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**The Birth of Flight.** Fifty years ago Wilbur and Orville Wright, in breathless suspense, launched above the dunes of Kitty Hawk the first free, controlled, sustained flight by man. Few happenings of equal significance to mankind have been so dramatically recorded as by a photograph taken with Orville Wright's own camera and preserved in the Wright collection of the Library of Congress. Wilbur has just released his hold on the forward upright of the right wing, which he balanced during its world-shaping take-off by running along with the clattering machine. The camera caught him with one hand upraised and body turned, outlining his facial features. Aided by a 21mph headwind, the Wrights' crude plane was airborne in less than 40 feet and flew at a 10 foot-per-second airspeed during its 12 seconds in the air. The total flight length, at an altitude of less than 10 feet, was about 21 feet less than the wing span of a B-29 Superfort. Just before Orville lay down in his place at the controls for the trial flight, he set the camera on a tripod. adjusted it, and focused it to a point near the end of the launching track. A bystander snapped the shutter according to instructions and made this striking shot of the airplane clearing the starting rail, the only photograph of the historic flight of 17 December 1903. With the aid of modern photographic equipment and techniques the Library of Congress has now made a print from the original glass-plate negative that shows many details not visible in previous prints. The flywheel of the engine, the bicycle-chain transmission, and even details of Orville Wright's body, prone on the wing, are distinct. Foot tracks in the sand around the position of the plane before take-off form a perfect outline of the right wing. The wingrest with C-clamp underneath, the shovel, a dope can with brush, and an unidentified gadget near the shovel stand out clearly. Blurs between the wings, caused by propellors whirling at 300 rpm's, and the crosswires between the wings and struts are visible on the print itself. In this fiftieth anniversary year of the event at Kitty Hawk, the United States Air Force, strong with its thousands of aircraft and its million men, proudly and respectfully salutes its humble beginning.

# A Leader Is Made by Man

MAJOR GENERAL R. C. WILSON

TO come right out with a flat statement that a leader is made, not born, is to wave a red flag in the face of many a fond grandmother, and many a doting parent, who can tell by just looking at little Herkimer that he is a natural born leader! It is also a shattering blow to the rationalizations of those "dumb driven cattle" who blame their stars for their ill-fated role as followers. But it is a true statement, and it can be proved.

The literature on leadership is so vast that no man is likely to read it all in a lifetime. But to the curious, only a sampling is enough to convince him of the variety of thought and lack of common agreement among authors. There is so much of the former, in fact, and so little of the latter that the field remains wide open for new investigators.

Recently, under the threat of having to deliver a lecture on this subject, and encouraged by the lack of widely accepted authority, I conducted an experiment or two in the field for myself. I present herewith this layman's effort to determine what combination of virtues, if any, conspire to make a man a leader among his fellows. Honesty compels me to confess that at the beginning I had no more idea of where to start than do you at this moment; that my analysis, once it got under way, produced a series of shocks to my preconceived ideas (fondly thought of as hypotheses); and that I arrived at last at a fundamental truth I should have recognized in the first place!

After going to Webster for a definition, appealing to the library for reference material, and thrashing about mentally for a starting point, it occurred to me that if, as Alexander Pope once said, "the proper study of mankind is man," then perhaps the proper study of leadership is leaders. This seemed a reasonable point of departure in the search for the true qualities of leadership for if one could examine a group of people known for their ability to lead their fellow men, and if one could isolate the characteristics common to them all, then perhaps it would be possible to find some clue to the elusive qualities of the successful man among men. The banality of this thought, and the obviousness of the approach, did not deter—but rather encouraged—your experimenter. One can become pretty desperate when he has to meet a lecture deadline!

Reaching around in the grab-bag of history, I produced the following specimens for my first experiment to determine the properties of leadership:

- Alexander the Great
- Alcibiades of Athens
- Peter the Hermit
- Joan of Arc
- Napoleon
- Washington
- Lee
- Steinmetz
- Churchill
- Mahatma Ghandi
- MacArthur

This is a panel selected more or less at random. Other lists could be made, of course, but almost any list of great leaders drawn from history should contain some of these names. I was interested here in people who are unquestionably accepted as leaders of action or thought; and I was interested in enough of them, a sufficient variety of them over a sufficient span of time to make any conclusions drawn from their study reasonably valid.

Now let's examine these people to determine what qualities of mind, body or spirit they all have in common. This seems an easy enough application of the scientific method, and if this sample justifies our hypothesis we can extend it to as many individuals as necessary to prove our point.

Let's start with Alexander the Great. Alexander was a brilliant, handsome, dynamic young man, well educated for his day in the arts of both peace and war. As we say in the military, he had great potential for further professional development, although it must be admitted that he was both selfish and dissolute.

Alcibiades, who contributed so greatly to the final ruin of Athens, was a mature man of magnetic personality and compelling persuasiveness. He too was handsome and brilliant, although, as events proved, he led his people down the wrong turning of history's highway. We see here some qualities in common with Alexander.

But what about Peter the Hermit, who aroused Europe to the First Crusade? Peter was uncouth, probably barely literate, and certainly personally filthy. Events proved him in the end to be a physical coward too, But he was ardent, selfless, and persuasive to a degree that embarrassed his superiors.

Joan of Arc was a saintly young woman in her teens. She too was selfless. She also was ignorant and unlettered. But she had a glamor compounded, among other things, of youth, beauty, piety and perhaps awe born of superstition.

Napoleon was short-statured, brilliant, ambitious, ruthless, egotistical, and the victim of something very like a persecution complex.

Washington was a man of massive integrity, enduring and both proud and jealous. He appeared to be very poor "officer material" at the start, but he learned the hard way and never made the same mistake twice.

Lee, at his zenith, was not unlike Washington, although he was more intellectual than the latter, had less personal pride of position, and was somewhat more human.

Steinmetz, great leader of thought, was a scientific genius; but he was also a painfully misshapen dwarf.

Churchill's great qualities are his breadth of vision, dogged determination and mastery of the inspiring phrase.

Mahatma Ghandi was a burning idealist, a dreamer whose manner of life was sedentary and whose plan of action was based upon a passiveness baffling to his opposition.

MacArthur's leadership was marked by intelligence, boldness, a feeling for drama, and a strong sense of history.

My interest, you may have noted, began to flag before I had gotten half-way through this list of thumbnail sketches (that is why the last few are so badly slighted). I had already begun to see the light. My first experiment was a failure. It is clear that these people have no single quality, let alone qualities, in common. The closest perhaps is brilliancy of intellect, but no one has ever claimed that Joan of Arc was brilliant; and Peter the Hermit was, at times, positively stupid! About the only conclusions we can draw are that:

(1) They are all indeed leaders—but we started with this as our assumption; and

(2) They all, naturally, had followers—this sounds a little silly. But let's look at it again. Isn't it true that leaders are raised to their position by something akin to the common consent of those who then become their followers? If this were not true, we would be dealing with command, which is imposed, rather than leadership which is voluntarily acknowledged. Thus, although the experiment has failed in its primary purpose, it has given us our first real clue.

Now if all the people on my list are unquestionably leaders, and if we can't isolate any qualities common to them all, why can't we list the characteristics which appear most frequently among them and thus set up a priority list of leadership qualities? It sounds reasonable, but I'll show you a little later that it won't work. Please accept my word for the moment.

Or, if each person on my list is an acknowledged leader, why can't we just pick out the one who appeals to us most and copy him? Suppose we select Napoleon. Think about it for a moment. We'd be ridiculous! We'd be even more ridiculous if we chose Caesar; and still more so if we copied Alexander the Great. We'd come a little closer to making sense if we chose Churchill or MacArthur. This idea obviously won't work either, but it does give us another clue: Time is important to the molding of a leader; he belongs to his own generation and is a misfit in any other.

And crises too are associated with generations. We say that every crisis produces a leader. We are inclined to think of this as a wonder, but nothing could be so inevitable. Men, consciously or unconsciously, long to be led, and in time of trouble will cast about among themselves for either someone to lead them out of their difficulties or someone to blame for their troubles. These "someones" are more often than not the same person. If he is successful, he's a leader; if he is a disappointment, he's a scapegoat. This gives us still another clue: Circumstances are important to the rise of a leader.

Without belaboring this subject any further, I am now prepared to state: first, that circumstances and time create the need for leadership and dictate the mold of the leader; and second, the leader is elected by the consent of those who then become his followers.

IT is thus clear to me that no man can make himself a leader. He can usurp the throne, he can make himself a ruler, a commander or a boss; but the leadership of men, which implies voluntary support on their part, is quite beyond his power to bestow upon himself. This, I believe, is extremely important for military officers, especially, to understand. It is all too easy for us to fall into the false belief that the insignia of rank which we wear automatically makes us leaders of men. We are not automatically leaders of men. We all know of groups in which one person is the commander and quite another the leader. And we all know that such situations are full of actual or potential trouble.

Ideally the commander should be the leader; and fortunately for him circumstances conspire in his favor in this regard. Remember that, deep down inside them, all men long to be led. And men look instinctively also to the commander for leadership. They actually will follow him for a while on faith alone—until either he proves himself or lets them down. This gives us a final clue and indicates a course of action: Although a man cannot make himself a leader, he can qualify for leadership; and if he is to be the commander of an effective organization, he must devote himself to this end.

But how to qualify? What qualities must a man develop? This is the essence of the problem. Perhaps, since the leader is elected, these qualities may be identified through the eyes of his followers. What sort of a man would I myself elect to follow? Let me list the qualities of my own ideal of a leader:

- He must have *Integrity of Character*—by which I mean honesty, honesty in all things great and small, and honesty with himself as well as with others.
- He must have *Knowledge.* I would require that he have a broad knowledge of his job. I would not require a knowledge of the detailed minutiae, but certainly knowledge of how these details are to be combined best to fulfill his mission.
- He must have the *Intelligence* to apply his knowledge adequately to his job.
- He must have *Faith* in what he is doing as well as an idea of how to accomplish the task.
- He must have *Executive Ability,* in which term I include initiative.
- He must have *Courage,* both physical and spiritual.
- He must have *Confidence* based upon knowledge. I make this distinction because mere "cockiness" is not enough.
- He must have a *Sense of Justice,* and he must employ it with consistency, not blowing hot one day and cold the next.
- He must have the *Perseverence* to stick to his task long after the novelty has worn off and the interest of the group is flagging.
- And he should have the human qualities of *Cheerfulness, Friendliness,* and human *Understanding;* never forgetting that loyalty starts at the top and works down and is only reflected back.

I think that this describes a pretty good man, but it is after all only my personal model for a leader of today. It might be useful to check it against some models set up by experts, and for this purpose I have constructed a chart.

I have listed on this chart the qualities of a leader as envisioned

QUALITIES OF AN IDEAL LEADER

| QUALITY | American Scholar | American Scholar | British Field Marshal | British Field Marshal | French Officer | U.S. Officer | U.S. Armored School | U.S. Infantry School | U.S.M.A. | USAF |
|---|---|---|---|---|---|---|---|---|---|---|
| energy and initiative | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| knowledge | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| purpose and direction | ✓ | | ✓ | | ✓ | ✓ | ✓ | | | ✓ |
| courage | | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | |
| common sense | | | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| enthusiasm | ✓ | ✓ | | | ✓ | | | ✓ | ✓ | |
| integrity | ✓ | ✓ | | | | | | | ✓ | ✓ |
| confidence | ✓ | | | | ✓ | ✓ | | ✓ | | |
| sense of justice | | | | | | ✓ | | ✓ | ✓ | ✓ |
| tact | | | | | | ✓ | ✓ | ✓ | ✓ | |
| decisiveness | ✓ | ✓ | | | | ✓ | | | | ✓ |
| friendliness | ✓ | ✓ | | | | ✓ | | | | ✓ |
| dependability | | | | | | | | ✓ | ✓ | ✓ |
| perseverence | | ✓ | ✓ | | ✓ | | | ✓ | ✓ | |
| robust mind | | | ✓ | ✓ | ✓ | | | | | |
| intelligence | ✓ | | | | | | | | | |

by two American scholars, two British Field Marshals, a French military scholar, an American military scholar and committees set up by the Armored School, the Infantry School, U.S. Military Academy, and the U.S. Air Force. Over forty qualities actually are listed by these various people, but I have combined the similar characteristics in order to reduce the list to a manageable number. You will note that each vertical column represents a well-integrated individual. You might think it possible to add the votes horizontally and to come up with a consensus or a composite model of a leader. This actually was my hope when I got this information together, but, as I warned you, it doesn't work out. For instance, there are nine votes for *Energy and Initiative,* six for *Common Sense,* and one for *Intelligence*. Such a person would have more energy and initiative than either common sense or intelligence. Even more significantly, he would have more than twice as much energy and initiative as integrity. If this chart were extended further, the consensus would become even more ridiculous. For example, Von Clausewitz, whom I deliberately omitted, not only leaves out *intelligence* but argues against it as dangerous in a leader. He contends that too much intelligence enables a man to see too many factors bearing on his problem, and thus makes it difficult for him to come to a timely decision.

This is another experiment that failed to yield the "composite leader" I had hoped to find. But, to me, these data serve to demonstrate that there are certain identifiable qualities which a leader should have, but that one may pick and choose among them; and that so long as one creates a proper balance, one man's model is quite as good as another's. This being true, I will stand by my own picture of a leader—for the age and circumstances in which we are living.

You will note how general this discussion was at the beginning and how personal it has now become. Leadership is a personal relation among human beings. It therefore should be no surprise to find that its practical application deals with people as people and not with theories or ideas. Assuming that our man possesses the necessary qualities of the *spirit, mind,* and *body,* he still is useless as a leader unless he can bring these qualities into active play. At this point we come down out of the theoretical blue and start laying out some rules.

BASICALLY, the leader's job, once he has been elected to that position, has *three* principal aspects:

(1) To select the right people for the right job.

(2) To organize these people in a manner which will maximize their efforts.

(3) To motivate the group toward achieving their goal.

The first job is a matter of judgment or common sense—calling into play his knowledge of his job and his knowledge of human nature. The better he knows his job, and the better he knows his people, the better he can perform his first task. Basic rules naturally follow:

(1) Strive to understand your job and how every function fits into the entirety. You need not know the details of each man's specialty, but you must understand where specialists are needed, and the contribution each one can make.

(2) Strive to understand your people. In no other field of human endeavor is there a greater necessity and opportunity to study men than in the military service. We are all in the personnel business from the day we are inducted. Our success literally depends upon our ability to get the most out of individuals. One of the surest ways is to appreciate the qualities of a man you assign to a job.

The second task is to organize men in a manner which will maximize their collective, as well as their individual, efforts. That is to say, in a manner which will produce more from their collective efforts than from the sum of their individual efforts. This is, of course, a broad definition of good management. Douglas Freeman, whose lifelong studies of leadership qualify him as an expert, said: "Not all good managers become great military leaders, but there has never been a great military leader who wasn't a good manager."

If you have a wealth of talent to choose from, organization is a simple case of providing a traffic pattern to prevent functional collisions or traffic jams. Of course you are seldom so fortunate. so organization is somewhat more complex. Still, there are certain rules of practical leadership which apply in any managerial situation:

(1) Definite and clear-cut responsibility must be assigned to each officer.

(2) Responsibility should always be coupled with corresponding authority.

(3) Whenever you change the scope or responsibilities of a function, you must make certain that the change is fully understood by all persons concerned.

(4) Orders should never be given over the head of a responsible officer. Rather than do this, you should supplant the officer in question.

(5) Criticisms of subordinates should be made in private—never in the presence of persons of equal or lower rank.

(6) No subordinate occupying a single position in an organization should receive orders from more than one source.

(7) No dispute or difference between subordinates as to authority or responsibility should be considered too trivial for prompt and careful adjudication.

(8) Promotions or disciplinary action should always be approved by the officer immediately superior to the one responsible.

(9) No officer should at the same time be an assistant to, and critic of, another of equal responsibility.

(10) An officer whose work is subject to inspection must be given the facilities to maintain his own independent check of his activity.

These you will recognize as the Ten Commandments of the American Management Association, modified to fit an Air Force officer. To them should be added, I think, two corollaries:

(1) Do not assign to an individual more immediate subordinates than he can supervise personally.

(2) Assign responsibility to subordinates and delegate them proper authority to the maximum practicable extent.

There is one final thought which bridges both organization and motivation. A leader must supervise the execution of his directives to his followers.

This leads us to the final task of a leader. He must motivate. This is the area which brings into play most of the leader's personal qualities. It is, perhaps, the most important of his three basic tasks, and is the area in which the leader is truly differentiated from the mere boss. The psychologist will tell you that the fundamental tools to use in this area are *reward* and *punishment. Reward,* in this broad sense, is—anything that gives an individual or group a "good" feeling. *Punishment* leaves a chastened feeling. This is too broad a classification to reduce to rules in a paper of this sort; but by eliminating punishment, which is the reverse side of the leadership coin, the field can be cut in half. This is reasonable since constructive leadership should minimize the necessity for punishment.

What makes a man feel "good?"

(1) A sense of belonging
(2) A belief in the cause he serves
(3) A belief that his own work is important to that cause
(4) A sense of achievement
(5) A knowledge that his efforts are appreciated, and
(6) A sense of present and future security.

There are many others, such as diversion, pleasant surroundings and the like, but if a man is in good physical and mental health, these are, in my opinion, the most important.

Now remember that we are dealing with a group, as well as with individuals within a group. So my first rules for motivation are "BE JUST" and second, "BE CONSISTENT." To these I would add: show some enthusiasm for your job, and demonstrate your staying power.

In dealing with the individuals in your span of control, I think these ten points are the key:

(1) Let each man know and share in the group's mission.

(2) Take your immediate subordinates into your confidence.

(3) Make each realize that he is important personally to the leader.

(4) Make each know that his duty is important to the job.

(5) Make each feel that so long as he does his best you will back him up and protect him from injury by chance forces.

(6) In situations of peril or uncertainty, tell each, as far as you are able, the risks that he faces.

(7) Never make promises you cannot keep.

(8) Give praise where it is due, but only where it is due.

(9) Be available.

(10) Encourage your subordinates to prepare for advancement.

I believe that I could extend this list to 20—50—or perhaps 100 items, but I have given enough to indicate clearly my trend of thought.

I have told you that *time* determines the mold of a leader—that *circumstances* dictate his rise to power. His potential followers, not himself, place him in the lead. No man can will himself into leadership; but every man can develop the qualities essential to leadership, these are the qualities a man most prizes in his own ideal.

The basic tasks of a qualified man in the position of leadership are three: To put round pegs in round holes, to organize his people so that the group accomplishes more than the sum of their individual efforts, and finally, in the words of a truly great leader —"Therefore, all things whatsoever ye would that men should do unto you do even so unto them."

*Air War College*

# The Attack on Electric Power in North Korea

## *A Target System is Studied, Analyzed, and Destroyed*

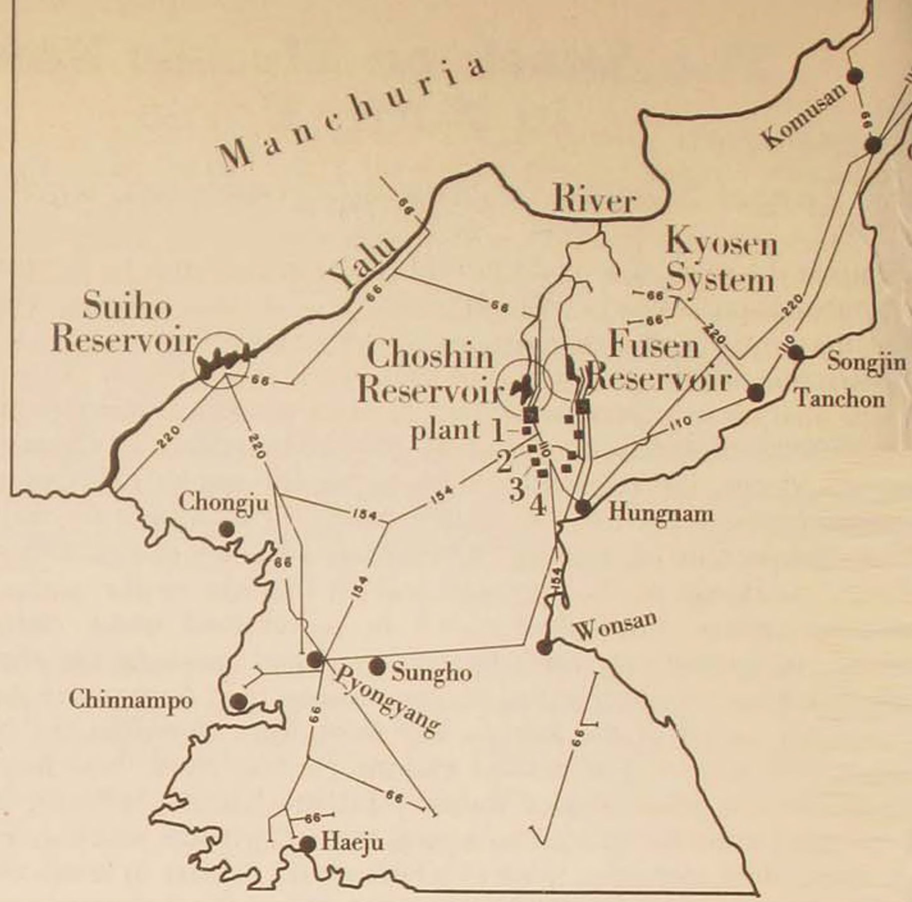
THIS is the story of a modern industrial complex and its destruction by aerial bombardment. World War II and its Combined Bomber Offensive taught us the necessity of hitting an entire industrial complex as a system and of the systematic follow-up required to keep it out of operation. This demands study and analytical understanding, since most modern industries are set up with a cushion of flexibility in their production flow. If certain elements are knocked out, the remaining elements of the system can step up production to compensate for the loss, or the reduced output can be reallocated to the most important consignees. It therefore becomes essential to study both the inner workings of the industry and its relation to the entire war economy of the enemy. Only then can it be determined which elements and how much of an industry must be destroyed and when in the theater timetable of bombing the destruction of the industry will become necessary.

At the outset of the Korean war there were 18 designated strategic targets in North Korea. For several reasons electric power was not one of these: (1) it was a power-source industry rather than a producing one, analagous to a coal mine in relation to a steel mill; (2) it was made up of a number of independent elements, none of which would be easy to bomb and all of which would have to be knocked out to rob the grid of electric power; (3) there were economic and political considerations as well as military ones. Not the least of these latter considerations was the fact that of all the economic and industrial resources in Korea, electric power would contribute the most to the rehabilitation of the country after hostilities had ceased. The cost of rebuilding the whole system of electric power, which had taken the Japanese two decades to build, would be almost prohibitive.

With the early elimination of the 18 strategic targets by FEAF B-29's there was no urgent military reason for attacking the electric power system. The industries which it had supplied were not producing; most of the power was not even being used. But by 1952 intelligence reports indicated that certain war industries were being reconstituted in dispersed and underground loca-

**On 23 June 1952 over 500 aircraft of the United Nations Command roared out of a heavy overcast and blasted the four major elements in the massive North Korean electric power system. The largest raid of the Korean war, it set off a series of repercussions and controversies which raged for weeks. Of immediate international concern was the fact that this lucrative target system was considered an especially sensitive spot in which to hit the Communists, and one which quite likely might goad them to some form of major reprisal. As the weeks went by and the suspected countermove failed to materialize, this particular fear was lulled, but others raged on. On the one hand a group demanded to know why the power system, the most extensive in the Far East, had been hit at all. Another group wanted to know why, if it was a justifiable target in June 1952, it had not been knocked out in June 1950. Putting aside the political and economic considerations as being outside its sphere, this *Quarterly Review* staff study exhibits the characteristics of the North Korean electric power system and reviews the military reasons for attacking it.**

The Electric Power System of North Korea




*The hydro-electric power plants and main interconnecting transmission lines. Town names locate strategic industrial targets, showing their proximity to power network.*

tions. The situation had reversed. It was now easier to stop production by hitting the power source than by hitting the industries.

## The Hydro-electric System

The vast hydro-electric developments constructed by the Japanese in the mountains of North Korea constitute one of the greatest industrial assets in Asia and rank among the major interlocking electric power systems in the world. The four major generating systems, Fusen, Choshin, Kyosen, and Suiho, together with a number of minor local power systems, were built over a period of 20 years and demonstrate high skill in engineering design and construction. Besides supplying approximately 90 per cent of the electric power capacity for the Korean peninsula, Suiho, the largest of the power producing systems, furnished almost 10 per cent of the electric current for the industrial centers in Manchuria. The total designed production capacity of the four major systems was approximately 1,695,000 kilowatts. The removal of several Suiho generators and turbines by the Russians, plus deterioration of equipment and inefficient maintenance by the North Korean government (which seized and nationalized the privately-owned Japanese power systems in 1945), had reduced the output to between 752,000 and 1,000,000 kilowatts.

An extensive network of transmission lines linked the hydro-electric power plants with all the major industrial centers of Korea. Almost all villages were served with transmission lines. Substations were spotted throughout the peninsula, varying in size from mammoth units, as in the Hamhung-Hungnam area, to small "step-down" stations at mines and local industries. All cities had at least one large substation to step down power for local industrial and domestic power consumers. All transmitted current was 60 cycle, with line capacities ranging between 3300 volts (3.3 kilovolts) and 220 kilovolts. Over 95 per cent of the current was three-phase.

Electric power production flowed into two integrated grid systems. Fusen, Choshin, and Kyosen furnished power for the eastern grid. Four sub-stations in Hungnam made the combined output of these three systems available to all industries, cities, and villages in the east. A 154,000-volt transmission line from Wonsan connected with the western grid at Pyongyang.

Power for the western grid came from the huge Suiho plant on the Yalu River. Its transmission lines served western industrial cities such as Pyongyang, Chinnampo, Kyomipo, Sinuiju, and Chongju. Frequent substations fanned lines out to smaller cities and towns. Until 1948 a substation at Pyongyang sent power from the western grid to South Korean citites.

Although in 1945 no connecting transmission lines between the eastern and western grid substations at Pyongyang had the capacity to transfer significant amounts of power from one grid to the other, such lines may have been installed after the Communist seizure of North Korea. An interlocking transmission network could feed power from any of the hydro-electric systems to any part of North Korea. The destruction of so flexible a system would require concentrated attack on the whole complex.

## The Eastern Grid

The terrain of northeastern Korea is well suited to extensive hydro-electric power development. The precipitous eastern slopes of the mountain ranges descend as much as 4000 feet in 25 miles. In contrast the western slopes of these ranges form broad plateaus. The great amount of precipitation on the western slopes makes the plateaus ideal sites for large reservoirs.

These terrain features were skillfully exploited in the five east coast hydro-electric power systems at Fusen, Choshin, Kyosen, and the smaller ones at Funei and Kongosan. Large reservoirs or series of reservoirs were built on the broad, shallow western slopes. From these reservoirs water was pumped through pressure tunnels across the drainage divide and dropped through penstocks and tunnels down the precipitous eastern slopes to a series of hydro-electric generating plants which were staggered in altitude down the mountain sides. When it had done its work at the first plant, the exhaust water was channeled into another tunnel or mountain stream leading to the second plant. This operation was repeated at all generating plants in each of the systems, so that the available water supply generated maximum power.

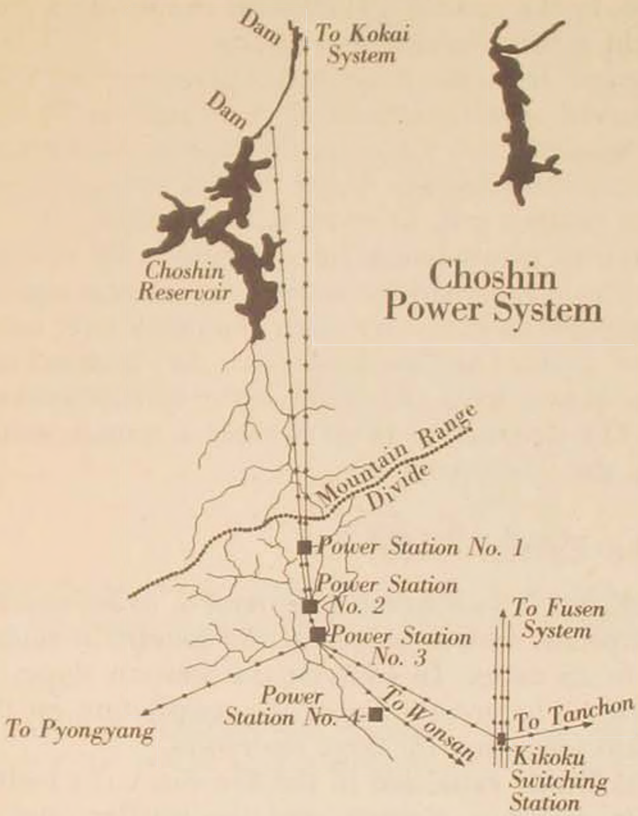
## The Fusen System

The first hydro-electric project undertaken by the Japanese was at Fusen. Four hydro-electric generating plants were built along the Pujon River, northwest of the port city of Hungnam. Construction of this system was begun in 1926 and completed in 1932 by the Japan Nitrogenous Fertilizer Company as a power source for its vast electro-chemical industry then under construction at Hungnam. Before this time electric power production facilities in Korea consisted of scattered, small-capacity thermal plants used primarily for municipal power. The construction of the Fusen system marked the beginning of the industrialization of Korea.

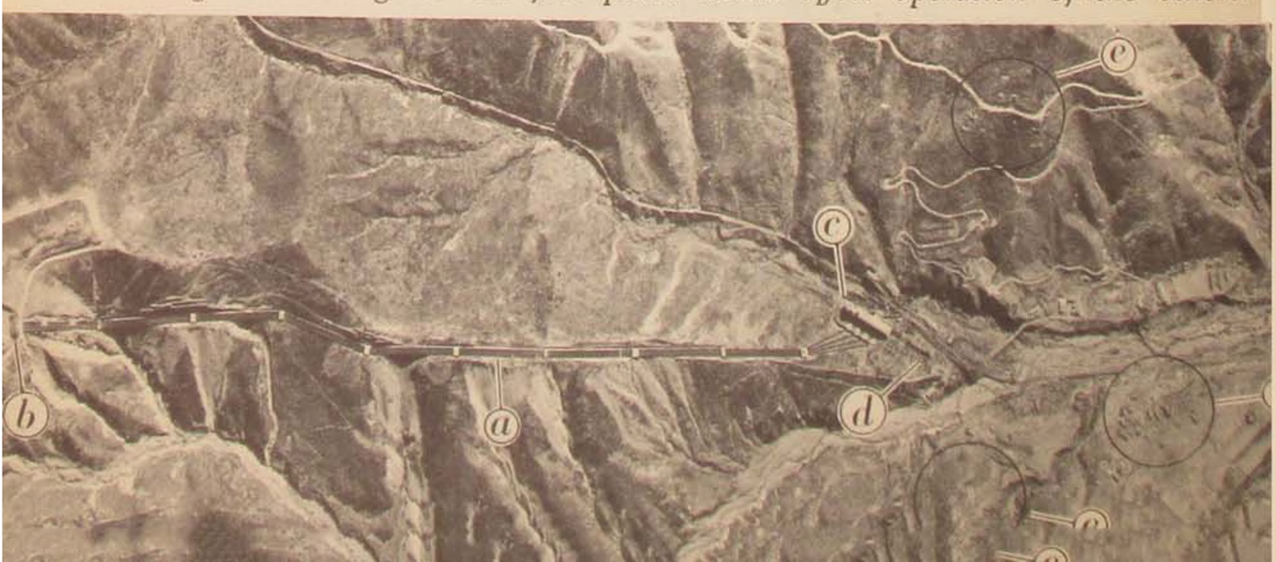
The four generating plants in the Fusen system derived their water supply

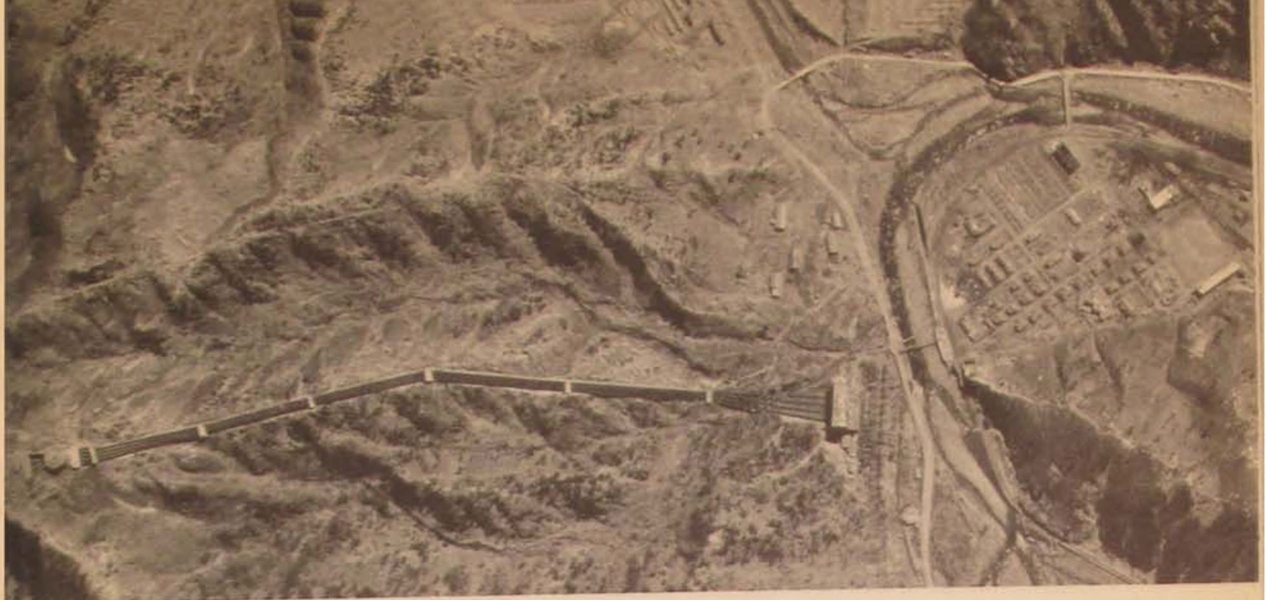
## THE CHOSHIN SYSTEM

**The second of the major hydro-electric developments was the Choshin system located west of Fusen along the Changjin River. Constructed by the Japanese in the 1930's to fill the urgent need for more electric power for the rapidly expanding industrial build-up along the Korean east coast, Choshin was larger and more modern than the Fusen system. Two reservoirs fed four hydro-electric plants. Choshin Reservoir, the scene of bitter fighting in autumn 1950, is the second largest inland body of water in Korea. As in the Fusen system, the four power plants are staggered down the eastern slopes of the mountains, while the reservoirs are across the drainage divide. Because of the greater volume of water passing through the Choshin system, generators in the primary plants are larger, with a total designed capacity of over 300,000 kilowatts. At the time of attack, output was estimated at approximately 150,000 kws.**




*This aerial view is of Choshin plant 1, designed to produce 144,000 kws. It shows the four 5-and-6-foot penstocks (a) leading, 5418 feet long, from the surge tank (b) to the power houre (c). Water is conducted 14.8 miles through a 14½-foot pressure tunnel (not visible) from Choshin Reservoir to the surge tank and dropped through the penstocks to the four horizontal, turbine-rotated, 60-cycle generators in the power plant, each of which produces 10,500 volts. Transformer yards and stepdown substations (d) are next to the big power building. At least five heavy flak batteries (e) surround Choshin 1, but defenses decrease at succeeding plants, indicating that damage to the first plant would affect operation of the others.*





*Choshin 2 lies approximately 4 miles down the eastern slope from plant 1. Discharge water from plant 1 is conducted 3½ miles through pressure tunnel to the surge tank in the lower left corner of the photograph. The four 2640-foot-by-6.6–5.1-foot penstocks carry the water down the steep slope to the second power plant to operate the four vertical generators rated at 31,111 kva each. Transformer yards and substation are in front of power building. Designed capacity was 106,000 kws.*

*Discharge water is carried 2.5 miles through a 15-foot pressure tunnel to Choshin 3 (left below) where three penstocks 860 feet long and 7.2–6.2 feet in diameter dropped the water to three vertical 15,500 kva turbine-rotated generators. Substation and transformer yards of plant 3 are located to the right of power house. Designed capacity of plant 3 is 42,000 kws. Last in the Choshin power chain is plant 4 (right below) which received water through 6.5 miles of 15.4-foot pressure tunnel. Three 695-foot, 6.5-foot penstocks conducted water to three vertical turbine-rotated generators producing 13,500 kva each. The substation and transformer yards are located in front of powerhouse. The designed capacity of plant 4 was 34,200 kws.*

from a series of three reservoirs located on the western platéau of the central mountain range along the Fusen River. Fusen Reservoir, the largest of the three, lies nearest the divide and is supplied in time of low water from the two downstream reservoirs by means of two pumping stations. Water from Fusen was carried 16½ miles through the divide in a 12.1-foot, concrete-lined, headrace pressure tunnel—one of the largest in the world—to a surge tank above plant 1. There it dropped through four 9280-foot penstocks to the four turbine-rotated generators in the plant. From the tail race of Fusen 1, the water was conducted through pressure tunnels and penstocks to the second, third, and fourth power plants located three, seven and twelve miles downstream from plant 1, and finally discharged into the Songchong River at Sinhung. Nine generators gave the Fusen system a designed capacity of 230,000 kilowatts, although output at the beginning of the Korean War was estimated at less than 80,000 kilowatts. Multiple transmission lines connect the Fusen power plants with the Hamhung-Hungnam industrial area, where Fusen's power was tied into the eastern grid and served the coastal areas north to the Manchurian-U.S.S.R. border at Aojidong south to Wonsan, and from there east to Pyongyang, where its lines met the Suiho or western grid.

