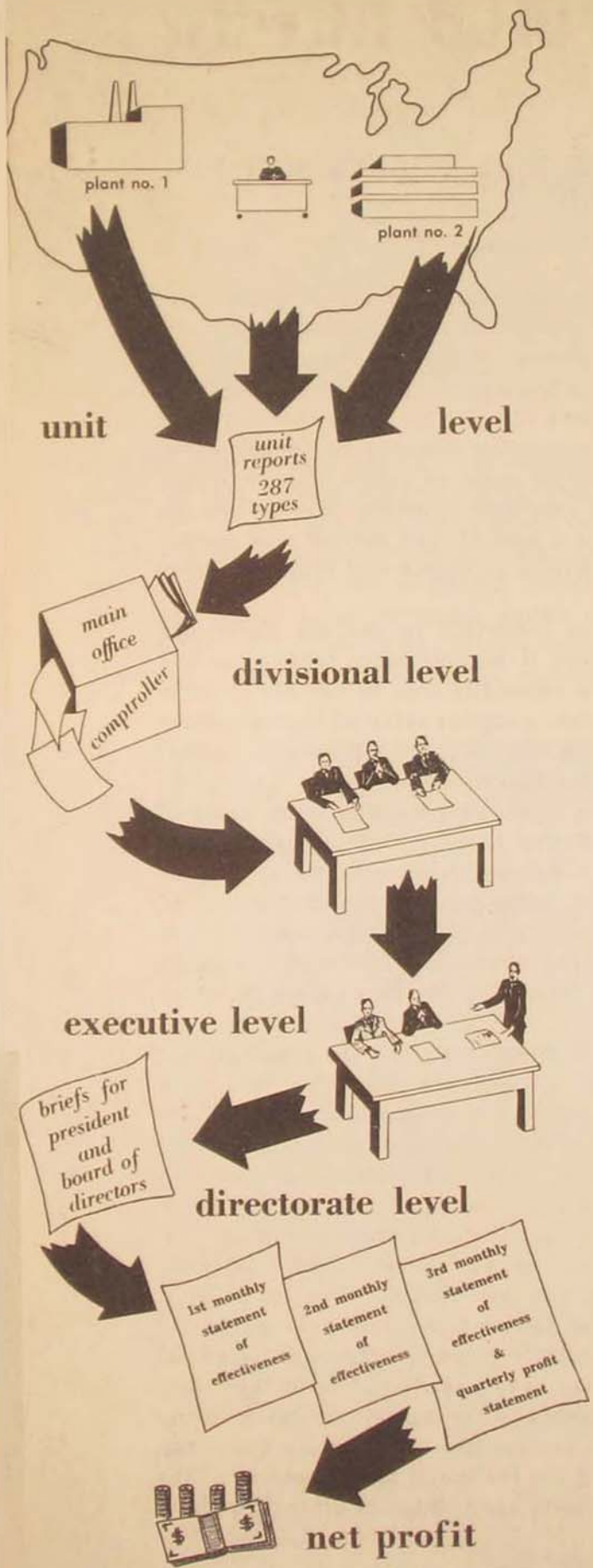
COLONEL JOSEPH F. MOONEY

WHEN an organization is small, the top man knows all his people personally. He can plan, organize, and control the daily operation himself. He is well aware of what is going on at all times, and no elaborate reporting system is needed to keep him abreast of current operations. This was the position of the Army Air Forces late in 1940. But with the outbreak of hostilities, and the enormous growth which began in late 1941, the Commanding General no longer knew all his people personally. He and his small staff could no longer plan, organize, and direct daily operations. Although the executive functions had to remain with the commander, it became obvious that a special staff section was needed to collect, evaluate, and report to him on matters of status and progress. Statistical control units were organized.

The armistices of 1945 and the following reduction in the Air Force did not diminish the problem of control. Rather it became more serious as our nation expanded its commitments. This was especially true in the Air Defense Command. The Air Defense Command now has a capital value of approximately 1.5 billion dollars, spends approximately one billion dollars each year on capital increment and operating costs, directs some 72,000 people spread among its 222 units of various types, and compares in size and resources with many of the largest industrial organizations of the United States. But the aggravation in this particular command was caused not primarily by numbers of men or units but by the extensive geographical area to be covered, the deployment of units, and the variety and types of units to be controlled. With such diverse components scattered over so large an area, the command staff found it difficult to furnish commanders a concise, over-all report on the combat readiness of the air defense network.

Not finding the answer to its particular problem in any of the standard Air Force reporting systems, the Air Defense Command examined the techniques of control in industry. Although the military has originated many of the principles of organization, we must credit the extensive development of modern control procedures to industry. If we apply the industrial definition of control—"Control is the examination of results"—we find it as applicable and desirable in a large military organization as in any industry. Furthermore when the relative problems and goals of industry and the Air Defense Command were examined in greater detail, numerous parallels were found. For example, it has often been stated that the military establishment does not have a "profit" motive and consequently cannot be patterned too much after an industrial organization. The Air Defense Command does have a profit motive in "kill effectiveness." This term is defined as "the probable percentage of attacking enemy aircraft that will be destroyed before bomb release line." To attain the maximum "kill effectiveness," all the 222 units of the command must perform at the same time, toward the same end, and with top efficiency. Fighter aircraft without

Industrial Organization



adequate air control and warning are at minimum effectiveness. Air control and warning units without proper calibration are likewise at minimum effectiveness. Either fighter or AC&W units without efficient logistical support are at minimum effectiveness. In arriving at kill effectiveness, we must consider the average efficiency of all units of the Air Defense Command and the interrelated effort of these units as reflecting the capability of the command in its entirety.

The similarities between industry and the Air Defense Command suggested that many of the control procedures which had worked so well for industry might benefit the command. The headquarters staff accordingly reviewed the whole system of reporting in the Air Defense Command. After much study, the system was revised and a new Combat Readiness Report—the nucleus of the reporting system—was prepared. This revised Combat Readiness Report has three basic objectives:

1. To provide factual data upon which an integrated commentary on the effectiveness of Air Defense Command could be submitted to the Commanding General, his principal deputies, and Air Defense Force commanders.
2. To provide accurate performance data for prediction of enemy bomber kill as related to critical targets and potential approach lanes, including predicted kill effectiveness on certain selected future dates.
3. To determine cost of air defense in relation to effectiveness.

A processing system was devised to convert the information received from the field and presented in the Combat Readiness Report into two concise, factual documents for use by the top command level: (1) the Statement of Effectiveness, a monthly status report on the command; (2) the Kill Effectiveness Report which shows the "net profit" of the Air Defense Command. These documents would inspire executive action, and inform planning. They make possible accurate cost estimates of air defense—in

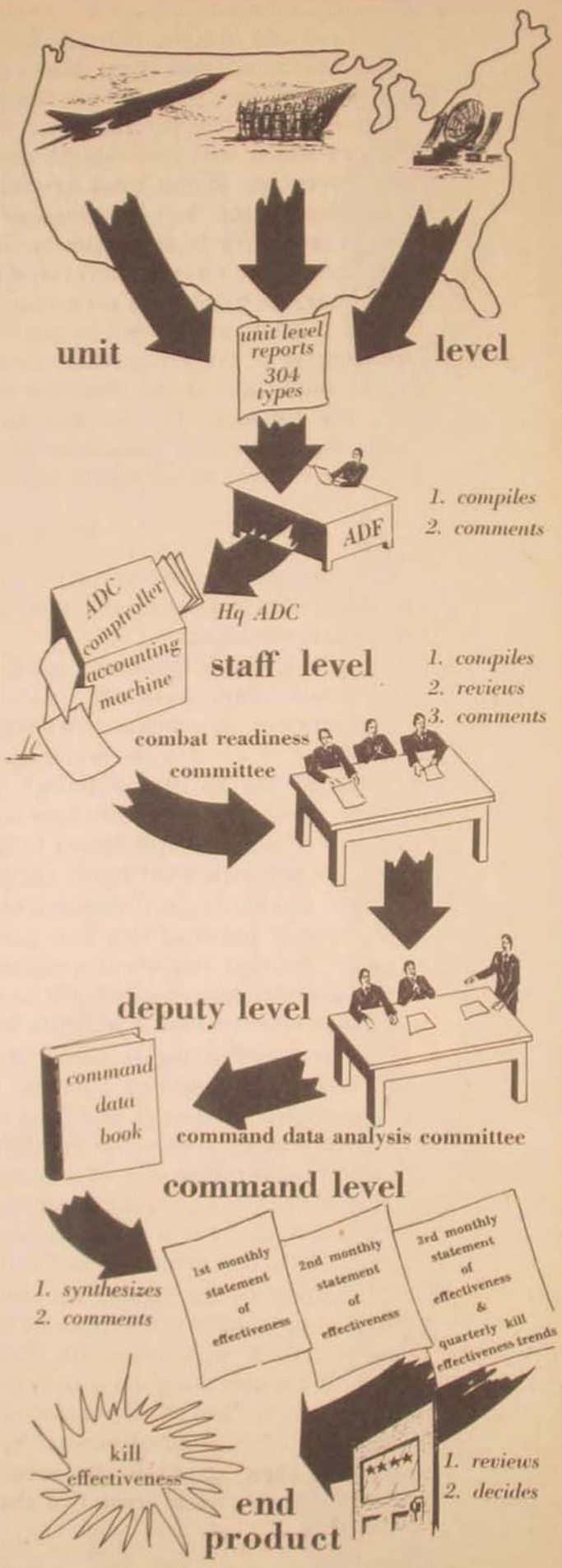
terms of money, matériel, and balance between primary and support missions. Figures 1 and 2 illustrate the flow of materials and the major staff agencies involved in processing and condensing the information.

Development of the Kill Effectiveness Report

When the spade work has been completed and the Combat Readiness Report written, the Kill Effectiveness Report, which is the end report, can be prepared. "Kill effectiveness" is the net profit of the Air Defense Command. Computation of the Kill Effectiveness Report is a joint responsibility of the Director of Management Analysis, the Deputy Chief of Staff for Intelligence, and the Operations Analysis Section. Before this computation can be made, numerous items of information are required: probable enemy force; combat ready aircraft available for defense; combat ready crews available for defense; per cent of scramble sorties ordered airborne; gunnery qualifications of crews; combat ammunition on hand; detection range capability of air control and warning system; positive identification capability; detection time to scramble order; force (combat aircraft) which can "scramble on"; scramble order time to airborne time; airborne time to intercept time; time for earliest identification as hostile; combat time; destruction capability; and antiaircraft destruction capability.

The sum of "kill effectiveness" by division areas reflects the "kill effectiveness" of an air defense force, and eventually the "kill effectiveness" of the Air Defense Command. This information is included by air division, air defense force, and Air Defense Command levels on a quarterly trend basis in the Air Defense Command Statement of Effectiveness.

The phases which are used in calculating the "kill effectiveness" of the com-



mand are shown in Figure 3. Basically the four phases of the entire problem can be reduced to time, distance, and force (both friendly and enemy).

The final tabulation of all these considerations results in *the probable number of enemy bombers, out of the entire attacking force, which will be destroyed.*

Entry of the time variables into the calculation reveals the number of enemy bombers which will probably be destroyed *before* and *after* bomb-release line. The percentage of the total attacking force which is destroyed *before* bomb-release line is the "kill effectiveness" of the Air Defense Command.

This procedure is emphatically not a rating system. While it can be used to determine the relative performance of like units in relation to their resources, its primary purpose is to accumulate all the facts, segregate these facts in an orderly fashion, and show the commander which factors most limit the over-all effectiveness of the air defense system. With this information the commander has an indication of the direction of effort or course of action required and a basis for decision. He also has the necessary facts to go to the next echelon of command for any assistance he may need. Conversely, corrections or reallocations of resources within his capability will be pointed out to him.

Price of Air Defense

The foregoing procedure may be designated as the qualitative evaluation of the Air Defense Command. The next step, presently under development, is quantitative evaluation.

The Air Defense Command is big business, costing hundreds of millions of dollars each year to operate. As custodians of this investment and directors of its operation, its commanders have grave responsibilities. It is quite clear that the amount of air defense which can be purchased is limited by the economic strength of the nation. Although an almost "leakproof" air defense system could be developed, its tremendous cost would severely tax the Nation's economy. The answer consequently hinges on how much air defense or "kill effectiveness" can be bought with what funds can be made available.

All the answers to this fundamental question are not yet known. Perfection of the second phase of this new procedure is expected to give an approximate answer. Another important question which can be attacked by this procedure is how much effectiveness *should* be secured from the funds being expended and how much effectiveness *is actually being produced.*

This cost accounting is based upon data currently being provided through the USAF Cost Reporting System. From these data the relationship is being developed between combat costs and support costs, based on operating costs alone. The initial tabulations so far completed indicate that approximately 75 per cent of the total operating cost of a fighter-interceptor wing is expended on support costs. Twenty-five per cent is directly applicable to the operation of the combat units of a wing. Since the reorganization of the Air Defense Command 1 February 1952, further refinements of this study are being made.

In addition to the fighter squadrons and air base support squadrons, it is necessary to include and break out into combat and support costs the operating costs of AC&W squadrons, air divisions, etc., to afford the basis for segregating all the operating costs in a given air division area. Correlation of these figures with the "kill effectiveness" of the air division will determine the monthly dollar costs of "kill effectiveness" by combat and by support activities. Those areas will show up which are spending too much on "support" in relation to "combat costs". Such areas can then be analyzed under the Management Im-

Components of Kill Effectiveness

PHASE I

enemy action

- number
- formation and size
- lanes
- target priorities
- speed and altitude
- armament

PHASE II

detection

- number of sites
- site status
- hours operative
- manning
- ground observer squadrons

PHASE III

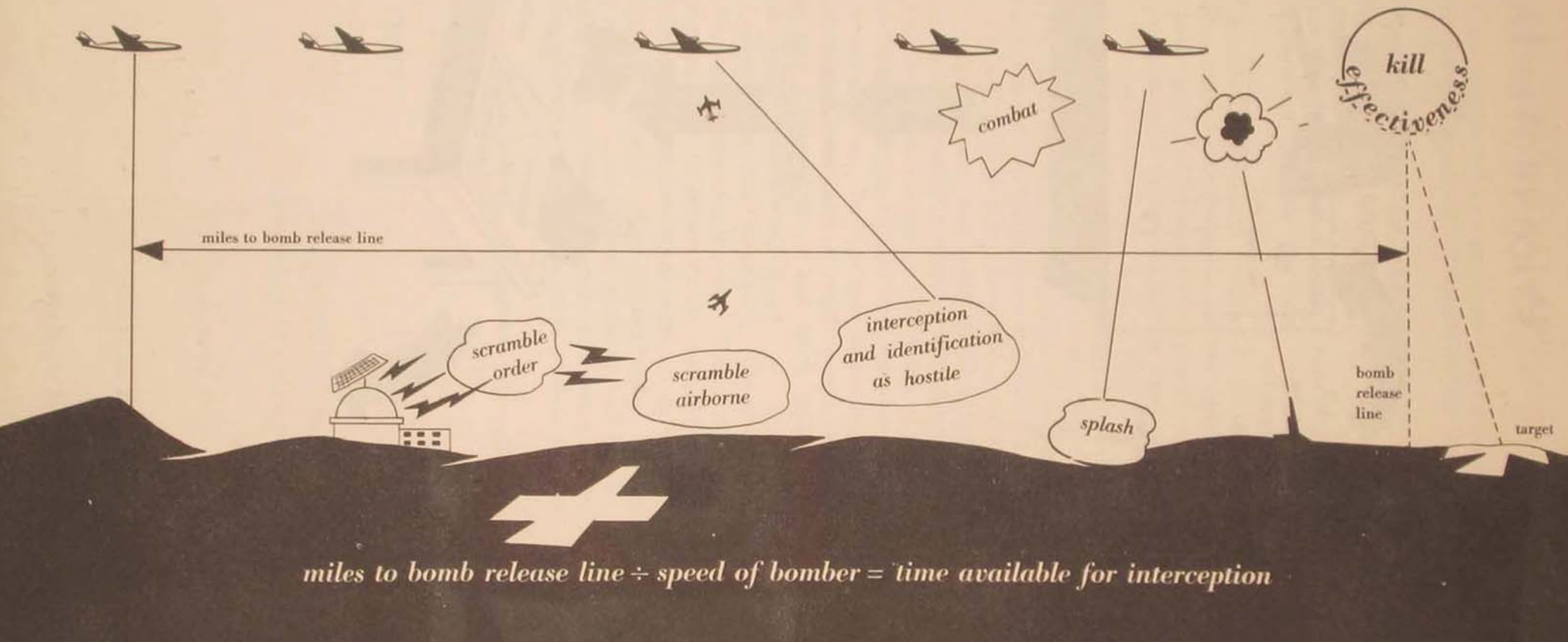
scramble to interception

- scrambles ordered
- scramble sorties airborne
- successful intercepts
- time and direction of intercept
- probability of identification as hostile

PHASE IV

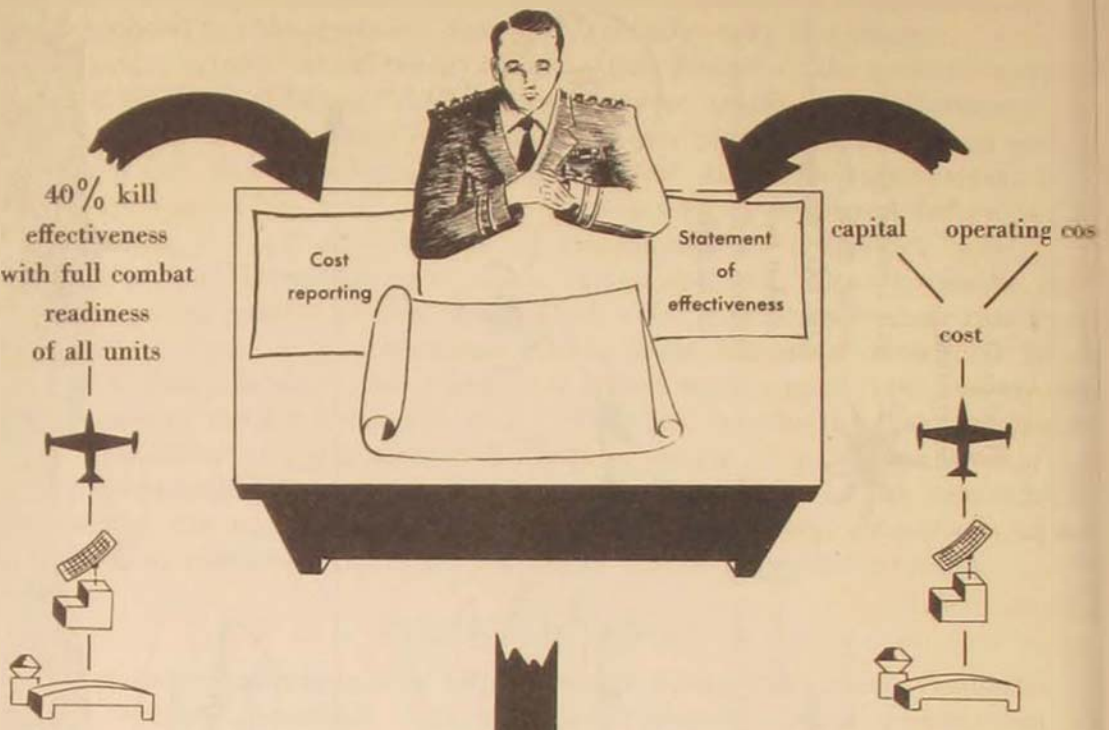
destruction

- unit essential a/c combat ready by type
- combat ready crews
- SAC-TAC-Navy augmentation
- combat time available
- location and effectiveness of AA batteries

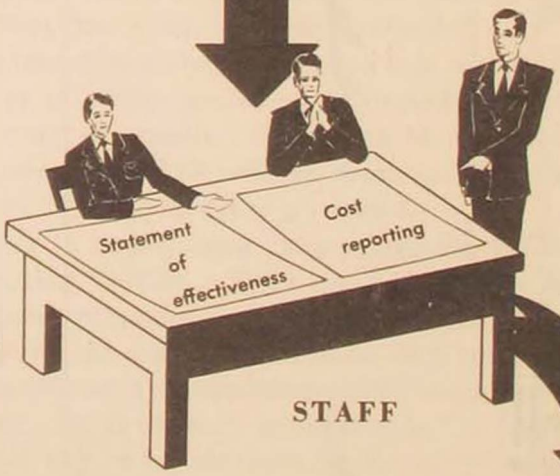


miles to bomb release line ÷ speed of bomber = time available for interception

Price of Air Defense



recommendation to raise effectiveness to 65 %



additional units required to achieve 65 % effectiveness

X no. of units

X no. of units

X no. of units

$ X total additional capital needed

$ X additional operating cost

$ X additional capital

provement Program. It will also be possible to calculate these two factors not only by air division but also by air defense force and for the entire Air Defense Command.

Figure 4, the "Price of Air Defense," sets forth the concept under which the latter phase of procedure is being developed. A hypothetical case of the 26th Air Division area displays two conclusions:

1. All units presently assigned are 100 per cent combat ready. The division has 40 per cent immediate "kill effectiveness" and 50 per cent "sustained kill effectiveness."

2. The operating cost of the division is $X per month, broken into X_1$ for combat and X_2$ for support. By predetermined standards, the combat and support costs are out of line. Immediate investigation of the reasons and possible corrective action are to be initiated. Completion of this action brings about the end result of Phase II.