Poor planning and bad engineering make it necessary to raise water from the two lower reservoirs into the big Fusen basin by means of pumping stations. The five 2500-horsepower pumps required to raise the water over 400 feet consumed nearly the whole output of power plants 3 and 4.

## The Kyosen System

Kyosen, the last of the major east coast hydro-electric systems, was begun by the Japanese before the completion of Choshin. The largest of the three, Kyosen consisted of four reservoirs, four power plants, and a network of connecting pressure tunnels similar in design and construction to Choshin. It had a designed capacity of 394,000 kws.

Kyosen reservoirs are located in step-like procession down the stream gradient and the capacity of all four was available to each of the power plants. Because of this greater volume of water each plant was equipped with four generators operating at 11,000 volts, 60 cycles, for a total of 16 generators compared with 14 for Choshin and 9 for Fusen. Larger pressure tunnels and penstocks guided the water down 9 to 11 miles of mountain slopes between each plant and the next. Kyosen's output in 1947 was operating at one-half to three-fourths of designed capacity.

## Other Systems

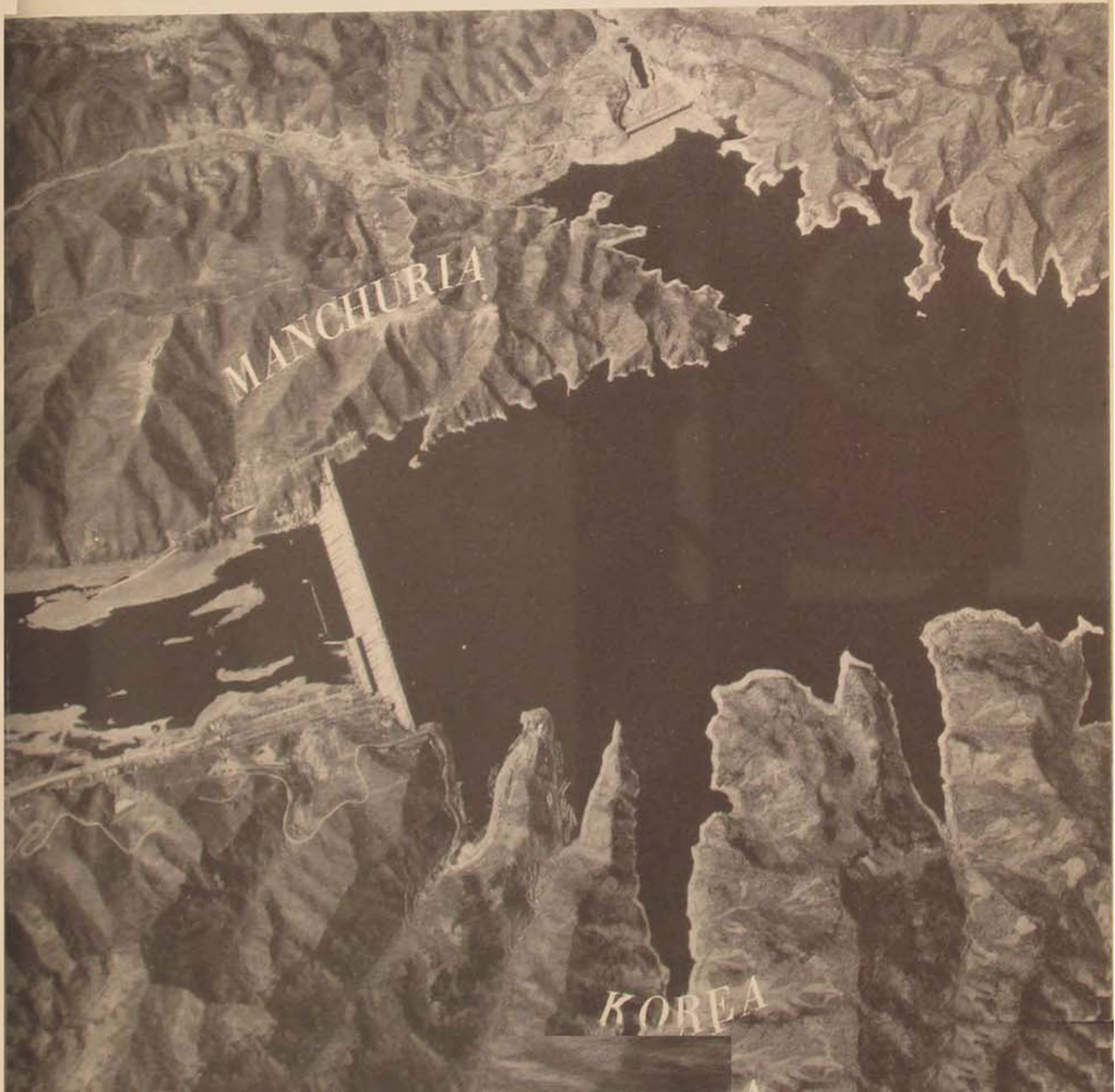
Other systems in North Korea include the Kongosan system south of Wonsan near the present battle line, the Funei system in the vicinity of the Munsan Iron Works in the Tumen River area; and the uncompleted Seitosui—near Chongjin—and Kokai systems in north-central Korea. These were built to supply local consumers. They do not approach Fusen, Choshin, or Kyosen in size and do not materially add to the grid system.

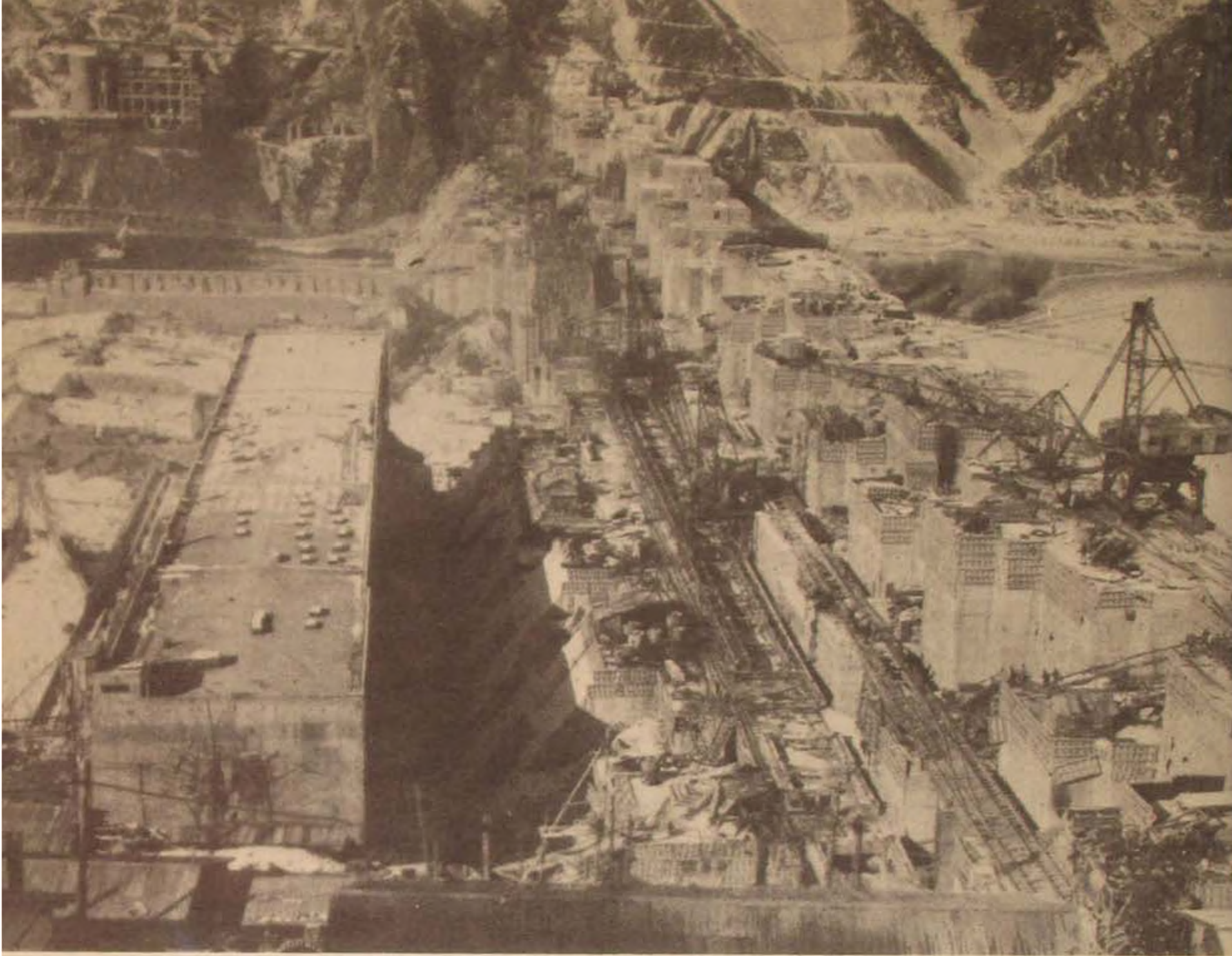
## Suiho: The Western Grid

The most important hydro-electric installation in Korea was the Suiho plant, a well-designed, modern installation embodying the latest in hydro-electric engineering. Completed in 1945 by the Japanese Nitrogenous Fertilizer Company under the impetus of the military expansion of Korean industry, Suiho is located on the Yalu River about 30 miles northeast of Antung, Manchuria. Before U.N. air attacks this huge power generating plant was the largest in the Orient and the fourth largest in the world. Unlike the east coast systems Suiho had an impounding dam with adjacent powerhouse. Hydraulic pressure depends on tremendous reservoir volume rather than head pressure produced by dropping smaller volumes of water down steep slopes. The Grand Coulee, Shasta, and Hoover Dams in America are similar installations and Suiho ranks just behind these three in size.

Suiho's designed capacity for seven generators was 700,000 kws, but since

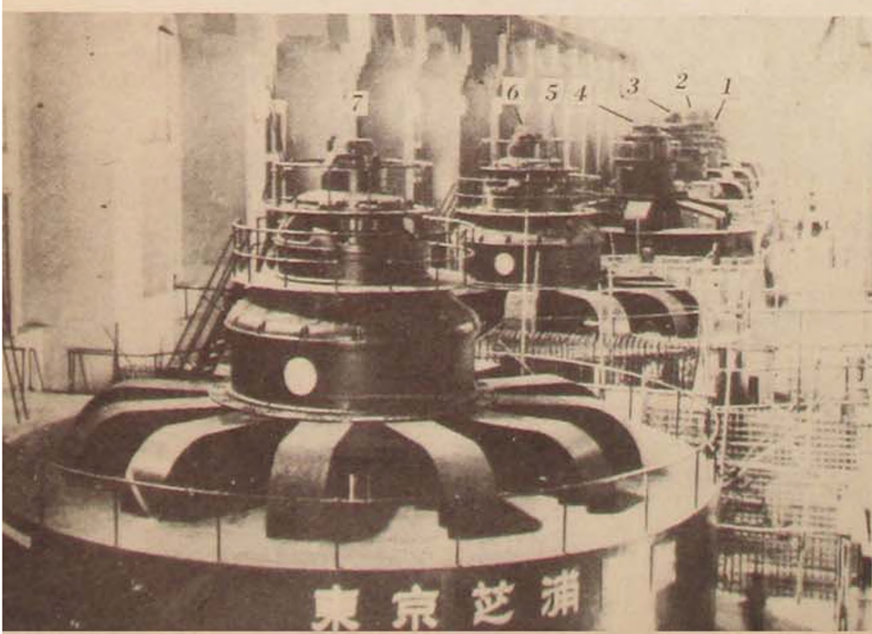
*A dramatic air view shows the principal components of the great power plant at Suiho. The massive concrete dam, 349 feet high and 2950 feet long, backs up 128 square miles of reservoir, which reaches 60 miles up the Yalu. At high water the flow over the dam is great in volume and in dry weather the water level may drop nearly 100 feet. The 3-story-high, 68-foot-wide, 590-foot-long generating house at the foot of the dam on the Korean side of the river is flanked by transformers and switchyards. Destruction of these elements made it unnecessary to bomb the dam.*



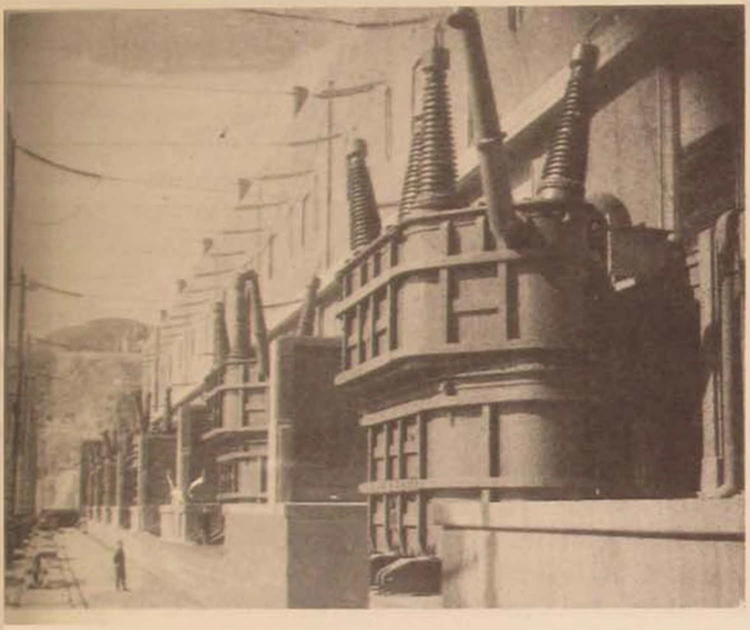


*Begun in the 1930's, construction of Suiho on the Yalu was completed under impetus of World War II industrial expansion of North Korea and Manchuria. This Japanese photo shows the massive Suiho dam under construction. The huge crane (right) is dwarfed by rising columns of steel-reinforced concrete into which were poured over 100,000,000 cubic feet of concrete. At left is completed powerhouse building.*

*Close-up view of Japanese-made Shibaura generators inside the Suiho power house. By 1945 six of the projected seven generators were installed—one of them German-made. Each unit had a capacity of 100,000 kws and was driven by a 105,000 h.p. Dengyosha vertical Francis turbine turning at 125-150 r.p.m. Numbered from the rear, generators 1, 2, and 3 produced either 50 or 60 cycle current; no. 4 produced only 50 cycle; no. 5 (not installed) was intended for 50 cycle; nos. 6 and 7 delivered only 60 cycle. In 1947 Russian engineers removed nos. 3 and 4 generators, 3, 4, and 5 turbines, and equipment for these assemblies. In 1950 nos. 1 and 2 produced power for Manchuria, nos. 6 and 7 for North Korea.*

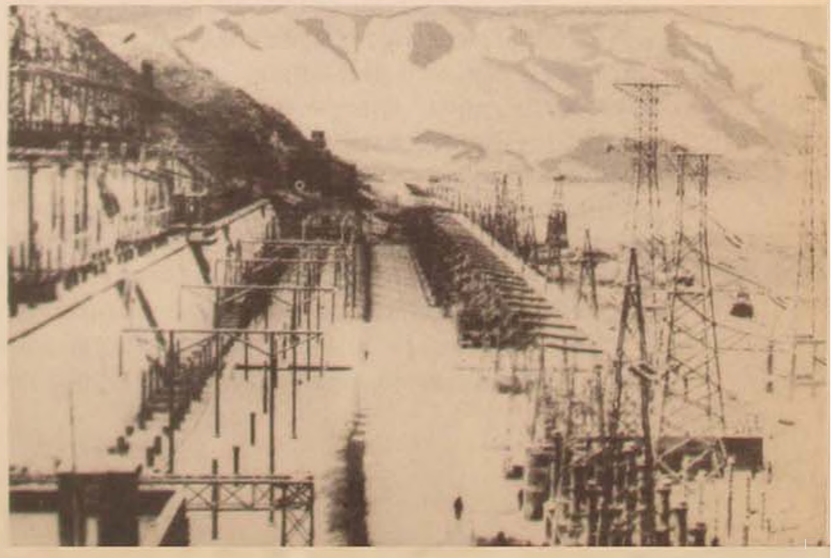


**Taken by the Japanese during the construction of the Suiho power plant, these pictures illustrate the magnitude of the project. When completed in early 1945, Suiho was a well-designed, modern installation embodying the latest advances in hydro-electric engineering. Without the seventh generator, a 100,000 kw German-made Siemens-Schuckert unit which shipping difficulties during World War II prevented from arriving, power production totaled 600,000 kws. The entire operation of the dam and power substation was controlled from a master switchboard in the power plant. Japanese engineers and scientists were so proud of Suiho that many wept bitterly at the news that Suiho and the three major east coast systems had been destroyed.**



*This Japanese photograph taken in 1944 shows the six 100,000 kva transformers located in stalls along the down-river side of the generator house. Each served one Suiho generator. A vital key to the power system, these transformers were the target of the U.N. air attacks.*

*Ranging downstream on the Korean side of the Yalu is the Suiho power switchyard and substation. From here the 60-cycle electric power was transmitted to the Korean grid and the 50-cycle to the Manchurian grid. Towers in the foreground lead to Manchuria. This substation was another target in the attacks on the Suiho power system.*



shipping difficulties during World War II made it impossible to deliver one of the German-built generators, the installed capacity never rose above 600,000 kws. A further loss was suffered in 1947 when two generators and three turbines were removed by the Russians during their occupation of North Korea. What the Russians could do with this equipment remains an enigma. Built especially for Suiho, it could not be used in any other hydro-electric plants unless it was rebuilt or a hydro-electric plant was constructed to Suiho specifications. Unconfirmed reports indicate it may be earmarked for Tomsk on the Ob River in Siberia, where a huge industrial complex and hydro-electric system is being constructed.

Despite the removal of equipment, the installed capacity in June 1950 was about 400,000 kws, making Suiho the largest single Korean producer of electric power. Four 16,500-volt generators were in operating condition. Two provided 60 cycle power for the Korean grid, with transmission lines fanning out to western industrial cities. Substations in these cities provided further distribution to smaller towns and industries in North Korea. Until May 1948 a substation in Pyongyang transmitted over 70,000 kws per day to Seoul and other south Korean cities—about 60 per cent of the local requirement. After June 1950 areas of South Korea captured by the Communists again received power from the North Korean grid. At the beginning of the Korean War an estimated 150,000 kws went from Suiho to the Korean western grid. Two generators at Suiho fed 50-cycle power to transmission lines which spanned the Yalu and joined into the Manchurian grid. In June 1950 an estimated 100,000 kws were going into the Communist industrial sanctuary north of the Yalu.

## The Attack

For over two years U.N. combat aircraft ranged at will over North Korea, tearing up roads and rail tracks; blowing up supply and troop concentrations, bridges, factories, barracks, and ammunition dumps; bombing and strafing every type of target, moving or stationery, that was of military or strategic value to the enemy. But except for one attack by B-29's on Fusen power plant 1 early in the war the vast hydro-electric power system in Korea—the largest industrial development in the peninsula—remained inviolate. Even U.N. ground forces, which occupied the various hydro-electric installations during the victorious march to the Yalu following the Inchon landing in 1950, did not harm the plants during their subsequent hasty retreat. The systematic aerial destruction of the 18 North Korean industrial targets, begun in the summer of 1950 and completed by the fall of 1950, had rendered assaults on electric power facilities unnecessary. With the using agencies eliminated, the mere possession of electric power was considered of little strategic or military value to the enemy and not worth the expenditure of effort and resources required to destroy it. Nor was the cutting off of the 100,000 or more kws going to the Manchurian grid—less than 10 per cent of the total Manchurian power—considered worth the risks of international repercussions which might follow the neutralization of the Suiho plant. Furthermore there were strong indications of an early end to hostilities. If peace came, electric power, more than any other industrial potential in Korea, would assist in the economic rehabilitation of the country.

But early in 1952, intelligence reports coming from behind enemy lines, supplemented by constant visual and photo reconnaissance over North Korea, revealed that the enemy had moved segments of his industry underground into abandoned railroad tunnels and caves. Other segments of industry had located in residential sections of cities and towns, setting up dispersed production units in Korean homes. War material was again being manufactured—thanks to ample electric power. This new move created a problem for U.N. commanders. To destroy underground factories would be extremely difficult, even if all the locations were known. To destroy industry dispersed in residential areas would require area bombing of whole cities, entailing mass slaughter of thousands of innocent citizens forced to remain in the cities as a shield against attack. On the other hand, without electric power to light the underground installations and run the machinery there and in the commandeered Korean homes, this renewed industrial effort would soon be effectively reduced.

The decision came late in the spring of 1952 in the form of joint operations order to Fifth Air Force and the Naval carrier task force off Korea for a joint concentrated attack on the whole North Korean power industry. Follow-up attacks were to be continued until the target system was completely and permanently out of commission.

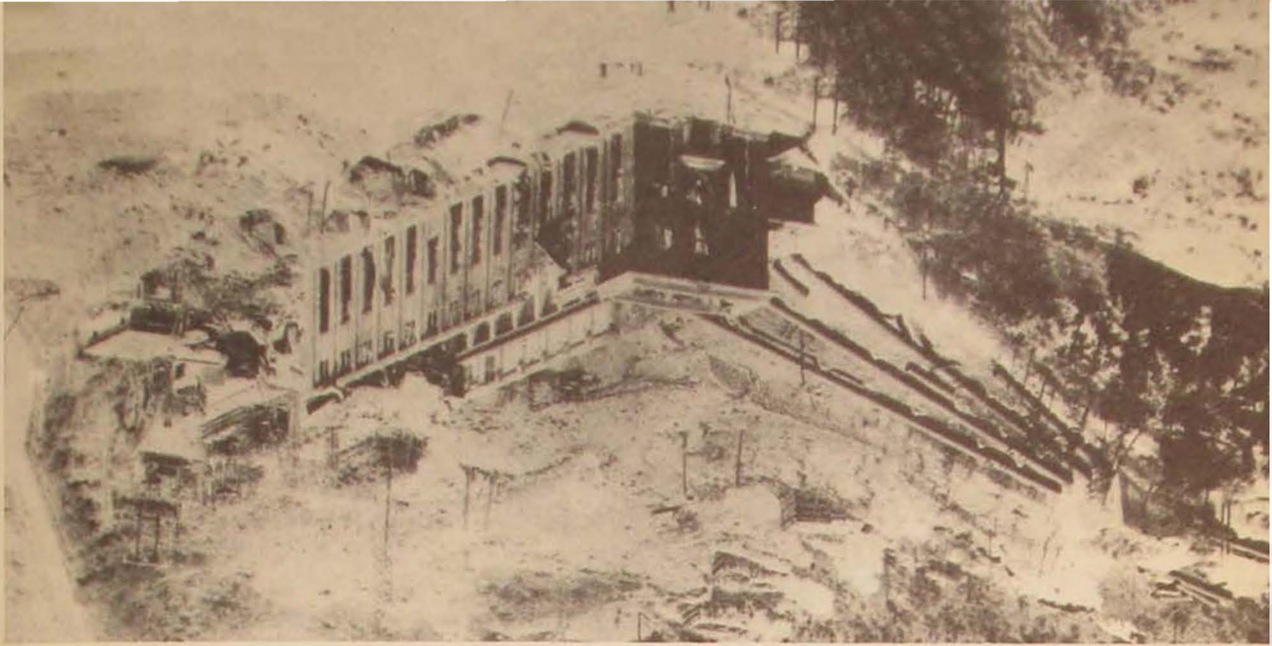
## Destruction

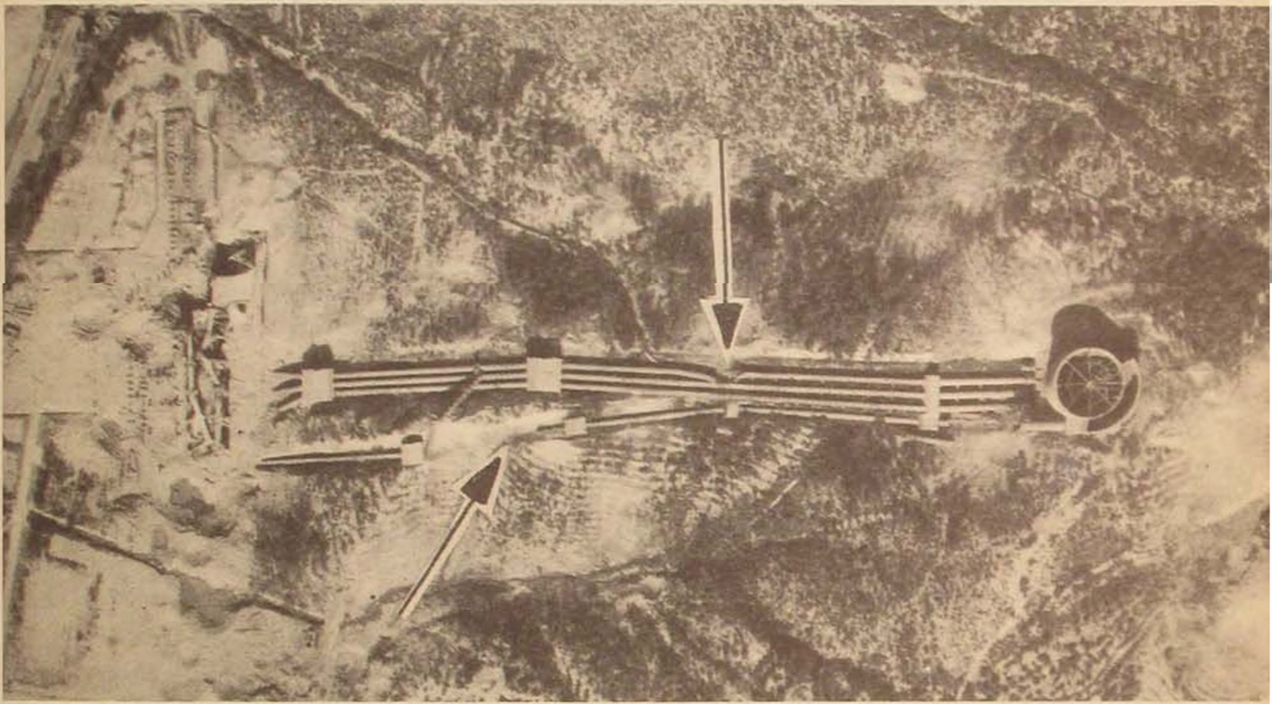
The initial attack on the power system was launched at 1601 hours on 23 June 1952. In one thunderous sweep a combined aerial task force of more than 500 combat aircraft from Fifth Air Force, Navy, and Marine units closed in on the key hydro-electric plants at Suiho, Fusen, Choshin, and Kyosen. This biggest single strike of the Korean war—comparable in scale to combined operations of World War II—proved the effectiveness of interservice planning and coordination of our air forces in the Far East.

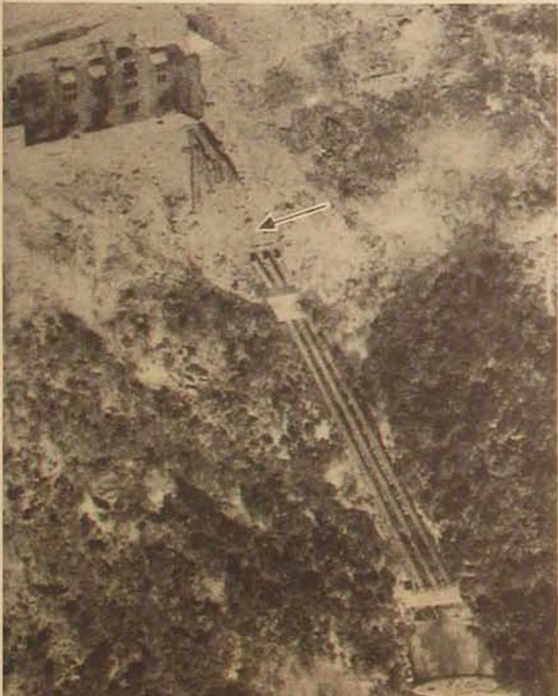
Over 230 carrier-based planes from the flat-tops Boxer, Princeton, Philippine Sea, and Bon Homme Richard of the Navy's Combined Task Force 77, joined with more than 270 fighter-bombers from Fifth Air Force's Korean-based 8th, 18th, 49th, and 136th Fighter-Bomber Wings and Marine Air Groups 12 and 33 to strike the four major power systems simultaneously—the first large-scale mission to employ aircraft from all air elements in Korea.

The most spectacular part of the combined operation was the attack on the Suiho plant. The target was within sight of the huge Communist airfield complex at Antung, Manchuria, and attacking U.N. pilots observed some 208 MIG-15's neatly lined up on the taxi strips. Many MIGs were seen to take off, but none challenged the U.N. armada. Instead they headed into Manchuria. Presumably they were either frightened by superior numbers or, thinking the attack was earmarked for Manchurian targets, were ordered inland to defend Chinese industrial sites and airfields. In either case the Korean targets were defenseless. It is well they did not give challenge, for over 100 Sabrejets of the 4th and 51st Fighter-Interceptor Wings, reinforced by Navy Panther jets, patrolled MIG Alley as cover for the attacking fighter-bombers.

Flights of flak-suppressing Navy Panthers preceded the initial attack, knocking out the antiaircraft installations on the Korean side of the Yalu while wave after wave of Navy and Air Force fighter-bombers waited to make their bomb run. Approximately 72 naval Skyraiders and Panthers flew 200 miles overland with their heavy bomb loads to make the initial dive bombing attacks, dropping 90 tons of explosives on the huge generator house and







*This series of post-strike photos taken by the 67th Tactical Reconnaissance Wing shows the damage done to some of the 12 generating plants of the North Korean hydro-electric power system hit in the series of raids during the week of 23 June 52. Photo 1, taken on 25 June, shows water still spraying from ruptured penstocks of Kyosen plant 3. The generator house, transformer yards, and adjacent buildings are severely damaged. A transmission line running up hill from the plant is severed. Photo 2 shows 100 per cent damage done by USAF fighter-bombers to Choshin plant 3. Penstocks connecting the surge tank with the generating house are completely severed. The generator house received four direct hits while adjacent switchyards suffered from blast damage. Photo 3 displays the accuracy of USAF fighter-bomber pilots who completely destroyed the generator house and adjacent transformer switchyards at Choshin 4. Two of the four penstocks are ruptured. Photo 4 shows Fusen plant 1 (which was partially damaged in 1950 by B-29's) with three of the four penstocks unserviceable and the generator house reduced to a scarred shell. In addition USAF fighter-bombers reduced transformers and power switchyards to tangles of wire and metal. In photo 5 columns of smoke rise from the transformer deck and generator house of the Suiho plant shortly after the mass 250-plane raid on 23 June. Several direct hits penetrated the power house roof, which was constructed to be bomb-proof. Targets on the Suiho raid were the generating house, the six huge transformers on the transformer deck adjacent to power house, and the transformer and switchyard substation extending down river from generator house. By pinpointing the bomb loads on the power generating equipment, U.N. pilots knocked out the power potential without touching the dam.*

transformer yards. They were followed by more than 120 Fifth Air Force Thunderjets and Shooting Stars which pinpointed their loads of demolition bombs and rockets on the same target.

Fifth Air Force post-strike reconnaissance revealed Suiho was temporarily out of commission. Of the plant's five primary transformers located at the Korean end of the transformer deck two were destroyed and a third was damaged. A huge hole through the "bomb proof" roof of the generator house indicated the two generators inside and facing the destroyed transformers were severely damaged. In addition to the heavy damage done to the switching yards, 20 heavy electric transmission lines, connecting the transformer deck with the switching system, were knocked out. Various auxiliary buildings in the vicinity of the power station were demolished. The huge 349-foot-high, 2950-foot-long dam was untouched, attesting to the precision with which fighter-bomber pilots followed their orders to hit only the generating and transmission equipment and facilities. Not a single aircraft was lost in this raid.

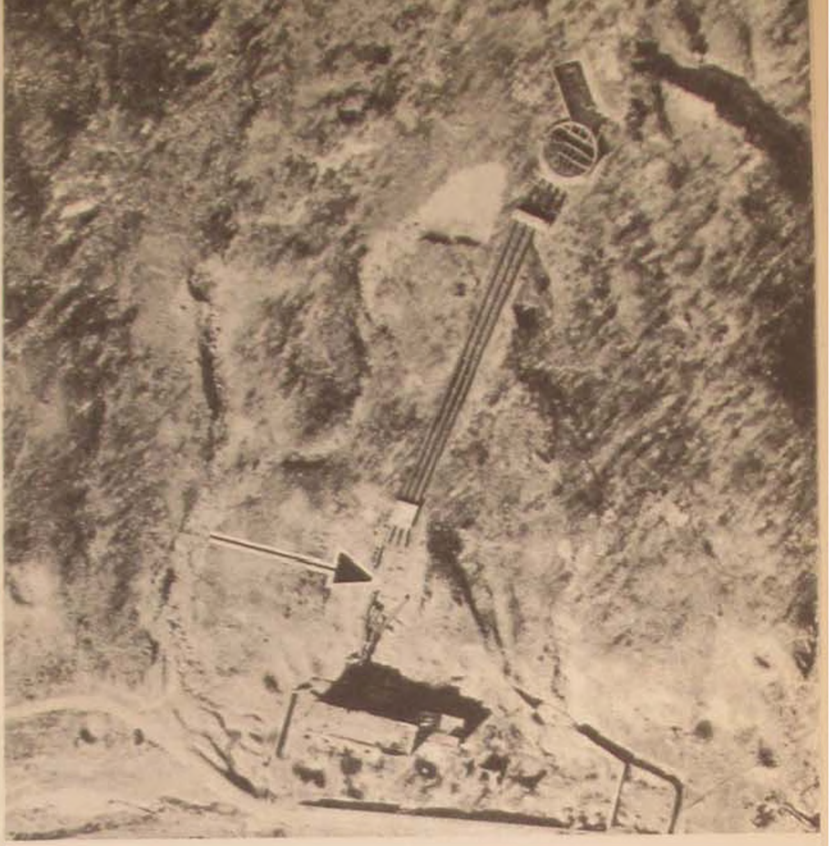
Simultaneously with the attack on Suiho parts of the eastern power systems were struck. The Kyosen system, easily accessible to carrier-based aircraft, was assigned to the Navy Corsairs, Skyraiders, and Panther jets. Heavy damage was inflicted on powerhouses and transformer yards, and penstocks were shattered. Fighter-bombers from the Fifth Air Force and Marine units hammered at the Fusen and Choshin systems. Principal targets in these two systems were the power generating houses, switchyards, and penstocks of Fusen plants 3 and 4, and Choshin plants 3 and 4, the least heavily defended elements in these systems.

By 1800 hours on 23 June, two hours after the attack on the whole power complex began, electric power production in North Korea had been abruptly halted, though not permanently or totally put out of commission. Several of the generating plants were not hit in the first combined raid. Of those attacked two or three had been only partially destroyed and could be repaired in a relatively short time. World War II had taught that to disable permanently an industrial complex as vast and flexibly interrelated as North Korean electric power, bombardment must be systematic and repeated.

The Suiho generating plant was considered inoperative for some time to come. But if any one or two of the 12 plants in the eastern grid remained operative, the interlocking power transmission lines could transfer that power to wherever it was needed. For several days after the initial attack the major air effort of our combined Korean air forces was concentrated on the three hydro-electric systems in northeast Korea.

On 24 June, the day after the big attack, fighter-bombers of the Fifth Air Force's 8th, 18th, and 136th Wings blasted Choshin plants 1 and 2 and Fusen 4. A flight of Thunderjets returning to Fusen 3 found the target still in flames and obscured by thick, heavy smoke, so they diverted their mission to railcutting in the Hungnam area. Carrier-based planes likewise followed up the first-day attacks by staging a group of raids on the still-smoking Kyosen plants and by hitting Fusen 1.

On 26th June aircraft of Fifth Air Force's 8th, 18th, and 136th Fighter-Bomber Wings, the 1st Marine Wing, the RAAF, ROK, and SAAF, ranged over the Choshin and Fusen complexes, ripping up transmission lines, destroying high-voltage switchhouses, transformers, and smashing the generator houses and penstocks. The following day fighter-bombers from the 49th and



*Constant reconnaissance of damaged power sites enabled USAF target experts to check on enemy repair activity and to keep plants neutralized by scheduling strikes when repairs became visible. This photo of Choshin 3, taken six months after the initial strike, shows the permanence of the destruction. Penstocks still lie askew as they appeared in the June post-strike photographs.*

136th Wings again attacked Choshin 1 and 2 power plants, penstocks, switchyards, substations, transmission lines, and adjacent buildings.

The combined mopping-up operations which followed the big attack of 23 June provided the "coup de grace" to the east coast hydro-electric power systems. All lights went out in North Korea.

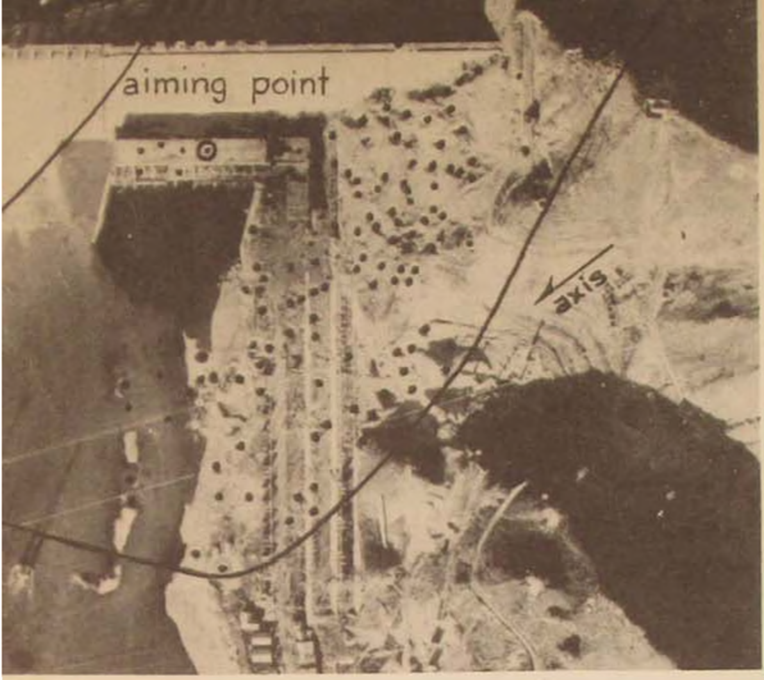
## Follow-up on Eastern Grid

The initial strikes of the week of 23 June 1952 had made North Korean electric power a legitimate target for U.N. aircraft. Reports that Russian, Chinese, and North Korean technicians had been rushed to the various power sites to assess damage and attempt repairs wiped out any delusion that electric power had been permanently disabled. By makeshift repairs and relocation of salvaged equipment, the enemy might make parts of the system serviceable.