To arrive at this pay-off, the desired "kill effectiveness" of the 26th Air Division area must be established. For this example, it is set at 65 per cent. Calculation has shown that it is actually only 40 to 50 per cent, with some increase possible from readjustments of resources between combat and support elements. But to achieve the desired 65 per cent, the air division must have additional fighter strength, AC&W units, logistical support bases, and possibly AAA batteries. Appraisal of current forces producing the immediate effectiveness will indicate how much additional strength is needed in each category. The cost of this increase in units can then be appraised both as to capital and operating increments, the resultant dollar figure being $X+. Perhaps this figure is greater than the national economy, considering all other defense requirements, can support. The problem then resolves into a calculation of how much defense insurance can be purchased, and what type of insurance will it be?

The "Procedure for Executive Control," then, has two phases. The first phase determines "kill effectiveness;" the second computes its cost. The relationship between their results enables the commander to determine the adequacy of his "kill effectiveness" for the funds expended and how much more air defense effectiveness may be achieved for any stated amount of additional funds. Finally if in later periods funds become available for additional units, he will be able to say firmly where augmentation is most needed. If further economies should be demanded of him, he will know where to cut with the least possible hazard to over-all "kill effectiveness."

Headquarters, Air Defense Command

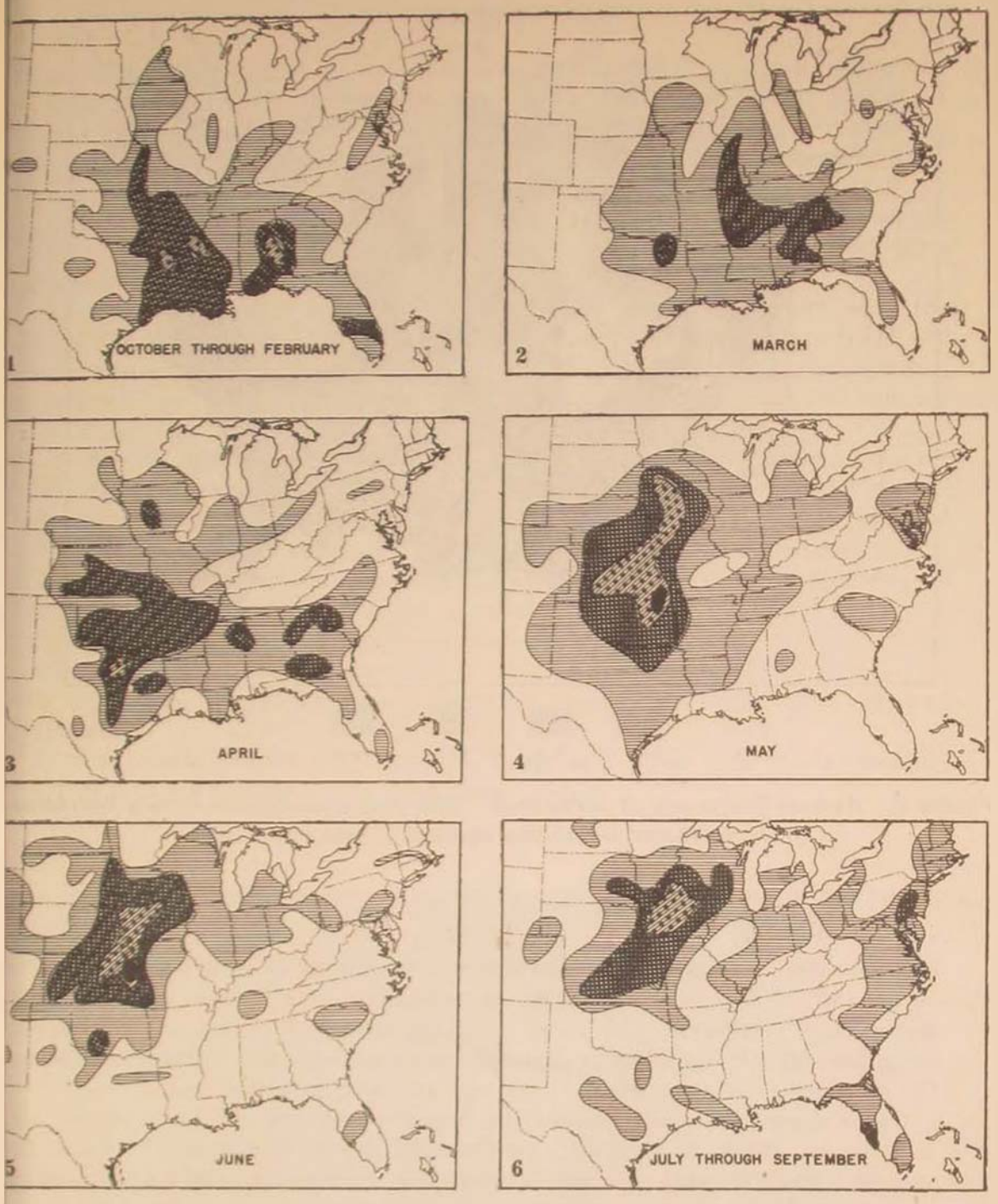
The greatest natural hazard threatening lives and property on military installations in the southern United States is the series of violent thunderstorms which sweep through this belt of states every spring and fall. While thunderstorms themselves have for years been forecast with accuracy, the vicious tornadoes and hailstorms which sometimes roar unannounced out of a seemingly average thunderstorm were generally considered too freakish and unpredictable to forecast with any precision. This was the situation on 20 March 1948 when a tornado ripped out of the thunderstorms predicted for that day and tore and twisted a path across Tinker Air Force Base, Oklahoma City, Oklahoma. The base weather officer and his assistants, dismayed at the inadequacy of tornado-forecasting information, immediately began to study the meteorological conditions which had existed and to compare them with those at the time of other tornadoes. A pattern of conditions which seemed to be necessary for the formation of a tornado began to emerge. The research paid off in a hurry. Only five days after the first tornado struck Tinker, the two weather men noticed that the day's forecast called for thunderstorms, with the same conditions prevailing as those occurring five days earlier. They went out on a limb and predicted a second tornado. And it came, as powerful and dangerous as its predecessor. But this time the warning had gone out, and with the big base buttoned down, damage was minimized. Encouraged by this success, Colonel Fawbush and Major Miller continued their investigation. It is to the credit of these officers and of the Air Weather Service that the importance of their findings was recognized by the establishment of the Severe Weather Warning Center. Mobile weather stations now range through the Southwest during the thunderstorm season and relay weather information to the central office at Tinker. In this article Colonel Fawbush and Major Miller report on their significant contribution to meteorology.

FORECASTING TORNADOES

LIEUTENANT COLONEL ERNEST J. FAWBUSH
and
MAJOR ROBERT C. MILLER

SEVERE thunderstorms, with tornadoes, hailstorms,, and excessive wind gusts, strike this country each year in greater numbers than most people realize. Only the few storms which hit populated areas and cause extensive loss of property and lives are publicized in newspapers. But even this number emphasizes the violence that nature can loose. In March 1952 occurred the most notable of such storms in recent years:

> . . . on the 21st and 22nd . . . a series of tornadoes swept through parts of Arkansas, Tennessee, Missouri, Kentucky, Alabama and Mississippi leaving over 200 persons dead, 1,200 injured, more than 1,200 homes destroyed, and over 2,000 buildings damaged. This [destruction] totaled nearly $15,000,000.—U.S. Weather Bureau, "Climatological Data," *National Summary*, March 1952, p. 58.



Figures 1–6. Seasonal frequency of the tornado.

o great is the violence of these storms that reinforced concrete buildings and teel bridges have been destroyed. Probably no building ever constructed ould withstand the force of a fully-developed tornado.

It is impossible to forecast all tornadoes. It is equally impossible to forecast the exact area over which the ones that have been forecast will pass. But

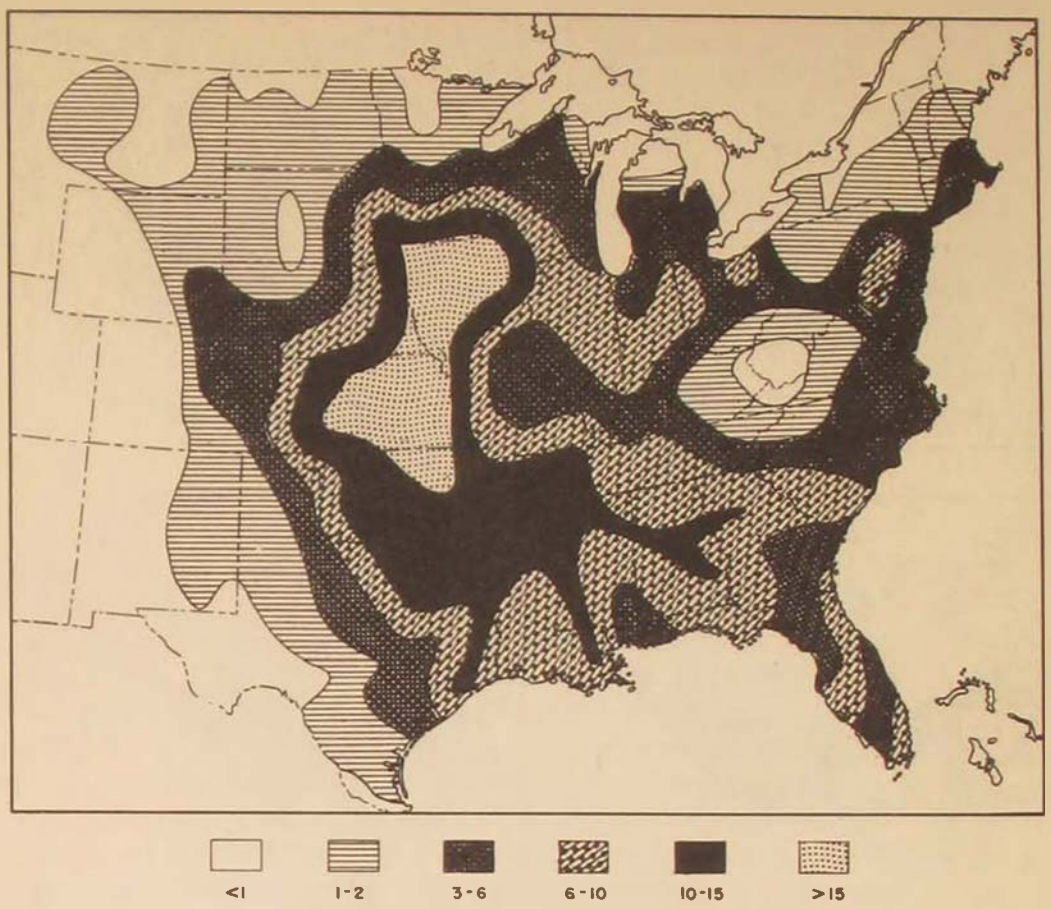


Figure 7. Annual frequency of tornadoes. The yearly maximum occurs northward from northeast Oklahoma through Kansas into Iowa.

it is possible to forecast the thunderstorm situations in which most tornadoes occur and to delineate a reasonably restricted geographical area in which destructive phenomena are most probable. Such forecasts require special techniques and hours of uninterrupted concentration and are therefore beyond the capabilities of base weather stations and busy weather centrals.