In the remaining weeks and months of 1952 and through March 1953 the electric power facilities of the Fusen, Choshin, and Kyosen systems were placed on U.N. target lists. Constant visual and photographic reconnaissance scrutinized the power generating sites. Whenever unusual activity was observed around any one plant or signs of repair became visible, a strike was scheduled. The eastern grid transmission line network, transformer yards, and power step-down stations spread throughout North Korea became routine targets for tactical aircraft. U.N. pilots foiled all enemy attempts to get the east coast system back into partial operation.

## Return to Suiho

Evidence that the Communists' military-industrial capability on both sides of the Yalu River had been badly hurt or virtually halted by the big 23 June strike on Suiho was revealed by constant post-strike surveillance. High-altitude photos taken by day and by night, plus reports of pilots returning from combat missions, revealed intense activity at Suiho. The enemy was attempt-




*On the night of 12 September 1952 thirty-one B-29's bombed Suiho by radar, pinpointing 300 tons of high explosives, including 2000-pound armor-piercing bombs, on the generator house, power substation, and adjacent hillside. Using the generator building as aiming point, the B-29's pulverized the power substation and the hillside where vital transformers were being relocated, and struck the generator building and transformer deck.*

ing to get at least one of the massive generators turning again.

Aerial reconnaissance on 14 July revealed eight of the transmission lines had been replaced. Photos taken on 21 August showed water beginning to flow through one tailrace at the northern end of the transformer deck. The enemy was testing to see if some small amount of vital electrical energy could be produced. On 30-31 August a number of the big transformers which flanked the power house had been moved to the hillside near the power house and dispersed up the slope in revetments. Repair work on the generator house roof was in progress. Miscellaneous debris in the switchyard substation was being cleared away and an unusual amount of truck activity was evident. In addition heavy concentrations of large-caliber antiaircraft guns had been moved in to protect the target. All this pointed to the high priority which the enemy had given to Suiho's rehabilitation.

Although Suiho, if operating at all, was far from full-scale production, target experts recommended a second heavy attack to eliminate the necessity of additional and hazardous mopping-up trips through greatly reinforced antiaircraft defenses. They also suspected that some of the heavy machinery which had been knocked out in the 23 June raid might be salvaged and removed by Russian and Chinese technicians.

The second big attack on the Suiho power plant was assigned to Japan-and-Okinawa-based B-29 Superforts of Far East Air Force's Bomber Command. The Superforts could deliver heavy bomb tonnages in a concentrated area and could also carry quantities of 2000-pound high explosive bombs which could penetrate the steel-reinforced concrete roof of the generator house. The heavy concentration of antiaircraft guns called for night attack from high altitude. Furthermore it was likely that the rows of sleek MIG's on the Antung airfields in Manchuria would be thrown into the defense against another attack on the vital power site.

The second attack took place on the night of 12 September 1952. Thirty-one B-29 Superforts from the 307th Bomb Wing, 19th Bomb Group, and 98th Bomb Wing streamed over the target for 2 hours and 40 minutes. First over the target was the 307th Wing armed with 500-pound demolition bombs, followed by the 19th also armed with 500 pounders. Intense smoke and fire rose skyward as the last formation from the 98th Bomb Wing approached the target area and dropped their 2000 pound armor-piercing bombs.

Night intruder B-26's patrolled the target area throughout the bombing, strafing searchlights and antiaircraft gun positions to defend the B-29's from ground fire. Even with this protection flak was moderate to intense, since the gun positions and searchlight batteries on the Manchurian side of the Yalu could not be touched. Several enemy night fighters, including jets, made non-firing passes at the Superforts, and an unidentified aircraft kept dropping orange-white parachute flares ahead of the bomber stream.

The B-29's approached the target from the east-southeast on a bomb run course of approximately 253 degrees. This course was chosen because it least exposed the Superforts to searchlights and antiaircraft fire from Manchuria before bomb release. It also enabled the greatest amount of surprise since the enemy could not know until the last few minutes of the bomb run whether the target would be Suiho or the airfield and industries at nearby Sinuiju—the latter being a frequent target for our night medium bomber missions. The disadvantage of the course was the sharp turn required immediately after bomb release. If the Superforts overran this turn, they would be over Manchurian territory both heavily defended and forbidden to U.N. aircraft.

Using the 68-foot-wide, 596-foot-long Suiho generator building as an aiming point, B-29 bombardiers pinpointed over 300 tons of high explosives in the target area. The power substation and adjacent hillside, where transformers had been reveted following the 23 June strike, was pockmarked with bomb craters. Several direct hits were made on the generator building and transformer deck, while others struck and glanced off the massive cement dam. One bomb dented the ridge of the dam near the Korean shore. The strike again put Suiho out of the power-producing business.

## And Again

For five months following the night attack on Suiho, Fifth Air Force reconnaissance recorded the enemy's progress in cleaning up the debris and their attempts to repair the big power plant. By 1 February 1953, four-and-one-half months after the second strike, photos and intelligence reports indicated that two of the generators might be back in business. New transmission lines had been erected. Salvaged transformers and switching equipment were re-installed. Damage to the generator house and transformer deck was being repaired. The battered target was ripe for a third strike.

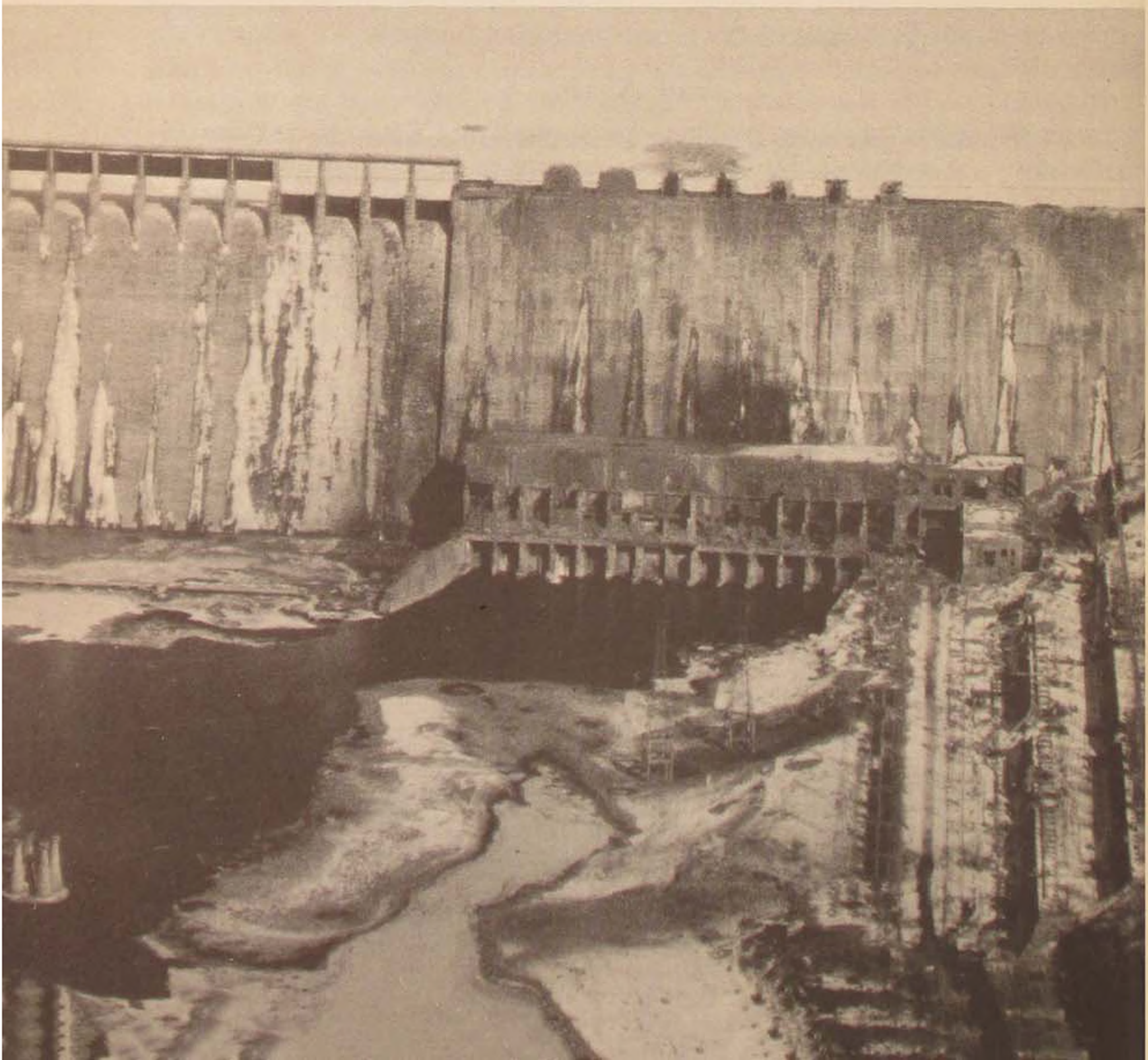
On the afternoon of 15 February a force of Fifth Air Force fighter-bombers slipped up to the Yalu River and came in low, sending their bombs and rockets into the generator house, transformer deck, and power switchyard. Sabrejets, flying protective cover for the attacking Thunderjets, tangled with a flight of MIG's which tried to break up the attack, and shot down two, probably destroyed a third, and damaged 4 others. The North Korean electric power system was once more at a standstill.

## Results

Primary targets in attacks on all systems in the power complex were the power generating equipment, transformers, and adjacent switchyards. Losses of this vital electrical equipment were calculated to be the most difficult and time-consuming to replace, whereas the vast manpower available to the Communists could easily repair damage to the physical installations in relatively short time. In the case of the east coast systems the destruction of the penstocks alone was a mortal blow to power production. These penstocks were especially constructed by the Japanese for the individual climatic and physical conditions of the specific sites. The materials and engineering design used in their construction took into account the exact terrain contour on the site, the wide variation in temperature change, and the degree and frequency of earthquake shock. Communist China does not possess technology or industrial capacity to reproduce and replace penstocks or generating equipment. Russian engineers would need several years to make the systems completely serviceable again. What influence the destruction of electric power will have on the future conduct of the war or the peace negotiations is unknown. But it can be said if war is settled across the peace table the aerial destruction of electric power will have been a major persuasive factor in convincing the Communists to bargain for peace.

*Air University Quarterly Review*

*This post-strike photo, taken by a low-flying RF-80 shortly after the third strike on Suiho, shows a striking scene of desolation. Generator house, transformer deck, and power switchyard are battered and deserted. Large chunks knocked out of the dam behind the generator house mark where bombs had struck and glanced off the solid cement structure. Evaluation of post-strike photos of third raid showed extensive damage which again neutralized Suiho. The fact that no water is gushing from sluice gates below transformer deck shows that generators are not in operation.*



# Current Practice in Air Defense

## Part II: Impact of Modern Weapons

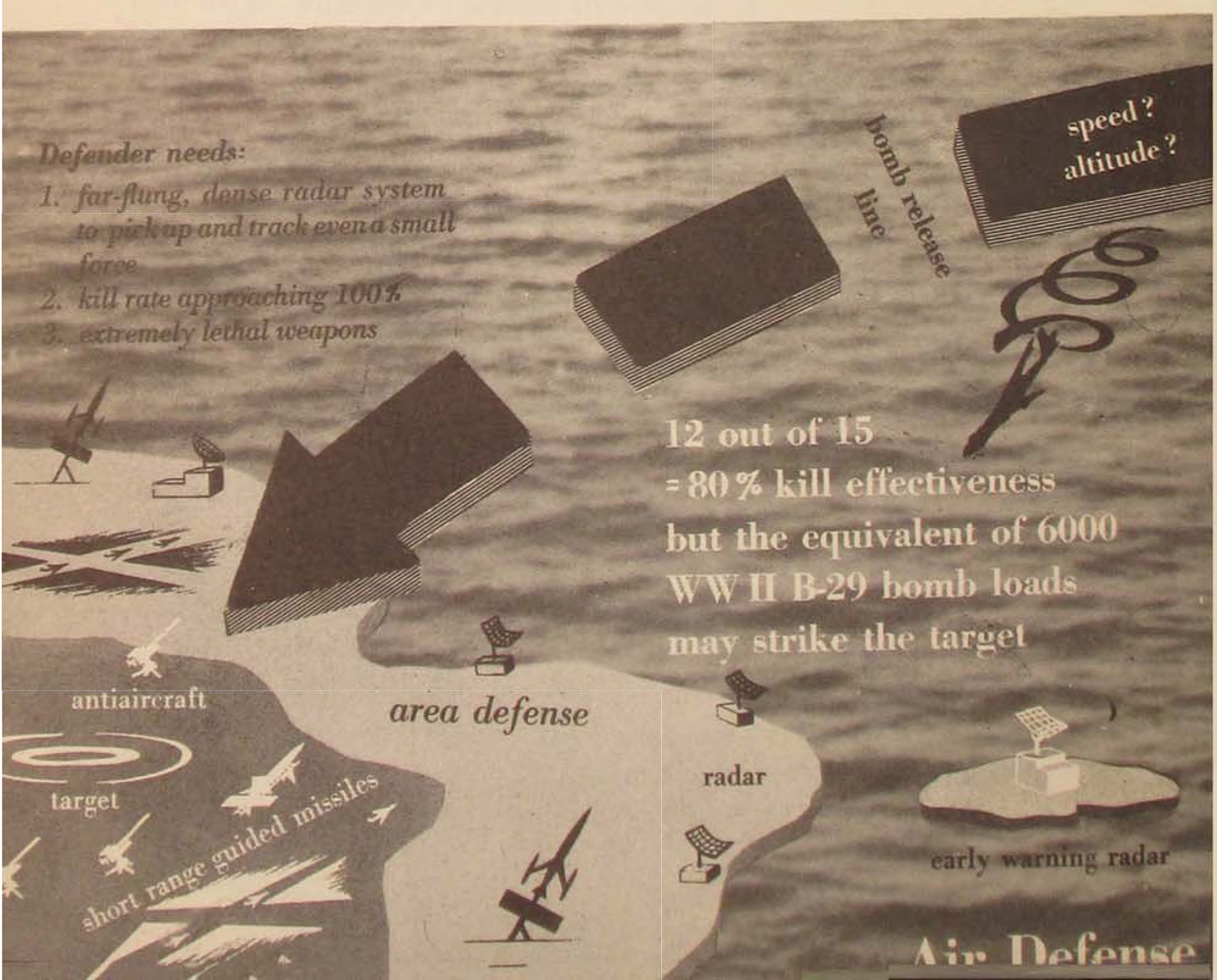
MAJOR GENERAL FREDERIC H. SMITH, JR.

IN Part I of this article, I attempted to define the basic actions common to any air defense system and to enunciate in fairly general terms how these basic actions are carried out. The treatment was designed to give the reader a general understanding of the elements of an air defense system without going into specific detail as to the impact of modern weapons and modern weapons carriers upon an air defense system. It is very important that we analyze these effects, for Hiroshima raised the curtain on a new era in warfare. So destructive has the modern aerial weapon become since World War II that what were only minor miscalculations in that war could result in major catastrophies in a third world war. In the following pages, I shall attempt to point up what I believe to be significant changes in philosophy engendered by the introduction of weapons of mass destruction, delivered by aircraft with ever-improving performance.

On the 6th of August 1945, a single B-29 virtually destroyed the Japanese city of Hiroshima. The warning was sounded on that day that a new era in warfare had been born and that defensive measures considered adequate in the past would need drastic revision in the future. A B-29 is designed to carry 20,000 pounds of bombs. The single bomb dropped on Hiroshima had the equivalent in energy of 20,000 tons of TNT, so that one bomber carried the equivalent in explosive power of 2000 B-29's carrying conventional explosives. We may be certain that nations possessing the capability for the production of atomic munitions have made substantial improvements since 1945 in the design and yield of such weapons. In any war of the future, atomic bombs will have enormously more destructive power than the one dropped on Hiroshima.

During World War II it was generally accepted that an air defense system which could consistently inflict losses only a little in excess of five per cent of the attacking bomber force could, in a relatively short time, bring strategic air campaigns to a halt The tremendous bomber force needed to destroy chosen target systems could not be effectively maintained in the face of repeated losses between five and ten per cent. This axiom was a measure

# Air Power Capabilities

# and Effects on Air Defense

325 mph
30,000 ft.

World War II strategic bombing campaigns relied on large fleets of relatively slow bombers to drop conventional explosives on a target system. The process was necessarily gradual and cumulative in its effect. To defeat this long-term purpose, the aerial defender had only to inflict steady losses of more than 5 per cent to achieve an attrition which the enemy could not accept.

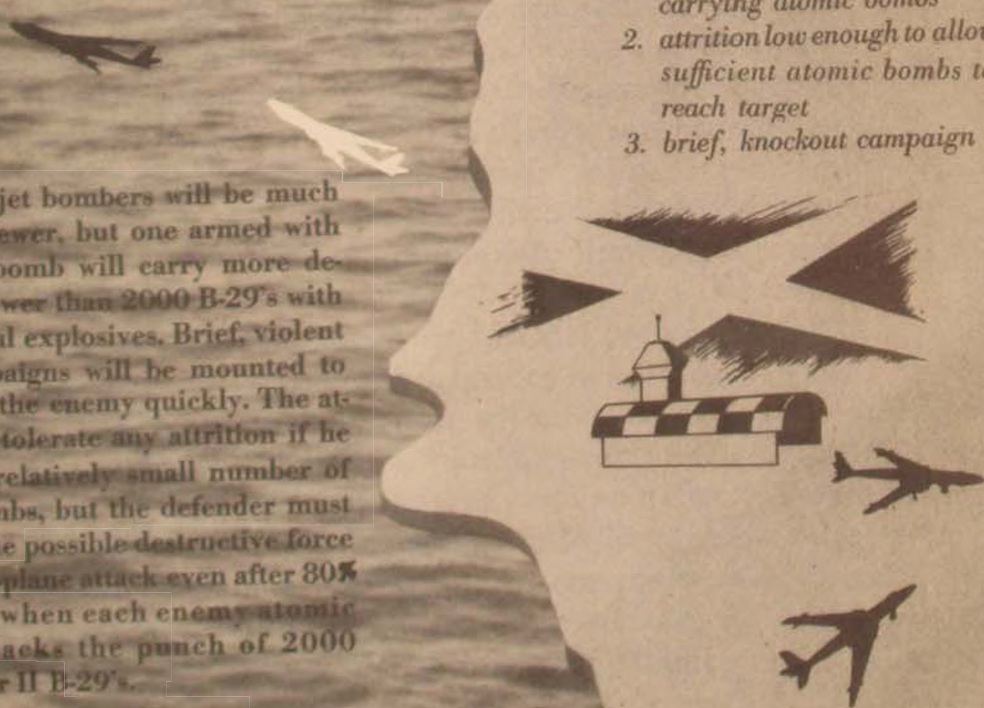
*Attacker needed:*

1. *large fleet of bombers*
2. *attrition of less than 5%*
3. *many large-scale raids to wear down the enemy*

## Air Defense

*Attacker needs:*

1. *fewer, faster bombers, some carrying atomic bombs*
2. *attrition low enough to allow sufficient atomic bombs to reach target*
3. *brief, knockout campaign*



Atomic-age jet bombers will be much faster and fewer, but one armed with an atomic bomb will carry more destructive power than 2000 B-29's with conventional explosives. Brief, violent aerial campaigns will be mounted to knock out the enemy quickly. The attacker can tolerate any attrition if he delivers a relatively small number of atomic bombs, but the defender must consider the possible destructive force left in a 15-plane attack even after 80% attrition, when each enemy atomic bomber packs the punch of 2000 World War II B-29's.

## in the Atomic Age

not only of the difficulty of replacing crews and aircraft but also of the economic investment in the bomber force, as opposed to economic and military effects upon the enemy. Similarly extremely long-range intercontinental air warfare could not be remunerative. The economic, manpower, and supply problems incident to such operations were out of all proportions to the results which might be anticipated. Thus during the last war the soil of the United States itself was threatened only by possible harassing attack. To protect vital overseas bases and lines of communication in our theaters of war, we and our allies had only to create a defense which could guarantee an enemy attrition of slightly over five per cent. Had the Germans realized earlier the threat posed by our Combined Bomber Offensive and devoted more energy and resources to the improvement of their air defense system, it is quite possible that that offensive might have failed. We all should realize what a narrow squeak this was.

Now contrast the World War II situation with the one facing today's air defender of vital ports, bases, and lines of communications overseas, or of the even more vital war potential in the home country. Each bomber aircraft penetrating these areas may be carrying a weapon comparable in effect to the combined tonnage of conventional munitions carried by thousands of bombers. A few atomic bombs on target can achieve the effect of a whole strategic air campaign of the past war. From the attacker's viewpoint a tremendously increased attrition rate can be tolerated, for he might well hope to achieve at one stroke what would have taken tens of thousands of sorties to achieve before.

From the above, we must infer that five to ten per cent attrition is far too low a capability for an air defense system designed to face current and future threats. To over-simplify the problem, we must create an air defense system so effective in imposing kills before bomb release line that the enemy will have exhausted his resources of atomic fission weapons before he has achieved decisive results.

In addition to nuclear weapons, we might well face an enemy in the future who has no scruples against employment of other weapons of mass destruction, such as biological and chemical weapons. On the ground the specific measures taken to lessen the effect after delivery are vastly different from nuclear and biological or chemical weapons. The air defender, however, may treat these weapons in exactly the same manner as the nuclear threat, for they are designed to achieve tremendous casualties with relatively small packages. So, as in the case of atomic carriers, a heavy premium is placed upon the destruction of carriers of bacteriological and chemical weapons prior to bomb release line

Of extreme importance to the air defender is the performance he can expect from enemy vehicles delivering weapons of mass destruction. With the advent of jet aircraft and turbo-prop aircraft the defender must be able to combat vehicles traveling at very high speed and at very high altitude. Not only must the defensive fighters and the local defense weapons systems perform well enough to combat successfully the ever-faster and higher-flying enemy aircraft, but the *reaction* of the system as a whole must be in a new "time" dimension. If we add the threat, which will arise at some time in the future, of surface-to-surface ballistic missiles and bomber-launched and submarine-launched missiles, we see that the time given the defender is tremendously foreshortened. Systems reaction must be truly split-second.

## The Ground System

In Part I we discussed the elements of a typical air defense system and how these elements feed into an integrated whole designed to employ all available weapons under optimum conditions. It is obvious that, as our first step, we must improve the functioning of all those elements so that they operate at the highest practicable level of efficiency. I will discuss first the ground environment of the air defense system.

Our present ground environment consists of early warning radar; a radar system deployed in depth back of early warning stations; and a comprehensive communications system, including provisions for ground-to-air communications. Let us examine this complex to determine what improvements are necessary to maximize its performance. Four basic functions must be susceptible of improvement: the gathering of information, the transmission of that information to the echelon responsible for action, the display of that information so that decisions may be made, and the allocation and control of weapons directed against the threat.

Time, so important to the air defender in the past, becomes of ever-increasing importance to the air defender of the future. The initial pick-up of hostile aircraft must be made at the earliest possible point after their take-off, and warning of their approach must be processed to the level of decision without delay. Early warning, so significant a factor in the past, becomes even more essential for the future. The current practices of voice telling and manual plotting introduce unacceptable time losses. We must have solid tracking of aircraft regardless of the altitude at which they are flying. There must be solid detection and immediate identification of attacking vehicles from the ground up and throughout the approaches and within the area to be defended. Data transmission and collection throughout the system must be so rapid as to preclude normal communication methods. We must therefore go to electronic means. Because the allocation of what always must be a limited number of defensive weapons is so vital to ensuring optimum results, we must make commitment decisions at the highest practicable echelon. Our data must flow from all radars to direction center and the air division combat center, and it must there be instantaneously available to the division commander in the form of over-all or specific displays. Any air defense system of the future must incorporate these improvements. It is also important that similar methods be employed within sub-systems, such as antiaircraft guns and guided missiles, so that weapons can be allocated against specific hostile tracks without delay and without confusion. The system we plan now must be flexible and capable of growth. Threat evaluation and weapon assignment must be made at the operational level where the knowledge of the air situation concerned is most pertinent, accurate, and readily available. Later, as the speed and number of enemy air weapons increases, it may be necessary that some threats be evaluated and weapons assigned by a level higher than division level. Not only must the system of the future be capable of this kind of growth, but it must be able to assimilate new weapons without materially changing its operating procedures. Yet this system must not be over-automatized. Human judgment must definitely play its part. In many instances electronic apparatus can do the human's job and do it faster and more effectively. This apparatus cannot, however, make all the last minute decisions necessitated by changing enemy tactics and countermeasures.

The ground environment must also contain means of directing the pilot to the interception without imposing a serious load upon him and his mental reflexes. This aid to the interceptor pilot is necessary because he faces far too complex an operation to be fully efficient without it. Not only does the aircraft itself demand more from him, but he must also handle properly his search radar and his fire control system. Ideally the interceptor pilot should only monitor the performance of his equipment.

## The Air System

The probability of killing enemy bombers should never be computed without considering our own fighter losses. Since the destruction of a hostile aircraft by interceptor aircraft is basically a function of the armament carried by the interceptors, it is only by means of better interceptor armament that we can tip the attrition equation in our favor. Interceptors equipped with caliber .50 machine guns or 20mm cannons must close to very short range before firing. This makes the interceptor pilot vulnerable to the guns of the bomber and at the same time averages a relatively small kill probability.

The new interceptors will increase kill probability and at the same time increase the interceptors' probability of survival. Rapid advancement must further increase this kill probability and chance for interceptor survival. To repell subsonic or supersonic bombers, we must have such armament as supersonic homing, air-to-air guided missiles launched from either subsonic or supersonic interceptors.

The development of interceptor aircraft for air defense purposes has been patterned to increase the destructive capability of the individual weapons, to decrease the time required to place the weapon on the target, and to maintain the edge in performance over the probable capability of the enemy vehicle. Very high climb performance, high speeds at extreme altitudes, and good maneuverability at high altitudes are essential. In addition our interceptors must be highly mobile so they can find the enemy bombers and destroy them at any point where they enter the air defense system. At present this mobility and flexibility of defense is best achieved by the use of manned interceptor aircraft. In the future it may become feasible to include in our family of weapons a ground-launched pilotless interceptor. Its "pilot" will remain on the ground, his "cockpit" being the electronic equipment necessary for initial guidance. Terminal or final guidance equipment will be contained in the missile itself. These missiles, short-range for point defense and long-range for area defense, should be designed to employ a variety of warheads. They should be flexible enough so that they can be employed against targets at any altitude. An obvious disadvantage of such weapons is that it is exceedingly difficult if not impossible to recover them once they have been used. But this could be offset by making these weapons so accurate and reliable that the chances of a miss or a dud are relatively nil.

It is highly improbable that one type weapon alone will do the job. The enemy could readily develop countermeasures against any single type of weapon. His freedom to choose from several strategies and routes of attack also dictate the necessity of several types of defensive weapons. It must be decided what the best possible family of weapons should be, and plans made accordingly for their production, maintenance, and the training of personnel.

## Survival: What Price?

The production of modern aerial weapons and the detection and control equipment is both extremely costly and time consuming, particularly when used in combination with atomic power. Today's interceptors, as an example, are bigger, extremely more powerful, and naturally more complex than their World War II predecessors. Certain types of our interceptors weigh two-thirds as much as the heavy bombers of World War II. The F-86D required more than twice the engineering design hours than did the F-51; requires more than twice as many man hours to build; and, of course, costs considerably more.

Outgrowths of the new and complicated equipments are the higher levels of personnel skills and training needed to operate the air defense system. The ground maintenance of both radar and jet fighter-interceptors has increased in complexity, number of personnel required, and degree of skill demanded of these personnel. The skills demanded of the pilot have also increased to the point where qualifying a pilot to be combat-ready in an F-86D is beyond comparison with the training required during World War II. As additional capabilities are afforded the air defense system, the complexity will also increase, continuing the demand for increased skill and training of our personnel.

Unmanned interceptors or guided surface-to-air missiles are expensive not only because of their complexity but also because they cannot be used more than once. Yet the existence of atomic weapons and the increase in speed and range of enemy bombers make the development of these pilotless aircraft or missiles a necessity. It is the only weapon family on our present scientific horizon with an ultimate promise of near-infallibility. Any weapon which could with reasonable certainty destroy an atom bomb-laden enemy bomber would be an exceedingly valuable asset at any price.

If there were no limit to the amount of money that could be spent for air defense, this defense task of course would be greatly simplified. But it must be remembered that defensive action alone will not win a war. Considerable sums must be spent in building and maintaining, ready for combat on a moment's notice, a retaliatory air arm capable of delivering crippling blows on the centers of the enemy's war-making capacity. Other services must also prepare for the battle for survival of this nation. How much, then, should we spend on air defense? This depends, first, on what sum the nation can afford for national defense and, secondly, on how important the air defense portion of national defense is. In other words, how much air defense shall we plan for? Do we require a 50 per cent kill in order to survive? Or should it be 95 per cent? Certainly, the absolute minimum is that defense necessary to ensure survival of our retaliatory air arm, our industrial potential, and our people's will to fight. All these are necessary in bringing a war to a successful conclusion.

I will not attempt here a discussion of how many bombs on target are required to neutralize the United States war effort. But let us assume that this number, whatever it may be, remains constant for a number of years. As the enemy atomic stockpile grows and as the number of enemy delivery vehicles increases, we in turn must be able to destroy a greater and greater percentage of total enemy bomb carriers in order to survive. This ratio must in time approach a very high percentage.

How can we obtain a kill ratio approaching 100 per cent? Considering the threat previously discussed, and after planning for the necessary surveillance and control facilities, it becomes primarly a matter of numbers of weapons—weapons equipped with the most lethal armament and warheads we can devise.

The over-all cost of air defense involves both capital investment and operating cost. It includes the cost of the Air Defense Command, the Army antiaircraft command, the cost of Air Materiel Command and Air Training Command support, and the contribution of other commands and services directly related to the air defense mission. This cost would also include annual expenditures for research, development, and engineering. The amount of air defense achieved—always considering the growing enemy capability—is relative to the cost of such defense. With proper planning, threat evaluation, and employment of weapons, we will continue to get a dollar's worth of air defense for each dollar expended. There appears to be no leveling off of the curve of cost versus capability which would require the expenditure of enormous sums of money for a small increase in kill. The curve seems to be a relatively straight line, with air defense capability increasing proportionately as additional money is used.

History indicates that defense has continually vied with offense in relative strength and capability. Today, with the possibility of the whole free world succumbing to devastating atomic blows, we cannot take a chance on a defense which has slipped behind the offense. It will be fatal if we rationalize ourselves out of providing a defense which will assure survival of our offensive forces and the nation's will to fight.

*Headquarters, Air Defense Command*

# Air-to-Air Combat in Korea

Colonel Harrison R. Thyng

Like olden knights the F-86 pilots ride up over North Korea to the Yalu River, the sun glinting off silver aircraft, contrails streaming behind, as they challenge the numerically superior enemy to come on up and fight. With eyes scanning the horizon to prevent any surprise, they watch avidly while MIG pilots leisurely mount into their cockpits, taxi out onto their runways for a formation take-off.

"Thirty-six lining up at Antung," Black Leader calls.

"Hell, only twenty-four taking off over here at Tatungkou," complains Blue Leader.

"Well, it will be at least three for everybody. I count fifty at Takushan," calls White Leader.

"I see dust at Fen Cheng, so they are gathering up there," yells Yellow Leader.

Once again the Commie leaders have taken up our challenge, and now we may expect the usual numerical odds as the MIGs gain altitude and form up preparatory to crossing the Yalu.

Breaking up into small flights, we stagger our altitude. We have checked our guns and sights by firing a few warm-up rounds as we crossed the bomb line. Oxygen masks are checked and pulled as tight as possible over our faces. We know we may exceed eight "G's" in the coming fight, and that is painful with a loose mask. We are cruising at a very high Mach. Every eye is strained to catch the first movement of an enemy attempt to cross the Yalu from their Manchurian sanctuary into that graveyard of several hundred MIGs known as "MIG Alley." Several minutes pass. We know the MIG pilots will become bolder as our fuel time limit over the "Alley" grows shorter.

Now we see flashes in the distance as the sun reflects off the beautiful MIG aircraft. The radio crackles, "Many, many coming across at Suiho above forty-five thousand feet." Our flights start converging toward that area, low flights climbing, yet keeping a very high Mach. Contrails are now showing over the Antung area, so another enemy section is preparing to cross at Sinuiju, a favorite spot.

We know the enemy sections are now being vectored by GCI, and the advantage is theirs. Traveling at terrifically high speed and altitude, attackers can readily achieve surprise. The area bound by the horizon at this altitude is so vast that it is practically impossible to keep it fully covered with the human eye.

Our flights are well spread out, ships line abreast, and each pilot keeps his head swiveling 360 degrees. Suddenly MIGs appear directly in front of us at our level. At rates of closure of possibly 1200 miles an hour we pass through each other's formations.

Accurate radar ranging firing is difficult under these conditions, but you fire a burst at the nearest enemy anyway. Immediately the MIGs zoom for altitude, and you break at maximum "G" around toward them. Unless the MIG wants to fight and also turned as he climbed, he will be lost from sight in the distance before the turn is completed. But if he shows an inclination to scrap, you immediately trade head-on passes again. You "sucker" the MIG into a position where the outstanding advantage of your aircraft will give you the chance to outmaneuver him.

For you combat has become an individual "dogfight." Flight integrity has been lost, but your wing man is still with you, widely separated but close enough for you to know that you are covered. Suddenly you go into a steep turn. Your Mach drops off. The MIG turns with you, and you let him gradually creep up and outturn you. At the critical moment you reverse your turn. The hydraulic controls work beautifully. The MIG cannot turn as readily as you and is slung out to the side. When you pop your speed brakes, the MIG flashes by you. Quickly closing the brakes, you slide onto his tail and hammer him with your "50's." Pieces fly off the MIG, but he won't burn or explode at that high altitude. He twists and turns and attempts to dive away, but you will not be denied. Your "50's" have hit him in the engine and slowed him up enough so that he can not get away from you. His canopy suddenly blows and the pilot catapults out, barely missing your

**The personal reactions of successful practitioners of the art of aerial combat make a story which can never be told too often. If this account of the duels in "MIG Alley" is more than usually tinged with concern for the progress of the over-all air battle and, after the battle, for the condition of the returning flights of Sabrejets, it is only natural, for the article reflects the views of a fighting commander. Now Deputy for Operations, Western Air Defense Force, Colonel Harrison R. Thyng returned from Korea late last year after having completed a tour of combat missions as commander of the 4th Fighter-Interceptor Wing, during which time he became the 16th jet ace of the Korean War. In addition to describing a typical fighter sweep to the Yalu, Colonel Thyng has some authoritative comments to make on the current dispute over the relative merits of the Sabrejet and the MIG-15 and on the mutual benefit derived from the Fifth Air Force combination of veteran Second World War pilots and eager youngsters recently out of flying school.**

airplane. Now your wing man is whooping it up over the radio, and you flash for home very low on fuel. At this point your engine is running very rough. Parts of the ripped MIG have been sucked into your engine scoop, and the possibility of its flaming out is very likely. Desperately climbing for altitude you finally reach forty thousand feet. With home base now but eighty miles away, you can lean back and sigh with relief for you know you can glide your ship back and land, gear down, even if your engine quits right now. You hear over the radio, "Flights re-forming and returning—the last MIGs chased back across the Yalu." Everyone is checking in, and a few scores are being discussed. The good news of no losses, the tension which gripped you before the battle, the wild fight, and the "G" forces are now being felt. A tired yet elated feeling is overcoming you, although the day's work is not finished. Your engine finally flames out, but you have maintained forty thousand feet and are now but twenty miles from home. The usual radio calls are given, and the pattern set up for a dead stick landing. The tower calmly tells you that you are number three deadstick over the field, but everything is ready for your entry. Planes in front of you continue to land in routine and uninterrupted precision, as everyone is low on fuel. Fortunately this time there are no battle damages to be crash landed. Your altitude is decreasing, and gear is lowered. Hydraulic controls are still working beautifully on the pressure maintained by your windmilling engine. You pick your place in the pattern, land, coast to a stop, and within seconds are tugged up the taxi strip to your revetment for a quick engine change.

Debriefing begins at once, and the excitement is terrific as the score for the mission mounts to four MIGs confirmed, one probable, and four damaged. A quick tally discloses that we had been outnumbered at least three to one, but once again the enemy had been soundly racked up.

This mission is the type most enjoyed by the fighter pilot. It is a regular fighter sweep, with no worries about escort or providing cover for fighter-bombers. The mission had been well planned and well executed. Best of all, the MIGs had come forth for battle. Our separate flights had probably again confused the enemy radarscope readers, and, to an extent, nullified that tremendous initial advantage which radar plotting and vectoring gives a fighter on first sighting the enemy. We had put the maximum number of aircraft into the target area at the most opportune time, and we had sufficient fuel to fool the enemy. Our patrolling flights at strategic locations had intercepted split-off MIGs returning toward their sanctuary in at least two instances. One downed MIG had crashed in the middle of Sinuiju, and another, after being shot-up, had outrun our boys to the Yalu, where they had to break off pursuit. But they had the satisfaction of seeing the smoking MIG blow up in his own traffic pattern. Both instances undoubtedly did not aid the morale of the Reds.

It is a hard bitter air war, with the cards all stacked in favor of the enemy. It is difficult to describe one's personal feelings about being unable to strike the enemy in his vulnerable spots with our great air capability. This is modern day fighting, yet in its code it parallels knightly warfare of the Middle Ages. Imagine patrolling up and down the Yalu, watching the enemy form up only three miles away on his field at Antung. From one end to another the place is just loaded with aircraft which one good strafing run would put out of commission forever. Supply targets and rail centers also within view could be destroyed and the enemy's capability of continuing war made impossible. But we are learning valuable lessons. We are training many pilots. We are proving to the enemy that American youths are not soft, but have the courage and the ability which was so apparent in their forefathers.

The mission of the F-86 units in Korea is to gain and maintain control of the air. The American Sabrejet is the only United Nations operational aircraft capable of sustained combat against the Russian-built jet fighters which we have encountered in Korea. The Sabrejet is definitely a slower aircraft and is out-climbed by the enemy. But it is a very rugged airplane, very maneuverable, and has the type of armament needed for fighter versus fighter combat. The radar ranging sight in the F-86 is one of the main reasons for our ratio of eleven kills to one loss. This sight is the answer to most of our gunnery problems. In large measure it compensates for the lack of pilot gunnery training or experience. The extent to which the handful of Sabrejets have gained and maintained air supremacy is best illustrated by the fact that not a single United Nations unit, installation, or ship has been hit by enemy bombers or fighters during the daylight hours. Secondly, the protective cover provided by the F-86's and their escort for fighter-bombers and fighter reconnaissance aircraft has been so effective the United Nations losses of these aircraft to enemy MIGs has been insignificant in the over-all proportions.

Sabres have flown thousands of sorties in Korea. I know of no single type of aircraft that has demonstrated the reliability of American equipment so well. The F-86 air frame and engine have performed most notably. I believe we are actually becoming complacent in the U.S. Air Force, as there is so little doubt in our minds that we will ever have a forced landing because of aircraft difficulties. We take dependability for granted, as well we should, and only when our equipment may not be fully exploited tactically do we become aroused.

From my experience in Korea I know that super attempts are successfully made to cope with any trouble we have experienced with our F-86 and allied equipment. The F-86 has a greater radius of action than the MIG-15, but we have not been able to exploit fully this tactical potential by striking enemy air power deep deep behind the lines, thus forcing the enemy to change his type of aircraft. The 86 could put the MIG so far away from the battlefield that the MIG would have no ground support capability and no possibility of attaining and maintaining any aerial supremacy near the battlefield area.

I believe that our Korean air fighting has taught us that close escort of bomber forces is not feasible unless the bomber has a high Mach capability. In my opinion the Korean air war has re-emphasized a great lesson: all types of modern combat aircraft must be capable of flying at high speeds and high altitudes. The most mightily armed aircraft, if slow, would find it difficult to live in the air against present high-altitude, high-speed fighters. Korean war experience must turn our thinking toward who can get the highest and who can move the fastest. That still does not resolve the kill problem entirely. The MIG today may possess a few operational advantages, but I do not believe it has the type armament or gunsight to take advantage of its initial superiority. Therein lies one reason for our effectiveness—our armament and radar-ranging gunsight. The MIG appears to be fully capable of performing its intercept mission. Its armament consists of two 20-millimeter and one 37-millimeter cannon. It has a two-way radio and instrumentation suitable for weather penetrations and descent missions. We have found it to be a sound aircraft with few noticeable structural limitations. When flown at maximum performance by a good aggressive pilot, it is a tremendous aircraft. It will take a lot of .50 caliber hits without breaking up. It has a fair radius of action and this can be increased by the use of droppable tanks. But I know the F-86, with its modifications and improved versions, is a better aircraft structurally and is a marvelous interceptor. There is no other United Nations aircraft that is in the same class or can be compared to it.

Finally, we must not forget the pilot. He has been the greatest single factor in the achievement of a very high kill-to-loss ratio in the air fighting. He has shown the benefit of superior training. He has learned to be part of a team devoted to the art of combat. What he has shown most of all is the fact that he has lived in a democracy and is able to think and act independently. Against present numerical odds he has had to be very aggressive. He has been living, sleeping, flying, thinking about—attacking—attacking—attacking, and attacking again. We in the Air Force call it being a "tiger," and contrary to some opinions, tigers are made as well as born. The combination of the older pilot, combat experienced in World War II, with the twenty-two-year-old pilot youngster has been complementary. The old tiger has really had to exert all his ingenuity and call upon all of his experience to remain a flight leader. And the youngster has derived great benefit from the cool, methodical way the old tiger has stalked and killed his enemy. It has taken great teamwork and faith in one another. This teamwork has taken any terror from the heart of the youngster and replaced it with respectful fear which translates itself into a driving desire to kill instead of being killed. Our Air Force aircraft for the next few years are going to be manned by these youthful Korean veterans with enough service to be great leaders. They will be the nucleus of any expanding force necessary to defeat a Red menace. Our country has now a great reservoir of service veterans who have seen other countries, other peoples, and had the opportunity to compare our way of life and government with theirs. Greater now is the incentive to fight and defend our heritage of freedom, not only for ourselves, but for free people everywhere.

*Headquarters, Western Air Defense Force*

# Air Force Logistics in the Theater of Operations

Major General Paul E. Ruestow

AIR logistics has one primary objective, and that is to keep planes in the air and capable of maximum air effectiveness in all phases of aerial warfare. Today, for the first time in history, jet aircraft are engaged in combat on a large scale. In providing logistical support for all United Nations air effort in the Korean and Far Eastern theater, the Far East Air Logistic Force has necessarily been faced with innumerable problems of combat air logistics that are new, peculiar to the rapidly developing pattern of air power. This experience will be valuable in shaping air logistics to meet combat support demands of air power as it moves ahead in the atomic age.

Supply and maintenance support of the Far East Air Force comprises the major logistic responsibility of the Far East Air Logistic Force. The geographic radius of logistic support includes Japan, Korea, Iwo Jima, Okinawa, Guam, and the Philippines. For all countries of the Far East receiving defense assistance, the Air Logistic Force administers the Air Force portion of the Mutual Defense Assistance Program and supports aircraft of Military Advisory Groups and Air Attaches throughout the Far East.

It has a many-faceted mission. Its depots act as the funnel for all Air Force supplies, personnel, and planes arriving in the theater. The simple expression "supply and maintenance support" embraces more than a quarter of a billion dollars in annual business. Tens of thousands of items and thousands of tons of supplies, ranging from bombs to small, delicate electronic units, comprise its supply mission. Maintenance depots operate with a production line tempo akin to that of large-scale industrial plants. Not only are combat-damaged aircraft repaired and theater aircraft periodically overhauled, but modifications suggested by battle experience are made on the spot.

The ten-thousand-mile supply line from the United States is supplemented by a widespread theater procurement program, which saves on initial cost and delivery time, increases theater self-sufficiency and ability to meet emergencies, supplements United States production, conserves United States resources, and at the same time strengthens the economy of our allies and hastens their return to self-sufficiency. The immensity of the over-all logistic program demands the utilization of theater resources and manpower skills. These resources enable logistic demands to be met within an effective time limit and materially reduce the demands which must be made on distant Zone of Interior facilities. As an employer of thousands of Japanese* and Filipino workers and as an important purchaser of native materials and services, the logistic force commander is an important factor in the theater economy. As head of this one-quarter billion dollar business he has an important quasi-diplomatic role which affects to a marked degree the economic bond between the theater community and the United States.

## Background of Far East Air Logistics

Following World War II, Air Logistic Forces in the Far East were reduced to skeleton proportions. Storage and repair facilities were concentrated into two logistic centers. One, the Marianas Air Materiel Area, located on Guam, served Air Force units stationed in the Philippines, the Ryukyus, the Marianas-Bonin Islands. In Japan the Japan Air Materiel Area served Air Force units operating within the main islands of Japan.

Not only were facilities limited, but stocks were low and in many instances incomplete. The rapid demobilization of the Air Force at the close of World War II was followed by an acute retrenchment which left little margin in the Air Force budget for replenishment. In the Far East, bases and depots were inactivated. In spite of skeleton personnel strength and a slender budget, property and supplies on hand at these bases were placed in the best standby storage possible to await future reclamation and utilization. It was from these accumulated stores that the Far East Air Force drew much of its support between 1946 and 1950. The activity of the logistic arm of the Far East Air Force in reclaiming, classifying, and returning to use more than a billion dollars of residual World War II supplies and equipment helped bridge the logistic lag interval that threatened the combat effectiveness of the Far East Air Force in the urgent expansion following the invasion of South Korea by the Communist forces on 25 June 1950. At best, such "roll-up" operations are more costly than need be, and today's air logistician will do well to include in his planning a program for orderly husbanding of resources which would be made surplus by a slackening of combat action

*See "FEALOGFOR and Japanese Labor," p. 93 of this issue.

or a geographic transfer of that activity. The Far East Air Logistic Force has such a plan operative today, and the end of the Korean conflict will see surplus materiel in the war theater swiftly absorbed into logistic reserves.

With the start of the Korean war the logistical workload of the Air Force in the Far East almost immediately multiplied more than five times, and it has continued to increase with each subsequent year. The two logistic centers of 1950 have now grown into a logistic organization comprised of four air depot wings located in Japan, Korea, and the Philippines. A flow of ammunition to the battle area is maintained by more than a half-dozen ammunition supply depots located in Japan, Korea, Guam, and Okinawa. The logistic force has been handicapped by a shortage of trained units, personnel, and facilities. Most particularly was that problem faced at the start of warfare in Korea. The building of a logistic base is at best a time-consuming proposition It must precede the arrival of combat units if the units are to have an immediate combat potential. No time was available in June 1950. The urgent need for sending combat units resulted in an overloading of the facilities then in being to support the small peace-time Air Force in Japan. Many supply difficulties were inevitable. Under the circumstances the materiel forces did a magnificent job.

## Supply

A wide variety of aircraft types is being supported in the Far East. This support requirement, combined with greatly increased aircraft complexity, meant that logistic forces had to supply a greatly increased variety of aircraft and aircraft component parts. The difficulties were aggravated by the effect of operations from advance bases in Korea as compared to home bases. Many unanticipated needs arose as a result of this type of operation. Furthermore we had no previous experience with the effect of combat on jet aircraft supply requirements. The closest coordination had to be established between the logistic force and the using units in order to forecast requirements adequately. We have emphasized provisioning conferences monitored by the logistic force. Periodically representatives of the tactical wings gather around the table with depot personnel and technical representatives to review and re-review experiences.

Technical teams on certain vital equipment were organized to keep constantly abreast of problems associated with the equipment. We have aircraft teams on F-86's, F-84's, F-94's, C-119's, and C-124's, as well as teams on electronics and special purpose vehicles. Since the number of teams has been limited by availability of qualified personnel, priority has been given to our most active combat types and to new equipment where "growing pains" were anticipated.

The wide variety of supply items, a large number of which were critical and in short supply, required the ultimate in supply control procedures. Communications proved a vital aspect of our supply operations. Bi-weekly telecon conferences with Sacramento Control Depot permitted us to keep the depot apprised of the latest problems and provided active follow-up and close coordination of the movement of critical supplies. Teletype facilities and conference hours were also arranged between the theater depot and wing bases.

Off-shore procurement has proved a vital element of the supply problem. Items required in emergency could often be obtained more rapidly in the theater. This provides vital flexibility and self-suffciency, which has expanded as production sources came into being as a result of our buying programs.

The lack of warehousing has continued to be a critical problem, resulting in considerable outside storage. Packaging for outside storage and corrosion control became important to prevent serious losses from deterioration. The lack of storage space has also required the use of scattered smaller locations, which in turn increased the control problem.

This is more evidence of the importance of adequate organization and facilities to receive large volumes of supplies. The Far East Air Logistic Force, then Far East Air Materiel Command (FEAMCOM), was not geared to receive the volume of supplies required to support the Korean effort during the first year or two. Much of our supply became lost on paper, so that although it was in the theater, it could not be distributed to using units. The result was great cost and loss of efficiency, just as happened in the first two years of World War II.

## Maintenance

Maintenance in FEAF, involving on the one hand the very latest jet aircraft and on the other antiquated conventional aircraft, requires a very versatile program. Today's quickly changing technological requirements demand that the combat theater apply scientific advances in equipment and armament as fast as they are developed. This has meant that theater maintenance necessarily assumes engineering and modification responsibilities as never before.

To illustrate the required versatility of theater maintenance, it might be interesting to list some of its varied assignments. Technical assistance is given to not only the actual combat units in Korea but to their new rear echelon maintenance organizations called REMCO's.* A total of 116 civilian technical representatives, working for some 25 aircraft companies and engine, radio, and electronics manufacturers, are constantly available to the various field organizations. These technical representatives have been invaluable. This Headquarters has organized specialized teams for three types of jet fighters in combat operations—the F-86, F-84, and F-94. These specialized teams, operating out of the Office of the Director of Maintenance, not only coordinate all maintenance matters but keep accurate up-to-date information on matters of supply that affect maintenance of these aircraft.

The depot assists in many modifications not only of jet fighter aircraft but also of all other aircraft from B-29's to L-19's. Modifications originating in the ZI, but not actually installed in aircraft, are completed in theater depots, tests are completed, and the aircraft is delivered to the combat units. Modifications range from changing actual gun configuration on fighter aircraft to installing loud speakers on cargo aircraft (so they may fly low behind enemy lines, broadcasting to the populace), to modifying tail wheels on L-19's, and to modifying T-6 aircraft to carry rockets.

The problem of structural repair of high-speed jet structures presents a totally new problem. This has not yet been fully solved. Specialists are being trained and special equipment prepared for movement to the theater.

There has probably been more direct war support in the field of armament than in anything else. New bomb racks were developed to carry more bombs than the aircraft were originally designed to carry. Range limiters arriving in the development stage have been completed and installed, along with considerable electronically controlled equipment used for the first time in this theater. Target-spotting rockets have been developed. Flash hiders to eliminate the telltale flash of caliber .50 machine guns at night were designed and are being depot manufactured.

In addition to a great many special projects too classified to mention, a crash barrier which acts as a "runway stretcher" for short runways and which will stop a jet aircraft that has lost its braking action because of battle damage or mechanical failure, is currently being installed at fighter bases in Korea after successful

*See "REMCO," p. 78 of this issue.

testing in Japan. Radar jeeps have been developed to check gun sights, and "forward control jeeps" outfitted for use by Air Force pilots detailed with infantry at the front lines. Recently jeeps have been modified to include starting units for the latest type jet aircraft. A depot program of straightening pierced steel planking has been underway for many months. Portable-pipeline hydrant refueling systems have actually been installed at bases in Korea.

The re-assembly of replacement fighter aircraft has been a major problem. Because of the transportation shortage, planes arrived by petroleum tanker, freighter, and aircraft carrier. All aircraft transported by ship have had to be partially disassembled and sealed against corrosion. Those arriving by tanker usually suffered serious damage from salt water corrosion. Those arriving by freighter were damaged to a lesser degree. Only the ones which were flown in could be placed into immediate service.

## Communications and Electronics

Communications and electronics have become highly specialized elements in the logistic pattern of air combat support. The modern concept of aerial warfare involves practically every phase of communications and electronics known to man—precision radar bombing, electronic gun sights, and elaborate communication nets and facilities necessary to support tactical operations. Certainly this phase of logistical support must receive priority attention if the highly technical air weapons of today are to function at combat effectiveness.

The Far East Air Logistic Force has the responsibility for the support of all ground communications and radar facilities. A Directorate of Communications and Electronics under the Deputy for Materiel is responsible for the planning, engineering, and installation of communications and electronics facilities within the Far East Air Forces, together with staff surveillance over the maintenance and supply of equipment.

Let us consider two of the most important elements in this division of logistics, tactical control facilities and air defense. Both involve a considerable amount of communications and electronics equipment. The necessity for effective logistic support of tactical control facilities cannot be overemphasized. The tactical commander is primarily concerned with the operational capabilities of his tactical control organizations, so the job of keeping the electronics facilities operational falls upon the logistic organization. When the commander of a tactical control group in Korea determines there is a need for depot technical assistance, a technical assistance team, composed of highly qualified maintenance and supply personnel, is immediately dispatched to the organization to take whatever action is necessary to put the facility back in operation.

In air defense comes the logistical support of the Japan Radar Defense Program. While this cannot be gone into in detail, it is one of the most important programs of the present conflict in the Far East theater. The FEALOGFOR has responsibility for the planning, engineering, and installation of the Aircraft Control and Warning program, designed to provide improved radar coverage for the perimeter of the Japanese Islands, Okinawa, and Guam in one of the largest electronics programs ever attempted in this theater. Not only must new equipment be installed, but the present system must be maintained and remain operational until the new system is completed.

## Theater Procurement

In its efforts to achieve the highest degree of theater self-sufficiency, the Far East Air Logistic Force has made use of native skills and materials. The result has been a more efficient and timely support of United Nations Forces, the supplementing of United States production, and the enlarging of the resources available to the over-all United Nations defense efforts.

In addition to the purchase of Japanese products for many supply requirements of the theater, contractual services have supplemented the Air Force depot maintenance program since the beginning of the war in Korea. Service contracts have included those to meet requirements for the maintenance of motor vehicles, cargo parachutes, and aerial cameras. Maintenance and overhaul contracts have been executed for electric motors, transformers, generators, fire-fighting equipment, office machines, and several types of aircraft.

U.S. Air Force procurement in Japan is mutually beneficial to the two nations. The United States saves time and transportation costs, and benefits by Japan's competitive position in the world with respect to those products which Japan can produce advantageously. Japan benefits by the increase in industrial activity, the sale of its products, and the importation of dollar funds. In the second half of 1952, FEALOGFOR let about six hundred separate contracts in Japan expending $13,000,000 for supplies and services. The present policy for procurement in Japan contemplates a decentralization. Local bases will spend more money in their communities. The benefits are being spread to many small concerns in many parts of Japan. Important Japanese industries, including aircraft companies, are rehabilitating their plants to fulfill Air Force contracts.

## Transportation

Transportation is a dynamic element of theater logistics. Materiel and supplies must be moved from the ZI either to Japan or to the combat zone direct. From depots in Japan units are supplied on the islands and in Korea. All forms of transportation are used—motor, rail, water, and air.

Military Sea Transportation Service provides water lift to Japan and Korea, and from Japanese depots to Korea. Government-owned vessels and commercial carriers are used. Should the demand exceed the available capacity, the theater commander decides what is to be given first priority. Air lift from the ZI to Japan is provided by the Military Air Transport Service. Its own capacity is augmented by the use of contract carriers. Within Japan, from Japan to Korea, and within Korea, the 315th Air Division (Combat Cargo) is the sole air transport agency. It moves personnel as well as cargo, using C-46, C-47, C-54, C-119, and C-124 aircraft. As aircraft capacity is naturally limited, tonnages are allocated to the using services by a Theater Air Transportation Board. The using agencies prepare and submit their requirements. Should the requirements exceed capacity, the Air Transportation Board attempts to reconcile the differences between the using services; failing to do so, the theater commander decides order of priority.

With the wide variety of demands inevitably placed on the logistic force and at widely scattered locations, adequate air transport is most important. Our use of aerial transport has been handicapped because the theater transport normally flies on set schedules and is to a large extent tied up with missions allocated by the Theater Air Transport Board. Experience indicates that air transport integral to the logistic force will materially facilitate the support of tactical forces.

## Mutual Defense Assistance Program

Air logistical support is provided to the Far East MDAP countries, Indo-China, Formosa, Thailand, and the Philippines, while the support of Korea is integrated with the present United Nations Korean effort. The MDAP mission of the Far East Air Logistic Force aligns local logistical operations with Air Force procedures to increase supply and maintenance effectiveness.

It is evident that there are many ramifications to such a program. For example, the language barrier of French, Chinese, and Siamese provides many problems when it is necessary to train nationals to take action in programming and stock transaction accounting, or to teach the USAF logistic system. Political aspects enter into the program in that materiel commitments must be provided in reasonable time at the right place. Diplomacy is required to sell a foreign national a new system, a new procedure, or a military reorganization plan to fit USAF logistical methods.

In providing Air Force logistical support to Title III countries, approximately $2,250,000 worth of equipment has been procured from Japanese industry through "off-shore" procurement. This materiel, as with shipments out of Far East Air Force stocks, must travel many more miles before it reaches its point of use. The operations in Indo-China provide a good example of transportation difficulties. Overland travel within this country is non-existent, and supplies unloaded at Saigon must move by air or water to the operations around Haiphong. We must consider the normal operations within each foreign country, translate it into workable Air Force logistics, and integrate the result with our own computations such as pipe-line and procurement lead-times, and capability to supply. From this figure, we must subtract or eliminate materiel that is not approved for program use, or that can be procured or repaired within the foreign country. The ultimate objective is that the MDAP countries be made individually and collectively self-sufficient.

The aircraft supported by the Far East Mutual Defense Assistance Program are all World War II aircraft such as the F-51, F-47, B-26, B-24, T-6, C-46, and the C-47 types. Also logistical support is provided for land-based Navy F6F and F8F in Indo-China and Thailand. The rapid advance of the Air Force into new types of aircraft and the phasing out of the World War II models presents an additional logistical obstacle. Much of this support is provided by screening limited theater stocks left from World War II.

The Far East MDA Program is effectively and rapidly solving many of its problems. Translations of AFM 67-1 (USAF Supply Manual) in French are available in Indo-China, and translations in Chinese are to be found in Formosa. Supply advisory teams go from one country to another for sixty to ninety days to concentrate on specific projects pertaining to stock control, inspection, inventory, property identification, warehousing, receiving, and shipping. Accurate stock balance, consumption reporting, and requirement computation are objectives of supply assistance.

The Far East MDAP logistical operation is invaluable for the practical experience it gives to USAF personnel in the establishment and maintenance of a multi-national logistics system. Further the operation provides the skeleton of a logistical structure capable of rapid expansion should the need arise. To work with our allies and to support the equipment we provide will require close consideration in world-wide logistical planning.

## Personnel

Air logistic manning documents for this theater provide for a greater percentage of the top two skill levels of airmen than is normally found in other types of Air Force commands. This is caused by the need for supervisory personnel to control the work of the thousands of Japanese technicians employed by the command. While the authorizations exist, actual assigned strength in the higher skill levels normally approximate only seventy per cent because of world-wide shortages in the higher skills. To obtain maximum efficiency from the Japanese labor force, the most desirable manning is to have assigned strength of the top two skill levels always at 100 per cent.

A combat air logistic force in an overseas theater is confronted with similar problems with respect to its officer complement. The mission of the combat logistic force parallels that of the Air Materiel Command in the ZI, but in ZI depots Department of the Air Force civilian personnel perform most staff and supervisory functions. These civilian, highly-skilled specialists are very limited in number in overseas depots. So we must divert to these jobs substantial numbers of officer personnel trained in the technical specialties. This additional requirement makes it highly desirable that officers assigned to depots in the Zone of Interior be assigned to the combat logistic force upon their transfer overseas.

Civilian personnel employed by the Far East Air Logistic Force include some recruited from the continental United States and Hawaii. But the vast majority of the civilian work force consists of foreign nationals—more than 14,000 in Japan alone. The small group of United States personnel is used primarily in supervisory and technical positions, to train and guide the large complement of foreign nationals. In aircraft maintenance, for instance, American civilian employees are used primarily in engineering and inspection activities.

Since the average monthly cost to the United States government for each Japanese employee is $68.00, it is to our advantage to use as many Japanese as practicable. The importance of the Japanese work force in the combat logistics mission should never be underestimated. The Japanese are industrious and readily trainable as artisans in a wide range of trades and skills.

To develop the potential of this work force, comprehensive training programs encompass management, clerical fields, safety, written and spoken English, depot supply procedures, electronics, and aircraft and motor vehicle depot maintenance. This training has amounted to one-half million training hours from July 1950 to September 1952. Japanese employees are now an integral part of all branches of the Far East Air Logistic Force. This skilled, stable work force has been of inestimable value.

For Air Force military personnel, great organizational flexibility is necessary. Table of Organization depot units are useful as a package to budget and program on a long-range basis, and to move personnel and equipment overseas. But once overseas, they must be adapted to available facilities and wide variations in work requirements. The logistic force must have the flexibility of putting these units on a Table of Distribution basis. It must further be able to change those tables, within resources available, to meet changing conditions. As an example, ammunition depot squadrons must have enough "self-sufficiency" to permit effective operation when separated from mother depot wings.

Here in the Far East, the Air Logistic Force has central control of all depot activities, except in matters of administrative policies of area commanders. These area commanders also normally handle diplomatic matters. For example, the Commander, Thirteenth Air Force, deals with the Philippine government.

The last word will never be written on so fluid a subject area as logistics. Just as the subject viewed today presents contrast to logistics of World War II, so will the future bring its changes. With ever-changing horizons of flight, one cannot predict with certainty the pattern of combat air logistics of the future. It is entirely possible that flight of the future may be so vastly different in speed and range that the logistic base may be concentrated entirely on the homeland.

But in the immediate years ahead the logistic experiences wrung from the introduction to jet-age warfare in Korea should serve as guide posts in the field of practical logistics and enable us to avoid many of the logistic shortcomings of the past.

*Far East Air Logistics Force*

# Diet and High-Altitude Flying in Korea

CAPTAIN FREDERICH J. HINMAN AND
CAPTAIN MARY C. HORAK

WHEN Napoleon declared that an army travels on its stomach, he was of course thinking in terms of the ground armies of his day. There is perhaps no better indication of the validity of his statement than the modern jet pilot's need for a carefully analyzed, thorough, low residue, non-gas forming diet meticulously prepared by expert dieticians.

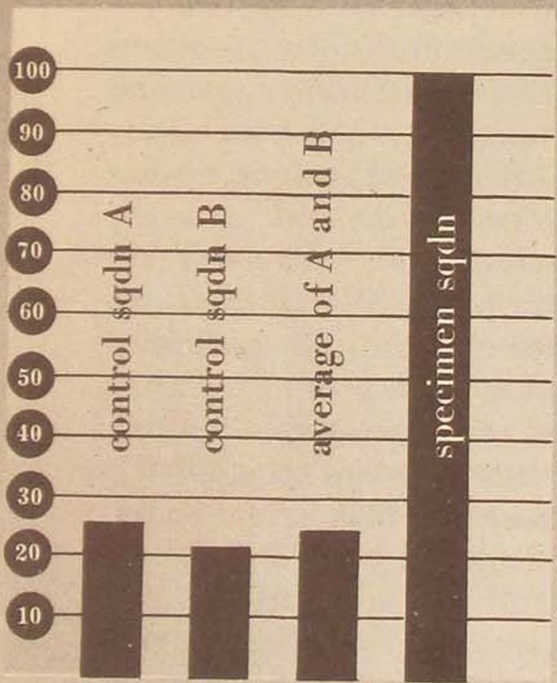
When jet aircraft took to the Korean skies, the flight surgeons in the theater were soon confronted with new and rather startling complaints with which they were not unfamiliar, but which they had not completely anticipated. Korea, in spite of its long history and ancient culture, is a rugged and primitive land in many respects. Combat installations throughout this old land are uniformly rough. The fighting forces in practically all instances were forced to maintain themselves under spartan field conditions. Mess sergeants struggled under tremendous obstacles to feed this growing army and air force. Fresh fruits and vegetables were difficult, if not impossible, to obtain. All water supplies were unsafe. Yet these obstacles were met and conquered. The fighting men ate and ate well. The diet was sturdy, filling, well-cooked, and uniformly good, even though there could be little variety.

In the aerial war the problem was especially tricky and intense. As the air above Korea began to resound to the crescendo of jet engines, flight surgeons received an increasing number of complaints from fighter pilots reporting abdominal cramps of varying severity during flight. The problem increased, and the flight surgeons with the fighter units began to take action.

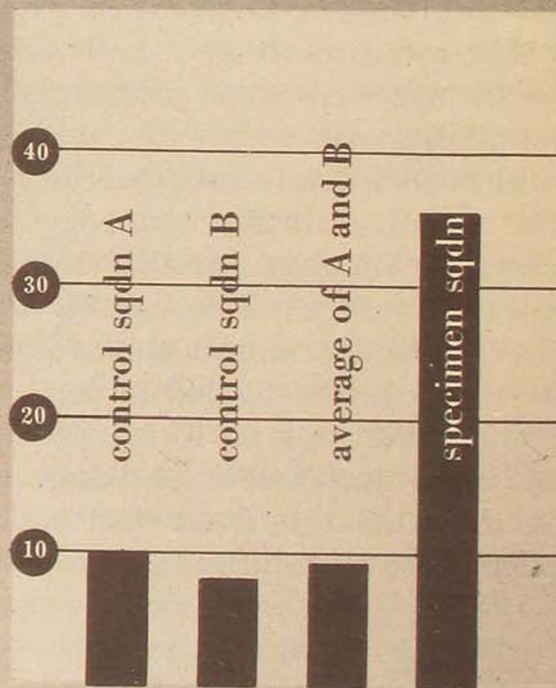
One of the aeromedical problems of high-altitude flight is caused by the difference between the outside air pressure and the pressure of gases within body cavities. As the atmospheric pressure diminishes with altitude, any gas within the body will expand. Using approximate figures for illustration, one liter of gas at sea level becomes four liters at 35,000 feet and 10 liters at 50,000.

In the past serious difficulty has largely been confined to the air spaces in the skull—the middle ear and the sinus cavities. The anatomic structure of the opening into these organs is such that the decrease in air pressure at increased altitude is quickly equalized by the free escape of air. But the reverse is not true. Descent increases air pressure and thus creates a relative vacuum within these organs. The only other gas-containing system of the body that has no free and open communication with the surrounding atmosphere is the gastro-intestinal tract. The stomach and large bowel normally contain a small amount of gas. The stomach's

## Does Special Diet Improve Pilot Combat Efficiency at High Altitudes?




*Percentage of claims against enemy aircraft (using specimen group as 100 )*




*Percentage of claims against encounters with enemy aircraft*

**The graphs above depict the relative percentages of combat effectiveness for a specimen fighter interceptor squadron in Korea which was fed a special diet to relieve abdominal pains occurring in high-altitude flight, as against the percentages for the other two squadrons in the same group and for an average performance derived from other air bases. The specimen squadron showed 4.2 times the number of claims against enemy aircraft (left graph above) and 2.3 times the number of claims for its encounters (right graph). The test was made because a number of fighter interceptor pilots flying at 35,000 to 45,000 feet had complained of a high incidence of abdominal pains which at times became so severe as to threaten abandonment of the mission. Flight surgeons felt the field ration diet, with its high proportion of gas-producing foods, was largely responsible for the trouble. While the study must be pursued for some time to come before these results can be considered definitive, the evidence now indicates that high-altitude aircrews in a combat theater benefit personally and are more proficient if given special dietary consideration. This article by Captain Hinman and Captain Horak is an interim report on the Korean high-altitude diet study and its results.**

large size, high distensibility, and ready egress of gas through belching means that it merely becomes painfully distended at high altitude. The small intestine never contains gas in a healthy person, so it is of no concern in this problem. The large bowel contains a gaseous mixture largely resulting from normal fermentations. This gas is normally absorbed or emitted. The amount of gas in the bowel is largely determined by the nature of the food mass entering, by the general health and normalcy of the system, and by normal elimination. Excessive carbohydrates, fats, and high residue foods tend to increase fermentation with its resultant gas production.

At high altitude this intestinal gas, not being restrained by a rigid structure and having no free escape, expands within the colon. Expansion is in direct relation to the decreasing air pressure as the pilot ascends. The expanding gas distends the bowel wall, producing distress, discomfort, and finally pain. The first sensation is one of abdominal fullness with difficulty in breathing because of pressure on the diaphragm. Further expansion may cause sharp and cramping pain, sometimes so severe that the pilot may have to discontinue his mission or descend to a less favorable operational altitude. It is conceivable that this type of pain could be of sufficient intensity to induce shock in which the pilot would be incapable of controlling his aircraft.

Before aircraft began to fly at altitudes of 30,000 feet and above, the problem of abdominal discomfort due to gas expansion was minor. During World War II, crews were flying in the 30,000 foot range, and often experienced the symptoms of meteorism (flatulent distention of the abdomen). At the present time our strategic bomber crews and fighter interceptor pilots are flying in excess of 45,000 feet with cabin altitudes as high as 35,000 feet, and they share the constant risk of sudden loss of pressure. Flight surgeons in the combat theater are reporting a very high incidence of discomfort and pain among the fighter pilots under their care. They feel that it constitutes a definite hazard to the comfort and safety of the pilots, as well as a potential, if not actual, threat to the successful completion of the mission.

One approach to relieving the problem is to increase the cabin pressure to a level consistent with comfort and adequate oxygenation. But there are definite limitations to pressurization—structural demands of the aircraft, compressor efficiency, and the danger of decompression by leaks or enemy action. It is probable that we have attained the optimum from this approach for present aircraft. The other controllable aspect of the problem is to be found in dietary control. As previously mentioned, the production of gas in the large bowel is in relation to the types of foods consumed, and it has been shown in the past that the careful selection and arrangement of the flier's diet can greatly reduce the incidence of abdominal pain and cramping.

To test the feasibility and validity of special dietary control in a combat zone, a study was made of a fighter-interceptor wing flying F-86E's and F-86F's in active daily combat at altitudes in excess of 40,000 feet. One of the three squadrons of fighters was selected to receive a special diet, while the remaining two squadrons continued to eat the standard field ration and became the control for the study. Each squadron consists of approximately 50 pilots.

A separate kitchen was established for the careful preparation of diets in collaboration with a dietician. The diet relied on its high protein content and eliminated excessive carbohydrates and fats, high residue foods, and excessively spicy dishes. Milk, fresh frozen vegetables, and salads were added. Stewed or fresh fruit was served twice daily. When broiled or fried meats were desired to increase variety and palatability, they were served in the evening so the pilots would not be called upon to fly after a fried meal. Meals were made tasty and attractive as possible, and the serving hours for all three squadrons were arranged so that the pilots need never miss a meal because of a scheduled mission or alert during the usual serving hours. Although the specimen group passed through a separate serving line, they continued to eat in the same mess hall as the other officers. No special restrictions were placed on alcohol consumption or on eating food obtained at the PX or from home. As these two sources of extraneous food were generally taken in the evening, they would play a negligible role in digestive upset if eaten in normal quantities.

Ten different daily menus were prepared and used in rotation. On Fridays a choice of fish or meat was offered. The menus were strictly adhered to, with very rare substitutions being made for temporarily unobtainable items.

The other two squadrons ate the regular field ration with supplemental fresh salad vegetables and fresh fruit as available. This ration, though entirely adequate for good nutrition and generally very palatable, contains a high proportion of carbohydrate. Meats are generally fried and somewhat greasy. Heavy fat and flour gravy is standard fare, and cabbage, sauerkraut, beans, and other gas-producing foods are served regularly. Milk, other than powdered milk for cereal and canned milk for coffee, is not served in the regular ration. All vegetables are canned, and green beans or tomatoes appear most frequently, rarely peas or corn. Not infrequently a pilot skips a meal because nothing being served appeals to him. This happens very seldom in the specimen group, because the variety of food invariably provided something that

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**High-Altitude Diet—Sample Menus**

| *Breakfast* | *Dinner* | *Supper* |
|---|---|---|
| Pineapple juice | Roast lamb w/brown gravy | Bouillon w/celery |
| Fresh fruit: orange | Mint jelly | Broiled pork chops |
| Dry cereal | Parsley potatoes | Scalloped potatoes |
| Crisp bacon | Green beans (fresh frozen) | Buttered cabbage |
| Soft boiled eggs | Tomato and lettuce salad w/thousand island dressing | Individual Waldorf salad on lettuce |
| Toast and oleo | Bread and oleo | Hot rolls and oleo |
| Apricot jam | Fruit cocktail | White cake w/maple icing |
| Coffee | Sugar cookies | Coffee |
| Cocoa | Iced tea | Tea |
| Milk | Milk | |

| *Breakfast* | *Dinner* | *Supper* |
|---|---|---|
| Tomato juice | Broiled steak | Hamburger patties |
| Grapefruit | Potato puff | Lyonnaise potatoes |
| Dry cereal | Carrots and peas (fresh frozen) | Spinach (fresh frozen) |
| Poached eggs | Pear cottage cheese salad on lettuce w/mayonnaise | Sliced tomato, cucumber, onion, and lettuce salad |
| Crisp bacon | Bread and oleo | Hot rolls and oleo |
| Plain or cinnamon toast and oleo | Fruit jello w/custard sauce | Chocolate pudding w/marshmallow sauce |
| Marmalade | Coffee | Coffee |
| Coffee | Milk | Tea |
| Cocoa | Tea punch | |

| *Breakfast* | *Dinner* | *Supper* |
|---|---|---|
| Orange juice | Roast beef w/natural pan gravy | Southern fried chicken |
| Applesauce | Mashed potatoes | Giblet gravy |
| Dry cereal | Parsley carrots | Baked sweet potatoes |
| Grilled bacon | Individual fruit salad w/cottage cheese on lettuce w/mayonnaise | Mixed vegetables (fresh frozen) |
| Soft boiled eggs | Bread and oleo | Jellied cranberry salad lettuce w/mayonnaise |
| Toast and oleo | Ice cream w/pineapple sauce | Hot rolls and oleo |
| Grape jelly | Coffee | Chocolate layer cake |
| Cinnamon rolls | Milk | Coffee |
| Coffee | Lemonade | Tea |
| Milk | | |
| Cocoa | | |

would appeal to the officer. Even if he omitted one course, he would eat a good meal. Complaints about the field ration mess are frequent and at times vociferous, whereas complaints literally did not occur in the study group. The control group did not complain at their exclusion from the special diet, but cooperated wholeheartedly with the study.