Unfortunately many people believe that these storms can be predicted days in advance. They do not recognize the difference between tornadoes and hurricanes. The life of a tornado is measured in minutes, and its path seldom exceeds 25 miles. A typical hurricane has a life of several days and a path a thousand or more miles in length. The development and movement of hurricanes can be detected by study of the reports of land, ship, and aircraft weather observations and by radar and air reconnaissance. Thus the movements of hurricanes may be extrapolated and adequate warnings issued. Tornadoes are formed so suddenly and dissipate so quickly that no more than a few minutes warning can be expected from tracking devices or methods. Only the probability of severe thunderstorms, tornadoes, and hail can be predicted, and that only by forecasting the weather conditions in which such storms develop. In this way warnings can be provided early enough for preparations and precautions to safeguard property and personnel.

The station weather officer is responsible for advising the base authorities of thunderstorm conditions that may affect the local area and to indicate the expected severity of activity. To aid the station weather officer, the Severe

Weather Warning Center was organized at Tinker Air Force Base, Oklahoma, in February 1951, with the mission to forecast within the United States the limited geographical areas of severe thunderstorms and their related phenomena of tornadoes, hailstorms, and wind gusts in excess of 50 knots. The techniques used are entirely empirical, with the maximum emphasis on the potential interactions between the layers in the vertical structure of the atmosphere. These data are then correlated with the situation found on that day's regular weather map.

The frequency and to some extent the violence of tornadoes vary with the season. During late autumn and early winter the area of maximum frequency lies in the southeastern Gulf states. During early spring the area of maximum frequency migrates westward and northward. By midspring and summer it is centered in the central plains states (as shown in Figures 1–6). During the northwest migration the frequency of tornadoes increases, with the yearly maximum occurring from northeastern Oklahoma northward through eastern and central Kansas into western and central Iowa (Figure 7). This seasonal migration of tornadoes suggested that it is related to another seasonal migration—that of the large-scale meteorological features over the United States. The similarity in pattern indicated a relation between tornadoes and certain air mass characteristics. When these characteristics were evaluated, it became possible to forecast areas of severe activity. As in all forecasting, accuracy is still limited by incomplete data, imperfect forecasting skill, and unknown variables.

Investigation disclosed that tornadoes occur only when four special weather requirements are fulfilled at the same time.

Conditions Required to Generate Tornadoes

1. **The air must be convectively unstable. This condition requires:**
   a. **A shallow moist layer of air near the surface.**
   b. **A deep layer of dry air aloft. The base of this layer is usually an inversion, capping the moist layer below.**
   c. **Conditionally unstable air, i. e., air with a temperature lapse rate greater than the saturated adiabatic lapse rate, from the top of the inversion, if any, to at least 24,000 feet pressure altitude.**
2. **The horizontal distribution of moisture within the moist layer must exhibit a steep gradient of humidity upwind to the midtroposphere (10,000–20,000 feet) wind pattern.**
3. **A narrow band of strong winds must be embedded in a weaker field in the middle troposphere. The maximum wind speed must exceed 35 knots, though observations are so widely spaced that occasionally such speeds are not reported.**
4. **The air column where the storm develops must be lifted high enough to release the latent energy indicated by the convective instability (the first condition). This lifting is usually accomplished by frontal action or by the motion of a squall or instability line.**

Table I

Features of the Mean Tornado Sounding, Based on 75 Cases

	Mean	General Range	Soundings in General Range	Maximum Range
Moist-layer depth (feet)	5200	4400-6000	70%	2600-8800
Inversion base Millibars (Mbs)	825	875-800	80	925-725
Inversion top (Mbs)	780	820-750	70	865-680
Zero Isotherm (Mbs)	620	660-580	80	700-560
Lifting level of free convection (Mbs)	660	700-600	70	800-540

Relative Humidity of Air Mass

	Mean Relative	Humidity Range	Soundings Showing Relative Humidity Less Than 50
Moist Layer	85%	65-100%	0
Inversion Base	85	65-100	0
Inversion Top	30	20-70	87%
700 Mbs	30	15-65	89
500 Mbs	40	15-75	73

It should be noted that these conditions are not static. Their evaluation requires the best efforts of the most capable meteorologists for successful forecasts. Geographic areas in which one to three of the conditions appear are constantly developing and moving, but only the coincidence of all four conditions justifies the forecast of a destructive storm. The length of the period of advance warning is directly proportional to the foresight of the forecaster.

The most important condition is the first one: latent or potential energy in the air. Very severe storms can develop only if there is a ready source of energy to support them. Since 1948 seventy-five soundings, considered to be representative of air masses in which tornadic activity developed, have been selected and a mean sounding prepared. The salient features of this mean sounding were listed in the first of the four conditions required for generating a tornado. The mean and ranges of the significant features are listed in Table 1.

Practical, routine forecasting of destructive thunderstorms, with their associated tornadoes, hail and strong winds, depends on thorough analysis of all available information. Although observational data still seem inadequate at times, they are so voluminous that a formal system must be introduced to summarize their meanings in a presentation that enables the forecaster to grasp their significance. The Severe Weather Warning Center has set up such procedures to reduce the mass of raw data to an intelligible description of the three-dimensional atmosphere.

Procedures for Determining Potential Instability

A. Upper air soundings are evaluated for:
   1. Showalter's Stability Index [a]
   2. Lowest level of free convection
   3. Convective condensation level
   4. Depth of moist layer
   5. Surface hail diameter as indicated by sounding
   6. Value in degrees Centigrade of zero degree wet bulb reduced to surface along the saturation adiabat [b]
   7. Difference between reported temperature at 600 mb and theoretical temperature of a parcel lifted along the moist adiabat from top of inversion or from the surface when no inversion is present

B. The above are plotted on charts, and isopleths [c] are drawn for items 1, 2, 4, and 7.

C. Constant pressure charts (Figure 8 is an example of a constant pressure chart):
   1. 850 millibar chart
   2. 700 millibar chart
   3. 400 millibar chart
   4. Combination 500 millibar chart with 850 millibar temperature and dew point (Figure 9)

D. The above four charts are analyzed as follows:
   1. 850 mb and 700 mb charts are analyzed completely.
   2. 500 mb and 400 mb charts are analyzed for temperature, humidity, and wind velocity. Contours are drawn only when wind observations are too inadequate to determine the wind field.
   3. On all charts, isotherms are drawn for intervals of 2°C or less. Care is taken to note all indications of even mild temperature advection, especially those in the form of tongues.

E. Winds aloft (Figure 10):
   1. A streamline [d] analysis is completed to indicate areas of streamline convergence and streamline divergence.
   2. The isotach [e] analysis is completed, with particular emphasis on the location of narrow streams of strong winds. Such streams often stem from larger bands, but locating them frequently requires skillful interpolation.

F. Surface synoptic [f] analysis (Figure 11).
   1. The pressure analysis is completed for intervals of 1 mb, 2 mb, or ½ mb, depending on the gradient and the difficulty of the situation.
   2. Reported pressures are followed rigorously in the analysis, including those from stations reporting thunderstorms.
   3. Every trough and ridge, no matter how minor, is inspected for associated current and past weather of a turbulent type.
   4. When weather conditions are critical, surface charts are plotted and analyzed hourly.

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[a] *Showalter's Stability Index.*—the difference between the ambient temperature at 500 mb and the temperature of a parcel of air raised from 850 mb along the dry adiabat to saturation (provided this occurs below 500 mb), then along the saturation adiabat to 500 mb. Positive values indicate stability, zero values neutral equilibrium, and negative values instability. Thunderstorm probabilities exist when values of plus six or less are indicated.

[b] *Saturation adiabat.*—a curve showing temperature change undergone by a parcel of saturated air as a result of change in pressure.

[c] *Isopleth.*—in the sense used here, a term for any line connecting points of equal value. Thus isobars and isotherms are both isopleths.

[d] *Streamline.*—lines which parallel the instantaneous direction of motion in a fluid.

[e] *Isotach.*—a line connecting points of equal wind speed, sometimes termed *isovel.*

[f] *Synoptic.*—in meteorology a study of weather over a large area at a given instant of time.