Data on changes in weight (Table 1) and incidence of abdominal symptoms (Table 2) were obtained through monthly questionnaires filled out by all pilots in both groups. A formal "opinion survey" was not necessary. Close association with the pilots made it very obvious that the regular ration was considered frequently unpalatable and productive of abdominal symptoms while no complaints were uncovered in interviews with the specimen group. Objective data concerning operational factors were extracted for us by the fighter group operations section. Comparative performance was based on several operational factors:

(1) Claims against enemy aircraft (kills, probable kills, damaged)
(2) Losses:
  (a) To enemy aircraft
  (b) Combat unknown cause
  (c) Combat operations
(3) Enemy encounters
(4) Percentage of claims against encounters
(5) Accidents
(6) Abort

Security restrictions prevent the release of this data, but two interesting features can be noted. Claims against enemy aircraft by the specimen group were 4.2 times the average for the control group, and the percentage of claims against encounters 2.3 times as great. Losses for any cause, accidents, and aborts for all three squadrons were closely similar. There were no significant differences in disciplinary actions taken, sick-call, venereal disease rates, or officers on duty not involving flying. No psychiatric cases were reported in any of the squadrons during the period. The great difference in operational performance cannot be wholly attributed to the dietary project but can be considered significant in view of the great similarity of the three squadrons in all other respects and in view of the lack of other known factors.

Morale is high in all three squadrons but is felt to have increased in the specimen group since the institution of the high altitude diet. Whether this is due to the diet or to unknown factors of morale cannot readily be determined. The wing commander, fighter group commander, and flight surgeon, considering all

**Table I: Percentage of weight changes in three squadrons**

| | *Per cent of pilots who gained weight* | *Per cent of pilots who lost weight* | *Per cent of pilots showing weight stability* |
|---|---|---|---|
| Control Squadron A | 13 | 43 | 44 |
| Control Squadron B | 30 | 30 | 40 |
| Average of A and B | 21.5 | 36.5 | 42 |
| Specimen Squadron | 36 | 28 | 36 |

In only two cases was there a weight change in excess of 6 lbs. All underweight pilots in the study squadron were able to gain, overweight pilots able to lose. This pattern was not evident in the control squadrons.

**Table II: Percentage of pilots reporting abdominal pain at high altitudes**

| | *Per cent mild to moderate pains* | *Per cent severe pains* | *Per cent with no pains* |
|---|---|---|---|
| Control Squadron A | 60 | 4 | 36 |
| Control Squadron B | 80 | 10 | 10 |
| Average of A and B | 70 | 7 | 28 |
| Specimen Squadron | 32 | 0 | 68 |

In no case was it necessary for a pilot to abort his mission due to abdominal pain, but change to a lower altitude was necessary in two cases of severe pain. The lower incidence of mild-to-moderate pain and the non-occurrence of severe pain in the study squadron is considered significant.

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aspects of the morale situation, strongly feel that the improvement is definitely due to diet. It must be pointed out, however, that the morale of any group singled out for special treatment of any kind generally tends to improve. Although all three squadrons are closely parallel in organization, location, size, and assigned mission, and all three have competent commanders, there are intangible factors that may have a large influence on morale and hence on performance.

More experience will be needed before a more definite conclusion can be drawn on the effect of this special diet on operational effectiveness of pilots. But the experiment does strongly suggest that abdominal pain experienced in high-altitude flying can be substantially reduced by proper diet.

*Headquarters, Far East Air Forces*

# The Heritage of Douhet

DR. BERNARD BRODIE

THERE is perennial value in recalling both the vision and the limitations of vision in the few incisive minds which have grappled with problems of military strategy. For in our own more limited ways we are all trying to see the future, particularly with respect to war and peace, and we can often absorb lessons from the predictive successes and failures of our predecessors which have little directly to do with the specific ideas they advocated.

General Giulio Douhet certainly possessed the largest and most original mind which has thus far addressed itself to a consideration of air power. Yet he fathered only a few basic ideas, almost all of them evident in his first significant publication.[1] He was much too busy pressing home those ideas upon a generally hostile audience—and paying penalties of varying severity, including a prison sentence, for his heresies—to have the time or stimulus within his comparatively short lifetime to develop and refine his thoughts, and very likely he lacked the temperament. His demonstrable errors are therefore considerable, and sometimes very crude. But his insights are more impressive than his failures. And since time has rescued him from his first and gravest error—his gross overestimate of physical effects per ton of bomb dropped—by introducing the atomic bomb, Douhet's thoughts are actually more valid today than they were during his lifetime.

And if that were not sufficient reason for studying Douhet, there is also the point that he has had enormous and enduring influence on air forces generally but especially on that of the United States. Douhet's convictions, as the late General H. H. Arnold admitted, provided the ideology of the United States Army Air Corps prior to World War II,[2] and since that war his ideas have been not so much modified as absorbed in a larger development.

His influence on the United States Air Force has indeed been far greater than that of its own prophet, Brigadier General William Mitchell. The latter's thinking was tactical rather than strategic, and events have so fully confirmed and vindicated him that his writing is today completely dated in a way that Douhet's is not.

To Douhet the changes which he saw taking place around him in the methods of waging war changed the basic character of war.

For that reason he was totally uninterested in military history prior to World War I. And with respect to the military use of aircraft, Douhet was of the simple opinion that World War I provided no guidance whatsoever for the future. Unfortunately he reached a quite different conclusion about the land campaigns of that war, a conclusion which was proved by the events of World War II to be the second cardinal error in his philosophy. To Douhet the first World War demonstrated that on land the defensive had gained a marked *and permanent* ascendancy, and he concluded that since this result had inevitably followed from the great increase in fire power in the hands of the infantry, the future, which must continue to improve that fire power, must confirm and expand that ascendancy. One of the things which he overlooked was the efficacy of aircraft when used *tactically,* a natural result of his preoccupation from first to last with what we now call strategic bombing.

Douhet's heavy insistence upon the inevitably static nature of the front in any future war has helped perpetuate the legend that his primary if not exclusive interest in advocating his ideas was the defense of Italy, which has all its land frontiers in the Alps. It is true that in one place he protests that his "first thought" is with the situation of Italy and that his theories "therefore should not be considered applicable to all countries." And he adds: "In all probability, if I were specifically considering a conflict between Japan and the United States, I would not arrive at the same conclusions."

The exception he makes is in itself most telling. With the limited ranges of aircraft in his day (and for that matter in World War II as well), he would have had to be a fool as well as a fanatic to want to apply his ideas without great modification to a war between the United States and Japan. When he wrote his imaginative account of a future war which would test his ideas, *The War of 19–*, the two countries which he postulates to be at war are France and Germany, with Italy playing no part at all. Douhet's mind and ideas were much too big to suffer the confines of a single country's military problems, particularly of a minor power like Italy.

Douhet's position in the history of strategic theory is relatively an extreme one. But unlike most extremists, including many of his own followers, Douhet both preached and practiced the strict discipline of logical reasoning. If there are basic errors in the Douhet thesis—and World War II, which was the "war of the future" of his constant reference, certainly revealed such errors—

they are to be discovered not in the deductions he drew from his premises but in the premises themselves: his extreme over-estimate of physical effects per ton of bombs dropped and his utter confidence in the great and permanent ascendancy of the defensive in ground warfare. Curiously, on these premises he was rarely challenged.

IN its broad outline, Douhet's philosophy is well known. His argument that in the age of airplanes an adequate national defense requires an air force capable of winning "command of the air" was novel and controversial at the time he promulgated it but is hardly so any more. The proposition which is distinctively Douhet's is, however, one on which controversy remains very much alive. He went on to argue that because of the very nature of air power, a force capable of winning "command of the air" is thereby capable of ensuring victory all down the line. In other words, command of the air is both necessary *and sufficient* for an adequate national defense.

To Douhet it is not that other things like ground and naval superiority do not matter, it is rather that these other things automatically follow from command of the air. The nation which has lost that command swiftly loses the means of regaining it—through the destruction by bombing of her aircraft industries—and immediately thereafter or even concurrently loses the means of mobilizing and maintaining her armies and navies, if indeed she does not previously lose the will to fight of her populace. The ascendancy of the defensive in ground warfare guarantees that there will be no decision prior to that which is won by the air arm, which for that matter comes with incredible swiftness. Thus the maxim of Douhet which he would have govern the allocation of military resources: resist on the ground (and on the sea) in order to mass for the offensive in the air.

Douhet does not deny the utility of armies and navies. But their essential defensive functions do not require superiority over the enemy and can be carried out with relatively modest forces. Any surplus in militarily useful resources should therefore be added onto the air force, which is already required for the performance of *its* minimum essential function (which is also the minimum essential function of the entire defense establishment) to be *superior* to the enemy air force, and which can use effectively for *exploiting* command any extra margin of strength it enjoys.

Douhet puts himself to considerable pains to explain what he means by "command of the air." He borrows heavily from the older concept of command of the sea, which is basic to naval strategy, and he several times defines the character and functions of air command in terms which could be used, by changing only a few words, as an orthodox definition of command of the sea. But of course Douhet was troubled by certain obvious differences between the vehicles of sea and air power which tended to militate against the transferability of the concept of command. Sea command is won by the ability of a superior fleet *to intercept* and destroy the inferior fleet whenever the latter sorties against a useful target within the area in dispute. But no one protested more vigorously than Douhet himself the very low probability for successful interception in the air. The swiftness and tri-dimensional movement of aircraft combined with their relatively low endurance puts them in marked contrast with naval vessels, and Douhet emphasizes repeatedly that a determined bomber attack will get through to its target, even in the face of a much larger defending air force.

Douhet nowhere faces up to this difference, but he nevertheless resolves it by stressing another characteristic distinctive to aircraft. A superior fleet can attack the inferior one only when the latter takes to the sea to effect some militarily useful purpose; it is incapable of attacking with its artillery, save at undue risk, those heavily defended naval bases which even an inferior naval force normally enjoys and to which it may retire at will. An air force, on the other hand, can fly over any ground defenses (and through any reasonable air defense) and destroy whatever forces, actual or potential, might be lurking behind them. Thus an air force which seizes and holds the initiative does not have to patrol the skies waiting for the enemy to offer himself for battle; it can seek him out on his bases, where he is most vulnerable, and destroy him forthwith. And (though Douhet does not make this point explicitly) since the superior air force can accomplish destruction more rapidly than an inferior one even if the latter adopts the same strategy, its superiority must grow by some geometrical progression, leading swiftly into that position of complete ascendancy which may be justly termed "command of the air." In fact, the inferior force has no alternative but to follow the same strategy, its only hope for ultimate success lying in its being more aggressive than its opponent and, incidently, in striking first.

Douhet's reasoning obviously requires him to place an enormous premium upon hitting first with all one's might, and he does not shrink from the implications of this requirement: "Whatever its aims, the side which decides to go to war will unleash all its aerial forces in mass against the enemy nation the instant the decision is taken, without waiting to declare war formally . . ."

Douhet makes clear that by "command" he does not mean such totality of control that "even the enemy flies are prevented from flying." But it is essential to the idea of command that the enemy be put into a position where it finds it impossible "to execute aerial actions of any significance." And to Douhet common sense demonstrates that such a degree of mastery is within the capability of any air force which enjoys a superiority in bombers over its opponent and, more important, possesses a properly aggressive spirit.

Clearly such a view implies a poor regard for the effectiveness of defenses against aerial attack, and Douhet leaves his readers in no doubt on the matter. For antiaircraft artillery defenses he expresses only a contempt mixed with anger at the prodigal waste which this form of defense entailed in World War I. Nor does he have much greater esteem for the work of fighter aircraft used defensively. The limited range and therefore poor air-keeping capability of fighters effectively prevents their massing to patrol the avenue of threatened attack. The inherent requirement for dispersal of combat units is less extreme and less conspicuous with defensive fighters than with antiaircraft guns, but no less real. And after all, attacking bombers (and their attending fighters, if any) can shoot back if shot at by defending fighters, besides which the latter have to achieve interception. Living in an age which knew nothing of radar, Douhet did not assign high probabilities of success to the effort to intercept.

The only way to destroy an enemy air force is to strike it on the ground at its own bases. This is Douhet's constant refrain. And the only force which can accomplish such destruction is a bomber force. Therefore, in the use of air power attack is not simply the best defense; it is the *only* defense. In Douhet's view the attitude of the superior bomber force to the air battle is one almost of indifference; it will neither seek combat nor let itself be deflected from its target in order to evade it. If enemy fighters intercept a bomber mission, some bombers will be lost, perhaps many; but the interceptors will suffer proportionate damage and (for reasons which Douhet does not make clear) even greater disorganization. And in addition those interceptors which miss or survive battle will suffer heavy losses at their bases between sorties. The scale and effectiveness of the air defense activities are therefore fated, following the first exchange of blows, to go into a rapid and drastic decline.

The proper function of fighter planes, in so far as they are used at all, is not to defend one's territories against enemy bombers but to support one's own bombers in the attack on enemy targets. "Viewed in its true light, aerial warfare admits of no defense, only offense. *We must therefore resign ourselves to the offensives the enemy inflicts upon us, while striving to put all our resources to work to inflict even heavier ones upon him.* This is the basic principle which must govern the development of aerial warfare."

Douhet's total commitment to the aerial offensive does not stem from that mystique of the offensive which has marred the thinking of so many other military officers. We must remember that he considered the only proper attitude for an army (at least at the outset of a war) to be a defensive one, for the simple reason that he considered an army to be much stronger on the defensive than on the offensive. Exactly the same quality and detachment of reasoning persuaded him that an air force was pitifully weak on the defensive and incomparably powerful on the offensive. Some of his most eloquent pages are devoted to an indignant castigation of the Allied generals in World War I, especially the French, for their insisting on the outbreak of war on "plunging in like a bull after a red cloth waved by the enemy" and continuing to plunge thereafter, and for no other reason than that they were "dazzled by the myth of the offensive."

It is clear that Douhet's system for the winning and exploitation of command of the air—from which all other victories flow—requires one more major component: a very high estimate of the physical, moral, and hence strategic effects produced by each ton of bombs dropped. A bomber force can afford Douhet's sublime disdain for interception and hence attrition only if the bombs getting through are effecting large and immediate results—on the enemy's air power among other things. So long as we refrain from giving Douhet credit for anticipating nuclear weapons, and certainly he deserves no such credit, we can handle his startling estimates of bombing effects with less than awe.

Douhet adduces as his basic "unit of bombardment" a force of ten planes carrying two tons of bombs each. These 20 tons, dropped in a uniform pattern, ought, he concludes—how or why is never made apparent—to be able to destroy any targets over a surface which "should be exactly the area of a circle 500 meters in diameter." With a penchant for standardization which is supposed to be more representative of Americans than Italians, Douhet suggests that this area of 500 m. (1540 ft.) diameter be considered a

*(continued on page 121)*

# In My Opinion . . .

## PROCUREMENT OF OFFICER PERSONNEL

LIEUTENANT COLONEL LEROY F. PROUTY

THE demands of the Korean conflict and the concurrent over-all expansion to 143 groups have made it necessary for the Air Force to procure thousands of additional officers during the past few years. This emergency expansion of officer procurement with its inevitable bottlenecks and shortcomings has to a certain extent obscured a long-range problem of much greater importance. That is, what plan will best provide the Air Force with a sound program of officer procurement to meet both the considerable needs of the Regular Air Force and the very significant needs of the Air Force Reserve Forces in the future? For not only must the Regular Air Force be replenished annually but a much larger reserve force must be revitalized and rejuvenated. This article will review the present program and recommend a program for the future.

The first expedient of the present emergency period was to call upon the vast pool of reserve officers who were for the most part veterans of World War II. The Air Force did the same thing with personnel that it was forced to do with air bases, equipment, and aircraft. It relied heavily upon World War II resources. And just as we found the aircraft to be obsolete and the air bases to be run down, too small, and beyond economical repair, we found that although the veteran of World War II met most of the requirements for another tour of active duty. there was no way to bridge the intervening years. A large gap existed in the ages of the World War II veteran and the new lieutenant. Countless thousands of good World War II officers no longer had the youth, the up-to-date training, or the desire to fill the gaps created by the expansion of the Air Force. This can be seen in the category of reserve fighter pilots. Of the tens of thousands of fighter pilots on the reserve lists, many thousands volunteered to return to duty. But there was a difference between the P-38 and P-47 pilot of 1942-44 and the F-86 and F-94 pilot of 1952. As far as flying technique was concerned, a pilot current in the P-38 or P-47 was qualified for check-out in a jet fighter. The main problem was one of mental attitude. The 1942-44 pilot simply did not want to start over again in 1950-52. It was immediately evident that only a few of these officers could fill the required positions in spite of the high-priority need for them. This was almost as true of other officer categories, rated or non-rated. Reserve lists had to be carefully processed to get men who would be most useful to the service. Partly because of these difficulties, the Air Force turned to other sources for the procurement of the young men it needed.

The Officer Candidate School is one very reliable source. It has always been an important and worthwhile procurement activity. But the number of men it provides is much too small to play a significant part in the over-all procurement plan. Since the Air Force has no academy of its own, such as the U.S. Military Academy and the U.S. Naval Academy, it has looked forward eagerly to its small annual share of graduates from these professional schools. Here again the number of officers realized is even less than the proverbial drop in the bucket. To bolster these meager numbers the Air Force made some selected direct commissions for men highly qualified in certain (predominantly scientific) fields. Another and a more lucrative source has been the flight training programs. The air crew training programs have usually provided many new officers. But now one must look back to the years 1946 through 1951 to appreciate what has been hap-

**The recent Air Force-wide emphasis on the importance of the Air Force Reserve Officers Training Corps program and the sweeping revisions which the program is currently undergoing make Col. Prouty's remarks on officer procurement especially timely. As Assistant Professor of Air Science and Tactics, Yale University, 1947-49, later in the AFROTC Directorate, Hq Continental Air Command, 1948-50, and then as Director, Personnel Planning, Hq Air Defense Command, 1951, Col. Prouty has had a variety of viewpoints from which to observe the AF officer procurement problems. His article, analyzing the problem from the Air Force point of view, can be profitably compared to an article in the March 1953 *Atlantic*, "Your Boy and the ROTC," by Harold W. Dodds, the distinguished president of Princeton University, who considers the value and effectiveness of ROTC from the civilian educator's approach. Like Colonel Prouty, Dr. Dodds examines the various sources of officer training and finds ROTC necessary and fundamentally sound. He, too, condemns certain phases of ROTC curriculum as unbalanced and not on a college level. Whereas Col. Prouty would reform the curriculum by having the AFROTC drop courses which duplicate regular college courses and instead concentrate on teaching more of what the Air Force and air power is all about, Dr. Dodds proposes a closer integration of the civilian and military curricula and faculties, with the college preparing special courses in such subjects as military history and the economics of warfare and furnishing instructors to teach them. Certainly there is no better time to air these and similar ideas for bettering the quality of Air Force officers.**

pening. With more than 100,000 flight crew officers on reserve rolls, the need for new rated officers following World War II appeared to be almost non-existent. Training programs were cut back to the barest minimum. As a result only a small number of new pilots and other crew members were graduated and commissioned. A program of this nature is extremely complex and must keep abreast of the times. Although this program was scheduled for build-up immediately following the outbreak of hostilities in Korea, as of 1952 it still was not going at full speed. Therefore this program too has failed in recent years to provide a significant number of new officers.

There remains one more program for the procurement of new officers for the Air Force. This is the Air Force Reserve Officers Training Corps (AFROTC). In number of officers produced, this program leads all the others combined. It has been the major source for the procurement of officers for the post-World War II Air Force. Without stirring up the old issue over whether a good officer need be a college man or not, it can be safely said that the national pool of college men is perhaps the most fertile source of officer material available. Today the Air Force ROTC program is active in 209 colleges and universities throughout the country and in the fall of 1952 it had a total enrollment of 140,000 students. Since this program is the primary source of future Air Force officers, it warrants much more consideration and study by those outside of its own administration than it has been getting. The success of this program is very definitely a necessary prerequisite to a strong Air Force.

THE Reserve Officers Training Corps is an old and revered Army program, dating back to the middle of the 19th century. During the 1920's the Air Service had its own small ROTC program. This insignificant effort was allowed to atrophy by 1930. After World War II, when it appeared that at long last the Air Force might become a separate service, it became evident that there must be some source for the procurement of large numbers of Air Force officers. In 1946 the Air Training Command was requested to look into the possibilities of an Air Force ROTC program. In one big rush colleges were notified that a plan was under way, and some 66 colleges were selected to start some sort of a program. Three groups of officers who had volunteered to be instructors were rushed through a brief course at Perrin Field in 1946. While these officers were en route to their new assignments, the responsibility for AFROTC was transferred from the Train ing Command to the Continental Air Command, because it seemed to have to do with reserve matters. And thus began a series of events unique in Air Force annals and, it might be added, in college experience.

Since it was starting the AFROTC from scratch, the Air Force had a splendid opportunity to set up in the colleges a very superior officer procurement program. For a complex series of reasons, too numerous and too involved to go into here, this big step was not achieved. Old as it is, ROTC has *never* been a reserve officers training program, because a reserve officer is not eligible to join it. It trains college men who are technically not even members of the military establishment. Actually, the Air Force was not instituting a reserve officers training program. Now this may seem like a minor issue; but look at some of the consequences. Because of its name, and in spite of the fact that the then Secretary of the Air Force, W. Stuart Symington, had stated that the primary purpose of the AFROTC program was to train college men to become officers for both Regular and Reserve components, the AFROTC program was assigned to Continental Air Command because it was considered to be a "Reserve Forces" activity. Following this same line of reasoning, it was assigned to the Special Assistant Reserve Forces in Hq USAF instead of to DC/S Personnel as a personnel procurement activity. Whether or not it seems important that the Air Force retained the ROTC designation, the name had significant repercussions in the formative years of that program. Only after six years of operation, in 1952, was the AFROTC program assigned to DC/S Personnel on the Air Staff, and to the Air University Command where it belongs. To complete this progressive action, it only seems fitting that the name of this program should be changed, perhaps to "Air Force College Cadet" program to correspond to the well-known "Air Force Flying Cadet" program. And more significantly to give meaning to its listing in 209 college catalogues.

Throughout its span of existence the AFROTC program has been afflicted with another misadventure. It has been long realized that the Air Force needs officers with special qualifications generally grouped into Air Installations, Comptroller, Maintenance Engineering, Communications, Armament, Flight Operations, and Administration. All of these except Flight Operations have been the major sub-courses of the AFROTC program for many years now. In setting up these sub-courses, called "Specialties", the AFROTC program has been guilty of carrying a tremendous load of coal to Newcastle. In connection with these sub-courses, AFROTC has been—and to a degree still is—requiring that all students be enrolled in one of the above fields. Then, ostensibly to assure that a student enrolling in the Communications course (as an example) would be potentially well qualified, the AFROTC directives have further stipulated that he must take an academic major in Electrical Engineering (or an allied field). On the face of it this sounds all right, but what happens in practice? This student who already is majoring in Electrical Engineering has been required to sit through a separate AFROTC course in Electricity. It was the rule rather than the exception to find an AF officer-instructor lecturing on the theory of AC and DC current to AFROTC students who had already had AC and DC theory as freshmen electrical engineer majors. And they had had their freshman classes under top-notch educators instead of from AF officers of varied background and experience. This was certainly needless, and it did a lot to discourage prospective enrollees. More important, it helped alienate college faculty members against an AF program which tended to invade their field and hence apparently reflected on their competency. Fortunately the pressure generated by the draft act and the Korean emergency could require students to take the course in spite of the curriculum. During the next few years this part of the AFROTC program will be belatedly phased out.

One other feature of this program bears consideration. A critical factor within the Air Force's need for new officers is the need for air crew members. It would be expected that the AFROTC program, by far the greatest source of new officers, should also be a major source of flying personnel. This has not been the case. In fact the AFROTC program has failed miserably in this respect. From the Office of the Chief of Staff down through the lower echelons, many statements have said in effect that the youth of today do not seem to have the same enthusiasm for flying shown by their older brothers. What is the reason? Does the young man of today want to stay away from jets and other modern aircraft? It is not that at all. The system of commissioning officers today makes it unnecessary for a man to go through flight training or obligate himself in any other manner to obtain a commission. Using jet aircraft as the excuse is only part of the problem. Perhaps a very minor part. Remember there are 140,000 young men in the Air Force ROTC (the Army and Navy have large units too), most of whom will be commissioned but will not go on to become rated. Yet the years 1939, 1940, and 1941 brought over

100,000 young men in the aviation cadet program. The 100,000 aviation cadets in 1939-41 were earning their wings, but, much more important, by earning their wings, *they were earning a commission.* Now consider the 140,000 young men in the 1952 AFROTC program. All they have to do is attend some classes, and an abbreviated summer camp and then they are given a commission without going to flying school or meeting any other long-range requirement. The AFROTC is in one-sided competition with the Flight Training program. A prime requirement of Flight Training has almost always been to have two years of college or its equivalent. Today if the young man is in college the chances are he is in one of the three ROTC programs. How can Flight Training compete against this? It would seem much more logical that the AFROTC program be producing candidates for Flight Training, not competing with it.

Another very important factor in this problem is that the AFROTC gives the man his commission first, and then asks him to go to flight training or to get into some other specialty. If you give a young man a commission first, why should he bother with flying school or other long-range commitments? Also consider that the college student is still predominantly under the influence of his family. To his parents, flight training inevitably means hazard, and eventual combat duty. These factors weigh far more heavily with them than do the slight advantages which may or may not accrue to a rated officer. Parents heartily endorse the AFROTC offer of a commission *sans* flying. Who wouldn't?

HAVING considered the sources and some of the factors involved in the complex but exceedingly important business of procuring the new officers of tomorrow's Air Force, what program should we follow now and in the future? First of all the Air Force sorely needs the steadying and maturing influence of a career school. Maximum effort should go into the establishment of an Air Force Academy dedicated to the only real specialty in the Air Force—the profession of the airman and the science of aerial warfare. Such a school could not conceivably produce the numbers of officers required by the Air Force, but it would be invaluable for the quality of its product and the significance of its teachings. Next a reasonable and highly selective direct commission system must be put into effect to acquire highly trained experts where Air Force experience *per se* is not a prerequisite. In many special fields this system is far superior to any other. In addition the Officer Candidate Schools must continue to turn out their officers. These men with a background of Air Force experience are very valuable. But quantitatively the most important part of this procurement plan must be the AFROTC. This program should be completely revamped with emphasis on procurement through *selection*—a selection unhampered by non-essential restrictions. It seems odd that the emphasis today is on the curriculum from an academic point of view. Isn't it enough that all AFROTC cadets are college men? The Air Force then should not try to *educate* with academic subjects. In so doing it encroaches upon the realm of the college faculty itself. The Air Force ROTC should teach what the Air Force is, should teach what air power is, and should endeavor to develop the officer qualities of its students. The AFROTC administration and its many officers stationed on campuses throughout the country should keep uppermost in their minds that the most precious attribute of the AFROTC program stems from the fact that it enables the Air Force to be represented on the faculties and staffs of the major colleges of the country. When an Air Force officer has seen a group of students progress through four years of college, he knows those seniors very well and very intimately. With the aid of his records and those of the college, he is in an unequalled position to *select* the type of officer the Air Force needs. This is the heart and soul of the AFROTC program: complete knowledge of these individuals and the ability to *select* the desired men upon completion of college to achieve quality as well as quantity.

This observation would be incomplete without due recognition of what was intended, but not achieved, in the first six years of the AFROTC program. It was hoped that the Air Force ROTC would provide "specialists". With *selection* as the primary criterion, this can be achieved. For example the Professor of Air Science and Tactics at Massachusetts Institute of Technology can be instructed to *select* a certain number of electrical engineers for commissions. He will prepare for this quota by encouraging electrical engineering majors to continue in the course, and should be able to fill his quota easily. This should work as well for all other officer requirements as it will for the engineers, assuring that enough qualified specialists are procured.

To give the AFROTC program the one more attribute it needs to meet procurement requirements, one step must be added. The commission contract must be two-sided. The Air Force offers the commission; the student must offer his services. Therefore the college graduate will only be eligible for his commission provided he completes the AFROTC program and either (a) agrees to go to flying school; (b) possesses a prerequisite specialty such as engineering or business; or (c) lacking both of these, he agrees to serve on active duty for a certain length of time on probation before his commission becomes final. This would automatically require the student to fulfill the most urgent needs of the Air Force's officer procurement program. Some of the basic ROTC legislation would have to be changed before this plan could be implemented, but this is long overdue. Our reserve forces pool, now made up of World War II veterans, will not be with us in sufficient numbers to meet the emergency of tomorrow unless it is rejuvenated by progressive procurement.

*1503d Air Transport Wing*

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SINCE Colonel Prouty's article was written during the period of transition in AFROTC curriculum and before the revisions were known, the Editor asked Headquarters, AFROTC to comment on the article and received this reply:

*That Colonel Prouty's thoughts on the AFROTC program were shared by many others is indicated by changes which have either been brought about already, or will be, beginning with the 1953-54 academic year. Colonel Prouty will be pleased to learn that:*

*(1) Through a generalized curriculum, the AFROTC course of study next year abandons the specialized options and provides the background education essential for all officers, regardless of Air Force specialty.*

*(2) Through curriculum and selection procedures the AFROTC has been reoriented to provide the bulk of rated officers for the Air Force. The majority of all students entering the advanced AFROTC course must be medically and aptitudinally qualified for flight training and must sign a certificate stating their intent to apply for flight training upon graduation. Students in this category who fail to apply for flight training at the proper time may thereby forfeit their opportunity for a commission. A much smaller number of students with no intent to enter flying training may be accepted into the advanced course, with emphasis given to those in technical or scientific academic majors.*

*(3) The new AFROTC program is not in competition with the flight training program: it is preliminary to the flight training program which the majority of AFROTC cadets must enter following graduation. It is the desire of the Air Force to procure officers first, to be followed by skill training to meet the job needs of the Air Force. In general, a college education is considered essential for officers. Thus the AFROTC program, in producing 80 per cent of Air Force officers, should provide officers with: (a) Education (College Graduate), (b) Military Training (AFROTC), (c) Skill Potential (Flying, Engineering, etc.).*

**Headquarters, AFROTC**

# Air War in Korea: VIII

## REMCO, A KOREAN WAR DEVELOPMENT

Major Carl G. Nelson

Every combat operation encounters terrain difficulties, tactical and operational peculiarities, and logistic problems not anticipated in the normal military organizational structure. When this combination of local circumstances seriously hampers operational efficiency, the standard organizational machinery must be modified or replaced by a new kind of unit which is tailored to meet local conditions. The Korean air war has fostered a series of such innovations, and one of the most effective is Rear Echelon Maintenance Combined Operation (REMCO). REMCO solves a major logistics and maintenance problem in Korean air operations by relieving two or more jet-aircraft groups operating in forward areas of their normal maintenance responsibilities for aircraft field maintenance, major inspections, engine build-up, and engine minor repair.

The trend to furnish tactical air units operating in Korea with maintenance support from secure installations in the rear areas was a response to the geographic, transportation, tactical, and air base facility problems in Korea.

The terrain of Korea is one of the principal restrictions on transportation activities on the peninsula. More than 70 per cent of the total area of Korea has slopes exceeding 30 degrees. The winding pattern alignment of the mountain ranges impedes movement in any direction, but the position of the north-south ranges makes east-west movements particularly difficult.

There are two main rail lines currently available to the United Nations forces. A double-track line between Pusan and Seoul runs through Taegu, Taejon, and Yongdungpo, and a single track between Pusan and Seoul connects Yongchon, Andong, Chechon, and Wonju. The terrain makes it inevitable that the railroads have steep grades and many curves, bridges, and tunnels which limit the capacity of these lines. On the single-track line, for example, there are 96 tunnels and 311 bridges in 310 miles.

Korea has virtually no paved highways. The roads are comparable to the poorest country roads found in the United States. In spite of the large effort expended in building and maintaining the basic road network essential to military operations, the roads are unpaved and are usually rough and rocky.

Pusan is the only major port in Korea with enough dock facilities and deep water to handle a substantial volume of cargo. Inchon is an important secondary port on the west coast of Korea and can berth coaster-size vessels. Pusan and Inchon together account for a large percentage of the port capacity of South Korea.

In combination with these physical obstacles the unusual tactical requirements of the Korean air war have imposed an additional burden on forward maintenance facilities. The large demand for tactical support missions, combined with the limited range of the jet fighters, has meant that combat air elements must be kept as far forward as possible. The air fields in use are usually only a few miles behind the front lines. During periods of rapid change in the ground battle situation, air units were displaced forward or to the rear several hundred miles while they sustained continuous operations.

Jet fighter wings are authorized approximately 10,000 measured tons of tools, supplies, and equipment, and light bombardment wings approximately 12,000 measured tons. During the particularly fluid stages of the Korean operation any attempt to operate wings as complete units in the forward areas was futile. Since they had to be constantly ready to move, the units kept most of their equipment in the original crates. About 80 per cent of their equipment was therefore inaccessible during the first six months of the war. One organization did not get its first machine tool into operation till approximately one year after it had been in Korea. Under such conditions heavy shop equipment was only an additional burden on the inadequate transportation system. Personnel carried along to operate this equipment, when and if it could be put into operation, added to the already precarious logistics load. Abandonment, pilferage, and deterioration from exposure to inclement weather cost the units approximately 50 per cent of their property.

Nor were air base facilities at this time any more favorable than the transportation situation. A typical base had two small hangars, totalling 14,000 square feet of floor space, initially used as supply warehouses. When other buildings were erected, the hangars reverted to maintenance activities. Winterized tents and small stucco barracks were erected the first winter, but the only maintenance shelter was a wind-break without a roof. Winter maintenance consisted chiefly of refueling, rearming, and such component replacement as was necessary to keep the airplanes flying. The inability to perform adequate maintenance, coupled with heavy operational commitments, resulted in rapid deterioration of the aircraft. When ten F-80 aircraft were sent to the depot after four months of operations under these field conditions, it required an average expenditure of 7500 manhours to recondition each aircraft.

At the outset of the Korean operation several variations of the combat wing were used in the theater, in accord with the desires of the commanders and with local conditions.

The scarcity of valid data restricts the statistical evaluation of the maintenance results obtained by these organizations, especially since tactical and local conditions often offset other factors. But the troubles encountered in attempting to move the entire wing as a unit can be illustrated by the experience of three tactical support wings. These wings suffered high operational losses which were not directly the results of battle damage and only partly of weather or airfield conditions. Because of the many moves equipment could not catch up with the organizations. Other equipment was lost to enemy action or delayed in transit. Unsatisfactory condition of the aircraft in these wings led to the establishment of an Intermediate Maintenance Support Unit at a depot in Japan. An attempt to correct some of the disadvantages of moving entire wings as units, the provisional Intermediate Maintenance Support Unit was under the control of Fifth Air Force Headquarters. While this support unit rendered valuable assistance, it was not a complete success. The lack of centralized scheduling system closely coordinated with the operating units resulted in backlogs of as many as 25 aircraft awaiting repair.

By the end of the first year of the Korean war certain units had found their own answer. Rather than drag the heavy maintenance equipment along with the wing, they established maintenance facilities at stable rear-area bases and flew the aircraft back to the equipment. The advantage of maintenance afforded by this system is shown by a comparison of two light bombardment wings during July to December 1951. One wing moved entirely to Korea during the summer. Small shops and two aircraft maintenance sheds were built. From July to December 1951 the "in commission" rate of this wing dropped from 78 per cent to 65 per cent. The monthly flying hours dropped from 5425 in July to 3904 in December. Accident rates rose, and staff visitors reported that the aircraft were in poor condition. The other light bombardment wing moved its operational units to Korea at about the same time, but the major portion of its aircraft maintenance section remained in Japan and the aircraft were flown back for repairs. From July to December 1951 this wing showed a marked improvement. Accident and abort rates dropped. The "in commission" rate rose from 57 per cent in July to 82 per cent in December, and the flying hours increased from 3884 in July to 4612 in December. Aircraft were in excellent condition.

Staff visits in the summer of 1951 noted that aircraft belonging to units which had rear area maintenance support were in the best condition. The trend toward performing maintenance in rear areas accelerated and by February 1952 all combat wings operating in Korea had some form of rear echelon maintenance facility. As this form of maintenance increased, the over-all condition of aircraft improved and accident rates dropped. One fighter wing, for example, had used rear echelon maintenance throughout its Korean operation. When its F-80's were replaced with new type aircraft in December 1951, the 25 F-80's in the poorest condition were sent to a depot for reconditioning. These aircraft had been in combat for over a year, yet each required only about 2000 man hours to recondition. This is in marked contrast to the 7500 man hours which it took the same depot to recondition the other F-80's previously mentioned—aircraft which had been in combat only 4 months but on which all maintenance had been attempted in the forward area.

A WING-BASE organization requires the services of more than 2000 men and from 10,000 to 12,000 measured tons of equipment. The movement and relocation of these masses is an enormous task and should never be undertaken in the combat zone.

The establishment of a fixed base, even when the desired facilities are already available, requires the major effort of the entire wing organization for approximately two weeks before complete support can be furnished to the operational units. This expenditure of time and energy can only be justified when the site selected is safe in relation to ground action. There cannot be complete mobility of an entire wing by air or ground transportation in Korea or any similar area. Plans which anticipate this degree of mobility can only end in failure and extravagant waste.