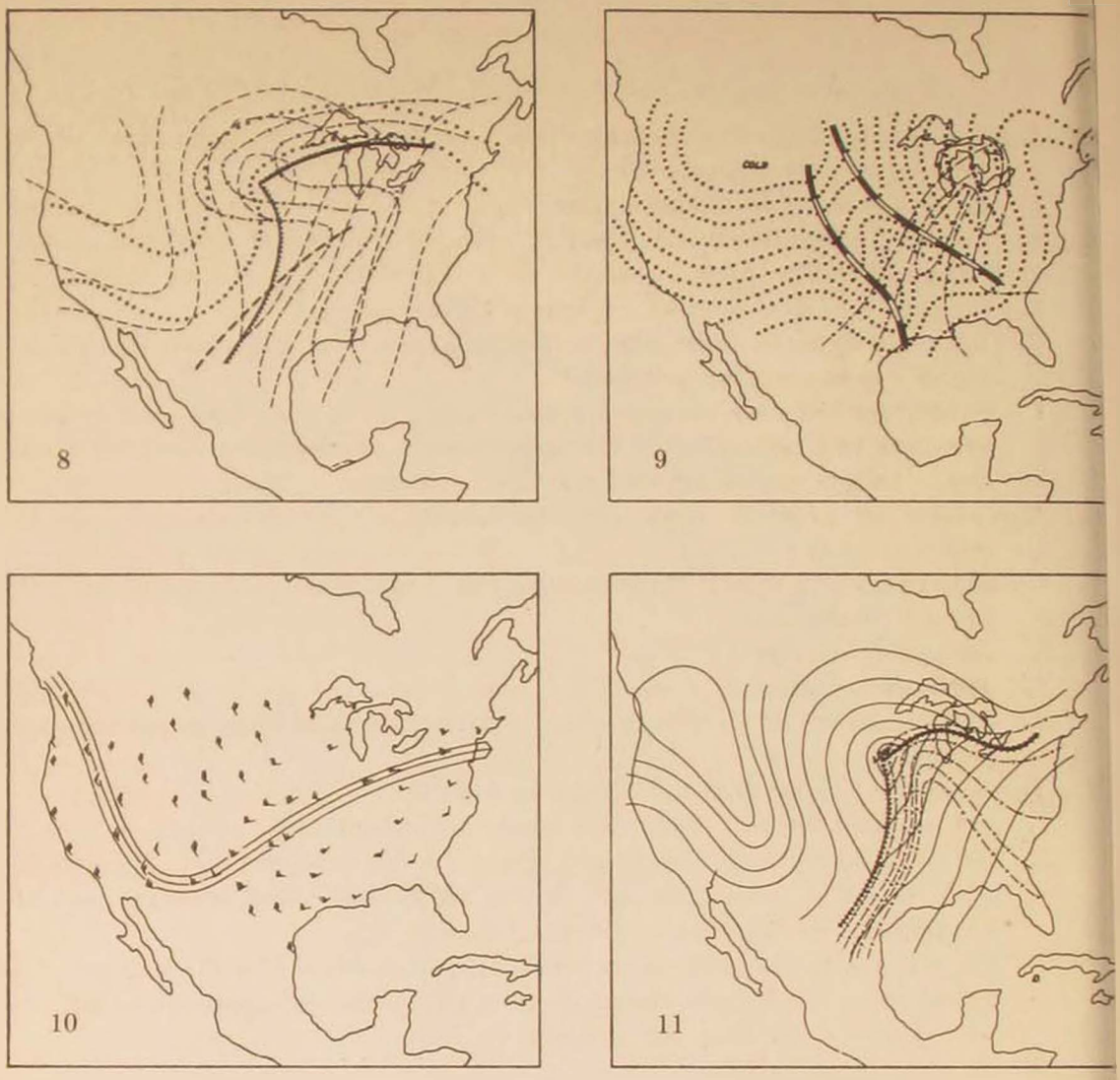


Figure 8. Example of a 700-millibar chart

Figure 9. Example of a combined 500/850-millibar chart

Figure 10. Example of a winds aloft chart

Figure 11. Example of a surface chart

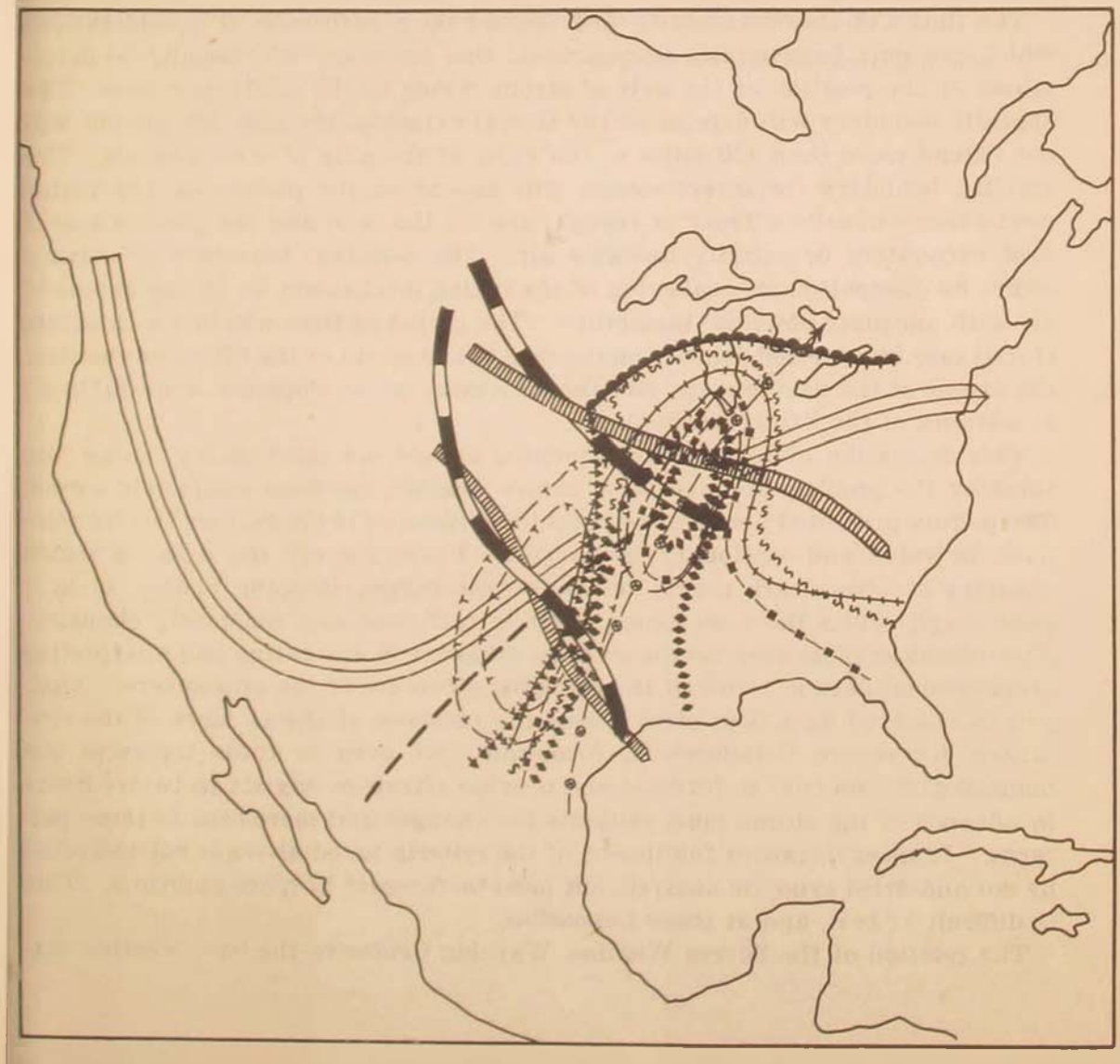
Legend for Figures 8, 9, 10, 11, and 12

- 700 millibar frontal positions
- axis of dry air influx (tongue) at the 700 mb level (50 per cent or less relative humidity)
- lines of equal dew point: 700 mb, 850 mb, 500 mb, and surface levels
- lines of equal temperature (isotherms)
- lines of equal height at the 700 mb level
- axes of cold air tongues or surges, 500 mb level
- band of strong winds aloft at middle troposphere level (10,000-20,000 feet above mean sea level)
- surface frontal positions
- lines of equal pressure (isobaral
- delta "T" or temperature differen at 600 mb level
- axes of 400 mb cold tongues surges
- moisture depth in feet above su face of ground
- Showalter Index
- lifting level of free convecti isolines
- mean moisture content in gra per kilogram through the moi layer
- axis of 850 mb moisture

Upon completion of these procedures a map is composed of indices considered valid for the determination of geographical areas wherein the occurrence of tornadoes is most probable (Figure 12).

This composite chart determines the areas most liable to very severe thunderstorms, hailstorms, and damaging windstorms, as well as tornadoes. The conditions the meteorologist must foresee can be best described by listing the criteria

Figure 12. Example of a composite chart (maximum potential instability chart). This chart is prepared by superimposing the geographical distribution of information from the previous analysis of vertical air structure: (1) From B, Showalter's Stability Indices; the levels of free convection; the depths of the moist layer; and the 600 millibar (mb) temperature differences; (2) From C, axes of tongues of dry air, usually extracted from the 700 mb chart; axes of cold air advection and warm air advection, normally taken from the 500 mb and 400 mb charts; axes of advection of warm, moist air, usually taken from the 850 mb chart; microanalysis of the critical values of Showalter's Stability Index as determined by the 500 mb temperature, the 850 mb temperature, and 850 mb dew point distribution; (3) From E, axes of the bands of high-speed winds, if in excess of 35 knots (the preferred layer for this item is from 12,000 to 16,000 feet); (4) From F, positions of fronts, pressure centers, and all minor troughs and ridges pertinent to the situation.



that *would be* satisfied on his chart if the analysis *were of data observed at the time of the storm.* These conditions and limits must all be present simultaneously in the storm area at the time of the storm.

Conditions Present at Time of Destructive Thunderstorms

1. **Showalter Stability Index of −6 or lower.**
2. **Intersection of axes of the highest moisture value of moist layer and of dry air aloft.**
3. **Steep moisture gradient in moist layer on side from which midtroposphere winds approach.**
4. **Pressure of free convection level 600 millibars or more.**
5. **Area must be within 150 miles to the right of a wind-speed axis which exceeds 35 knots between 10,000 and 20,000 feet.**

If, in addition to the potential instability indicated by these criteria, lifting action in the form of a front or squall line is forecast to move into the area, then tornadoes must be forecast.

The limits of the endangered area depend on a multitude of considerations which can only be generally summarized: One boundary will usually be determined by the position of the axis of strong winds in the midtroposphere. The opposite boundary will depend on the lateral extent of the unstable air but will not extend more than 150 miles to the right of the axis of strong winds. The starting boundary for severe storms will depend on the position of the lifting mechanism—usually a front or trough, and on the time and the place where it first encounters potentially unstable air. The terminal boundary is marked either by dissipation or weakening of the lifting mechanism, or by the extent of air with adequate potential instability. The period of time within which severe storms may be expected depends on the rate of movement of the lifting mechanism, the extent of the unstable air, and the movement or development of unstable air in advance of the lifting mechanism.

This discussion of forecasting principles should not mislead the reader into thinking the problem of forecasting severe weather has been completely solved. The picture presented here may be considered ideal, as if the various factors were fixed in value and stationary in position. Unfortunately the data on which analyses are based are nearly instantaneous values, stopping motion as in a photograph, while the atmosphere itself is turbulent and constantly changing. The forecaster must exercise the greatest diligence in evaluating and interpreting observational data in terms of the changing structure of the atmosphere. Analysis of observed data does often reveal the presence of one or more of the conditions for severe thunderstorm formation, but even in these instances the meterologist who tries to *forecast* and provide warnings, say six to twelve hours in advance of the storm, must estimate the changes and movement in these patterns. In most instances fulfillment of the criteria listed above is not indicated by cut-and-dried synoptic analysis but must be forecast in space and time. This is difficult at best, and at times impossible.

The relation of the Severe Weather Warning Center to the base weather sta-

tion is analogous to that of the medical specialist to the general medical practitioner. By setting up special facilities, giving its forecasters special training, and concentrating on one particular problem, the Center can provide a service beyond the capabilites of the base weather station, but it in no way replaces or reduces the importance of the latter unit. The special facilities comprise, chiefly, collection of a wider coverage of observational data. The special training has not yet been formalized but is of the on-the-job or apprentice type. Concentration on forecasting tornadoes, hail, winds over 50 knots, and severe turbulence permits a different type of analysis and forecasting than is required for ordinary operations. For example, in weather centrals and most base weather stations, surface maps are analyzed to emphasize the large-scale systems, highs, lows, and fronts. In the Center these are followed rather casually, while small perturbations in pressure, temperature, and humidity are investigated closely. For ordinary operations, radiosonde observations are examined for general stability, moisture distribution, and cloud bases. In the Center these same reports are evaluated for the amount of potential energy the air mass contains and for the location and availability of this energy under possible future conditions.

It may be stated that the Center concentrates its efforts on the factors necessary for the production of the severe thunderstorm and analyzes these factors critically with the purpose of improving severe weather forecasting to such an extent that all very severe weather may be forecast in time for adequate warning and may be pinpointed to spare unaffected areas needless worry.

Severe Weather Warning Center

Books and Ideas . . .

*Pacific Outposts and U.S. Strategy**

PROFESSOR CHARLES Y. HU

MR. POMEROY has prepared a scholarly and useful treatise concerning some of the strategic Pacific outposts of the United States. His main thesis is to trace the changing concepts and shifting policies of the United States concerning these outposts, especially the Marianas groups, during the past fifty years or so since the acquisition of some of these outposts from Spain in 1899 by the United States.