The lessons learned in the Korean operation point to two specific conclusions:

(1) Every combat wing operated under these conditions must establish a home station in the rear area. It should include all facilities for the support of assigned aircraft and be within range of combat ready aircraft flying to and from the expected forward operational base.

(2) The forward operational base should limit its maintenance personnel to the number necessary to perform preflight and postflight inspections, complete servicing and arming of the aircraft, one-time flight repairs, and emergency engine changes.

Once these lessons had been underscored by bitter experience and all wings began setting up rear bases, the combination of two or more wing maintenance shops into an organization such as REMCO was inevitable because of local conditions.

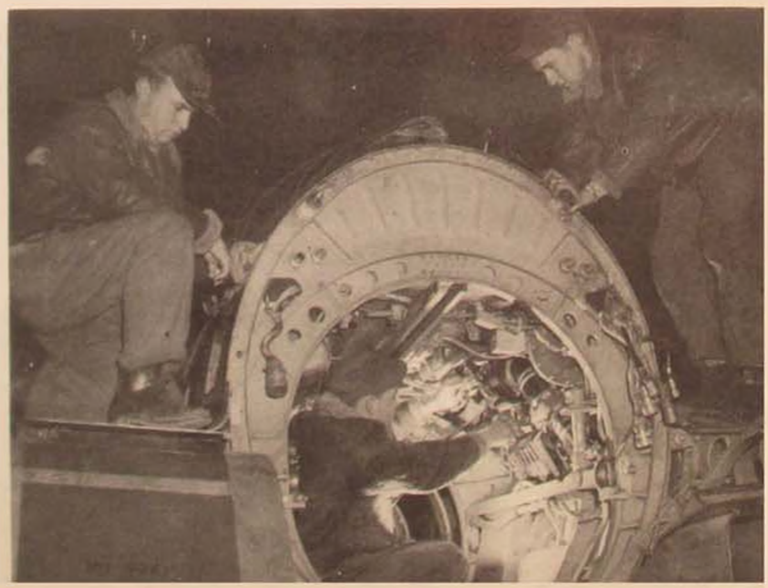
The limited number of suitable air fields adjacent to the Korean peninsula made it necessary for more than one wing to share the same base as a rear echelon facility. This joint occupation would have led to numerous duplications of shops and functions had not the respective commanders apportioned the responsibilities and agreed on the joint use of the facilities available. This type of maintenance support operation was given the name of REMCO, Rear Echelon Maintenance Combined Operation.

In the beginning, organizational structures were complex and command channels cumbersome. Since then two basic patterns have evolved:

(1) One wing becomes the parent organization and is responsible for all base functions at the REMCO location. The tactical group of this wing is deployed to a forward base, minus the maintenance personnel required to do periodic aircraft inspections. These maintenance personnel are attached to the maintenance squadron of the maintenance and supply group to form an additional section called the periodic or specialized maintenance section. This section is augmented, in proportion to the number of aircraft to be supported, by temporary duty personnel from the other forward wings making joint use of the facility. Normally the supply squadron is augmented in a similar fashion.

(2) The REMCO functions as a tenant on a base with base support, including supply, furnished by another command. In each pattern the jet engine minor repair function is combined with the engine build-up section when required.

While the organizational structures vary with the facilities available and the number of wings supported, the functions are similar, except for the variations imposed by jet engine minor repair. All REMCO's perform all major inspections on aircraft; perform all field maintenance, including repair of battle damage; perform technical order compliance on aircraft and engines: perform acceptance inspections and combat markings on all new aircraft; accomplish engine build-up for all organizations supported; make major and special inspections on engines; do minor repair on jet engines; and prepare engines for shipment to Zone of the Interior depots.



*Disassembled aircraft undergo thorough and rigid inspection in REMCO shops. Aircraft frame and installed equipment is minutely inspected, and damaged or worn parts are marked for repair or replacement. Everything from small skin rivets to gun bore is scrutinized.*

Personnel and supply were major growing pains in the early days of REMCO. The method of assigning personnel on a temporary duty basis was unsatisfactory in many respects, particularly for reporting purposes. An over-and-under manning procedure is alleviating this difficulty. The required personnel spaces and grades are withdrawn from the several table of organization units and allotted to REMCO, so that REMCO becomes a single organization reporting directly to Fifth Air Force headquarters. Personnel reports made to higher headquarters show all REMCO personnel under the authorized positions in the table of organization units from which the allocations were withdrawn. This avoids the complex reporting procedures imposed upon provisional organizations.

Tools and equipment necessary to the operation of REMCO are mostly provided from the authorizations to the table of organization units. While some special issues of equipment have been necessary because of local situations, new systems installed in the aircraft, or additional technical and inspection requirements, the total requirement for many items of shop and test equipment is substantially reduced when maintenance is accomplished under the REMCO system.

The general methods used in aircraft inspection and shop repair are similar in the wing base and REMCO organizations. The selection of specialized dock, production line, or crew techniques is dependent upon the space and facilities available, qualifications of the personnel, and the volume of work. The large volume of aircraft inspections handled by the periodic maintenance section of a REMCO organization does more readily adapt itself to production line methods. Just as maintenance methods do not vary greatly between wing-base and REMCO organizations, the functions of planning, scheduling, and control are critical in any joint operation. Neglect of any one of these functions results in excessive backlogs of aircraft awaiting work, excessive turn-around time, inefficient utilization of man-power, and erratic supply support and ultimately means that the tactical units do not receive proper support.

Since the purpose of logistics is to support operations, maintenance planning must be based upon operational projections. The operational projections for the next month, including both combat and training requirements, are converted into flying hours and flying hours into the number of major inspections required to support the operations. REMCO consolidates the


*In REMCO production line maintenance hangars, disassembled Thunderjets are repaired and reassembled in one continuous operation. The aircraft sections are moved from station to station until the "assembly circle" is completed. Next step is preflight. REMCO's expensive maintenance equipment, machinery, and skilled mechanics are not subject to quick evacuation or imminent attack as they are in a combat area.*

inspection requirements submitted by the forward units. After careful analysis of the requirements, the planning section draws up a master schedule showing the number of aircraft to be delivered to REMCO per day. Each tactical unit receives an individual schedule indicating the exact days on which its aircraft should be delivered to REMCO.

The importance of proper scheduling cannot be over-emphasized. At the forward location both operations and maintenance must participate in scheduling. Care must be exercised that aircraft are used by the forward units in such a way that inspections can be staggered over the entire month. If each squadron schedules the aircraft to be used for missions, aircraft within 20 hours of a major inspection are monitored at tactical group level to insure an even flow of work to REMCO. Aircraft with less than 20 hours flight time remaining are reported to REMCO, and their progress is kept under observation. Daily liaison between REMCO and the forward units takes care of schedule adjustments for weather "stand-downs" and special requirements.

While scheduling is critical to successful rear-echelon maintenance, production control can rightfully be considered the heart or nerve center of REMCO. REMCO cannot function efficiently without a well-organized and efficient production control. The production control organization and procedures outlined in Air Force Manual 66-11, "Air Force Production Control," function effectively for REMCO. Four units operate under a Production Control Chief: Work Order Planning, Material Control, Scheduling, and Analysis. Since the functions of control are common to all field maintenance squadrons and shop activities, only those portions peculiar to REMCO, or operations which must be emphasized, are discussed here.

In planning combat missions, the tactical commander must know what aircraft will be available to him. This means that REMCO-repaired aircraft must be returned to the forward unit on a guaranteed time schedule, the only exceptions being aircraft which have experienced major combat or operational damage. Scheduling must be precise, materials and parts must be pre-positioned in the production complex, and follow-up action must keep aircraft on schedule. The controller must have an exact picture of the progress and status of each aircraft at least twice daily. This information is best portrayed on a status board.

The work order planning unit must make accurate forecasts of require-

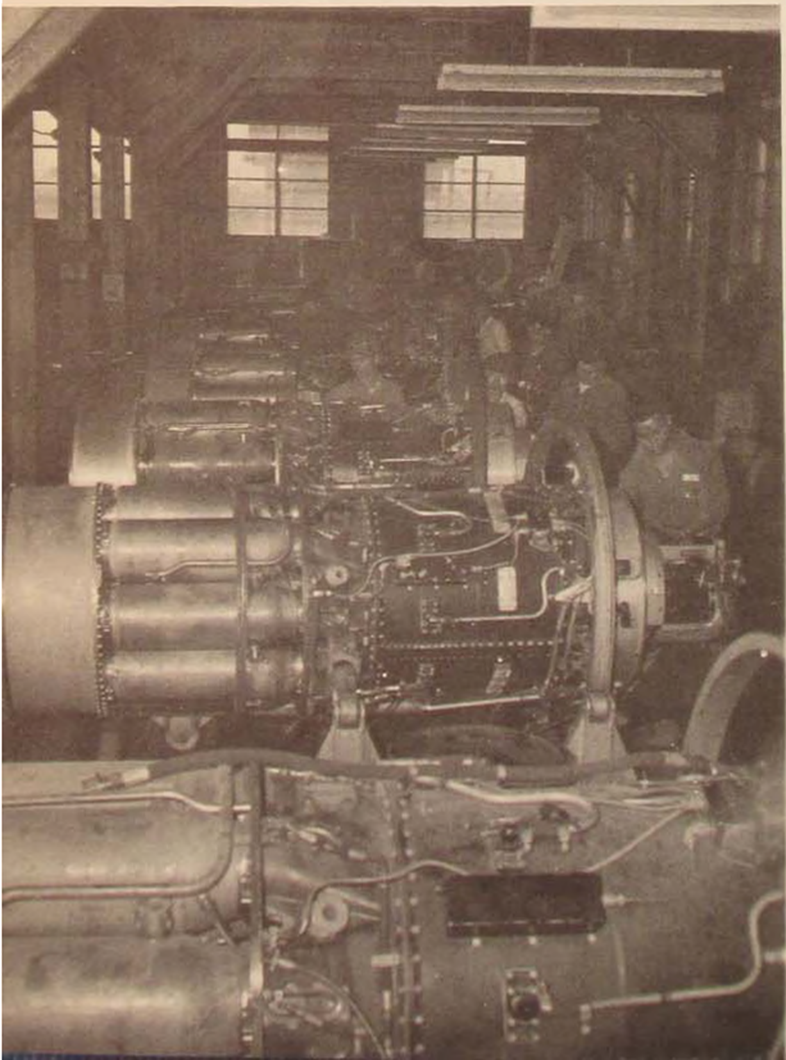
*Complete overhaul of this Thunderjet flown into a REMCO base in Japan begins with removal of the 4000-pound-thrust J-35 engine. The engine will be sent to the engine build-up and repair shop while the dismantled aircraft moves into production-line maintenance hangars. There it will receive thorough inspection, dismantling, and overhaul. After final re-assembly, aircraft are flight tested and returned to combat units.*

ments for parts and materials, keeping a card file system of records on individual aircraft so that parts and materials will be on hand for technical order compliances and components upon which the allowable operating time will expire. Processing these requirements sufficiently in advance allows supply activities to use routine supply procedures and reduces time lost awaiting parts. Projections must also be made on aircraft engine consumption, so that enough built-up engines are always on hand. Engine life expectancy tables developed from past theater experience furnish projections within acceptable accuracy limits.

Analysis materially aids planning, scheduling, and over-all management. Careful observation of the expenditure of manhours eliminates time losses and furnishes realistic planning factors.

Upon arrival at REMCO from the forward base, aircraft are immediately given a shake-down inspection for work over and above the scheduled routine inspection. The inspector's work sheet is coordinated with production control while the aircraft is being cleaned on the wash rack.

Production control releases a work order for this aircraft and instruction slips are made up for necessary shop work. All work on the aircraft is recorded against this work order number. Minor field maintenance and repair of battle damage is accomplished during the inspection. The stage of the operation at which this work will be done is carefully coordinated to prevent interference with the progress of the inspection. Aircraft requiring major repair of battle damage or excessive shop work are transferred to the field maintenance part of the REMCO.



*REMCO engine build-up shops have crews capable of doing any job in the field of engine build-up and repair. Crews are assigned engines and stay with them until test run. Thoroughness, quality, and efficiency of REMCO maintenance is not possible under fluid combat conditions.*

*Combat aircraft which would have been classified "war weary" in WWII have been reconditioned and are lined up at a REMCO station in Japan ready for delivery back to combat units in Korea. REMCO's production line systems average four "fly-aways" per day each. REMCO also pulls acceptance checks on new aircraft arriving in theater and assigned to the AF combat units in Korea.*


As soon as the work order is released, the materiel control unit starts to position that aircraft's components at the assigned dock position or along the production line and to obtain the materials needed for special requirements noted by the inspectors. As in any production line, parts, components, and materials must arrive at the place and time they will be needed. Skilled technicians must not be diverted from maintenance work to get their own supplies.

While the REMCO system of support to tactical operations may not in all cases be the most desirable, it has shown the following advantages during the Korean campaign:

(1) Mobility of the forward "staging" bases has been increased.

(2) The mechanical condition of combat aircraft has been improved.

(3) Increased maintenance output due to more efficient working conditions and supporting facilities has meant a greater potential number of flying hours per aircraft.

(4) Logistic support requirements in the forward areas have been reduced.

(5) Maintenance work has been done more quickly, more thoroughly and more consistently because logistics support channels in the rear are not disrupted by frequent moves and better transportation facilities are available.

(6) Consolidation of units supporting the same type aircraft has allowed closer supervision of the supply of critical parts.

(7) Mechanically qualified Japanese could be used in the rear areas.

(8) Security for the heavy facilities and the aircraft undergoing work is increased by distance from the active area.

The cost of the modern aircraft and its installed systems precludes the World War II practice of declaring an aircraft "war weary" when it requires extensive maintenance or repair of battle damage. The almost unlimited supply of new aircraft available toward the end of the war engendered an "economy of plenty" which may well never be with us again. Future emphasis must focus on maximum conservation of equipment. Planning must take into full account provisions for constantly increasing maintenance effectiveness.

*Headquarters, Far East Air Forces*

# TACTICAL AIR CONTROL IN KOREA

Colonel James R. McNitt

As the Korean war ends its third year, we find the ground situation stabilized along the entire front, with the United Nations air arm ranging over all North Korea. Not only do our tactical aircraft dominate over the battle lines but our fighters and fighter-bombers operate freely against air and ground targets as far north as the banks of the Yalu River. Encounters with the MIG and air strikes against important military centers occur almost daily.

Of utmost importance in the operation of the tactical air forces is an effective tactical air control system. Through this system the commanding general of tactical air maintains an up-to-the minute status report of air operations and issues last-minute instructions to his strike aircraft already airborne. Controllers aid in individual interceptions against hostile aircraft, navigate fighter-bombers to ground targets or to let-down points, assist in rescue missions, divert flare aircraft, and perform many other functions necessary to effective tactical air performance. In addition to its offensive value, the tactical air control system furnishes the Aircraft Control and Warning element of the air defense of the forward friendly area. This includes the identification of aircraft, the passing of alert warnings on hostile aircraft, and the scrambling and control of friendly interceptors. Both the offensive and defensive missions are carried out simultaneously.

With the exception of its organization the control system in use in Korea is patterned after the one used in Europe late in World War II. It consists of a tactical air control center, tactical air direction centers, tactical air direction posts, and light-weight early warning radars. At the Air Force headquarters where the tactical air control center is located, the air situation is represented by target stands on a large plotting board. This center receives its information directly by voice telling from tactical air direction centers located near the front. The tactical air direction centers are equipped with heavy radar and exercise the bulk of the close control over tactical aircraft. Feeding information to the tactical air direction centers are light-weight early warning or gap-filler radars. Tactical air direction posts guide aircraft on pinpoint bombing missions.

A tactical control group operates the system. Equipped to be self-supporting and completely mobile, the group installs, operates, and maintains the extensive communications network which ties the control system together, provides its own first and second echelon radar and communications maintenance, and on changes of location, disassembles and re-installs the radar gear.

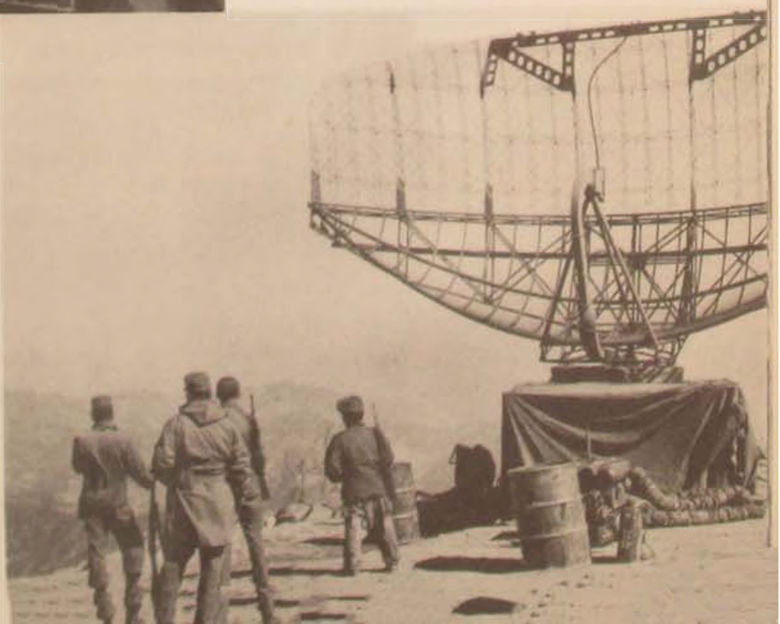
**While the tactical air control system in Korea has in the main derived from the system developed during World War II, some modifications have been necessary to adapt its operations to new conditions. In this article, Colonel James R. McNitt, Deputy for Communications and Electronics, Headquarters, Japan Air Defense Force, and former Director of Communications, Fifth Air Force, reviews the system employed in Korea, the changes made since World War II, and the new problems which have arisen with the advent of jet fighter aircraft, together with peculiarities of the Korean terrain and certain unusual aspects of the air war in Korea. Additional information and photographs have been supplied by the 502d Tactical Control Group and the 6147th Tactical Control Group, Fifth Air Force.**

# Deep Penetration Control

*The tactical air control center is the heart of the tactical air control system. Theater-wide information on airborne missions is continually fed in from the radar-equipped tactical air direction centers and is presented on the big map table. On the basis of this information the commander of the tactical air forces can direct his attacking aircraft.*

*At the tactical air direction centers controllers view a segment of the air battle on radarscopes. The shadowy picture enables them to monitor and control aircraft to the targets, during the strike, and on the way home. Thus controllers take over many parts of the pilot's burden such as navigation, spotting enemy aircraft, and flying too close to restricted areas. They enable the pilot to concentrate his attention on the target.*

*From their leveled perches on mountain peaks, heavy radar sets are the eyes and ears of tactical air control. Located as close as possible to the front lines, these sets support the tactical air offensive. On defense they give us early warning on hostile aircraft.*



This arrangement is a distinct improvement over the one prevailing in World War II. Then, rather than a single group operating the complete system, Signal Aircraft Warning battalions under the Signal Corps operated the radar portion of the control system, and fighter control squadrons under the Air Force handled the tactical control centers. The disadvantages of the World War II system are obvious. Now with all elements under a single unit commander, teamwork and close coordination are much better and administration and maintenance are simplified.

The equipment in use in the Korean system is basically World War II gear. There have been a few technical improvements since then, but the basic radar and communications equipment is obsolescent.

As part of the over-all control system, visual guidance and control in Korea are furnished by the ground tactical air control parties (TACP) and airborne spotters commonly referred to as "Mosquitoes." The TACPs use radio contact with the strike aircraft to guide them visually into a target. The Mosquito is a radio-equipped AT-6 which operates as an airborne tactical air control party. These two control elements have performed magnificently in Korea and deserve more space than can be devoted to them here. Therefore this discussion will deal with that portion of the complete control system which operates beyond the visual range of the Mosquitoes and TACPs.

The control system in Korea, considering its obsolescent equipment, has reached a very high state of efficiency. With the ground war at a standstill the components of the control system have remained in place for many months, and maintenance personnel have been able to "peak" the heavy ground radar equipment and maintain this peak. Similarly, reworking of the communications systems has resulted in good system performance. Teamwork between controllers and pilots has been emphasized and given momentum through briefings, visits, and indoctrination courses. Operating procedures have been tried, discarded, and new ones substituted until they, too, have been well standardized. The best sites available are now occupied by units of the control system.

In a more normal war situation than the present one in Korea the battle lines will be fluid. The tactical air control system must be able to keep up with a moving front, and its moves must necessarily be leap-frog ones, since tactical air control must be continuous. Movement in Korea, with the equipment now in use, would present many serious problems. There are few roads anywhere in the peninsula. There are no roads to mountain tops desirable as tactical air control radar sites. Yet these sites must have roads if they are to be occupied by the heavy gear. Since a moving ground situation would not afford time for road construction, less desirable sites would have to be used. Thus in a fluid battle situation in Korean-type terrain, the efficiency of the system would be less than it is at the present time. The problems offered by terrain must be overcome through the redesign of tactical air control radar gear. Such items as radar remoting systems and lighter weight antennas should be incorporated into the system, so that only the antenna assemblies need be moved from one high site to the next. Then the main operating and control components can use a main supply route as an air axis. It is conceivable that radar antenna assemblies with their remoting terminals could be lifted from one high site to the next by helicopter. Until "radar relay" becomes available, every effort should be made to pro-

# Close Support Control

*For the precise and difficult job of target spotting and control of bombing in close support operations, the Air Force relies on the aerial eye of AT-6 trainers and the ground observations of forward air controllers. Dubbed Mosquitoes, the AT-6's spot ground targets, fire smoke rockets into them as markers, and call in and direct fighter bombers during the attack.*

*Moving close to the enemy lines, forward air controllers park their radio jeep (right) in the shelter of a cliff and, from an exposed peak (below), spot enemy strong-points, direct air strikes, and report the results. Controllers are Air Force Mosquito pilots who spend a period as ground controllers before returning to squadrons to complete their tour of air missions.*

duce a light-weight, long-range, mobile search radar with high track-handling capability.

Before further examining the tactical air control situation, let us briefly review the philosophy underlying a tactical air control system. Stated succinctly, tactical air control simplifies the pilot's task and makes him more efficient. A fighter-bomber pilot is saddled with a number of tasks when he flies a mission. First he must fly the airplane. Next he must navigate time and distance over enemy territory. Simultaneously he must be on the lookout for enemy aircraft. He must also watch friendly traffic in the skies. Remembering information on enemy flak, he must avoid its concentrations if possible. He must remember rescue information. Then there is his target to consider. He must be able to recognize the target area, find the target, attack and destroy it, and then withdraw and return to base. Other information important to him includes data on weather, bomb line location, and restricted areas.

If the pilot could be relieved of all the tasks except flying the airplane, attacking the target, and withdrawing, he would obviously become more efficient. Tactical air control tries to do just that. It can navigate the pilot, steer him around known flak areas, warn him of the approach of enemy planes, advise him of friendly aircraft in his vicinity, tell him when he is over the target area, and can navigate him back to base after the attack. If the pilot has to bail out, he can be directed to the nearest safe bail-out area. Bomb-line and restricted area information is kept current at the tactical air control facilities. When the pilot is over or past the bomb line or is about to violate a restricted area, he can be advised and given a proper course. All this assistance makes it possible for the pilot to concentrate on his two main tasks—flying the airplane and destroying the target. Under tactical air control, he can be thinking and planning his attack while en route and keep a clearer picture of his target in mind. The same condition holds true for many other types of missions associated with tactical air. Flare missions, day and night interceptor missions, night intruders, and reconnaissance missions are given a helping hand by tactical air control.

A tactical air control system is analagous to an air traffic control system as operated by the Civil Aeronautics Administration and the Airways and Air Communications Service. One might say that tactical air control is air traffic control over enemy territory. Indeed in Korea the two systems work closely together. The AACS system in the rear of the battle area passes flight-plan information on battle-bound air traffic to the tactical air control system. Similarly information on air traffic returning from the battle area is passed from the tactical air control system to the air traffic control system of AACS. Since there are no homers, range stations, or localizer markers in enemy territory, control beyond the battle line must originate from friendly territory. These facilities must have excellent coverage deep into enemy territory. Heavy ground radar has given the best results, since their radarscopes enable controllers to "see" the friendly aircraft as they proceed into and return from enemy territory. The controller also tries to "see" enemy aircraft on his scope, viewing the complete air situation within the coverage of his radar.

Voice radio contact with friendly aircraft must also be continuous and have deep penetration. This is true for still another device which assists considerably in the control of friendly air traffic over the battle area—the direction finder fixer system. Consisting of a number of radio direction finding stations, it is an adjunct to the radar system used primarily to furnish steers to lost aircraft or to those in distress.

During World War II the tactical air control system in Europe for the IX, XIV, and XXIX Tactical Air Commands had to move many times in the advance through France, the Low Countries, and into Germany. These moves followed the leap-frog principle, and system operation was continuous. While the Korean and World War II systems are practically the same, the two factors of the terrain and jet aircraft make operation of the systems quite different. The terrain differences need no elaboration. The difference in fighter characteristics caused the revision of control procedures. World War II P-47 fighter-bombers carried a large supply of fuel and could range over the target for hours. But jet time in a target area is measured in minutes. With so little flexibility or margin in timing aircraft on a target, jet aircraft must arrive at the target on schedule. Furthermore the bulk of the work done by the fighter-bombers in World War II was within 75 miles of the bomb line. As jet aircraft in Korea range in excess of 150 miles north of the battle line, the tactical air control system must "see" deep into enemy territory. The speed differential between the jet and P-47 must also be considered. Controlling jets is a more precise task, with little margin for error. A plot passed from a radarscope to a plotting board must be handled more expeditiously if it is to be of value. A two-minute-old plot on a 500 m.p.h. jet aircraft is a much older plot in point of distance traveled than one representing a P-47.

In methods of passing plots and the display of the air situation in the

*Isolated mountain tops are the most suitable sites for the radar and radio equipment essential to the tactical air control system. But to build a passable road to such a heavy radar site takes six weeks. In fluid war operations, the front is seldom stabilized enough for roadbuilding to be practical, as the equipment must always be pushed as far forward as is posisble. Wherever the mountain sites are inaccessible to conventional supply transportation, the isolated units have been supplied by airdrop. For lighter-weight equipment, such as that used on radio-relay sites, the whole station has been packed up the mountainside on the backs of Korean laborers.*

tactical air control center, the Korean system is identical with the World War II system. There still are delays and inaccuracies in passing plot information from radars at the tactical air direction centers to the tactical air control center. And jet speeds have made these delays more significant, reducing considerably the amount of over-all control which can be exercised at the tactical air control center. No doubt automatic systems for the passage and display of radar data will eventually be developed to alleviate this difficulty.

The tactical air control system in Korea has not been free from enemy contact. Because many of the sites are just behind the front lines, they must be continuously guarded against attacks by guerrillas and infiltrating enemy troops and protected against enemy artillery and enemy air attack. Personnel manning the sites must be given adequate training in security measures as well as in technique and operations. In a fluid situation life at the outlying stations becomes a bit rugged. But there is always activity and morale is good. Air Force personnel who operate and maintain the sites are "in the war."

Logistics problems are acute. At radio relay stations, at sites occupied by light-weight gear where roads are non-existent, or at other sites where access roads have become impassable, air drop or the rugged Korean mountain climbers with their "A" frame must resupply the isolated units. On the whole the supply system is working very well. In some instances Japanese industry has provided some of the vitally needed radar parts. Skilled Japanese technicians have proved themselves adept at exact copying or sufficiently close approximating of worn parts. Naturally the Japanese source has its limitations, since it lacks certain critical materials.

Of the many lessons learned from the Korean war some significant ones deal with the tactical air control system. In the foreseeable future new techniques and engineering know-how will permit the remodeling of the system to provide it with much greater mobility and improved data telling and display features. Korea with its rugged terrain and jet air warfare is an excellent testing laboratory. Perhaps some would characterize Korea as a "special situation." But a considerable portion of the earth's surface is covered by terrain similar to that of Korea. Who can say that we will not again be fighting in hills and mountains? If a tactical air control system can move rapidly through this type of terrain and simultaneously occupy the best sites so that it can do its best job, less severe topography should present no obstacles.

*Headquarters, Japan Air Defense Force*

# FEALOGFOR and Japanese Labor

In modern war where global operations are often conducted at extreme distances from sources of production and supply, theater utilization of local labor and resources helps to solve many knotty and pressing logistic problems. Since the summer of 1950 Far East Air Logistic Force (FEALOGFOR) has met the growing demands placed upon it by the Korean War through constantly increasing the employment of Japanese laborers to assist in stocking and funneling over 220,000 different items of supply to using agencies and to repair, reclaim, and modify USAF aircraft and equipment. More than 14,000 Japanese laborers, clerical workers, and skilled craftsmen now work side by side with USAF civilian and military personnel in FEALOGFOR's rambling materiel depots. These Japanese employees represent many pre-World War II levels of professional skill and endeavors, from a former ranking Japanese Air Force commander and a pre-war Japanese physicist down to a common laborer in the once-humming Mitsubishi airplane works.

FEALOGFOR's policy of maximum employment of native skills and materials has meant more than 50 million dollars of annual saving to the American taxpayer. Battle-worn clothing, damaged aircraft, unserviceable vehicles, replaced assemblies, all of which in the past would either have been cast aside or dispatched on the long and costly return to the Z.I. for refabrication, are now repaired in Japan or systematically cannibalized for usable parts. These parts are catalogued, stored, and used in rebuilding serviceable equipment. Wastage has been cut to the bone. One salvage unit alone reclaimed

*Nimble fingers and skilled craftsmanship of Japanese female workers renovating winter flying clothing typify Far East Air Logistic Force's salvage operations that save millions in tax dollars yearly and help shrink lengthy transoceanic supply lines. More than 100,000 items of clothing, ranging from flight jackets to sheep-lined flying boots, were reclaimed, for example, in one two-week period, at a saving of $3,000,000 for American taxpayers, by employing inexpensive Japanese workers.*

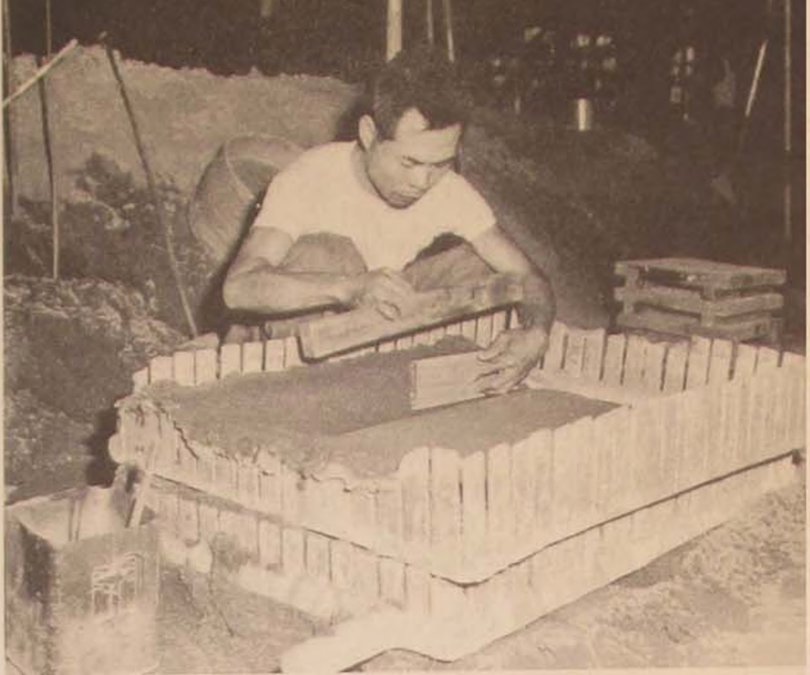
*Willingness on the part of FEALOGFOR workers to perform the most tedious and back-breaking tasks necessary for total reclamation has helped in keeping USAF tactical units effectively airborne. Sweating*

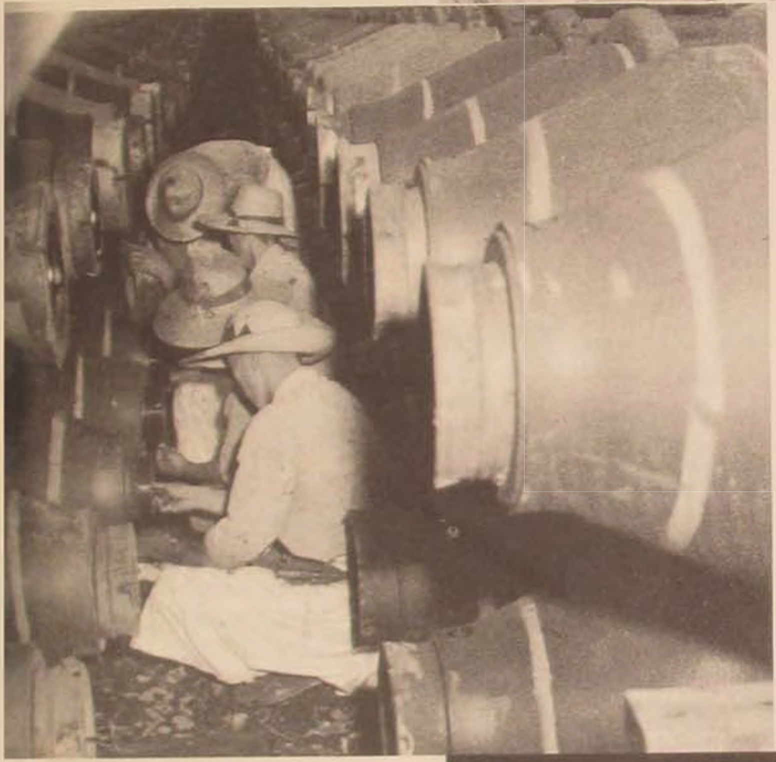
**more than $800,000 worth of discarded items in a single year. This reclamation included everything from wood crates to platinum scraped from burned-out spark plugs. Irreparable items were sold to Japanese concerns. But most important in this program and of especial value to the combat commander is the greatly shortened time lapse between his requisition and his procurement of critically needed items which is provided by theater reclamation and reissue.**

**FEALOGFOR's Japanese workers bring a variety of skills and desirable traits to the job. Willingness to undertake any task, frugality born of centuries of making the most of the least, and tireless energy lend themselves to economical and efficient air depot operations. A Japanese worker filing the rough edges of rivets on a salvaged F-84 canopy can make it combat ready within a matter of hours. A skilled craftsman using both modern and age-old tools can modify old or construct new parts according to required specifications. A clerical worker keeping stock records up to date and handlers of explosives plying their ticklish trade—all release hundreds of U.S. military specialists for other theater duties. Thanks to the aptitude and skill of Japanese laborers, battle-damaged aircraft of all types have been repaired and sent back into action. Japanese workers have assisted in developing ingenious designs, techniques, and devices for filling immediate requests for items such as fragmentation bomb racks, ramps for cargo-type aircraft, and many other useful modifications which saved thousands of man-hours and the pipe-line time lag which normal ZI procurement requires.**

**In part FEALOGFOR's use of indigenous manpower for the various manual, clerical, highly-skilled, and professional "housekeeping" jobs has relied upon an educational program to develop and increase skills. The worker beginning at any given level within a trade is encouraged to broaden his skill through**

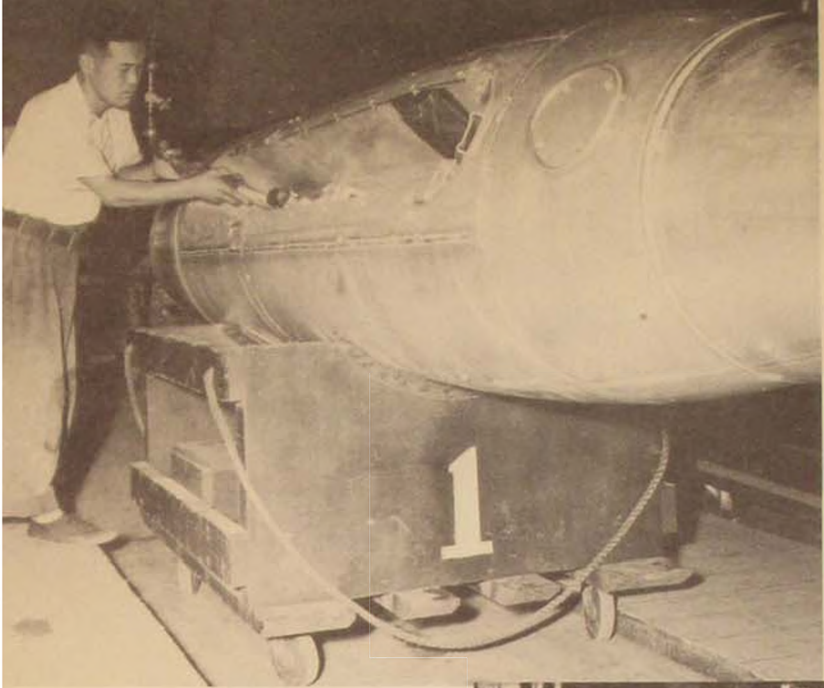
*against a background of fumes and vapors, a foundry worker dips into a cauldron of molten lead while a fellow worker (right) painstakingly uses age-old methods to prepare a mold for a new casting.*





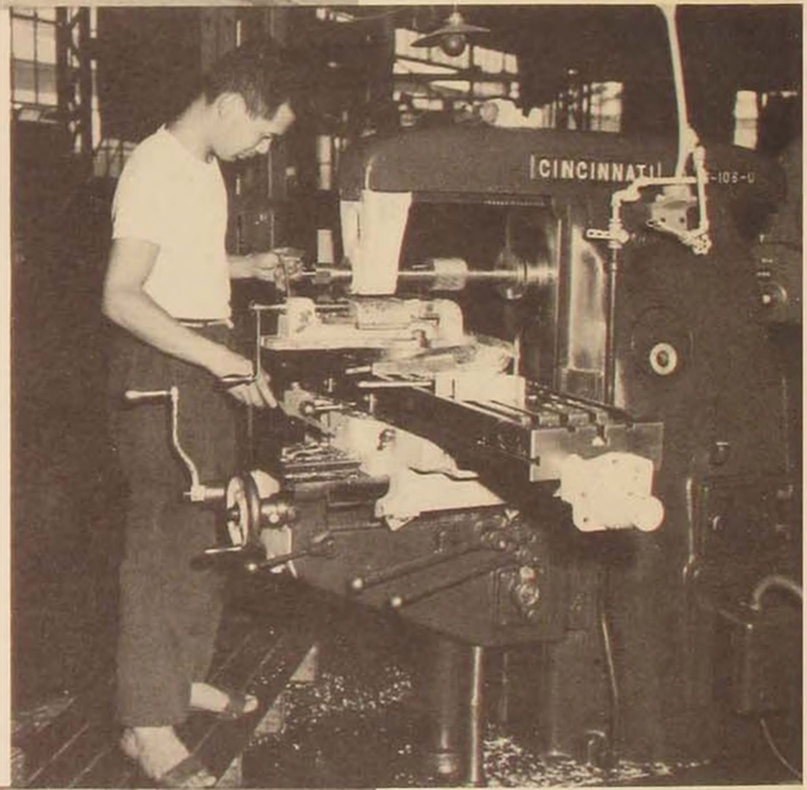
*Squatting in the shadows between two rows of massive 2000-pound bombs, straw-hatted Japanese workers in a FEALOGFOR ammo dump calmly check the fin-end of the deadly missiles. Munitions deteriorate rapidly, must be used by age groups and frequently turned on their racks. Conscientious and quick to learn, these men perform necessary tasks in handling, inspecting, and renovating touchy bombs.*

*A Japanese worker files the rough edges of rivets on a canopy after it has been repaired at FEALOGFOR. Within a matter of days it will be back in use over North Korea.*



*An air hose is used to check pressure seals on a wing tip fuel tank of a USAF combat aircraft by a FEALOGFOR maintenance worker. All-wooden dollies, probably made by Japanese workers of scrap material in an adjoining carpenter shop, facilitate moving unwieldy and bulky aircraft assemblies.*

*A Japanese grinds out precision instrument components on an American-made machine. With experience gained during World War II in aircraft plants, many workers were familiar with aircraft and vehicular maintenance. Power tools from Japanese plants—some in almost constant use since before World War II—represent substantial savings of U.S. machine tools and make the most of current Western production methods and modern techniques.*




*Japanese engineers and draftsmen bend over drawing boards preparing USAF technical drawings which fellow workers will translate into finished products. More than 14,000 skilled men and women work in technical, managerial, and service roles in FEALOGFOR's huge aircraft maintenance and theater-air supply organization.*

*A warehouse supervisor keeps tab on all stored supplies within his building, run entirely by Japanese. Managerial potential is encouraged and developed by the civilian training branch, which affords some type of training and schooling to all employees. Numerous forms and manuals have been translated from English into Japanese, and shop work orders are bilingual. Japanese typists, ditto machine operators, unit supervisors, and similar clerical-managerial workers are widely needed.*

**an internal training program. Courses in manual training, aircraft sheet metal work, aircraft hardware, automotive engine repair, aircraft construction, electronics, and production control are offered as corollaries to on-the-job training. Aside from vocational trade instruction in specific job categories, successively higher levels of semi-professionl and professional training are attainable through courses in management, supervision, language, and technical operations. To date more than 6000 employees have been trained in the various courses offered. The real value of this instruction is reflected in the increased output per worker and the notable rise in individual skill and personal job satisfaction. Monthly personnel turnover averages 1½ per cent—consistently lower than that of Japanese employment and comparing favorably with industry in the U.S.**

**The average wage of Japanese employees is $68 per month. Individual wages run according to types of positions and degrees of skill and are the maximum allowable by law of the Japanese government.**

**Employment of Japanese labor not only has been a saving in USAF personnel and equipment but has been a decisive stimulant both in dollars and in morale to the recovery of Japanese economy. Its educational program has increased individual effectiveness and afforded training in trades and professions which will be of great value to the Japanese nation in future years as these individuals take their places in the reviving Japanese industry. Most important it has furnished both supplies and critical services to combat units at a fraction of stateside cost and in considerably less pipe-line time.**

## AIR EVACUATION—MEDICAL OBLIGATION AND MILITARY NECESSITY

COLONEL ALLEN D. SMITH, USAF (MC)

OF the many arts and sciences which contribute to the development of military power and the waging of war, most are directed toward efficient destruction of men, materiel, or war potential. Medicine alone stands out as primarily concerned with the saving of lives and the repair of sick and wounded bodies. It is a strange fact that the healing art goes ever hand-in-hand with war, the destroyer. In the practice of medicine a physician is primarily motivated by his desire to repair and heal. In the military environment this is justified by the increased effectiveness of the military machine.

In the history of medicine the earliest known writings by a physician, dated about 3000 B.C., were based on that doctor's experiences with the ancient Egyptian armies. This first recorded medical mission was to bind the wounds caused by the primitive weapons. That ancient man of medicine was not interested so much in the military operation as he was in the prospect of unlimited clinical material to widen his knowledge, advance his skill, and develop new techniques. This activity took him into the battlefield. There is no indication that he was officially attached to the military.

In those ancient days, indeed until quite recent times, sickness caused more casualties than war wounds, yet it was some time before the physician was invited to treat sickness in camp and on the march. And even when it came, this treatment was not in the interest of humanity or good medicine. The military commanders were trying to increase their military effectiveness by curing the ailing who impeded advance. A little later the medical men became interested in food, water, sanitation, and even clothing and armor.

As soon as the military physician enlarged his interests beyond the immediate care of wounds on the battlefield, he was really on the team. He made more troops available to the commander by keeping more men combat ready and lessening the number of non-effectives in the combat area. From these humble beginnings military medicine has developed to an activity which encompasses all the various clinical specialties, advanced field techniques, widespread research, and the responsibility for rearward evacuation of non-effectives to hasten rehabilitation and return to duty or disposition outside the combat area. Military medicine has made great contributions and has learned great lessons in prolonging life and adding to the comfort and well-being of all mankind. Smallpox, typhoid, and tyhpus are controllable diseases rather than plagues largely as a result of military experiences and research. Lessons learned on the battlefields of World War I contributed greatly to advances in chest surgery, treatment of burns, infectious wounds, and fractures, and many other now commonplace techniques. Preventive medicine and sanitation, identification and control of disease carriers, blood transfusion techniques, antibiotic therapy, and methods of evacuation have all been advanced by military necessity.

Transport of wounded away from the noise and danger of the battlefield has always been a problem. The physician of old treated only those wounded whom he believed would survive. Those who could limp or crawl had a chance; a few were carried on their own shields. As methods and weapons of warfare developed, the distance which wounded had to be evacuated increased. Sleds, chariots, pack-animals, various horse-drawn vehicles, trains, automobile ambulances, and now aircraft have all been used, in keeping with medical knowledge and methods of transportation of the day.

Casualty aeromedical evacuation is rooted in the desires of the medical man to practice the best medicine under the best possible conditions, and it is justified in a military operation because it raises the efficiency of the men actually in contact with the enemy.

Indeed unless we morally resign our responsibility to our wounded by denying them the benefits of modern medicine and exposing them to continued combat conditions, we really have no choice but to continue the development of evacuation by air. The battlefield of today is no longer a river ford, a single hill, or a grain field. Our lines of communication are not measured by a few miles. Our defense and combat effectiveness embrace time and space and technology, not merely distance and firepower.

The great extension of the theater of operations in our mechanized age has in one lifetime geared all past experience in military science and transport to a new concept in which the airplane is dominant. By the same token the ambulance concept of evacuation, removal of the sick and wounded in small numbers for a relatively short distance, has become invalid. Fortunately that same mechanization which has made long-range evacuation necessary has also produced in the airplane a vehicle for its accomplishment.

Today we find many able military thinkers trying to analyze the lessons being learned in Korea. In many ways that operation is a refutation of modern military concepts for waging war, especially in its peculiar "ground rules" which limit the effectiveness of air power in its various aspects. On the other hand the Korean situation emphasizes the necessity for flexibility in adapting our military training and plans to any conditions.

One of the U.S. Armed Forces' accomplishments to date in the Korean conflict has been the further development of medical air evacuation. Along with the advances in use of antibiotics and blood therapy, air evacuation must receive major credit for reducing deaths among those combat casualties reaching medical care to approximately half the rate for similar circumstances in World War II and to one-fourth that of World War I. But although a working system of casualty air evacuation started functioning almost immediately in Korea, the theater operations order authorizing medical air evacuation was not issued until more than a year after hostilities began.

Present military thinking still includes a large segment which considers the sick and wounded as so much impedimenta which must be moved at a certain cost per ton mile to maintain military efficiency. Another quite different kind of thinking, particularly among medical circles, would provide the quickest and best possible medical care. Both viewpoints have validity, but only if both are considered together. The real answer lies not so much in a compromise wherein both viewpoints relinquish certain claims, but in each viewpoint gaining from the other certain additional principles which result from the tremendous advances in transport equipment and techniques and in medical care.

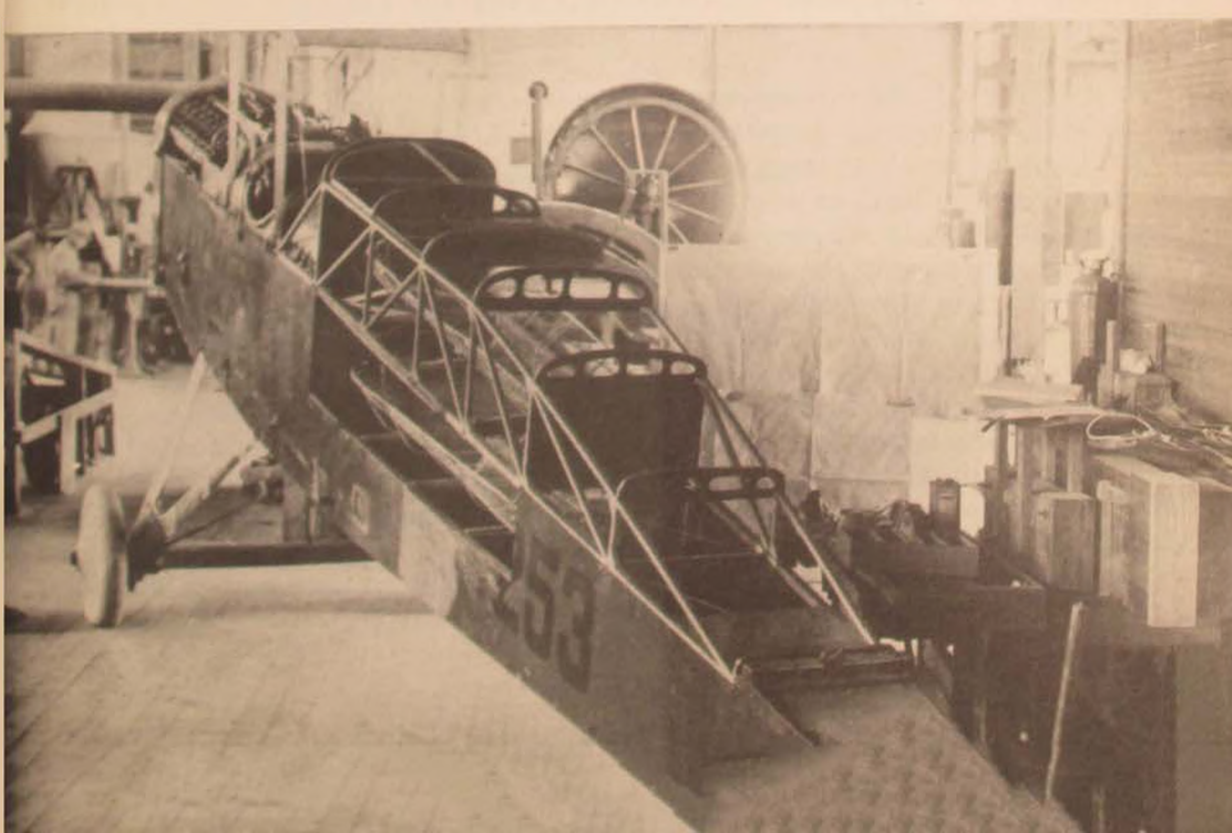
## Early Medical Air Evacuation

*Following the first successful flight of an airplane by the Wright brothers in 1903, it was only seven years until an airplane was designed for transporting patients. In 1910 Captain G. H. R. Gosman, MC, and Lt. H. L. Rhoades, CAC, flew an airplane ambulance of their own construction at Fort Barrancas, Florida. They reported the results to the War Department and requested funds to improve the airplane. The War Department disapproved their request. In May 1912 representatives of military aviation recommended to the Secretary of War that airplanes be used to transport patients, but their recommendation was also disapproved. That same year Colonel A. W. Williams, USA (retired), flew with Lt. Hap Arnold, became enthusiastic about the airplane's possibilities as a means of transporting patients. At the meeting of the Association of Military Surgeons in Baltimore, Maryland, in November 1912 he recommended to the Committee of Transportation of Wounded in War that the airplane could be used to transport from the battlefield to a general hospital those wounded requiring immediate surgery. The Committee was interested and approved his suggestion, but the next day the idea was discarded when an editorial in the* BALTIMORE SUN *stated "the hazard of being severely wounded was sufficient without the additional hazard of transportation by airplane."*

*In February 1918 Major N. E. Driver, MC, USA, and Captain W. C. Ocker, AS, USA, converted a JN-4 into an airplane ambulance at Gerstner Field, Lake Charles, Louisiana. As a result of their activities the Director of Air Service ordered the conversion of one service-type airplane (JN-4) into an air ambulance at each field.*

*Despite the fact that patients were flown in airplanes during World War I, the majority of American military authorities and the general public did not favor using the airplane to transport the sick and wounded. Airplanes were not easily adapted to carry litter patients, and in most the litters had to be wedged into an open cockpit. The remodeled Curtiss Jenny (JN-4D), with space for a pilot, a medical officer, and one litter patient, was being used in 1919 by the U. S. Army. The improvised litter, consisting of six-foot pipes, covered with canvas, with broad belts to strap down the patient, fitted snugly under the hinged fuselage section.*

*In 1920 the first U.S. Army aircraft with a fuselage designed for transporting the sick and wounded was built and flown at McCook Field, Ohio. The airplane was a DeHaviland (DH-4A) (similar to the one shown below under construction at Kelly Field), with space for a pilot, two litter patients, and a medical attendant.*




*By 1921 the Army had a Curtiss Eagle airplane which would accommodate four litter or six sitting patients. Unfortunately for the progress of aeromedical evacuation, this most advanced airplane ambulance crashed in a severe electrical storm in Maryland on 28 May 1921, resulting in the death of seven officers and men. This one untimely crash probably had a decided effect in delaying the development of aerial transportation of patients in the United States. But several medical officers continued to see a great future for medical air evacuation. In 1929 Major Robert K. Simpson, MC, USA, stated "evacuation by airplane will be a very important factor in handling the wounded of the next war if not the method of choice, altogether."*

*In 1928 the U.S. Marines evacuated sick and wounded from isolated jungle posts in Nicaragua to general hospitals by airplane. The airplane carried supplies on its trip into the jungle to evacuate patients. This was the first time that an airplane ambulance was utilized on both incoming and outgoing flights. The two-way pay load, or rather using return space otherwise not filled, was a real step forward.*

*The transportation of the sick and wounded by airplane at the U.S. Army Annual Field Exercises in April 1930 aptly demonstrated the advantages of the airplane ambulance. A tri-motored Ford transport was used which could carry six litter patients, a pilot, a co-pilot, a flight surgeon, a medical technician, medical equipment, and medical supplies. In May 1931, at the First Air Division maneuvers, all patients were evacuated by airplane ambulances. By 1932 transport aircraft with litter supports in the cabins were in use. They could easily be converted into airplane ambulances. In 1935 Lt. Colonel C. L. Beaven, MC, USA, recommended that the U.S. Army adapt as airplane ambulances a small rescue-type airplane and a large transport airplane for peacetime as well as wartime transport of patients.*

## Air Evacuation in World War II

Despite the fact that acceptance and employment of the airplane as a means of transporting sick and wounded had advanced to a considerable extent since World War I, the beginning of World War II found many military authorities supporting the belief that air evacuation of patients was not only dangerous but medically unsound and militarily impossible. This adverse criticism of air transportation of patients was soon proved wrong by the air evacuation operations in the Burma campaign during April 1942. In the Burma theater the climatic and geographical conditions were far from ideal for flying, but nearly one hundred per cent of the sick and wounded were evacuated by air and flown "over the hump" to India.

The first large-scale air evacuation operation by the U.S. Army Air Force under combat conditions was in New Guinea in August 1942. During an Allied counter-offensive against the Japanese, the Fifth Air Force evacuated 13,000 patients a distance of seven hundred miles over the mountains to Australia in seven days.

As the war progressed, the Thirteenth Air Force provided air evacuation for the sick and wounded in the South Pacific, moving 24,767 patients from Guadalcanal in 1943. The Ninth Air Force evacuated 2194 patients in the Libya campaign. In the Italian campaign 75,000 patients were evacuated by airplane from September 16, 1943, to July 31, 1944, with no deaths occurring in flight. Following D-day in June 1944, there arose an urgent requirement for air evacuation. Airplanes and airfields were made available, and 383,676 patients were evacuated from Europe from June 1944 to January 1945.

Improvements in equipment were of great benefit to air evacuation. One of the more important ones was the replacement of the Douglas metal-type litter supports by webbing-strap supports. The new webbing-strap litter supports reduced weight, eased stowage, could be permanently attached to the airplane, increased patient capacity, and eased preparation for use and loading. Other important improvements were the portable oxygen unit and the venturi aspirator assembly. All these made air evacuation more acceptable, since better care could be given to all types of patients.

As might be expected evacuation aircraft in the early stages of World War II were the types of planes operational in the area. The B-17 bomber was used extensively to evacuate the sick and wounded, especially in emergencies. By placing litters in the bomb bay and on the floor in the waist of the aircraft, six to nine litter patients could be evacuated on each flight. Similarly the B-24 carried eight litter patients; the B-25, two litter patients; and the B-26, four litter patients. The chief transport aircraft available in World War II for air evacuation were the C-47, carrying 18 litter patients on metal litter supports or 24 litter patients with the webbing-strap litter supports, or 25 ambulatory patients; the C-54, carrying 18-36 litter patients, or 31-45 ambulatory patients; and the C-46, carrying 24 litter and 9 ambulatory patients, or 37 ambulatory patients. Less extensively used was the C-87, carrying 14 litter and 6 ambulatory patients, or 19 ambulatory patients. When landing facilities were limited, the L-5B, a single-engine liaison airplane, could carry one litter or one ambulatory patient. Also limited in use, was the single-engine C-64, which carried three litter and two ambulatory patients.

Helicopters were seldom used in World War II. In November 1943 the Sikorsky R-6 helicopter became the first flown for air evacuation purposes.

It carried two litter patients, a pilot, and a medical attendant. The litter capsule was attached to the external structure of the aircraft and was designed so that the litter was easily loaded or unloaded. During the flight the patients could be seen through the capsule window by the crew, and two-way intercommunication was possible between the patient and the crew.

Air evacuation, which was not planned or organized at the start of World War II because of the disapproval of many military authorities, came into its own. By the end of World War II it was accepted as an ideal method of evacuating the sick and wounded during a major war.

General Grant, Air Surgeon of the Army Air Forces, summarized the air evacuation operations of World War II as follows: "The gigantic plan of air evacuation in the Army Air Force was conceived during the Tunisian encounter early in World War II, was nurtured largely by the Twelfth Air Force in the Mediterranean Theater of Operations, and rapidly matured in the European Theater during the great offensive.

Following the cessation of hostilities in World War II, air evacuation for military patients requiring transport was continued. Particularly within the United States where evidence supported the need for better medical care and convalescence nearer the home of the patient, the practice of air evacuation has been encouraged and supported logistically and politically. The authorized function of air evacuation of military medical patients was included in the worldwide operational charter for the Military Air Transport Service (MATS) when that organization was established by direction of the Joint Chiefs of Staff.

On 7 September 1949 the Secretary of Defense directed that evacuation of all sick and wounded, in peace and in war, would be accomplished by air as the method of choice. Only in unusual circumstances would hospital ships and other surface transport be used. Air evacuation had "arrived"!

In 1950 Dr. Richard Meiling, Chairman of the Armed Forces Medical Policy Council, stated: "As a peacetime operation, the air transportation of patients is steadily improving in efficiency. As a military operation under combat conditions, a lot of improvement is still required. There still . . . is the small minority which is unable or unwilling to recognize the inherent soundness of air evacuation."

## Air Evacuation in Korea

The Korean outbreak proved Dr. Meiling to be correct. It was some time after the outbreak of hostilities before an orderly system of medical air evacuation could be established. It is difficult to understand the reluctance on the part of some Army medical officers to exploit aeromedical evacuation properly. In the Korean combat zone inadequate roads, rail, and port facilities made medical air evacuation more valuable than during any other campaign. Rugged terrain and inadequate hospital facilities probably did more to establish widespread aerial evacuation in the Korean theater than the fact that the Air Force had the airlift available, although in the case of the helicopter both Army and Air Force medical officers immediately realized its value and employed as many as could be made available for patient evacuation.

With the exception of helicopters, aircraft used in Korea for transporting patients are to a great extent the same types as those used in World War II—C-47's, C-46's, and C-54's. Post-war C-119's are used under emergency condi-

*The extensive use of helicopters to evacuate wounded men from the battle area has been one of the medical highlights of the Korean War. Begun by the 3rd Air Rescue Squadron as an outgrowth of its mission of picking up airmen downed behind enemy lines or in isolated territory, the system has now been adopted by the Army and the Marines. By 1 October 1952, over 7100 men had been picked up by helicopters and flown to landing fields from which larger aircraft could speed them to modern hospitals and medical specialists in Japan or in the United States.*

tions, and during the last year C-124's have replaced C-54's where adequate airfields are available.

The use of helicopters, the most dramatic life-saving device to grow out of the Korean War, deserves additional comment. Helicopter medical evacuation was not planned or ready for immediate action when the conflict began. Evacuation of patients by helicopter was begun in August 1950 by the USAF's Third Air Rescue Squadron, whose primary mission was retrieving downed pilots. Fifth Air Force saw the immediate value of this mercy-flying operation, and a new section was incorporated in the over-all mission of the Third Air Rescue Squadron. The Chinese offensive that began in November 1950 really put the helicopter in the business of transporting patients. The Marines first used helicopters for medical evacuation in November 1950, and the Army began to do the same in January 1951.

Many problems arose in the use of helicopters. Ground forces had to learn that successful operation of the helicopter had certain limitations. Helicopters cannot fly in bad weather, land in just any terrain, or operate successfully at night. The all-important marking of landing sites, the transmission of accurate coordinates, and the proper restriction of helicopter evacuation to critical cases were a few of the many obstacles to be overcome by medical personnel. Some of the available types of helicopters did not prove successful in evacuating patients. Probably the most useful of the early types of helicopters was the Sikorsky H-5. But it was a problem in that the type in use was no longer in production. Procurement of parts and maintenance in general was difficult.

The problems that faced forward air evacuation by helicopter did not apply to combat cargo operations. The C-47's, C-46's, and C-54's were fairly well maintained. Some of the more important problems were the failure on the part of the Army to establish hospitals near landing fields and the continued utilization of hospital trains and hospital ships while transport planes were delivering cargo and returning empty. This did not apply to all the Army surgeons. Some did establish their hospitals adjacent to airfields and relied heavily on air evacuation. One Corps Surgeon found a good and proper use for hospital cars; he used them for troop housing.

Realizing that evacuation of patients by air was more economical and

*The Navy hospital ship Consolation awaits the landing of a U.S. Air Force helicopter on the specially constructed landing deck. This scene reflects one of the consequences of medical air evacuation from the battleline to rear-area hospitals to the most modern medical facilities in the Zone of the Interior. Instead of ferrying patients to the ZI, hospital ships now anchor off shore as floating hospitals.*

more efficient than water transportation, the Navy used hospital ships as relatively stationary floating hospitals. After the construction of a special deck the hospital ship Consolation was stationed above the 38th parallel to receive patients. The Third Air Rescue Squadron supplied two helicopters and over a test period of approximately ten days landed patients directly upon the hospital ship. This operation proved so successful that the Navy added decks to other hospital ships. This has become a routine operation in Korea where the geography lends itself to such a situation.

The evacuation of patients by air consists of three distinct types of operation—(1) forward (principally helicopter operation); (2) tactical (troop carrier type operation); and (3) strategic ·(Military Air Transport type operation). This military division is perfectly logical as far as it goes. The strategic type of evacuation is particularly logical. It clears the zone of communications of long-term non-effective personnel. Since it uses otherwise dead space which can be calculated and predicted, strategic evacuation can be scheduled. The problems involved are such that, once a solution is reached, it can be applied directly to succeeding operations on a relatively long-term basis. Best of all, one terminal point is in the ZI where the emotional appreciation of an informed public will demand and be assured that nothing but the best and most considerate medical care is afforded military sick and wounded.

This is as it should be, but it does not settle the military, logistic, medical, and morale problems which are peculiar to a theater of operations where the enemy is met face to face. Therefore let us limit our discussion here to the two phases of combat evacuation, forward and tactical.

Already mentioned are some of the problems encountered in the Korean conflict. It would be extremely dangerous to place too much emphasis on the experience gained thus far in Korea, since the Korean conflict has been unusual for several reasons. Political considerations have limited the offensive military efforts by the United Nations. The enemy has, for reasons of his own, conducted very little aerial warfare except over his own territory. The lack of air offensive on the part of the enemy has made air evacuation simple. With the exception of one or two scattered incidents, helicopters have been free from enemy air attack. What could we expect if the enemy suddenly committed a considerable number of aircraft to do battle in South Korea, as we are doing daily in North Korea? To be sure, our fighter aircraft would wreak considerable damage upon the enemy, but enemy planes that got through would find our scheduled combat cargo planes easy targets. Helicopters would find their forward and behind-enemy-line evacuation almost an impossible task.

Medical evacuation has been and is a by-product and probably will continue to be just that. There is always critical cargo that must go forward. Personnel, ammunition, food, and vital equipment are priority loads. This means that airlift is available to return the sick and wounded. Accepting that situation and utilizing the space is the least that can be done. But that is not enough. Modern combat operations are not the result of only military planning and maneuvering. International politics and the pressures of world-wide economic factors are increasingly influential. Even moral scruples and sincere belief in the possibility of eventual international understanding influence present-day military operations. It is in this moral climate that we must face the medical and moral obligations toward combat wounded.

Aircrew members who are shot down and then retrieved from enemy-held

*The cavernous interior of a C-124 can accommodate a load of 136 litter patients and 35 medical attendants, with room for a portable operating room. But for tactical air evacuation this huge capacity means that it takes at least 30 minutes to load. Lack of cabin soundproofing and insulation increases patient discomfort. Col. Smith advocates an aircraft the size of the C-47 but with better performance.*

areas by helicopter operations and men who fall in hand-to-hand fighting and are brought out of the firing zone by medical corpsmen have experienced the benefits of that moral and medical obligation. But the potential for saving their lives has just started. Antibiotics and plasma do wonders at this point, but early surgery and definitive medical care are essential in saving lives and assuring a chance for the future. The additional requirement is fast, immediate, and assured evacuation, suitable to the needs of the patient. There are times when the by-product may approach the importance or value of the primary operation. Who is to tell the combat wounded man that his future life is secondary to the delivery of a load of cargo, maps, shells, or bombs?

A look at the aircraft available for medical evacuation now in the field and many that are being constructed reveals that more emphasis has been placed upon the cargo pay load than the medical by-product. The appearance in Korea of the C-119 and the C-124 provided a greatly increased bulk cargo capacity. These aircraft created problems for the airfield engineers, the Air Force mechanics, the crew members (at least for a short period of transition), and also for the air evacuation squadron. Considerable comfort and safety factors had to be forfeited to acquire the additional space. These aircraft are wonderful for moving cargo of all types and are constructed so that loading cargo is no problem. The question arises as to whether these are suitable aircraft to accommodate the medical patient. Why not have within the troop carrier organization these big aircraft for bulky cargo transportation and paradrop (to include airborne troops) operations and also have a more versatile type for hauling of less bulky, smaller loads of cargo and for the evacuation of patients? Such aircraft are in production and time will find us with a dual purpose aircraft that will satisfy both the cargo and medical air evacuation mission. The C-124 and C-119 certainly have definite limitations in patient comfort. In addition they cannot land and take-off on the smaller airfields.

It may be that the C-123 will be an improvement in landing and take-off characteristics, but it too will be fairly uncomfortable for the patient.

Do we need aircraft that are as big as the three mentioned above? If they are lost, we lose more cargo or we lose more personnel whether they be troops or patients. Time on the ground for loading patients is not less than 30 minutes for the C-124. In Korea the antique C-47 served admirably. It could land and take off on the smaller fields. An aircraft of similar size with better performance characteristics is a must. Why not an aircraft that is smaller and more comfortable for patients, with improved turn-around time? Perhaps the answer is aircraft of both types in the troop carrier group.

The same tendency towards construction of larger and larger aircraft seems to be the case also with helicopters. The writer believes that helicopters that carry four or five patients are and will be more valuable than the larger types.

As with all interesting and complex problems, there is no simple answer to the question of how air evacuation should be organized and applied. As always the ultimate solution will be a compromise.

But instead of considering air evacuation as an air ambulance operation or a means for clearing a combat zone of non-effective personnel, let us redefine the aspects of air evacuation in terms of its two principle considerations: military and medical. Militarily the air age has made air evacuation a logistic necessity which should be an integral part of any resupply or air support plan. It must not be treated as an afterthought. Without complete air superiority the evacuation zone will be much larger, and the impact of unmoved or slowly moving non-effectives will increase the support needs.

If World War II drove home one lesson of great importance, it was the absolute necessity for centralized control of each special type of combat activity. This cardinal rule applies to the organization of air evacuation as much as it applies to any other military operation. Yet there remains a powerful body of thought which would split the responsibility and control for the movement by air of sick and wounded. Air evacuation, from battlefield pick-up to movement out-bound for the ZI, cannot successfully be divorced from over-all USAF air logistic planning and operations. It must be integrated with the planning and conduct of all phases of the air war. Not always will we find a theater situation like the one in Korea, where forward helicopter evacuation is free from air attack. These forward operations must depend on control of the air, which aspect of battle certainly is best understood and provided for by the theater air commander. We must also recognize that regardless of who operates forward hospitals, the rearward movement of patients from them depends on available air lift. For some time to come space occupied by in-bound supplies will be allocated outbound to sick and wounded. Patients must not be assembled and kept waiting at forward airstrips because weather or other unavoidable circumstances has delayed a scheduled flight. Neither can valuable cargo space wait at the landing field for hours on patients to be brought from some distant hospital by helicopter or ambulance. The urgency of combat and priority of cargo movement dictates the shortest possible turn-around time at forward airstrips. With theater airlift controlled by the theater air commander it is imperative that he have complete control of all movement of patients if close coordination of such movement is to be maintained. If forward helicopter operations are not closely meshed with scheduled USAF logistic missions we are turning back the clock and forfeiting the speed of movement the helicopter and the airplane can afford. The Chief Surgeon of the ETO in 1944 stated, "During World War II there were so many agencies which controlled air evacuation within the theater that the medical service found it was unable to effect a good liaison with the Air Force." So many echelons of command were involved that in many cases it took more than a week to make the proper contact. This situation can again occur under conditions of a fast moving, fluid battle situation and a combat zone vastly larger than Korea. One central agency should control all air movement of patients.

Distinct advantages of one controlling agency are that communication difficulties are minimized, unnecessary movement of patients is eliminated, and patients are transported earlier to hospitals of a specialized type. One controlling agency decreases the administrative red tape relative to numerous medical facilities—curtailing logistical problems that reflect all along the echelons. It avoids duplication of flight operations by another agency—parts, maintenance, personnel, and facilities for forward helicopter evacuation. *In Korea it was proven that all helicopter operations—namely, rescue, supply, and patient air evacuation—can be accomplished by one organization.*

Apart from considerations such as weather and enemy action, the success of aeromedical evacuation of patients depends upon good liaison between the different services and sound organization under one control.

I should like to emphasize that, in a combat theater, air evacuation of all types of cases is accomplished even if the risk is great. There is not conclusive evidence that evacuation by air is 100 per cent contraindicated for any particular type of patient. It is believed that all types of cases can be transported by air, provided that the airplane is adequately equipped and that medical personnel are well trained in the principles of aerotherapeutics.

Medically air evacuation is an opportunity to exploit the miracles of modern medicine for the saving and rehabilitation of more lives. But the best in modern medicine requires considerable hospital support. The farther and faster the wounded are removed from the combat area, the better, more efficient, and more economical will be the medical care.

That there are divergent views on air evacuation is evident. There is a real need for staff training of military personnel to emphasize the interrelation of medical and military requirements. Wounded men are not just so much space and weight. Anyone who stops to think knows and appreciates this fact. But grand-scale logistical thinking may submerge the human factors. Conversely adequate patient comfort does not require a hospital with wings on. The answer will come, but only when logisticians, design engineers, flight surgeons, operations personnel, and military commanders strike a solution which considers all requirements, and they agree on a plan and equipment with which all are determined to do a job.

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# Books and Ideas . . .

## *The Middle East*

DR. PAUL L. HANNA

TODAY'S strife between the Communist and the non-Communist worlds gives peculiar significance to conditions and events in the borderlands which divide the Soviet Union and its satellites from what (for want of a really suitable term) is called the Western sphere. Finland, Germany, Austria, Yugoslavia, the Middle East, Pakistan, India, southeast Asia, Formosa, Korea—all these are regions of tension and uncertainty, where Communists and anti-Communists plan, intrigue, and battle to gain the advantage. Not least in importance among these border regions is the Middle East.

Books, pamphlets, and magazine articles dealing with the individual countries of the Middle East or with special topics pertinent to the area have in recent years been produced in constantly increasing numbers. Many of these are of excellent quality. Attempts to deal with the Middle East as a whole have been less common and generally less successful. All too often they have been journalistic reports, superficial or of merely ephemeral interest. But within the past year several worthwhile works have appeared in America. One, an excellent brief discussion of the current situation in the Middle East, is J. C. Hurewitz's pamphlet, "Unity and Disunity in the Middle East" (*International Conciliation*, May, 1952). Another, a full, almost encyclopedic treatment of the Middle Eastern scene, is George Lenczowski's new work, *The Middle East in World Affairs.**

Lenczowski's book, designed for textbook use in college courses in the contemporary Middle East as well as for the general reader, concentrates its attention on the period from the First World War to 1951 but provides a useful introductory chapter covering the earlier history of the Ottoman and and Persian empires. Several chapters on the First World War and the peace settlement survey the Middle East as a single unit, but the major part of the books consists of a detailed, country-by-country account of events, largely political and diplomatic, from 1919 to the present. This type of organization, though common in text books and possibly necessary in dealing with a large and diverse area, results in considerable repetition and in obscuring regional trends and area-wide movements. To some extent this defect is rectified in a group of concluding chapters on the area's strategic waterways, the Arab League, and the role of today's great powers (Britain, Russia, and the United States) in the Middle East. Lenczowski is probably at his best when he writes of Iran, for he has lived in that country and has made it his special field of study. There is a good but unannotated bibliography. Economic conditions, which in general receive too little attention from Lenczowski, may be examined in *The Middle East, a Political and Economic Survey* (London: Royal Institute of International Affairs, 1950) and in Hedley V.

***The Middle East in World Affairs, by George Lenczowski (Ithaca, N. Y.: Cornell University Press, 1952, $6.00), pp. 459.**

Cooke's recent study, *Challenge and Response in the Middle East: The Quest for Prosperity, 1919-1951* (New York: Harpers, 1952).

The Middle East—or, as the National Geographic Society and the American State Department would prefer it, the Near East—is defined by Lenczowski as the territory lying between the eastern shores of the Mediterranean and the western frontier of Pakistan and from the southern borders of the U.S.S.R. to the Indian Ocean. This includes Egypt, the lands of the Arabian peninsula (Saudi Arabia, Yemen, Aden, Muscat and Oman, Trucial Oman, Qatar, Bahrein, and Kuwait), the countries of the Fertile Crescent (Israel, Jordan, Lebanon, Syria, and Iraq), Turkey, Iran, Afghanistan, and the island of Cypress. Other authorities often include the Sudan and sometimes even the Moslem states of North Africa—Libya, Algeria, Tunisia, and Morocco.

Defined narrowly without its possible African extensions, the Middle East is a region about the size of the United States, lying at the juncture of the European, Asiatic, and African continents. Its northern reaches, fronting the Soviet Union, are composed of the mountains and uplands of the Anatolian and Iranian plateaus. To the south are the arid lands of the Egyptian, Arabian, and Syrian deserts and the fertile ribbons along the Levantine coast and in the lower Nile and the Tigris-Euphrates valleys. The region is in general poor in natural resources. In the Persian Gulf area, however, are located over 40 per cent of the world's known petroleum resources. Strategically the territory is of great significance. Through it pass the Suez Canal, a vital link in European sea-borne trade with the Orient, and the Turkish Straits, uniting the Black and Mediterranean Seas and offering Russia the possibility of a water route to the south. Across the Middle East inadequate but still important rail and highway routes link Europe with southwestern Asia and Egypt, and the shores of the Caspian Sea with the head of the Persian Gulf. Over it and through its great new landing fields at Beirut and Dhahran pass the air routes from Europe to India and the Far East.