The book is divided into six chapters. The first five chapters are mainly historical, each dealing with an historical period in which the status of these outposts was discussed. These five periods are "From Spain to the United States"; "Between Wars 1899–1914"; "The World War, 1914–19"; "Naval Limitation"; and "Rearmament Proposed and Defeated." In the sixth and last chapter the author discusses Guam as a test case for his analysis of the problem. The book is well-documented and has an excellent bibliography, including many valuable primary sources.

Since Mr. Pomeroy's approach to the problem is primarily historical and the organization of the whole book has been so designed, he has been handicapped from analyzing in more general and broad terms the problem concerning the strategic significance of the Pacific outposts to the over-all national defense scheme of the United States. The present writer, after reading Mr. Pomeroy's stimulating book, can not help from expressing some of his thoughts concerning the problems under discussion.

1

The significance and geo-strategic position of the Pacific outposts in relation to the national defense of the United States

One of the obsolete and misleading geographic terms still existing in present-day literature is the term "Far East". In the heyday of the British Empire, this term was used to include all the western Pacific areas, including China, Japan, and other continental parts of east and southeast Asia, as well as some of the Pacific islands. In other words, the term was designed to refer to that part of the world solely with Great Britain as a reference point. But with the radical change of world power make-up and with the rapid emerging of the United States as one of the foremost nations of the world during the past decade, the term "Far East" has little or no validity today. Especially it is unfortunate and misleading to an average American, who is led to think that the way to East Asia from the United States and the approach to her Pacific outposts is by way of the Atlantic and the Indian Oceans. Actually, insofar as the United States is concerned, the Pacific area is neither too "far" (at least not in

***A Postscript to Mr. Earl S. Pomeroy's book entitled: *Pacific Outpost* (Berkeley: Stanford University Press, 1951, $5.00), pp. 198.**

terms of traveling time by modern airplanes) nor to the "east". The area now commonly referred to as the "Far East" may indeed be truly called the "Near West" of the United States. This is not merely quibbling over the use of a geographic term but insistence that a clear understanding of the term is essential for gaining a proper perspective and a correct orientation for the average American in the geographical relationship between Asia and North America.

Looking on a globe or on a world map, one is immediately aware that the United States is one of the few great continental powers, if not the only one, that borders two large oceans, with two coastal fronts. Really, insofar as her national defense against land or sea invasions is concerned, the United States may be called a "continental island" or a "continental peninsula" (if the writer may be allowed to create a new term), i. e. continental in size but actually island or peninsular in nature (if her northern border facing Canada may be called a "land-ocean" front). This unique geographical position of the United States has placed her almost in the center of present-day world affairs. One of the serious fallacies of late Harold Mackinder's original Heartland Theory on world geopolitics was his failure to take into consideration the strategic position and power potential of America, especially that of the United States.

The unique geographical position of the United States is a great asset in time of peace because of her accessibility to the vast oceans which provide almost free highways for transportation. But in time of war, it is also a liability, because they form open routes over which potential enemies of the United States might attack, raising the problem of defending two ocean fronts.

During recent years, with the United States deeply involved in world affairs and with the problem of national defense and security as her major concern, many people have argued that the Atlantic is the front door of the United States and the Pacific, the back door, while many others have insisted that the exact opposite is true Regardless of which contention is correct, it should be clearly recognized by all strategic planners that where armed conflict with her potential enemy is concerned and where exposure of the continental United States to attack is concerned, the Pacific door is just as important as the Atlantic door. The truth of the matter is that an attack from the Pacific, if successful, can achieve the same result as by way of an Atlantic door. The United States can not afford to ignore her Pacific front and the outposts associated with it, if she intends to maintain a sound and well-balanced national defense system.

Furthermore the closest neighbor by land of the United States (other than Canada and Mexico) is the U.S.S.R.—Siberia. Alaska is only separated by the narrow Bering Strait, less than 56 miles wide and rather shallow, having a maximum depth not over 300 feet in most places. Here lies the boundary between Asia and North America, and within this narrow strait are located the two Diomede islands, which might serve as stepping stones for land invasion from Asia. In addition, the Pacific outposts, major possible approaches from America to Asia, may also be avenues of invasion from Asia to America. In fact, the United States was drawn into World War II, via the Pacific front, through Pearl Harbor, the back door to some planners. That fateful day of December 7, 1941, one of the most memorable dates in the history of the United States, marked the first time in 165 years of national existence that the United States had been attacked by an Asiatic nation. It is probably no exaggeration to say that while Christopher Columbus discovered America on October 12, 1492, the United States discovered Asia or the Pacific front on December 7, 1941, insofar as her exposure to attack from the direction of Pacific is concerned.

Actually, in an air age, attacks can come from all fronts, including the top

of the world—the polar areas. A glance at a polar projection map will convince any one of the simple truth of this fact. Unfortunately, most people including many strategic planners, often overlook the study of maps drawn on polar projections.

2

The inconsistency and ineffectiveness of past U. S. policies concerning Pacific outposts

It should have been obvious to all strategic planners of the United States to recognize the importance of the Pacific front to national defense. Actually they have not, at least in our policies concerning the Pacific outposts. Here, as Mr. Pomeroy has so ably pointed out in his book, policy has been characterized by inconsistency, hesitance, inaction, uncertainty, indecision, and even sheer negligence. Prior to Pearl Harbor attack, the direction of United States strategy in the Pacific was never too clear, and no consistent plans were ever made for the fortification of some of the outposts there. There was not only a lack of decision about which ones were to be defended but also a lack of the means of defending them. For instance, Guam was acquired by the United States from Spain in 1899 as a coaling and cable station, but little was done until after the Second World War to make it into a stronghold for military use. Even at the eve of the Pearl Harbor attack, Guam was a naval station in name only and in no sense a base. Previously, strategic planning concerning Micronesia (of which Guam is a part) had never gone beyond the broadest of outlines. Little or no effort was made to exploit these Micronesian outposts from a military point of view. The early strategic planners of the United States certainly minimized American interests in the Pacific.

It is especially important to note that before the Japanese attack at Hawaii, a majority of people in the United States, including most political leaders and even many strategic planners, thought that an attack in the Pacific against the United States was inconceivable. It was maintained that the United States, protected by a vast ocean extending for nearly 10,000 miles in the west, was safe and unassailable.

The Japanese constantly strengthened their position in these Pacific outposts, just as the United States constantly overlooked them. As a matter of fact, the Japanese wanted the United States to contract her frontier in the Pacific as much as possible, so that there would be no daggers pointing at their hearts. Immediately following the Pearl Harbor attack, the Japanese had no difficulty in overrunning U.S. Pacific outposts, for by that time it was too late for the United States either to defend or prepare to defend them.

Thus when Japanese bombs fell on Pearl Harbor, the American people looked westward and saw for the first time a line of Japanese outposts stretching between them and the enemy's homeland, later to cover Japan's offensive and retard that of the United States. In the subsequent Pacific campaigns it was necessary to break it before advancing farther west. During the Pacific island-hopping operations of 1942–45, United States forces landed on many former Pacific outposts of their own as if they were invading foreign lands, and had to depend largely on wartime observations and intelligence for their planning and operations. The cost of recapturing these Pacific outposts was heavy, and the bill

was paid not only in terms of billions of U.S. dollars but also in hundreds of thousands of American lives. Many Americans died at Guam, Saipan, Iwo Jima, Tinian, and other Pacific outposts because there was little or no pre-campaign knowledge about the reefs and tides, as well as because the Japanese were there.

Unfortunately, in the past, our actions and policies concerning these outposts have been based wholly on political rather than realistic military considerations. The United States should never have mingled strategic judgments with expressions of trust in a potential enemy. One of the basic principles in any strategic planning is not so much what one's potential enemy will do or will not do but rather what he is capable of doing.

Even after the Second World War, some people, including a few supposedly well-known military experts, suggested that there was little to be defended in the western Pacific after the United States gave up the Philippines. (See Hanson Baldwin's opinion in *Foreign Affairs*, XVII, 471). This was indeed a tragic estimate of the situation. The inconsistency and failure of American Far Eastern policy reached its most dramatic climax and sharpest focus in recent years when she publicly and solemnly announced that she has already drawn her defense line in the Pacific east of Korea and Formosa. Only a few weeks later, she found it absolutely necessary for her to defend both. The Korean "police action" is already three years old and still no end is in sight, but it has already become one of the most costly wars in the whole history of the United States, exceeded in magnitude only by the First and Second World Wars and the Civil War.

Mr. Pomeroy has summarized in an excellent manner this whole changing and inconsistent American policy concerning these Pacific outposts during the past fifty years as follows:

> . . . Soon after 1865 and 1898 and 1918 the more normal resistance to military preparations returned. In the early 'twenties resistance came out of hope of international agreement, and out of parsimony, even though the country's prosperity and the government's resources were unparalleled in peace time. In the 'thirties, when the threat of war was more imminent, resistance continued, though there was little hope of international agreement after 1934, and less than the usual fear of governmental spending. The nation shifted from trust in naval limitation treaties to trust in the so-called neutrality laws of 1935, 1936, and 1937. . . . from optimism to pessimism, from internationalism to nationalism. It was not internationally minded enough at another time to maintain full sovereign rights over American territory. It was indifferent enough toward the Philippines to leave them militarily undefended, but not enough to leave them politically independent. It wanted friendship with Japan enough to yield American territory and interest as hostages, but not enough to keep the exclusion of a handful of Japanese immigrants exclusion in fact only, it must have exclusion in form as well.
>
> With all the shifts and contradictions in American policy in the 'twenties and 'thirties, American power in the western Pacific was virtually static. The islands that would naturally be the fulcra of American naval power remained undeveloped, undeveloped until it was too late to make use of them before war came. (Pomeroy, p. 115.)

To this penetrating observation of Mr. Pomeroy, the writer concurs wholeheartedly.

3

Geographical Qualities and Usefulness of the Pacific Outposts for National Defense of the United States

Generally speaking, there are seven groups of outposts in the Pacific which are of great strategic importance to the United States. These include: (1)

the Polynesian group, especially Hawaii; (2) the Micronesian group, especially Guam; (3) the Melanesian group, especially New Guinea; (4) the Northern Alaskan chain and Kurile group; (5) off-shore islands along the China coast, including the Japanese archipelago, Okinawa, and Formosa; (6) the Philippine Islands and Indonesian archipelago; and (7) Australia and New Zealand. Only a few of these strategic outposts mentioned above are under actual control of the United States.

It is generally agreed among strategic planners that for an outpost to become a powerful major navy and air base, it must provide a spacious harbor in which a fleet can maneuver under air attack and there must be ample and spacious air fields to accommodate large numbers of planes to protect the fleet and shore installations. Such situations are rare indeed among the Pacific islands. Of the American possessions, only Hawaii and to a degree Guam offer most of these qualities. Therefore many far-sighted military planners consider it wise for the United States to obtain more outposts of this kind in the Pacific for emergency use. They may serve both as offensive advance bases and defensive strongholds. Imagine what would have happened if the Pacific campaigns of 1942–45 had not had Australia as a major base of operation and likewise what serious difficulties would have resulted to the United States if the current Korean struggle had been denied the Japanese Archipelago as its staging base.

Except for the Aleutian chain to the north, the United States strategy of defense in the Pacific should revolve about a center line running north of the Equator through the Hawaiian Islands, the Micronesian group (including the Marshalls, the Carolines, and the Marianas), and the Philippine Islands. To strengthen these two lines of defense, some off-shore islands along the China coast, such as Okinawa, Bonin groups, and possibly Formosa, should also be included as a third line.

Adequate fortification of some of these outposts and firm control of them through a superior air and naval force will enable the United States to utilize the vast Pacific Ocean to her maximum strategic advantage. The Pacific will then be both wide enough for the United States to stand against those whom she must repulse and at the same time be narrow enough for her quickly to move sufficient forces to overwhelm an enemy in the west Pacific.

For the present paper the writer would also like to limit his discussion to that group. In total area, population, and resources, these Micronesian islands are of minor importance. They lie in a great intercontinental space and are mere specks of land in a vast ocean. The total land area of the entire Micronesian group is less than 900 square miles, many of them composed of only sand, coral, and volcanic rocks. Within this group the Marianas islands are of special strategic significance. They stretch for 1,300 miles from north to south, and 2,700 miles from east to west and lie astride the route from Hawaii to the Philippine Islands. Guam (measuring 30 x 8 miles) is by far the largest and strategically the most important island of this group. It lies almost in the center of a vast water space between Japan to the North, New Guinea to the south, the Philippines to the west, and Hawaii to the east. It is about 1,300 miles south of Japan and 1,500 miles east of the Philippines. Guam and Hawaii are the two strategic foci of the whole Pacific defense, with Guam as the hub of the western Pacific and Hawaii of the eastern Pacific. Guam, as a well-developed navy and air base, can dominate nearly every strategic area from Vladivostok to Singapore.

In the vastness and tremendous distances of the Pacific, in which the total

land area is small as compared with total water surface, these island outposts have performed and can again perform valuable services in a war emergency. During the Second World War, they have served as stepping-stones for air routes, as forward fighter bases, as rescue stations for airmen, as fleet bases and campaign headquarters, and other functions vital for air and naval operations. Moreover, they were useful bases from which to intercept air and sea traffic of the enemy. On the other hand, before their recapture by the United States, Guam, together with other Marianas outposts, was successfully employed by the Japanese as an effective screen concealing their movements. The island afforded them a defense in depth which was penetrated by the United States forces only at a high cost.

Many strategists agree that Guam must be strongly fortified if the United States intends to undertake a two-ocean defense. In 1945, Admiral King, former Chief of Naval Operations, estimated that Guam as a base was capable of supporting one-third of the Pacific fleet. (Pomeroy, p. 167.) In addition to Guam other Micronesian groups include the Marshalls and Caroline islands, island bridges linking Asia to Indonesia and Australia and affording a number of excellent sub-bases for destroyers and submarines.

Military strengths of modern nations should not only be in terms of numbers of battleships and airplanes but also in numbers of strategically located, well fortified, and strongly defended bases. With Honolulu, Guam, and Dutch Harbor converted into Pacific Gibraltars, the necessary permanent garrisons at the western air and naval bases in the United States could be reduced. These well-fortified outposts in the Pacific, together with a strong coastal defense, would keep the enemy from ever approaching continental United States and make the task of defending her west coast easier and more effective. The writer believes that beginning at the California gateway, the United States must push her defense as far as necessary across the Pacific. By so doing, we will reduce the Pacific defense scheme to the simplest possible terms and greatly lighten the task of the defense of Hawaii and the west coast of the United States.

It may also be pointed out that sound strategic planning for the Pacific front should be so designed that the potential enemy of the United States will never be allowed to come near these outposts. Any enemy must not be allowed to seize these strong points and to use them against the United States in a future war. When and if this situation occurs and these outposts again fall into the hands of the potential enemy of the United States, it will indeed form a threat to the western Pacific defense of the United States. This time the United States may have to face a more powerful and more dangerous enemy in the western Pacific. Personally the writer believes that the major U.S. naval and air bases in the western Pacific should be in a more northerly position than either Guam or Hawaii, possibly in Okinawa, or Formosa, or even in the Japanese archipelago or the Aleutians, because these latter bases would be more convenient for military operations in these areas in the near future.

After the Second World War, many Americans began to realize the strategic value of these Pacific outposts; and even those who traditionally opposed imperialistic activities of any kind and condemned territorial aggrandizement of any sort now urge permanent American control over Pacific islands taken from Japan after the Second World War. These people do not consider their position inconsistent. They believe the retention of these islands does not mean American imperialism, since there are negligible economic resources and small numbers of people on these islands. They are convinced that the United States' only desire in controlling these outposts is a strategic one, with the sole purpose of

protecting her western frontier. Admittedly, there is some element of rationalization in this kind of reasoning and it is difficult for many foreign observers to understand, but basically there is a considerable amount of truth in this contention. Certainly it is a realistic position to take in this troublesome world.

Some planners have argued that with the introduction of atomic bombs and long-range aircraft, these Pacific outposts of the United States have lost their strategic significance and therefore it may no longer be necessary for her to hold them and fortify them. While some of these tactical advances may curtail to a certain degree the usefulness of these outposts, they will never completely eliminate the strategic significance and the vital geographical positions of these outposts as useful air and naval bases in case of war in the west Pacific.

Nevertheless, it should he pointed out that there are a number of limitations in the full utilization of these outposts for military purposes. First, in order to operate efficiently and to hold firmly these Pacific outposts, air supremacy over them is absolutely necessary. One of the basic reasons for the failure of the Japanese in their operation in these outposts during the Second World War was their loss of air supremacy over these islands and the surrounding seas. For instance, the loss of their great stronghold at Truk in the Caroline group was mainly caused by the loss of air supremacy. Second, it is also important to realize that single island positions are not satisfactory as strong and impregnable bases. Mutually supporting base networks with well selected outposts are required to permit full exploitation of mobility of all military power, especially air and naval forces based on them. And this in turn increases the degree of defensibility of each of these individual outposts. Third, the strategic qualities of the various Pacific outposts vary greatly. For instance, the low atolls of the Marshalls and Carolines are difficult to defend, whereas the high islands such as the Marianas, the Palaus, Iwo Jima, and others can be effectively held from strong positions dug into their rocky slopes.

In addition to strategic considerations, the fortifying of these Pacific outposts would have a significant psychological effect among peoples in Asia and in the United States. It might convince the peoples of Asia about the United States' determination not to mimimize the importance of her Pacific front and thereby evidence her resolve not to abandon her allies and friends in the Pacific. On the other hand it would remind the political leaders and citizens in America that there is a Pacific front to be defended. This double awareness would help discourage the ambitions of the ruthless aggressors and thus aid in stabilizing the flexible and turbulent political situation in Asia at present.

In sound and well-balanced strategic planning, the psychological and moral effects are often just as important as purely military considerations.

4

The Future of Pacific Outposts of the United States in an Air and Atomic Age

To ensure maximum effectiveness and complete success in the operation of these outposts when and if war once breaks out again in the Pacific, it is essential to have careful advance planning and adequate preparation in time of peace. In the past, the United States has suffered repeatedly as a result of neglecting to establish strategic bases in time of peace. During the Second

World War, these Pacific outposts were paid for by heavy investments of both American money and American blood. This recent tragic lesson has raised the question in the minds of many strategic planners: how long can the United States afford to continue this cycle of fighting and winning and giving away, only to fight and build and win and give away again? The United States has indeed given away more territory vital to her national defense and done it more frequently, than any other modern power. This is especially true in the case of her Pacific front.

The post-war policy and strategy of the United States in the Pacific has also been most inconsistent and disappointing, as evidenced by the whole Korean affair. Indecision, hesitancy, and inconsistency can only bring disaster. Still worse, the potential enemy of the United States may interpret these inconsistencies or any pacifist and indecisive gestures on the part of the United States as only signs of weakness as did the Japanese in ordering the Pearl Harbor attack. One must clearly realize that in these critical days of cold war and ruthless encroachment of the strong over the weak, the luxuries of appeasement and hesitancy should indeed be matters of the past. It is essential that all planners for U.S. national defense be awakened to the fact that the fortification of the Pacific outposts should form an integral and vital part of the total national defense system of the United States.

It is unfortunate that with the development of atomic bombs and large long-range bombers, there have been growing doubts in the minds of some planners as to the utility of these outposts. This tends to develop and encourage a new wave of isolationism and hampers an over-all and well-balanced view on this whole problem of national defense. For instance, as earlier champions of naval power had often doubted the need for an infantry war, many enthusiasts for air power today have been minimizing naval and other forces. Actually, atomic bombs and air supremacy have not changed radically the strategic significance and usefulness of these Pacific outposts nor the effective contributions of other branches of military forces in the time of future wars in the Pacific. It should be remembered that any use of atomic bombs is going to depend on planes, and planes will depend on sea power and land power to secure and hold strategically located bases from which these atomic bomb attacks may be most conveniently launched. In modern warfare in the foreseeable future (as in the recent past), it will require absolute teamwork of all branches of services, including air, army, and navy forces, if complete success of an operation is to be assured.

It is especially hoped that with our growing emphasis and recognition of the great potential of air power as an effective weapon for future military operations, our strategic planners of today will not be led into new isolationism which will minimize the strategic significance of useful outpost bases, and worst of all, usher in a false sense of security based on a surrounding wall of long-range aircraft.

The time has come for the United States to formulate a clear-cut policy toward the Pacific front in her national defense system and then tend to it persistently and consistently. We hope there will be no repetition of Pacific island-hopping campaigns of 1942–45, nor another Korean "police action" of 1950. Let us not be late again this time. Many foreign critics have often branded the traditional United States' foreign policy as a "Dollar Foreign Policy." Regardless of the validity or fairness of such a criticism, it must be remembered that even dollars cannot buy yesterday and dollars cannot revive the valuable American lives lost as a result of the negligence and mistakes of our policy makers. The truth

of the matter is: if the United States does not plan carefully and prepare adequately in time of peace, she will have to pay dearly and to sacrifice unnecessarily in time of war. It is fervently hoped that those now charged with the important responsibility and this vital task of strategic planning of national defense for this great nation of the United States—the tower of strength and symbol of hope of the whole free world—will be guided by vision, consistency, and determination. Both our friends and foes are watching us. Time may not be on our side this time. Certainly we can not afford to make any more mistakes.

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Briefer Comment

Background of the Middle East, edited by Ernest Jackh, pp. 236.

Seventeen authorities cover the past and present of the Middle East: the three religions interwoven in its history, the rise and decline of the Arab Caliphate, the growth of the Turkish Empire, the impacts of European imperialism and Russian Communism, law, social, and economic conditions, the rise of nationalism, and the problems of oil.