The Middle East is populated by 90 to 100 million people of whom, despite the region's Arab core, somewhat more than half are ethnically and culturally non-Arab. Along the northern fringe are the Turks, the Kurds, the Iranians, and the peoples of Afghanistan. In Cypress are Greeks, and in Palestine the Israelis. Well over 90 per cent of the people are Moslems, but Christians of various sects (largely concentrated in Lebanon, Egypt, and Cyprus) and Jews (now chiefly in Israel) comprise a culturally and politically significant element. The region undoubtedly finds its strongest cohesive force in Islam, for Mohammedanism is a way of life as well as a religion. The Sharia law in theory prescribes every aspect of social conduct. Yet the strength of this bond can easily be exaggerated. In the first place, Islam is not limited to the Middle East. Some 200 million Moslems live under varied political and social conditions outside the region. Further, Middle Eastern Islam itself is split into mutually antagonistic sects and groups. Finally, secularism, most notable in Turkey but present also elsewhere, has weakened the role of religion in the life of the people. The cultural unity of the Middle East is more myth than fact.

The disunity of the Middle East is revealed also in the diversity of its political institutions. Turkey, Syria, Lebanon, and Israel are republics. Egypt (at the moment of writing), Jordan, Iraq, and Afghanistan are constitutional monarchies. Saudi Arabia, Yemen, and the principalities on the southern and eastern fringe of Arabia are tribal or semi-feudal autocracies. Cyprus and Aden are British crown colonies. Yet even these groupings are far from adequate to describe the situation. Turkey and Israel possess effective representative and democratic systems. Their governments are stable, and the level of social services is high. But in Syria and Lebanon, western-style constitutionalism has never functioned effectively, either under the French mandate of the 1920's and 1930's or in the independent states since the Second World War. Wealthy landed proprietors, religious leaders, and now in Syria the army officers have manipulated governmental institutions and dominated the state. The situation in Egypt, Jordan, Iraq, Iran, and to some degree in Afghanistan has paralleled that in Syria and Lebanon despite the difference in governmental forms. Today the army plays a dominant role in Egypt, just as it does in Syria, and has an important role in Iraq.

Outside the feudal and tribal areas, nationalism has become one of the strongest forces in the Middle East. Not only are the upper classes and the small but growing middle class intensely nationalistic, but the masses of the people as well rally to the slogans of patriotism and anti-foreignism. The present countries of the Middle East are young, and many of them gained their independence only after a struggle with external forces. The Turkish republic was born out of the First World War and the effort to expel the Greeks from Anatolia in 1919-1922. Egypt won its freedom piecemeal from Britain in the years after 1919. Iraq, Jordan, Syria, and Lebanon chafed under British and French domination in the years between the World Wars. Iran suffered foreign occupation in both the World Wars of 1914 and 1939. It is not surprising, therefore, that most Middle East nationalism tends in its expression to be negative rather than positive. It is anti-foreign before it is pro-Iranian, pro-Egyptian, or pro-Syrian. Israeli nationalism, in some ways unique, has its bases in the religio-cultural unity of the Jewish people and in the Zionist endeavor to create a Jewish sovereign state in Palestine. Jewish clashes with British policy and with Arab national sentiment and the emergence of Israel as the result of a successful war with the neighboring Arab states have merely confirmed and intensified Israeli nationalism.

The existence since 1945 of the Arab League and the more recent conclusion of an Arab collective defense pact may seem to belie the intensities of divergent nationalisms in the Middle East. But the Arab League includes only states of the Arab core of the area. And while it is certainly true that a real sense of Arab cultural unity exists, in practice this unity is weakened by the divisive interests of the various states. Egypt seeks to use the League for its own aggrandizement. Lebanon fears that its slight Christian majority may be swallowed up in a greater Islamic unit. Egypt and Saudi Arabia are alarmed lest a union of the Fertile Crescent states damage their power and prestige. The Arab League has shown unity chiefly when expressing the common Arab opposition to Israel and to Western imperialism, and even then the unity has been more verbal than actual.

Despite the significant development of manufactures in Israel, Turkey, and Egypt during the past thirty years, the economy of the Middle East is still dependent upon agriculture and the extractive industries. Cotton from Egypt, citrus from Israel, dates from Iraq, chromium from Turkey, and petroleum from the Persian Gulf states provide the major exports of the region. Cereal and root-crop production, together with sheep and goat herding, are important in the local market. Most of the agriculture is subsistence farming conducted under primitive conditions. The prevailing systems of land tenure (particularly in the Arab countries and Iran) have made of the agricultural laborer either a poverty-stricken share-cropper or a debt-ridden petty proprietor working a farm too small to supply the needs of his family. Population nevertheless is increasing rapidly. Poverty and economic distress are ever present.

Lack of adequate raw materials, unavailability of skilled labor, and shortage of capital dim the prospect of raising the standard of living through rapid or widespread industrialization. Extensive (and expensive) irrigation and drainage projects could open large tracts of land to cultivation in Syria and Iraq and small but appreciable areas in other countries. Improved methods of farming could increase the productivity of land already under cultivation. That amazing progress can be made through land reform, agricultural development, and the fostering of suitable industries has been demonstrated in Turkey and in Israel.

The principal significance to the outside world of the culturally and politically divided and economically underdeveloped Middle East is strategic. Throughout history many of the major empires of the world—Egyptian, Persian, Alexandrian, Roman, Islamic, and Ottoman—have possessed or sought to possess this crossroads of the continents. In the nineteenth century Russia and Great Britain became major contenders for control of the area, and in the mid-twentieth century the United States is finding its foreign policy deeply involved in Middle Eastern affairs.

In the building of the Russian state the Tsars expanded southward at the expense of both Turkey and Iran. The unsatisfied Russian desire for an outlet to the Mediterranean and control of the Straits was chiefly responsible for the celebrated Eastern Question which plagued nineteenth-century European diplomacy. Today the Middle East lies adjacent to the oil-producing areas of the Soviet Union and to some of its most highly industrialized regions. Controlled by a powerful enemy of the U.S.S.R., the Middle East might become a vantage point for attack upon areas vital to the Soviet economy. Controlled by the Soviet Union, the Middle East might serve either as a bastion for defense or as a corridor and base for aggression. Under these circumstances the U.S.S.R. still casts a covetous eye toward the south. In 1940 Molotov sought from the Germans agreement to Russian control of the Dardanelles and the creation of a Russian sphere of influence in Iraq and Iran. Soviet postwar pressures on Turkey and Iran and various attempts to exploit the Palestine situation suggest that Communist desires have not altered.

The poverty of the people of the Middle East, the frequently unrepresentative political regimes, the plight of Arab refugees from Israel, and the xenophobic and peculiarly anti-western attitudes of leaders and peoples alike present opportunities for Soviet influence to expand. Soviet agents mendaciously offering land and bread, industrialization without foreign exploitation, and full national sovereignty are in a strong position to enlist disciples for Communism. Iran, adjacent to Russia and weakened by the loss of its oil revenues, appears to offer an open door into the heart of the region. But yet Communism has made only slight inroads in the Middle East. Turkey, in so many ways non-typical of the weaknesses of the region, is strongly anti-Communist and is now a member of the North Atlantic Treaty Organization. In most of the other lands Islam provides a real, though not an insurmountable, barrier to the spread of Communism. Furthermore the wealthy and middle-class groups which dominate the Arab states and Iran would be the first to suffer in case of a Communist victory. This they realize.

British interest in the Middle East, like that of Russia, is of long standing. In the nineteenth century Britain sought to develop commerce with the area, to control the trade routes which cross it, and to block the attempts of Russia to expand southward. In the years between the First and Second World Wars Great Britain was the dominant foreign power in the area. The British governed Cyprus, Palestine, Trans-Jordan, and Aden and had preferential treaty relationships with Egypt and Iraq. In Iran the British government held a controlling interest in the Anglo-Iranian Oil Company. Yet the rise of nationalism in the Middle East, the weakening of Britain's position at home and throughout the empire, and the stresses of the Second World War seriously weakened Britain's power and prestige. The Cypriots today want union with Greece. Israel is independent, and Jordan is weak and uncertain. The Sudan has been promised self-determination, and Egypt is seeking to eject Britain from the military and air bases along the Suez Canal. Iraq seethes with anti-foreign ferment. Iran has nationalized the Anglo-Iranian petroleum industry. It is true that British military, naval, and air installations in Cyprus, Egypt, Jordan, and Iraq are still of great strategic importance and that British knowledge of the area is still a valuable asset. Nevertheless the day of effective British control in the area is over.

The United States until very recently had few interests in the Middle East, and these few were chiefly missionary, educational, and philanthropic. In the years between the World Wars concern for oil was added as American companies secured concessions in Saudi Arabia and Bahrein and shared in other concessions in Iraq and Kuwait. With the decline of British power and the outbreak of the cold war between the Communist world and the West, the United States was catapulted into a position of leadership in the Western world and perforce developed deep concern for the security of the Middle East. For better or for worse, America became in large degree heir to the former British position in the area.

American objectives in the Middle East, though closely linked together and overlapping, are actually threefold: to prevent an extension of Soviet power into the region; to employ the resources of the area (chiefly oil and strategic location) for the strengthening of the West; and, in order to attain these goals, to foster political stability and economic and social progress. Considerable military and economic aid has been given to Greece and Turkey and a little to Iran. Economic aid has gone to Israel and the Arab lands. Plans have been drafted for a Middle East defense system to link in partnership the major states of the west and those of the Middle East.

This American program for the Middle East is not easy to fulfill. The divergencies and disunity of the region make a single approach to its problems difficult. United States support for Israel, a dynamic non-Arab and non-Moslem state arising at the heart of the Arab and Moslem worlds on territory long claimed as Arab, has weakened the American position among the Arabs. To the suspicious eyes of the Arabs and Iranians, politically and economically weak and only now escaping the shackles of Western imperialism, American suggestions for the use of their resources and their territories to strengthen the West appear as thinly veiled efforts of a new and powerful imperialist state to deny their independence and steal their potential wealth. If the United States supports its Western allies in conflicts with the Middle

Eastern states or their neighbors, as in the cases of the British disputes with Iran and Egypt over oil and the defense of the Suez Canal, or the French conflict with the Moroccan and Tunisian nationalists, it runs the risk of antagonizing the Middle East. If it supports the Middle Eastern peoples, it endangers its Western alliances. If it remains rigidly neutral, it offends both sides. Finally there is a fundamental conflict involved in American policy. The creation of a strong Middle East, impervious to Communist propaganda, must mean an economic, political, and social revolution in large areas of the Middle East. Living standards for the masses must be raised; government must be made to serve the interests of the people; special privilege must be eliminated. But at the moment the forces of stability and order in many countries of the Middle East are the forces of privilege and the *status quo*. Out of desire for stability the United States appears impelled to support these forces. Yet their continued dominance can, in the long run, lead only to popular unrest and the spread of Communist influence. It is, of course, possible that the rise of dictator-reformers like General Naguib in Egypt may provide a partial solution to this American dilemma. The example of Kemal Ataturk in the Turkey of a generation ago offers hope.

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## Physics and Medicine of the Upper Atmosphere

Dr. Harvey E. Savely

IN the fall of 1951 the USAF School of Aviation Medicine and the Lovelace Foundation for Medical Education and Research sponsored a symposium which has resulted in the publication of a book* containing the papers presented at the meeting. Thirty-four scientists from the fields of astrophysics, aeronautical engineering, radiobiology, and aviation medicine have discussed the present state of knowledge in their specialty in relation to the topic of the symposium. The result is an attractive volume of about 600 pages composed of 39 papers covering a variety of aspects of the scientific and technical problems important to research and aviation in this new frontier, new because the means are now at hand for exploring and exploiting it.

The principal papers may be classified broadly into the following categories:

- Physics and chemistry of the atmosphere: 6 papers
- Methods and instrumentation for study of upper atmosphere: 7 papers
- Physiology of temperature, vision, cabin environments, orientation, and escape: 7 papers
- Review of engineering aspects of environment control problems: 1 paper
- Atomic power plant radiations: 1 paper
- Papers, including some of above, oriented toward various aspects of space travel: 10 papers
- Physics and biology of cosmic radiation: 7 papers

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***Physics and Medicine of the Upper Atmosphere, edited by Clayton S. White, M.D., and Otis O. Benson, Jr., Brig. Gen., USAF (Albuquerque: Univ. of New Mexico Press, 1952, $10), pp. 611.**

The symposium either through design or through the predominant interest of the participants seems to lean heavily on problems of outer space travel for subject matter, particularly when the papers on cosmic radiation, which seem to have meaning only in this context, are included. No criticism can be aimed at the intent of the symposium, its general timeliness, or the motivation which led to its organization. As recorded in this book, it is important for focusing attention on the need for correlation of work of the various disciplines interested in the upper atmosphere and forms a basis of comparison for further symposia which it is hoped will be forthcoming after an appropriate interval.

The physics of the upper atmosphere is of considerable theoretical interest in the fields of geophysics, meteorology, astronomy, and nuclear physics and has been studied largely from this motivation as well as the potentiality of applying the results in aviation. The papers on this phase of the symposium are generally concise summaries of the state of knowledge on various aspects of the subject. An appreciation of the interest of the physicist is important to the biologist, but much of the information does not have a bearing on the human factors in flying. Understanding of biological problems in the upper atmosphere must, of course, be based on physical knowledge. Many flights of more than short durations in the region above 50,000 feet should provide the physical scientist possibilities for direct observation. One of the prime objectives of the symposium was to bring together biologist and physicist, so that such interrelationship could be emphasized and fostered.

The physiological aspects of environmental control and provisions for emergencies are not thoroughly treated in relation to the past and present trends in aviation, although the individual papers on tolerance to temperatures and sound problems are realistically presented. The paper by an aeronautical engineer gives the best over-all treatment of the subject, as might have been expected from one so intimately concerned with the orderly progress from one state of aircraft complexity to another. The history of aeromedical research indicates that extension of altitude and speeds of aircraft do not create completely new problems. Rather they are for the most part changes in degree and complexity of existing problems.

The biological problems encountered below 50,000 feet have been a subject of intensive study during the past two decades, with the result that many of the physiological limitations of man for flight in the upper atmosphere are understood and great advances have already been made in engineering development of aircraft and personal protective equipment to compensate for these limitations. Examples are the physiological limits to low oxygen tension, low barometric pressure, and low temperature. These have been overcome by developments in cabin pressurization, air conditioning, oxygen breathing equipment, and pressure suits. Further advances upward do not call so much for increase in basic physiological knowledge as for technological development and applied physiological research to provide cabin environments and emergency equipment based on known human limits. Physiological research will take the form of applied research closely coordinated with the aircraft and equipment designers to provide practical compromises for each type of aircraft. For example, the effects of aerodynamic heating and solar radiation will call for special engineering solutions to be worked out in cooperation with biologists. Similarly introduction of closed cabins with storage systems for pressure, refrigeration, and control of humidity and $CO_2$ at altitudes above 70,000 feet will require additional physiological research to provide practical application of known physiological principles.

Much of the effort of biologists and engineers must be devoted to protecting man under emergency situations where his normal environmental control has failed, and these problems become extremely more complex and difficult of solution as speed and altitude are increased. Since the problem has been exclusively military, security probably is responsible for the limited space devoted to the subject. The problems of emergency escape will be with us for many years, unless the chances of mechanical failures or enemy action are reduced to a point where the risks will be assumed by pilots. There is little hope for this. In any event new and untried experimental aircraft cannot be expected to have such reliability and will require means for retrieving pilots following emergencies.

The extent to which the ejection seat, which has been so successful at lower speeds, can provide reliable escape at higher speeds and altitudes is not yet known. It is generally assumed that a change to an ejectable cockpit or capsule will eventually be required. Either of these solutions will be expensive to develop and test, as experience has shown, and will impose a difficult engineering problem on the designer. The study of such methods of escape is underway, but as it proceeds efforts are being made to find and extend the limits of usefulness of the ejection seat because of its relative simplicity and lower penalty on the aircraft.

Provisions for the loss of cabin pressurization imposes another complex task on the developer of personal equipment. In effect a personal pressure cabin in the form of some kind of pressurized suit is required. This suit must also offer mechanical protection to the body against explosive loss of cabin pressure. The form the suit will take may depend largely on the duration of protection required. At best it adds another impediment to the flyer, which adds to the problem of keeping him comfortable and efficient.

An example of a physiological limitation which may be a factor of increased importance in the upper atmosphere is vision, which heretofore has not appeared as a serious limitation in aviation. This is brought about by the increased speed which reduces the time for recognition and by the absence of the effects of the atmosphere in scattering light rays, leading to a disturbance of normal visual adjustments to brightness.

The toxic effects of the increased ozone concentration at high altitudes may be a factor but none of the authors estimated its relative importance. The problem will be avoided above 70,000 feet because of engineering considerations, which will require a closed cabin with a storage system for breathing, pressure, and refrigeration. Below this altitude cabin pressures of less than 1 atmosphere, combined with use of the oxygen breathing equipment, seems to rule out ozone as a serious problem.

The physics and biological effects of cosmic radiation are treated thoroughly and at some length. It is comforting to learn by sifting the large amount of information presented that the consensus is that there is no problem below 60,000 feet and only a remote possibility above this altitude, unless prolonged flights in space ships are considered. In relation to the many other hazards of flight cosmic radiation can be dismissed from practical consideration in the foreseeable future of military aviation.

Mastery of the region below 50,000 feet is not complete, and we may look forward to many years of effort on the part of the biologist, physicist, and engineers before we are at home in the region up to 100,000 feet. Major General Harry G. Armstrong, the Surgeon General of the Air Force, points out in his introduction that knowledge of human factors should precede engineering design and that this requires a lead time of 5 to 10 years. It is apparent that this lead time is already advancing far into the new frontiers (and we may assume that aircraft of more advanced designs are already being considered), at a time when research on the new problems introduced by travel at these altitudes is in the beginning stages. These problems, particularly those in the region from 50,000 to about 100,000 feet, are real and immediate. Those responsible for advances in military aviation will need to ask what aspects of this immediate problem can be neglected in favor of the more remote problems of orbital satellites and interplanetary space ships.

Space travel such as encountered in manned orbital satellites and interplanetary rockets is a prominent feature of the book in the discussions of a number of authors who seem to have a strong bias for this subject. While such discussion might seem to be beyond the scope of the symposium, as indicated by title, their inclusion provides an interesting play of the imagination on a subject that will probably long attract the speculations and dreams of man. The attractiveness of the idea is attested by the recent flood of popular books and magazine articles on the subject, not to mention the popularity of science fiction books, films, comics, and TV programs. Scientific and technological progress has been so rapid in the last 50 years that even scientific observers are overwhelmed and overawed. Scientific and technical achievements seem limitless. Those who may have doubts are cautious about voicing them for fear of being classed with those men of limited vision who have failed to appreciate each of the great technical achievements in the past. It is easy to assume that because a thing is technically possible it will ultimately be done, or should be done. This ignores the question of whether it is worth doing. This is a matter beyond science and technology and must involve economics, politics, sociology, philosophy, and religion—in other words the total aims and resources of a civilization. The scope of projects such as man-carrying orbital satellites and interplanetary rockets are no longer ventures for small groups of men but would involve a significant portion of the human and natural resources of a nation. That society will place sufficient value on space ships to make the sacrifices necessary to have them is highly unlikely and would be gross misdirection of energy if it ever came about.

*Wright Air Development Center*

## *THE HERITAGE OF DOUHET*

*(continued from page 69)*

"unit of destruction." At the time he made these statements, Douhet had apparently given no thought to what the proper size or character of the individual bomb ought to be and was presumably talking in terms exclusively of high explosive. However, in his last written work, *The War of 19–*, he has the belligerent of the future (Germany) who is executing his precepts adopting three types of bombs, identical in weight at 50 kg. (110 lbs.) but varying in content by three categories: high explosive, incendiary materials, or poison gas. These three types are loaded in each squadron in the proportions 1, 3, and 6 respectively. World War II was to show that for the destruction of vital parts of significant industrial systems, high explosive bombs of 10 to 20 times the individual weight stipulated by Douhet were often insufficient.

Throughout his work Douhet indulges in recurring fantasies about what his "bombing units" carrying 20 tons of bombs each can accomplish. "An Air Force of 50 bombing units [500 planes] each capable of destroying a surface 500 meters in diameter, could in a single flight completely destroy 50 enemy objectives, such as supply depots, industrial plants, warehouses, railroad centers, population centers, et cetera." Speculations representing roughly the same arithmetic occur again and again. In his *The War of 19–*, he has 150 railroad centers being simultaneously bombed with an *average* of 20 tons of bombs each, some receiving as little as 10 tons each. The figures, incidentally, presumably make full allowance for the limitations on accuracy of aerial bombing. And they must be interpreted in the light of a "guiding principle" he had expressed earlier: *"the objective must be destroyed completely in one attack, making further attack on the same target unnecessary."* So it is not at all remarkable that the conflict he describes is for all practical purposes decided in a single morning.

Related to his exaggerations of the physical effects of bombing is his general vagueness on the subject of target selection. One of his utterances on the *importance* of target selection leaves nothing at all to be desired on the homiletic side and is deservedly treated as a classic statement on the subject. Immediately following an enthusiastic survey of what an Air Force of 50 bombing units could do he adds this cautionary note:

> All this sounds very simple; but as a matter of fact the selection of objectives, the grouping of zones, and determining the order in which they are to be destroyed is the most difficult and delicate task in aerial warfare, constituting what may be defined as aerial strategy. Objectives vary considerably in war, and the choice of them depends chiefly upon the aim sought, whether the command of the air, paralyzing the enemy's army and navy, or shattering the morale of civilians behind the lines. This choice may therefore be guided by a great many considerations—military, political, social, and psychological, depending upon the conditions of the moment.

Nothing in Douhet is more profoundly true or better stated. It is only a pity that he gave the matter little further thought.

One must of course give him due credit in this area for avoiding simple conclusions. He properly insisted that "no hard and fast rules can be laid down on this aspect of aerial warfare," and significantly added: "It is just here, in grasping these imponderables, in choosing enemy targets, that future commanders of Independent Air Forces will show their ability." Lesser minds than his have been all too ready to give final answers to the terribly difficult problem of selecting targets for the bombers. Nevertheless, it is disappointing that Douhet contents himself with only the most random observations.

One would be tempted to add that it is astonishing as well. How could one who had so little idea of what it is necessary to hit be quite so sure of the tremendous results which would inevitably follow from the hitting? What keeps it from being unduly surprising in Douhet's case is simply that many of his more ardent followers, both professional officers and civilians, have shown down to the present day the same relative unconcern with the problem of knowing what to hit and why.

Douhet's whole philosophy would seem to point to his putting the enemy air force and his aircraft production industry at the top of the priority list among target systems to be attacked. But he allows for certain exceptions to the rule, as for example "when the enemy's aerial forces are so weak it would be a waste of time to devote men and materials to so unimportant an objective." Unfortunately, he was so confident of the ascendency of the defense in ground warfare that he never asked himself what the first objective should be if the enemy had a substantial air force but also a powerful ground force which was already rapidly invading one's own territory—as the Germans invaded Poland in 1939 and France and the Low Countries in 1940. And his answer would have been meaningful only if he were not quite so sure that either danger could be effectively eliminated in one day.

But even granting that Douhet would in most cases designate enemy air power in all its forms as the first objective for one's bombers, the question remains: what next? Command of the air is, after all, only a means to an end. On the subject of what targets to choose after the elimination of the enemy air force, Douhet is extremely vague. He appears to favor what is now called strategic bombing rather than tactical, and on the tactical side he clearly favors interdiction rather than front-line targets, but he avidly follows his own injunction to avoid hard and fast rules. Fundamentally Douhet reposed his faith on the bombing of cities *per se*, on the attack against population. Certainly there is no evidence of his having given the slightest attention to what is involved in the attack on an industrial system, as for example the aircraft industry, which is almost the only industry which Douhet ever mentions in his few allusions to targets.

There is, however, one dictum which Douhet is willing to assert without qualification, and which indeed he offers as a compensation for his refusal to commit himself to specific rules on the choice of objectives: *"Inflict the greatest damage in the shortest possible time."* His reason is apparent in a sentence which follows almost immediately: "A really strong Independent Air Force . . . could inflict upon an unprepared enemy such grave damage as to bring about a complete collapse of his forces in a very few days." On this basis he considers the value of the surprise attack (prior to declaration of war) to be "obvious." In other words, one must quickly annihilate the enemy or be quickly annihilated oneself. Perhaps no other rule laid down by Douhet is as firmly embedded in contemporary thinking as this one.

Most of the rest of Douhet's thinking is plainly derivative from the general principles we have already reviewed. Nevertheless, it is interesting to recall some of his ideas on the organization and operation of air forces, if for no other reason than to observe how some of them have persisted into the present, either because of their intrinsic merit or the sheer momentum accorded them by the magic of Douhet's name.

The grand mission which he assigns to air power permits no subservience of the air forces to the demands or requirements of the land and naval arms. The nation's air force must therefore be independent. But Douhet went further and insisted that *all* the nation's military aviation must be contained in the Independent Air Force, that "Auxiliary" aviation—that is, aviation integrated with ground and naval forces—was "worthless, superfluous, harmful." He considered it worthless because it could not contribute to winning command of the air and yet was dependent upon the achievement of command for its own operation. It was superfluous because after the indispensable command was won and its major benefits exploited, the Independent Air Force is in a position to divert a substantial part of its strength to ground and naval support if needed. It was harmful because it represented a diversion of aerial force from the essential purpose of that force, and thus put the achievement of that purpose into needless jeopardy. Thus, Douhet's slogan for the allocation of the national military resources is a dual one: The major national resources must be concentrated in the Independent Air Force, and *all air* resources must be concentrated in the Independent Air Force.

It must be added that Douhet put himself to no pains to explore how the Independent Air Force, after it had carried out its major mission, would devote itself to direct ground force and naval support. He makes several allusions to the use of aircraft against what would now be known as "interdiction" type targets, but it seems fairly obvious that his conception of air power did not encourage its use in any manner which made it competitive with or supplementary to field artillery. Although he is not explicit on the matter, one would guess that it was less a matter of his considering such a use inappropriate than of its being unnecessary. An air force properly used would bring about first disorganization and then collapse of enemy armies and navies—if the enemy homeland did not collapse first—and that was all there was to it.

As might be guessed from his emphasis on the inherently offensive nature of air power, Douhet emphasized the bomber as the unit of value in the air force rather than the fighter or pursuit plane. The latter, which is useful only as an escort to the bomber, need only be proportionate to the enemy's in numbers, whereas the more bombers the better. Certainly if one must lack either type, the lack of pursuit planes was the lesser of two evils.

In Part II of his *Command of the Air,* which he added in 1926, Douhet rejected the fighter altogether in favor of what he called the "Battleplane," which was simply a bomber with sufficient armament and armor to enable it to defend itself against enemy fighters. The battleplane was, as he put it, "the *only* type of plane which should make up the operating mass of an Independent Air Force— the *only* organism necessary, because sufficient in itself, to wage aerial warfare." On the other hand, in his very last written work, *The War of 19—,* he has the Germans effectively using very fast fighters, not indeed as escorts but in "explorer squadrons" flying separate offensive missions in support of their bombers.

WITH respect to the wider problems of war, the consideration of the national aspirations and objectives which should give not only meaning but direction to any issue of arms, it must be acknowledged that Douhet was no Clausewitz or Mahan. Yet neither does he wholly belong to that more numerous genre of strategic thinkers and writers who are content to leave politics to the politicians, who disdainfully dismiss as "philosophic" if not "idealistic" a concern with making the means fit the ends.

The very opening sentences of Douhet's second major work, the *Probable Aspects of the War of the Future,* published in 1928, express the kind of sentiment which modern military men normally steel themselves against:

> The study of war, particularly the war of the future, presents some very interesting features. First is the vastness of the phenomenon which makes whole peoples hurl themselves against one another, forgetting for a time that they all wear the aspect of human beings, that they belong to the same family of humanity striving toward the same goal of ideal perfection, to become wolves and throw themselves into torment and a bloody work of destruction as though possessed by blind folly.

Now this is a statement which Clausewitz could never have written because to him the notion of fighting a war in any such compulsive manner as is reflected in the last clause quoted above was totally inadmissible. It represents the negation of all that is timeless in the Clausewitzian philosophy—the idea that war is an act designed to further a political objective or group of objectives and therefore must be governed from first to last by those objectives.

Douhet's attitude was not merely one of expressing regret and shrugging his shoulders. His severe criticism of the French General Staff for its handling of World War I was based, at least implicitly, on the very point that the terrible bloodletting which attended the futile offensives could not but sacrifice the essential long-term political and social interests of France, besides being militarily stupid and dangerous. But apparently he saw no comparable problem in the conduct of air operations, or rather he felt that the very nature of air war was such as to leave no alternative to a simple paroxysm of unrestrained violence as the proper means of fighting it. Judgment and choice were to be exercised only in determining the order of things destroyed, but not the rate of destruction.

Nor was Douhet driven to this conclusion by any undue respect for the traditional "principles of war" with their emphasis on concentration in time and space. On the contrary, he goes out of his way to express something like contempt for those principles. But he was impressed with the gigantic potency of the offensive as compared with the impotence of the defensive in his own image of air warfare. He therefore concluded that air war was a race against annihilation, in which the only way to escape that end is to be swifter in heaping destruction on the enemy than is the enemy in his attempt to do the same—about like the oldtime Western gun-fighter whose life depended on the quickness of his draw. To be sure, a few points in the scoring were left to the nation best able to sustain the initial blows:

> Tragic, too, to think that the decision in this kind of war must depend upon smashing the material and moral resources of a people caught up in a frightful cataclysm which haunts them everywhere without cease until the final collapse of all social organization. Mercifully, the decision will be quick in this kind of war, since the decisive blows will be directed at civilians, that element of the countries at war least able to sustain them. These future wars may yet prove to be more humane than wars in the past in spite of all, because they may in the long run shed less blood. But there is no doubt that nations who find themselves unprepared to sustain them will be lost.

This is all so simple, so straight-forward, so inexorable. Every war *must* be a total war, regardless of the character of the powers waging it, the causes of the conflict, or the original objectives of the statesmen who have let themselves be drawn into it. In fact, there can be no meaningful objectives other than survival through the elimination of the threat-posing rival. It must be total because the decision "must depend upon smashing the material and moral resources of a people . . . until the final collapse of all social organization." We are a long way indeed from Clausewitz, and the distances we have moved reflects in this instance not so much the profound changes since his time in the political and social structure of the world as it does the development of a mechanical instrument, the airplane. Douhet regrets it, but he has to "accept realities." Like the poet Housman, he lives "in a world I never made." Perhaps so, but one senses here the final and frightening abandonment by the soldier of any sense of responsibility for the political and social consequences of his military acts, not only abroad but at home as well.

> It is useless to delude ourselves. All the restrictions, all the international agreements made during peacetime are fated to be swept away like dried leaves on the winds of war . . . The purpose of war is to harm the enemy as much as possible; and all means which contribute to this end will be employed, no matter what they are . . . The limitations applied to the so-called inhuman and atrocious means of war are nothing but international demagogic hypocrisies.

This is different in character from the glorification of total war of a Ludendorf, but the results are the same. It might be noted that in the latter two sentences above quoted, Douhet is clearly wrong. Whatever the *purpose* of a war (as distinct from the means employed in it), it must surely be something other than "to harm the enemy as much as possible." And while the historical efforts to apply limitations to the means of waging war may have been illusory and possibly naive, they have nevertheless in the main reflected the earnest aspirations of responsible statesmen. They have very rarely been merely "demagogic hypocrisies."

Anyway, subject as he was to such convictions, Douhet was scarcely free to attempt any consideration of how the strategy of air power could be adjusted to different political and geographical situations. He gave no thought to the use of air power as an instrument of national policy both in war and in peace, rather than merely an instrument of limitless destruction.

Yet strangely when in *The War of 19–* he projected into the future the application of his principles to a specific though imaginary war, he made a significant departure from his own previous axioms. He has the German air force deliberately holding back its attacks and permitting the French bombers to strike at Germany first, in order that the Germans should have a better position before "world public opinion" for their own planned "reprisals." Indeed, the Germans go so far as to warn the French of the day and hour at which they will begin "the disintegration of the enemy's national resistance." It is the civilian foreign minister who remonstrates that such warning means giving up the advantage of surprise, and the military commander who replies that it is "the Independent Air Force which would constitute the real surprise, and not the hour at which it would go into action." If this seems like a small concession for Douhet to be making to the utility of a good propaganda position, one must remember the enormous importance he had previously attached (and presumably still attached) to hitting first. With each attack (in his mind) counting for so much, the kind of surprise which he has his hero cast away is no trifle. Had he not decided that the course of the war was not worth describing once the command of the air had been indisputably won, had he therefore not terminated his account after describing the second morning of the imaginary conflict, his mature insights might well have continued to play tricks on his own dogmas.

AND how have Douhet's dicta fared in the one great test they have received thus far? The answer to the question depends on the level of generality on which one seeks confirmation. If we disregard the over-all vision and consider only specific assertions, it is clear that in World War II Douhet was proved wrong on almost every important point he made.

Let us be clear that World War II was a fair test. It began a full sixteen years after the publication of his *Command of the Air*. And while none of the belligerent governments was anything like fully committed to his ideas and therefore ready to apply them in unadulterated fashion, it is nevertheless true that the bomber fleets which ultimately took to the air at least on the Allied side were vastly larger, by several orders of magnitude, than those which Douhet thought would be sufficient to win a decision in a single day. And the tonnage of bombs they dropped on Germany alone, and on specific targets within Germany, were in wholly different realms of figures from those which populated Douhet's fantasies.

Yet today there are intelligent and relatively unbiased persons who have made a close study of the data and have concluded that there is no incontrovertible evidence to prove that the Allied bombing of Germany made a really significant contribution to the winning of the war. Whatever one's own views are, it is startling enough that there can be a difference of opinion among serious people on that question. Certainly it is clear that whatever military results did follow from the bombing did not come quickly.

On more specific issues, the tally of findings against Douhet is impressive. First, land fronts proved to be anything but static, as demonstrated most conspicuously by the quick German invasions of Poland and especially of France. The dilemma of the NATO security system today lies largely in the question: what happens on the ground while the war is being fought in the air? Secondly, the fact that bombing could not bring anything like the swift returns that Douhet dreamed of and that vastly greater tonnages than he called for were necessary to bring any returns at all means inevitably that defenses against air attack proved far more effective than he expected. Douhet did not deny that fighters could shoot down invading bombers. But he was able to postulate a situation where an attacking force could lose one-third of its strength on the first day of a war and then go on to win. In World War II, where the bombing campaigns were really trucking operations requiring repeated hauls by any one aircraft, attrition rate of 5 to 10 per cent could be very serious to the attacker. The Battle of Britain resulted in an outright victory for the defense—and the attacking Germans were at that time quite literally following Douhet's precepts. The Allied assault on Germany resulted in a complete Allied victory in the air, but it was touch and go during more than one phase of the operation, and there are grounds for believing that if the Germans had played their hand better they might have made our losses prohibitive. Even the antiaircraft gun, which Douhet so much despised, enjoyed the considerable respect of bomber crews.

The assault on Japan was another kind of case. As a test of Douhet's ideas it was vitiated in several ways, particularly by the fact that Japan was a defeated power—and recognized to be such by her military chiefs, especially of the Navy—before our strategic bombing campaign was well begun. The bombing attack exerted great and unremitting pressure on the Japanese leaders to acknowledge their defeat by surrender—a pressure which was finally and decisively augmented by the introduction of atomic bombs—but the origin of defeat lay in other realms of action. And in both the German and the Japanese campaigns, the effects of bombing on civilian morale and the effects of depressed morale on the strategic decisions of the leaders turned out to be far less than Douhet predicted.

Nevertheless, when all this is said, the acuity and insight of Douhet's vision command respect. It may be true that the atomic bomb gives his theories a support that would be very much missed without it, and that Douhet deserves no credit for anticipating the atomic bomb. But it is also true that he was able to create a framework of strategic thought which is considered by many responsible airmen to fit the atomic age astonishingly well.

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NOTES

1 Douhet's principal writings are: *Il Dominio dell' Aria; saggio sul' arte della guerra aerea* (Rome: Stab. Poligr. per l'Admministrazione della guerra, 1921); (2nd ed. with addition of Part II, Rome: Instituto Nazionale Fascista di Cultura, 1927); "La Guerra del' 19—," *Rivista Aeronautica* (March 1930), pp. 409-502. The above works, along with a monograph of 1928 and a long polemical article published in the *Rivista Aeronautica* for November 1929, have been translated into English by Dino Ferrari and published in a single volume with the title of *The Command of the Air*—which is actually the original title of only one of the works included (New York: Coward McCann, 1942). All subsequent references in this paper to Douhet's writings will be to the Ferrari translation.

2 A French translation (1932) of a substantial part of the 2nd edition of *The Command of the Air* was in turn translated into English in 1933 and put into mimeographed form for officers of the United States Air Corps. General Arnold has the following to say about Douhet's influence in the U.S.A.A.C. in the 'thirties: "As regards strategic bombardment, the doctrines were still Douhet's ideas modified by our own thinking in regard to pure defense. We felt, out in the 1st Wing, that we were doing much to furnish the practical tests for, and proofs of, the Maxwell Field theories. A different attitude from Douhet's toward bomber escort and a very different view of precision bombing resulted." *Global Mission* (New York; Harper, 1949), p. 149. Incidentally, it is difficult to see how the views of American airmen could have been significantly different from Douhet's on either of the issues mentioned. Douhet straddled the fighter-escort-of-bombers question by assuming somewhat different positions at different times and generally settling with the idea that it was desirable but not necessary. On the question of bombing accuracy, he has almost nothing to say except that aerial bombing can never be as accurate as naval gunfire—a conclusion which has certainly not yet been disproved.

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### ATTENTION

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