Cornell University Press, $3.50

India and the Passing of Empire, by Sir George Dunbar, Bt., pp. 225.

An historical interpretation of India and its modern evolution. The author was lecturer on India to the British Services and the U. S. Army during the war.

Philosophical Library, $4.75

The United States and Mexico, by Howard F. Cline, pp. 452.

The newest volume in The American Foreign Policy Library, edited by Sumner Welles. This series presents, almost in handbook format yet readably, the outstanding geographic, historical, political, economic, and social features, past and present, of various nations as related to the affairs of the United States. Very useful.

Harpers, $6

The Russian Mind, from Peter the Great through the Enlightenment, by Stuart Ramsay Tompkins, pp. 291.

An attempt to answer the question of how the Russians got the way they are today. Education, journalism, and other political and social characteristics from the Middle Ages down to 1855 are viewed for a psychological portrait of the Russian mind.

University of Oklahoma Press, $4

I Cover Japan, by Kimpei Sheba, pp. 268.

An easily read account of life and manners among the Japanese as they appear to one of their own people, the managing editor of the *Nippon Times*. A good introduction.

Tokyo News Service, Ltd., $2.75

Canada's Century, by D. M. Lebourdais, pp. 214.

A survey with emphasis on industrial enterprise. Especial attention is also given to the Canadian North.

Praeger, $4.50

Arctic Solitudes, by Admiral Lord Mountevans, pp. 143.

A history of Arctic expeditions from the days of search for the northern passages to the conquest of the Pole by air. The author was second in command of Scott's last expedition.

Philosophical Library, $4.50

Five Gentlemen of Japan, by Frank Gibney, pp. 373.

The historical and social forces that mold contemporary Japan are depicted by studies of five Japanese: a newspaperman, a steel worker, an ex-Navy vice-admiral, a farmer, and the Emperor himself. The author is a former head of the Tokyo bureau of *Time Magazine*.

Farrar, Straus, and Young, $4

Geography in the Twentieth Century, edited by Griffith Taylor, pp. 630.

Twenty specialists combine to study the growth, fields, techniques, aims, and trends of modern geography. Major attention is given to studies of special environments and advances in geomorphology, meteorology, climate, soils, and sociological effects. Useful as a basis for readings in geopolitics and geophysics.

Methuen (London) and Philosophical Library, $8.75

For study or reference.

Europe, second edition, by Samuel van Valkenburg and Colbert C. Held, pp. 826, Wiley, $7.50.—The authors propose to discuss "not only the salient aspects of the enduring geographical factors in Europe but also the complex contemporary forces arising from geographical patterns that make Europe the focus of world attention at mid-century." A geography that is also a text in geopolitics.

Contemporary Foreign Governments, third edition, by Herman Beukema and Associates in Government, Department of the Social Sciences, U. S. Military Academy, pp. 610, Rinehart, $5.50.—Surveying the governments of the United Kingdom, France, Germany, the U.S.S.R., and Japan, this textbook is extremely useful for numerous assignments in foreign service.

Technical publications of value.

A Pilot's Meteorology, by Charles Greham Halpine, second edition, pp. 351, van Nostrand, $5.

Principles of Aerodynamics, by Daniel O. Dommasch, pp. 389, Pitman, $7.50.

Aerodynamics of Propulsion, by Dietrich Kuchemann and Johanna Weber, pp. 340, McGraw-Hill, $9.

Aircraft Structural Mechanics, by Franz R. Steinbacher and George Gerard, pp. 346, Pitman, $6.50.

Minerals, A Key to Soviet Power, by Demitri B. Shimkin, pp. 452, Harvard, $8.

The Quarterly Review Contributors

Major General Frederic H. Smith, Jr. (U.S.M.A.) is now Vice Commander, Air Defense Command, Ent Air Force Base, Colo. From July 1950 to February 1952 he was Commanding General, Eastern Air Defense Force, Stewart Air Force Base, Newburgh, N. Y. He has held positions as Chief of the Requirements Division under the Director of Training and Requirements in the office of the Deputy Chief of Staff for Operations; Chief of Staff of Strategic Air Command at Andrews AFB, Md.; and National Commander of the Civil Air Patrol. During World War II General Smith served as Commander of the 8th Fighter Group, Fifth Air Force, Chief of Staff of the Advanced Echelon of that force, Chief of Operations of the Allied Expeditionary Air Forces, Deputy Chief of Air Staff at AAF Headquarters, and directed Fifth Fighter Command attacks against Japan.

Generalleutnant Adolf Galland (Ret.), formerly of the Luftwaffe, has been an advisor to the Argentine Air Force since 1948. He was an American prisoner of war from 1945–47. A squadron leader in the Spanish Civil War, he later participated in the Polish campaign, the campaign in the West, and the Battle of Britain. During the years 1941–45 he served as Inspector General of German fighter aviation. When he was captured at the end of the war, he was in command of the super-priority unit of Me–262 jet fighters which he organized in the last three months of the air war. Several of his articles have appeared in *Revista Aeronautica Nacional:* "What Happened in Germany to Jet Aircraft?"; "The Channel Break-Through of the Heavy German Cruisers"; and "The Battle of Britain as Seen from the German Perspective." General Galland is at present writing a book on the "Antecedents, build-up, splendor and collapse of German fighter aviation."

Oliver Philpot (B. A., Oxford University) served as Acting Pilot Officer in the Coastal Command at Wick, Scotland, during World War II. On December 11, 1941, on North Sea patrol, he was shot down off the coast of Norway and picked up by the Germans. He was taken to Stalag Luft III prison camp at Sagan, Silesia, and became the first man ever to reach freedom from this impregnable prison camp.

Captain Robert H. McDonnell (St. John's University, N. Y.; St. Louis University) is at present a member of the Combat Crew Standardization Board, 91st Strategic Reconnaissance Wing, Lockbourne AFB, Ohio. During World War II he was a B–24 navigator with the 43d Bomb Group in Southwest Pacific and Okinawa. In Korea he flew 16 combat missions as RB–45 pilot with FEAF detachment of 91st Strategic Reconnaissance Wing. He holds aeronautical ratings of pilot, navigator, radar observer, and bombardier.

Dr. Helmut E. Landsberg (Ph. D., University of Frankfurt, Frankfurt, Germany) is now Director of the Geophysics Research Directorate, Air Force Cambridge Research Center, Cambridge, Mass. Prior to this he was Executive Director of the Committee on Geophysics and Geography, Research and Development Board. He was formerly in charge of the Industrial Climatology Section of the U.S. Weather Bureau. Dr. Landsberg inaugurated a Geophysical and Meteorological Laboratory at Pennsylvania State College. During World War II he served as special consultant to the Army Air Forces, and later as Operations Analyst concerned with strategic meteorological and climatological studies for the Air Force Weather Service and the Operations Analysis Division, Twentieth Air Force.

Lt. Joseph G. Albright (B. S., Northeast Missouri State College; M. A., George Washington University) is currently assigned to duty with the Air Order of Battle Branch, Directorate of Intelligence Evaluation, Hq. Far East Air Forces. Lt. Albright has served continuously over the past ten years as an airman in the USAF. During World War II he was Sergeant Major of Hq. 7th AACS Wing at Hickam Field, T. H., and Ft. McKinley, Manila, P. I. He received a direct appointment in the USAF Reserve in May 1952, after five years with the AFROTC, Georgetown University, and was ordered to active duty in commissioned status with assignment to FEAF.

Colonel Joseph F. Mooney (B. S., Temple University) is currently Director of Management Analysis, Air Defense Command, Ent AFB, Colo. He served with the Sixth Air Force, 1942–43, and commanded a Troop Carrier Squadron in FEAF, 1946–48. He is a graduate of the Comptroller Special Staff School, Air University, Maxwell AFB.

Lt. Colonel Wendell A. Hammer (A. B. and M. A., University of California at Los Angeles; Ph. D., University of Southern California) is at present Chief, Research Branch, Plans and Operations Division, Hq. Air University. He was Instructor in Weather and Navigation, Basic Pilot Training Schools, AAF, 1942–44; writer and editor of pilot training student handbooks and instructor guides, 1944–47; and writer of AFROTC textbooks, 1947–48. "Implications of the New AFROTC Course of Study," written by Col. Hammer, will appear in an early issue of the *Journal of Higher Education*. He was the officer in charge of Air University studies on USAF requirements for Air University graduates.

Lt. Colonel Ernest J. Fawbush is Officer in Charge, Severe Weather Warning Center, Air Weather Service, Tinker AFB, Okla. His wartime service includes: Detachment Commander of Air Weather Service units at Nome, Alaska, and Elmendorf Field, Alaska; Officer in Charge, Alaska Weather Central, Elmendorf Field, Alaska; Weather Officer with U.S. Navy Task Unit at Petropanlosk, Kamchatka Peninsula, Siberia; Detachment Commander, Tinker AFB, Okla.; Asst. Chief of Staff, Operations and Training, 2059th Air Weather Wing, Tinker AFB, Okla. Some of the articles co-authored by Col. Fawbush are: "An Empirical Method of Forecasting Tornado Development," "A Mean Sounding Representative of the Tornadic Air Mass Environment," and "The Tornado Situation of March, 1951."

Major Robert C. Miller (Occidental College, Los Angeles) is now Asst. Officer in Charge, Severe Weather Warning Center, Tinker AFB, Okla. During World War II he saw duty with the 15th Weather Squadron, Southwest Pacific area. He was Officer in Charge, Air Force Weather Station, Meraupe, Dutch New Guinea, and Morotai Island, Netherlands East Indies. Returning to the U.S. in December 1945, he became Officer in Charge, Base Weather Station, Lawson Field, Fort Benning, Ga., and was later assigned as Group Weather Officer, 325th Night Fighter Group, McChord AFB, Washington, and Hamilton AFB, Calif. He was reassigned to Air Weather Service, March 1948, with duty station at Tinker AFB, Okla. He is co-author with Col. E. J. Fawbush of several articles on tornadoes.

Dr. Charles Y. Hu (B. A., University of Nanking; M. S., University of California; Ph. D., University of Chicago) is currently Professor of Geography, University of Maryland. He was Research Geographer and Acting Chief, East Asia Desk, Topographic Branch, U.S. War Department, 1944–47, and concurrently Professor of Military Geography, Strategic Intelligence School, War Department General Staff. From 1941 to 1944 he was Research Associate, Instructor and Lecturer, Department of Geography, University of Chicago, and concurrently Consulting Economic Geographer, United Air Lines Transportation Corporation, Chicago, Ill. Formerly an instructor at the University of Nanking, he is author of many publications on China, among which are: *The Frontier Regions of China; Notes on a Journey to Japan, Korea and Asiatic Russia; Land Utilization of Szechuan Basin, China; Special Report on Japan; Military Geography of South China Coast; Military Geography of East China; Military Geography of North China; Military Geography of South Central China.*

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